NEXUS STAR

Routing in a new Dimension

Star Router on a distributed NEXUS Network • Routing Capacity: 4,096 Inputs to 4,096 Outputs • more than 16 Million Crosspoints • throughput > 12 Gbps • Supports Optical Lines of up to 100 Kilometres / 62 Miles on the NEXUS Network • supports all Standard Audio Formats • only 19", 6 Units in Height (even when fully equipped) • Fully Redundant Bus System

STAGETEC

NEXUS STAR Routing in a new Dimension

The NEXUS STAR audio-router system was designed by Stage Tec for the most extensive routing requirements typically found, in broadcast centres, large production companies, and exhibition grounds. The NEXUS STAR is a routing node serving as the core of a NEXUS installation and interconnecting numerous NEXUS Base Devices scattered over separate studios and apparatus areas via optical cables.

It is a versatile audio-network and routing system for controlling studio or mixing-desk resources, for apparatus-area and broadcast-complex networking, for OB trucks, sound reinforcement, and for any other professional audio technology applications.

NEXUS STAR accommodates up to 16 boards each with 256 inputs and 256 outputs. This allows for routing a maximum of 4,096 inputs to 4,096 outputs, resulting in more than 16 million crosspoints.

If more I/O resources are required, multiple NEXUS STAR units can be cascaded. Any input can be freely routed to any output, so point-to-point lines as well as point-to-multi-point sets can be created.

Contents:

When it came to technical implementation, Stage Tec broke new ground: Instead of a bus configuration as used on the NEXUS system, NEXUS STAR includes a dual matrix for routing inputs to outputs. This routing matrix allows for a very high clock rate and thus supports the reliable implementation of an accordingly large number of time-slots, resulting in an internal throughput of more than 12 Gbps. This is the secret behind the extremely large routing capacity.

NEXUS STAR acts as a star router: Unlike the distributed structure of a traditional NEXUS network, the Base Devices connect to the core router in a star configuration. NEXUS STAR is located at the very heart of the network.

This topology offers maximum flexibility, is easy to implement and is very user-friendly thanks to layout clarity. Another key benefit is the minimal cabling requirement and the resultant savings in cabling hardware.

NEXUS STAR currently supports two different interface boards designed for carrying signals over long cable runs: the RFOC optical interface board is used for connecting other NEXUS units and the RMF board supports the MADI multichannel standard format. This enables large digital audio systems including, for example, mixing consoles or multitrack recorders to be connected directly. Thanks to the modular structure of NEXUS STAR, an existing system can be upgraded with additional cards at any time.

One further benefit: Just like every other member of the NEXUS family, the NEXUS STAR always operates in sync. The system introduces a very low and constant latency of just 6 samples for all signals. This figure makes NEXUS STAR entirely suitable for time-critical applications where minimum latency is a must (e.g. live broadcasting).

NEXUS STAR Routing in a new Dimension

NEXUS STAR and the other NEXUS devices are operated via a graphical user interface running on conventional desktop or laptop computers. They can also be operated using Stage Tec's AURUS and CRESCENDO mixing-console systems. The graphical control software provides intuitive access to, and control of, all system components. All settings can be stored, and presets can be recalled easily.

Existing NEXUS users will notice scarcely any operational difference if they integrate a STAR router into the audio network since the STAR is fully integrated into the familiar user interface.

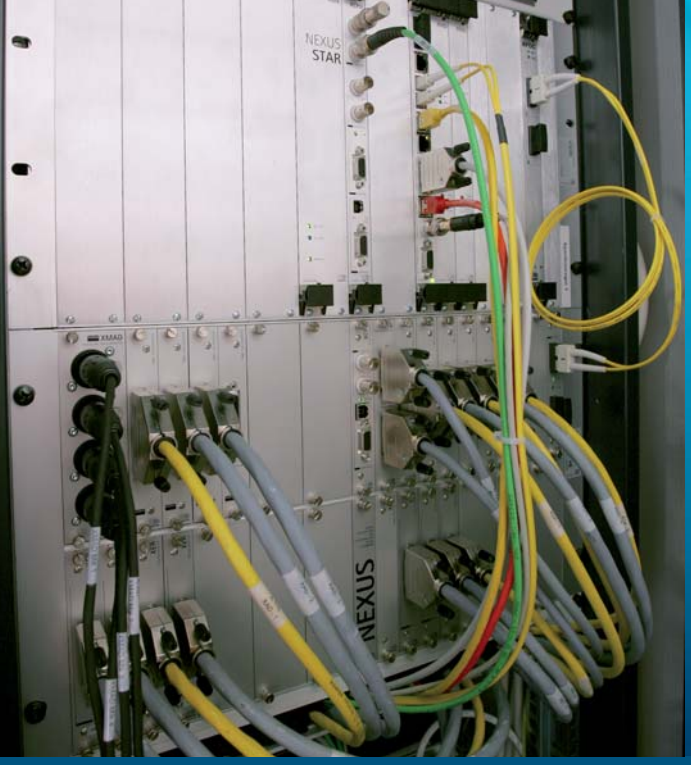
The latest NEXUS STAR generation is designed for use in extensive installations where absolute reliability and total redundancy are essential. Clients benefit from state-of-the-art systems and the maximum reliability achievable.

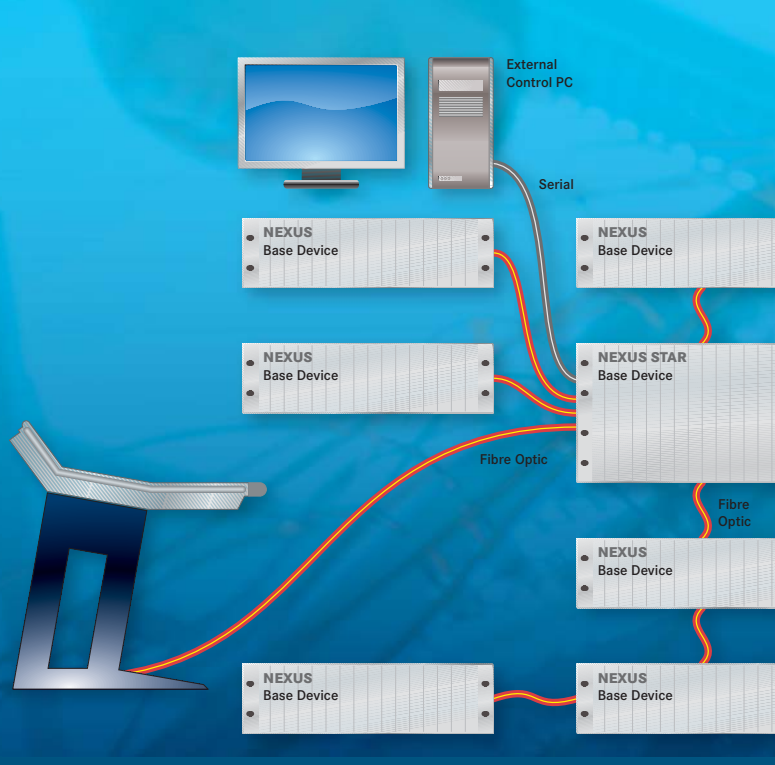
Suggested Applications

- **In radio and TV broadcasting:** Switching rooms, broadcast-complex networking, studio audio matrix, signal transmission
- **In recording and post-production studios:** Mixing-console and studio routers, broadcast-complex networking
- **In theatres, concert halls, convention centres, and exhibition grounds:** Interconnection of recording studios, stages, sound-reinforcement facilities and other areas, hall and complex networking

NEXUS STAR Specifications Overview

- Digital audio network and routing system
- Mixed operation of MADI and optical interfaces on a NEXUS Base Device
- 4,096 × 4,096 crosspoints on the NEXUS STAR
- In-sync signal processing
- Up to 31 Base Devices can be connected
- Cascadable
- Backplane with 21 slots (4 HP each) including 16 I/O-board slots
- Constant latency of just 6 samples
- Modest space requirements (6 units in a 19" rack)
- Innovative high-speed routing unit with transmission rate of 12 Gbps and bus clock rate of 2 × 100 MHz
- Sample rates: 44.1, 48, 88.2, 96 KHz (dependent on configuration)
- Globally adjustable full-scale level (0 dBFS = 0 to 22/24 dBu analogue level)
- Multiple redundant power-supply units supported
- Continuous execution of internal test routines
- Hot-swap capability
- Uninterrupted signal re-routing (requires redundant optical lines)





NEXUS STAR Routing in a new Dimension

Concept

NEXUS STAR Audio Network

NEXUS STAR and NEXUS are fully-digital audio-signal routers and distribution systems. They are designed as distributed systems comprised of multiple Base Devices with a modular configuration. The routing systems and audio networks are configured individually for each customer and may be extended at any time.

Extensive audio networks can be implemented using basic NEXUS building blocks. With large installations, using the NEXUS STAR router enables simple yet powerful network structures to be created that can also demonstrate cost savings. Acting as the core of the installation, NEXUS STAR handles the routing using a specially designed and highly optimised routing matrix. This matrix is capable of routing 4,096 inputs to 4,096 outputs.

NEXUS STAR. The Core Router

In a distributed NEXUS audio network, the NEXUS STAR acts as a star router and is capable of networking up to 31 NEXUS Base Devices. A variety of analogue and digital I/O boards as specified by the customer is installed into these NEXUS Base Devices. The Base Devices are interconnected using optical cabling. This enables the Base Devices to be de-centralized and located exactly where they are needed. Distances of up to 100 kilometres (62 miles) can be achieved. This is why even a fully populated NEXUS STAR is a compact 19" rack unit just 6 U high.

Straightforward Concept

A NEXUS STAR based audio router network consists of the following:

- **NEXUS STAR router** (including MADI boards as requested)
- **NEXUS Base Devices** featuring customised I/O resources in analogue and digital formats and DSP boards for signal processing (on request)
- **Duplex optical cables** interconnecting the STAR router and the NEXUS Base Devices
- **One or more control computers** providing the interface between the NEXUS STAR audio network and the user

The RBP router backplane provides 21 slots laid out for 4-HP boards. 16 of these slots are reserved for accommodating I/O boards.

The following boards are available for NEXUS STAR:

- **RBPR** Backplane featuring one or more XPSU power-supply units
- **RCX** NEXUS STAR controller board and routing matrix
- **RMF** MADI audio-I/O board
- **RFOC** Optical interface board for connecting to standard NEXUS Base Devices which offer I/O interfaces in various audio formats such as A/D, D/A, AES/EBU, MADI, Y2, TDIF, SDIF-2 SDI, HD-SDI, 3G-SDI, ADAT, or Dolby E.
- **RSYNC** synchronisation board allowing for synchronising the NEXUS STAR system to a video clock or other sources.

NEXUS STAR Routing in a new Dimension

All boards except the RBPR backplanes and the power-supply units are implemented as service-friendly slot-in boards. The universal bus system enables optical, MADI, or mixer boards to be installed in NEXUS STAR slots as required.

All slot-in boards feature standard ports. Future standards are also considered in the design.

Industry-standard PCs as control computers

Industry-standard PCs running Microsoft™ Windows™ are used as control computers for the audio system. The control computers are connected to either the NEXUS STAR controller board or to a NEXUS Base Device controller board over a serial interface port (RS 232, Ethernet or USB). Notebook computers can also be used as portable control computers.

The entire audio network can be accessed from each connected PC. The system is controlled either from a single control computer, or concurrently from multiple computers. All control computers are synchronised to each other by the system. At any time, even during operation, a PC can be connected to, or disconnected from, a NEXUS STAR or NEXUS Base Device without affecting the audio-network status. Changes are only applied by deliberate action. The current settings are stored on the NEXUS network separately from the control computers.

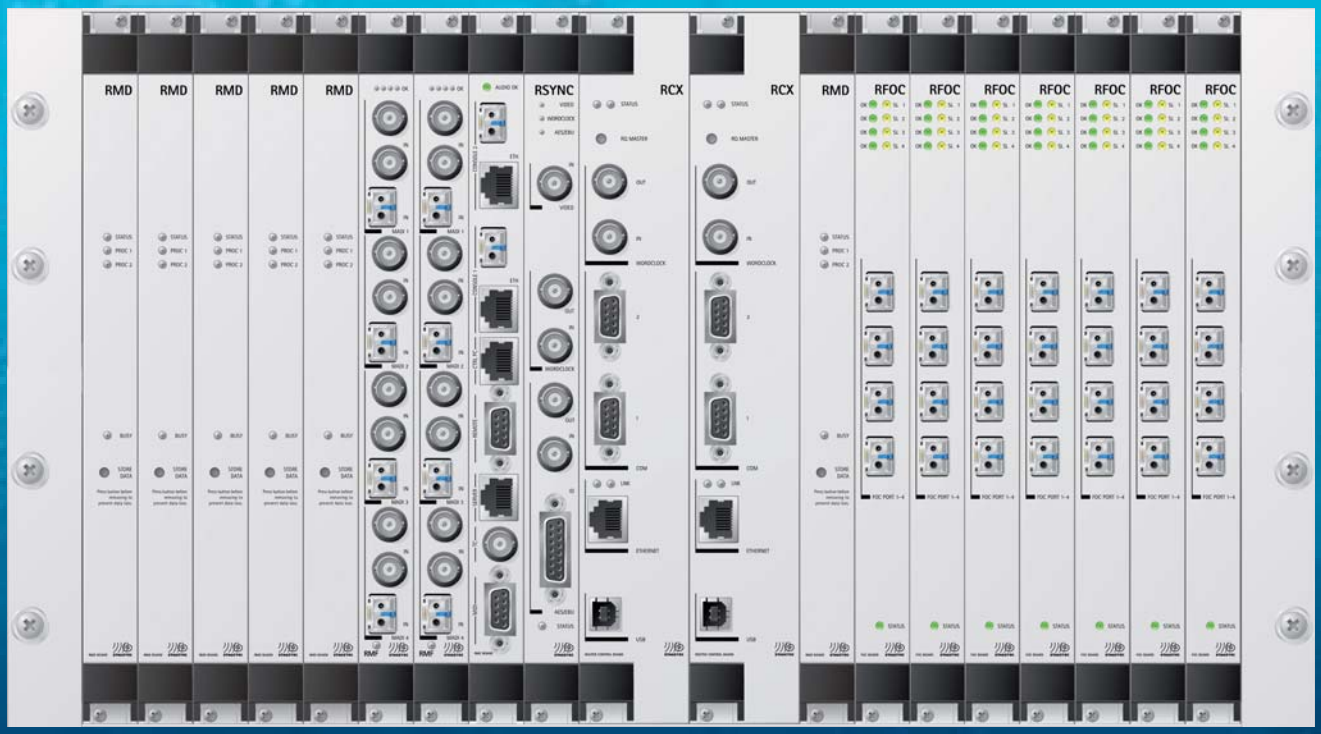
Redundancy

The newly designed RBPR NEXUS STAR backplane supports a redundant configuration with central controller boards and the RCX routing matrix. If there are two RCX boards installed on the NEXUS STAR, the Base Device can switch over to the spare board in case of malfunction. All routing and other settings will be applied to the spare board.

The RBPR, too, supports redundancy by design. Just like normal NEXUS Base Devices, the NEXUS STAR can be configured with (up to four) redundant power-supply units fed from separate mains. At failure, the router switches over to a spare signal path automatically and without signal interruption.

With this new hardware architecture, the NEXUS STAR offers a remarkable level of security: Even a defective board damaging the bus system would not result in router failure.

Extra security is provided by establishing redundant cable connections between the NEXUS Base Devices and the NEXUS STAR. The NEXUS transmits every signal from the Base Device over the two parallel lines to the NEXUS STAR. The router decides which of the two input signals should be used. Both signals are constantly monitored for data errors using CRC. The NEXUS will normally ignore the redundant signal; however, if an error occurs on the active signal while the secondary signal received in parallel is still »good«, the NEXUS will automatically switch to the other port within a single sample. The result is an smooth inaudible change to the good signal. This is true redundancy! Of course, the same is also true for the return path to the Base Device.



NEXUS STAR Routing in a new Dimension

System

Operating Principle

The actual I/O routing is performed by an active routing matrix incorporated into the RCX board, which replaces the former RMX. The star-topology audio bus connects the board to the respective I/O boards (RFOC or RMF).

The NEXUS STAR accommodates a maximum of 16 boards – eight on the left side and another eight on the right side of the router. All boards are controlled in parallel. The RCX (which replaces the RCPU) handles the central control and management tasks and the control-computer connections and also provides the synchronisation interfaces.

The I/O boards convert the input signals to the internal linear data format, route the data to the audio bus, or read it. Multiple boards can read and use the same signal at the same time.

The RFOC fibre-optic interface boards (which are referred to as XFOC boards on the NEXUS), bundle the 256 signals to transfer them over optical lines to the corresponding boards in other Base Devices. These also route the signals to audio buses.

Interfaces

The NEXUS STAR currently supports two different interface formats:

- The **RFOC** fibre-optic interface board is available for connecting NEXUS Base Devices to NEXUS STAR.
- The **RMF** board supports the MADI multichannel format. It provides direct connectivity to multitrack recorders or digital mixing consoles.

Thanks to the modular structure of NEXUS STAR, further interface-boards can be added at any time, e.g. for upgrading the system to handle future formats.

The following explains the number of channels that can be transferred on the respective paths within NEXUS STAR and on the overall system:

Bus

The NEXUS STAR backplane features 16 slots for interface boards. The star-topology audio bus transfers 256 input channels and 256 output channels to each of these slots.

Routing Matrix

The star point is the RCX switching matrix that performs the actual routing of 4,096 (16 × 256) inputs to 4,096 outputs.

Interface Boards

Thus, up to 256 inputs and 256 outputs are available for each I/O board. For example, on the RMF MADI board, these resources are distributed to four 64-channel ports.

Fibre-Optic Interface Board

The RFOC optical-interface board provides up to four ports with an overall capacity of 256 input channels and 256 output channels. The board connects directly to NEXUS fibre-optic interface boards.

NEXUS STAR Routing in a new Dimension

NEXUS STAR, NEXUS, AURUS, and CRESCENDO

In addition to the routing unit, a NEXUS STAR might also contain the audio processor of the AURUS or CRESCENDO mixing-console system. In this case, the core router not only accommodates all of the AURUS/CRESCENDO mixing-console system's signal processing components (i.e. for several hundred audio channels) but also the overall I/O-routing hardware and the MADI boards and NEXUS optical-interface boards that connect to the studio peripherals.

The mixing-console section of the audio processor is controlled by a dedicated controller board that is connected to the consoles via fibre-optic lines and to a server via an Ethernet connection.

This flexible system allows extensive and complex audio systems to be built comprising multiple NEXUS STAR routers, AURUS/CRESCENDO mixing consoles (a maximum of two consoles per router), and a large number of NEXUS Base Devices.

The use of NEXUS as an audio-network and routing system for AURUS or CRESCENDO provides for setting up a flexible and distributed overall system. NEXUS handles a large number of distributed Base Devices, thus covering a multitude of applications ranging from standalone systems to full studio-complex and broadcast-centre networking.

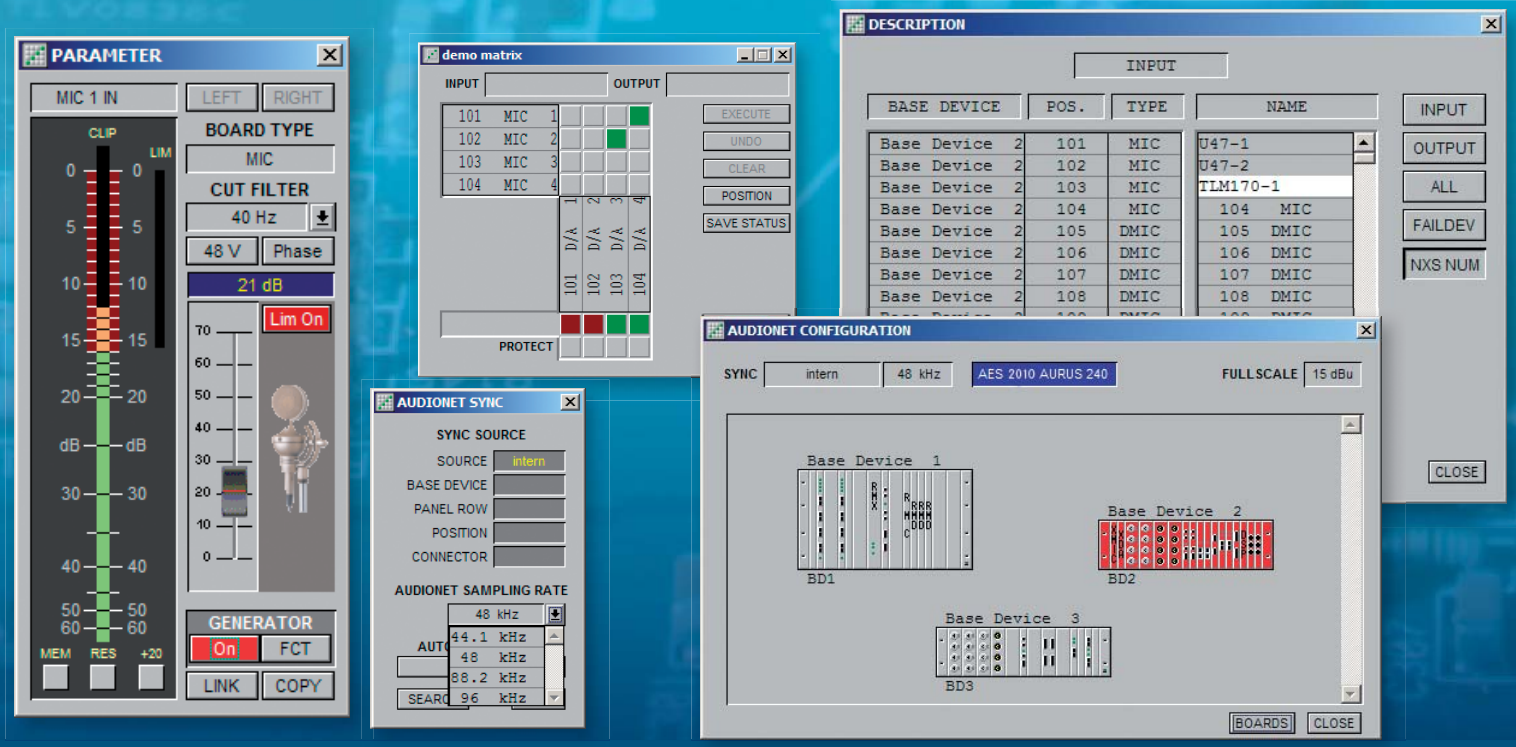
The exclusive use of fibre-optic cabling simplifies installation and allows for spanning distances of 100 kilometres (62 miles) or more between Base Devices. Inputs and outputs of multiple AURUS or CRESCENDO systems integrated into a single NEXUS routing system can flexibly be shared and distributed as required.

Audio Transmission

NEXUS is able to forward audio data transparently and without modification. This feature allows diverse compressed data formats (DTS, AC3, MPEG, et cetera) to be distributed over the NEXUS audio network.

Dolby E is a transmission format designed by Dolby® for forwarding multichannel audio over an AES stereo channel in production and broadcasting environments. NEXUS users can transparently distribute Dolby E signals containing up to 8 channels plus ancillary data on the NEXUS system (AES/EBU, MADI, SDI). Dolby® has officially certified the NEXUS hardware. Stage Tec is now an official Dolby E partner.

Dolby E
PARTNER



NEXUS STAR Routing in a new Dimension

Features

The Graphical Control Program

A graphical control program running on PCs under Microsoft™ Windows™ provides the interface between the user and NEXUS STAR. The software includes a system-view function with various views, graphical routing matrices (matrix windows), various editing and metering windows (parameter windows), and management functions for projects and snapshots.

The control programs running on all connected computers fully integrate with the NEXUS network data exchange system and are therefore always – even after reboot – aware of the system status separately stored on NEXUS STAR. All displays and indicators are automatically updated, thus notifying the user of the current routing-matrix status.

System View

There are various selectable views of the overall system used for clearly visualising functional or spatial relationships required for various purposes:

- The **normal view** shows a graphical representation of the NEXUS network, active control computers, and external synchronisation. It allows inputs and outputs to be selected, for example, when setting up partial matrices, and shows failed devices.
- The **alternative view** shows the Base Devices without their front panels. This allows for viewing boards with detached or missing front panels – for example, boards that are hidden behind other panels for space-saving purposes.
- The **patchbox view** shows any inputs, outputs, and processing channels clearly arranged as resource pools (or patch boxes).
- The **graphical patchbox view** shows these resource pools on a background image such as a floor plan. It provides for a graphical allocation of the buttons to the resource locations.

Matrix Windows

Making and breaking of I/O connections on the NEXUS audio network is achieved using so-called matrix windows. The routing status of the individual crosspoints is represented by the colours of the corresponding buttons and can be simply changed using the mouse. In **direct mode**, all changes are immediately applied. NEXUS also offers a **prepare mode** where multiple crosspoint connections can be preset and subsequently applied together with a single mouse click.

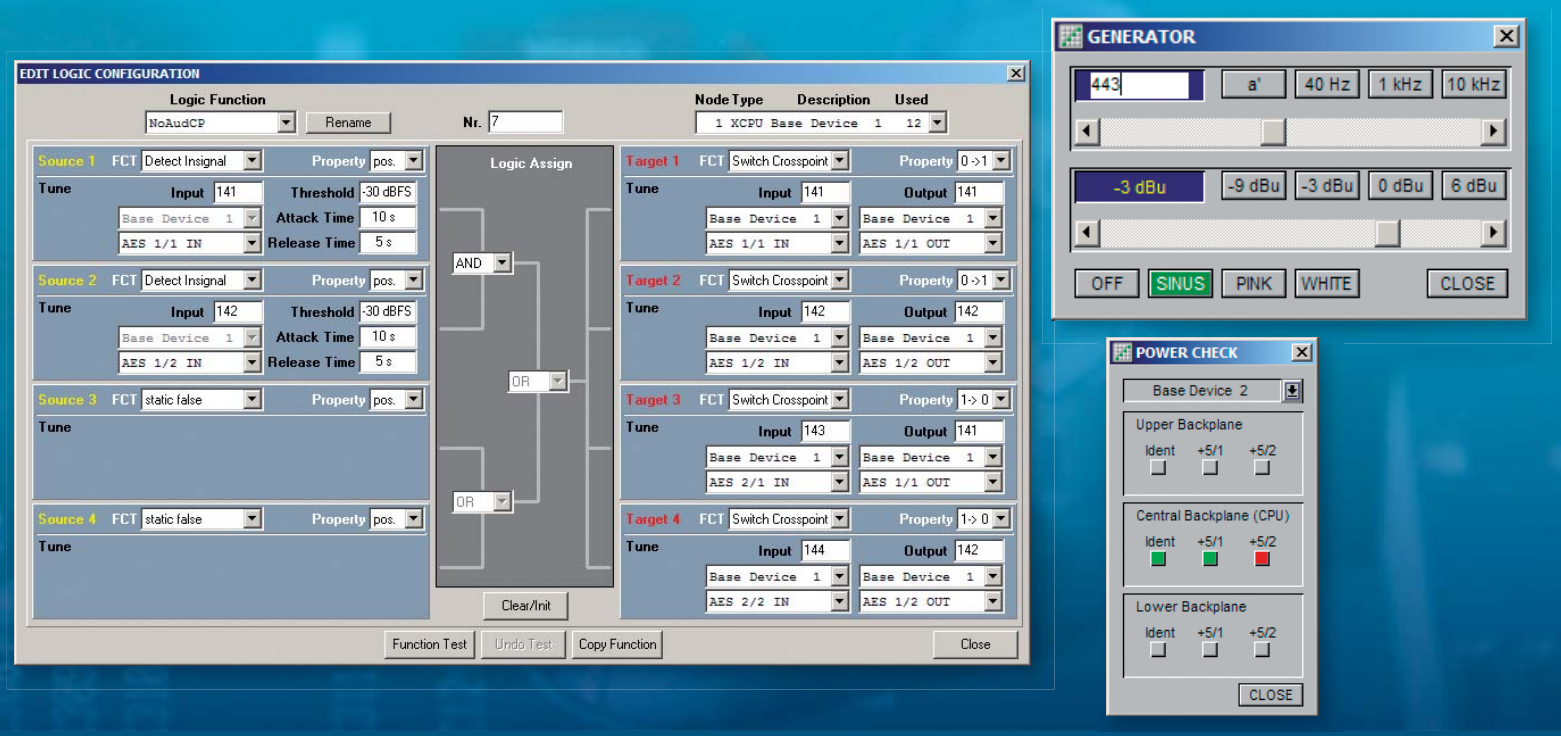
Beside the **overall matrix**, distinct **partial matrices** can be created that show only those inputs, outputs, and processing channels actually required. Partial matrices are part of a project file.

At any time the system can generate a special partial matrix showing only the currently enabled crosspoints.

Parameter Windows

A parameter window can be accessed from the matrix window. It includes the meters and allows for displaying, creating, and changing parameters of NEXUS resources. A parameter window always shows the input and output of one crosspoint.

Depending on type, specific windows are provided for DSP-channel settings. For example, there is a window for parametric equalisers where the frequency, Q, and gain settings are individually adjusted, while generic module-parameter windows are provided for user-specific channels.



NEXUS STAR Routing in a new Dimension

Project Management

Set-ups containing all critical data and settings are stored as project files. These set-ups include, for example, editable names of inputs and outputs, configured partial matrices and stored routing-matrix statuses. Project files are created, stored, copied, and deleted using the NEXUS control program.

Projects are always related to the control computer where they are stored. This means that different projects can be created on different computers. This is reasonable, for example, when multiple partial matrices are to be stored to different workplaces. Project files are stored to local hard disks or removable media, or over a computer network.

Snapshots

Different routing-matrix statuses can be stored as snapshots (also referred to as scenes or statuses) within the project: **Global status** contain the statuses and parameters of the overall system. However, a **partial status** can store individual parameters, i.e. those of the current partial matrix.

Snapshots are stored to the project file. They can be reloaded to the control software at any time and then be applied to the NEXUS system. This feature allows for fully or partly restoring the saved settings on the audio network.

Matrix outputs can be individually protected to prevent unwanted changes when recalling a status (»Isolate« function).

Test-tone Generator

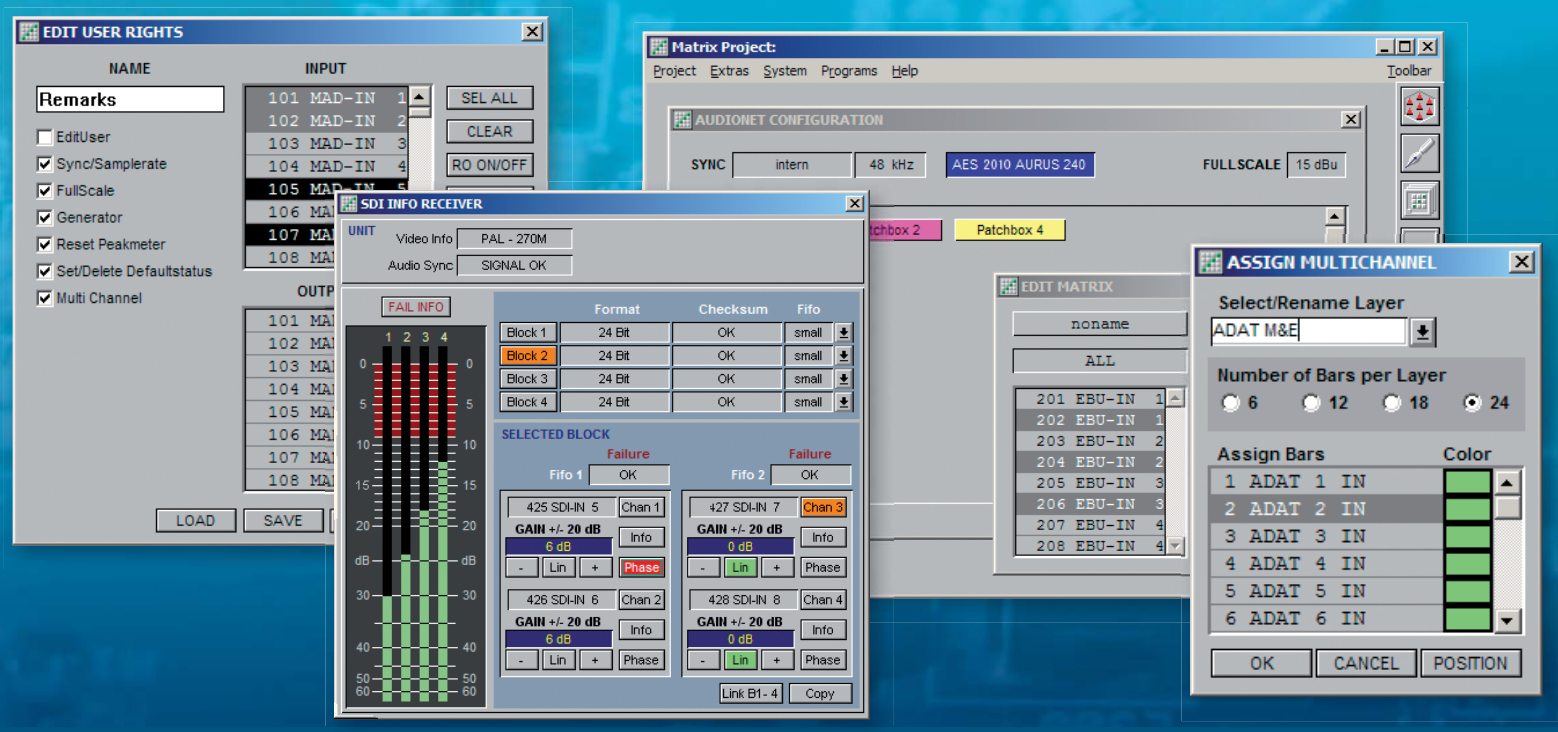
Each Base Device on the NEXUS system includes a test-tone generator that can be applied to all analogue inputs via a separate bus. The generator signal is also fed to an additional digital bus.

The following settings can be made by the user:

- **Level:** –34 to 6 dBu (direct access, adjustable in 1-dB steps)
- **Frequency:** 20 Hz to 20 KHz (adjustable in 1-Hz steps) plus typical fixed frequencies
- **Shape:** The generator can also be used as a noise generator offering the choice of white and pink noise as well a sine wave.

The test-tone generator can be used for calibrating installations or rooms as well as for troubleshooting purposes. The generator produces a standard-level signal for calibrating or comparing input signals. In addition, it generates an internal signal that can be used for troubleshooting the NEXUS system or verifying settings.

The generator employs a sophisticated structure (digital generator, D/A converter, analogue generator bus, extra digital bus), with the critical A/D-converter components integrated into the signal path.



NEXUS STAR Routing in a new Dimension

Features

Logic Control

Logic Control is a programmable logic unit for routing functions that can be individually configured on a per-user basis. Logic Control allows various NEXUS parameters to be queried, for example, crosspoint statuses, fader-start relays, input or output levels, and internal error statuses. In combination with an AURUS console, it can also be used to evaluate the status of specific mixing functions such as fader-start relays and machine control keys.

Logic Control provides for controlling a huge number and variety of outputs and events including, for example, red light control, mute keys, routing switches, level and crosspoint monitoring, fader starts, automatic breakdown measures, and intercom systems.

Panels

Operating NEXUS with buttons and encoders: Using the NEXUS XCI communication-interface board and user-specific operating panels allows custom solutions to be implemented for quick and easy control of the routing matrix – in particular, for inexperienced users.

Desktop or surface-mounted panels with keys, encoders, matrix displays, and arc indicators can be used as an alternative or in addition to the control software. The communication boards control the panels and serve as intelligent interfaces to the NEXUS system.

The Protect Function

Protection against misuse: All system outputs can be globally protected against modification to prevent inadvertent operation.

This protection applies to the output parameters, the associated crosspoint, and the parameters of any input routed to that output. The protect function is implemented on the NEXUS system and is thus provided separately from the control computers.

Assigning User Rights

Granting and denying user rights: Each user's access can be restricted to a freely configurable selection of resources.

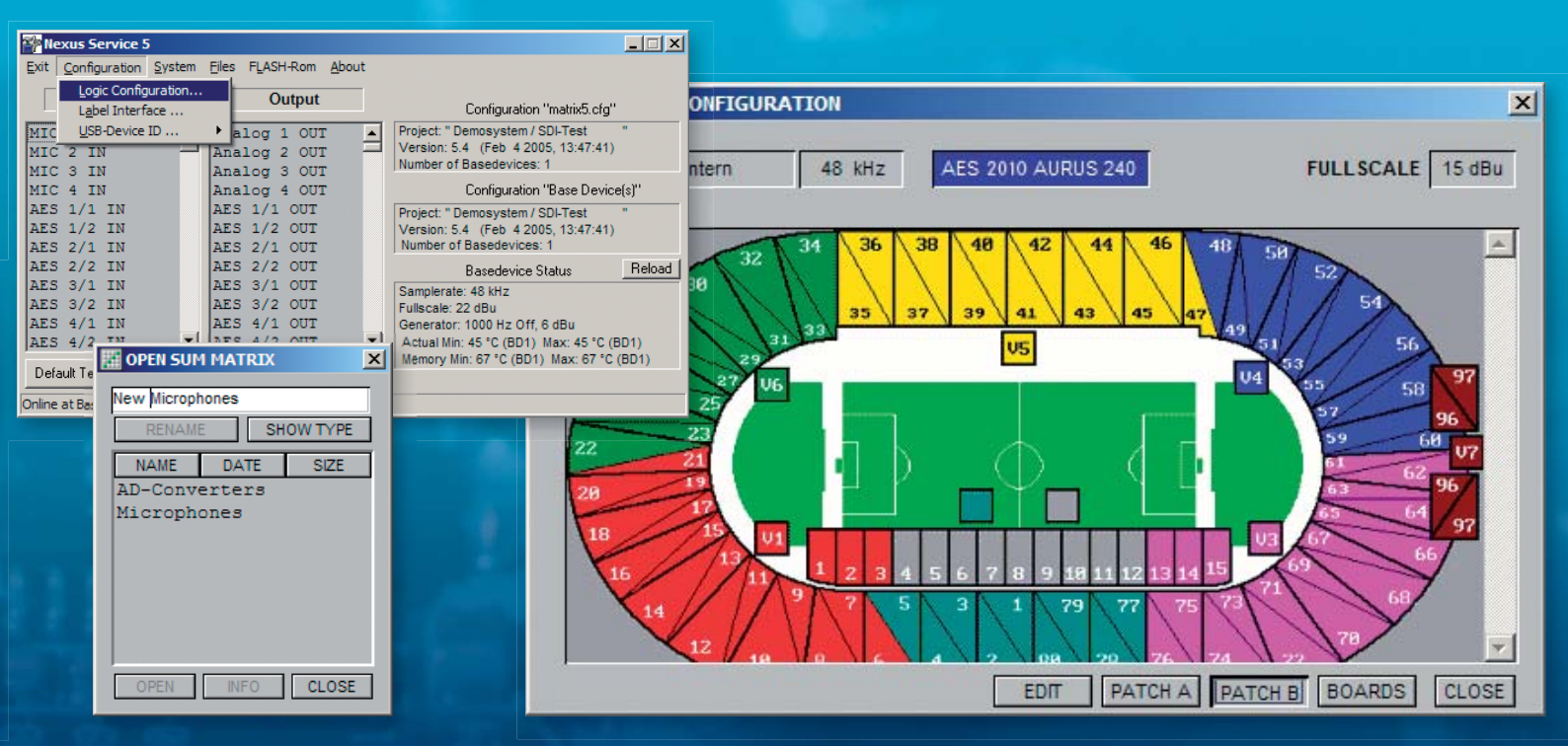
User rights can be used for limiting the view and operability of the routing system: The inputs, outputs, and processing channels are either accessible or blocked for each user. Global system settings such as the full-scale level or the sample rate can be blocked, too.

Three access modes are available: With **full access**, the parameters of the assigned sources and targets can be used and modified. With **read-only access**, only the sources can be routed; parameter editing is blocked. **No access** means that the user rights are stopping any attempt to access the resources. In this case, inputs, outputs, and processing channels are not even displayed to the user.

User rights can be configured either over the network or locally on control computers.

NEXUS on a Computer Network

Sharing NEXUS: The NEXUS control software can also be configured for network use. In this case, any of a number of networked Windows PCs can be used to access NEXUS via one or more communication servers. Network access restrictions can also be configured to restrict usage to specific user groups.



NEXUS STAR Routing in a new Dimension

MIDI and Remote Control

Changing the routing-matrix status with a MIDI message: Control computers equipped with MIDI interface boards are available as an option for easy external control of NEXUS systems.

MIDI program change messages can be used for recalling and enabling snapshots. MIDI messages are allocated to the project snapshots using an editable list in the control software.

Multichannel Metering

Comparing levels: The multichannel meter displays the levels of up to 48 audio-network inputs and/or outputs on any control computer. This is part of the NEXUS graphical control program but can also be used as a standalone application.

For example, clicking on the meter of a microphone input will open a window where all relevant parameters of that input are displayed and can be modified. When an output meter is clicked, an interactive window showing the microphone input routed to that output will open. This feature is useful in scenarios where the levels of just a few microphone channels are to be controlled.

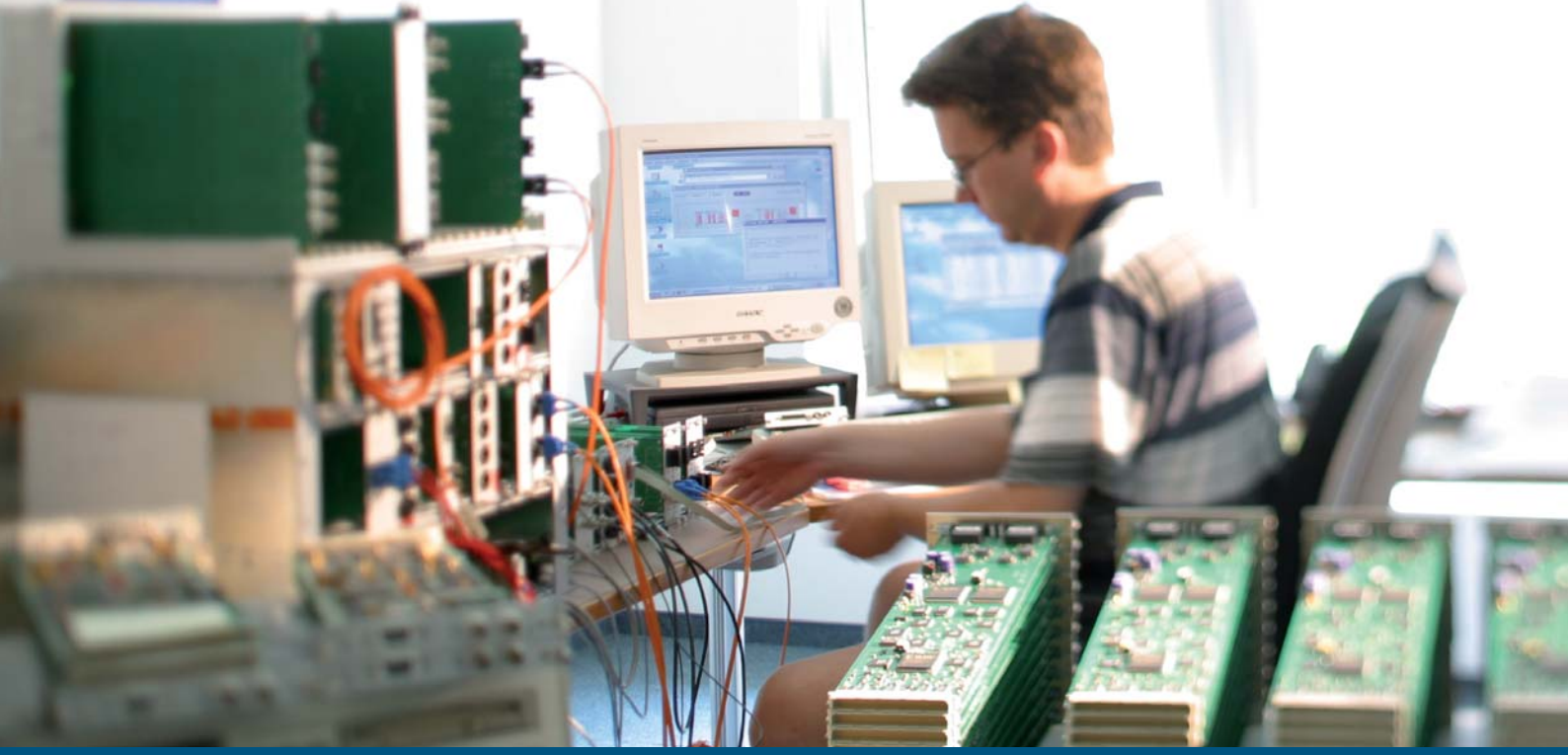
Group Matrices

Efficiently editing I/O resources: An optional »group matrix« is available for grouping multiple I/O resources, thus simplifying operation. Access to the grouped resources is then possible via a single group matrix crosspoint that represents a group of real crosspoints.

Using this extension allows for simultaneous routing of all inputs or outputs of audio or processing units – no individual crosspoints need to be enabled or disabled. This is especially convenient when working with multi-channel formats.

Mix Matrices

Routing multiple inputs to a single output: The NEXUS audio network was basically designed as a routing-matrix system where inputs are routed to outputs. Thanks to additional NEXUS options such as the signal-processing board XDSP, the system supports a multitude of applications that conventional routers can only offer when used with external audio components. Using mix matrices implemented on the signal-processing board enables multiple inputs to be routed to an output: In this case, the input signals are mixed.



NEXUS STAR Routing in a new Dimension

Technology

Networking

The NEXUS STAR router is networked using only RFOC fibre-optic interface boards and duplex fibre-optic cables. This approach enables a variety of network setups to be implemented, for example, star topologies with parallel and redundant fibre-optic lines between Base Devices.

The NEXUS Base Device network is an entity: All inputs, outputs, and processing channels can be accessed and operated from anywhere on the routing system. In the control program, a single cross-point simply connects an input to an output – it is up to the system to establish the fastest connection on the Base-Device network.

Optical Lines

The optical lines between Base Devices are always bidirectional, carrying a total of 256 audio channels plus control and sync information. The number of audio channels per direction is variable: either 128 are transferred in each direction, or assymetric set-ups with 192/64 or 64/192 channels are used.

Fibre-optic cables are convenient in mobile applications, too: Despite their immense transmission capacity, they are thin and lightweight. The galvanic separation established by optical lines avoids groundloops and confers increased electrical safety. Fibre-optic cables can span several thousand meters without signal loss and are insusceptible to electromagnetic and electrostatic interference. Therefore, new cables can be run in existing cable channels with no requirement for shielding.

System Size

A system can offer a maximum of 65,536 I/Os. It allows for routing up to 4,096 input channels to any number of outputs at the same time. This enables systems to be created that cover all possible applications from simple format converters in a studio to fully networked broadcasting complexes and even complete exhibition-centre networks.

The optimum network structure and the number of fibre-optic connections required are determined during the planning stage. For example, the network structure depends on the physical location of the Base Devices and on the routing capacity required.

Signal Distribution

On NEXUS STAR, inputs are routed to outputs using the RCX active routing matrix. The matrix centrally manages all audio channels of the interface boards (up to 16) installed into NEXUS STAR.

Connections are created dynamically, i.e. routing capacity is allocated for actual routing connections only. Therefore, the number of physical I/Os on the network can exceed considerably the already large number of 4,096 routable channels.

Synchronisation

In accordance with the NEXUS philosophy, NEXUS STAR operates fully in sync. This allows for a constant and short delay of all routed signals: the latency is just 6 samples. This figure makes NEXUS STAR perfectly suitable for time-critical applications where minimum latency is a must (e.g. live broadcasting).

NEXUS STAR Routing in a new Dimension

The incoming sync clock is processed on the RCX controller board to ensure a low-jitter Base Device clock. This clock signal is made available at the wordclock output of the STAR router for use as a studio master clock or synchronising external recorders.

The absence of the requirement for a separate wordclock network simplifies the installation of large-scale systems and mobile operation.

Sample Rates

The NEXUS STAR routing system operates with the standard sample rates of 44.1 or 48 as well as 88.2 and 96 KHz. The NEXUS network sample rate is selected using the NEXUS software running on a control computer.

Sync Sources

The following sync sources on NEXUS STAR and the NEXUS Base Devices can be used for synchronising the NEXUS network:

- Any wordclock input
- Any digital input
- The internal clock generator
- Any optical input
- The optional RSYNC board (video, WCLK, SDI, AES/EBU)
- MADI (RMF) if available

The clock signal of an external source is processed on the NEXUS STAR RCX controller board or the XCPU controller board of any connected Base Device and is then distributed on the NEXUS network as a low-jitter clock.

Generator

The clock generator integrated on the control boards is based on a precision quartz crystal oscillator and can be used as a master clock for the entire studio. The standard version provides a frequency accuracy of better than ±10 ppm, thus meeting the requirements of AES-11, grade 2.

Auto Sync Search

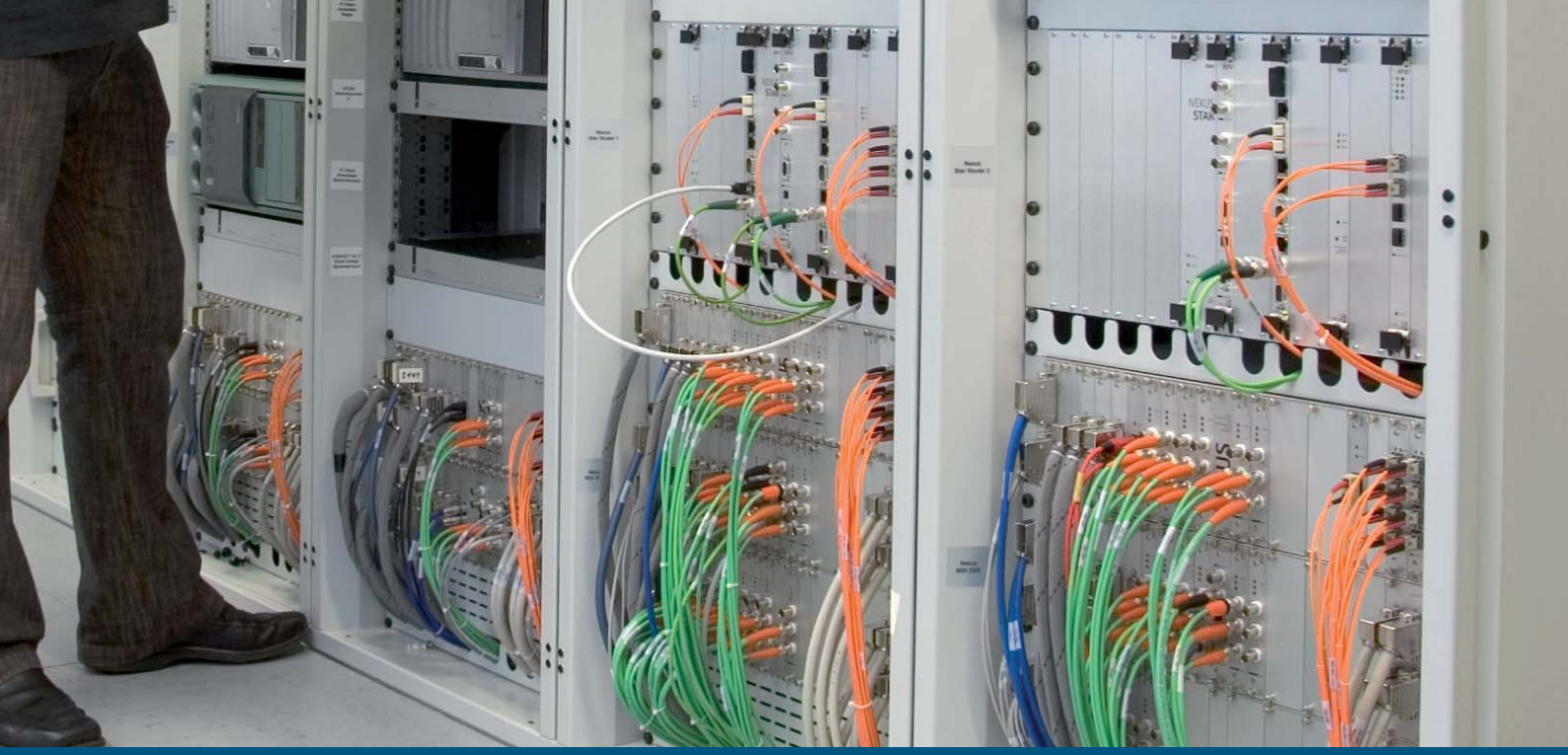
At sync-source failure, NEXUS STAR and the NEXUS network will automatically select another clock source. The change occurs smoothly and without interruption. If no legitimate sync source is found (for example, because inappropriate sample rates are used), the system will switch to the internal clock generator of NEXUS STAR or a Base Device.

A freely configurable priority list determines the order of up to eight sync sources considered for auto sync search.

Power Supply

NEXUS STAR is a highly energy-efficient system. Even when fully populated, it requires a mere 200 W. Switch-mode, wide-range power supply units are mounted onto the router back panel. Operation with redundant supply units and automatic supply takeover is a standard feature; for this purpose, up to four power supplies can be connected to the router backplane. When a power supply fails, changeover is performed automatically and seamlessly.

While no NEXUS Base Device uses forced ventilation, attention must be paid to ensuring NEXUS STAR has sufficient air supply and circulation due to the high component density. In thermally critical areas, air-conditioning should be considered seriously.



NEXUS STAR Routing in a new Dimension

Characteristics

Professional Quality

NEXUS STAR is built for professional use. Beside exceptional audio quality, the developers were committed to outstandingly high reliability. This is especially true for external impacts such as power failure or broken optical cables.

Audio Quality

The consistent use of first-class analogue components throughout the entire NEXUS network ensures the highest sonic fidelity in recording, mix-down, and sound-reinforcement applications. The line-level A/D and D/A converters feature a dynamic range of 133 and 131 dB(A) respectively, while the microphone A/D converter offers 158 dB.

NEXUS STAR meets all requirements imposed by functional specifications 3/2 and 3/5 (as defined by the German Institute for Radio Broadcasting Technology, (IRT), also for analogue inputs and outputs. Digital and analogue components have successfully been tested by the Institute for Radio Broadcasting Service Technology (RBT) in Nuremberg/Germany and Italian and Swiss radio and TV broadcasting services.

Fibre-optic Networking

NEXUS system wiring requirements are reduced to a minimum. NEXUS STAR and NEXUS Base Devices are interconnected solely via duplex fibre-optic cables for audio-signal, word-clock and control-data distribution. This simplifies the installation of widely distributed systems and prevents problems in mobile use.

Distributed Control

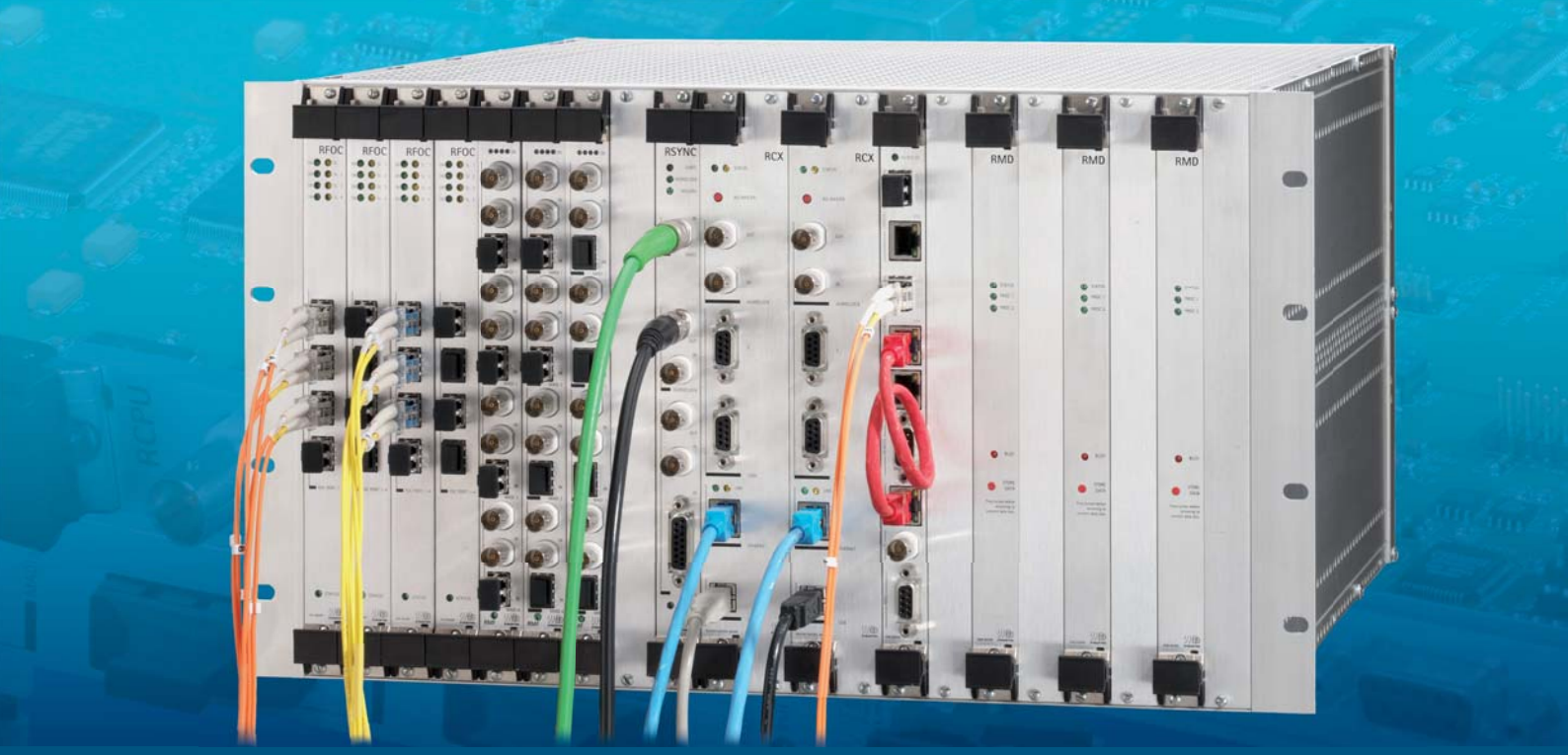
Thanks to its own dedicated controller board, the basic functions of a NEXUS STAR are provided independently of control computers and fibre-optic connections. Thus, the failure of one or more control computers does not affect the audio transmission on the routing system.

The NEXUS data exchange system uses all connections available on the Base Device network. Therefore, it remains operational even if fibre-optic lines or Base Devices break down; thus, the audio network and any emerging partial networks remain largely operable on their own.

Data Retention

The RAM on the RCX and XCPU controller boards is battery-backed; in case of power failure, the most recent system status is memorised. When power is up again, it will take only seconds to restore all settings – NEXUS STAR will be ready for operation in no time.

System and routing settings are also retained: When the overall NEXUS system is powered up, it resumes its most recent status within a few moments. All this is achieved automatically on the NEXUS system independently of any control computers.



NEXUS STAR Routing in a new Dimension

Self-monitoring Functionality

NEXUS STAR and the NEXUS network continuously monitor their own functionality and the network status. Problems detected by the system include:

- Failed or wrongly installed boards
- Breakdown of optical lines
- Power-supply failure
- Sync-source failure
- Base Device failure on the network
- Exhausted routing capacity of Base Devices or connections

Failed or incorrectly installed module boards will normally not affect other functions or module boards. The boards can be replaced even while the system is in use.

Failure Indicators

Error messages are distributed system-wide and are displayed on all active control computers. Furthermore, the graphical control software logs error messages to simplify subsequent analysis.

In the system view, the graphical control software indicates failed boards, power supplies, and Base Devices by red-coloured icons, thus providing a quick survey of the system status. In addition, the dedicated Power Check window provides detailed information about the Base Devices supply voltages.

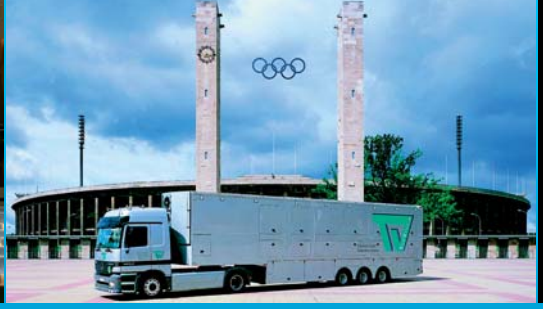
Maintenance and Service

Maintenance of the NEXUS audio network and the NEXUS STAR router is hardly an issue. »Analogue« boards do not need to be calibrated – there are not even any trim potentiometers! Servicing is limited to the replacement of the RCX's/XCPU's buffer battery that must be performed when the system reports that the battery is exhausted (which should only occur at around five year intervals).

For ease of servicing, the system provides numerous support options:

- A control computer can be connected to the NEXUS network for error analysis.
- The graphical system view of the control software shows the physical location of failed boards.
- All module boards and their ports are accessible from the front, so they can easily be checked.
- All boards (except the RCX) can be installed and/or removed during operation without affecting any signal (hot-swap capability).
- Newly replaced module boards are detected and updated within seconds.
- The firmware of all Base Devices on the NEXUS network can be updated from a single control computer.
- A remote-maintenance system is available on request. This system provides for quick and low-cost support by the manufacturer over ISDN, analogue phone lines, or the Internet.
- All events are logged in the control computer.

Grand Théâtre de la Ville, Luxembourg



TopVision, Berlin, Germany

WDR TV, Germany

Bundesmedienhaus, Bern, Switzerland

RTBF TV, Brussels, Belgium

House of Music, Moscow, Russia

NEXUS STAR Routing in a new Dimension

References

The following list includes a number of exemplary NEXUS STAR installations – large and small ones, more or less randomly selected. Therefore, the project selection and sequence does not imply a rating. A detailed up-to-date reference list with all our projects listed by their respective products is available on our website (http://www.stagetec.com).

Audio-System Conversion at Antena 3 in Madrid

Antena 3 – one of Spain's three largest TV broadcasters with an annual turnover of 800 million EUR – completed their networked global digtal audio system at the end of 2009. Maximum flexibility in daily use was at the top of the list with this project. Therefore, Antena 3 opted for six fixed AURUS consoles with up to 48 faders to handle all the applications of a large TV broadcasting centre effortlessly – from talk shows to extensive off-air recordings of live performances in front of an audience.

A total of five NEXUS STAR routers plus 31 NEXUS Base Devices form the backbone of the digital audio network. All components are installed at the various TV studios, the audio-control rooms, and the main switching room.

To achieve utmost flexibility, two additional AURUS remote consoles with 8 faders each plus three extra NEXUS Base Devices were implemented for mobile use. Those remote consoles can be used, for example, for expanding a stationary console or for placing an independent audio subsystem anywhere on the premises when used in conjunction with a mobile NEXUS.

Nexus on U.S. Musical Tour

Wicked is a Broadway musical that debuted in 2003 and has been staged subsequently at many theatres and venues. Following on from this, a big tour across North America started in March 2009. Sound designer Tony Meola and audio engineer Kai Harada who are in charge of the production, put a custom NEXUS network into operation just in time for the first shows at Fort Myers, Florida. Although it was originally installed as a replacement for the analogue multicore cable, the system's additional functionalities soon convinced its users. First, there is the logic programming feature. This makes it possible to integrate a large number of additional tasks – from instrument muting to routing the conductor's talkback microphone, to configuring wireless systems' monitoring.

Five NEXUS Base Devices and a NEXUS STAR core router make up this new and completely digital audio network. With the additional tasks in mind, each NEXUS Base Device was configured with a relay board, the basis for extensive logic control. On the audio side, NEXUS interconnects all the relevant components. No matter whether the FOH or monitor consoles are connected directly to the STAR over MADI, the wireless systems and the pit lines, or if the amplifier feeds are to be integrated – the star topology allows Base Devices to be positioned exactly where they are required. This enables ultra-short analogue cables to be used. The microphone-input boards splitting option is another key function. Each mic signal is converted directly to 32-bit audio and made available at four independent outputs. This enables, for example, the FOH desk and monitoring console engineers to configure different gain settings that do not affect each other.

NEXUS audio quality was particularly persuasive. While the original specification required that audio passing through the switch must not be degraded by it, the upgrade in fact led to a significant quality improvement. Furthermore, the elimination of the hum problems analogue cabling is notoriously prone to is a thing of the past thanks to the digital nature of this tour package.

Double Safety at Canal+

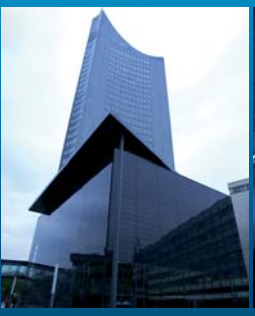
Paris-based Canal+ – the largest commercial-subscription broadcaster in France – added two NEXUS STAR routers to their existing large NEXUS network. The existing NEXUS network was expanded by two NEXUS STARs. Under normal conditions, the two STARs divide the signal routing between them. In case of failure however,

BR TV, Munich, Germany

Fuji TV, Tokyo, Japan

tpc Zürich AG, Zurch, Switzerland

MDR TV, Leipzig, Germany



Guthrie Theater, Minnesota, USA

Olympic Games, Athens, Greece

Eurovision Song Contest, Kiev, Ukraine

NEXUS STAR Routing in a new Dimension

each STAR has sufficient resource reserves to perform the routing by itself. This redundancy was a decisive factor for Canal+ because the entire internal audio wiring is also based on NEXUS.

Nuovo Auditorium di Roma

The Auditorium – one of the world's largest concert buildings – houses three concert halls. Each of these halls has its own control room and NEXUS network including up to nine Base Devices. Other NEXUS Devices are available to the three OB trucks, for uplinks, the audio/video archive, and the rehearsal rooms. The overall installation comprises 34 NEXUS Base Devices. These are controlled using a NEXUS STAR featuring 24 MADI ports with 64 inputs and outputs each.

NEXUS STAR in Kuwait

Radio Kuwait was the first user of a large NEXUS system in the Middle East. A NEXUS STAR core system and 18 Base Devices form a star network with true optical redundancy and carry out the entire audio routing of the station.

Each of the six analogue and six digital control rooms has been equipped with a Base Device used as a local matrix and I/O interface to the CCR. The CCR houses the STAR router and a large Base Device providing many analogue I/O ports for connecting sources from the – still analogue – environment. The network also comprises a stage including an associated audio-control room. One more Base Device is used as a transfer line to Kuwait TV. This installation emphasises NEXUS' ability to provide a branched audio-routing network.

A NEXUS Galaxy: Two Stars and 23 Planets

The most extensive NEXUS audio network so far has been implemented on the premises of a customer in the United States (who is not named for copyright reasons): two NEXUS STARs with 23 NEXUS Base Devices. A 100-percent hardware fail-safety was one of the decisive factors for the client to opt for a NEXUS network. As he broadcasts a 24/7 program to many countries worldwide, broadcasting-signal failure would have a disastrous effect. Therefore, the audio system is primarily based on the redundancy principle. This is not limited to the dual STARs; for example, each presenter in the studio always has a main and a backup microphone. All microphones are connected to separate XMAD microphone boards in separate NEXUS Base Devices. In turn, each of the two Base Devices connects to both of the two NEXUS STARs via four pairs of optical fibres. The cables are run through separate raceways in different parts of the premises, so if one part was damaged, the other one would remain usable. Thanks to automatic signal-path switching on NEXUS, no viewer would notice anything at all.

SWR: A Twinkling STAR for a Major Station

In the good old analogue days, huge audio routers and patch bays dominated the switching room. Not any more. Today, one German broadcaster demonstrates how an entire central audio switching system can be transferred to just two 19" racks – courtesy of a new STAR. Locally installed, traditional, NEXUS Base Devices and digital high-performance devices with MADI interfaces are connected to SWR's NEXUS STAR. This allows it to distribute the signals in a STAR configuration from any source to any output on the premises. The system networks six digital and seven analogue control rooms.

A Great Star in Poland

The Polish Broadcasting Service in Warsaw has extended its NEXUS installations to their studios: 18 distributed NEXUS Base Devices connect to a NEXUS STAR centrally located in the CCR. The network interconnects two buildings that are 13.5 kilometres/8.4 miles apart. The distance is bridged by a monomode optical cable connecting the second building to the STAR.

Philharmonie Hall, Berlin, Germany

Euroscena, Rom, Italy

National Convention Centre NCC, Hanoi, Vietnam

Radio Bremen, Bremen, Germany

Alexandrinsky Theatre, St. Petersburg, Russia

BMW-Welt, Munich, Germany

NEXUS STAR Routing in a new Dimension

References

The Bundeshaus Bern: High Tech behind Old Walls

Outdated technology, not enough workplaces: Journalists had been suffering from bad working conditions at the Swiss parliament – the Bundeshaus (Federal House) – for some time. The same was true for the local production facilities used by the SRG (Swiss Broadcasting Service) which is responsible for broadcasts from the Bundeshaus. Now things have changed. A new information centre for the media named Bundesmedienhaus was constructed in a 19th century building complex close to the parliament. The centre houses not only modern workplaces but also a new central multimedia-control room with an AURUS/NEXUS system.

The heart of the new control room is an AURUS with 32 channel strips, 80 audio channels, and 64 buses. A star-topology network of nine NEXUS Base Devices and a NEXUS STAR is used for routing all audio signals between the plenary assembly hall, the CCR, and the control room. A particular requirement of this installation is that the broadcast audio must be made available in multiple languages since German, Italian, French and Rhaeto-Romanic are all spoken in Switzerland. For this reason, a program feed mixed down from the hall-microphone feeds will be created first using the AURUS – an approach familiar from large international productions. The commentary voice-overs in the four languages will be added to the feed subsequently. The four commentary signals are recorded directly to the camera audio tracks thus also ensuring audio/video synchronicity for subsequent mixdowns.

Schaubühne in Berlin

The Schaubühne at the Lehniner Platz is considered to be the avant-garde theatre in Berlin and is an excellent venue for high calibre dance productions. The theatre is home to three halls separated by sliding steel panels. These halls can be used separately or in varying combinations including one large hall. This high degree of flexibility is reflected by the STAGETEC installation, which comprises four AURUS consoles and a NEXUS audio network including two STAR routers and eight Base Devices just for the audio side of the set-up. Two fixed AURUS consoles are used in the control rooms while the remaining two are portable and can be hooked up to connecting points inside the halls whenever the production requires it.

The Impressive AURUS Installation at Berlin Philharmonic

The Berliner Philharmonie Hall is one of the top concert halls in the world and home to the Berlin Philharmonic Orchestra, conducted by such legends as Furtwängler, Karajan, Abbado, and Simon Rattle.

After almost 15 years of continuous operation, the most important sound control room »Studio 3« has been modernised and completely digitalised. The audio network now comprises an AURUS with 56 faders, a NEXUS STAR router housing the AURUS boards at the heart of the star-topology network, and three NEXUS Base Devices.

The New National Theatre, Tokyo

The New National Theatre Tokyo (NNTT) is one of Japan's biggest theatres – and renowned for its versatility: It stages modern drama and houses an extra opera hall, also used for ballet shows, plus a stage for contemporary dance.

An integral part of the new AURUS set-up is a NEXUS STAR audio router. The NEXUS acts as the I/O unit of the console and as the theatre's audio network at the same time. This considerably enhances the overall system's flexibility. Audio signals can be routed to and from anywhere in the complex – a highly convenient extra benefit. The NNTT owns four stationary NEXUS Base Devices installed in the playback control room, near the sound-reinforcement power amplifiers and in the orchestra pit. In addition, there are two mobile units available that can be used anywhere in the house as required.

Robert Schumann University of Music

Robert Schumann University of Music (RSH) in Düsseldorf, Germany offers unique audio engineering courses in collaboration with another institution: The Düsseldorf University of Applied Sciences (DUAS). RSH focuses on the artistic considerations of music and on practical aspects of music recording while DUAS provides training

TVP Telewizja Polska, Warsaw, Poland

Theater Grosses Haus, Gera, Germany

FM 802, Osaka, Japan

National Stadium, Beijing, China

Best of Musical, Stage Entertainment, Germany

NDR Norddeutscher Rundfunk, Hamburg, Germany

NEXUS STAR Routing in a new Dimension

in science and technical subjects. This education, known collectively as the Düsseldorf School, has an excellent reputation – not least because of the institutes' excellent technical equipment.

These systems include an AURUS with 56 faders plus a NEXUS system equipped with numerous MADI interfaces; the obligatory NEXUS STAR, a stationary Base Device in the control room and an additional mobile Base Device. A specialty of the installation is the five mobile workstations. These hook up to wall sockets providing flexible access to DAW resources located in the central equipment room as well as distributed connectivity to the NEXUS. As a result, many students can work on different projects in external rooms at the same time while the mixing studio is reserved for handling more complex tasks efficiently.

NCC Hanoi

Long, polished limos glide past, helicopters circle overhead and vigilant security guards are everywhere. The atmosphere is electric. High ranking visitors, among them Vladimir Putin and George W. Bush, have assembled at the NCC for the APEC Summit, held in Vietnam for the first time in November 2006.

Excellent sound and clear speech are ensured by a Stage Tec audio network comprising around 700 inputs and 700 outputs that are made available by a configuration of 13 Base Devices and 2 NEXUS STAR routers. The installation is based on a star topology, with the two interlinked NEXUS STARs at its centre.

NEXUS STAR live on tour

Until recently it was not uncommon for promoters to build a completely new venue for a new musical show, or at the very least to refurbish. Stage Entertainment, the undisputed market leader in Germany, now takes some of its shows on tour. For example, »Best of Musical 2006« and »Best of Musical 2007«.

A 30-piece orchestra, split stage left and stage right, support the 20-strong choir and nine soloists. Unlike opera or classical music concerts, modern musical productions are entirely reliant on high quality PA systems, especially in enormous venues such as the Olympiahalle. To achieve the desired results, 126 input channels are employed. 102 of these are equipped with TrueMatch microphone converters. Each console has unrestricted access to each and every one of them. Every soloist is fitted with a miniature personal microphone and transmitter hidden in their costume, under make-up or in their hair.

The show is mixed on the 48 fader AURUS console front of house in the auditorium. Monitoring is taken care of by a 32 fader console that can operate completely independently thanks to it's own RMC card and STAR router. Inputs and outputs are furnished by four NEXUS Base Devices stationed stage left, stage right, and at the two console positions. NEXUS STAR routers, each fitted with seven DSP cards are at the heart of the network.

A STAR in the Van

When it comes to Bundesliga, the Champions League, the Nordic Skiing World Cup in Oberstdorf, or any other major sports event, the TopVision OB vans are almost certainly on the spot. The outside-broadcasting experts provide all of Germany's public and private TV stations with image and sound from these events. Early in 2006, TopVision was already prepared for HDTV: An HDTV-enabled OB van with 24 cameras became the flagship of their fleet.

The NEXUS audio network is remarkably powerful for an O.B. truck system: 16 NEXUS Base Devices and a NEXUS STAR router provide 1,776 × 1,732 I/Os – a truly remarkable number. This includes 208 microphone inputs all of which are equipped with STAGETEC 28-bit TrueMatch converters. Nine stationary Base Devices network the audio and video control rooms and the recording facilities; the remaining seven NEXUS Base Devices are for mobile use and can be placed wherever they are required.

NEXUS STAR Routing in a new Dimension

Specifications

Router

NEXUS STAR is designed as a 19" mainframe for router boards and contains the backplane (TDM bus), the controller boards, and power-supply units. Redundant power-supply units are available optionally. Interface boards are implemented as requested.

Configuration

- 19" mainframe (flightcase or mounting racks on request)
- 1 front-panel row (6 units in height)
- RCX controller board and routing matrix
- 2 to 4 backplane power-supply units (including up to 2 redundancy units), system-specific configuration
- RFOC and RMF I/O boards as requested
- Slot grid: 4 HP (20.32 mm)
- 21 slots available (16 for I/O-board)

Power-supply Units

- Input-voltage range: 90 to 264 VAC
- Line frequency: 47 to 63 Hz
- Power consumption: 100 W (max.) per unit

Dimensions

- Height: approx. 265 mm (6 units)
- Width: approx. 482.6 mm/19"; front-panel area: 84 HP
- Depth: approx. 470 mm including ports (without handles)

Reliability

- Up to four extra redundant power-supply units can be installed
- Hot-swap capability
- Continuous execution of internal test routines
- Uninterrupted signal re-routing in case of malfunctions
- Redundant implementation of controller and routing boards, redundant bus system

Control Computer

NEXUS systems are normally shipped without a control computer. Any standard Windows PC can be used. A control computer must be equipped with a free serial, Ethernet, or USB port for NEXUS-system connection. The control software is optimised for high operating speeds, so a standard PC running Windows XP can be used.

XPSU Power-supply Unit

- Wide-range unit supplying all components
- Up to four power supply units connectable to a router (including redundant units)
- Space-saving back panel installation

NEXUS STAR Routing in a new Dimension

Components

RCX Controller Board and Routing Matrix

- Main-controller board and routing matrix for the NEXUS STAR router
- Controls and monitors all components of NEXUS Base Devices
- Organises routing and sync functions plus clock generation
- Handles up to 16 lines with 256 inputs and 256 outputs each
- Transparent forwarding of 24-bit audio
- 3 computer-interface ports (RS 232/422, USB, or Ethernet)
- Wordclock I/O

RFOC Fibre-optic Interface Board

- Communication between Base Devices and the router via duplex fibre-optic cables
- Up to 4 ports with an overall capacity of 256 inputs and 256 outputs
- Configuration-specific spanning distances of up to 100 km (>62 miles)
- Control-information forwarding
- Sync-information forwarding
- Redundant operation supported

RSYNC Synchronisation Board

- Video, wordclock and AES/EBU inputs
- Automatic detection of video formats
- Input filter for restoring analogue video signals
- Video-sync input (BNC) for bi-level and tri-level sync signals
- Wordclock and AES/EBU outputs

RMF 01 I/O Interface

- MADI-format I/O board
- Extended number of channels compared to the MADI standard format (up to 64 channels)
- 4 equal ports per board
- Automatic channel-number detection (1 to 64)
- Synchronisation to the input-signal wordclock
- Featuring either optical or electrical ports
- Dolby E signal transmission officially certified by Dolby®

RMF-BLC I/O Interface

- MADI-Format I/O Board
- Extended number of channels compared to the standard MADI format (up to 64 channels per port)
- 4 equal ports per board
- Automatic channel-number detection (1 to 64)
- Adjustable I/O gain
- Synchronisation to the input-signal wordclock
- Optical and electrical ports
- Dolby E signal transmission officially certified by Dolby®

RCX Controller Board

NEXUS STAR Controller Board and Routing Matrix

- Main-controller board and routing matrix for NEXUS STAR routers
- Controls and monitors all components of a NEXUS STAR
- Organises routing and sync functions plus clock generation
- Handles up to 16 lines with 256 inputs and 256 outputs each
- Transparent forwarding of 24-bit audio
- Stores the current system status separately from the control computer
- Operation and status indicator LEDs
- Clock generation + synchronisation to various sync sources
- Connects the system to control computers (RS 232/422, USB, or Ethernet)

The RCX integrates two functions of the NEXUS STAR router on a single board: the main CPU formerly contained on the RCPU board and the audio-routing matrix (formerly provided by the RMX board).

The RCX as the central control unit is a mandatory component of the NEXUS STAR router.

The NEXUS RCX and XCPU boards are the basic components of large NEXUS audio networks. The combination of a NEXUS STAR central router and distributed NEXUS Base Devices offer an overall matrix capacity of 4,096 × 4,096 crosspoints – more than 16 million crosspoints in total.

Like with the NEXUS system, all volatile data of the RCX board is stored to battery-backed SRAM. This ensures that the most recent status can be recovered after power failure or shutdown.

To provide redundancy it is possible to install two RCXs to a single RBPR backplane. In this case, one board is in live operation while the other one remains in hot standby mode. If the active RCX fails, switchover occurs automatically; however, it can also be performed manually.

CPU Functionality

The CPU handles communication with external control computers, system management, and control and monitoring of all system components including the router backplanes and the power-supply units. Connectivity to control computers is provided via two RS 232/422 ports, one USB port, or one Ethernet port (10/100).

Synchronisation and clock generation are achieved using a PLL with extended time constant to provide a low-jitter system clock. Standard sample rates of 44.1, 48, 88.2, and 96 kHz are supported. (Other rates are available on request.)

The CPU features a wordclock input for external synchronisation and a wordclock output sending the synchronised internal clock. The following sync sources are available: internal source, the wordclock input, any digital input (including inputs from NEXUS Base Devices), any optical input, the optional RSYNC board (video, WCLK, AES/EBU), and MADI (RMF) if available.

The CPU not only provides control functions but also monitoring features. It continuously monitors the battery status and checks for device failure. A thermal sensor is mounted on the RCX board and continuously monitored by the CPU.

The firmware is stored in a flash memory soldered onto the CPU and can be updated using a utility program running on the PC. No physical components need to be replaced for this purpose.

Router Functionality

The audio-routing matrix is adjacent to the CPU on the RCX board. It is the switching centre for all audio signals on the NEXUS STAR. In contrast with the bus structure in a standard NEXUS system, here the audio is transmitted using an active routing matrix.

The audio-routing matrix manages all audio channels of the up to 16 audio-interface boards that can be installed into a NEXUS STAR. It makes 256 inputs and 256 outputs available to each of the interface boards, thus providing a routing capacity for 4,096 paths. In addition, it also allows single input signals to be routed to multiple outputs. Data is forwarded to many outputs from one input.

The routing options of cascaded NEXUS STAR Base Devices depend on the system configuration: The number of audio channels transmitted between Base Devices relies on the number of RFOC fibre-optic interface boards reserved for this transmission.

The data resolution is consistently 30 bits (including 24 audio bits) on the NEXUS STAR and the NEXUS system. The matrix routes all data fully transparently with regard to their standards – the data is neither evaluated nor modified.

The matrix operates in full sync with the word-clock and has a locking latency of just 3 samples.

Both mono channels and grouped signals can be routed.

RCX Specifications		
	Compatible with RBPRxx only!	
CPU	Type	Motorola MCF547x
	Clock rate	Core: 200 MHz. Bus: 50/100 MHz
Ports	2 × 9-pole D-Sub port, RS 232/RS 422 (for connecting the control computers)	
	1 × USB (control-computer port)	
	2 × BNC (wordclock I/O)	
	1 × RJ 45 (Ethernet, 10/100Base-TX)	
RS 232C interface	Ports	9-pin D-Sub ports, female, galvanically isolated
	Data rate	38.4 kbps (typ.), 115.2 kbps (max.)
	Cable length	10 m (max., recommended)
RS 422/485 interface	Ports	9-pin D-Sub ports, female, galvanically isolated
	Data rate	38.4 kbps (typ.); 115.2 kbps (max.)
	Input level	–7 to 12 V (max.)
	Impedance	Input and output: 120 ohm
	Cable length	100 m/330' (max.) over 110-ohm line; ±20 %
USB interface	Version	Compliant with USB 1.1, Type B; standard-compliant wiring, galvanically isolated
	Data rate	38.4 kbps (typ.); 115.2 kbps (max.)
	Cable length	5 m/16.4' (max.) over 90-ohm line; ± 15 %
Wordclock in	Ports	BNC, galvanically isolated
	Level	1 to 5 V
	Impedance	75/500 ohm (switchable)
	Rates	44.1, 48, 88.2, and 96 kHz
	Required frequency stability	< ±150 ppm min. (±50 ppm typ., compliant with AES 11, Grade 2)
Wordclock out	Ports	BNC, galvanically isolated
	Level	2.4 V on R_L = 75 ohm
	Rates	44.1, 48, 88.2, and 96 kHz
	frequency stability	±10 ppm (max.), ±5 ppm (typ.) (internal generator)
	Output port adjustable to AC or DC	
RJ45 Ethernet	Data rate	10/100 Mbps
	Cable length	100 m/330' (max.), CAT5e or better recommended
Power supply	Voltage	+4.75 to 5.25 V
	Current	1 to 3 A (configuration specific)
Operating conditions	Temperature range	0 °C to +70 °C / 32 to 158 °F
	Humidity	90 % (max.), non-condensing
Storage conditions	Temperature range	0 °C to +70 °C / 32 to 158 °F
	Humidity	90 % (max.), non-condensing
Physical properties	Appearance	Board for 19" mainframe, 8 HP/6 U
	Front panel	6 U × 8 HP (approx. 40 mm × 262 mm/ 1.58" × 10.31")
	Slot requirements	2 dedicated slots per backplane

RFOC Fibre Optic Interface Board

Optical Interface Board for NEXUS STAR Systems

- Designed for networking NEXUS Base Devices using standard duplex fibre-optic cables
- 1...4 ports, application-specific configuration (can be changed at any time)
- Up to 4 ports with an overall capacity of 256 inputs and 256 outputs plus control and sync information
- No additional cabling required for control and synchronisation
- Extensive error recognition
- Supports redundant lines (automatic changeover within one audio sample)

The Router Fibre-Optic Connection board (RFOC) provides interconnectivity between NEXUS STAR routers and to the NEXUS system using duplex fibre-optic cables.

The board allows for four independent bidirectional connections transferring all audio and control data required for audio network operation; extra cabling is not required.

The ports available on the board are largely independent.

Fibre-Optical Connection

Using fibre-optic connections allows high data rates up to 1.25 Gbps and distances of up to 100 kilometres (>62 miles) between two Base Devices. Highly distributed audio networks are thus possible.

Depending on the mode used each fibre-optic connection can transmit up to 256 audio channels for each cable and direction plus control and sync data.

Thus the board is usable for a wide range of applications.

Audio Channels

Audio is transferred in uncompressed 24-bit resolution. The board routes the complete AES-3 frame width of 30-bits. This allows for complete and transparent AES/EBU-signal exchange between two Base Devices.

Control Data

The control data is transmitted in the form of a buffered transparent transmission channel asynchronous to audio and sync data. The maximum net data rate depends on factors such as the system clock, the operating mode, and the protocol used.

Control data is mainly used for communication between Base Devices (system control) but may also be utilised for distributing ancillary data on the NEXUS network.

Sync Information

Sync data includes the internal word clock of the transmitting Base Device. A Base Device can be synchronised to any fibre-optic connection and makes its internally synced wordclock available at the wordclock outputs of the RCX and XCPU controller boards. Therefore, one Base Device can act as a master device on the NEXUS network, and all other Base Devices will synchronise to it via their fibre-optic lines. There is no need for an extra wordclock connection between Base Devices.

Compatibility and Reliability

The protocol used by the RFOC board is compatible with the one used by the NEXUS XFOC 07 board. The data streams from and to the respective ports are subdivided into blocks and are marked with a signature to be verified by the receiver. In case of error, this allows the respective ports to be muted automatically after a timeout.

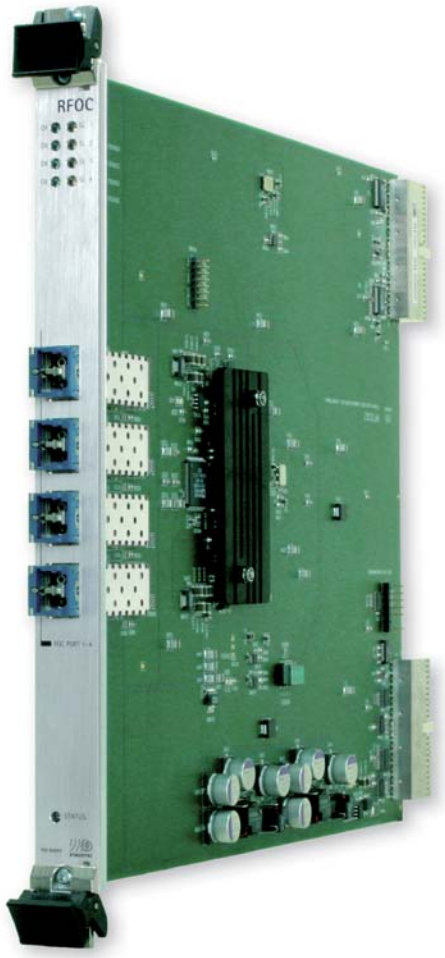
The communication-data pre-processing is performed using an extra signal processor monitored by a watchdog.

The largely independent nature of the ports provides for a high degree of resiliance against hardware errors in redundant operation via the same board. Data loss during changeover is prevented as the current audio sample is always memorised.

Options

On request, the following optical-transceiver options are available:

- For variable wavelengths
- For spanning distances of up to 100 km (>62 miles)
- With bidirectional modules (both transmission directions on a single fibre)
- CWDM



RFOC 02 Specifications		
	Unless otherwise specified, the following specifications relate to one RFOC port (transmitter/receiver unit).	
Connections	Audio channels	128 bidirectional channels per port, 30-bit, 48 KHz, clustering
	Communication channel	1 bidirectional channel per port
	Sync channel	1 bidirectional channel per port
Data rate	Per fibre-optic cable	1.25 Gbps (gross bit rate)
LWC transmitter (multimode)	Standard version for spanning distances of up to 500 m (>1,640 ft)	
	Optical power	-9.5 to -3 dBm @ 50/125-µm optical fibre
LWC transmitter (single-mode)	Special version for large spanning distances up to 100 km (>62 miles)	
	Optical power	-9.5 to -3 dBm @ 9/125-µm optical fibre
Note	The multimode and single-mode transmitters are classified as CLASS1 LED/LASER PRODUCTS.	
LWC receiver (multimode)	Optical sensitivity	-20 to -3 dBm @ 50/125-µm optical fibre
LWC receiver (single-mode)	Optical sensitivity	-20 to -3 dBm @ 9/125-µm optical fibre
Recommended type	Multimode fibre	Graded-index fibre 50/125 µm or 62.5/125 µm
	Single-mode fibre	Single-mode fibre 9/125 µm
Port	Standard version	1 to 4 LC duplex ports
Power supply	Voltage	+4.75 to 5.25 V
	Current draw	approx. 1.3 A (4-port configuration)
Operating conditions	Temperature range	0 to +60 °C/32 to 140 °F
	Humidity	90 % (max.), non-condensing
Storage conditions	Temperature range	–35 to +70 °C/-31 to 158 °F
	Humidity	90 % (max.), non-condensing
Physical properties	Appearance	Board for 19'' mainframe , 4 HP/6 U
	Front panel	6 U (approx. 20 × 262 mm / 0.79 × 10.31")
	Slot requirements	1 slot

RMF-BLC MADI I/O Board

1 to 64-channel MADI Digital I/O Board

- MADI-Format I/O Board
- Extended number of channels compared to the standard MADI format (up to 64 channels per port)
- 4 identical ports per board
- Automatic channel-number detection (1 to 64)
- Adjustable I/O gain
- Synchronisation to the input-signal wordclock
- Optical and electrical ports
- Dolby E signal transmission officially certified by Dolby®

MADI-Format I/O Board

The Router MADI Format board connects to the serial MADI interface (**M**ultichannel **A**udio **D**igital **I**nterface) and includes four 64-channel MADI ports. The board provides 256 inputs and 256 outputs on just 4 HP.

This NEXUS STAR interface board enables, for example, multichannel audio recorders or external mixing consoles to be connected.

In addition to the operating modes required by the MADI standard (AES 10-2003, AES 10id-1995 1995, AES 10-1991/ANSI S4.43-1991), the RMF-BLC board provides the following extra features:

- The number of transmitted I/O channels is extended to 64. When receiving data, the number of channels is detected automatically. The number of output-channels is user-configurable.
- The input signal can serve as sync source on the NEXUS audio network.
- Adjustable gain per transmit and receive channel.
- Supports legacy and double-frequency mode at 96 KHz.

Inputs and Outputs

The bidirectional board features BNC ports (75 ohm, coaxial) and optical ports (LC, 1,300 nm, 62.5/125 µm). The optical ports implement the SFP system supporting various optical-port modules.

There are optical and electrical ports for each of the four MADI interfaces, so both formats are available at the same time. Output signals are transmitted in parallel (i.e. on both port types) while the input type is selected using the NEXUS control software. There is also an auto-select mode.

The BNC interface comprises balanced input and output ports that are galvanically isolated from the system. (This feature exceeds the MADI standard.)

Input Data

The RMF-BLC receives audio on all 56 channels as specified by the standard. In theory, the structure of the MADI data format supports transmitting a maximum of 64 channels (which is not standard-compliant). This allows for transferring 64 channels from one NEXUS RMF-BLC/XMF to another using just a single MADI port. The number of input channels is automatically detected.

All inputs are equipped with gain controls allowing for adjusting the input signal by ±20 dB. User data is transparently forwarded on the NEXUS system, for example, to AES/EBU or other MADI-interface boards.

The RMF-BLC board detects the following information and ancillary data in the data stream:

- Number of input channels.
- Sample rate.
- The first four channel-status bytes containing the following information: multichannel descriptor, format, emphasis, lock, sampling frequency, channel mode, aux use, and audio-sample word length.
- Channel parameters (ON/OFF, A/B, validity).

Output Data

The RMF-BLC board sends all audio channels in MADI standard (a maximum of 64 channels can be achieved). In transparent mode, all ancillary information is adopted from the signal source (MADI, AES/EBU).

The User and Validity data can either be fixed to static values or are copied from the signal source (MADI, AES/EBU) in transparent mode.

The number of channels to be transferred can be set to either 56 or 64. In addition, the ON/OFF and A/B information can be configured per channel. In 96-KHz use, legacy and or double-frequency modes are available. While the sender is in 96-KHz mode, the receiver of the same port automatically interprets an incoming signal with more than 32 channels as legacy format.

Loop Mode

In practice, loops are sometimes created for testing purposes or to form dedicated signal-processing flows; in such set-ups, the output signal of a board such as a MADI board is connected to the input of the same or another board using a short patch cable. With the RMF-BLC, such loops can be created internally, so no patch cable is required. This loop mode applies to all channels of the respective MADI port – the individual inputs are directly routed to the respective outputs.

Legacy Mode

To use external legacy 48-KHz machines for 96-KHz productions, the RMF-BLC supports a legacy mode on both the input and the output side. This mode allows for playing or recording 96-KHz audio from/to 48-KHz systems.

Metering

The RMF-BLC board features two signal processors that determine the levels of all received and transmitted channels in a cumulative manner and transfer the values to the RCX controller board. These DSPs are monitored by watchdogs.

Error Detection

Failure of ingoing MADI signals is detected and reported to the RCX. The RMF-BLC also features a bus selector for use in redundant NEXUS STARs.

Versions

All versions of the RMF-BLC incorporate optical and electrical I/O ports. Both port types can be used at the same time.

The pinout of the BNC electrical ports is MADI compliant. Thanks to the implementation of SFP modules, the optical ports can be custom-populated. User-configurable LC duplex ports are typically used.

RMF-BLC Specifications		
	All relevant specifications comply with the following standards: AES 10-2003, AES 10id-1995, AES 10-1991 (ANSI S4.43-1991).	
Data formats	MADI: 24-bit audio	
RMF -BLC inputs	4 independent ports, optical (LC) and electrical (BNC) formats	
	1 to 64 channels per port @ 48 KHz (1 to 32 channels @ 96 KHz)	
	Legacy mode supported, auto-switchover	
RMF-BLC outputs	4 independent ports, optical (LC) and electrical (BNC) formats	
	1 to 64 channels per port @ 48 KHz (1 to 32 channels @ 96 KHz)	
	Legacy mode supported (enabled using the control software)	
Cabling recommendations	Coaxial	Cable length: 50 m (max.)
		Impedance: 73 to 77 ohm
		Attenuation: 0.1 dB/m @ 1 to 100 MHz
	Optical (IEC-793 and FDDI compliant)	Cable length: 2 km / 1.2 miles (max.)
		Bandwidth: 500 MHzkm @ 1,300 nm (max.)
		Attenuation: 0.9 db/km (max.) @ 1,300 nm (only cabling)
Data rate	125 Mbps (typ.)	
Sample rates	44.1, 48, 88.2, and 96 KHz	
Power supply	Voltage	+4.75 to 5.25 V
	Current intake	• approx. 1 A (board with no optical module installed) • approx. 150 to 300 mA for each optical module, version-specific
Operating conditions	Temperature range	0 to 50 °C/32 to 122 °F
	Humidity	90% (max.), non-condensing
Storage conditions	Temperature range	–35 to +70 °C/-31 to 158 °F
	Humidity	90% (max.), non-condensing
Physical properties	Overall	Board for 19" mainframe, 4 HP/6 U
	Front panel	6 U × 4 HP (approx. 20 mm × 262 mm)
	Weight	0.54 kg

Versions	
RMF-BLC	BNC/LC combo I/O board, MADI compliant, without SFP modules, see below
available SFP modules:	
SFPM-MF-01	LC multimode version 1,310 nm, 1,500 metres (50/125 µm)
SFPM-MF-02	LC single-mode 1,310 nm, 2 km (9/125 µm)
SFPM-MF-04	LC single-mode 1,310 nm, 30 km (9/125 µm)

RSYNC Synchronisation Board

Video, WCLK, and AES/EBU Sync-Input Board for the NEXUS STAR

- Video, wordclock and AES/EBU inputs
- Automatic detection of video formats
- Input filter for restoring analogue video signals
- Video-sync input (BNC) for bi-level and tri-level sync signals
- Wordclock and AES/EBU outputs

The RSYNC board for the NEXUS STAR was designed for connecting to external studio systems and devices. It provides three inputs used to synchronise the NEXUS system remotely: video, wordclock, and AES/EBU. The synchronisation source is selected using the NEXUS control program.

Sync Inputs

AES/EBU The NEXUS can synchronise to an external AES/EBU signal. The synchronising signal is applied either to a standard AES/EBU input on the system (e.g. on a XER board) or to the RSYNC directly. For space-saving purposes, the RSYNC front panel provides a BNC port as well as a D-Sub port. Both the BNC and D-Sub ports are balanced; the BNC port has an 75-ohm impedance, and the AES inputs have a standard impedance of 110 ohm. Changeover between the two ports occurs automatically. Both inputs are galvanically isolated and balanced.

Video External video signals are applied to a BNC standard port. It is galvanically isolated and unbalanced (as specified by the format). The video input handles a number of formats: It accepts not only composite, component, and HDTV video but also new HD formats including tri-level sync information as sync sources. The RSYNC detects the applied formats automatically, so manual switchover is unnecessary. It incorporates a composite filter, selectively enabled, for suppressing analogue interference (noise, voltage peaks).

Wordclock The wordclock input is implemented as an isolated BNC port. The input port is balanced and galvanically isolated and accepts TTL signals. The nominal input impedance of 75 ohm can be changed to approx. 500 ohm. This enables a single source to feed multiple destinations.

Sync Outputs

The (externally applied or internally generated) NEXUS system clock is made available to external units on one TTL wordclock output and two AES/EBU outputs. All outputs are balanced and are galvanically isolated.

Just like the inputs, the AES/EBU outputs are implemented as BNC and D-Sub ports. The D-Sub port has a 110-ohm impedance.

Compatibility

The RSYNC boards can be used on first generation NEXUS STAR routers as well as on current-generation routers incorporating a redundant RCX/backplane configuration.

Thus, the RSYNC is compatible with the RCPU/RMX and RCX controller boards as well as with the RBP and RBPR backplanes.

Indication and Error Detection

The RSYNC detects and indicates sync-signal failure.

Hot Swap

As is usual with NEXUS components, the RSYNC board can be removed and installed during operation. If necessary, the NEXUS switches automatically to the next available internal or external sync source.

RSYNC Specifications	
Video input	Port: BNC
	Galvanic isolation
	Sensitivity: 1 V (nom., 0.5 to 2 V_{PP})
	Impedanz: 75 ohm
	Required stability: < ±100 ppm (±50 ppm typ., compliant with AES 11, Grade 2)
	SD formats (NTSC, PAL): • 525 lines interlaced, 59,94/60 Hz (NTSC) • 525 lines progressive, 59,94/60 Hz • 625 lines interlaced, 50 Hz (PAL) • 625 lines progressive, 50 Hz (PAL)
	HD formats (SMPTE 296M): • 720 lines progressive, 50; 59,94 and 60 Hz
	HD formats (SMPTE 274M, SMPTE 260M): • 1035 lines interlaced, 59,94/60 Hz • 1080 lines interlaced, 50; 59,94 und 60 Hz • 1080 lines progressive, 23,98; 24; 25; 29,97; 30; 50; 59,94 und 60 Hz
Wordclock in	Port: BNC
	Balanced, galvanic isolation
	Sensitivity: TTL, 1 to 5 V
	Impedance: 75/500 ohm (jumper-configurable)
	Frequency: 44.1, 48, 88.2, and 96 KHz
	Required stability: < ±150 ppm (±50 ppm typ., compliant with AES 11, Grade 2)
Wordclock out	Port: BNC
	Balanced, galvanic isolation
	AC/DC coupling: jumper-configurable
	Level: ≥ 2.4 V on R_L = 75 ohm
	Impedance: 75 ohm
	Frequency: 44.1, 48, 88.2, and 96 KHz
	NEXUS frequency stability min. ±10 ppm, typ. ±5 ppm (when using internal generator)
AES/EBU input	BNC and D-Sub, 15-pin, female
	Balanced, galvanic isolation
	Ground connection: configurable on D-Sub port
	Input voltage: ±0.2 to 7 V
	Impedance: 75 ohm (BNC), 110 ohm (D-Sub)
	Frequency: 44.1, 48, 88.2, and 96 KHz
	Required stability: < ±150 ppm (typ. ±50 ppm, compliant with AES 11, Grade 2)
AES/EBU output	Port: BNC and D-Sub, 15-pole, female
	Balanced, galvanic isolation
	Ground connection: configurable on D-Sub port
	Impedance: 75 ohm (BNC), 110 ohm (D-Sub)
	Level: • 1 V_{PP} (nom.) on R_L = 75 ohm (BNC output) • > 2 V_{PP} on R_L = 110 ohm (D-Sub output)
	Frequency: 44.1, 48, 88.2, and 96 KHz
	Frequency stability: min. ±10 ppm, typ. ±5 ppm (when using internal generator)
Power supply	Operating voltage: +4.75 to 5.25 V Power consumption: approx. 0.4 A
Operating conditions	Temperature range: 0 to +50 °C/32 to 122 °F Humidity: 90 % (max.), non-condensing
Storage conditions	Temperature range: –35 to +70 °C/-31 to 158 °F Humidity: 90 % (max.), non-condensing
Physical properties	Front panel: 6 U × 4 HP (approx. 20 mm × 262 mm) Slots: 1





Digital Innovation

From its formation in 1993, Stage Tec Entwicklungsgesellschaft für professionelle Audiotechnik mbH has specialised in the design of digital audio technology. Since then it has set new benchmarks, thanks to continuous research and development.

Milestones on the creative path have been

- the CANTUS digital mixing console (1994),
- the AURUS, AURATUS, and CRESCENDO direct-access consoles (2002/2008/2009) offering different features sets for dissimilar applications,
- NEXUS (1993) – the first digital audio router with consistent optical networking and a distributed concept.

Stage Tec has become a world-leading vendor of professional audio systems. The bright new building on the bank of the River Spree in Berlin, houses the R&D department as well as production facilities with multiple commissioning rooms and a dedicated recording studio. Supported by a powerful partner, 13 graduate engineers founded the business as some kind of employee-owned company. All of them active partners in the company still today, constantly advancing innovation and efficiency.

Stage Tec imposes stringent standards on its hardware designs. All modules must be compact and lightweight with ultra-low power consumption and, at the same time, must have impeccable sound quality. Only then can you design lightweight, intelligent and flexible products like AURATUS, AURUS, CRESCENDO, or NEXUS.

At Stage Tec, the software and hardware domains are inextricably linked. Highly optimised hardware demands purpose-built software solutions. Stage Tec relies on its own skills and expertise. The entire software, the algorithms employed in the individual DSP building blocks and the control programs of the NEXUS and the consoles with their graphical user interfaces, all come from the in-house software-development department.

Whether NEXUS, NEXUS STAR, TrueMatch RMC, AURUS, AURATUS, or CRESCENDO, every Stage Tec product has been a trend-setter. With CANTUS (Stage Tec's very first console) and NEXUS, the consistent separation between mixing and the I/O matrix is innovative and allows efficient decentralised systems to be constructed. The AURUS, AURATUS, and CRESCENDO consoles extend the family tree and excel with their unique operating concept: instant access to all key parameters. Something of a novelty in the digital world!

Superlative sound quality and ultimate reliability in professional use is the norm for all Stage Tec products. 40-bit floating-point arithmetic and 32-bit TrueMatch converters are standard features along with automatic self-test routines, hot-swap capable components, redundant power-supply units and fibre-optic lines. Distributed intelligence confers further security by ensuring there is no single point of failure that would disable the complete system.

Furthermore, all Stage Tec products are extremely compact, lightweight, and power-saving thanks to state-of-the-art design and the use of modern, innovative materials. These criteria are of considerable importance in many fields, for example in OB trucks.

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