SVSI Networked AV

N2600/N3300 Pre-Implementation Guide

IMPLEMENTATION

SVSI's N-Series line of Networked AV products provides extensive, seamless matrix switching and AV-over-IP content distribution for professional AV dealers. Our Networked AV solutions deliver exceptional video and audio quality at bandwidths suitable for any network segment or link. Matrix switches as large as 2000x1200 have been built on a converged network using SVSI Networked AV products. Alternatively, many customers implement SVSI N-Series systems on a physically separate network to keep video traffic distinct from production data or voice. In this latter scenario, one option for control is to place the control system on the house network and connect it to an N-Command N8002 Controller, enabling control of the SVSI N-Series system from their corporate network.

Item	Description
Encoders/Decoders	
N2612S 4K Encoder	Encodes to distribute 4K applications with resolutions up to 4K60 4:4:4. Supports HDCP 2.3. Motion-based wavelet codec solution delivers video with nearly imperceptible latency at a bandwidth of 500-700 Mbps. Features a Simultaneous H.26X codec supports resolutions of 720P or 1080P. Can be powered by a PoE+ switch Support for Dante AV-A including support for 2 channels of audio.
N2615D 4K Video over IP Decor-Style Wall plate Encoder	Encodes to distribute 4K applications with resolutions up to 4K60 4:4:4. Supports HDCP 2.3. Motion-based wavelet codec solution delivers video with nearly imperceptible latency at a bandwidth of 500-700 Mbps. Can be powered by a PoE+ switch. Support for Dante AV-A including support for 2 channels of audio.
N2622S 4K Decoder	Decodes to distribute 4K applications with resolutions up to 4K60 4:4:4. Supports HDMI 2.0 and HDCP 2.3, offering increased compatibility with 4K sources and displays. Decodes H.26X video streams. Can be powered by a PoE+ switch. Support for Dante AV-A including support for 2 channels of audio.
N2625D 4K Video over IP Decor-Style Wall plate Decoder	Decodes to distribute 4K applications with resolutions up to 4K60 4:4:4. Supports HDMI 2.0 and HDCP 2.3, offering increased compatibility with 4K sources and displays. Can be powered by a PoE+ switch. Support for Dante AV-A including support for 2 channels of audio.
N3312 H.26x Compressed Video-over-IP Encoder	Encodes to distribute 4K applications with resolutions up to 4K60 4:4:4. Supports HDCP 2.3. H.26x streaming solution delivers video with nearly imperceptible latency at a max bandwidth of 50 Mbps. Features a Simultaneous H.26X codec supports resolutions of 720P or 1080P. Can be powered by a PoE+ switch Support for Dante AV-H including support for 2 channels of audio.
N3322 H.26x Compressed Video-over-IP Decoder	Decodes to distribute 4K applications with resolutions up to 4K60 4:4:4. Supports HDMI 2.0 and HDCP 2.3, offering increased compatibility with 4K sources and displays. Decodes H.26X video streams. Can be powered by a PoE+ switch. Support for Dante AV-H including support for 2 channels of audio.

Audio Transceiver	
Item	**Description**
N4321D Audio Transceiver (ATR)	Sends/receives eight-channel audio over IP (balanced or unbalanced). Support for 2x2 channels of Dante Audio. Supports 2xRelay, 1xGPI (General Purpose Input), and 48v Phantom Power.

Control Software/Appliance	
Item	**Description**
N-Able Software	Free N-Series Equipment setup utility and troubleshooting tool. Supports PC or Mac. *PC version - http://www.amx.com/products/N-ABLE-PC.asp* *Mac version - http://www.amx.com/products/N-ABLE-MAC.asp*
N-Act	On-board control. All N-series Encoders/Decoders have on-board, built- in control capability via events that can trigger any number of TCP/UDP commands to other IP controllable devices.
N-Command Control Appliances	N8002 web-based hardware controller. Offers control options for multiple users and devices. See page 4 for more info. Capable of interfacing with third-party control systems for simplified end user control.

Third-Party Control

For direct control of units, refer to our Direct Control API documents for the series being controlled. For HControl of units, refer to our HControl API documents for the series being controlled.

Implementation Considerations

- N-Series Networked AV solutions are based on gigabit Ethernet protocol.
- Networked AV devices can be installed on a physically separate network or converged onto an existing gigabit Ethernet network.
- By default, units come configured in DHCP mode. If there is no DHCP server on the network, they switch to Link-Local IP mode with IP addresses of 169.254.xxx.xxx.
- Any control software or device must have a Dynamic or Static IP address in the same subnet as all Networked AV devices.
- Virtually any layer-3 switch or layer-2 switch (so long as it supports IGMP snooping and querying) can be used for routing Networked AV video streams. Specific applications also require IGMP Immediate Leave to be enabled. A list of supported and not-supported network switches can be found here: AMX Network AV Supported Ethernet Switches
- When incorporating Video and Dante/AES67 onto the same VLAN, careful consideration should be applied to keep the traffic properly prioritized and not conflict.
- AMX recommends keeping Control traffic and Video traffic in separate Vlans to avoid conflicts and dropped packets.
- A video network can incorporate 10/100-baseT devices such as third-party controllers or point-of-sale devices. However, video traffic must be blocked from going into the network port to which the device is connected. This can be done through an extra switch port on an N-Series device or through a port on a switch with IGMP snooping enabled.
- The maximum distance between devices directly over the CAT5e cable is 100 meters (328 feet). This distance can be extended in increments of 100 meters (328 feet) by using a gigabit switch as a repeater between devices. Copper Ethernet connections can be up to 100 meters, but the use of fiber can extend network connections to many kilometers.
- The system is controllable through an N8002 controller, AMX Control Systems, or a third-party control system using TCP/IP (e.g., Savant, Utelogy, Crestron, Q-Sys, Extron).
- If being added to an existing house network, the involvement of the IT administrator as early as possible will help ensure successful implementation. AMX recommends purchasing the Netgear AV line of network switches for stand-alone networks.

NOTE: *Virtually any system that can open a socket and send ASCII strings will be able to control an N-Series system.*

Batch Configuration of IP Addresses

N-Able can export and import comma-separated value (CSV) files. Once units are auto-discovered in N-Able, the CSV file can be exported into Excel, where parameters such as IP address, subnet mask, gateway, stream number, audio settings, etc., can be configured. Once configured, importing this CSV file back into N-Able will assign those parameters to the appropriate device and reboot the device to activate. This procedure can be used to configure multiple Networked AV devices at the same time. It can also provide valuable diagnostics by allowing the user to see the last known device configuration and scan the network for new devices (regardless of IP configuration).

N-Able and N-Command Controllers

N-Able is a free device setup utility that installs and runs on a host machine. The host machine must be connected to the network containing (and have an IP address in the same range as) the N-Series equipment. The N8002 series controller is a dedicated hardware device that simplifies set-up and allows expanded web-based control.

The following table lists the host PC system requirements for installing N-Able software:

Operating System	Windows 7/8/8.1/10/11 or Mac OSX
RAM	1GB MB minimum, 4GB recommended
Network Connection	Ethernet (1000-baseT recommended)
Hard Disk Space	120 MB

The following table compares the features of the N-Able, N-Touch, and N-Command Controllers:

Features	N-Able Control Software	N8002 Controller
Web-Based Control		✔
Group Management		✔
Third-Party Control		✔
Remote Web-Based Diagnostics		✔
Software Installation Not Required		✔
Virtual Matrix Switching	✔	✔
Touch-Panel Editing and Hosting		✔
Mobile Device Support		✔
Panel Builder		✔
Scripts		✔
Interface to Networked AV System	Host Network Interface	Dual Network Interfaces
Max Number of Users	1	Unlimited
Max Number of Devices	Unlimited	Unlimited

VIDEO INPUTS

Digital video is input directly to any Encoder through the digital video input (HDMI IN 1 or HDMI IN 2) connectors.

Supported Resolutions

Each Encoder samples the incoming digital video frequency and adjusts accordingly. The supported video resolutions are:

Source	Resolutions (width x height)	Supported Frame-Rate
4K	Up to 3840 x 2160	Up to 60-Hz for all modes

4K is only supported on select N-Series products.

All Decoders have a scaling option that can be turned on or off. For seamless-like switching between video streams, all inputs should be scaled to the same resolution. Enable Decoder scaling to enable seamless switching between video streams of different resolutions. Disable Decoder scaling to bypass display scaling and present content at the highest fidelity. Enable a static resolution for the Decoder scaler and enable the Last-Frame-Hold option on the Decoder.

EDID Information

Most video sources have the capability to output in multiple formats. The supported video resolutions and formats are stored in Extended Display Identification Data (EDID). Some video sources will query the attached display's EDID to assess supported resolutions and then output the highest common format. Other video sources will not query and instead start outputting in a pre-determined format. Each N-Series Encoder acts like a display to a video source and comes pre-stored with a specific EDID indicating supported resolutions and formats. N-Able software allows an Encoder to be loaded with the EDID from a particular display. It may be necessary to restrict the video source output format to only those supported by a particular monitor. Alternatively, enabling scaling on the Encoder allows selection of a format that may be compatible with the display.

HDCP

Harman's Networked AV products provide HDCP and EDID management. Encoders support HDCP versions 1.x and 2.x and allow changing the advertised version of HDCP. If the HDCP Support option is set to None, the Encoder will not advertise HDCP. If HDCP content is played, the decoder will display an error message, and the HDCP Support must be adjusted to permit HDCP content to pass.

NETWORK PROPERTIES

Networked AV products use different network packet protocols for different operations. These network formats are described in the table below, followed by a table listing the applicable port numbers:

Signal	N-Able	N8002 Series Controllers	Default Address Range	Comments
Auto-discovery	UDP/IP Broadcast	UDP/IP Broadcast	255.255.255.255	• switchable but not routable • not configurable
Control	UDP/IP TCP/IP Unicast	UDP/IP TCP/IP Unicast	169.254.xxx.xxx	• IP address settable in N-Able or N8002 controller
Video (Interleaved)	UDP/IP Multicast	UDP/IP Multicast	239.255.0.1 – 239.255.255.253 (odd addresses)	• administratively-scoped IP address • switchable and routable with correct router configuration • IGMP can be used for flood control
Audio (Interleaved)	UDP/IP Multicast	UDP/IP Multicast	239.255.0.2 – 239.255.255.254 (even addresses)	• administratively-scoped IP address • switchable and routable with correct router configuration • IGMP can be used for flood control
USB 2.0 (Interleaved)	UDP/IP Multicast	UDP/IP Multicast	239.7.x.x – 239.7.x.x	• administratively-scoped IP address • switchable and routable with correct router configuration • IGMP can be used for flood control
Multicast Discovery	UDP/IP Multicast	UDP/IP Multicast	239.254.12.16	• administratively-scoped IP address
AES67 Audio	UDP/IP Multicast	UDP/IP Multicast	239.0.0.0 – 239.255.255.255	• administratively-scoped IP address • switchable and routable with correct router configuration • IGMP can be used for flood control
OOB Control (Device Control)	UDP/ IP Multicast	UDP/ IP Multicast	225.1.0.0 – 225.1.0.1	•
PTP Time Protocol	UDP/IP Multicast	UDP/IP Multicast	224.0.1.129	• Precision Time Protocol (PTP) for AES67 audio synchronization

NOTE: *Multicast addresses may be user-configured.*

Product	Interface	Type	Port
N2600 Series	Control	UDP TCP	50001 50001, 50002
	H-Control	TCP	4197
	Audio	UDP	50003
	Video	UDP	50002
	Serial	TCP	50004
	HTTP Webserver	TCP	80
	HTTPS Webserver	TCP	443
	AES67	UDP	5004
	PTP	UDP	319, 320
	Signal (Internal Control)	TCP	6850
	Signal (Internal Control)	TCP	59700
	RS-232 (Internal Control)	TCP	52367
	IR (Internal Control)	TCP	59401
	Dante AV-A	TCP	60000 + Randomized
N3300 Series	Control	UDP TCP	50001 50001, 50002
	H-Control	TCP	4197
	Serial	TCP	50004
	RTSP	TCP	8554
	RTCP	UDP	50011
	HTTP Webserver	TCP	80
	HTTPS Webserver	TCP	443
	Transport Stream	UDP	Default: 18888 User-configurable to 1-65535.
	AES67	UDP	5004
	PTP	UDP	319, 320
	HTTP Live	TCP	8080,8081
	Dante AV-H	TCP	50201
N-Command	Control/Status	UDP	50005, 50006
	Panel Builder	TCP	3001
	HTTP Webserver	TCP	80
	HTTPS Webserver	TCP	443
	Direct Control API	TCP	50020
	HTTP Unit WebView	TCP	10000 + number of units
	HTTPS Unit WebView	TCP	20000 + number of units

NOTE: *The SSL version for the Control and Serial port is the original port number + 100. For example, for Control Port 50001, the SSL version would be port number 50101.*

These network protocols should be familiar to any network engineer. Because our Networked AV solutions bridge the gap between the audio-visual (AV) and information technology (IT) worlds, AMX suggests involvement of both AV and IT departments in any installation.

FIG. 1 illustrates the basic installation of one Encoder and one Decoder. A video source provides the digital video content to the Encoder which converts to Ethernet packets and sends to the attached Decoder. The Decoder reconstitutes the video with synchronized audio for presentation to the attached display. If high-fidelity video and audio are playing on the display in this simple configuration, the N-Series hardware is operating successfully.

FIG. 1 Simple Installation

The same system can be connected through a network as shown in FIG. 2.

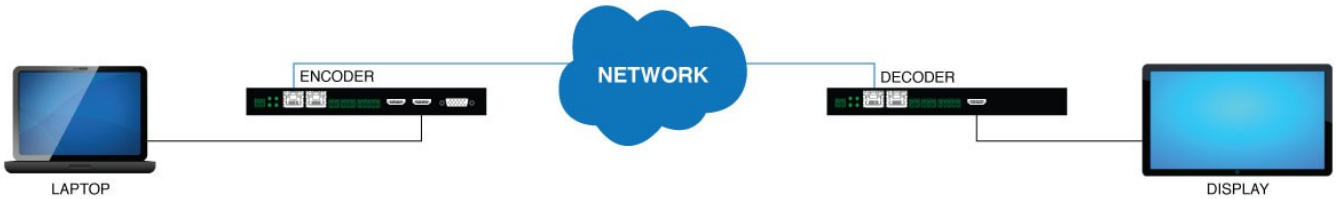

FIG. 2 Network Installation

If the same Decoder when connected through a network to the same Encoder does not deliver high-fidelity video, a network problem exists. In most cases, the device IP addresses are incompatible with the existing network configuration. Contact your network administrator to determine network properties and configuration.

More elaborate video networks can be constructed as illustrated in FIG. 3.

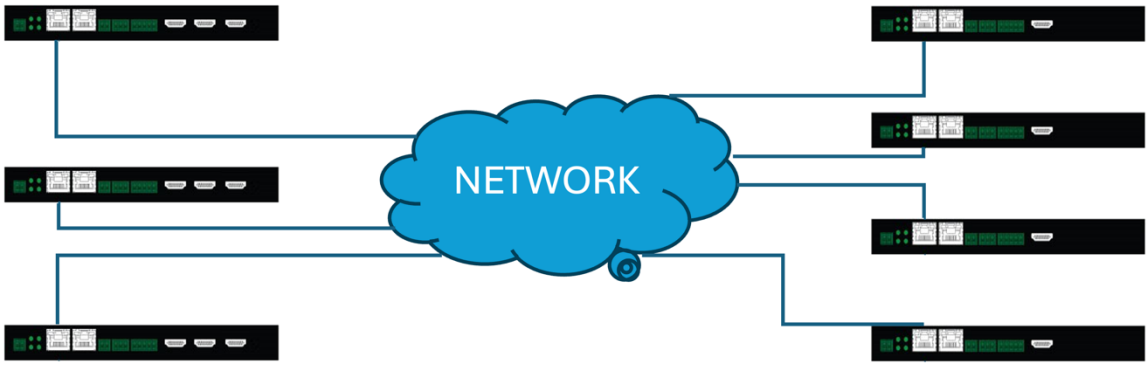

FIG. 3 LAN Installation

Controlling Multicast

N-Series Encoders and Decoders use UDP/IP multicast for audio and video distribution. This works perfectly for high bandwidth applications such as streaming media because in multicasting, there is one source (sender) sending data to multiple recipients. Still, there is only a single copy of the data being sent and shared among all of the recipients. This is accomplished by splitting the single transmission among the multiple users using multicast trees. If you would like to read more about IP multicast, a document found at the following wiki link:
https://en.wikipedia.org/wiki/Internet_Group_Management_Protocol

There are two ways to control multicast on the network. Which one you choose depends on your network requirements.

- IGMP (Internet Group Management Protocol) Snooping: For use when streaming in a single VLAN. Allows video streams (groups) to be dynamically routed only to those ports requesting the video stream. The IGMP snooping feature prevents the multicast video traffic from flooding the network. This is the recommended setting for N-Series equipment. To use IGMP, the AV network switches must have IGMP snooping enabled and there must be a single main IGMP querier. For more information, visit the following Cisco website: https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/ipmulti_igmp/configuration/xe-16/imc-igmp-xe-16-book.html
- PIM (Protocol Independent Multicast): For use when streaming multicast AV traffic between different VLANs. PIM functions independently of IP routing protocol. PIM Sparse Mode (PIM-SM) or PIM Source-Specific Mode (PIM-SSM)is recommended by AMX as it provides the lowest amount of overhead traffic on the network. You can find more information about PIM by visiting the following Cisco website: https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/ipmulti_pim/configuration/xe-16/imc-pim-xe-16-book/imc-tech-oview.html

N-Series control signals are TCP/IP unicast and can be routed. Video signals are multicast and can be routed in certain cases. Many Cisco routers require that the routing table be pre-loaded so that the processor does not have to touch each packet to determine its destination. Static routing has been used successfully to route multicast video traffic. Alternatively, existing routing protocols like generic routing encapsulation (GRE) or equivalent can be used to route video traffic. These protocols generally encapsulate the multicast packets in unicast wrappers for point-to-point transmission between routers. Once at the intended unicast destination address, the unicast wrapper is stripped and packets revert to multicast.

Although N2600 Encoders output only multicast video, N2600 H26x, and N3300 Encoders can output unicast video natively at a bandwidth compatible with lower speed links. N3300 also supports standard streaming protocols like RTP, RTSP, RTMP, and HTTP Live commonly used with content delivery services.

Defining Multicast Addresses Using the Stream Number

To support backwards-compatibility with legacy products, N-Series products use a special calculation to determine the multicast address based on the stream number. To better understand this calculation, refer to the examples given in this section. To quickly determine a unit's multicast address, it is easiest to just refer to the unit's Settings webpage (see FIG. 4).

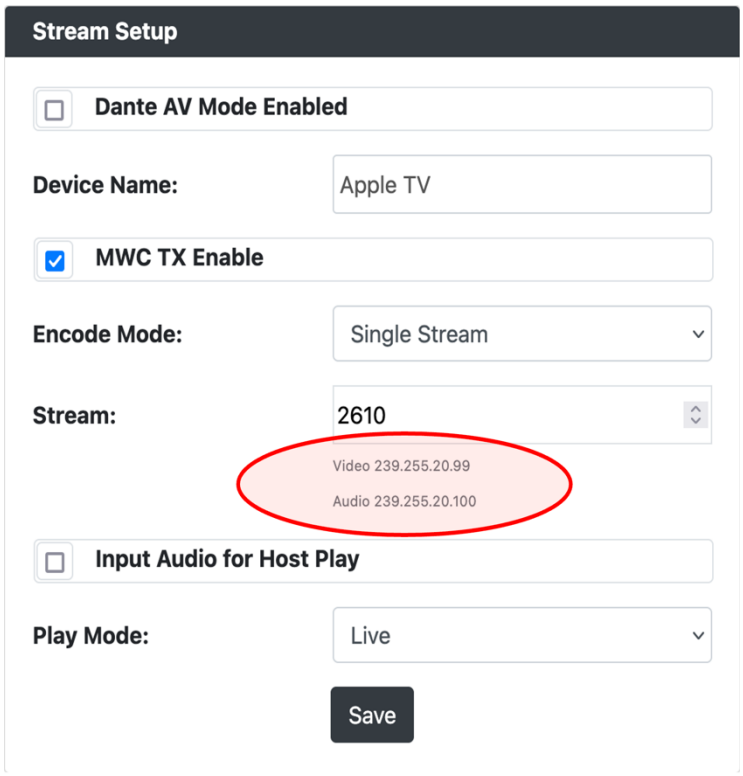

FIG. 4 Video/Audio Multicast Address

Installation Over an Existing Network

Notes:

Installation notes regarding deployment of SVSI systems onto a network are listed below. These are guidelines and any action shall be consulted by the network engineer or architect responsible for the network operation.

- Video, Audio, and Control should be placed on their own VLAN to maintain traffic resilience.
- Inter-Vlan routing should be enabled to allow for communication between VLANs.
- Ports connected to control systems should be blocked for receiving IGMP traffic.
- PoE calculations should be considered for the entire switch and system.
- Total system bandwidth should be calculated based on worst case scenario for the series being deployed.

Legacy network equipment may or may not be fully gigabit-enabled. Even though most installed networks are gigabit, it only takes one 100-BaseT switch or router within the video pathway to degrade or block the signal completely. If you are unsure of your network configuration, contact your network administrator before trying to implement a Networked AV solution on your network.

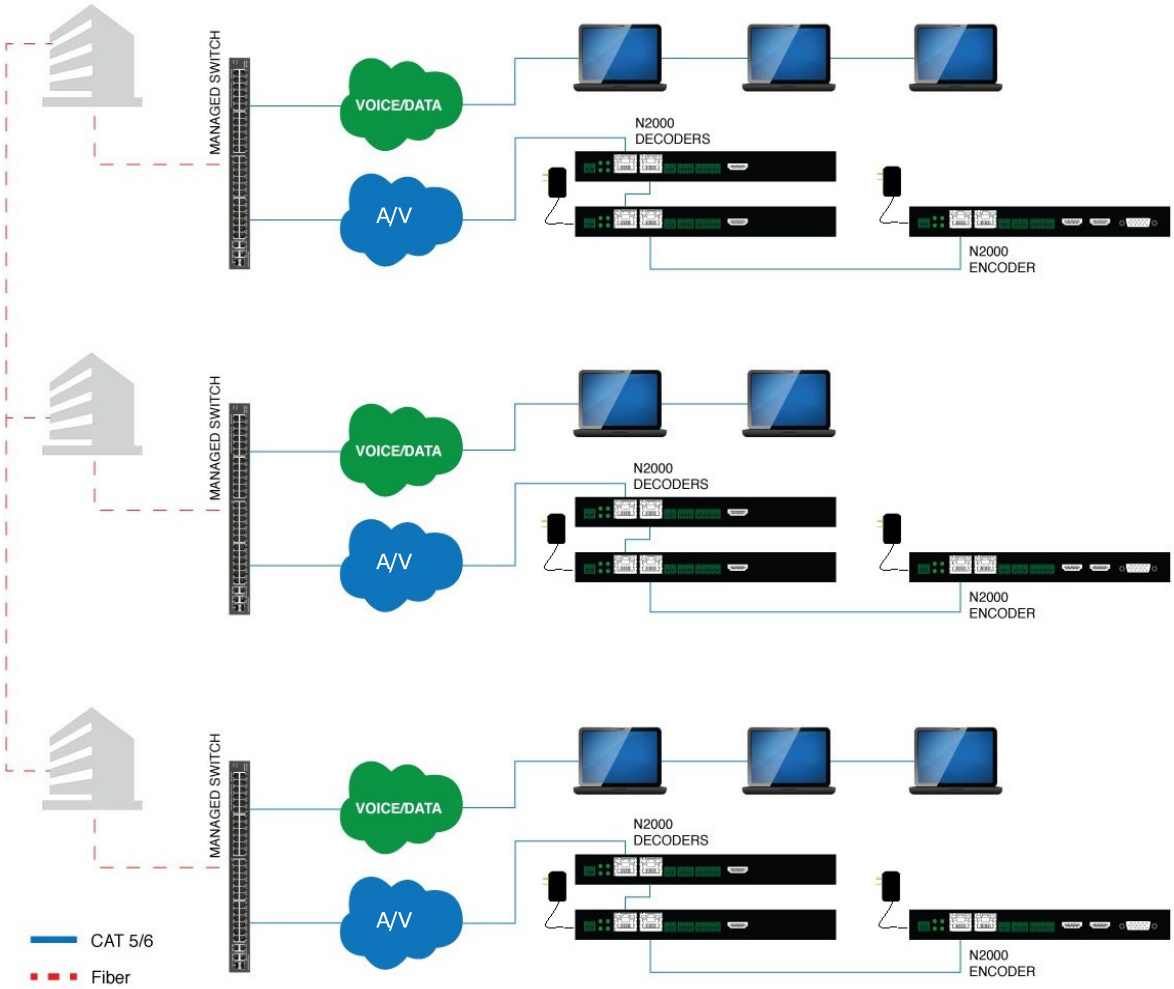

FIG. 5 Existing Layer-2 Network Installation

Even if a particular network is gigabit-enabled, installing Networked AV components can cause excessive amounts of video packets to overwhelm a network segment, VLAN, or device depending on the background traffic level. This can adversely affect other users on the network and must be avoided. Contact your network administrator before installation to determine traffic levels. N-Able software allows each Encoder's video stream to be disabled before connecting to an existing network. Once connected, Encoders can be enabled one at a time to determine network impact. AMX strongly recommends that all Encoders be disabled and variable bit-rates set as low as possible before connecting to an existing network.

FIG. 4 illustrates how Networked AV products can be installed on an existing layer-2 network over a dedicated VLAN separate from voice and data traffic while using an organization's existing infrastructure.

The following steps can be taken (at the discretion of your network administrator) to facilitate integration with an existing network:

- Ensure current ACLs (Access Control Lists) are not filtering multicast or control traffic.
- Remove Flow Control and/or Storm Control on any network port passing the video stream.
- Enable IGMP querying and snooping on all supported network switches.
- Enable VLANs to separate video traffic from data and voice.
- Allow multicast traffic on all network ports through which video streams pass.
- Turn all Encoders off in N-Able when not in use.
- Upload slideshow content to LocalPlay and display this locally-stored content when possible.
- Manually enter devices by MAC address to prevent N-Able from sending out broadcasts to locate. For a large number of devices during setup, a CSV file can be imported/exported using N-Able.

Any or all of these items can help integrate your video onto an existing network.

Network Diagnostic Utilities

AMX recommends these free network utilities if needed during deployment.

- Wireshark – Features an N-Series plug-in for extracting packet information from our Networked AV devices, this utility captures network packets to show source, destination, and payload. All multicast and broadcast packets will be captured and decoded. Wireshark does not require the host to have a compatible IP address.
- N-Able software – Available for PC or Mac, this software provides an easy and efficient way to setup and troubleshoot N-Series systems.
- VLC – Available for PC or Mac, this open-source software is a portable, media player and streaming media server (written by the VideoLAN project). Use it to view N2600S H26x, and N3300series streams on your desktop (e.g., UDP, RTP, RTSP and HTTP protocols). Download for free at http://www.videolan.org/index.html.

NOTE: *HDCP protected content is encrypted and therefore not visible using third-party viewers.*

Installation Over a Dedicated Network

If so desired, AMX recommends a dedicated layer-3 network for transmitting AV over IP. AMX recommends the Netgear AV line of network switches.

It is possible to overwhelm a single switch port using IGMP when more than one N2600 Decoder is on a single ethernet port and requests different video streams. When this happens, all video streams on the port will drop significant numbers of frames and appear jerky or cease to display video at all. This situation cannot be managed through the network except by reducing the bit-rates for all video streams where possible. Avoidance of more than a gigabit of traffic per wire during installation is the preferred method to prevent this occurrence.

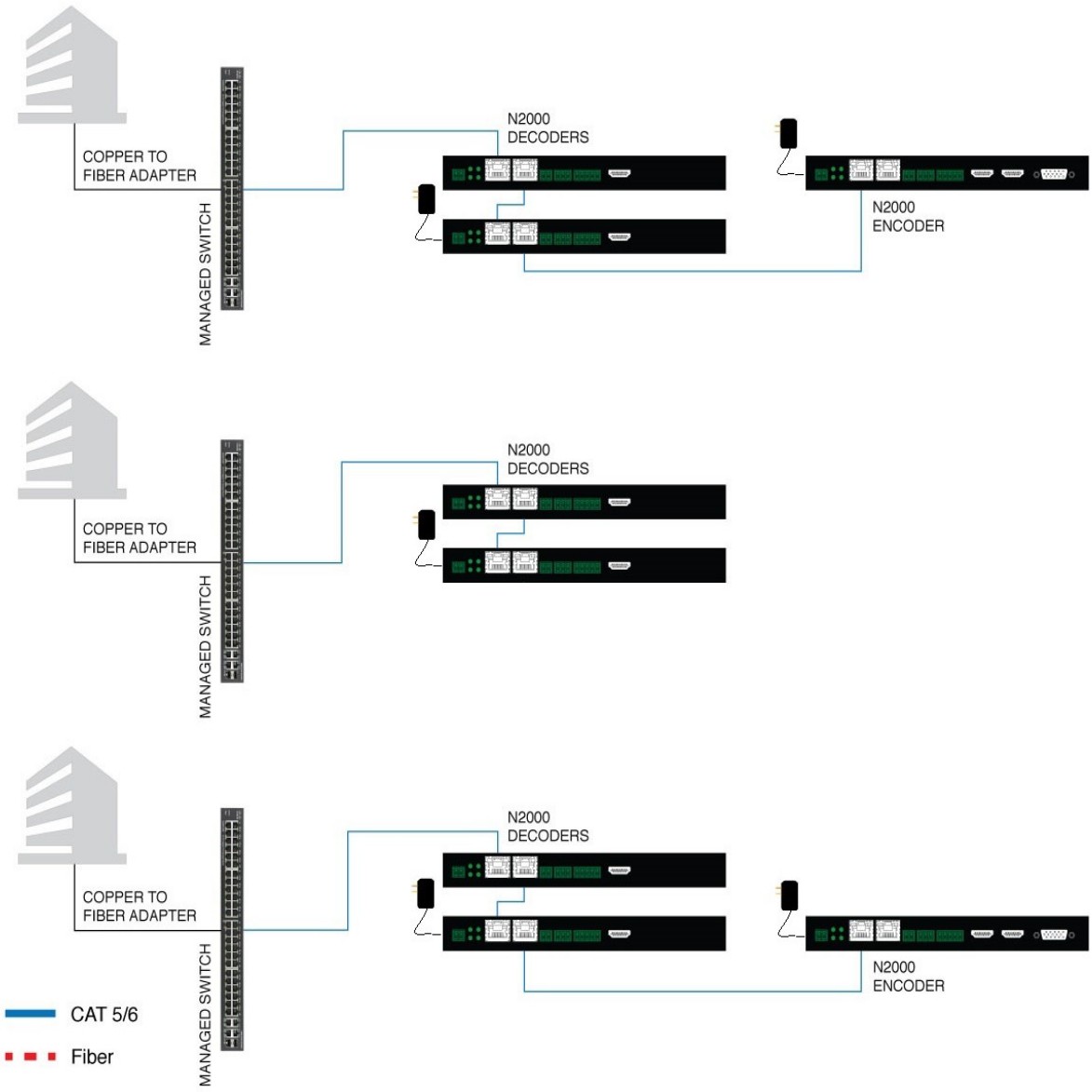

FIG. 6 Dedicated Network Installation

The network diagnostic utilities discussed on page 12 can also be used for Networked AV systems deployed over physically separate dedicated networks.

In many cases, the customer wants control of the AV system over the house network but does not want the multicast video traffic touching the house network. This is easily accomplished with an N8002-series controller. Dual Network Interfaces are available on the N8002 to functionally bridge control information from one physically disjointed network to the other.

VIDEO OUTPUTS

Decoders attached to the video network request the video stream and convert the IP packets to synchronized video and audio for display. All Decoder video output is digital and is output through the **HDMI OUT** connector. Balanced analog audio is available through the 5-pin Phoenix connector on the Decoder, or embedded digital audio is available through the **HDMI OUT** connector. Most Decoder and Encoder models have an IR transmitter and bi-directional serial port built-in for control of the display or third-party device co-located at the Decoder. Please check your specific N-series model to make sure IR and serial control options are available if required.

Each Decoder and Encoder have locally-stored splash-screens (LocalPlay on Decoder and HostPlay on Encoder) that can be commanded to play or will show in the event of network or video signal outage. When the network link goes down, this image will automatically play and can be used for diagnostics. Users can upload their own LocalPlay images and audio for digital signage when live video may not be needed.

The N-Series Networked AV IP format allows it to be integrated over copper, fiber, or wireless links with the appropriate network hardware. With IT support, high-definition video and audio can be streamed over common networks to be delivered when and where it is needed.

For questions specific to an existing network, please contact your IT manager and refer to this document.

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