



NetworkHD™ Technical Reference Guide

NetworkHD™ 100 | 200 | 400 | 600 Series

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Overview

NetworkHD™ is a robust and highly scalable AV over IP solution designed for the distribution of audio, video, and control signals over a standard IP Network. The truly modular nature of the NetworkHD system allows an AV distribution of a hugely scalable number of sources and displays to be created over a standardized cabling infrastructure and a managed Network switch topology.

To achieve this, NetworkHD consists of three compression technology options – each with its own set of advantages.

NetworkHD 100 & 200 series utilizes the highly efficient, low-bandwidth H.264/H.265 standard for AV compression and features CEC & RS-232 capabilities. They also support 1080p and HDCP.

NetworkHD 400 Series leverages JPEG 2000 compression to provide a visually lossless 4K image with very low latency. Support for 4K, HDR, HDCP2.2 and multichannel audio is also included.

NetworkHD 600 series is powered by SDVoE technology. This allows for mathematically identical audio and video to be distributed over a 10Gb network segment. With support for 4K/60Hz 4:4:4, 4K/60 HDR, HDCP2.2, multichannel audio and discrete audio the 600 series is a premium, lossless AVoIP solution.

System Components

NetworkHD comprises of a combination of hardware and software common to all NetworkHD Series components. This unified approach removes the need to learn different setup methods across the NetworkHD family. This helps to reduce system design times and offers a known platform from which an Integrator can specify any NetworkHD Series, focusing instead on the concerns of the deployment.

Controller (CTL)



The NHD-000-CTL is the heart of a NetworkHD AVoIP system, it provides the interface point that act as a control bridge for the encoders and decoders, allowing for the selection of content and displaying it at the end point. With features like auto discovery of all NetworkHD components, intuitive Web-based user interface (UI), and the ability for 3rd party control, the CTL provides the power that makes the NetworkHD system one of the most simple and quickest-to-configure AVoIP systems available.

Whether using the NetworkHD Console configuration software, the built in Web UI, NetworkHD touch, or a 3rd party control system, all communications to NetworkHD traverse through the CTL. Only a single CTL is required per system.

Encoders



NetworkHD TX Encoders enable the transmission of AV signals onto the network. Source components such as Set-top boxes, PCs, Blu-ray and media players are connected, and their signals are converted into network packets for transmission over the Local Area Network (LAN).

Every NetworkHD Encoder supports the direct connection of HDMI devices and DVI-D (via adapter), while other connection types are available on other products.

- NetworkHD 400 series adds VGA for the wall plate encoder
- NetworkHD 600 series also introduces native DisplayPort connectivity.

Analog audio de-embedding is available on most encoders with the additional ability on the 600 Series and some 400 Series models to inject analog source audio.

Decoders



NetworkHD RX Decoders receive the A/V stream from the TX Encoders over the Network and convert the signal to HDMI. This allows the content to be used via HDMI on Visual Display Units (VDU) such as TVs, monitors or projectors, as well as HDMI/analog audio processors.

Through optional video resolution scaling, frame-rate conversion and color-space conversion, NetworkHD decoders output content that can be formatted correctly for the connected display. This allows for content to be shown using optimum video requirements without affecting the source transmission.

Analog audio de-embedding is available on most decoders with the additional ability to utilize discrete audio source switching and also advanced audio matrixing on the 600 Series decoders.

NetworkHD Series Encoder/Decoder Comparison

Features	100/200 Series	400 Series	600 Series
Maximum transmission resolution	1920x1200 (1080p)	4K UHD	4K UHD/DCI
Video Compression Codec	H.264/H.265	JPEG 2000	SDVoE
Maximum 4K Timing	N/A	60fps 4:2:0	60fps 4:4:4
Multichannel Audio	✗	✓	✓
Minimum Latency	250ms / 60ms	16ms	0ms
PoE	✓	✓	✗
Analog Audio Breakout	✓	✓ (excluding Type E)	✓
Analog Audio Input	✗	✓ (DNT model)	✓
Analog Video Input	✗	✓ (IW model)	✗
Audio Delay Adjust	✓	✗	✗
Auto-discovery	✓	✓	✓
Background/Failsafe Image or Video	✓	✓	✗
Balanced Audio	✗	✓ (v3 decoder)	✗
Video Wall	✓ (110-RX only)	✓	✓
Bezel Gap Correction	✓	✓	✓
Image Rotation	✗	✓	✗
Bandwidth control	✓	✗	✓
CEC	✓	✓	✓
Batch Firmware Upgrade	✓	✓	✓
HDCP 2.2	✗	✓	✓
HDMI Pass-through on Tx	✗	✓ (excluding Type E)	✗
HDR	✗	✓	✓
NetworkHD Touch™ Control	✓	✓	✓
Instant Switching	✓	✗	✓
IR Out	✓ (110 models)	✓ (excluding Type E)	✓
IR Passthrough	✓ (110 models)	✓ (excluding Type E)	✓
KVM (Keyboard/Video/Mouse)	✓ (110 models)	✓ (excluding Type E)	✗
Maximum video wall size	16x16	16x16	8x8
Multiview	(250-RX only)	✗	✓
Open Control API	✓	✓	✓
Network Type	1Gb Multicast	1Gb Multicast	10Gb Multicast
PC Software Suite	✓	✓	✓
Peak Bandwidth per Tx	30 Mb/s (x4 on 140-TX)	850 Mb/s	10 Gb/s
Rack Mountable	Yes - NHD-000-RACK4 NHD-140-RACK-1U (140-TX)	Yes - NHD-000-RACK4	Yes - NHD-000-RACK3
Preview Stream	✓	✓	✓
RS-232 Out	✓	✓	✓
Small Form Factor	✓	✓	✓
Warranty (years)	5	5	5

NetworkHD Touch™

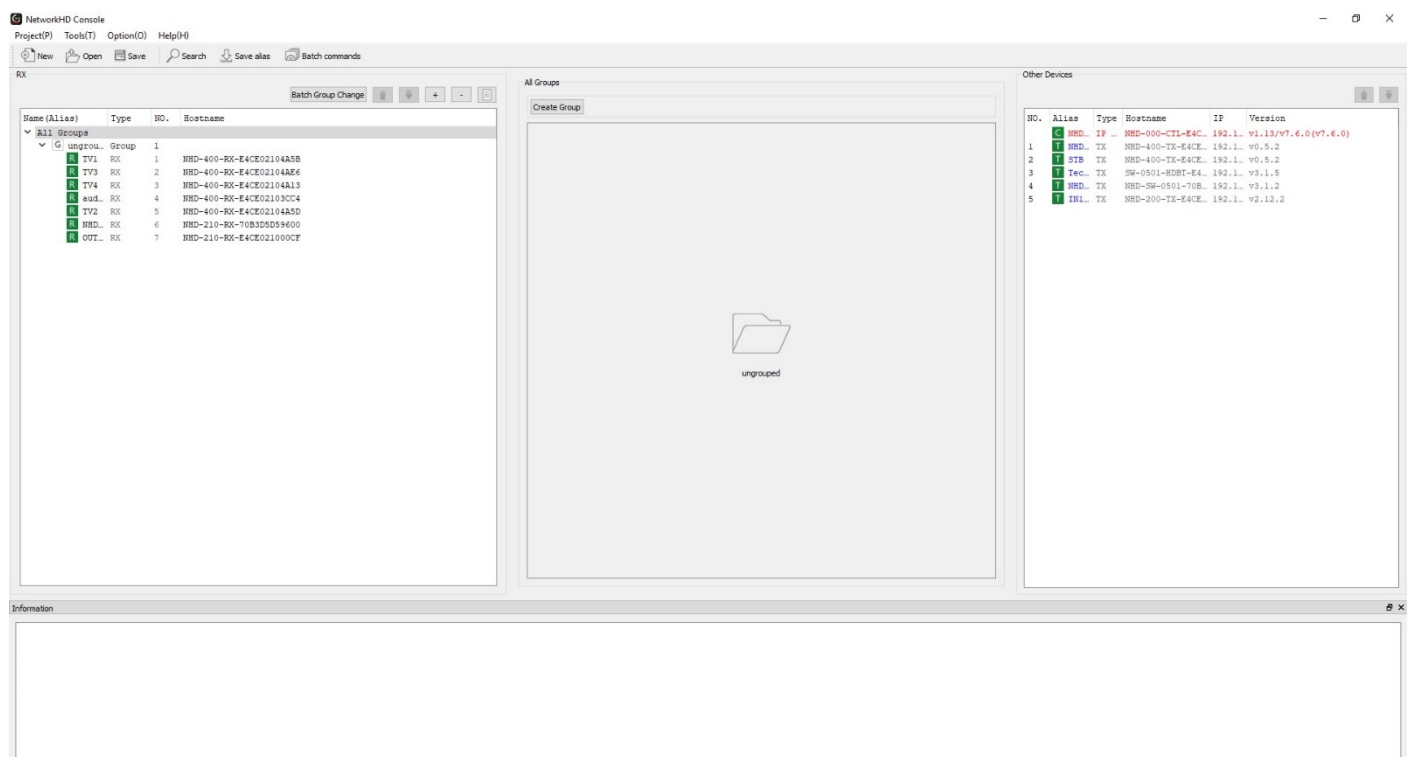


The NetworkHD Touch™ App for iPad is available as a free download on the App Store. It allows instant deployment of drag-and-drop control for NetworkHD AV switching, Video Walls and Multiview. By communicating with the NetworkHD configuration file stored on the CTL, NetworkHD Touch can be configured with minimal setup.

NetworkHD Touch does not require a separate control system or Driver, allowing for instant control deployment of simple display control and system verification checks. By adding integration to a 3rd-party control processor, NetworkHD Touch can utilize more advanced equipment control.

Watch the [NetworkHD Touch product video](#) on our YouTube channel to see how easy it is to use.

NetworkHD Console Software



NetworkHD Console is a software configuration tool for Windows PCs enabling the configuration of NetworkHD components and the construction of A/V matrix switching, video walls or Multiview displays for use in projects.

It is also ideal for configuring “set & forget” systems where a control system is not required. It offers fast, powerful configuration options and an intuitive UI for setting up all system settings while helping build a collection of video-wall and Multiview configurations for use with capable NetworkHD components.

NetworkHD Console is part of the WyreStorm Management Suite configuration tool, which contains other tools for configuring NetworkHD as well as other WyreStorm products. It is available on the website via the product pages.

Visit the [Management Suite](#) page for more information.

Application Scenarios

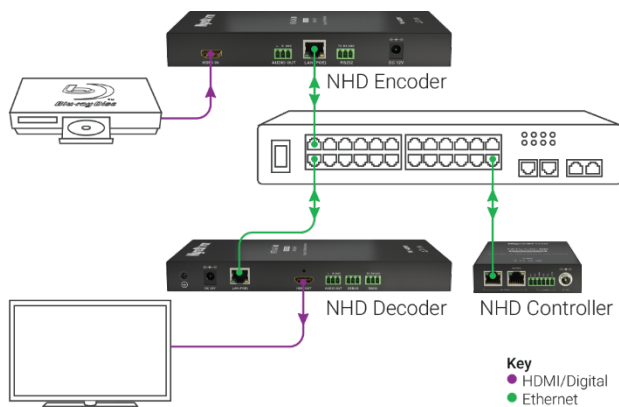
NetworkHD can be used for a variety of applications, ranging from simplistic single source to single VDU or complex multiple source to multiple VDUs scenarios. The number of end points in a deployment can be scaled after the fact by adding/removing encoders and decoders as needed.

One to One Scenario - Single Encoder and Decoder

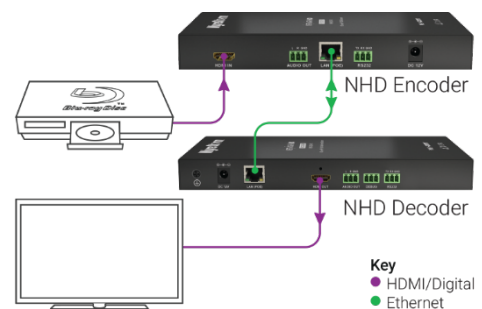
In the simplest of installation scenarios, a single encoder and decoder can be linked directly or via the LAN, to send video from a source to a display in another location. If linked directly, the devices must each be powered with the supplied external power supply and the Ethernet cable linking them should not run more than the Ethernet standard dictates, depending on the cable type used and installation environment.

The encoder and decoder may not automatically connect and must first be connected via an NHD Controller and/or the Console software application. This will require connection to a managed Network switch, although once linked the devices can then be connected directly.

One to One Switch Connection

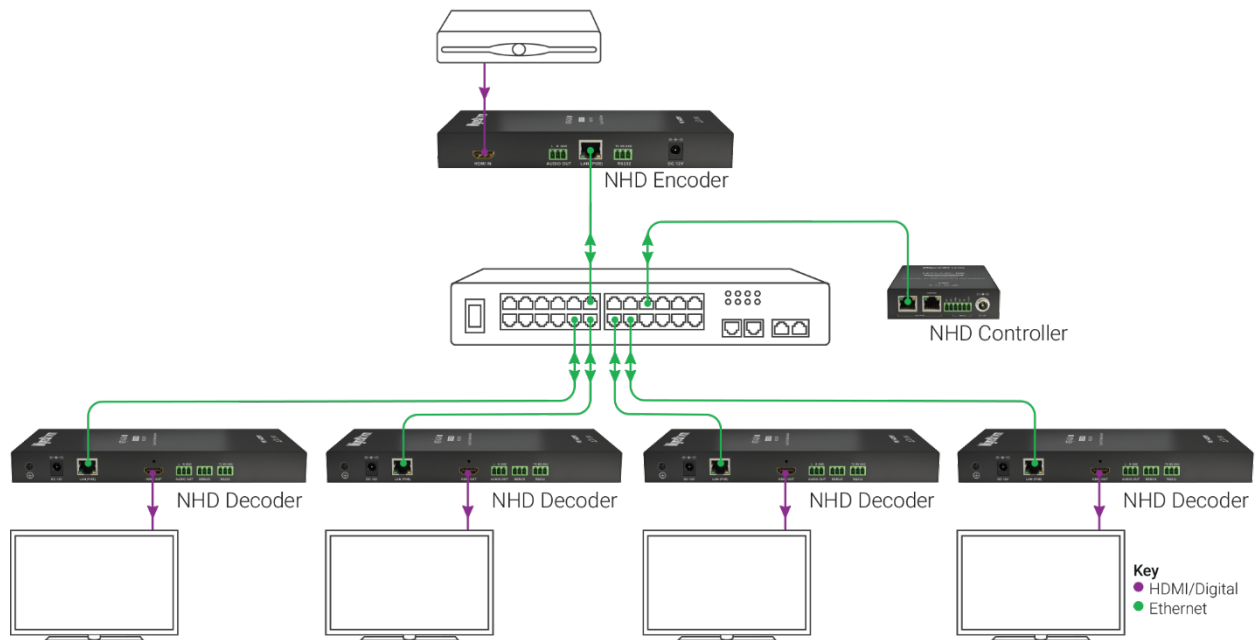


One to One Direct Connection



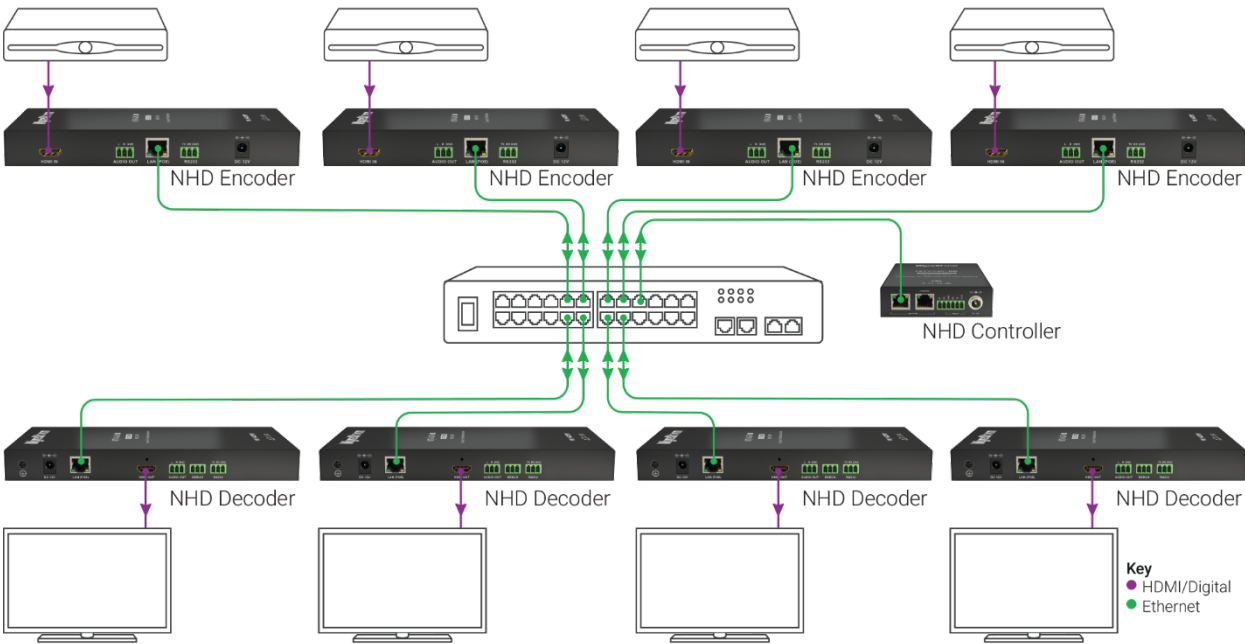
One to Many Scenario - Single Encoder to Multiple Decoders

Using NetworkHD components for one to many installations dramatically decreases the amount of equipment required at the source location. NetworkHD can be used to form a virtual "distribution amplifier" for source equipment.



Many to Many Scenario - Multiple Encoders and Decoders

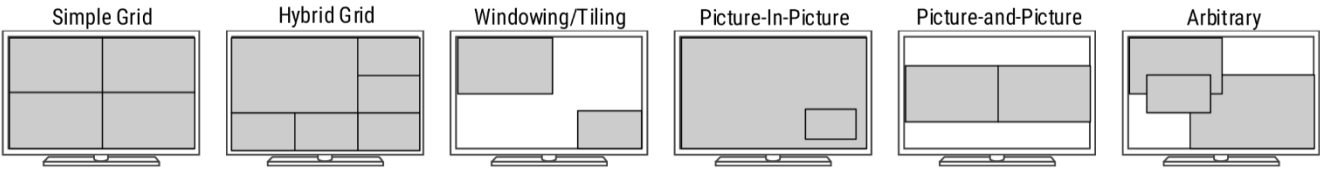
The truly modular nature of the NetworkHD system topology allows an AV distribution with a hugely scalable number of sources and displays. NetworkHD can be used to form a virtual “matrix switch” for AV and control signals to and from source and sink equipment.



Multiple Images on a Single Display (Multiview)

Going above single images on a display, NetworkHD can also render images from multiple encoders onto a single display, this is known commonly as Multiview. Not all decoders support this functionality and there are differences in the modes supported. Refer to the table below for products and available modes.

Multiview Modes



	NHD-220-RX	NHD-250-RX	NHD-600-RX
Simple Grid Modes	X	X	X
Hybrid Grid Modes	X	X	X
Video Windowing/Tiling		X	X
PiP , PaP		X	X
Arbitrary Layouts		X	X

NHD-600 Multiview

Each NetworkHD 600 encoder has a secondary low bandwidth sub-stream that is designed for use in Multiview applications. This secondary stream is required as 600 series decoders cannot decode more than one high bandwidth uncompressed stream at the same time. By using the secondary stream, multiple separate encoders can transmit to the same decoder.

Due to this, there are use-case limitations when incorporating more than one NHD-600-RX in the same system to process Multiview. Depending on the Multiview layout being displayed on the 600 decoder, the encoders will scale the secondary stream to fit in the PiP layout. For example, if using a "Simple Grid" layout (like the one shown in the graphic above) on a 4K screen, each encoder's stream would be scaled to 1080p so that they fit appropriately in the layout.

Since the secondary stream is scaled at the encoder, this means if a second 600 decoder wishes to use the same encoder stream but in a different PiP layout, there can be a scaling mismatch. This will translate to a video source either being too large or too small for one of the PiP windows.

Therefore, when sharing encoders across multiple Multiview decoders, the resolution of the PiP windows must match.

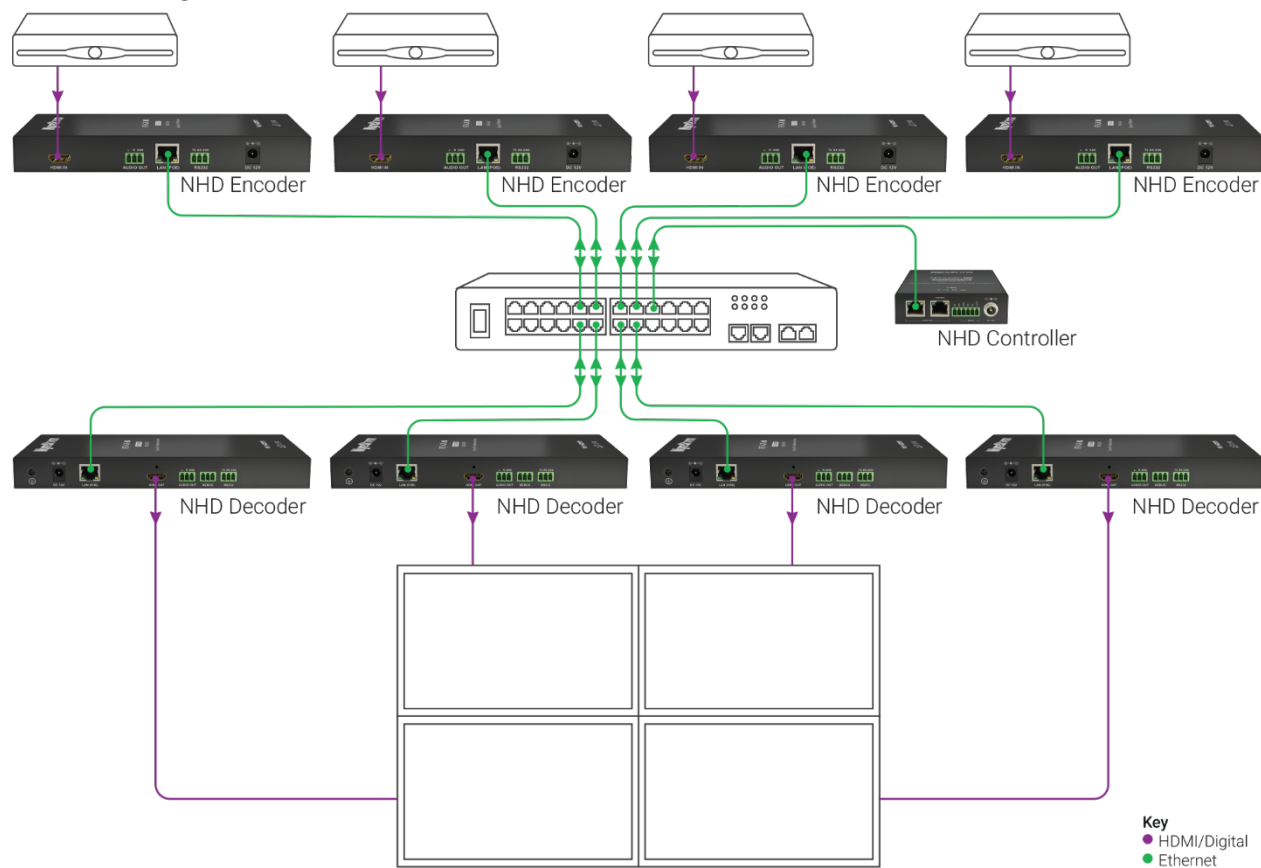
Single Image Spread Across Multiple Displays (Video Walls)

In addition to AV and Control matrix switching, NetworkHD can also be used in video wall scenarios to display a single image across multiple displays. Each panel in the wall requires an RX decoder in order to display the image. Not all decoders support this functionality and there are differences in the number of panels that can be used. Refer to the tables below for products and available modes.

Video Wall Features

	NHD-110-RX	NHD-400-RX	NHD-600-RX
Maximum Number of Displays	16x16	16x16	8x8
Image Stretch	X	X	X
Display Bezel Compensation	X	X	X
Image Rotation	X	X	
Genlock Synchronization			X

Video Wall Wiring



System Design Guidelines and Requirements

While NetworkHD is easy to configure and install, there are some guidelines and requirements that make the system operate to their optimum level. By following this section, a NetworkHD deployment can be designed, configured, and operated at its optimum performance level.

Preparation for Design and Installation

Build the system and test all components before attending the installation site. Doing so will find any issues before moving to the less flexible and time sensitive environment of the install itself. Knowing that a unit was configured properly before installation makes it far easier to pinpoint the cause of the problem, saving time and money for your business.

WyreStorm offers several resources to improve the effectiveness of the preparation stages, we recommend that these items are downloaded and utilized before starting any system design, configuration, and/or installation.

- Latest version of [NetworkHD Firmware](#).
- Latest version of the [WyreStorm Management Suite](#) required to configure a NetworkHD system.
- [Switch Configuration Guides](#) for a wide array of popular network switches.
- [Switch Mapping Worksheets](#) for recording IP addresses and alias names.
- [3rd Party Drivers](#) for a wide array of popular control systems.

Powering NetworkHD Components

A majority of NetworkHD components support PoE standards which minimizes the use of external power supplies and allows for centralizing the power distribution for the components. This not only reduces the cable count at various stages, but also enhances the effectiveness of labor time on site. When utilizing PoE be sure to observe the power requirements of the quantity of NetworkHD components connected to a network switch and ensure this is within the PoE power budget and in accordance with the standards provided by a network Switch.

System Cooling and Airflow

Ineffective thermal considerations can have a detrimental effect on the lifetime of electronic products. Ensure proper passive or active cooling strategies are used to ensure heat is moved away from the components allowing them to remain within their operating temperatures. Poor positioning of components or installation of cables may attribute to creating hotspots that trap heat, whenever possible avoid placing cables in areas that will prevent air from reaching the components limiting proper cooling.

NetworkHD rack-mount kits (NHD-000-RACK3 | NHD-000-RACK4|NHD-140-RACK-1U) have been designed to allow for optimal mounting and cooling of the NetworkHD equipment within an AV rack. We recommend that these are used in order to ensure a clean installation that also allows for proper thermal performance. Should the installation not allow for the use of a rack-mount kit, the encoders and decoders should never be positioned flat against a shelf or stacked on top of each other. At least 1.5in/38.1mm of clearance should be left on the top and sides of each NetworkHD component to ensure adequate airflow is maintained.

Software/Firmware

Where possible WyreStorm ships all components with the most up to date firmware, however before starting any installation the firmware in the components should be verified to be the latest. This will allow for the components to operate properly and ensure that the latest features are available. We also recommend that the firmware version on all third-party hardware, particularly network switches and TVs, is verified to be the latest as well. Refer to the relevant manufacturers content for information on how to obtain and install any new firmware required.

Mounting/Installation

The correct mounting of devices, particularly in the unforgiving environment of an AV or IT rack is vital to any successful installation. When mounting devices using the included wall brackets, observe the orientation of the device conforms to the correct method to allow for secure mounting and proper cooling.

For AV and IT racks, WyreStorm offers rack mount kits to allow for quick and easy installation that provides a clean installation with adequate airflow. All rack mount kits provide a steel housing that can be used in a central and secure location for the components.

NHD-000-RACK3 is designed for 600 series encoders and decoders. It is also compatible with the NHD-000-CTL Controller.

NHD-000-RACK4 is designed for 100/200/400 series encoders and decoders as well as the NHD-000-CTL Controller.

NHD-140-RACK-1U is designed for the NHD-140-TX encoder.

Source & Display Settings

WyreStorm NetworkHD components use the highest quality encoding available to provide efficient distribution across a large number of video and audio endpoints. However, the video quality starts with and depends on the source content being encoded. The following guidelines apply to any and all encoding within a NetworkHD system.

- Some legacy NetworkHD 100/200 series encoders are not compatible with interlaced sources. For those devices, ensure that all source content is set to Progressive scan (e.g. 720p/1080p) and not interlaced (e.g. 1080i). Interlaced content is supported on the NHD-140-TX, NHD-110-TX, 400 & 600 series which use H.264, JPEG 2000 or SDVoE compression respectively.
- Low power modes should be disabled on the displays and sources to ensure the system is always supplied with content. If a display shows no image, ensure the source device or display device has not entered a power-saving mode or is in a standby mode.
- Enabling CEC for all displays ensures that NetworkHD can power them on and off making them available to display an image when the system is accessed. This setting may be called something other than CEC and is not always enabled by default. Refer to the technical information for the display for details. By default, NetworkHD utilizes a specific subset of CEC power commands, One Touch Play and Standby that may not be supported by all third-party equipment vendors, however alternative CEC commands may be defined using the NetworkHD setup software.
- Overscan or “smart” aspect ratio settings should be disabled in any display that is part of a video wall, if it is enabled the image may not be a correct representation. This setting is almost always enabled by default and often hidden in advanced settings menus. Refer to the technical information for the display for details on how to disable it. Video wall displays should have video scan or aspect ratio processing disabled as well.
- Ensure that displays or other HDMI sinks used are fully compatible with the signal type used. The NetworkHD decoders feature a video scaler which can influence a signal presented to a display, depending on the scaler settings used. Refer to [Appendix A.2](#) for details of the NetworkHD output signals.

AV Input Compatibility

The NetworkHD family supports standardized input video/audio attributes at an encoder. Details such as supported input resolutions, frame rate, bit depth, color-space, chroma subsampling, HDR, audio type and audio channels are specific to each NetworkHD series and are listed in the product pages found at WyreStorm.com. Please ensure that the correct NetworkHD Series is chosen for the intended connected source device at each encoder.

Refer to [Appendix A.1](#) for a table showing the input attributes available for the NetworkHD family.

AV Output Compatibility

The NetworkHD family support standardized HDMI output attributes at a decoder. Details such as supported output resolutions, frame rate, bit depth, color-space, chroma subsampling, HDR, CEC, audio type and audio channels are specific to each NetworkHD series and are listed in the product pages found at WyreStorm.com. Please ensure that the correct NetworkHD Series is chosen for the intended connected HDMI sink device at each decoder.

Refer to [Appendix A.2](#) for a table showing the output attributes available for the NetworkHD family.

Control Signal Compatibility

In addition to AV signals, the NetworkHD family supports the routing/switching, and in some cases the generation of common control data types such as RS-232, Infrared, CEC, USB and Ethernet.

Refer to [Appendix A.3](#) for the control signal attributes available for the NetworkHD family.

System Infrastructure Guidelines and Requirements

Ensuring the correct infrastructure is key to a successful NetworkHD deployment. Read through and follow the information provided in this section to allow for successful deployment and operation of a NetworkHD system.

AV Cabling Guidelines

Due to the ever-changing technologies for transmission and increases in content bandwidth, preparing for changes at the time of installation is advisable.

As signal bandwidth increases, useable AV or control cable lengths can decrease. To avoid connectivity issues due to cable length, ensure connected AV or control devices are located as close to NetworkHD components as possible. Refer to the relevant standards for the signal type used (e.g. HDMI, RS-232 etc.)

Testing & Certifying a Network Cabling Infrastructure

While WyreStorm products are manufactured and tested to the highest standards, the installation environment can have an adverse effect on system performance. WyreStorm recommends that network each cable is not only tested for correct termination but is also certified to conform to the relevant network bandwidth, crosstalk and interference limit standards for each link type and distance required before installation of NetworkHD components.

Refer to the [Required Network Switch Features](#) section for information regarding the network connection to a NetworkHD device.

Choosing an Ethernet Switch

The flexibility of a WyreStorm NetworkHD solution brings AV distribution into the network domain. Many network switch vendors exist but the interoperability of any network depends on the support of various network standards. WyreStorm NetworkHD products take advantage of well-established, common network standards found built into the majority of managed switches.

The guidance that follows is intended to give various details on the network standards required of a switch selected for use with NetworkHD. Refer to the NetworkHD [Switch Configuration Guides](#) located on [WyreStorm.com](#) for detailed, vendor-specific switch information when choosing and configuring a network switch.

Basic Switch Parameters

The main features of a selected network switch depend on the NetworkHD devices used:

NetworkHD 100/200 Series (Multicast)	1GbE switch	Layer 2+* / Layer 3
NetworkHD 110 Series (Unicast)	1GbE switch	Any layer switch
NetworkHD 400 Series	1GbE switch	Layer 2+* / Layer 3
NetworkHD 600 Series	10GbE switch	Layer 2+* / Layer 3

It should be noted that most 10GbE switches support backward compatibility with 1GbE devices.

*Layer 2 switches must have support for IGMP Snooping and Multicast Filtering.

Preconfiguring an Ethernet Switch

Network switches that are directly connected to NetworkHD components should always be configured prior to connecting any components. Due to the encoder's instant-on feature, a multicast stream could disrupt the expected behavior of a switch if it is not configured to accept multicast traffic in advance.

WyreStorm offers a library of [Switch Configuration Guides](#) specific to many tested network switches to help reduce set-up times.

NetworkHD 100/200/400 Series components have subtle differences to the 600 Series. Although all NetworkHD multicast operation is the same, the NetworkHD 600 Series requires a 10Gb infrastructure rather than the typical 1Gb. This means that the WyreStorm recommended switches for 100/200 & 400 may not be common to the 600 Series and a separate list of recommendations exist.

As the NetworkHD solution is inherently scalable, it is recommended that a switch is purchased that will have more Ethernet ports than NetworkHD devices so that more can be quickly added in the future where required.

Required Network Switch Features (Multicast)

Switch Ports

The WyreStorm NetworkHD family devices utilize twisted pair cable Ethernet standards. The Ethernet switch port connecting directly to a NetworkHD device must therefore support the following:

NHD-000-CTL:	100Mb/s Full-duplex	100Base-TX	IEEE 802.3u
NHD 100, 200 and 400 Series:	1Gb/s Full-duplex	1000Base-T	IEEE 802.3ab
NHD 600 Series:	10Gb/s Full-duplex	10GBase-T	IEEE 802.3an

Jumbo Frames

Switches for the 400 Series must support Jumbo frames, specifically with an MTU size ≥ 9000 bytes.

Additional Switch Features

- Multicast forwarding or filtering
- IGMP Snooping
- IGMP v2 Querier
- IGMP Fast-leave

Packet Routing

To enable the transmission of a source to multiple destination, NetworkHD devices make use of Multicast. The default behavior of an unmanaged Ethernet switch could be to broadcast those packets to every switch port. This means that every packet will be transmitted to all connected devices.

This is why any network switch used with NetworkHD has to support IGMP Snooping. NetworkHD devices use the IGMP protocol to request data from a specific multicast group (encoder) and the switch uses IGMP snooping to identify IGMP messages and efficiently forward multicast packets only to decoders that want to receive them.

Many switches have the IGMP Snooping feature disabled by default and manual configuration is required. Often, a simple check mark near "Enable IGMP Snooping" is the only thing needed to enable IGMP Snooping. However, the implementation of IGMP Snooping is vendor specific and more configuration is often needed.

An Ethernet switch can be informed that a device wants to leave a multicast group by sending it an IGMP LEAVE GROUP packet. Once received, the time it takes for the switch to apply the new configuration may vary from one switch to another. Most switches implement and include a FASTLEAVE configuration option. When enabled, it takes much less time for a particular switch port to leave a multicast group and to assign the port to a different multicast group. The end result is often a noticeably shorter video switching time. However, care must be taken when using FASTLEAVE across multiple switches.

A selection of Ethernet switches exist that are pre-configured for NetworkHD packet forwarding by default. In this situation, for a pure NetworkHD system, the switch is simply plug-and-play out of the box. This only applies to single switch deployments however and further NetworkHD device setup will still be required.

Refer to the [NetworkHD Switch Recommendations](#) document located on WyreStorm.com for a list of plug-and-play switches currently supported.

Ethernet switch configuration (Multicast)

The following list includes all network switch configuration options that WyreStorm engineers have come across so far. NetworkHD data is typically contained in one VLAN. Look for these or similar options when configuring your switch.

Feature	Setting
IGMP Snooping	• Must be enabled
IGMP Snooping on VLAN 1	• Must be enabled when all ports default to VLAN 1 • Other VLAN IDs can be used, so long as Snooping is enabled
Filter/Drop unregistered Multicast traffic	• If not applied, the behavior of the switch will be to broadcast multicast packets if the switch has no known destination for that packet • Must be enabled if found
Unregistered Multicast Flooding	• Must be disabled if found
IGMP Querier	• Must be enabled, if found • For VLAN1 - Must be enabled, if found • Must be set to IGMP v2 • Multiple switch topologies may require this to be disabled on some switches See Using the IGMP Querier Function for more information.
FASTLEAVE on port (x) and VLAN1	• Should be enabled for single switch deployments, if found • Multiple switch topologies may require this to be disabled on some switches See Using the FASTLEAVE Function for more information.
Green or Energy Saving feature	• Must be disabled, if found
PoE on port X (IEEE 802.3af)	• Optionally enabled, if found
Jumbo Frames	• Must be enabled, if found (MTU size $\geq$ 9000 bytes)

Refer to the NetworkHD [Switch Configuration Guides](#) located on [WyreStorm.com](#) for detailed, vendor-specific Switch information.

Using the IGMP Querier Function

In order for IGMP, and thus IGMP snooping, to function, a multicast router or IGMP Querier function on a switch must exist on the network and generate IGMP queries. The tables created for snooping (holding the member ports for each a multicast group) are associated with the Querier. Without a Querier, the tables are not created and snooping will not work. Furthermore, IGMP general queries must be unconditionally forwarded by all switches involved in IGMP snooping. Some IGMP snooping implementations found on many switches include full Querier capability.

One IGMP Querier should exist on a NetworkHD VLAN. In multiple switch deployments for example, when cascaded switch topologies exist, only one switch should enable the Querier function with it disabled (manually or automatically) on all other switches.

Using the FASTLEAVE Function

An Ethernet switch can be informed that a NetworkHD device wants to leave a multicast group by the device sending the switch an IGMP LEAVE packet. When a switch receives an IGMP V2 leave message from a NetworkHD device, it sends out multiple multicast group-specific queries. If no other NetworkHD device replies within the waiting period, the switch stops forwarding traffic. When FASTLEAVE is configured, and when the switch receives an IGMP leave message on a port, it immediately stops forwarding to that port. The switch then does not send multicast group-specific queries. When FASTLEAVE is configured on a switch, you must not have multiple NetworkHD devices connected on any port in the switch. This includes links between multiple switches. Thus, care must be taken in multiple switch topologies when using this function.

Using PoE

Most NetworkHD devices utilize PoE for local power as an alternative to the supplied external power supply adapter. This can offer centralized power distribution from the switch as well as reduction in component count, cable count and installation labor time.

The power options available to NetworkHD devices related to switch PSE PoE ports is as follows:

NHD-000-CTL	PoE compliant (AV Port) 15.4W - IEEE 802.1af or Local DC power supply
NHD 100*/200/400 Series	PoE compliant 15.4W - IEEE 802.1af or Local DC power supply
*NHD-140-TX	Local DC power supply
NHD-SW-0501	Integrated AC power supply
NHD 600 Series	Local DC power supply

When selecting a PoE capable switch, the total PoE budget must be considered. For example, some switches can supply PoE to only a subset of ports when running at 15.4W per port, other switches can support 15.4W on every port simultaneously. Switch PoE budget can easily be calculated by adding the number of NetworkHD devices that require PoE.

For example: 24x NHD-110-RX = 370W total switch PoE budget

Using multiple Network switches

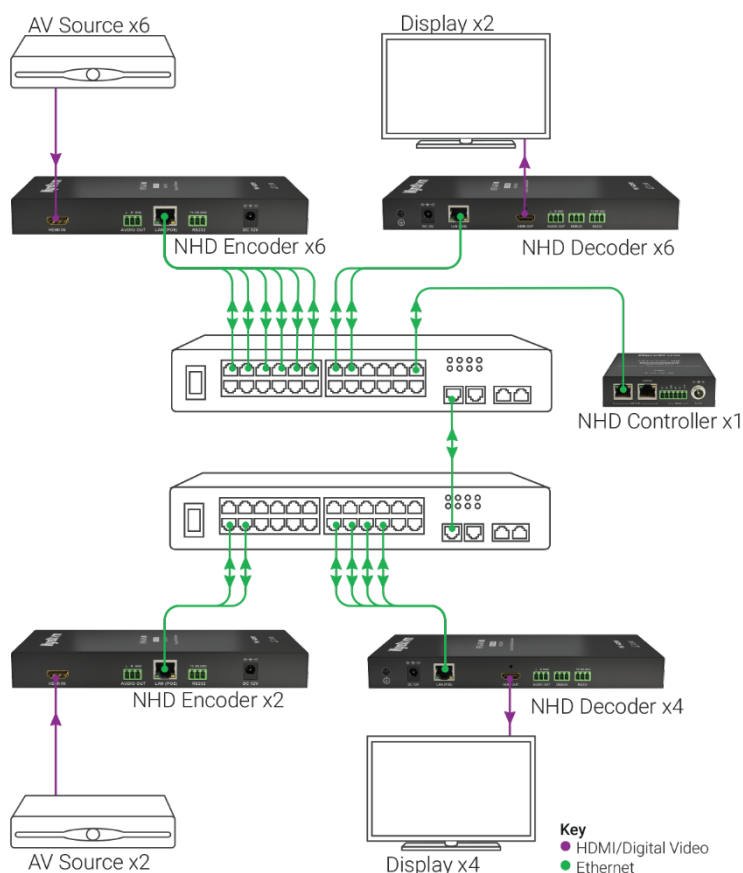
When using more than a single network switch with multicast, further configuration options must be considered.

Multiple switch topologies usually employ 2 main methods:

Switch Stacking

A stackable switch is a network switch that is fully functional operating standalone but which can also be set up to operate together with one or more other network switches, with this group of switches showing the characteristics of a single switch but having the port capacity of the sum of the combined switches.

- If a switch supports operating in this mode, be sure that the configuration guidance shown above applies to the entire switch stack to ensure unified stack multicast support.
- Often, switch vendors will utilize special port modes for use with stacking and some switches make use of dedicated stacking ports and cables. These will have a finite bandwidth.



Switch cascading

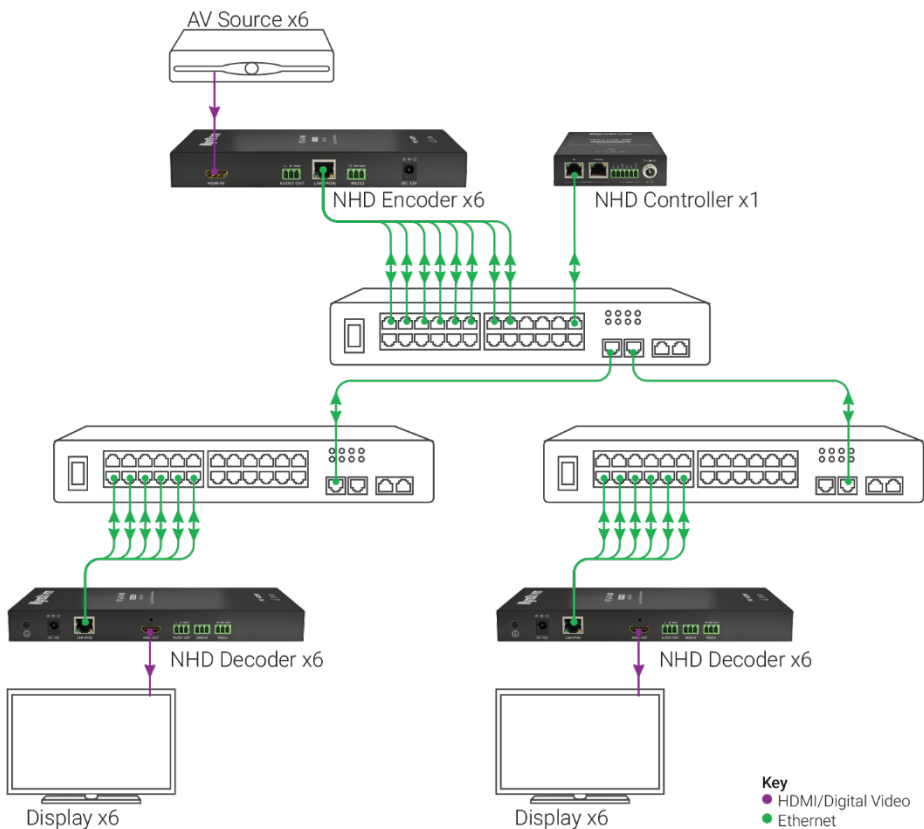
Linking switches together, often with links that support a greater bandwidth, is an alternative method by which to increase the amount of NetworkHD units connected to a system.

Either by using dedicated link ports or aggregated link ports, network switches can extend the NetworkHD VLAN across multiple locations using varying topologies. Bandwidth requirements should be considered, with the maximum peak NetworkHD stream bandwidth required being exceeded by the link segment between switches.

Further Considerations for Multiple Switch Deployments

Ethernet switches that are used for cascaded topologies must also support the following functions:

Dynamic multicast router port	Must be enabled on all switches that do not contain the IGMP Querier function
Forwarding unknown multicast to multicast router port X only	Must be enabled on all switches that do not contain the IGMP Querier function



Switch Configuration (Multicast)

Feature	Single Switch Networking	Cascading Networking	
		Core Switch	Extended Switch
Green or energy-saving feature	Disable	Disable	Disable
Multicast forwarding or filtering	Enable	Enable	Enable
IGMP Snooping	Enable	Enable	Enable
IP address of IGMP Querier	Must be assigned a valid value		Does not matter
IGMP Querier	Enable	Enable	Disable
IGMP snooping fast leave	Enable	Disable	Enable
Dynamic multicast router port	Disable	Disable	Enable
Forward All unknown multicast	Disable	Disable	Router port only*

* Port which connects the extended switch back to the switch running an IGMP Querier

Unicast Mode for 110 Series

The NetworkHD 110 series components support two operating modes, Multicast and Unicast. When in Multicast mode, a Layer 2 or higher switch is required just like when using the 400 or 600 series devices. When the 110 series is programmed for Unicast mode, this removes the need for a managed switch and IGMP Snooping. Unicast mode can be enabled within the NetworkHD Console software v9.0.6 or newer.

Unicast mode offers the benefit of universal compatibility with any network switch but does introduce some limitations. When in Unicast mode the 110 series are not compatible with any other NetworkHD 100 or 200 series component, NHD-110-TXs are only compatible with NHD-110-RXs.

Additionally, when using unicast mode, bandwidth usage changes. Unlike multicast which only sends one stream per encoder regardless of the number of decoders receiving that stream, unicast duplicates the stream for every decoder receiving it.

For example:

Multicast using H.265 - 1 TX to 50 RX = 5Mbps of bandwidth

Unicast using H.265 - 1 TX to 50 RX = 250Mbps of bandwidth

WyreStorm recommends limiting the number of RXs receiving video from the same TX to 50. This is to ensure performance and reliability.

NetworkHD Stream Bandwidth

The NetworkHD encoders transmit AV content at a known bitrate. It is the encoder bandwidth that makes up almost all of the Network traffic in a VLAN. Each NetworkHD encoder sends multicast stream data at the following peak bitrates:

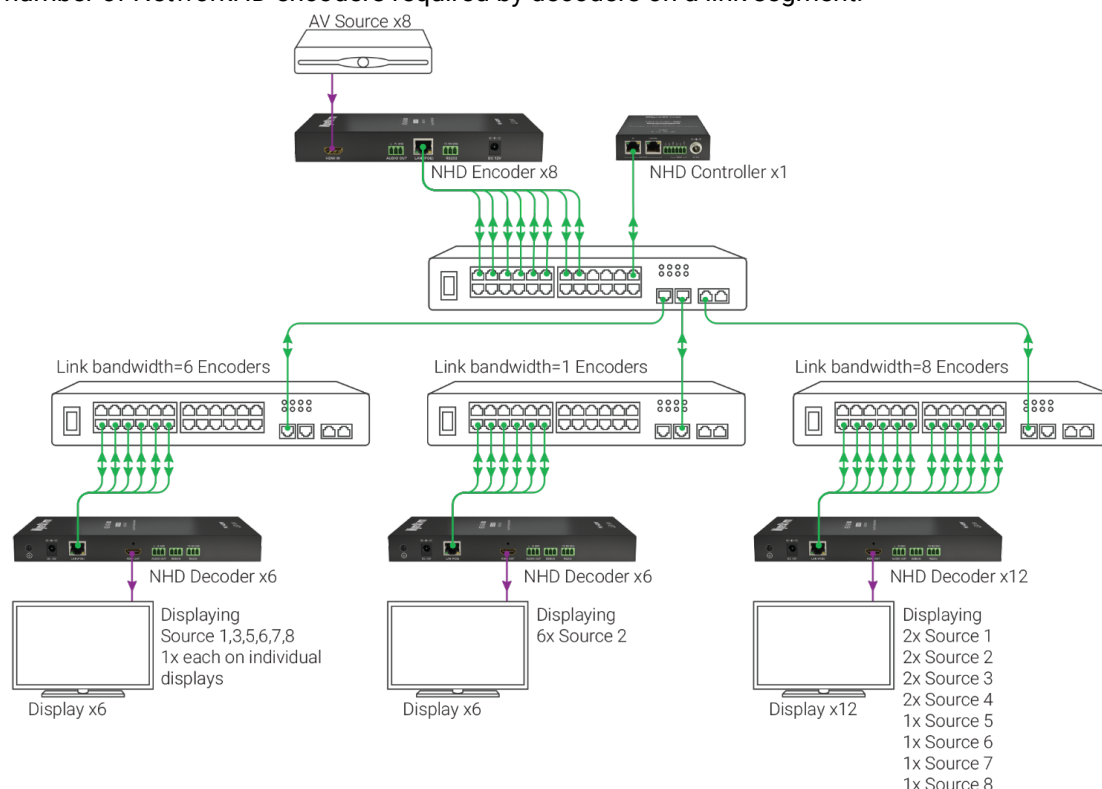
NetworkHD NHD-100-TX encoder:	30Mb/s	1GbE switch required
NetworkHD NHD-110-TX encoder:	30Mb/s(H.264) 5Mbps (H.265)	1GbE switch required
NetworkHD NHD-140-TX encoder:	120Mb/s	1GbE switch required
NetworkHD 200 Series encoder:	30Mb/s	1GbE switch required
NetworkHD 400 Series encoder:	850Mb/s	1GbE switch required
NetworkHD 600 Series encoder:	10Gb/s peak (varies by source resolution)	10GbE switch required

When using a single switch with multiple NetworkHD encoders, the main consideration is the backplane speed of the switch which must exceed the bitrate sum of the total number of NetworkHD encoders.

For example: 10x NHD-400-TX = 10x 850Mb/s = 8.5Gb/s total bitrate

When using multiple switches, the considerations extend further, introducing the need to calculate the link bandwidth between switches. This should be considered both for switch stacks and for other topologies.

For example, when using a core/extended topology, the link speed between switches must exceed the bitrate sum of the total number of NetworkHD encoders required by decoders on a link segment.



NHD-600-TX bandwidth varies depending on the video timing of the source content. Below is bandwidth consumption based on resolution.

1080p@60Hz 12bit - 3.4Gbps
 4K UHD@30Hz 4:4:4 8bit - 6.6Gbps
 4K UHD@60Hz 4:4:4 8bit - 9Gbps (with light compression)

The remaining bandwidth out of the available 10Gbps is used for transmission of control signals and the multiview sub-stream.

Note: NetworkHD 110 series encoders support both H.264 or H.265 video encoding, which can be programmed via the NetworkHD Console software. When using H.265 encoding, NHD-110-TXs are only compatible with NHD-110-RXs or the NHD-250-RX and will not be inter-operable with other 100 or 200 series components.

Multiple VLAN NetworkHD

NetworkHD components are typically designed to reside within a single VLAN. By default, many switches will have a single VLAN (perhaps VLAN ID 1). Unless specifically noted or required, it is not necessary to create an additional VLAN.

Multicast routing using PIM or an equivalent multicast routing process is not currently supported by NetworkHD.

The NHD-000-CTL is equipped with dual Ethernet ports so that it can simultaneously connect to two separate networks or VLANs without the need for additional routing functionality configured within the switch. Both NHD-000-CTL ports are separately compliant with the NetworkHD control API or control system driver communications channel. This enables a Control network to be completely isolated from an AVoIP network, while connected to the NHD-000-CTL, without further considerations for Network administration.

Where physical network isolation utilizing the dual NHD-000-CTL interfaces is not used and a control system that needs to communicate with the NetworkHD Controller exists on a different VLAN or broadcast domain, the following information can be used to aid routing of the API or control system driver communication channel:

NHD-000-CTL: Telnet server <NHD-000-CTL IP address>, CTL ingress on TCP Ports 23 and 23000, CTL egress TCP port undefined

It must be noted that the factory default "AV" port interface IP address of the CTL uses a value that is a link-local address (default IP statically assigned as 169.254.1.1/16) and thus might not be routable unless changed to a routable IP address.

The data generated by the CTL (where the destination IP is outside the scope of the relevant network interface) is forwarded to the Gateway IP address assigned to the relevant CTL interface. It is thus important that a Router at this Gateway IP address is configured to forward the data to the correct route for the intended destination IP.

NetworkHD Encoder Preview Streams

The NetworkHD encoders in the 100, 200 and 400 Series all produce a low-bandwidth, low quality unicast Motion JPEG video stream of the source content intended to provide a real-time preview of the source content that can be separately accessed by a control system's UI. The NetworkHD Touch App for iPad uses these streams to present real-time video previews of each encoded source in the Touch UI. The same streams can be used for this purpose in a 3rd-party user interface or for monitoring source content in a Web browser.

The preview stream is generated by each encoder. Thus, the unicast source IP address of the preview stream is that of the encoder generating it. When using the source preview stream in a UI or for monitoring purposes the IP address of the encoder must be reachable by the device requesting it.

Example preview stream request URL syntax:

http://<encoder IP address>/stream

For more information on the source video preview function, the details can be referenced as part of the [NetworkHD Installation Guide](#) document or [NetworkHD API](#) document.

If the device, such as a control processor, PC hosting a Web browser, or iPad running NetworkHD Touch is not within the same VLAN or broadcast domain as an encoder generating a preview stream, the following information can be used to aid routing of the preview stream data:

NetworkHD Encoder (TX): Web server <TX IP address>, TX ingress on TCP Port 80, TX egress TCP port undefined

It must be noted that the factory default encoder (TX) port interface IP address uses a value in a range of potential link-local addresses (169.254.0.0/16) and thus might not be routable unless changed to a routable IP address. In addition, after factory reset the encoders utilize stateless address autoconfiguration. This means that without assigning a static IP to an encoder, the IP is subject to change after boot. This is also a concern if using DHCP client mode. Thus, it is highly recommended that if preview streams are to be used, even if no routing is required, the target encoder's IP address should be statically assigned after initial device discovery.

The data generated by the encoder (where the destination IP is outside the scope of the relevant network interface) is forwarded to the Gateway IP address assigned to the encoder's network interface. It is important that a Router at this Gateway IP address is configured to forward the data to the correct route for the intended destination IP.

Dante Audio Streams

Dante is an uncompressed, multi-channel digital media networking technology, based on industry standards, developed by Audinate.

To maintain maximum compatibility, Dante encoders built within WyreStorm products comply with all Audinate software tools for Dante. Thus, Audinate software should be obtained and used for configuration and switching of Dante audio.

Although not mandatory, it is recommended that Dante network data is separated from NetworkHD AV over IP data to simplify the Dante networking.

WyreStorm has designed Dante audio encoders into NetworkHD products so that they can be isolated from general AV over IP network traffic, removing any concern from Dante network administrators regarding how the Dante network data may or may not be “affected” by general NetworkHD AV over IP network traffic, despite sharing a physical network port. Due to WyreStorm’s unique design, the Dante encoder elements within a NetworkHD product have a separate MAC address and IP address compared with the NetworkHD encoder elements. Considering that a managed Layer 2 or Layer 3 switch is mandatory for use with NetworkHD products, all compatible switches used for NetworkHD will include a simple function to filter Dante data ingress at the switch port and isolate this data away from NetworkHD AV over IP data. The most ubiquitous technique used for this process is the MAC-based VLAN function.

Please refer to the [Dante MAC-Based VLAN Application](#) note and the various NetworkHD [Switch Configuration Guides](#) located on [WyreStorm.com](#) for detailed, vendor-specific Switch information.

Inter-VLAN Routing

In situations where the CTL API/Control system driver communication channel or encoder preview stream data needs to be accessed from a different VLAN the data will need to be routed. When using Inter-VLAN routing to route data between VLANs there will need to be a Gateway IP defined within the CTL (API channel) IP settings or each encoder (preview stream) IP settings. This Gateway IP is required to be the interface IP address of the Router’s interface that is connected to the NetworkHD VLAN. This necessitates that the Gateway IP address is within the scope of the IP subnet assigned to the NetworkHD CTL or encoder.

Likewise, equipment connected to a VLAN different to that of the NetworkHD VLAN will need to send data to a Router that can forward the data to the correct route so that the destination IP (the IP address of the target NetworkHD device) can be reached.

The router(s) used therefore may require additional routing table entries assigned to them depending on your network setup.

Switch Operation Verification

During WyreStorm’s testing, we’ve found that different vendors and models of switches vary in performance when handling multicast data packets. Therefore, although a switch may meet the previous requirements, they may still not be suitable for use with NetworkHD. A final conclusion can be made through practical function verification and pressure testing. WyreStorm cannot offer detailed support on switches that are not documented by our library of switch configuration guides, therefore choosing to use other switch models is done so at the installer’s own risk.

Refer to the NetworkHD [Switch Configuration Guides](#) located on [WyreStorm.com](#) for detailed, vendor-specific Switch information.

Security Protocol Implementation

Security protocols were implemented on the following components with the firmware/software listed below. These protocols can be enabled or disabled depending on application requirements. By default, security protocols are disabled and all NetworkHD components will operate using standard methods of Telnet and HTTP.

Firmware versions below or newer incorporate security protocols:

NetworkHD 400 Series (all models) - v2.0.3
NHD-000-CTL - v9.1.3(9.1.4)
NetworkHD Touch - v5.0.4
Console software - v9.0.6
Maintenance Tool - v5.0.4

In order to fully secure a NetworkHD system, both the NHD-000-CTL and the encoders/decoders need to have SSH and HTTPS enabled. Security services for the encoders/decoders are enable in the NetworkHD console software. Security services for the NHD-000-CTL are enabled from within its web interface.

Enabling SSH and HTTPS on the NHD-000-CTL provides:

- Secure internal API communication between TX and RX devices
- Secure external API communication between CTL and 3rd-party control system
- The ability to change external API SSH TCP port
- The ability to change external SSH API password
- Secure access of the web interface

Enabling SSH and HTTPS on the 400 series components provides :

- Secure internal API communication to CTL
- Secure access to web servers (preview streams)

In addition to hardware firmware updates, the NetworkHD Touch iPad app supports communication to the NHD-000-CTL and encoders/decoders via SSH and HTTPS using the app version listed above.

In addition to the above mentioned security protocols, NetworkHD 110, 400 and 600 series components utilize AES 128-bit encryption of multicast audio and video streams over the network.

Note: Not all NetworkHD models support SSH and HTTPS protocols. Only the models listed above have this capability.

Installation Checklist

In order to efficiently install and configure a NetworkHD system, please follow the steps listed below:

System design Preparation

1. Establish the number of NetworkHD encoders required for AV source equipment ☐
2. Establish the number of NetworkHD decoders required for HDMI sink equipment ☐
3. Evaluate how many NHD-000-CTL units are required ☐
2 or more may be needed for failover deployments
4. Evaluate the most appropriate NetworkHD Series ☐
suited to AV Source, type of compression most appropriate and the distribution topology requirements
5. Evaluate the appropriate Network switch topology ☐
Based on the Network distribution requirements and number of switches required
6. If using multiple switches, evaluate the bandwidth requirements needed between Network switches ☐
7. Establish the Network switch port quantities required ☐
When using multiple switches, evaluate how many ports are required on each switch
8. Evaluate if PoE will be utilized ☐
9. Review published Switch Configuration Guides matching the model of the switches used in the system ☐
10. Select Network switch(es) based on steps 1 – 9 and other information provided in this TRG ☐

System Configuration Preparation

1. Download the following from [WyreStorm.com](https://www.wyrestorm.com).
 - Latest version of [NetworkHD Firmware](#).
 - Latest version of the [WyreStorm Management Suite](#) required to configured a NetworkHD system.
 - [Switch Configuration Guides](#) for the appropriate switch(es) being used.
 - [Switch Mapping Worksheets](#) for recording IP addresses and alias names.
 - [3rd Party Driver](#) for the appropriate control system being used if any.
2. Restore Network switch(es) to Factory Defaults and configure based on the information in this guide.
3. Install NetworkHD devices in their relevant physical locations ensuring the MAC address of each device is noted on the NetworkHD IP Switch Mapping Worksheet.
4. Connect one NetworkHD NHD-000-CTL device to the Network switch via the “AV” Network port. While more than one NHD-000-CTL can exist on a NetworkHD system, they will have the same default IP address and should be configured one at a time.
5. Configure the administration PC Network interface details so that they match the IP subnet of the target NetworkHD NHD-000-CTL device. For IP details and IP Address restoration, refer to [Appendix A.4](#).
6. Open a web browser and load the Web UI for the target NHD-000-CTL by typing the IP address into the address bar.
7. Check that the latest Firmware version running on the NHD-000-CTL matches the latest Firmware version downloaded from [WyreStorm.com](https://www.wyrestorm.com).
8. Update Firmware on the NHD-000-CTL if required, using the Web UI.
9. Reboot CTL.
10. Connect all NetworkHD encoder and decoder devices to the Network switch(es) via the primary Network port. Ensure the device is powered by PoE or an external power supply.
11. Configure the administration PC Network interface details so that they match the IP subnet of the target encoder or decoder devices. For IP details and IP Address restoration, refer to [Appendix A.4](#).
12. Run the WyreStorm Management Suite on the administration PC and open Maintenance Tool.
13. Search for the NetworkHD encoders and decoders using Maintenance Tool.
14. Ensure all expected encoders and decoders are shown in Maintenance Tool. If any devices do not show up, please refer to the Troubleshooting section in this TRG.
15. Check that the latest Firmware versions of all encoders and decoders match the latest Firmware versions downloaded from [WyreStorm.com](https://www.wyrestorm.com).
16. Update Firmware on relevant encoders and decoders as required using Maintenance Tool. Up to 20 devices can be batch upgraded at once.
17. Ensure all encoders and decoders reboot and come back online by searching in Maintenance Tool. Verify that the expected Firmware is loaded.
18. Continue to configure the NetworkHD system using the NetworkHD Series Console software in conjunction with a completed NetworkHD IP Switch Mapping Worksheet.

19. For further training and details on the NetworkHD Series Console software, please visit WyreStorm.com.
20. When using third-party control systems, many popular Drivers are available from WyreStorm.com.

Troubleshooting

Device does not power up

- Check that the device does not have the power LED illuminated.
- Verify that the device is connected to the supplied power supply or plugged into a PoE compliant Network switch port.
- If a PoE configuration does not seem to work, ensure the device power can be applied using the external power adapter.

Device cannot be found using NetworkHD Console or Maintenance Tool

- Verify that Network activity and connectivity is indicated on the primary Network port LEDs.
- Verify that the connected Network switch has been configured using the information in this document and/or the appropriate [Switch Configuration Guide](#).
 - As multicast is used for all NetworkHD components, this also includes switch ports connected to the administration PC running the WyreStorm software.
- Verify that the Network adapter settings on the administration PC are set to the same subnet as the target NetworkHD devices.
- Verify that all WyreStorm software is correctly allowed to traverse any firewall on the administration PC.
- If IP address details are unknown, restore a NetworkHD device to the factory default IP address.
Refer to [Appendix A.4](#).

Contacting Technical Support

Should further clarification of the content in this document or assistance on troubleshooting be required, please contact WyreStorm technical support.

Phone: UK: +44 (0) 1793 230 343 | ROW: 844.280.WYRE (9973)

Contact Request: <http://wyrestorm.com/contact-tech-support>

Appendixes

Appendix A.1 Encoder AV Input Compatibility Table

	NetworkHD 100/200	NetworkHD 400	NetworkHD 600
Compatible HDMI Version ¹	1.4	2.0a	2.0b
Compatible HDCP Version	1.4	1.4, 2.2	1.4, 2.2
Maximum HDMI Bandwidth	4.46 Gb/s	8.91 Gb/s	17.82 Gb/s
Maximum DisplayPort Bandwidth	NA	NA	17.82 Gb/s
Maximum HDMI/DP TMDS Clock	165 MHz	300 MHz	595 MHz
Maximum HDMI Timing	1080p@60 8b 4:4:4 1920x1200@60 8b 4:4:4	2160p@30 8b 4:4:4 2160p@60 8b 4:2:0 2160p@30 12b 4:2:2	2160p@60 8b 4:4:4 2160p@60 12b 4:2:2
Maximum VGA Timing ²	1920x1200@60 8b	NA	NA
Maximum YPbPr Timing ²	720p@60 8b	NA	NA
Interlaced Video Support	Y ³	Y	Y
Color Space	RGB	RGB, YCbCr	RGB, YCbCr
YCbCr sampling	NA	4:4:4, 4:2:2, 4:2:0	4:4:4, 4:2:2, 4:2:0
HDR Support	N	HDR10 / HLG	HDR10 / Dolby Vision / HLG
2ch PCM Audio	Y	Y	Y
Multichannel PCM Audio	N	Y	Y
Dolby / DTS Audio Support	N	Y	Y
2ch Analog Audio	Y ⁴	Y ⁵	Y

¹ HDMI version compatibility indicates the most applicable HDMI version to which a product is compatible. This does not indicate compliance with all aspects of the specified HDMI version and is purely indicative. Please refer to the relevant HDMI signal attributes to establish possible variables not specifically implied by HDMI version compatibility.

² Not NHD 100 Series. Only applicable to 200 Series products with analog video input.

³ NHD-140-TX only

⁴ NHD-200-TX only

⁵ NHD-400-DNT-TX only

Appendix A.2 Decoder AV Output Compatibility Table

	NetworkHD 100/200	NetworkHD 400	NetworkHD 600
Compatible HDMI Version ¹	1.4	2.0a	2.0b
Compatible HDCP Version	1.4	1.4, 2.2	1.4, 2.2
Maximum HDMI Bandwidth	4.46 Gb/s	8.91 Gb/s	17.82 Gb/s
Maximum HDMI TMDS Clock	165 MHz ²	300 MHz	595 MHz
Maximum HDMI Timing	1080p@60 8b 4:4:4 1920x1200@60 8b 4:4:4 (3840x2160@60 8b 4:4:4 ³)	2160p@30 8b 4:4:4 2160p@25 8b 4:4:4	2160p@60 8b 4:4:4 2160p@60 12b 4:2:2
Interlaced Video Support	N	Y	Y
Color Space	RGB, YCrCb	RGB, YCbCr	RGB, YCbCr
YCbCr sampling	4:4:4	4:4:4	4:4:4, 4:2:2, 4:2:0
HDR Support	N	HDR10 / HLG	HDR10 / Dolby Vision / HLG
2ch PCM Audio	Y	Y	Y
Multichannel PCM Audio	N	Y	Y
Dolby / DTS Audio Support	N	Y	Y
2ch Analog Audio	Y	Y ⁴	Y

¹ HDMI version compatibility indicates the most applicable HDMI version to which a product is compatible. This does not indicate compliance with all aspects of the specified HDMI version and is purely indicative. Please refer to the relevant HDMI signal attributes to establish possible variables not specifically implied by HDMI version compatibility.

² In Tile mode the maximum TMDS clock supported by the NHD-250-RX is 594MHz

³ In Tile mode the maximum resolution supported by the NHD-250-RX is 3840x2160

⁴ Not the Type E model

Appendix A.3 Control and Switching References

Appendix A.3.1 Control Signal Compatibility Table

	NetworkHD 100/200	NetworkHD 400	NetworkHD 600
RS-232 Pass-through			
TX > RX	NA	Routed	Routed, Broadcast
RX > TX	NA	Routed	Routed, Broadcast
RS-232 Generation (API)			
To TX	Y	Y	Y
To RX	Y	Y	Y
RS-232 Notification (API)			
From TX	Y	Y	Y
From RX	Y	Y	Y
RS-232 Serial Bit Rate			
Stepped rates between	50 – 230400 b/s	50 – 230400 b/s	2400 – 115200 b/s
Data Bits			
Byte size supported	5, 6, 7, 8	5, 6, 7, 8	6, 7, 8
Stop Bits			
No. of stop bits	1, 2	1, 2	1, 2
Parity Bit			
Type supported	None, Odd, Even	None, Odd, Even	None, Odd, Even
Infrared Pass-through			
TX > RX	Routed	Routed	Routed, Broadcast
RX > TX	Routed	Routed	Routed, Broadcast
Infrared Generation (API)			
To TX	Y	Y	Y
To RX	Y	Y	Y
Infrared Notification (API)			
From TX	N	N	Y
From RX	N	N	Y
CEC Generation (API)			
To RX	Y	Y	Y
Discrete 1GbE Switch			
At TX	N	N	Y
At RX	N	N	Y
USB Pass-through			
Device (RX) > Client (TX)	Y	Y*	N
USB Class Device Quantity per TX	HID: Unlimited	HID: Unlimited Other: 5	NA
USB Max. Data rate	115200bps	64Mbs	NA

* Requires FW v0.9.4 or higher

Appendix A.3.2 RS-232 Compatibility

RS-232 on all NetworkHD devices with RS-232 ports is full duplex and compatible with the TIA-232-C standard. All NetworkHD devices utilize 3-wire RS-232 and thus do not support hardware flow control. Due to the nature of control signal translation in the NetworkHD system, the RS-232 data transmission cannot be guaranteed to be isochronous. Some NetworkHD devices may also include a +12V power rail on the same RS-232 connector. Be sure to observe the device port labelling to avoid connection issues.

Where RS-232 data pass-through is supported, ensure that the correct default UART settings on an encoder or decoder are set using the NetworkHD Console software application before connecting external equipment. These will remain statically assigned until modified in the Console application. This may include baud rate, number of data bits, number of stop bits and type of parity bit (if used). When utilizing the NetworkHD API to generate RS-232 data, the UART attributes in the API command and subsequently generated RS-232 data can be different from the statically assigned, default values.

Appendix A.3.3 Infrared Compatibility

Using WyreStorm infrared emitters and receivers is the best way to ensure that most IR coding formats are transmitted and received by the NetworkHD system. Other 3rd party emitters and receivers can be used, however these devices must operate in the same manner as the WyreStorm devices.

On the 400 series the IR data modulation (carrier) frequency is passed through NetworkHD from the receiver to the emitter, however on the 600 series the carrier frequency is fixed at 38kHz when used in pass-through mode. When using the API, the carrier frequency can be defined for greater compatibility.

Due to differences in IR across 3rd party control systems, their IR ports should never be connected directly to a NetworkHD system as an incompatibility may exist. WyreStorm offers a cable known as the CAB-IR-LINK that allows for connection to 3rd party control systems that compensates for voltage differences, as well adjusts for differences in the pins used within the port. Use of this cable helps ensure compatibility between the control system and the NetworkHD system. Refer to the [CAB-IR-LINK](#) product page for more information.

Appendix A.3.4 CEC Compatibility

CEC wiring is mandatory in HDMI ports and cables, although implementation of CEC in a product is optional. It was defined in HDMI Specification 1.0 and updated in HDMI 1.2, HDMI 1.2a and HDMI 1.3a.

HDMI-CEC is often branded differently depending on the equipment vendor. Some common examples are listed below:

- Anynet+ (Samsung)
- Aquos Link (Sharp)
- BRAVIA Link, BRAVIA Sync, Control for HDMI (Sony)
- CE-Link, Regza Link (Toshiba)
- E-link (AOC)
- EasyLink (Philips)
- Fun-Link (Funai, Sylvania, Emerson, Magnavox, Philips)
- HDMI-CEC (Hitachi)
- INlink (Insignia)
- Kuro Link (Pioneer)
- NetCommand for HDMI, Realink for HDMI (Mitsubishi)
- RIHD (Remote Interactive over HDMI) (Onkyo)
- RuncoLink (Runco International)
- SimpLink (LG)
- T-Link (ITT)
- VIERA Link, HDAVI Control, EZ-Sync (Panasonic)

It is important to note that some third-party equipment may not support the commands generated by NetworkHD devices. It is imperative that compatibility is verified before assuming this feature will be compatible with any chosen third-party equipment.

CEC control command generation via the HDMI interface is supported on some NetworkHD devices. This can be useful for controlling a connected HDMI sink device that supports specific CEC commands. The default CEC commands generated by NetworkHD devices are as follows:

- **One Touch Play:** Allows NetworkHD to switch the HDMI sink to use it as the active source when playback starts. This typically turns on a display and selects the correct HDMI input on a display.
CEC Address: NHD 400 Series: 0xF0 | NHD 100/200 Series: 0x40
CEC Message ID: 0x0D
- **System Standby:** Allows NetworkHD to switch the HDMI sink into a standby mode.
CEC Address: NHD 400 Series: 0xFF | NHD 100/200 Series: 0x40
CEC Message ID: 0x36

Appendix A.3.5 Discrete Ethernet Compatibility (Virtual Switch)

The NetworkHD 600 Series includes a "Virtual Switch" capability. This allows third-party Ethernet-capable devices to connect to an encoder or decoder and be linked to other devices connected to other NetworkHD 600 Series encoders and decoders.

The IEEE 802.1ab compliant "LAN" ports on NetworkHD 600 Series devices are linked together to form a "virtual" 1GbE unmanaged switch. It must be noted that the 1GbE links are encoded as part of the SDVoE connectivity used for the main 10GbE port on a 600 Series device. Thus, the Network topology of the "LAN" ports follows that of the host NetworkHD device within a Network deployment. The "LAN" ports themselves do not offer discrete Layer 2 or Layer 3 configuration options and should be treated as basic nested, unmanaged Layer 2 switch ports.

It is important that network loops are not created when using the 1GbE ports. Note that access to the 1GbE ports is typically achieved at the 10GbE switch.

The 10GbE ports and the 1GbE ports are logically connected together.

Appendix A.3.5.1 Control Signal Limitation - NHD-110 Series

The NetworkHD 110 series components support three methods of control signal pass-through/routing: USB, Infrared & RS-232. Due to hardware limitations, the 110 series components can only support 2 of these 3 protocols simultaneously, meaning one of the control signals will be disabled. The disabled control signal can be changed from within the NetworkHD console software.

Appendix A.3.5.2 100/200 Interoperability with 110 Series

In most scenarios the NHD-110 series is interoperable with other device in the 100/200 series family. Refer to the chart below of use-case limitations.

	NHD-110-TX	NHD-110-RX
NHD-100-TX	N/A	Compatible
NHD-140-TX	N/A	Compatible
NHD-200-TX	N/A	Compatible
NHD-100-RX	Compatible	N/A
NHD-210-RX	Compatible. Video walls cannot mix and match 210-RXs and 110-RXs	N/A
NHD-250-RX	Compatible	N/A

*The above table refers to multicast operational modes on NHD-110.

*AES encryption must be disabled for interoperability between series.

Appendix A.3.6 USB Compatibility

The NetworkHD 110 and 400 Series support USB passthrough and routing. The 110 series uses USB v1.1 and is designed only for keyboard and mouse applications. The maximum USB bandwidth supported is 115200bps.

The 400 series offers a higher data-rate USB 2.0 (up to a max. theoretical data-rate of 64Mbps) on v2 or newer hardware. See below for USB modes and supported devices types on the 400 series.

Supported USB Device Types:

1. Bulk Data transfer:
 - a. Devices such as Printers, Scanners, Memory Sticks, HDD/SSD and other devices that do not rely on time sensitive data transfer.
2. Control Data Devices:
 - a. Devices such as Keyboard, Mouse, Touchscreen and other user-initiated data transfers.
3. Interrupt Data Devices:
 - a. Devices that generate asynchronous but not time sensitive data that generally require user attention.

Unsupported USB Device Types:

1. Isochronous Data Devices:
 - a. Devices that require time-sensitive data transfer, such as some Webcams and audio devices. Due to the data transfer of AV over IP technology favoring the Video and Audio streams, the USB data is sent in bursts and cannot guarantee isochronous behavior. Thus, support for some time-sensitive device types cannot be guaranteed. WyreStorm recommends testing such products for compatibility in advance of system deployment.

USB Operation:

When an encoder is connected to a host machine via a USB cable, the host machine will enumerate a Standard USB Hub. If KMoIP mode is enabled on the encoder the host machine will also enumerate a HID class composite device.

USB functionality operates in the following two modes:

Mode 1 – USBolP:

USBolP allows up to 5 USB devices to be routed simultaneously to any encoder. It offers transparent redirection technology, allowing the encoders and decoders to appear invisible to the host machine. When a device is attached to a decoder and a decoder with attached devices is assigned to an encoder, (via a matrix assignment command) the connected devices will enumerate on the host machine as if they are connected via a standard USB Hub to a host USB port. This mode is selected automatically if the device connected at a decoder is not of the USB HID class type (Base Class 03h) or if KMoIP mode is disabled on the decoder.

A maximum of 5 USBolP mode devices is supported on any one encoder. When an encoder is assigned a 6th USBolP device on a decoder, the connection will be ignored and the host machine will not enumerate it. If a USBolP device leaves an encoder (a USB device is unplugged at an RX or an RX becomes unassigned to a TX), space at a TX will allow more USB devices to be assigned. This will not happen automatically; the USB assignment will have to be established again via an API or control system command.

Mode 2 – KMoIP:

KMoIP mode (if KMoIP mode is enabled on the decoder) is automatically selected if the device connected to a decoder is of the USB HID class type (Base Class 03h). KMoIP mode offers emulation of a composite keyboard and mouse device to the host machine, enumerating at the point at which the encoder is connected, via a USB cable to the host machine.

KMoIP mode offers a few advantages over USBoIP mode:

- An unlimited number of keyboard or mouse devices can be used at the same time, connected to the same host machine
- When switching a host machine (using a matrix assignment command) to a KMoIP mode decoder, the host need not enumerate the device each time, leading to much quicker switch times and instant usage.

KMoIP mode only enumerates on the host machine as an 84/101/104 standard keyboard and up to 8-button mouse with one wheel. At this time, touch panels, gamepads and joystick devices may not be supported, depending on the USB profile they require. To use unsupported HID class (Base Class 03h) devices the decoder can be instructed to disable KMoIP mode and revert to USBoIP mode.

To enhance the user experience, devices utilizing KMoIP mode will block other KMoIP devices assigned to an encoder when they are in use. This results in only one keyboard, for example, sending data to the host at any one time. The block is in place for 100ms after a keystroke. After 100ms has elapsed any assigned KMoIP device can then send data to the host again.

KMoIP mode is enabled on both the encoder and decoder by default or after a factory reset procedure.

When changing the KMoIP mode on an encoder or decoder the setting will only be realized after a device reboot.

Please note that if KMoIP mode is disabled on the encoder but enabled on an assigned decoder, and a HID class device is used with a decoder, the device communication to the encoder will be blocked. Thus, it is recommended that KMoIP mode on the encoder is always set to “enabled” unless the host machine explicitly requires enumeration removal of the HID class composite device.

Appendix A.4 Default Factory Values

Appendix A.4.7 Default IP Addresses for Factory Restored NetworkHD devices

A NetworkHD device restored to factory defaults will have the following IPv4 Network details:

	Host IP	Netmask	Default Gateway
NetworkHD 100, 200 & 400 Series	169.254.x.x (auto-IP)	255.255.0.0 (auto-IP)	NA (undefined)
NetworkHD 600 Series	DHCP, auto-IP	DHCP, auto-IP	DHCP, NA (undefined)
NetworkHD NHD-000-CTL (AV)	169.254.1.1	255.255.0.0	169.254.1.254
NetworkHD NHD-000-CTL (Control)	192.168.11.243	255.255.255.0	192.168.11.1

It must be noted that when devices are in auto-IP mode, Routers will not forward packets with link-local (auto-IP) addresses.

Appendix A.4.8 Restoring Default IP Addresses for NetworkHD devices

All NetworkHD devices support restoring to factory defaults in software and many NetworkHD devices feature a physical “reset” button or buttons. Please ensure any button is depressed for 30 seconds.

If a NetworkHD device has previously been set to DHCP client mode, simply connect the device to a DHCP server and observe the allocated IP address table within the DHCP server to identify the device IP address.

NHD-100-TX, NHD-200-TX, NHD-210-RX: No physical reset button – use the IP Finder utility within NetworkHD Console to identify the IP address then use the Factory Reset option within NetworkHD Console.

NHD-110-TX, NHD-110-RX, NHD-140-TX, NHD-220-RX, NHD-250-RX, NHD-SW-0501, NHD-400-TX, NHD-400-RX: Press and hold the reset button for up to 30 seconds

NHD-600-TX, NHD-600-RX: Disconnect the DC power adapter. Press and hold the button labelled “1”. Hold the button and apply power using the DC adapter. Continue to hold the button for up to 30 seconds.

NHD-000-CTL: Press and hold the reset button for up to 30 seconds

For help and advice please contact the WyreStorm Technical Support Team.

Document Revision History

V6.0.2 – January 2021	
All Sections	Added details pertaining to NetworkHD 110 series devices
V6.0.1 – April 2020	
Appendix A.4	Corrected default IP settings
V6.0.0 – March 2020	
All Sections	Added references for new products.
System Infrastructure Guidelines and Requirements	Added Dante Audio Streams information.
V5.0.0 – March 2019	
Supported Product Firmware/Software	Added NHD-250-RX to table.
NetworkHD Series Encoder/Decoder Comparison	Updates to multiple features for multiple products.
Multiple Images on a Single Display (Multiview)	Removed note regarding NHD-600 as the current version of firmware now supports this.
Single Image Spread Across Multiple Displays (Video Walls)	Removed NHD-210-RX feature checkmarks.
Using PoE	Added NHD-140-TX.
NetworkHD Encoder Preview Streams	Updated stream address.
V2.1 – January 2019	
Various Sections	Formatting Cleanup.
V2.0 – January 2019	
Supported Product Firmware/Software	Added section.
NetworkHD Series Encoder/Decoder Comparison	
Mounting/Installation	Updated to reflect latest product and firmware releases.
Source & Display Settings	
Control Signal Compatibility	
Basic Switch Parameters	Updated for changes to requirements for Layer 2 switches.
Packet Routing	Updated wording for improved explanation of content.
Using PoE	
NetworkHD Stream Bandwidth	Updated to reflect latest product and firmware releases.
Multiple VLAN NetworkHD	
NetworkHD Encoder Preview Streams	Added section.
Inter-VLAN Routing	
Appendix A.1	Maintenance on wording of content.
Appendix A.2	Maintenance on wording of content and release of latest/future products.
Appendix A.3	Maintenance on wording of content and release of latest/future products.
Appendix A.3.6	Added to support new features the result of updated firmware.
Appendix A.4.7	Maintenance on wording of content and release of latest/future products.
v1.1 – April 2018	
Multiview Modes	Added note regarding this feature not being available on v1 of NHD-600.
Video Wall Features	Added note regarding this feature not being available on v1 of NHD-600.
v1.0 – March 2018	
All Sections	Initial Release.

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