



WyreStorm NetworkHD™ Technical Implementation Guidelines

NETWORK HD



Version chart

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Introduction

This guide is intended for installation project managers and site administrators to ensure you are aware of WyreStorm's installation best practice guidelines for NetworkHD systems. The knowledge and recommendations contained within will improve your installation experience with our products and reduce installation and troubleshooting time. These issues have been gathered from thousands of installation reports, support calls and our own personal experiences to help you and your staff keep installation time and troubleshooting to a minimum.

We ask that all staff working with NetworkHD are aware of this information and are vigilant in enforcing the recommendations throughout every stage of the install. Preventing faults in the installation is far easier than resolving them once the site is active.

Should you not be able to find the answers to your questions within this guide, please check the resources available at wyrestorm.com or contact support@wyrestorm.com.

NetworkHD Overview

NetworkHD is a robust and highly scalable HDMI over IP solution designed for the distribution of high definition AV content over a standard Ethernet network. The truly modular nature of the NetworkHD system topology allows an AV distribution of almost any number of sources and displays to be created over inexpensive cabling infrastructure and a managed gigabit switch.

To achieve this the NetworkHD product offering consists of two compression technology options - each with its own set of advantages.

The NetworkHD 100 & 200-Series products use H.264 compression to provide a crystal clear, configurable HD image with resolutions up to 1920 x 1200 at 60Hz at incredibly low bandwidth. As well as this the system features CEC, and RS-232.

The NetworkHD NHD-IP Series products leverage JPEG2000 compression to provide a “visually lossless” HD image with very low latency. These products also feature RS-232 and an even smaller form factor, providing a simpler solution for a wide range of commercial applications.



NetworkHD System Components



Encoders

NetworkHD TX Encoders enable the transmission of AV signals onto the network. They connect to source components such as Set-top boxes, PC's, Blu-ray and media players and convert the input into network packets for transmission over the Local Area Network (LAN).

All NetworkHD Encoders support the direct connection of DVI and HDMI devices, whilst the 200 series enables Component and VGA to be encoded.



Decoders

NetworkHD RX Decoders receive IP transmissions from the network and convert the signal back to an HDMI signal. They connect via HDMI to VDU's such as TVs, monitors and projectors.

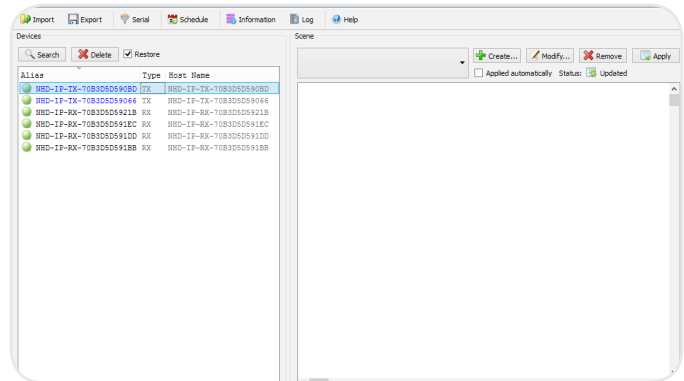
The NetworkHD decoder units are able to output content formatted correctly for its connected display, through transcoding or scaling, without affecting the source transmission so that all displays show the content in its optimum resolution.



Controller

The NetworkHD CTL Controller is an innovative control interface that makes the powerful NetworkHD system the simplest and quickest to configure HD over IP system available.

NetworkHD's use of zero configuration networking and Apple's Bonjour platform enable auto discovery of all NetworkHD components through a single simple and intuitive web-based user interface (UI). The Controller Interfaces to major control systems through a powerful freely available API that is used in our free to use drivers for market leading systems including WyreStorm Enado.



NetworkHD Console

The NetworkHD Console is a software tool for Windows PCs enabling the configuration of NetworkHD components and the construction of video walls for use in projects.

It is 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 whilst helping build a collection of video-wall configurations for use with capable NetworkHD components.



Installation Recommendations

Preparation

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

Power

Your installation is nothing without power. Use a UPS (Uninterruptible Power Supply) to ensure a clean, consistent power supply to all components in the rack. Be sure to calculate your total load and run time requirements ahead and leave enough room in the rack.

Heat

High temperatures are the biggest killer of electronic products. Just a 3° Celsius rise in external temperature can equate to a 15° degree rise in internal temperature and trigger thermal runaway. Ensure proper rack design and passive or active cooling strategies are used to ensure heat is moved away from the components in the rack. Poor installation of cables looks messy and creates hotspots that trap heat, preventing it moving away from components – avoid this at all costs.

The NHD-IP-RACK & NHD-000-RACK have been designed for optimal mounting of the NetworkHD Encoders in the rack and should always be used. Encoders and decoders should never be laid flat or stacked on top of each other. At least 1.5 inches of clearance should be left by the vents to ensure adequate airflow through the units.

Software/Firmware

Where possible WyreStorm ship all components with the most up to date firmware, however before starting any installation please check the downloads section of the products on wyrestorm.com to ensure there are no updates to your system components. Please also try to use the latest firmware on all third party hardware – particularly switches and TVs. Please check with the relevant manufacturer for upgrade instructions.

Redundancy

With all the planning in the world, even the most experienced installers make mistakes and accidents will always happen. For this reason, it is best practice to always run two cables to each Decoder location. This may increase the cost of cabling but is nothing compared to replacing a single or even multiple defective cables that have been sealed into the wall.

Although WyreStorm are incredibly proud of the reliability and robustness of our products from time to time units can fail. Therefore, mission critical products such as the CTL and Decoders in hard or impossible to access locations should be installed with spare, redundant units that can be swapped to if required.

Mounting/Installation

All WyreStorm products should be mounted so that the logo and text printed on the unit is correctly aligned. This will allow for the optimal airflow through the product. As already stated the vents should not be obstructed with adequate clearance. Units should be secured using suitable fixings such as those supplied in the box.

The correct mounting of devices, particularly in the unforgiving environment of an AV or IT rack, is vital to any successful installation and the NHD-000-RACK does just that with a steel housing designed for mounting multiple 100 and 200-Series encoders within a central location for a secure and organized NetworkHD install.



Source & Display Settings

WyreStorm NetworkHD components use the highest quality encoders available to provide visually lossless compression over a large number of displays. However, the compression can only be as good as the source content that is put in. NetworkHD 100/200 series use H.264 compression that is not compatible with interlaced sources. Please ensure that all source content is set to Progressive scan (720p/1080p) and not interlaced (1080i).

On the displays and sources – low power modes should be disabled to ensure the system is always fed with content. The customer does not want to be troubleshooting if the source has gone into standby.

The displays should have CEC enabled so that NetworkHD can power them on and off. This setting is called different things by different manufacturers and is not always enabled by default.

Any screens that are used in video walls must also have Over Scan disabled. This setting is always enabled by default and often hidden in advanced settings menus. Without it disabled the video wall will not align.

Testing & Certification

WyreStorm products are manufactured and tested to the highest standards but the best installation environment is paramount to successful installation. The only way to guarantee the installation is fit for purpose is to test and certify cables. All IT cable companies will certify cables throughout a network as standard, yet they are passing a fraction of the data in short bursts that NetworkHD transmits 24/7. Although testing a cable proves that it is correctly terminated, it does not show how much interference on the run is affecting bandwidth. Certification of every cable should always be performed before and after walls are sealed.

Cabling

Prepare your installation as best you can for future technologies. Running extra cables to all display locations to provide extra bandwidth for future technologies is important. As a best practice, run fiber to end points to ensure compatibility with future transmission technologies.

Cabling Guidelines

- Ensure source components are located next to encoders with HDMI cables that are as short as possible, as HDMI distances will reduce as content bandwidth increases.
- Use trunking so that cables can be easily replaced down the line.
- Never seal HDMI cables in the wall as they cannot be re-terminated or replaced easily.
- The use of patch panels, wall plates, cable extenders, kinks in cables, and electrical or environmental interference can have an adverse effect on HDMI transmission limiting performance. Steps should be taken to minimize these factors (or remove completely) during installation for best results.

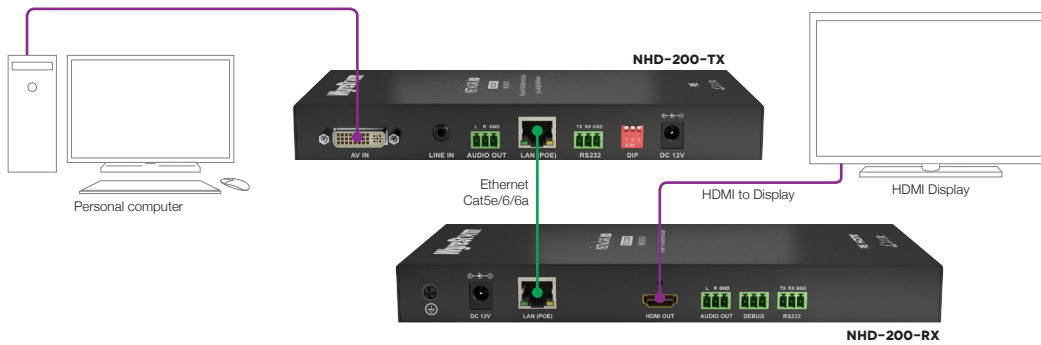


System Examples

One Encoder to One Decoder

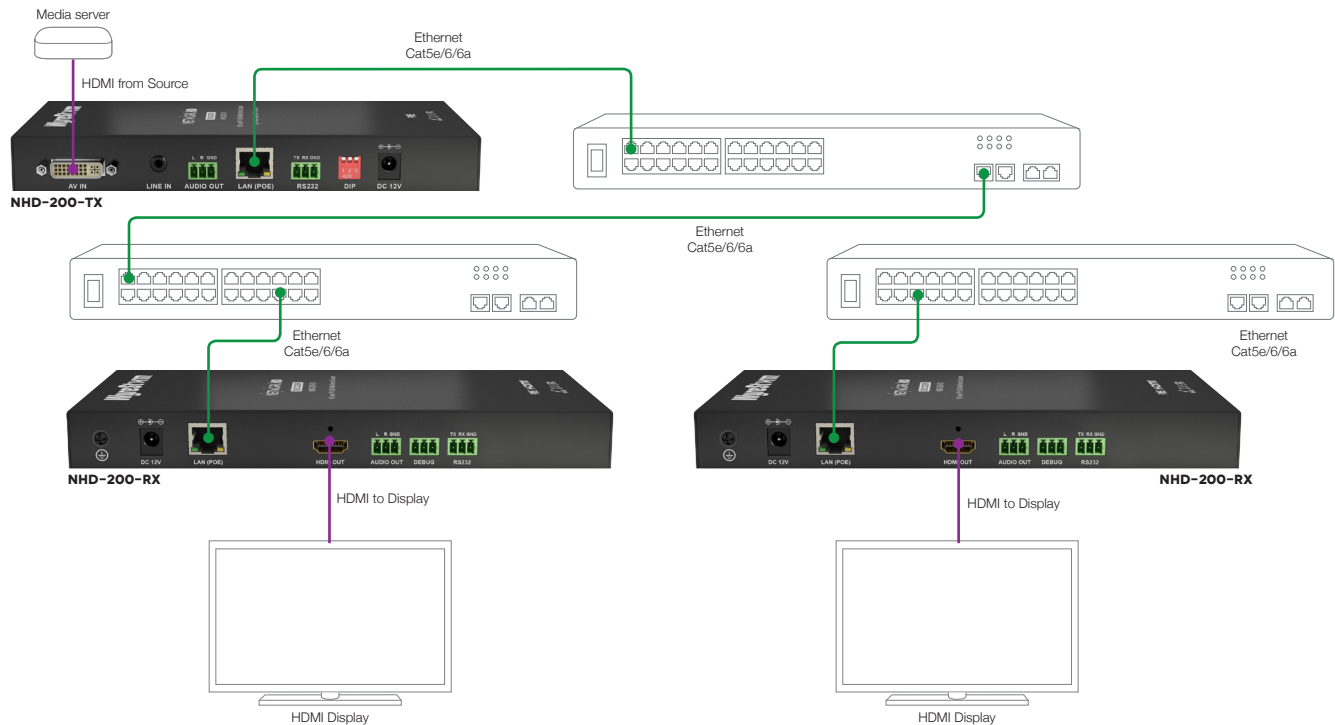
In the simplest of installation scenarios, a single encoder and decoder can be linked directly or via the LAN, to send video from a source to a display in another location. If linked directly the devices must each be powered with a power supply and the CAT5e/6 cable linking them should not run more than 100m/328ft.

The devices will not automatically connect and must first be connected via an NHD Controller or the Console software application. This will require connection to a network although once linked the devices can then be connected directly.



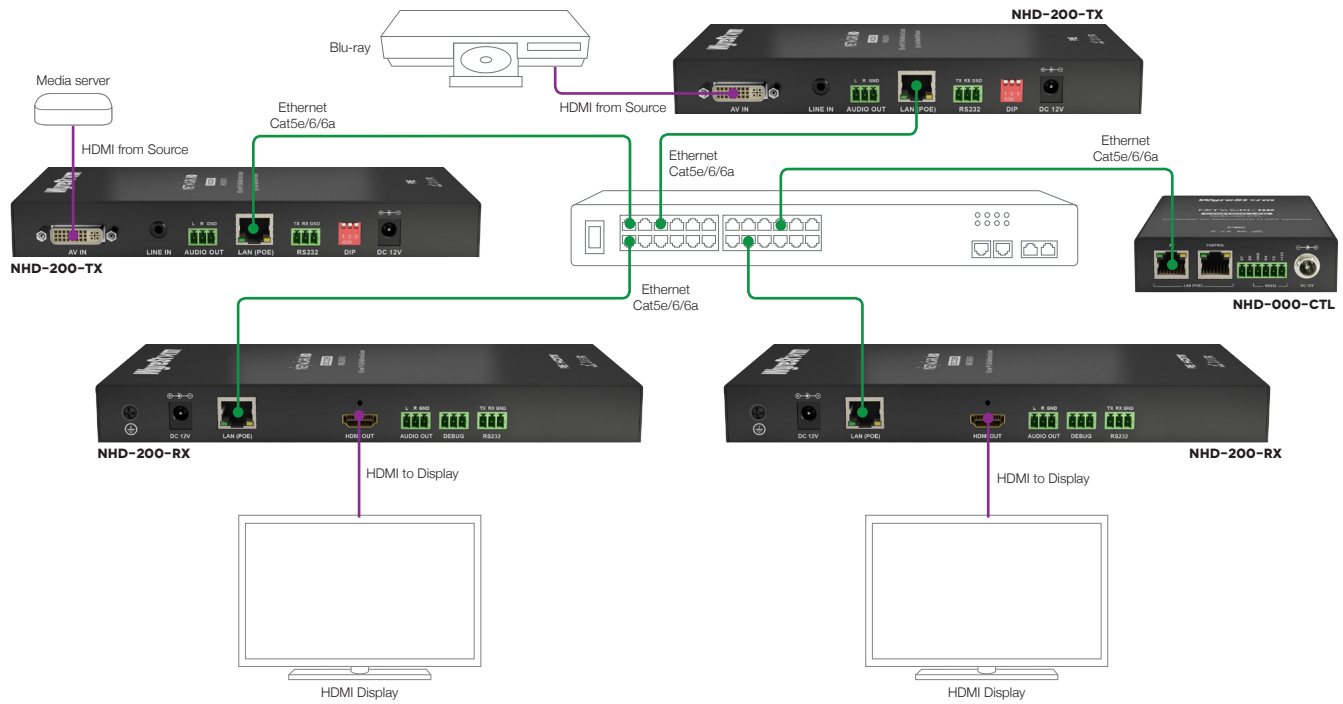
One Encoder to Multiple Decoders

Using NetworkHD components for one to many installations dramatically decreases the amount of equipment required at the source location, Each decoder can be located up to 100m/355ft from the switch.



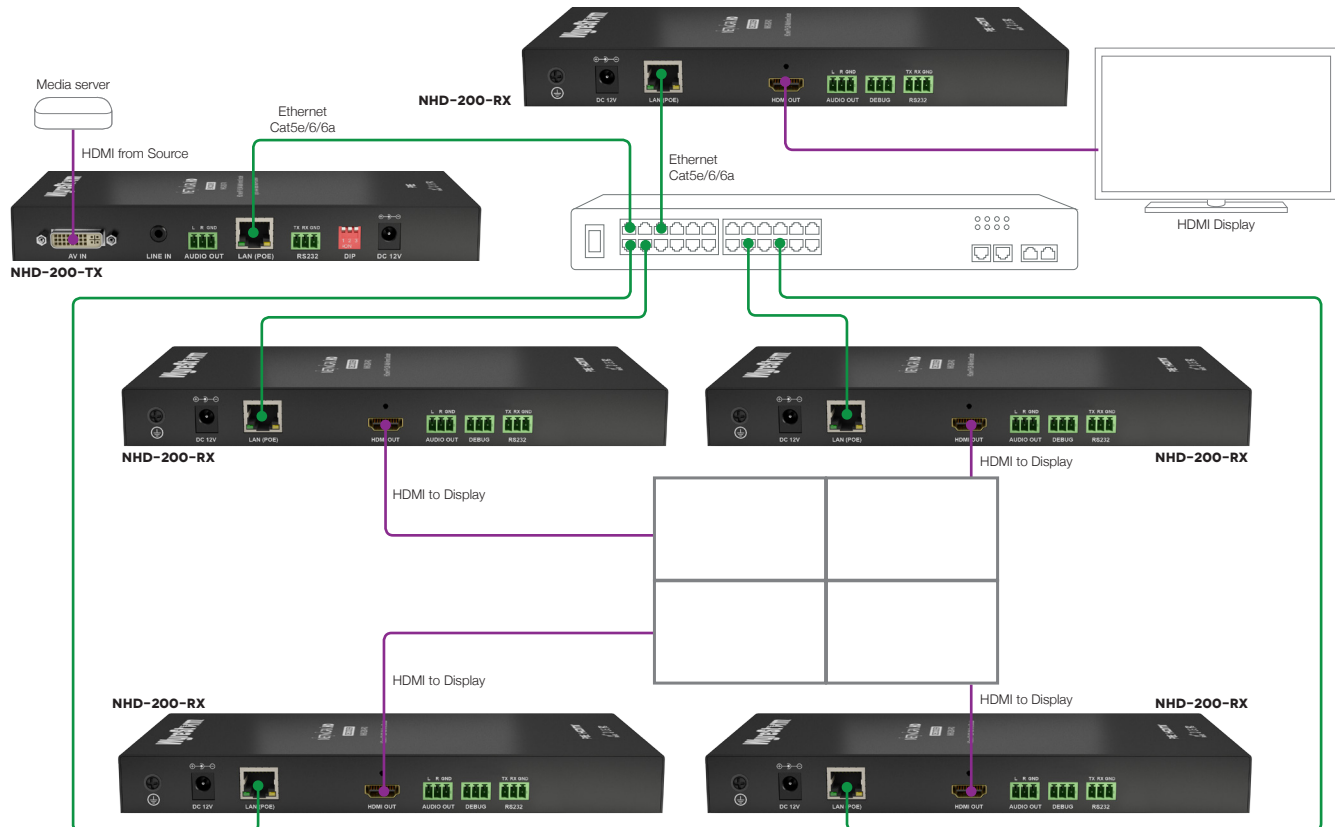
Multiple Encoders to Multiple Decoders

The truly modular nature of the NetworkHD system topology allows an AV distribution of almost any number of sources and displays. Multiple switches can be linked by fiber to expand the size and reach of the system to an almost limitless scale.



Video Wall

The versatility of NetworkHD's powerful video wall functionality lets a collection of displays display multiple images or a single image and any combination in between, at the press of a button.





Network Design

Choosing an Ethernet Switch

The Ethernet switches in a NetworkHD installation must support the following functions:

- Multicast forwarding or filtering
- IGMP Snooping
- IGMP Querier
- IGMP snooping fast leave

If the Ethernet switches are used for cascading networking, they must also support the following functions:

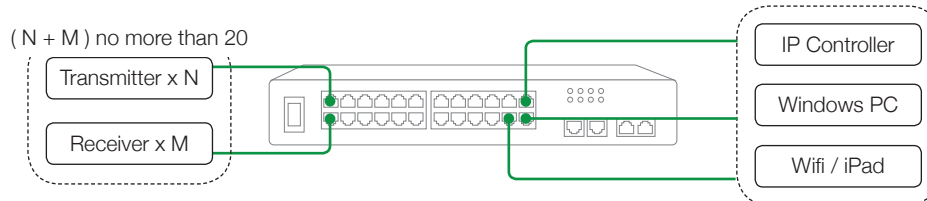
- Dynamic multicast router port
- Forwarding unknown multicast to multicast router ports only

During WyreStorm's testing, we've found that different brands and models of switches perform works very differently when handling multicast data packets. Therefore, although a switch may meet the previous requirements they may still not be suitable for use with NetworkHD. The final conclusion can be made through practical function verification and pressure testing. WyreStorm cannot support switches that are not recommended in this document, therefore using other switch brands and models is done so at the installers own risk.

Single Switch Networking

When the NetworkHD devices are no more than 100m/355ft from the central distribution point, and number less than or equal to 44 devices, a single switch design is recommended.

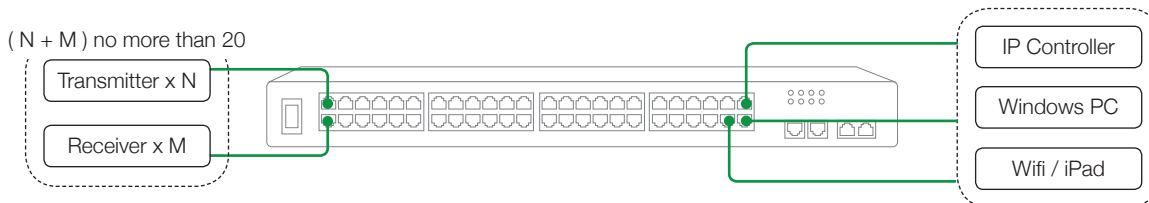
24-port Single Switch Networking



WyreStorm have tested and recommend the following CISCO switches:

- 24-port 1000Mbps Ethernet switch: SG300-28, SG500-28, WS-C2960X-24TS-L
- 24-port 1000Mbps PoE Ethernet switch: SG300-28P/MP, SG500-28P/MP, WS-C2960S-24PS-L, WS-C2960X-24PS-L

48-port Single Switch Networking



WyreStorm have tested and recommend the following CISCO switches:

- 48-port 1000Mbps Ethernet switch: SG300-52, SG500-52, WS-C2960X-48TS-L
- 48-port 1000Mbps PoE Ethernet switch: SG300-52P/MP, SG500-52P/MP, WS-C2960X-48FPS-L

Cascaded Switch Networking

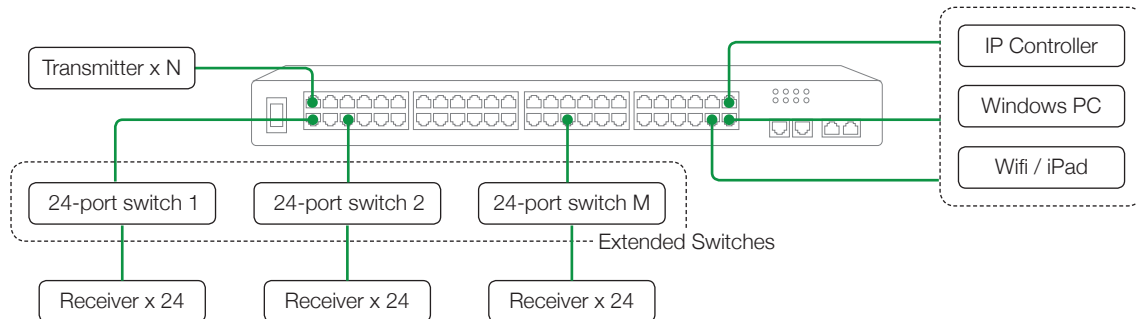
If more devices are required, it is recommended to cascade switches.

When using 1Gbps connections between switches - bidirectional data flow must not equal more than 1000Mbps between the core switch and extended switches, whilst leaving enough headroom for additional traffic. By taking a typical encoder bitrate of 40Mbps for example, the number of Encoders connected to a single extended switch should be not more than 22. Leaving 120Mbps of headroom.

If the number of encoders is higher than 15 or the distance between the core switch and extended switches is more than 100m/355ft, you should use fiber-optic cables for cascading switches.

In all cascaded networking scenarios it is recommended that the core switch is connected the NetworkHD CTL controller, wireless access points and third party control devices.

Simple Cascaded Switch Network



In this installation scenario, the encoders will be centrally deployed.

For example, a system has 40 encoders. Extended switches are 48-port switches. This networking can support 176 decoders (4x44) to create 40 x 176 distributed matrix. We would recommend that you use Cisco 500 series switch or higher when cascading switches.

1. Core switches

- 48-port 1000Mbps Ethernet switch: SG500-52, SG500X-48, WS-C2960X-48TS-L
- 48-port 1000Mbps PoE Ethernet switch: SG500-52MP, SG500X-48-P, WS-C2960X-48FPS-L

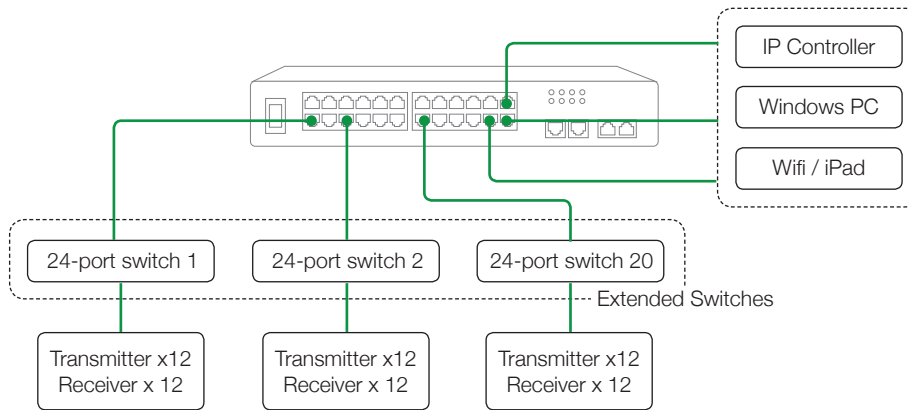
2. Extended Switches

- 24-port 1000Mbps Ethernet switch: SG500-28, SG500X-24 WS-C2960X-24TS-L
- 24-port 1000Mbps PoE Ethernet switch: SG300-28P/MP, SG500-28P/MP, SG500-X-P WS-C2960S-24PS-L, WS-C2960X-24PS-L



Complex Cascading Switch Networking

If Encoders are not centrally deployed or the number of encoders exceeds 44, you should consider more complex factors when cascading. For more information, consult WyreStorm support and we will help plan your project.



Note: As shown in the figure above, the core switch is connected to the NetworkHD CTL Controller, PC, Wi-Fi network. The others can be connected to extended switches, each of which is connected to 12 Encoders and 12 Decoders. Therefore, the maximum possible number of Encoders and Decoders is 240 (12 x 20), creating a 240 x 240 distributed matrix. If the core switch and extended switches are 48-port models, the number increases to 1056 (24 x 44), creating a 1056 x 1056 distributed matrix.

Configuring the Switch

Configuration of the Ethernet switch will vary with networking strategies. The following table describes the recommended settings for each topology:

Feature of Switch	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*

Note: *indicates that extended Ethernet switches must forward unknown multicast messages to multicast router port only.

Different brands and models of switches may have different names for these features. Please refer to the Ethernet switches' user guide or manufacturer for assistance.

Multiple VLAN networking

NetworkHD requires a single VLAN for all encoders and decoders to reside within. The NHD-000-CTL is equipped with dual Ethernet ports so that it can sit across two separate networks or VLANs without the need for Layer3 functionality in the switch. This enables the Control network to be completely isolated from the AV network which minimizes the possibility of broadcast loops that can occur if all network equipment is not properly configured.

The NHD-IP-CTL does not have dual Ethernet ports and therefore all system components must reside within the same VLAN.



Interlinking switches

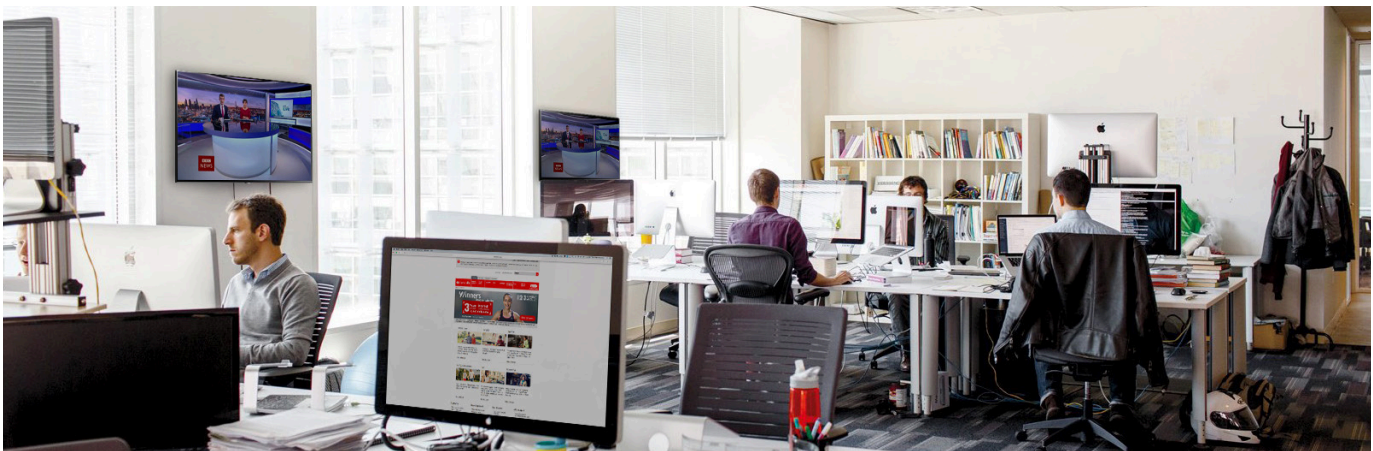
When cascading switches – where possible WyreStorm recommend utilizing fiber connectivity to ensure the maximum possible bandwidth is available between devices. The use of the following SFP modules is recommended:

1G SFP Modules

Fiber	Bandwidth	Description	Max Distance
XSA-SFP1	1Gb	1310-nm wavelength Multi-mode fiber	550m / 1800ft
XSA-SFP+	10Gb	850-nm wavelength Multi-mode fiber	300m / 1000ft

10G SFP Modules

Fiber	Bandwidth	Description	Max Distance
SFP1-10G-SR	10Gb	850-nm wavelength Multi-mode fiber	300m / 1000ft
SFP1-10G-LR	10Gb	1310-nm wavelength Single-mode fiber	10km / 6mi
SFP-10G-LRM	10Gb	1310-nm wavelength Single or Multi-mode fiber	300m / 1000ft



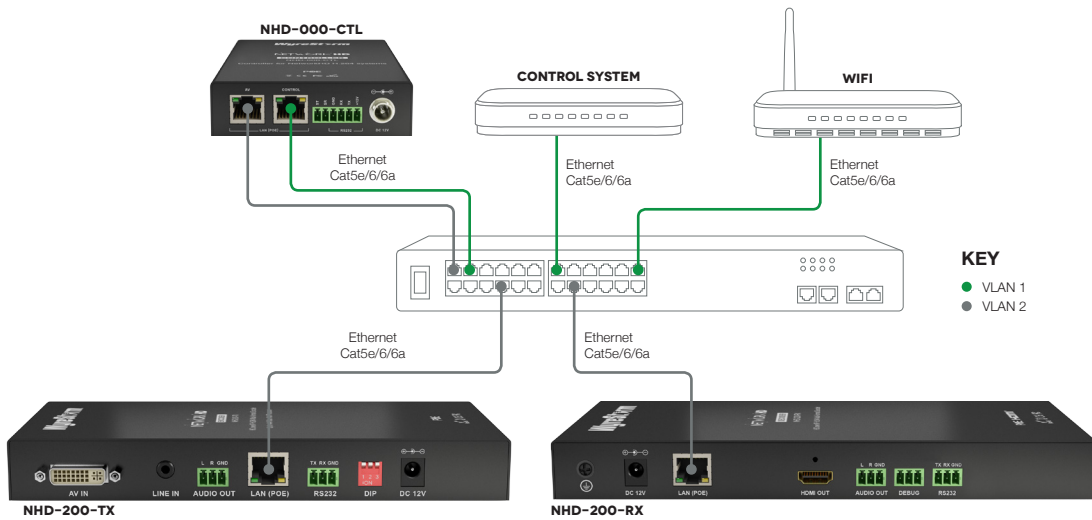
Dedicated or Integrated?

When implementing NetworkHD in any of the topologies mentioned on page 7/8, it is important to decide at the earliest stages of planning if the system will be integrated into the rest of the network or if it will reside on a dedicated AV network. Each has its own advantages and disadvantages but where ever possible WyreStorm recommends the use of a dedicated network switch. Using the existing network is of course possible – but it adds extra complexity to the installation and often removes control of the networking equipment from the sites AV staff or installer.

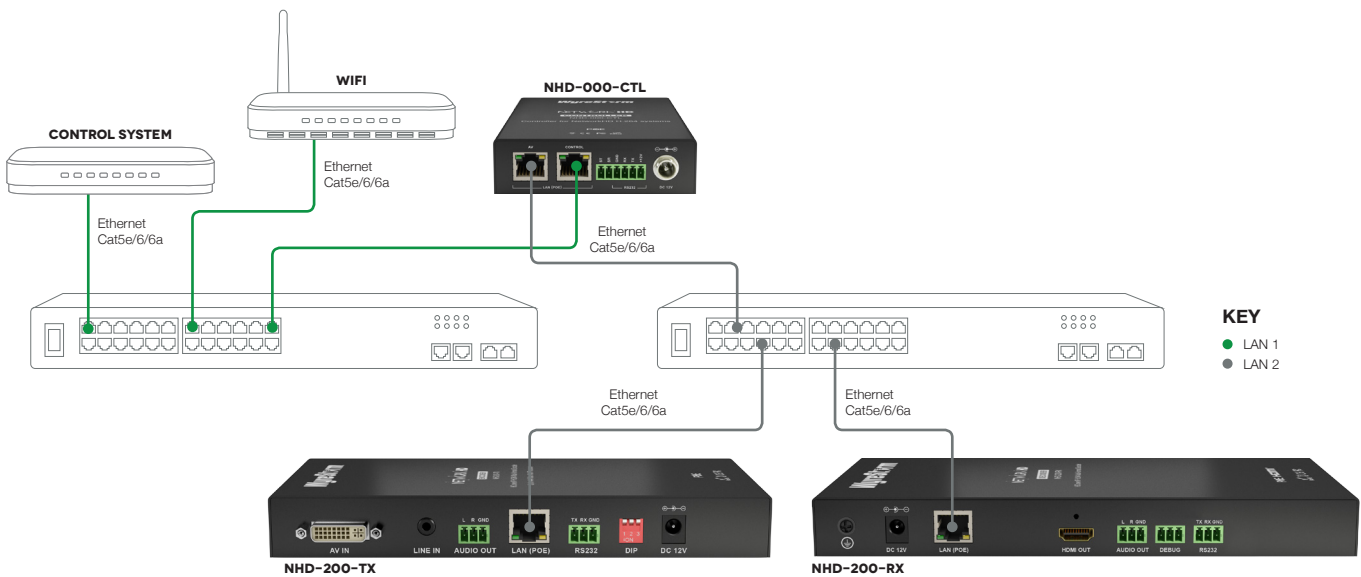
The first thing to be considered is how much control the install and site teams have over the network configuration. Do they have access to and clearance to change the managed switch configurations on the fly? Is the network administrator willing to make the necessary changes to support multicast and IGMP traffic on their network. Will they allow the creation of a VLAN or change their existing VLAN configuration to support the required configuration of NetworkHD?

If the answer to these questions is no, then it is highly recommended that the system be installed on to a separate dedicated network switch. If this is not an option then a conversation needs to take place with the network admin staff to ensure they are aware of the requirements listed in this document ahead of the install date.

Integrated Into the Existing Network



Integrated Into the Dedicated Network





PoE

Power over Ethernet (PoE) allows an Ethernet switch to provide both data and electrical power to a network device through a single cable. Doing so reduces the number of cables required to install NetworkHD and the need for many power supplies in the system. The result is lower cost, less downtime, easier maintenance, and greater installation flexibility than with traditional wiring.

A PoE system consists of Power Source Equipment (PSE) and Powered Devices (PD).

- PSE is a device such as a PoE Ethernet switch that provides other devices with power via the Ethernet cable.
- PD is a device powered by a PSE and thus consumes energy. The NHD Encoders and Decoders for example.

The PoE standard has two versions.

- IEEE 802.3af: This PoE standard provides up to 15.4 W of DC power at the PSE. Only 12.95 W is assured to be available at the PD.
- IEEE 802.3at: This PoE standard, known as PoE+ or PoE plus, provides up to 32W of DC power at the PSE. Only 25.5 W is assured to be available at the PD.

All NetworkHD components use the IEEE 802.3af standard and therefore use a maximum of 15.4W. PoE Plus is not required.

Choosing PoE Power Supply Schemes

The total power capacity of the PoE Ethernet switch is essential. Many PoE Ethernet switches are unable to provide enough power to have POE devices on all ports simultaneously. For example, many 48-port PoE Ethernet switches can provide up to 370W of DC power. If each port needs 15.4W, these switches can only supply power up to 24 ports together.

For how to select an appropriate PoE switch please follow these strategies:

PoE Power Supply Scheme

All our IPAV products are Class 0 devices that comply with PoE standard, which provides up to 15.4 W of DC power at the PSE. We strongly recommend that you calculate the total number of ports that PoE Ethernet switches are able to supply power to using 15.4W on each port.

In order to calculate the number of devices that can be used on a switch please divide the total POE power capability of the switch by 15.4 and round down. For Example, the CISCO SG300-52P with a POE power output of 375W:

$$375 / 15.4 = 24.35$$

Therefore 24 devices can be powered by this switch.

In order to have all ports powered by POE on a switch an MP series should be used in this example an SG300-52MP which provides 740W.

$$740 / 15.4 = 48$$

Therefore 48 devices can be powered by this switch.

Exceeding this limit can cause erratic behavior of the NetworkHD system as units will reset seemingly at random as the PoE switch cuts power to prevent overloading.



Real World Use

The actual power consumption of NetworkHD components may be less than 15.4W. In this case, more devices can be connected to the switch. When more PD are connected, if they consume more energy than usual at any given moment, the overall consumption could exceed the switch's power capacity while each PD may consume less than 15.4W, and thus affect the system operation. To avoid this issue, WyreStorm highly recommends the use of switches with enough capacity for 15.4W of power to every port.

Other Factors

We should consider other factors when using PoE power of Ethernet switches.

1. Non PoE Capable Ports

The number of PD that PoE Ethernet switches can supply power to may be less than the number of ports on the switch. You should disable the PoE function on ports that are not used to provide power so that system stability will not be affected by connecting additional devices after the initial installation. Please see the user guide of the switch for instructions on how this can be achieved.

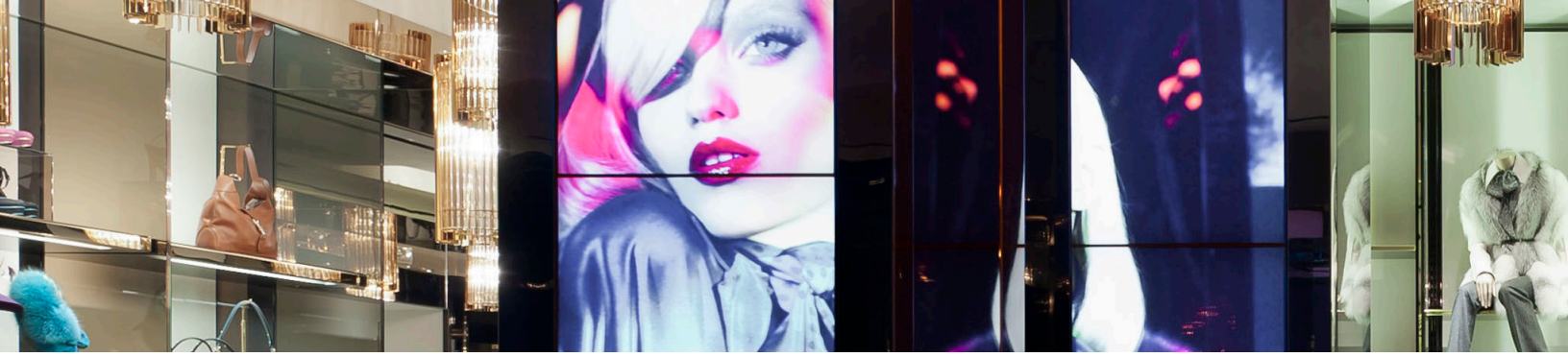
2. Higher PoE Power Consumption

Although when viewing the current PoE power draw in the switches console or log, the total draw may be far lower than 15.4W per device. The actual power consumption fluctuates dramatically every millisecond.

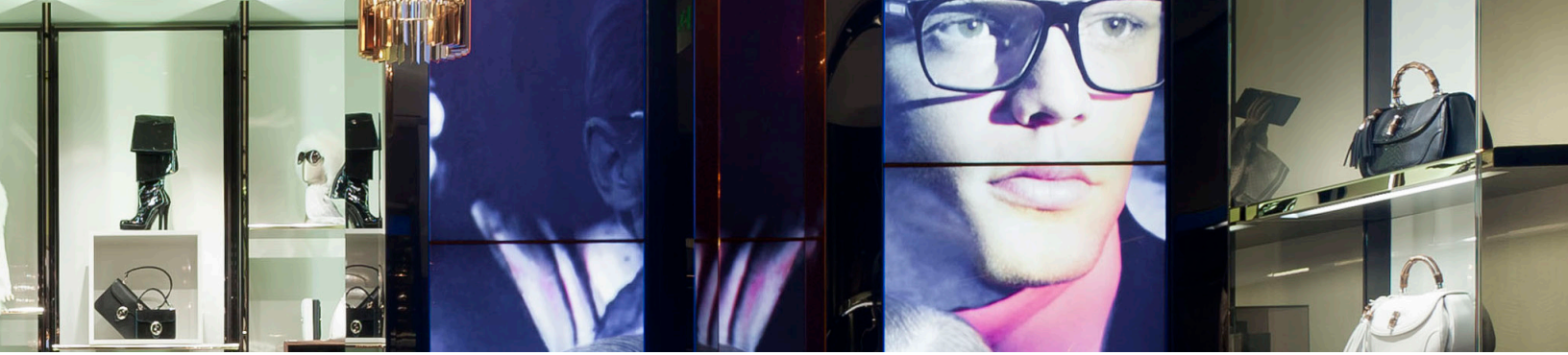
3. Cables

As previously stated: The quality of every NetworkHD installation is only as good as the infrastructure it is installed onto. The quality of cables used is paramount to a successful and problem free installation. WyreStorm highly recommend that cables are fully certified prior to the installation of NetworkHD components.





Notes



Notes



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