

HDb3000 Network Requirements



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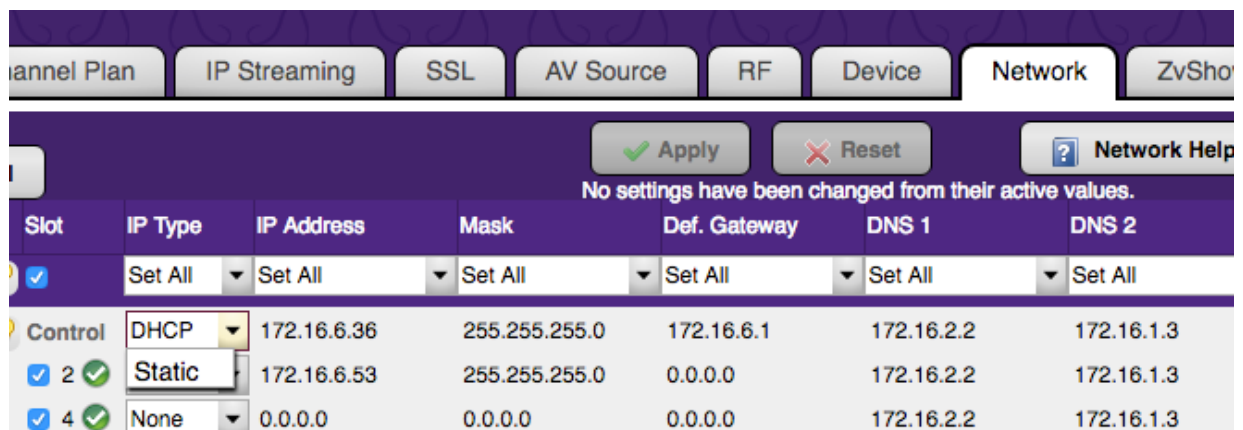
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Basic elements of HDb3000 communication

HDb3000 uses layer 2 / layer 3 IPV4 protocols

IP Address allocation

The HDb3000 will use an available DHCP server to assign an IP address to the Control Module for configuration and management. Alternately a static IP address can be assigned manually from the Maestro **Network** tab. Note that the IP address of the HDb3000 can always be obtained from the front LED panel. When using the HDb3000 for IP Streaming, each i-series Media Module (slot) will require at least one IP address to be assigned, either via DHCP or with a Static IP address. For the 4-port HDMI card (3KHVM4i) two IP addresses are required, one assigned on the Network tab, and one on the IP Streaming tab.



Slot	IP Type	IP Address	Mask	Def. Gateway	DNS 1	DNS 2
Control	DHCP	172.16.6.36	255.255.255.0	172.16.6.1	172.16.2.2	172.16.1.3
2	Static	172.16.6.53	255.255.255.0	0.0.0.0	172.16.2.2	172.16.1.3
4	None	0.0.0.0	0.0.0.0	0.0.0.0	172.16.2.2	172.16.1.3

Video and Audio (multicast)

One focus of the HDb3000 i-series modules is transporting high resolution video and audio data across 1 Gb Ethernet networks. A typical MPEG2 video data stream consumes twenty megabits per second, depending on its resolution format. A typical MPEG4 video data stream consumes six megabits per second. In order to manage this bandwidth, the basis of HDb3000's AV transmission protocol is multicasting. This way, these high data rate streams are only sent through ports across links where they are needed. Some of the most serious considerations for network deployment – especially in multi-switch environments – are around ensuring that the network is setup to handle this properly. Bandwidth management is a key design consideration. Any significant loss of data (due to oversubscription or other reason) will result in visible on-screen problems. Ensuring that high data rate streams are routed *only* where they are needed is critical.

Channel Beacon

The channel beacon allows ZeeVee set top boxes (ZvMXE and ZvMXE+) to automatically detect multicast streams created by the HDb3000. The ZV channel beacon uses the 239.13.1.19 multicast address. In a single layer 2 network this should always work. In a routed layer 3 network, this multicast address needs to be added to the router's forwarding table explicitly. By default, routers will not forward this address. The actual command to do this varies by router.

Switch selection and network topology

HDb3000 is compatible with any 1 Gb Ethernet switch that has Layer 2/3 “non-blocking” switching capabilities. Support for multicast, IGMP v2 with IGMP snooping is required. IGMP v2 fast-leave is recommended.

When IGMP v2 fast-leave is configured, when the device receives a leave message, it immediately stops forwarding to that port.

Most switches' default behavior is to broadcast multicast packets. Watch out for this and make sure to enable multicast and IGMP before trying to use HDb3000.

Regarding “stackable switches”

A stackable switch works with other stackable switches to present themselves as one cohesive “single switch.” The entire system can be easily configured from a single IP address. This type of system is compatible with HDb3000; but note that bandwidth must still be managed. Typically, a system of stackable switches is *not* fully non-blocking, meaning that there will be bottlenecks (often 10 Gb links between switches with 24, 48, or more 1 Gb ports). Bandwidth demands of the HDb3000 system must be compared against the user requirements (how much video must be routed over the stacking ports to meet the user requirements) and all this must be considered in the design of the system's connectivity.

Note: This is only truly a consideration in deployments with hundreds of endpoints. A single non-blocking 1Gb Switch can handle 50 multicast streams and the 10Gb link between switches could handle 500 streams.

Regarding “leaf-spine”

Leaf-spine comes into play when number of endpoints surpasses the size of a

single switch. HDb3000 devices connect to leaf switches and leaf switches connect to spine switches. Leaves mesh into spines meaning that every leaf is connected to every spine. This is compatible with HDb3000 but like for Stackable switches, bandwidth has to be managed where the limiting factor will be the trunk bandwidth between leaves and spines.

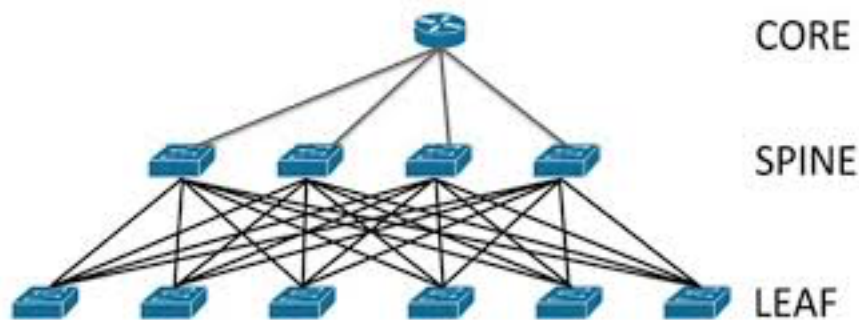


Figure: Illustration of leaf-spine topology

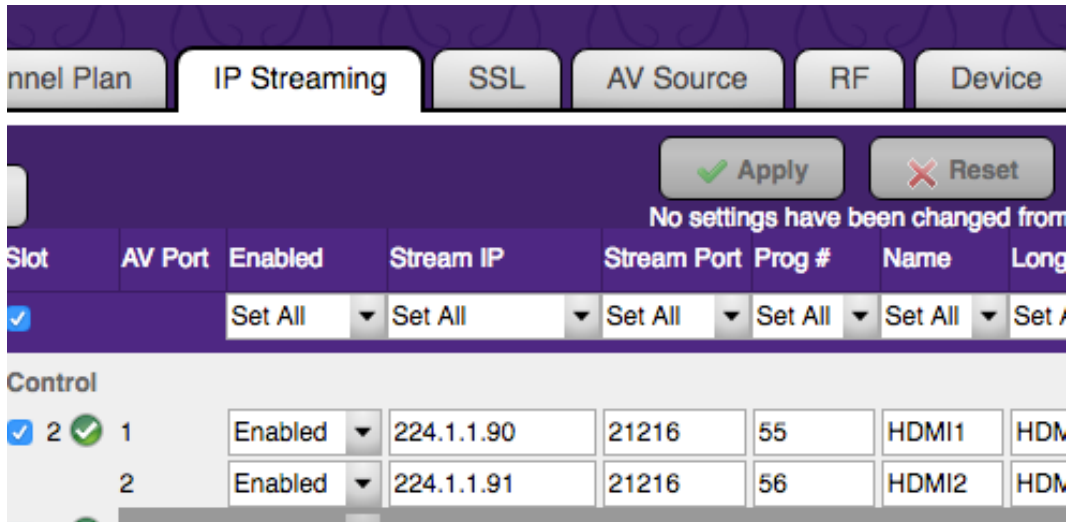
Multicast management

In order to minimize overall bandwidth consumption, HDb3000 relies on multicast routing for distributing audio and video data. The basic idea is to *only* send AV data through switch ports where it is needed.

Important note: the switch must be configured to drop any packets from a multicast stream with no subscribers. Some switches could treat such packets as broadcast and impact the bandwidth and performance of the entire network.

Multicast/Unicast source addresses

Multicast or Unicast addresses for each stream are selected via the Maestro configuration tool. Once in the Maestro tool, navigate to the “IP Streaming” tab. The **Stream IP** field is used to set the Multicast or Unicast address of each stream and the **Stream Port** field is used to set the Multicast port. If using a multicast address then any endpoint subscribing to that multicast stream will receive the stream. If a valid unicast address is entered, only that specifically addressed endpoint will receive the stream.



Deployment Considerations

To receive and display an IP stream, a suitable device must be present on the Ethernet network. Common devices are:

- **IP Set Top Box** – like a Cable Set Top this device registers and receives an IP transport stream, and renders it to a port which is attached to a display. Examples include the ZvMXE and ZvMXE+.



- **Computer or Server** - If secondary processing of the stream is desired, the stream can be sent to a server or servers. In this case UDP unicast addressing is typically used to avoid congestion issues on the Ethernet network



- **PC or Laptop** – With suitable display software, the IP stream can be received and rendered on a computer. The open-source program VLC is commonly used.

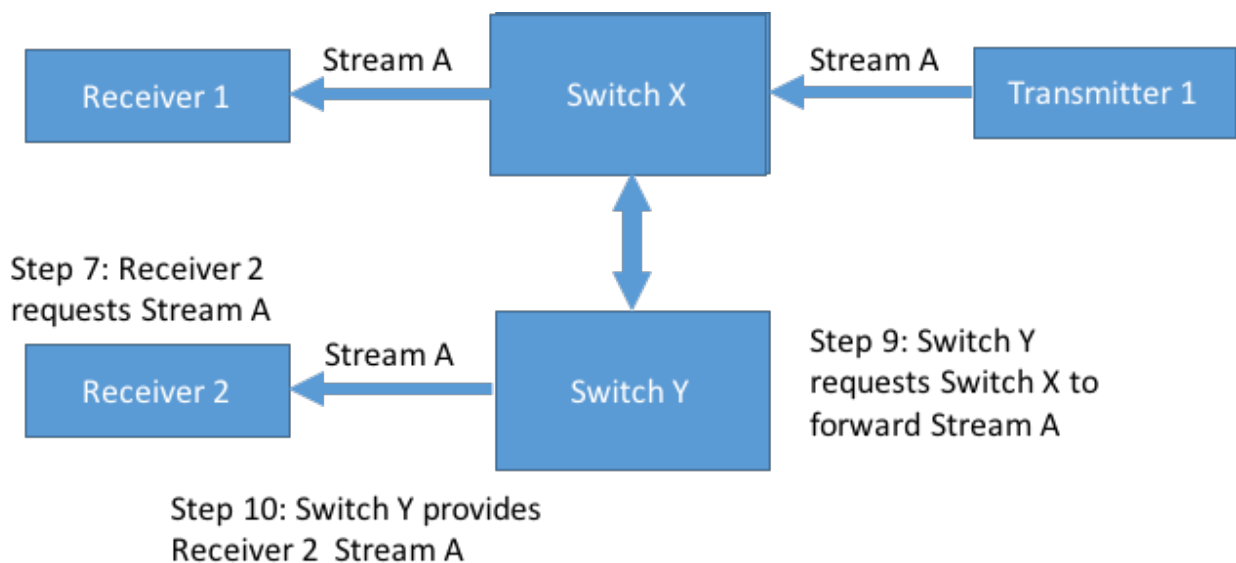


Multicast routing management

In a single switch environment, IGMP suffices to enable the switch to understand which traffic must be routed to which ports. In a HDb3000 system, the switch will only route a transmitted video to those ports where a receiver has requested a particular stream. In a multi-switch environment, higher-level protocols must be employed so that “switch X” can understand which streams are demanded by receivers connected to “switch Y.”

The basic communication flow is:

1. Switch X is connected to switch Y via a 10 Gb trunk link. No video traffic is currently passing between them.
2. Transmitter 1 is connected directly to switch X, and sending stream A into that switch.
3. Switch X needs to notify switch Y that stream A exists. Stream A still does not traverse the trunk link.
4. Receiver 1 is also connected directly to switch X, and makes an IGMP request to switch X for stream A.
5. Switch X begins routing stream A to receiver 1, who displays the video signal. Still there is NO video traffic across the trunk port between switches.
6. Receiver 2 is connected directly to switch Y.
7. Receiver 2 requests stream A by issuing an IGMP request to switch Y (which receiver 1 is connected to directly).
8. Switch Y realizes that it does not have access to stream A, but switch X has notified switch Y about stream A.
9. Switch Y sends a request to switch X to provide stream A across the trunk link.
10. Switch X complies, begins routing stream A across the trunk link to Switch Y, and switch Y begins providing stream A to receiver 2.
11. Later, if receiver 2 releases his IGMP subscription to stream A (and no other receivers on switch Y have requested stream A), then stream A should be removed from the trunk link.



The implementation of these higher-level protocols is vendor specific. One example of such a protocol is Protocol Independent Multicast (PIM), implemented by Extreme Networks and others.

Network performance issues

Bandwidth management

The HDb3000 video system has no tolerance for link oversubscription. Lost packets translate to lost pixels on screen. Video data is transmitted via UDP or HLS, so there is no retransmission (since retransmitted packets would be too late anyway). Any significant loss of data will result in significant image problems on screen.

The easiest solution is to design a fully non-blocking network. This is relatively straightforward for smaller systems, with affordable “top of rack” switches ranging to around 100 non-blocking ports. Beyond that size, blade-based systems of non-blocking switches exist, but can be expensive. A spine and leaf architecture may be more affordable, and also may fit more neatly in the physical layout of the network.

To design a cost-efficient system, the video routing use cases must be carefully considered and weighed against bandwidth availability.

Bandwidth Use Summary

The HDb3000 can transmit AV data from multiple sources simultaneously over the 1 Gb Ethernet port.

Output Stream Format	Maximum Bandwidth
MPEG2 Video + Audio	20 Mbits/sec (1920x1080) per stream
MPEG4 Video + Audio	6 Mbits/sec (1920x1080) per stream
HLS Video + Audio	6 Mbits/sec (1920x1080) per stream

Appendix 1: Recommended Switches

The following 1Gbit switches are recommended for use with the HDb3000. Please note this is not an all-inclusive list. There are many other switches available that will function with the HDb3000.

Manufacturer	Model #	Number of 1Gbit Ports	Notes
Netgear	M4300-28G	24	Includes two 10Gbit RJ45 and two 10Gbit SFP+ Ports
Netgear	M4300-52G	48	Includes two 10Gbit RJ45 and two 10Gbit SFP+ Ports
Netgear	M4300-28G-PoE+	24	Supports PoE
Netgear	M4300-52G-PoE+	48	Supports PoE
Netgear	S3300-28X	24	Includes two 10Gbit RJ45 and two 10Gbit SFP+ Ports
Netgear	S3300-52X	48	Includes two 10Gbit RJ45 and two 10Gbit SFP+ Ports
Netgear	S3300-28X-PoE+	24	Supports PoE
Netgear	S3300-52X-PoE+	48	Supports PoE
Netgear	GS728TP	24	Supports PoE
Arista	7010T-48	52	Includes four 10Gbit SFP+ ports

Appendix 2: Switch Configuration Options

Some Switches will work directly out of the box with zero configuration required. Nearly all switches however will provide the user some ability to customize the configuration. The list below includes various switch configuration options that ZeeVee has encountered. Look for these or similar options when configuring your switch.

1. Enable IGMP Snooping
 - a. Must be enabled
2. Enable IGMP Snooping on VLAN used by HDb3000
 - a. Must be enabled when all ports default to VLAN1
3. Filter/Drop unregistered Multicast traffic
 - a. If not applied, the behavior of the switch will be to broadcast multicast packets if the switch has no known destination for that packet.
 - b. Must be enabled if found
4. Unregistered Multicast Flooding
 - a. Must be disabled if found
5. Filter Unregistered Multicast (different wording than number 4 above)
 - a. Must be enabled if found
6. Disable IGMP Query
7. Disable IGMP Query on VLAN used by HDb3000
8. Set IGMP Version to IGMP V2
 - a. Must be set if found
9. Enable FASTLEAVE on port X
 - a. Should be enabled, if found
10. Enable FASTLEAVE for VLAN used by HDb3000
 - a. Should be enabled if found
11. Disable Multicast Storm Control on **Netgear ProSafe XS708T**. (*Security-Traffic Control-Storm Control-Status=Disable*)

Appendix 3: Maximum Transmission Distance

The table below details the maximum transmission distance between the HDb3000 and a Network Switch.

Cable / Transmission Type	Maximum Distance
Category 5	Not supported
Category 5e	55m (180 ft)
Category 6 UTP	55m (180 ft)
Category 6 STP	100m (330 ft)
Category 6A UTP	100m (330 ft)
Category 7	100m (330 ft)

UTP = Unshielded Twisted Pair

STP = Shielded Twisted Pair