ATLONA
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OmniStream™

IT Deployment Guide

AT-OMNI-111/WP AT-OMNI-121 AT-OMNI-512
AT-OMNI-112 AT-OMNI-122 AT-OMNI-521

Atlona Manuals
OmniStream

Version Information

Version	Release Date	Notes
4	Aug 2024	Documentation updates based on supported products.

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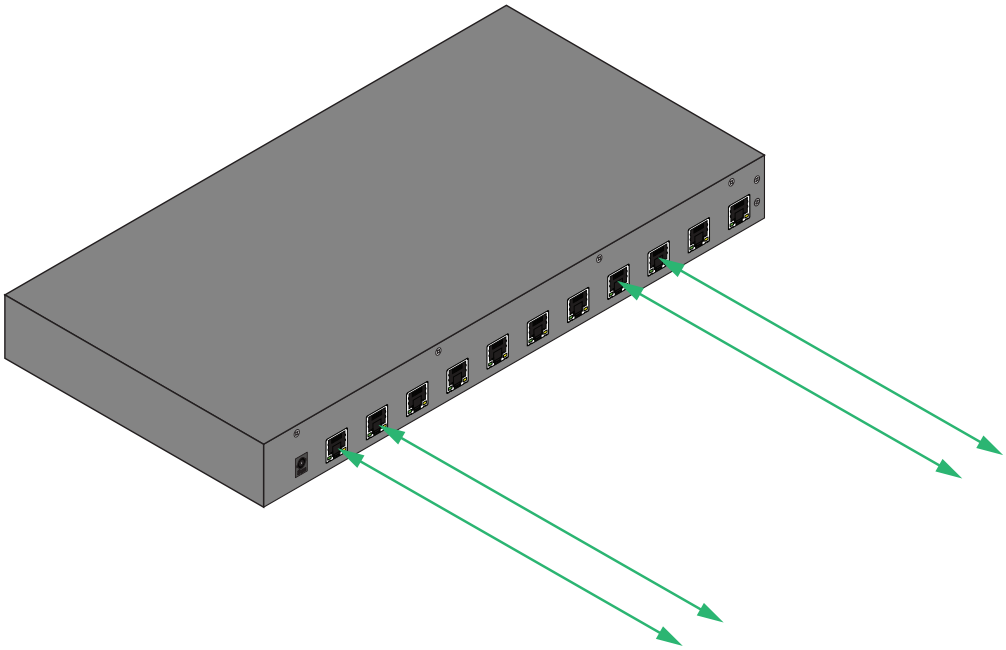
Network Topologies

A network topology is how the various components of a network are arranged. For our purposes, this refers to the various devices that OmniStream is connected to and how those devices are connected to each other.

Although there are a variety of different network topologies, OmniStream will nearly always be connected to one of three groups: single logical switch, star, or fat tree. Each of these topologies has its own distinct advantages and disadvantages, which we'll briefly discuss here.

Single Logical Switch

By far, the simplest network topology we will come across is that of a single switch. In this type of system, each OmniStream device is connected to a single logical switch that is not connected to any other switches/routers. Note that this type of topology could refer to a single physical switch, or multiple physical switches that are stacked and act as one logical switch.



Advantages

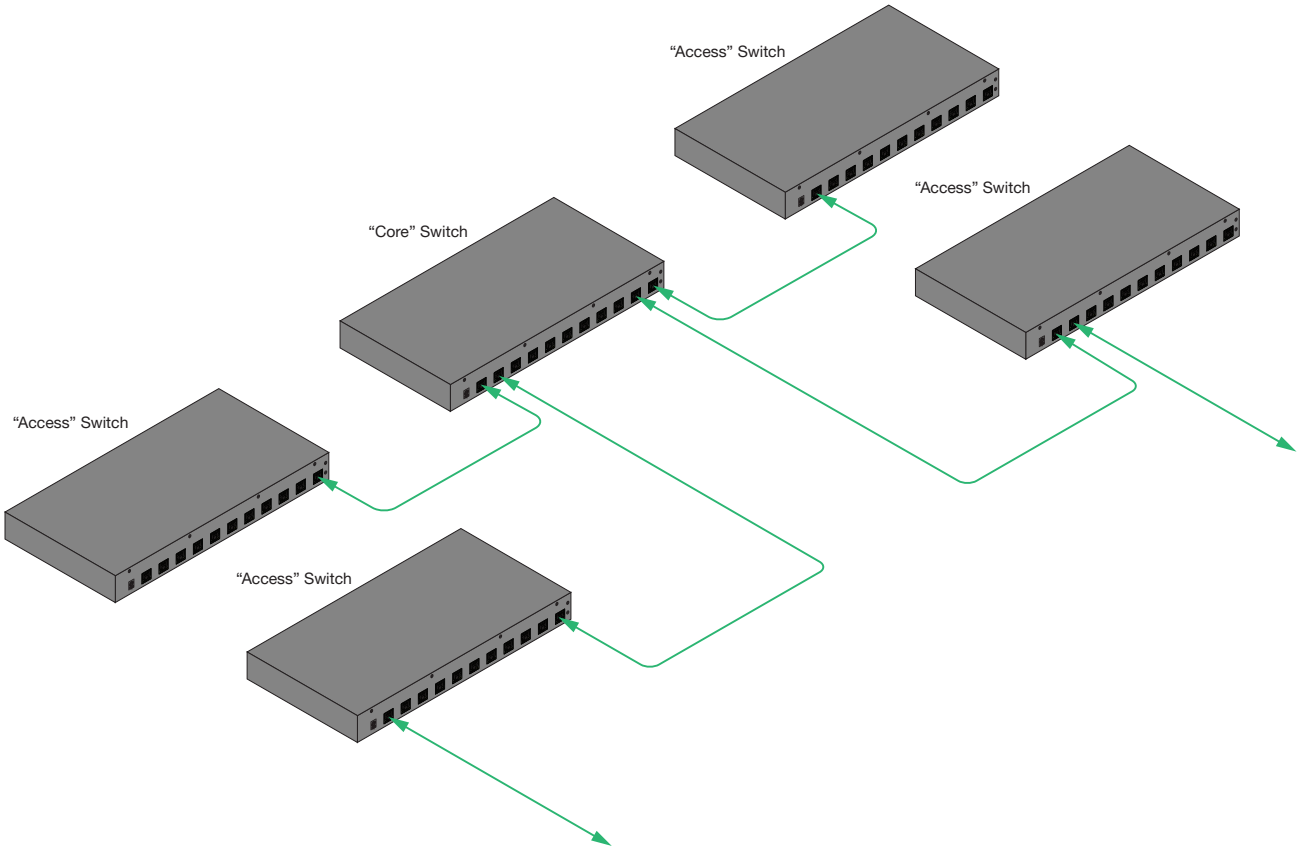
- Simple.
- Easy to manage.
- Limited network impact of video traffic.
- Inexpensive.
- Atlona provided configuration files available for a variety of switch models.

Disadvantages

- Limited scalability options.
- No network redundancy; single point of failure.

Star

For systems needing more scalability than that offered by a single logical switch, multiple logical switches can be each connected to a single switch for intercommunication. In this topology, the central switch is referred to as a “core” switch, with the other switches being referred to as “access” switches. This type of system will typically see OmniStream connected to the access switches.



Advantages

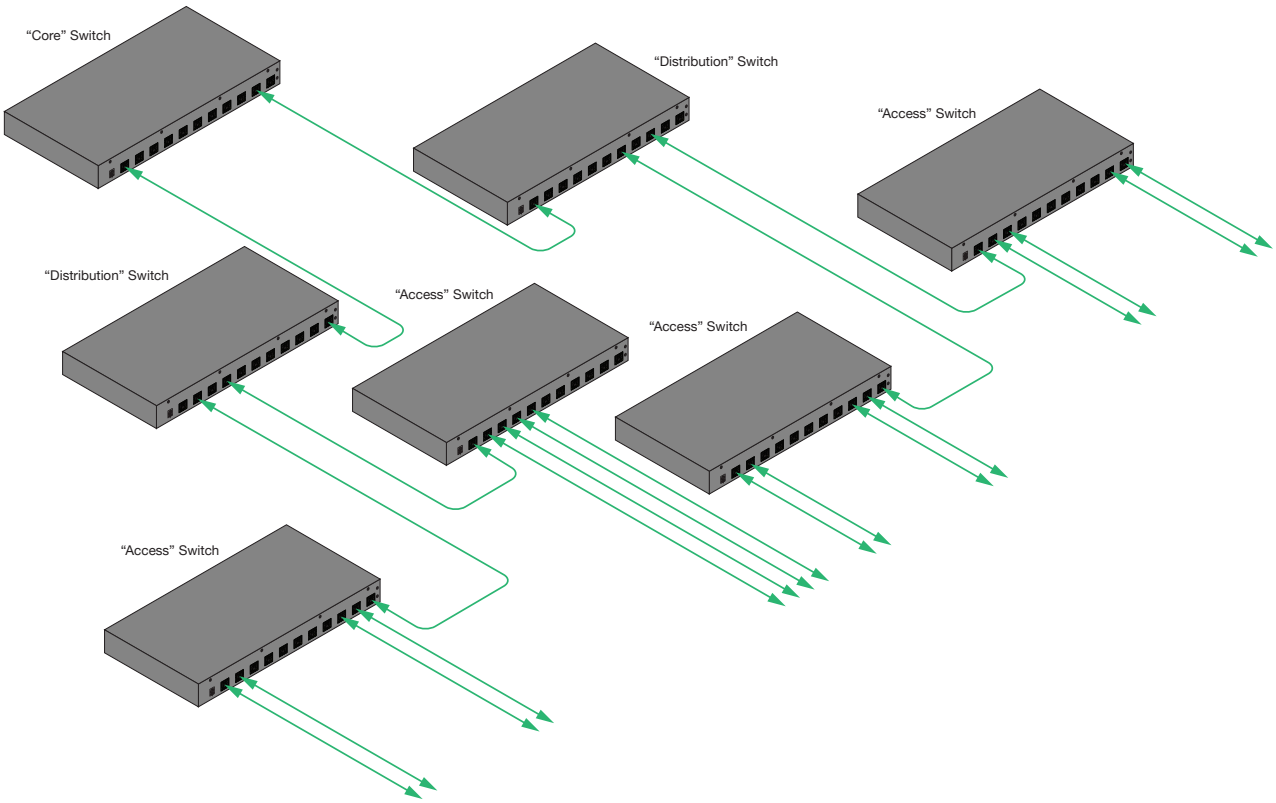
- Much more scalable than a single logical switch.
- Multiple access switches can create a level of redundancy.

Disadvantages

- Physical network layout can make cabling very expensive, as all access switches must be directly connected to the core.
- Single core switch creates a single point of failure.

Fat Tree

Very large network systems often fall into the category of a fat tree topology. Here, access switches are connected to a distribution switch in a manner like a star network. Multiple distribution switches are in turn connected to a core switch. There can be multiple layers of distribution switches, and multiple core switches can be interconnected. Links further up the tree (closer to core switches) are “fatter”, or higher bandwidth, than links further down the tree (closer to access switches).



Advantages

- Ultimate scalability.
- Potential for highly redundant networks.

Disadvantages

- Highly complex to manage.
- Very expensive.

Layer Terminology

Users often refer to switches as a “layer 2 switch” or a “layer 3 switch”, often insisting that a “layer 3 switch” is necessary for a multicast network to function properly. This statement isn’t always true, but to understand why, the terms “layer 2 switch” and “layer 3 switch” must be first understood.

These terms come from the OSI (Open Systems Interconnection) model, which defines how networks communicate by partitioning the system into layers. In this model, layer 2 refers to the data link layer and layer 3 refers to the network layer.

As such, a “layer 2 switch” is one that performs switching on the data link layer using MAC addresses. A “layer 3 switch” is one that performs switching on the network link layer using IP addresses.

Another easy way to understand it to relate the layer terminology to a more common vernacular:

- Layer 2 switch = switch.
- Layer 3 switch = switch/router.

Per Stream Bandwidth Utilization

To effectively plan a network, it is necessary to understand how bandwidth on that network will be utilized. By first understanding how much bandwidth each stream on each switch will utilize, it becomes easy to see how bandwidth across the system will be utilized.

Scrambling

OmniStream AV over IP products support AES-128 encryption (“scrambling”) of individual sessions containing video, audio, and/or data streams, enabling protection of content across the IP link.

The bandwidth penalty for using scrambling is negligible and does not noticeably increase the overall bandwidth utilization of the system.

Redundancy (AT-OMNI-1xx Only)

OmniStream AT-OMNI-1xx products support redundancy of video and audio streams, allowing for decoders to automatically detect stream failures and switch to backups.

For encoder bandwidth utilization per port, add the calculated bandwidth utilization for each session configured for the port in question together.

For decoder bandwidth utilization per port, the calculation must be done differently depending on the redundancy mode used.

- Join when active – In this mode, only the active stream is subscribed, so total bandwidth utilization is the sum of either primary or backup, using whichever stream’s utilization is higher so that worst case is calculated. Take care to ensure that if it is possible for both HDMI’s input streams can flow on the same port, that this is included in the calculation. For example:
  - IP input 1 – 450 Mbps, ETH1, primary video for HDMI 1
  - IP input 2 – 450 Mbps, ETH1, primary video for HDMI 2
  - IP input 3 – 450 Mbps, ETH2, backup video for HDMI 1
  - IP input 4 – 450 Mbps, ETH2, backup video for HDMI 2
  - In this case, it should be figured that bandwidth per port is calculated as 900 Mbps, but the unit (both ports) will not exceed 900 Mbps.
- Join always – As both primary and backup streams are always subscribed, the total bandwidth utilization is the sum of all streams configured for the port in question.

Video

Video bandwidth utilization has the most significant impact on the network.

For OmniStream AT-OMNI-1xx units, including the OmniStream Wallplate, the total bandwidth utilization for a video stream is the value configured for Bit Rate, on the Encoding tab, of the encoder generating the stream.

For OmniStream AT-OMNI-5xx, the total bandwidth utilization for a video stream is 900 Mbps.

FEC (OmniStream AT-OMNI-1xx Only)

Forward Error Correction (FEC) has a bandwidth penalty associated with its use. Atlona's implementation of FEC is per SMPTE 2022-5:2013 and does not require any extra network consideration beyond the bandwidth penalty described here.

For video streams, OmniStream adjusts the bitrate used for video encoding automatically so that video bitrate + FEC = configured bit rate.

State	Configured bitrate	Used for video	Used for FEC
FEC disabled	900 Mbps	900 Mbps	0 Mbps
FEC enabled, 4x4	900 Mbps	600 Mbps	300 Mbps
FEC enabled, 10x10	900 Mbps	750 Mbps	150 Mbps
FEC enabled, 20x20	900 Mbps	818 Mbps	82 Mbps
FEC enabled, 4x4	450 Mbps	300 Mbps	150 Mbps
FEC enabled, 10x10	450 Mbps	375 Mbps	75 Mbps
FEC enabled, 20x20	450 Mbps	409 Mbps	41 Mbps

Audio

OmniStream audio bandwidth utilization, in Mbps, can be calculated using the following formula:

$$Bitrate\ (Mbps) = \frac{8 \times (Sampling\ rate\ in\ Hz) \times (Number\ of\ channels) \times (4\ bytes\ per\ sample)}{1000000}$$

For two channel PCM formats, see the quick reference chart, below.

Sampling rate (Hz)	Channels	Bitrate (Mbps)
32000	2	2.05
44100	2	2.82
48000	2	3.07
88200	2	5.64
96000	2	6.14
176400	2	11.29
192000	2	12.29

For compressed formats, such as Dolby® Digital or DTS®, 3.07 Mbps should be used as a worst-case calculation.

FEC (OmniStream AT-OMNI-1xx Only)

Atlona's implementation of FEC follows SMPTE 2022-5:2013 and does not require any extra network consideration beyond the bandwidth penalty described here.

Unlike video, audio FEC bandwidth utilization must be calculated if needed. Typically, as the bandwidth utilization of audio is quite small compared to video, this is not necessary.

To calculate audio FEC bandwidth utilization, use the following formula.

$$Bandwidth\ utilization = Audio\ bitrate \times \frac{Rows + Columns}{Rows \times Columns}$$

Data

As data traffic is comparatively low bandwidth (typically < 100 kbps), it doesn't significantly impact the overall system bandwidth utilization calculations.

Trunk Bandwidth Utilization

In star or fat tree topologies, multiple switches are interconnected with trunk links. Trunk links are interconnections between switches which enable higher bandwidth connections between switches. To understand how link bandwidth will be used, you must first understand how the traffic will flow.

It is recommended that trunk link bandwidth utilization not exceed 80% of trunk link capacity.

Unicast vs Multicast Routing

For unicast streams, the network will automatically find a path for traffic to flow from source to destination. *Figure 1* shows an encoder and decoder on the same switch in unicast mode. *Figure 2*, on the following page, shows an encoder and decoder on separate switches in unicast mode.

Figure 1 - Unicast mode: encoder and decoder using same switch.

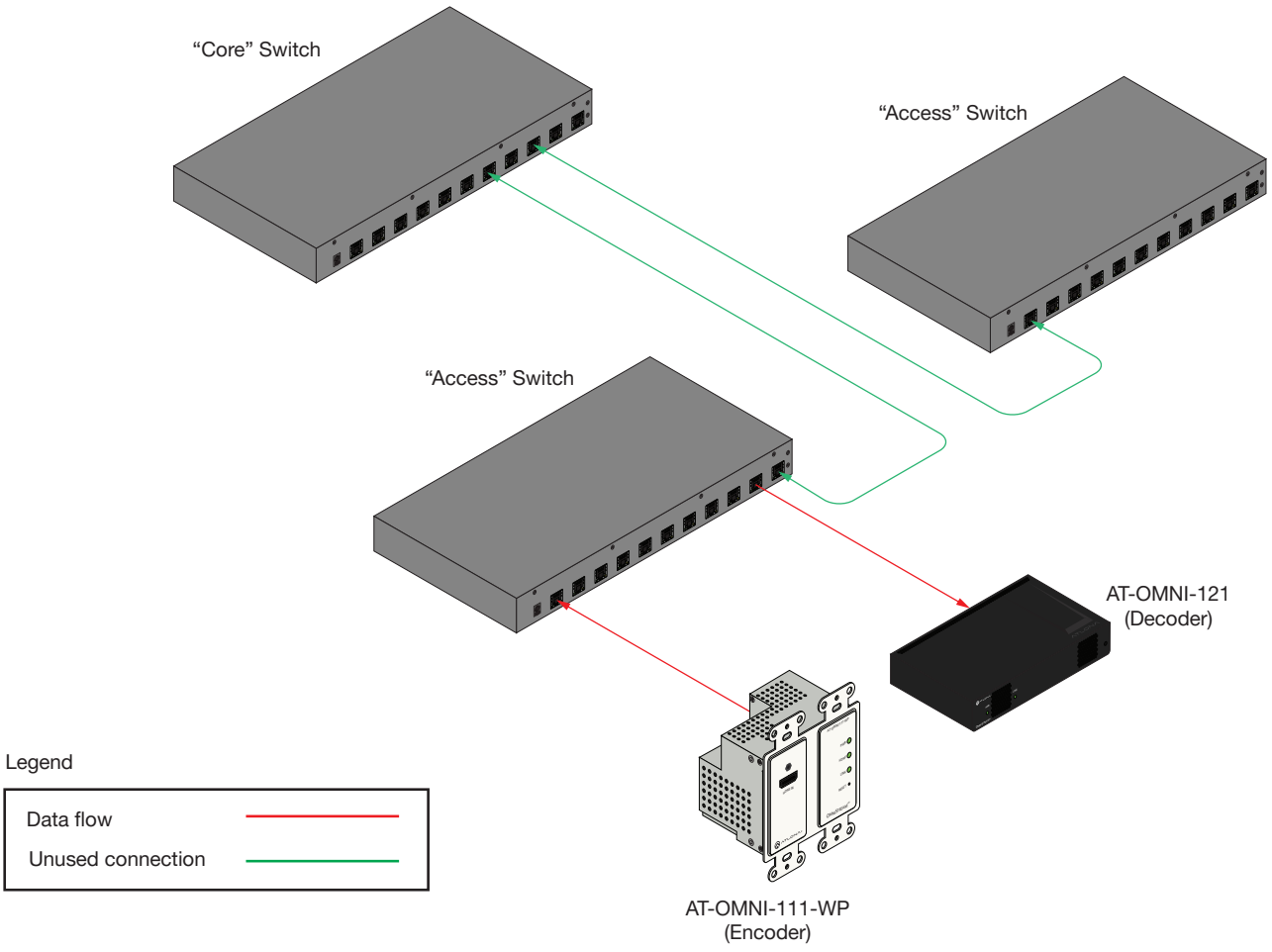
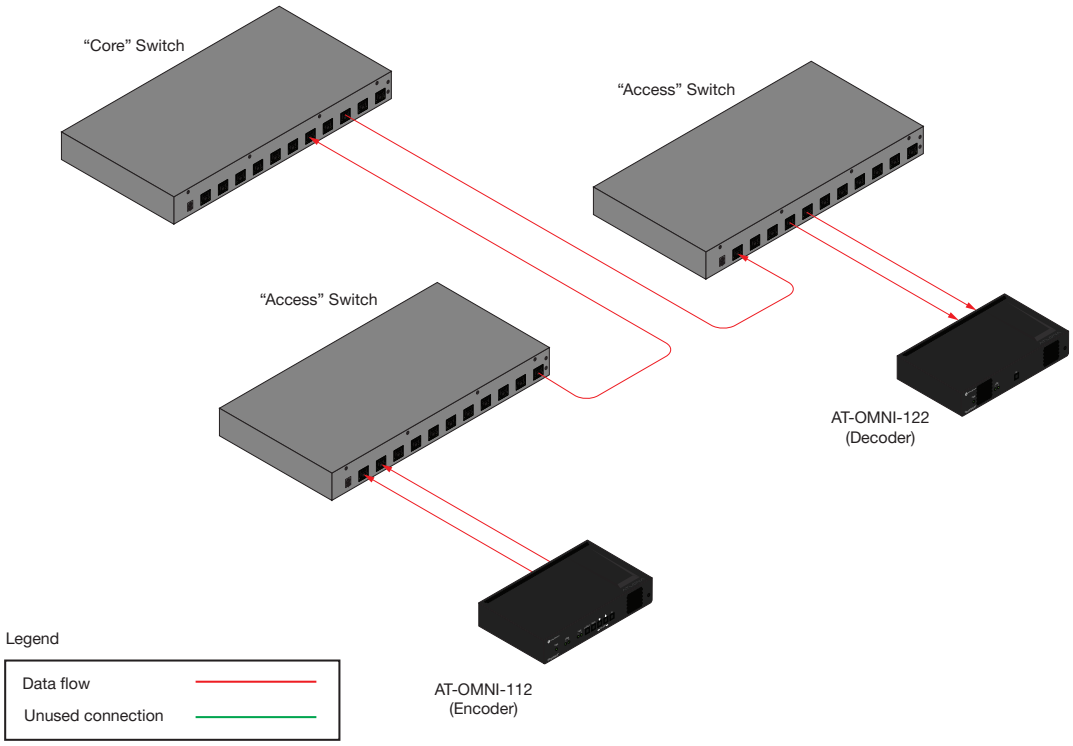


Figure 2 - Unicast mode: encoder and decoder using different switches.



For multicast streams, the network will do two things:

- Find a path for traffic to flow.
- Propagate all multicast sources to the master IGMP querier/multicast router.
  - » For networks with multiple IGMP queriers, the IGMP querier with the lowest IP address is automatically selected as the master IGMP querier. The master IGMP querier can optionally be statically defined, but this requires extra configuration on all switches.

Figure 3 - Multicast mode: encoder and decoder using the same switch.

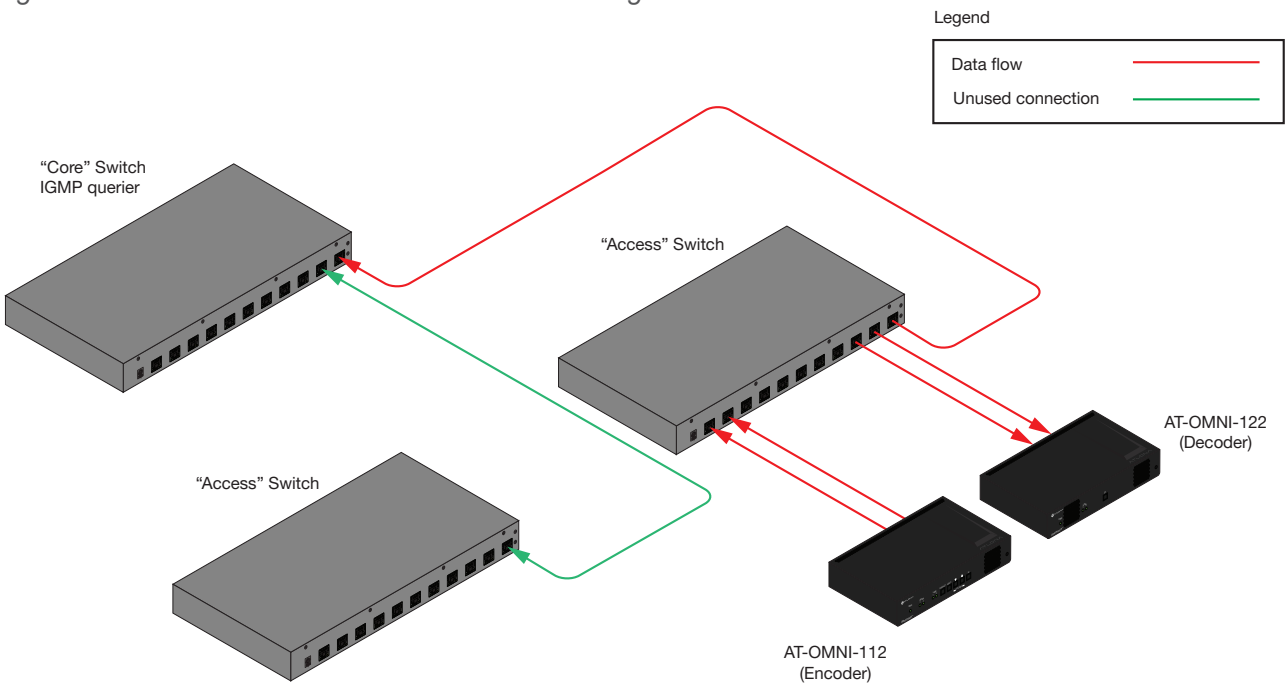
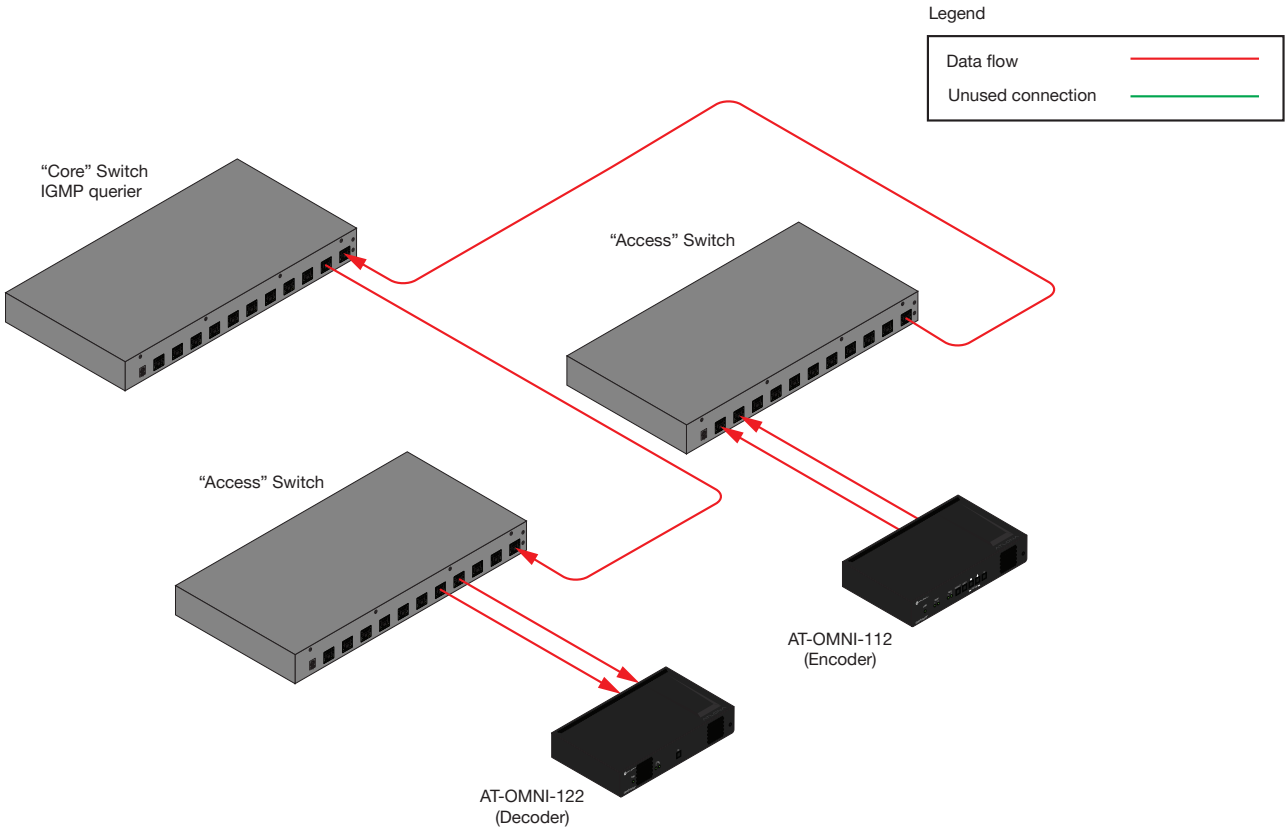


Figure 4 - Multicast mode: encoder and decoder using different switches.



Trunk Port Definition

Trunk ports on a switch are simply those ports used to connect to other switches. Note that multiple physical ports can be bonded to create a higher bandwidth trunk link. Trunk links are always full duplex, which means that a 20 Gbps trunk link is capable of 20 Gbps uplink and 20 Gbps downlink simultaneously.

Trunk Uplink

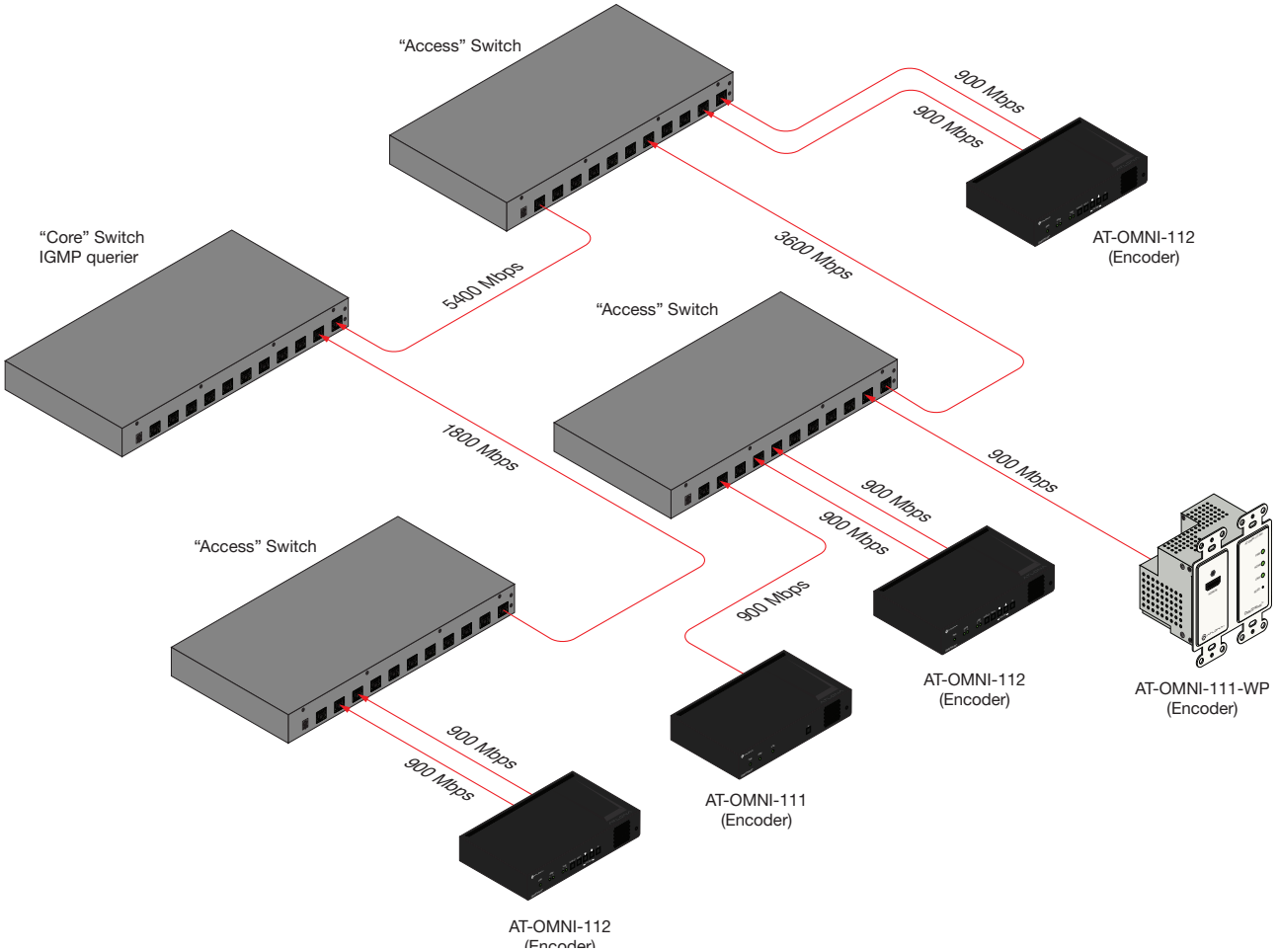
The trunk uplink bandwidth utilization is the sum of all traffic flowing from the switch in question to the other switch connected to the link.

When computing trunk uplink bandwidth utilization, remember that any multicast sources (encoders) connected to the switch in question must send their payloads to the master IGMP querier/multicast router. If another switch is the master IGMP querier/multicast router, then the multicast traffic must flow to that switch.

Refer to the next page for an example diagram showing uplink calculation.

Trunk Bandwidth Utilization

Figure 5 - Diagram showing uplink calculation (multicast mode).



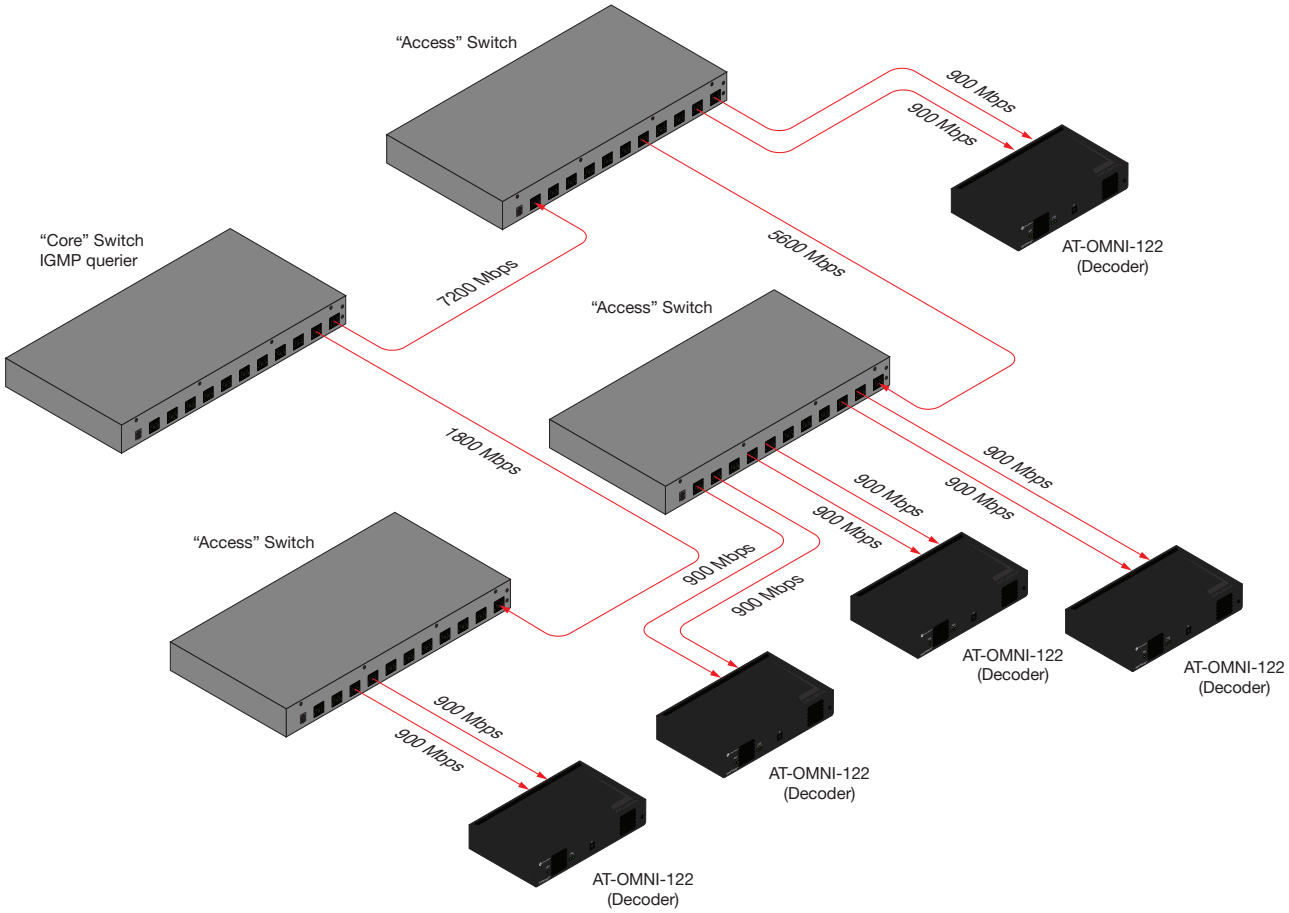
Trunk Downlink

The trunk downlink bandwidth utilization is the sum of all traffic flowing to the switch in question to the other switch connected to the link.

When computing trunk downlink bandwidth utilization, it is best practice to assume worst-case by accounting for the maximum amount of multicast traffic possible, coming from another switch.

NOTE: The following diagram does not show encoders. It is assumed that all encoders are connected to a separate switch that is connected to the "core"/IGMP querier switch.

Figure 5 - Diagram showing downink calculation (multicast mode).



IGMP / Multicast Routing Requirements

For networks using unicast only (point to single point), there is no special configuration needed for IGMP/multicast routing.

For networks using multicast or a combination of unicast and multicast, IGMP/multicast routing must be properly configured to avoid traffic flooding ports and causing unnecessary outages.

Note that based on unit configuration, multiple unicasts/multicasts can be generated from single HDMI sources.

Multicast Address Assignment

It is recommended that each stream be assigned a unique multicast address and port address.

IGMP Snooping

Each switch carrying multicast traffic must have IGMP snooping enabled.

IGMP Querier

For networks that do not require routing multicasts from one VLAN to another, only an IGMP querier is needed. Important parameters are detailed here.

- Query interval – 30s
- Query response interval – 10s
- Last member query interval – 100ms
- IGMP querier version – v2
- Immediate leave enabled
  - » Lack of immediate leave will often cause issues with stream switching.

Multicast Routing

For networks that need multicasts routed from one VLAN to another, a multicast router is necessary. We will only discuss Protocol-Independent Multicast (PIM), as that is the most common method of routing multicasts between VLANs. There are three basic types of PIM, with PIM sparse mode being the recommended mode for multicasting high bitrate video.

- PIM sparse mode (PIM-SM) (**recommended mode**) – multicasts are only propagated across VLAN boundaries when a device request necessitates it. A rendezvous point (RP) is used in a similar manner to an IGMP querier.
- PIM dense mode (PIM-DM) – multicasts are flooded to all parts of the network and then pruned back based on which devices request to continue receiving them. With high bitrate video multicasts, this can quickly cause flooding issues.
- Bidirectional PIM (bidir-PIM) – similar to PIM-SM for downstream traffic, but with enhancements for upstream traffic. Requires that all multicast routers in the domain have bidir-PIM enabled. Also not compatible with some network redundancy schemes, as traffic can never utilize multiple paths simultaneously.

Handling of Unregistered Multicasts

Some switches (e.g., Cisco SG300) allow the user to choose whether to filter or flood unregistered multicasts. If this option is available, it should always be set to filter unregistered multicasts on all ports to avoid flooding when new video streams are added.

Multicast DNS (mDNS)

The Atlona Management System (AMS) uses mDNS for automatic device discovery. By default, mDNS discovery does not function beyond VLAN/subnet boundaries.

Switchport Configuration

On switches that support it, any ports connected to OmniStream devices should have the below options configured to enable the port to establish a link quickly upon device connection.

- Ports defined as access ports.
- Spanning tree portfast should be enabled.

Jumbo Frames

Jumbo frame support is not necessary for OmniStream.

QoS

Quality of service (QoS) is not necessary or recommended for networks running OmniStream. If it must be used, it is recommended that OmniStream's DSCP value be configured to "Highest" and the network be configured so that OmniStream packets have the lowest probability of being dropped.

NOTE: A DSCP value of "Highest" on OmniStream correlates to 101 000, or 40 (CS5).

PoE

OmniStream devices using Power over Ethernet (PoE) should plan 15.4 W consumption per device connected to PoE.

If analog audio is going to be used on OmniStream Pro AT-OMNI-12x devices, an external 48V power supply must be used.

Dual channel OmniStream devices (AT-OMNI-112, AT-OMNI-122, and AT-OMNI-512) support load balancing/sharing between the two PoE ports, but do not consume more than a total of 15.4 W per device.

IMPORTANT: Some switches (e.g., Cisco Catalyst switches) will allocate 15.4 W to each PoE capable port connected, regardless of whether that much power is consumed or not. For these switches, it is important to plan 15.4 W consumption per port connected, even if both ports are on the same OmniStream device. Other switches (e.g., Cisco SG300) do not try to intelligently allocate power and thus do not require this.

Velocity™ Device Manager

The Atlona Velocity Device Manager is used for centralized management of OmniStream devices.

All UDP ports between Velocity Device Manager and OmniStream must be open and available, as Velocity Device Manager uses WebSockets to communicate with OmniStream.

System requirements for Velocity Device Manager including operating system and minimum hardware can be found in the Velocity Device Manager user manual.