
CRESTRON®
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infocomm

Preparing for the Network Generation an A/V guide

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Course Objectives

Converging on the Network

Why are we here

The IT Language

Network terminology

Components

Crestron on the Network

Technologies

Requirements

The Network

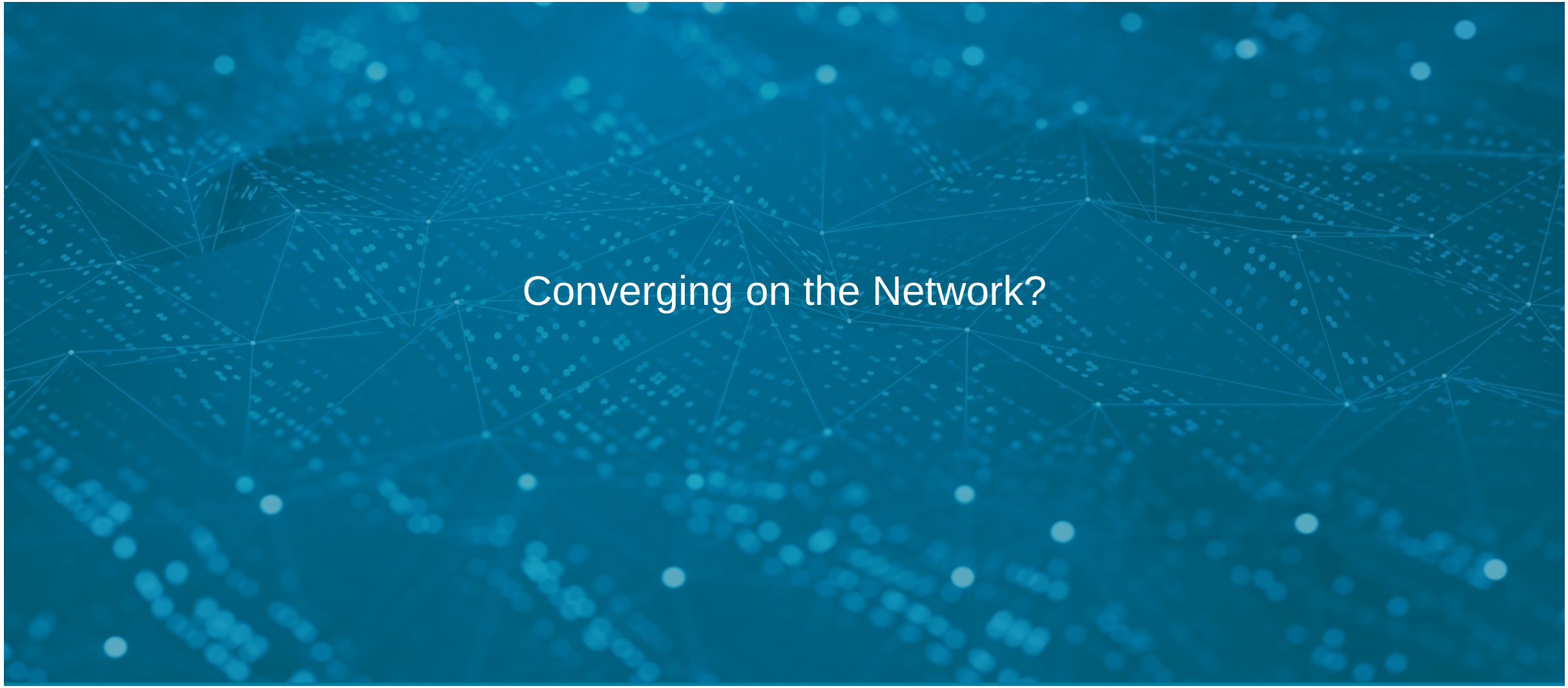
The physical network

The logical network

Network Design

Examples

What's Next?!


Converging on the Network?

Converging on the Network?

Why not the network?

Flexibility

Opportunity

New applications (functions)

Resolves challenges

Converging on the Network?

Converging on the Network?

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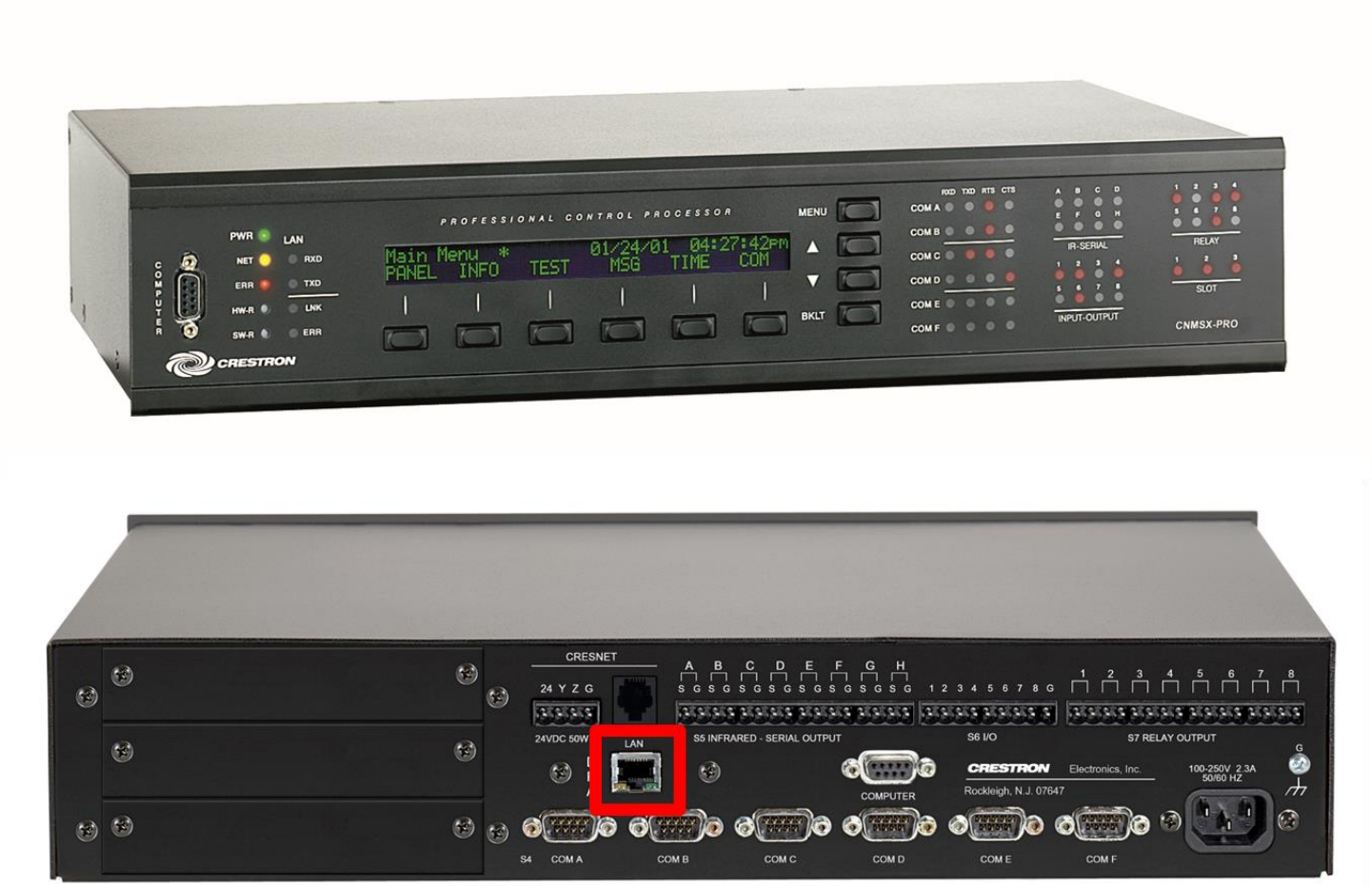
Converging on the Network?

20 Years ago what happened, what did Crestron do?

Converging on the Network?




The IT Language

Network Terminology

802.1x

IEEE 802.1x allows for the authentication of hosts on a network. It is a port-based network access control (PNAC) protocol that authenticates devices connected to an Ethernet network by utilizing the Extensible Authentication Protocol (EAP). 802.1x-based authentication requires an 802.1x-compliant host device, 802.1x-enabled networking hardware, and the presence of an authentication server (i.e. RADIUS) on the network. Host devices that fail to authenticate with the server are denied access to the protected portion of the network.

Active Directory® (AD)

Active Directory® authentication is a set of services developed by Microsoft for managing and administering Windows© domain networks. Active Directory® at its core, is responsible for authenticating users and devices and authorizing their access to the domain. Once a user/device supplies login credentials, the credentials are verified against those stored within the domain's Active Directory® server (or 'domain controller'). In addition to user credentials, a domain controller also stores each user's configured access or privilege level within the domain. This allows domain administrators to dictate what devices and/or services each user within a domain is allowed to access.

Network Terminology

Blocking

The description of a network switch (or network segments) that does not possess sufficient overall backplane and/or uplink bandwidth to allow all ports/devices to communicate at full speed.

Broadcast domain

A broadcast domain is a logical division of a computer network in which all nodes can reach each other by a broadcast at the data link layer. Any computer connected to the same Ethernet repeater or switch is a member of the same broadcast domain. Computers connected to the same set of inter-connected switches/repeaters is a member of the same broadcast domain. Routers and other higher-layer devices form boundaries between broadcast domains. In practice, each unique VLAN on a network will have its own, individual broadcast domain.

Extensible Authentication Protocol (EAP)

EAP is a framework for the authentication of point-to-point network connections using EAP methods, such as EAP-TLS (certificate-based) and EAP-MSCHAPv2 (username/password-based). EAP defines the syntax of EAP messages – which other protocols convert (or “encapsulate”) into their own format – and it also defines the EAP methods these other protocols (i.e. IEEE 802.1X) use to authenticate connections.

Network Terminology

Host

A network host is a device with a network address that is connected to a computer network. Hosts that provide services (e.g. printing, file sharing, streaming, etc.) to other network hosts are called servers. Hosts that access and use these services are called clients.

Internet Group Management Protocol (IGMP)

IGMP is a subscription-based Internet layer protocol that manages multicast traffic within a broadcast domain (e.g. a VLAN). In the absence of IGMP, network switches treat multicast traffic like broadcast traffic, flooding the traffic to all ports. With IGMP enabled, traffic associated with a multicast stream only flows to hosts that want the stream. A host expresses its interest in available streams by sending IGMP messages to subscribe to them (i.e. join) or unsubscribe from them (i.e. leave). Network switches that support IGMP can perform IGMP snooping, which allows them to look at these IGMP messages and to determine what multicast streams hosts are interested in receiving. Once a host has successfully joined – or subscribed – to a stream, the switch forwards the traffic to the subscribed host.

Network Terminology

Link Aggregate Group (LAG)

Link aggregation is the use of standard or vendor-specific approaches to combine or aggregate the throughput of multiple, physical connections into a single, logical connection channel. Depending on the selected aggregation scheme and how a LAG is configured (i.e. statically or dynamically), link aggregation can also provide additional redundancy to inter-switch connections. A dynamically configured LAG can automatically “fail over,” allowing the LAG to provide uninterrupted uptime in instances where one physical connection in the otherwise functional LAG is compromised.

Media Access Control (MAC) address

A MAC address is a 48-bit, globally unique number that identifies a network interface controller (NIC) for Layer 2 communication in an Ethernet-based network segment. MAC addresses are also known as physical, hardware, and burned-in addresses and they are commonly expressed using hexadecimal notation.

Multicast

Multicast is a one-to-many, UDP-based form of network data transmission. With a properly specified and configured network, multicast-based distribution is more efficient and scalable, compared to unicast communication. Multicast transmissions do not target the IP addresses of the receiving hosts themselves, but are instead sent to IP addresses within a special range of addresses set aside by the International Assigned Numbers Authority (IANA) for multicast communication.

Network Terminology

Open System Interconnection (OSI) model

The OSI model is a conceptual framework that standardizes how devices communicate and share data with one another over a computer network. It is divided into seven unique layers and serves as a basis for comparing different, real-world protocols – and their individual layers and components – against one another.

Protocol Independent Multicast (PIM)

Protocol Independent Multicast is a family of multicast routing protocols (PIM-Dense Mode, PIM-Sparse-Mode, etc.) that allows multicast traffic to be routed and exchanged between different networks (e.g. LANs) or subnetworks (e.g. VLANs).

Remote Authentication Dial-In User Service (RADIUS)

RADIUS is a client/server-based network protocol that provides authentication, authorization, and accounting (AAA) services for network devices in a secure way. RADIUS is commonly used as the “back-end” authentication method for 802.1X authentication. RADIUS authentication relies on the presence of a configured RADIUS server (e.g. a Windows server) running the RADIUS protocol as a service. A network’s RADIUS server may also be configured to act as a server for other network services (e.g. DNS) or to perform Windows domain management functions (e.g. Active Directory).

Network Terminology

Subnetwork

A subnetwork, subnet, or IP subnet, is a logical subdivision of a network with its own corresponding broadcast domain. Subnets create smaller, isolated broadcast domains, as opposed to a single broadcast domain for an entire network. Subnets are typically structured to include hosts that are organizationally or functionally related to one another.

Unicast

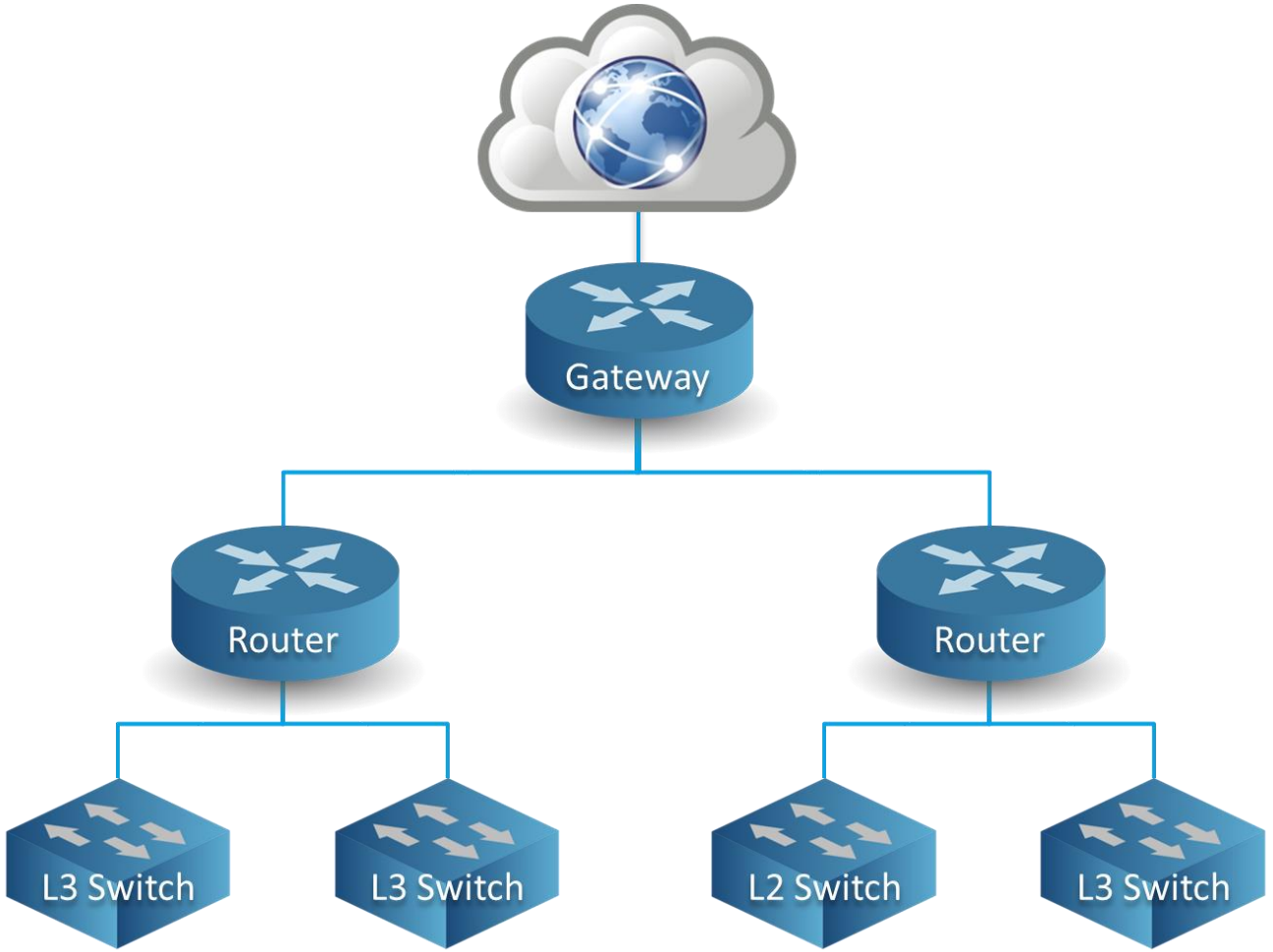
Unicast is a one-to-one, TCP-based form of communication on a network. A unicast host wishing to communicate identical information to more than one device must generate a unique connection and data stream for each interested recipient. Unicast transmissions are directed towards the IP addresses of their respective receipts.

Virtual Local Area Network (VLAN)

An 802.1Q VLAN is a non-physically sequestered broadcast domain (or network partition) that is isolated at the data link layer. VLANs allow network administrators to create different logical subnetworks within a single physical network. This insulates or sequesters switch ports and their network traffic – across one or more switches – from all other ports and traffic on the network.


IT Components

IT Components



Hardware Items

Switches

Routers

Specification


Switches and Routers

The IT Language - Components

A/V Matrix

IT Matrix

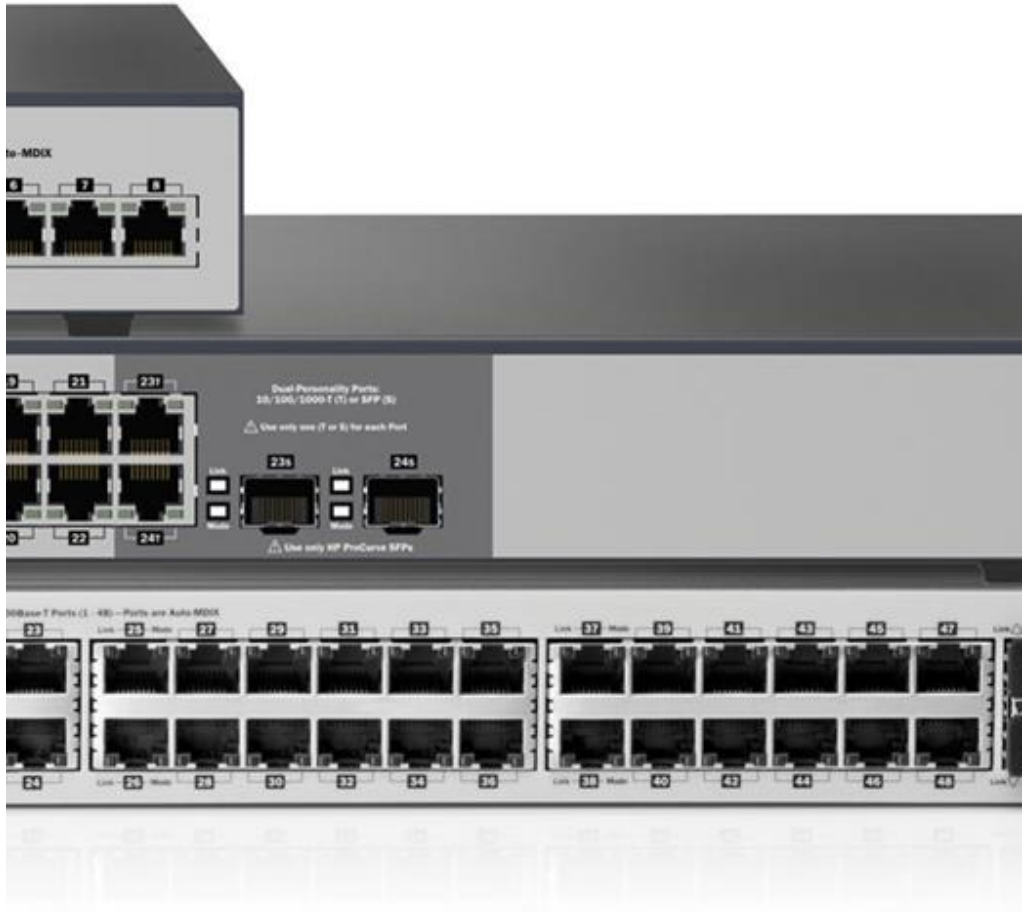
Switches, Routers – Switches

Optimize the available bandwidth of the network

- Traffic only goes where it is intended and needed.
- Nodes get “their” traffic instead of “everyone else’s”

Reduces processing overhead

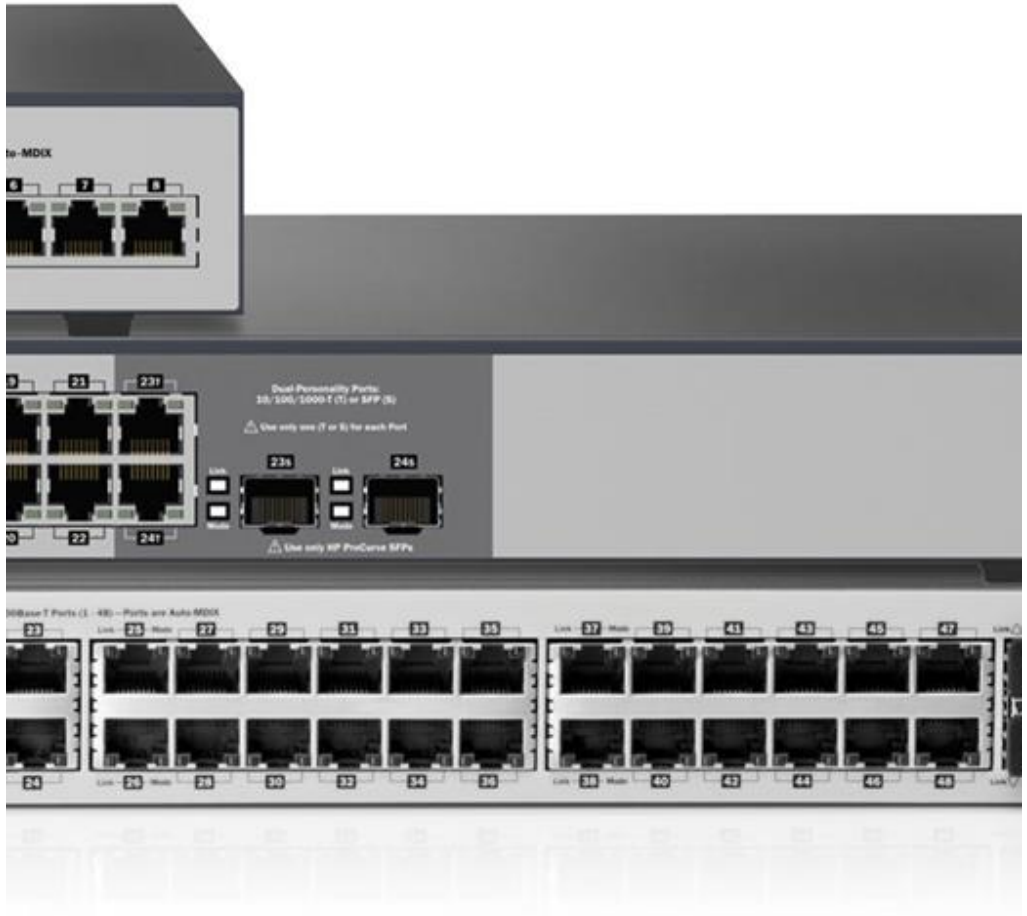
- Devices inspect all incoming data to see if it is meant for a connected node



Switches, Routers – Switches

May be unmanaged or managed…

- **Unmanaged** - no additional configuration options; “plug and play”
- **Managed** - provide additional features, such as the ability to implement VLANs, Spanning Tree Protocols, QoS (via CoS), diagnostics, etc.



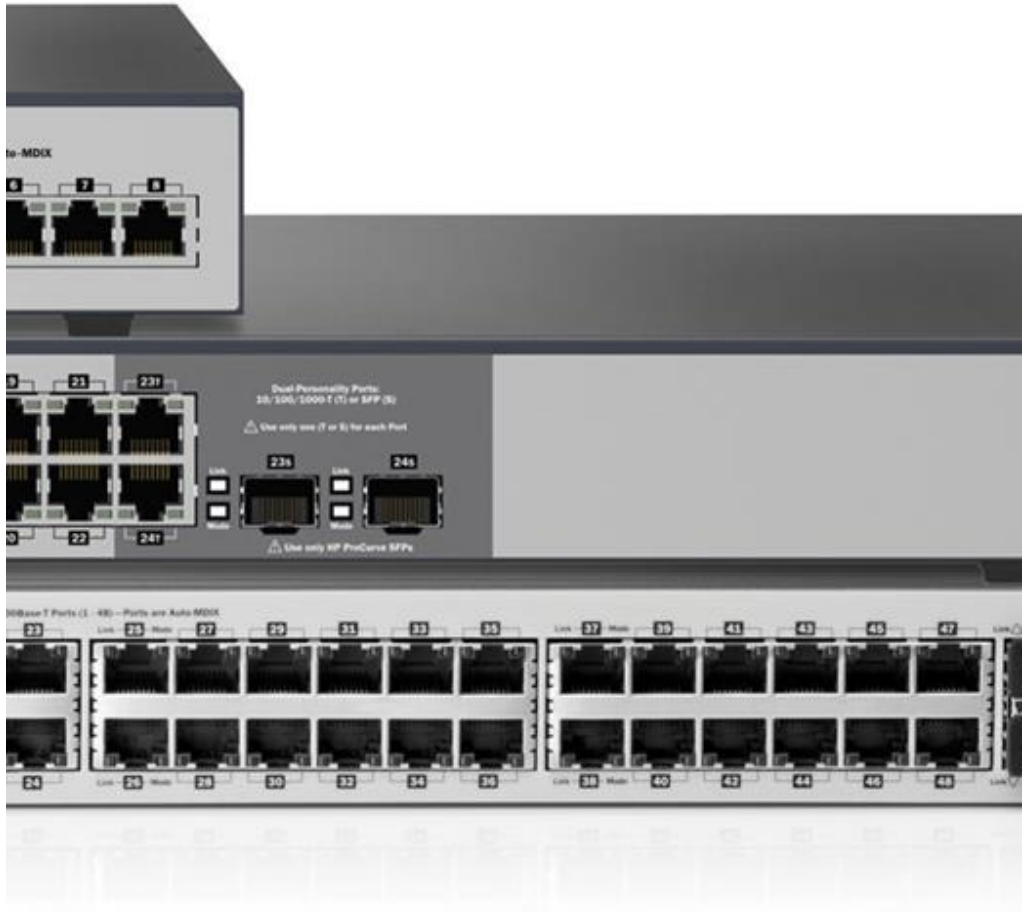
Switches, Routers – Layer 2 vs Layer 3

Layer 2: MAC / Ethernet

Switches look at destination MAC only to determine where to send data

Layer 3: IPv4/IPv6 and IGMP:

Switches also look at the destination IP addresses, and or Multicast groups




The A/V Influence

The AV Influence

Crestron XiO Cloud™ Service

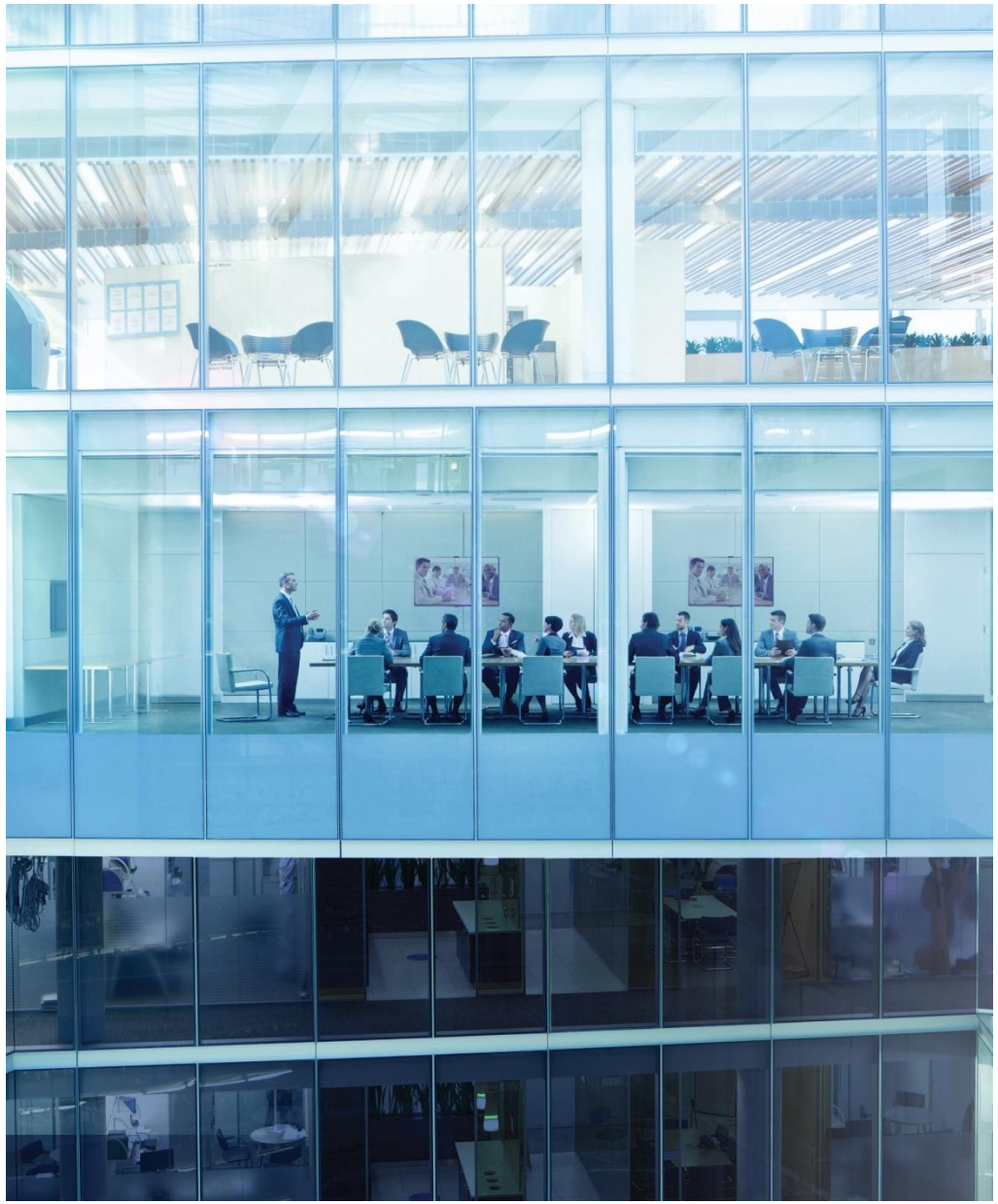
Control

Dante® audio networking

DM NVX™ technology

Security

Other



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Crestron XiO Cloud™ Service

The AV Influence: Crestron XiO Cloud™

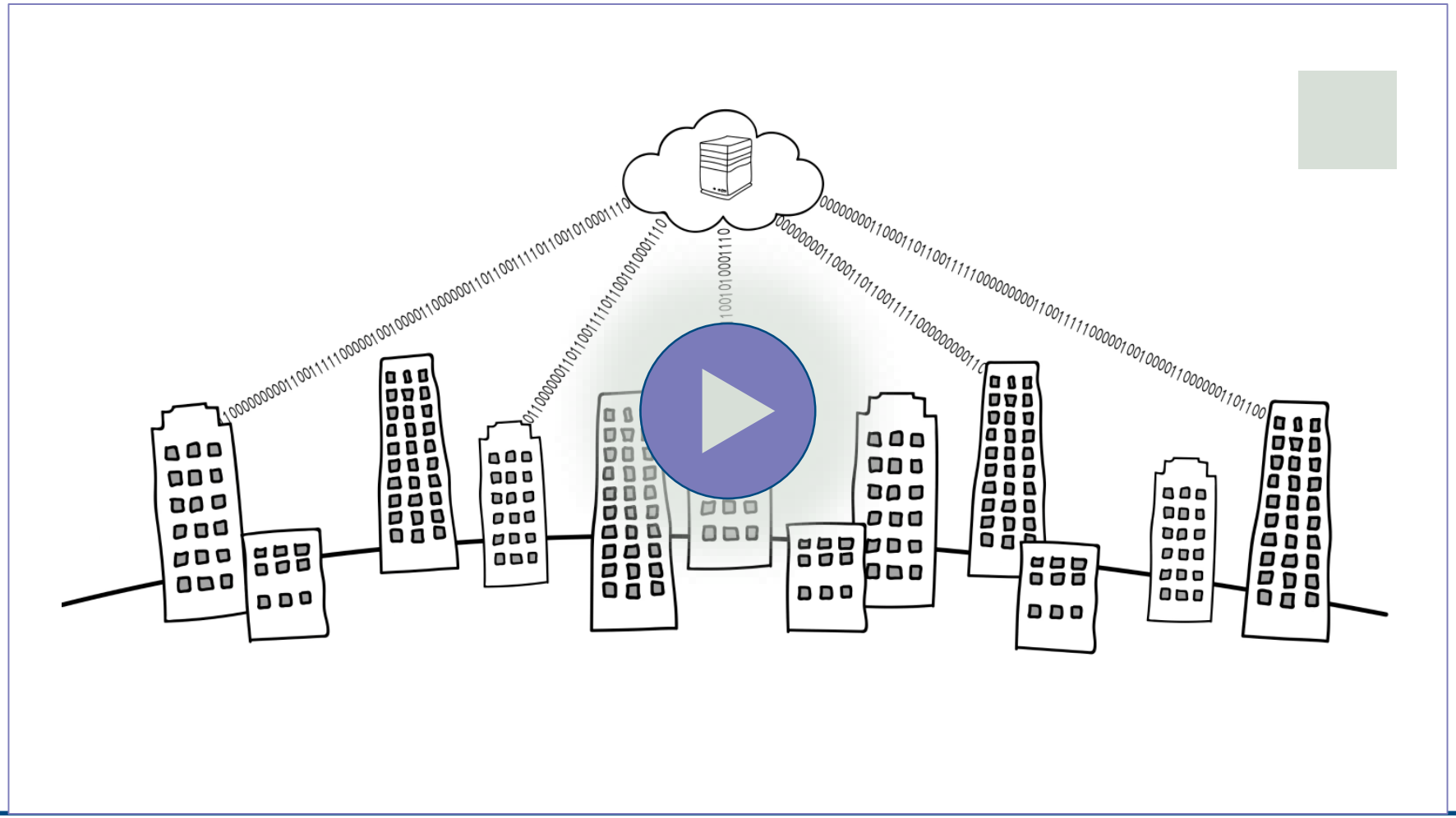
Reduce install time and cost

Configure millions of devices instantly

Resolve events remotely

Gather data with zero programming

Crestron XiO Cloud™



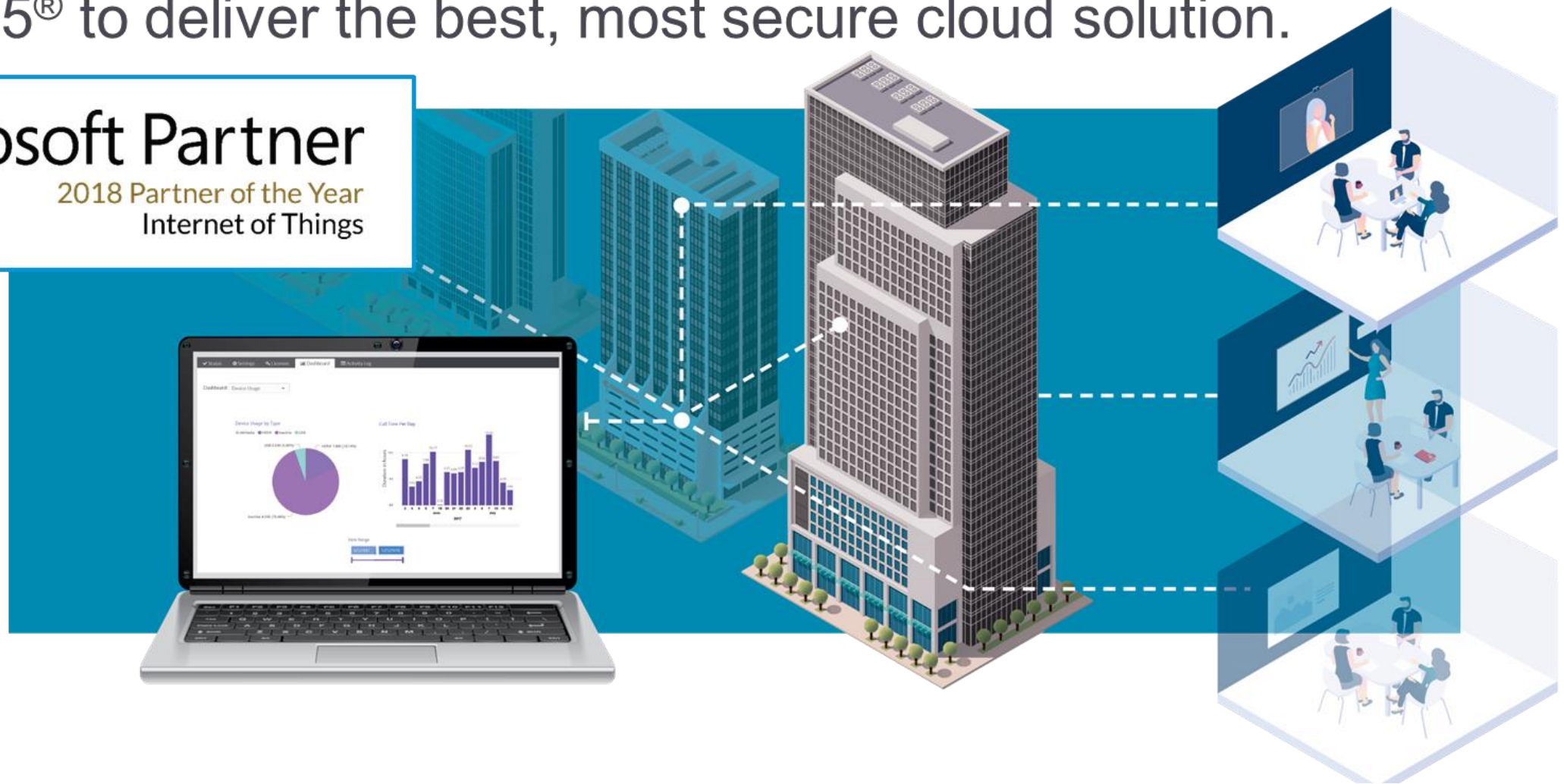
Built on the Microsoft® Azure® platform

- Crestron XiO Cloud is located in the same Cloud as Office 365® to deliver the best, most secure cloud solution.

Microsoft Partner

2018 Partner of the Year

Internet of Things



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Control

The AV Influence: Control

Time is critical

Traffic is small

Destinations are important

The AV Influence: Control

Crestron listen ports

Port	Protocol	Service	Notes
21	TCP	FTP	3-Series® control system only
22	TCP	SSH/SFTP	3-Series control system only
23	TCP	Telnet	-
80	TCP	Web access	For user program interface and setup pages Required for XPanel with Smart Graphics® using a web interface
843	TCP	Web access	Required for XPanel with Smart Graphics using a web interface
161	UDP	SNMP	-
443	TCP	Web access	Active with SSL enabled
41794	TCP/UDP	Crestron over IP	Proprietary Crestron control communications
41795	TCP	Crestron console	Requires proprietary management tool
41796	TCP	Crestron over IP	Active with SSL enabled
41797	TCP	Crestron console	Active with SSL enabled

The AV Influence: Control

Crestron connect ports

Port	Protocol	Service	Notes
21	TCP	FTP	3-Series control system only
25	TCP	SMTP	Only if enabled in control program
42	TCP/UDP	WINS access	-
53	UDP	DNS access	-
67/68	UDP	DHCP configuration	-
80	TCP	HTTP	3-Series control system only
161/162	UDP	SNMP	-
443	TCP	HTTPS	3-Series control system only
41794	TCP/UDP	Crestron over IP	Proprietary Crestron control communications
41796	TCP	Crestron over IP	Active with SSL enabled


Dante® Audio Networking

The AV Influence: Dante®

Dante® implements IGMP v3/v2 for multicast

Support for IGMP is required

Dante® can use DiffServ QoS

QoS is required for 100Mbps or mixed 1Gbps/100Mbps networks

Green Ethernet is not supported IEEE802.3az

The AV Influence: Dante®

Internet Group Management Protocol

IGMP – Snooping

IGMP – Querier

IGMP version

- IGMP v1
- IGMP v2
- IGMP v3

The AV Influence: Dante®

Dante® uses UDP for audio both unicast and multicast

Precision Time Protocol (PTP) for time synchronization


DM NVX™ Technology

The AV Influence: DM NVX™ Technology

Network requirements

Network switch

- 1 Gigabit port
- Non-blocking
- Layer 2 or 3, 3 recommended
- IGMP v2 minimum

The AV Influence: DM NVX™ Technology

Network requirements

Multiple switches

- Uplink size appropriately
- PIM-SM recommended

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Security

The AV Influence: Security

Sensitive content is on the network

Available anywhere there's a network drop

Security is now critical

Rogue devices cannot access protected content (with security)

The AV Influence: Security

Security: 802.1x

Devices are explicitly authorized

No rogue access

Authentication server (RADIUS)

- EAP-TLS certificate
- EAP-MSCHAP V2 password

The AV Influence: Security

Security: 802.1x

Authorize access to devices on the network

Manage

- Username
- Password

Used for

- Machine log-in
- Email
- VPN


Other

The AV Influence: Other

Comparison of PoE parameters				
Property	802.3af (802.3at Type 1) "PoE"	802.3at Type 2 "PoE+"	802.3bt Type 3 "4PPoE"	802.3bt Type 4 "PoE++"
Power available at PD	12.95 W	25.50 W	51 W	71 W
Maximum power delivered by PSE	15.40 W	30.0 W	60 W	100 W
Voltage range (at PSE)	44.0–57.0 V	50.0–57.0 V	50.0–57.0 V	52.0–57.0 V
Voltage range (at PD)	37.0–57.0 V	42.5–57.0 V	42.5–57.0 V	41.1–57.0 V
Maximum current Imax	350 mA	600 mA	600 mA per pair	960 mA per pair
Derating of maximum cable ambient operating temperature	None	5 °C (9 °F) with one mode (two pairs) active	10 °C (20 °F) with more than half of bundled cables pairs at I max	10 °C (20 °F) with temperature planning required
Supported cabling	Category 3 and Category 5	Category 5	Category 5	Category 5
Supported modes	Mode A (endspan), Mode B (midspan)	Mode A, Mode B	Mode A, Mode B, 4-pair mode	4-pair mode

The AV Influence: Other

Other: PoE

Calculate power needs

- Devices requirements
- Number of devices

Verify PSE supply

- Power reserve
- Additional power supplies

Move or balance as needed

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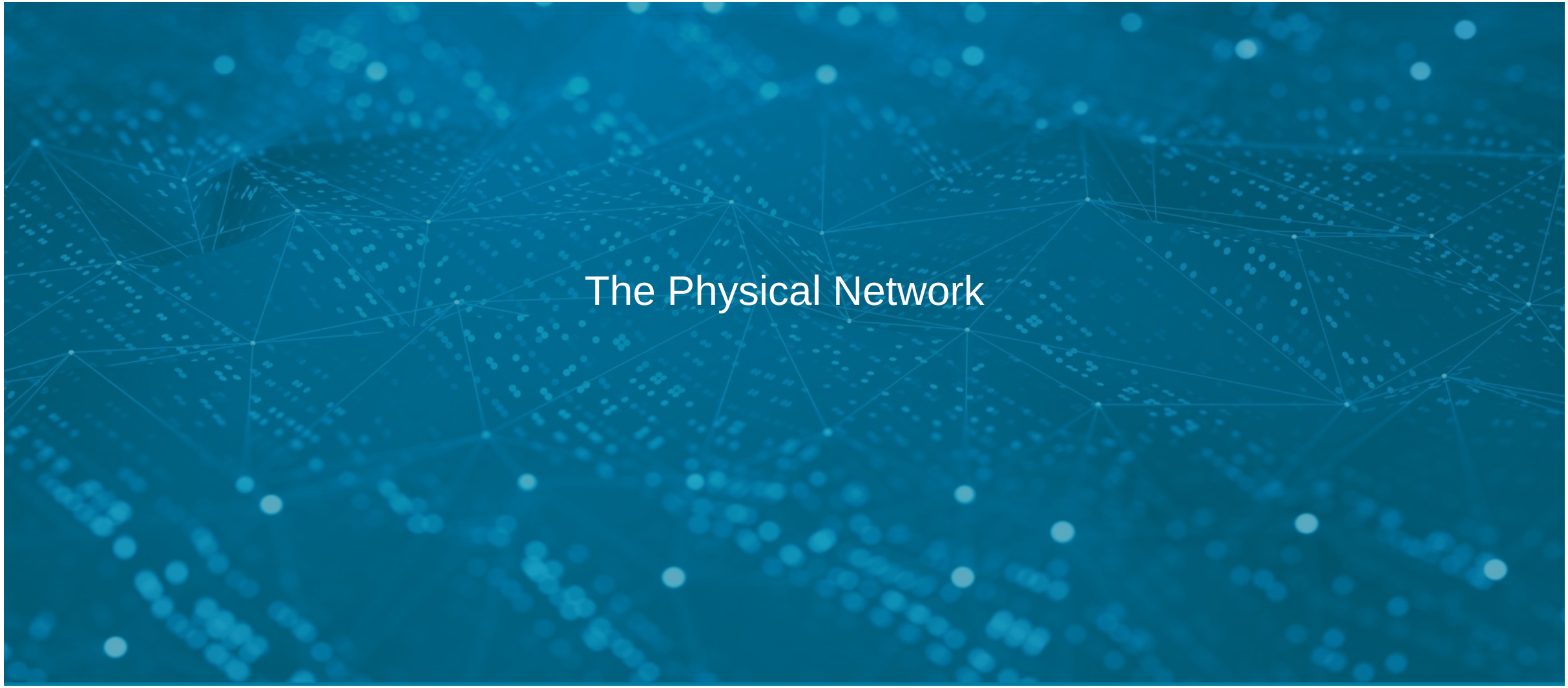
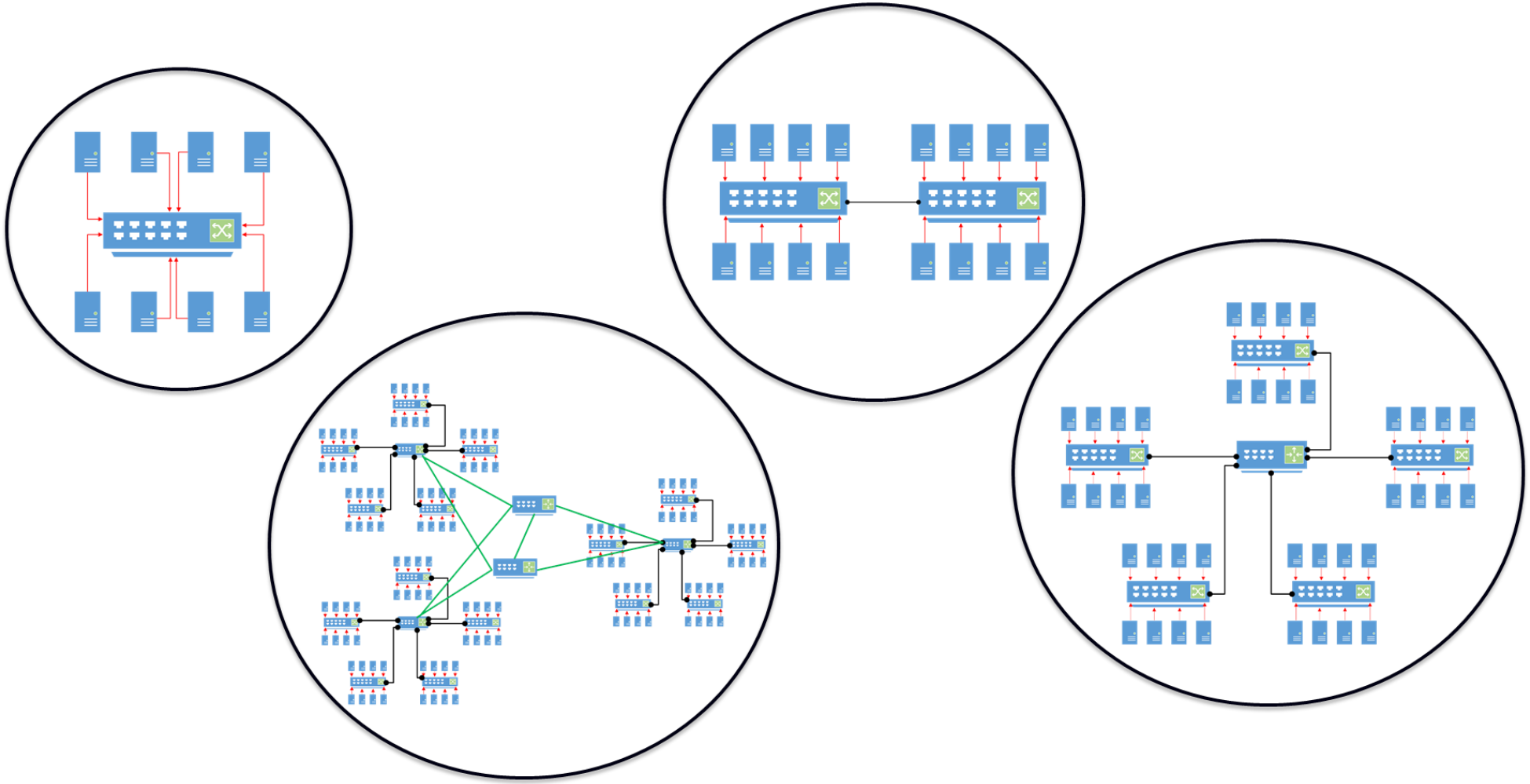

The Physical Network

The Physical Network

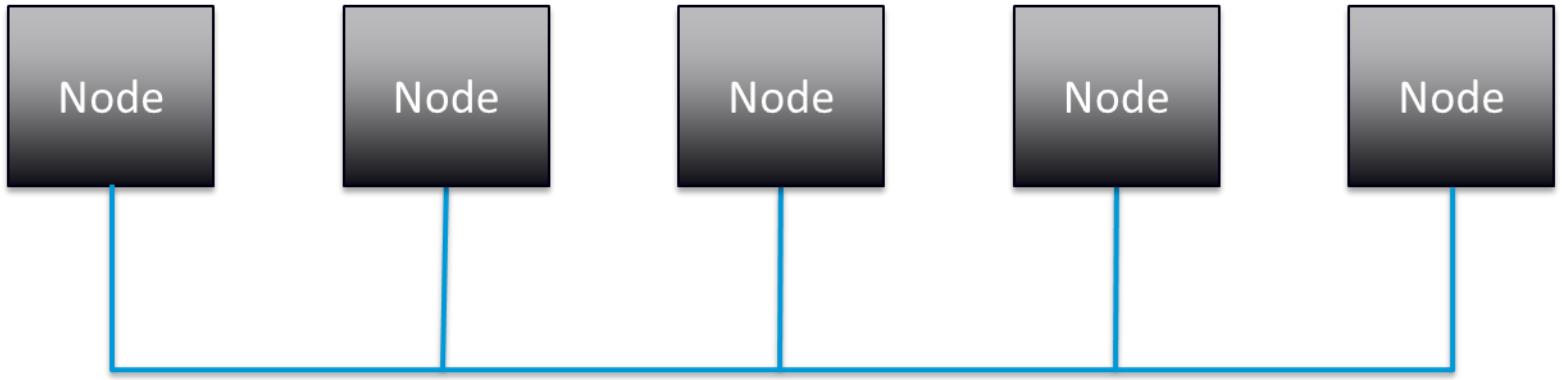


The Physical Network

Point-to-point

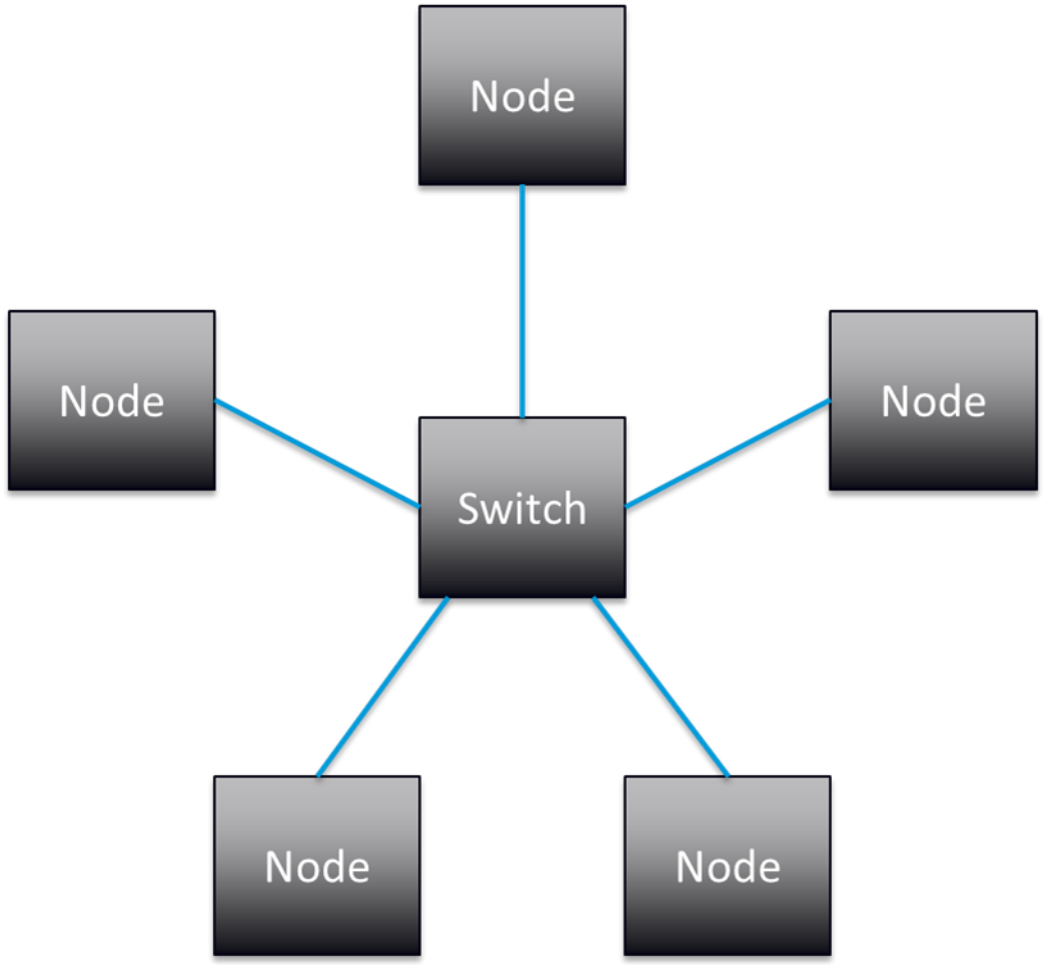
The Physical Network

Bus



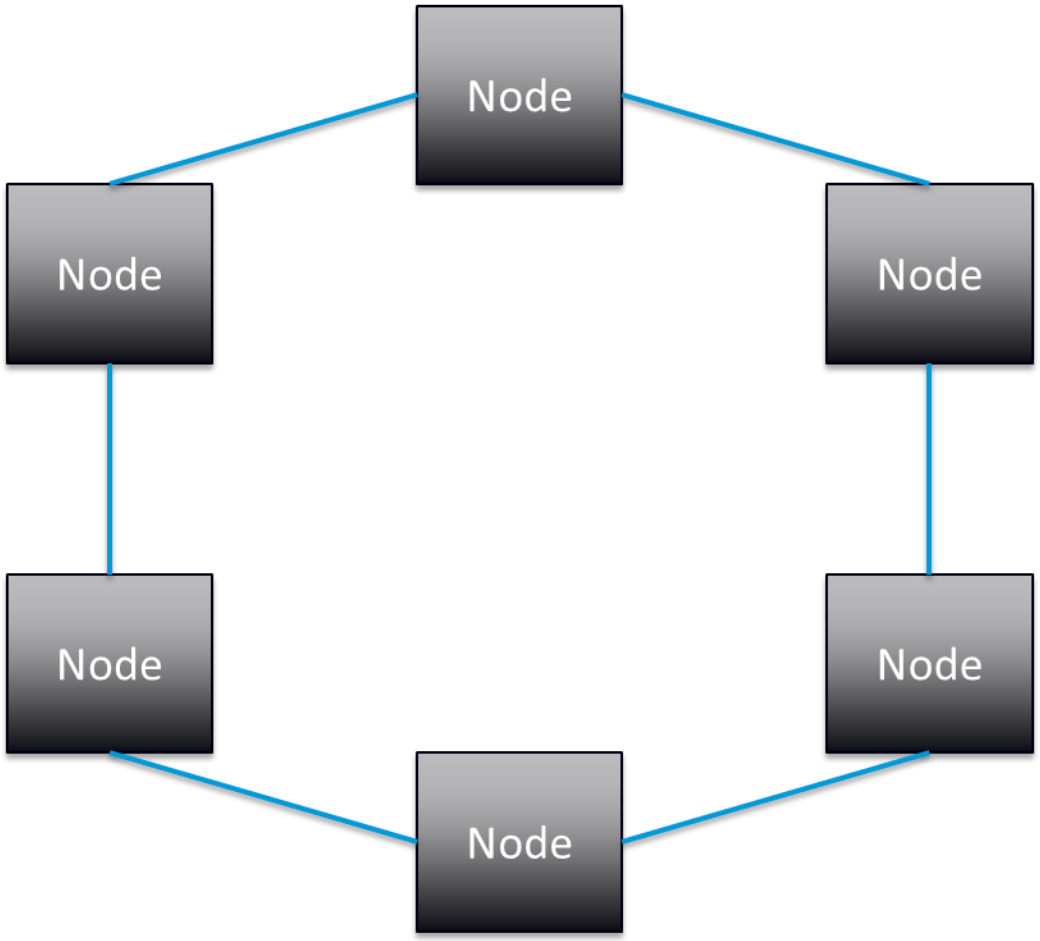
The Physical Network

Star



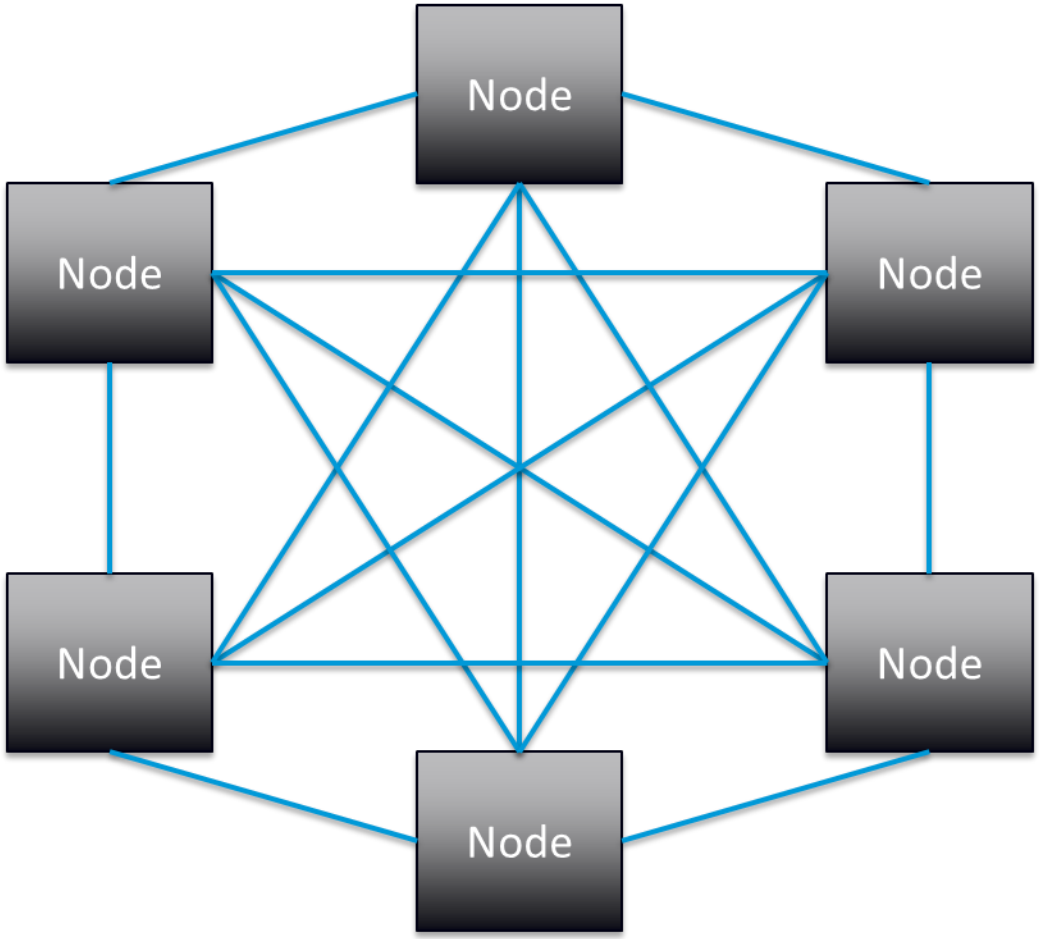
The Physical Network

Ring – not used… ish



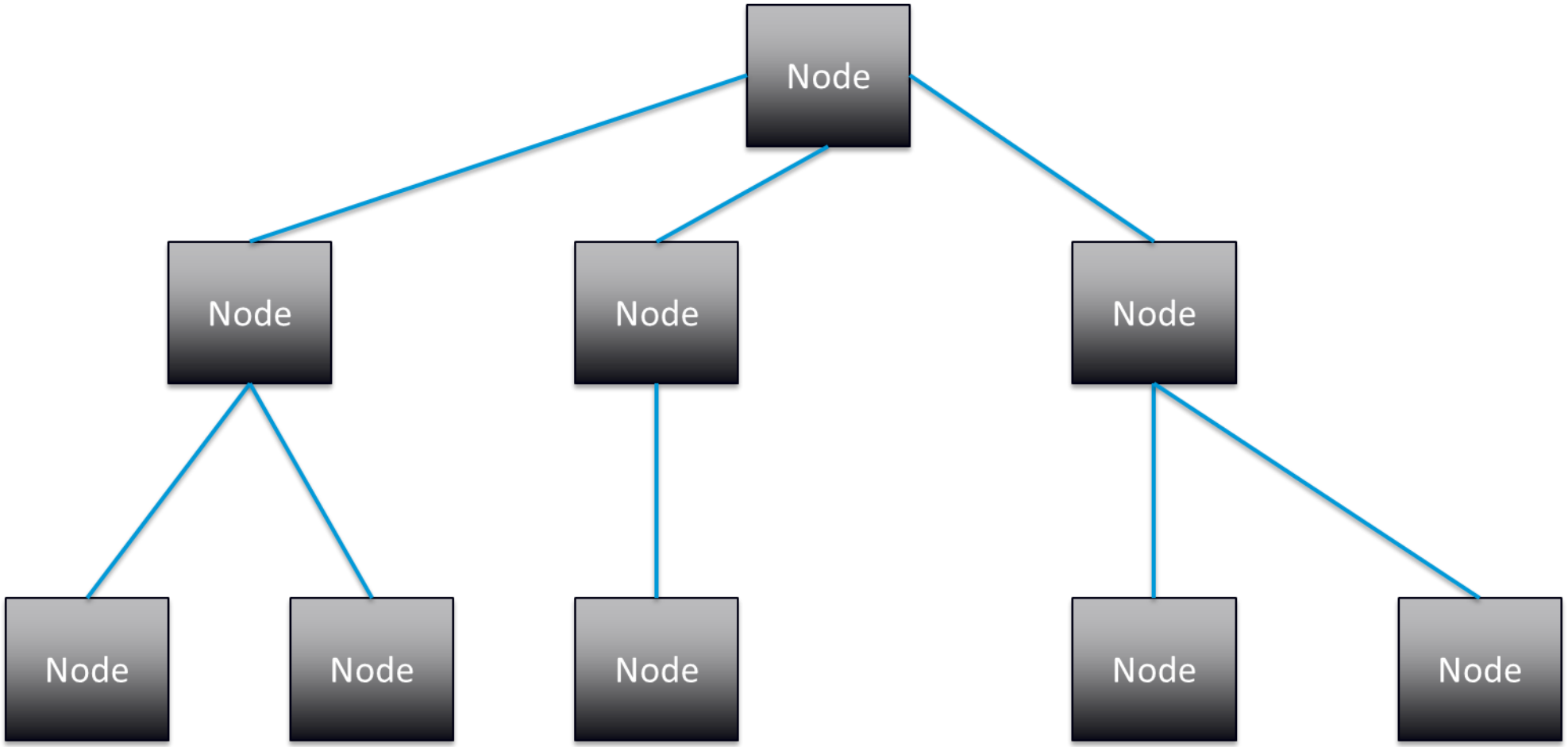
The Physical Network

Mesh



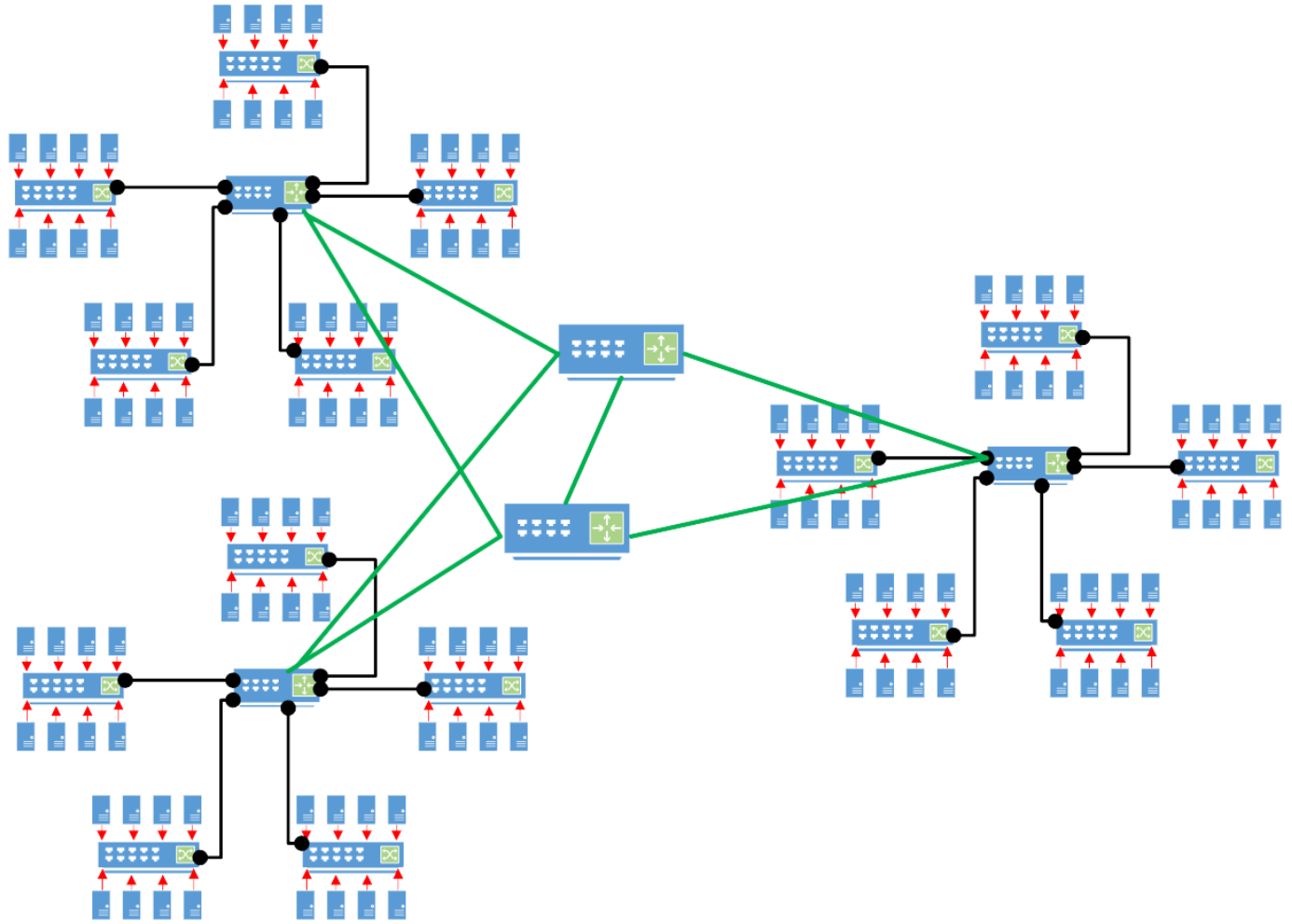
The Physical Network

Tree




The Logical Network

The Logical Network



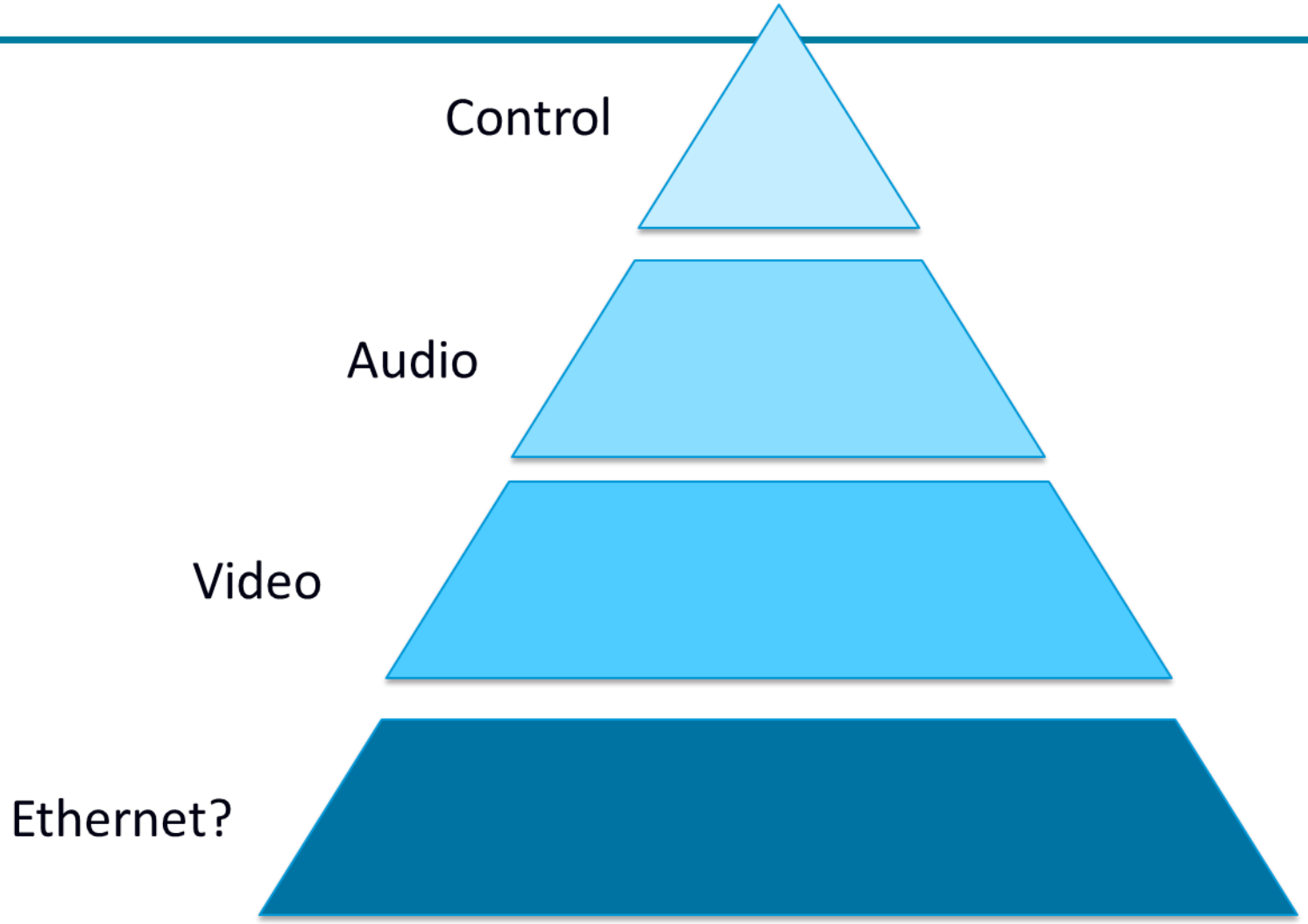
The Logical Network (in some cases physical, too)

AV matrix

IT matrix

The Logical Network

Traditional AV



The Logical Network

Today's technology

Control

- Direct connection
- Cloud based

Video

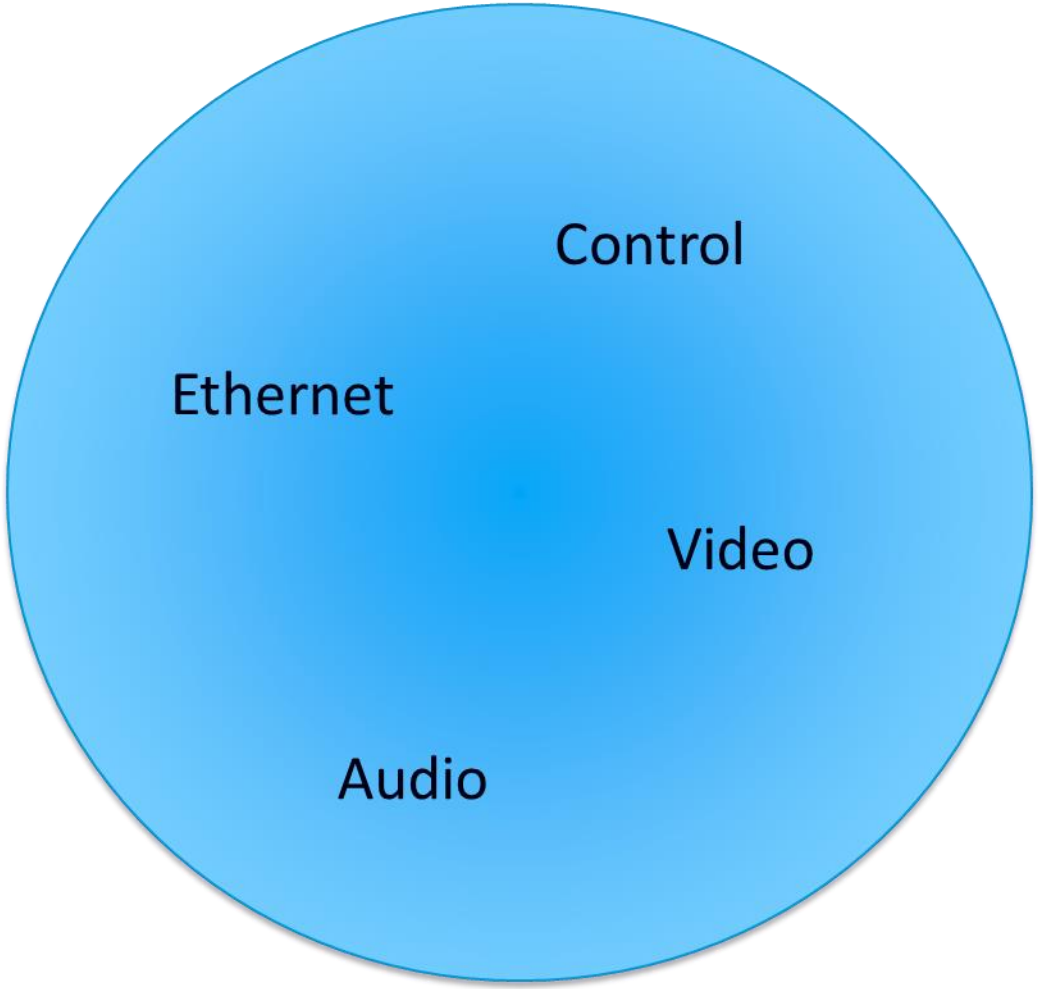
- IP video (streaming)

Audio

- Dante® audio networking technology
- AES 67

Ethernet

- Common communication



The Logical Network

Physical – Single Switch

Logical Configuration – Flat

Cost effective

Limits hardware

One subnet

The Logical Network

Physical – daisy chain (bus…ish)

Logical Configuration – can be flat

Cost effective

Limits hardware

One subnet

The Logical Network

Physical – ring…..ish

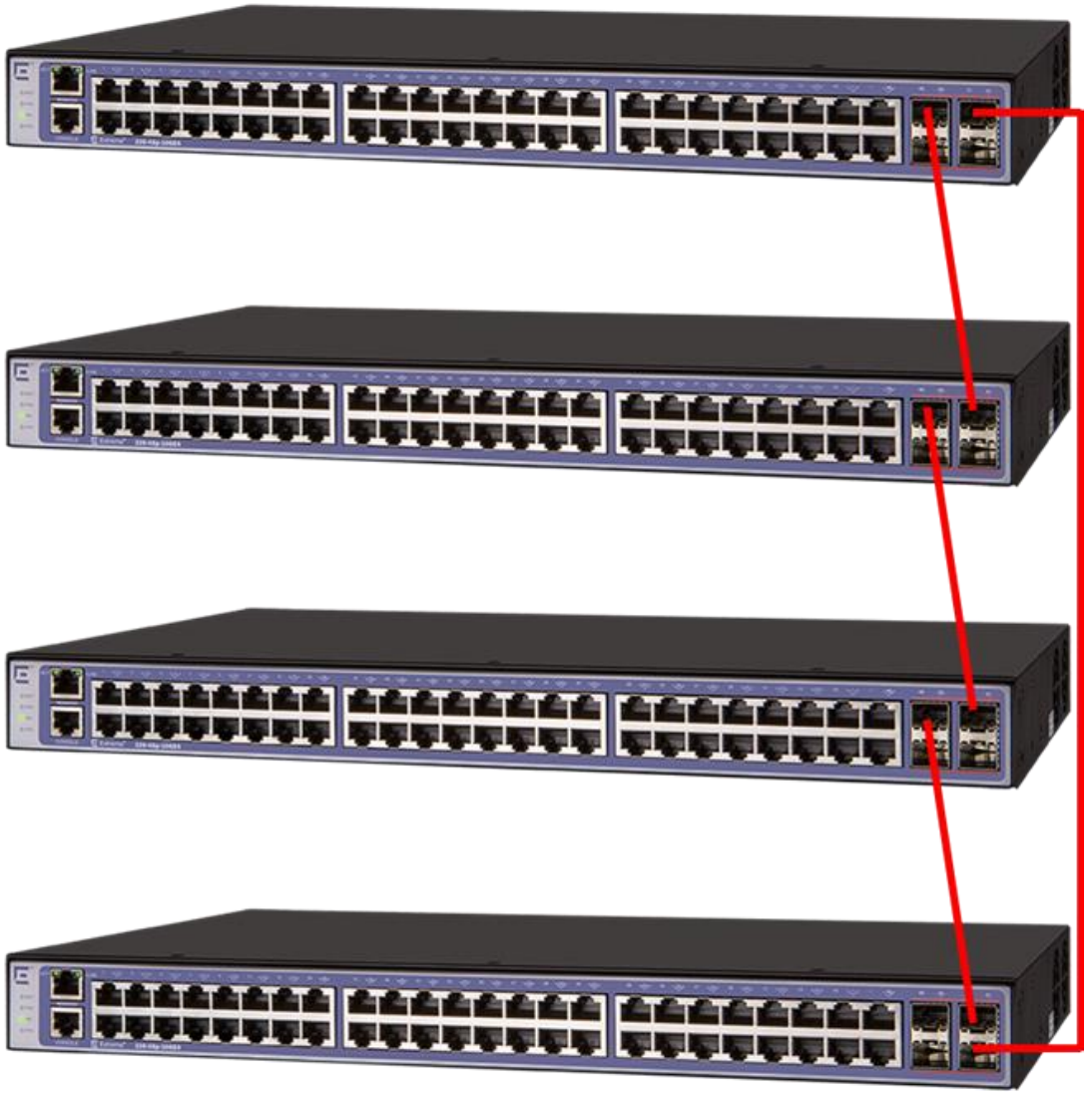
Logical configuration – can be flat

Switches connect to each other.

Configuration when stacking

Switches report as one switch to the Network Admin tools

Some switches have dedicated stacking ports



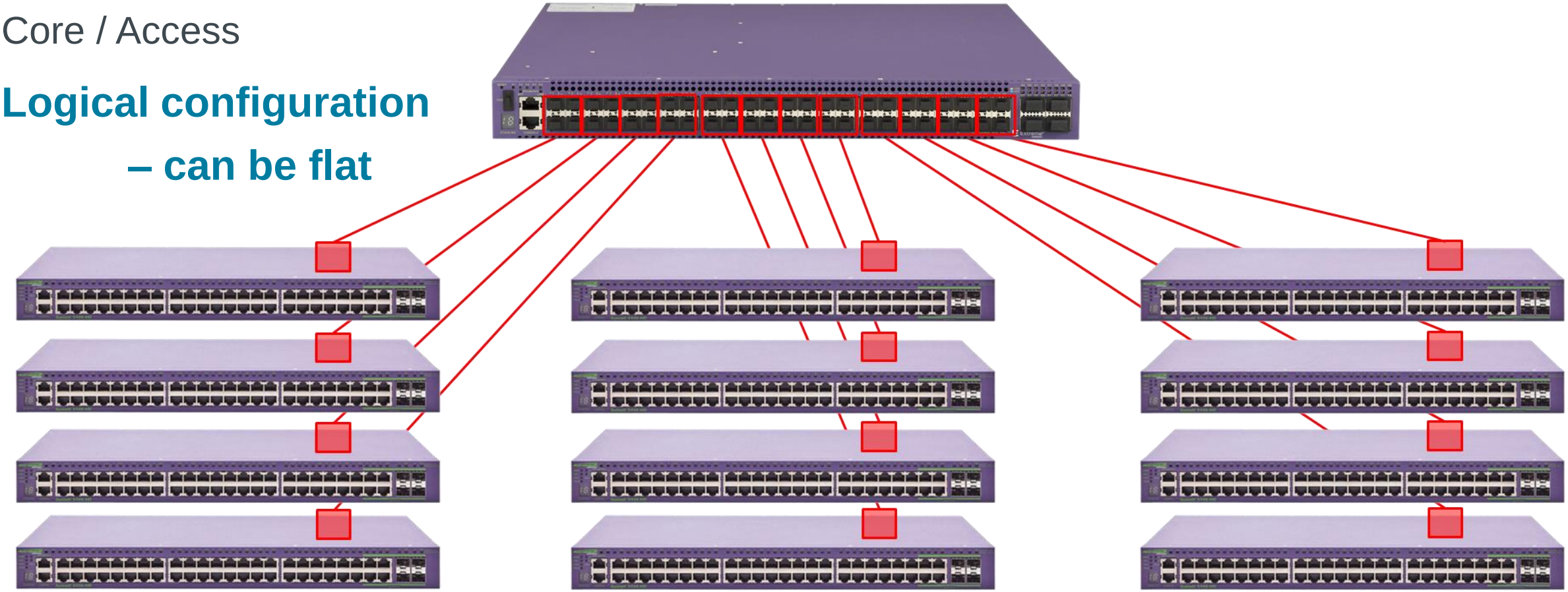
The Logical Network

Physical – tree/star

Core / Access

Logical configuration

– can be flat



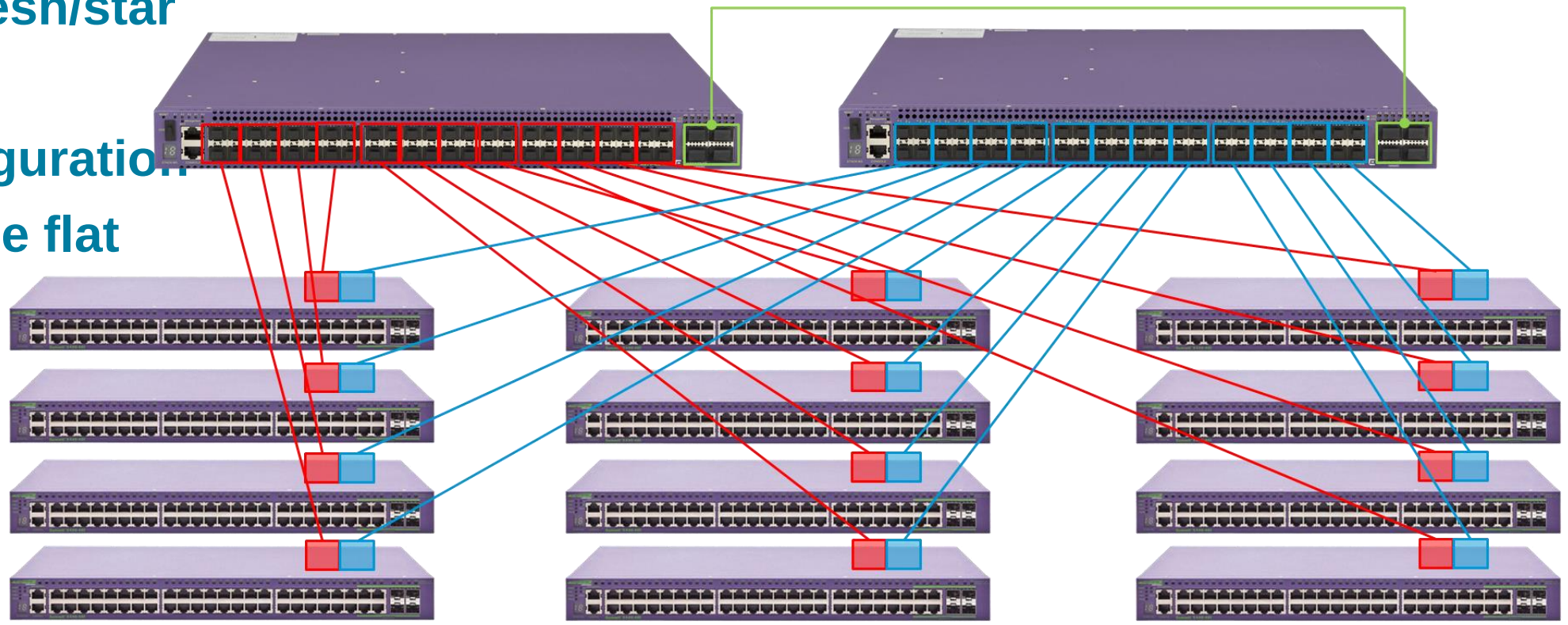
The Logical Network

Physical – mesh/star

Core / Access

Logical configuration

– can be flat



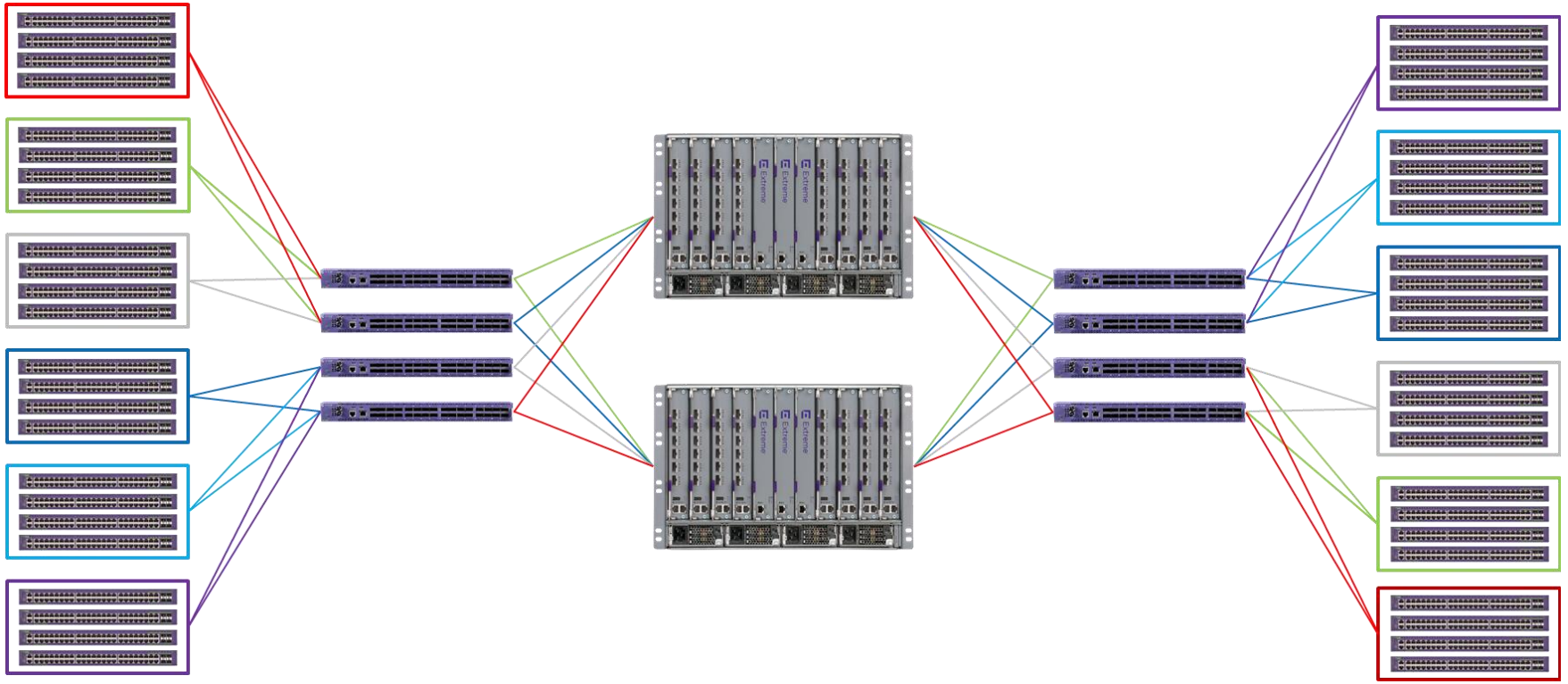
The Logical Network

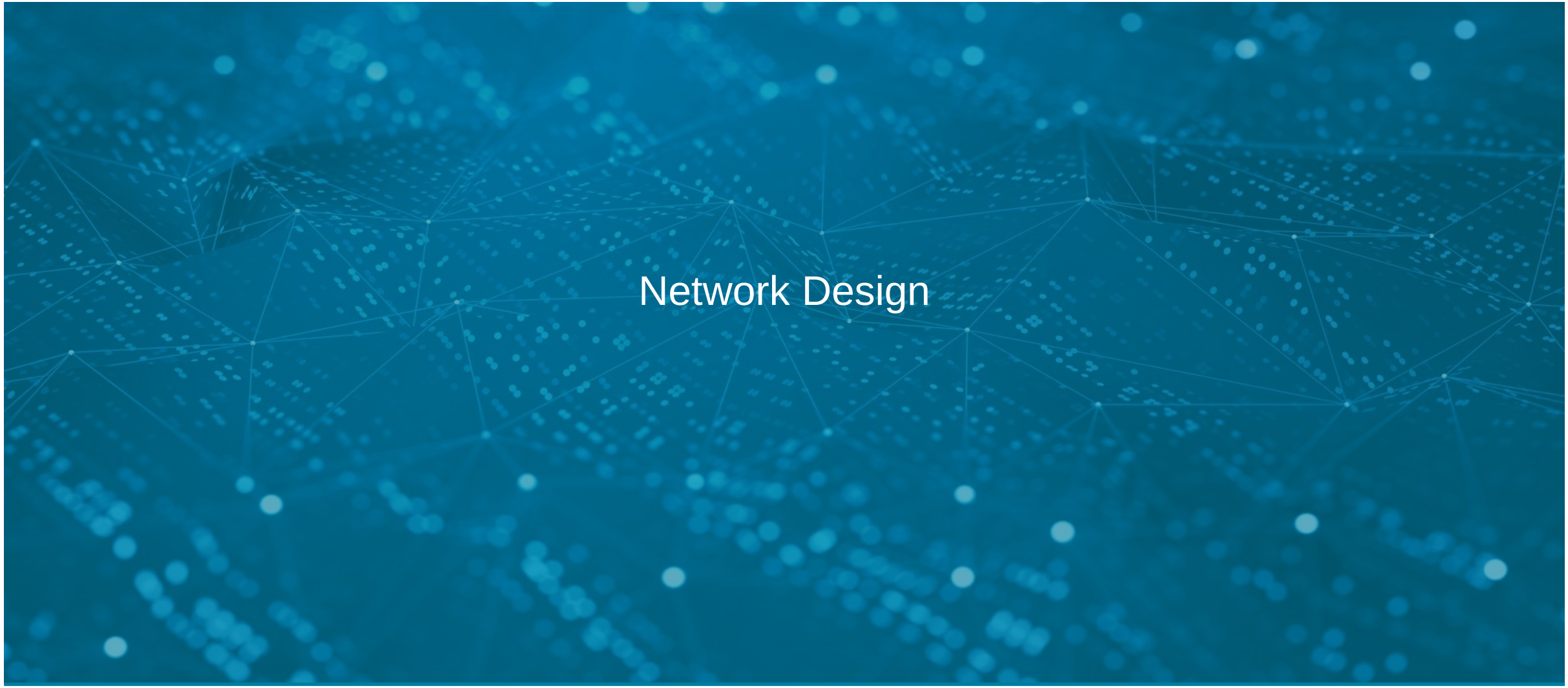
Physical – mesh/star

Core / Distribution / Access

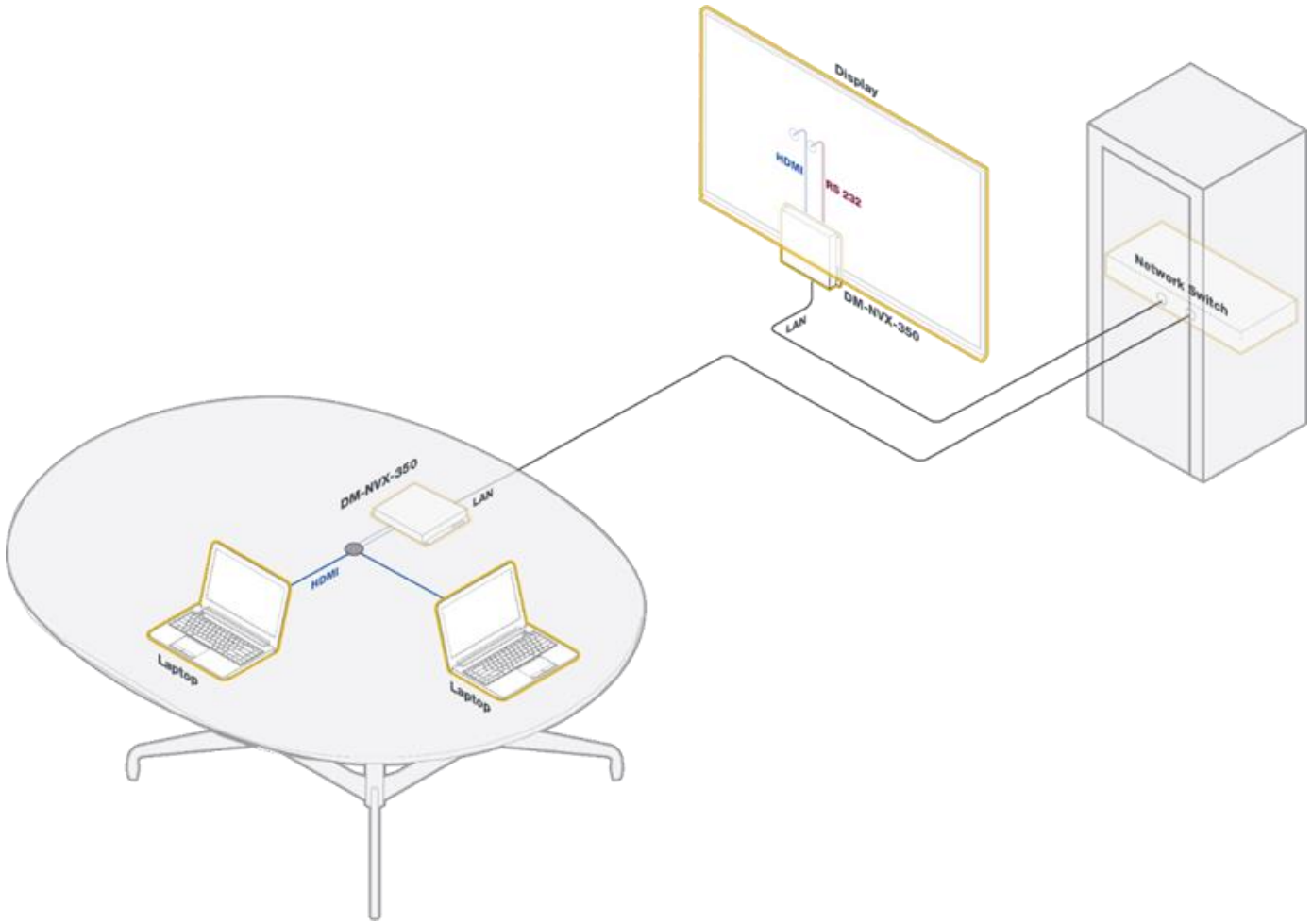
Logical configuration

– can be flat




Network Design

Example 1: IP Video Point to Point



Scope

IP Video

- (1) Encoder (1) Decoder

Computer

- (2) connections

Other

- (1) Display
- (1) Internet

Example 1: IP Video Point to Point

Topology - Tree/Star

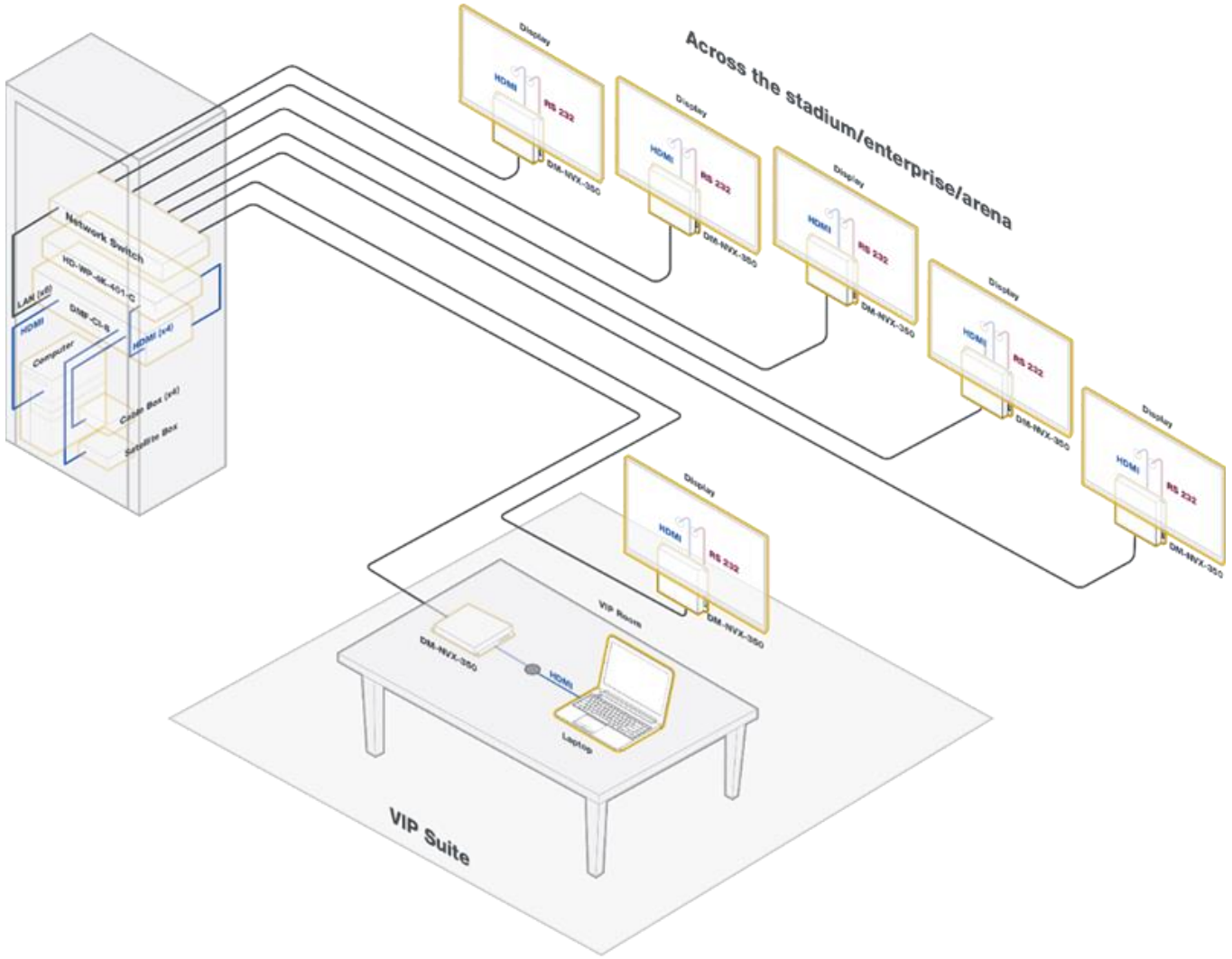
Configuration - Flat

Cost effective

Limits hardware

One subnet

Example 2: IP Video Multi-source to Multi-displays



Scope

IP Video

- (7) Encoders, (6) Decoders

Computer

- (2) PC and Laptop

Other

- (6) Displays
- (1) Control
- (1) Touch panel
- (1) Internet

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Example 2: IP Video Multi-source to Multi-displays (Ring)

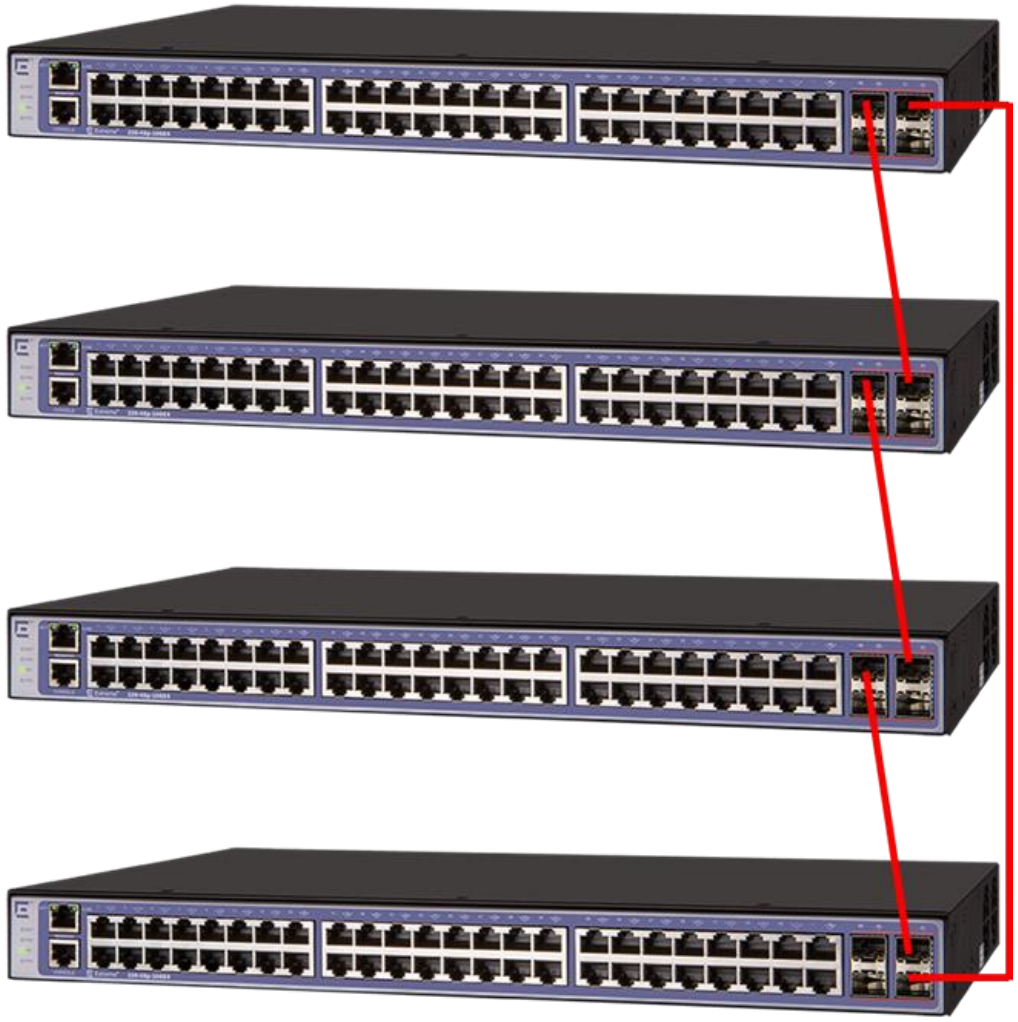
Switches connect to each other.

Configuration when stacking

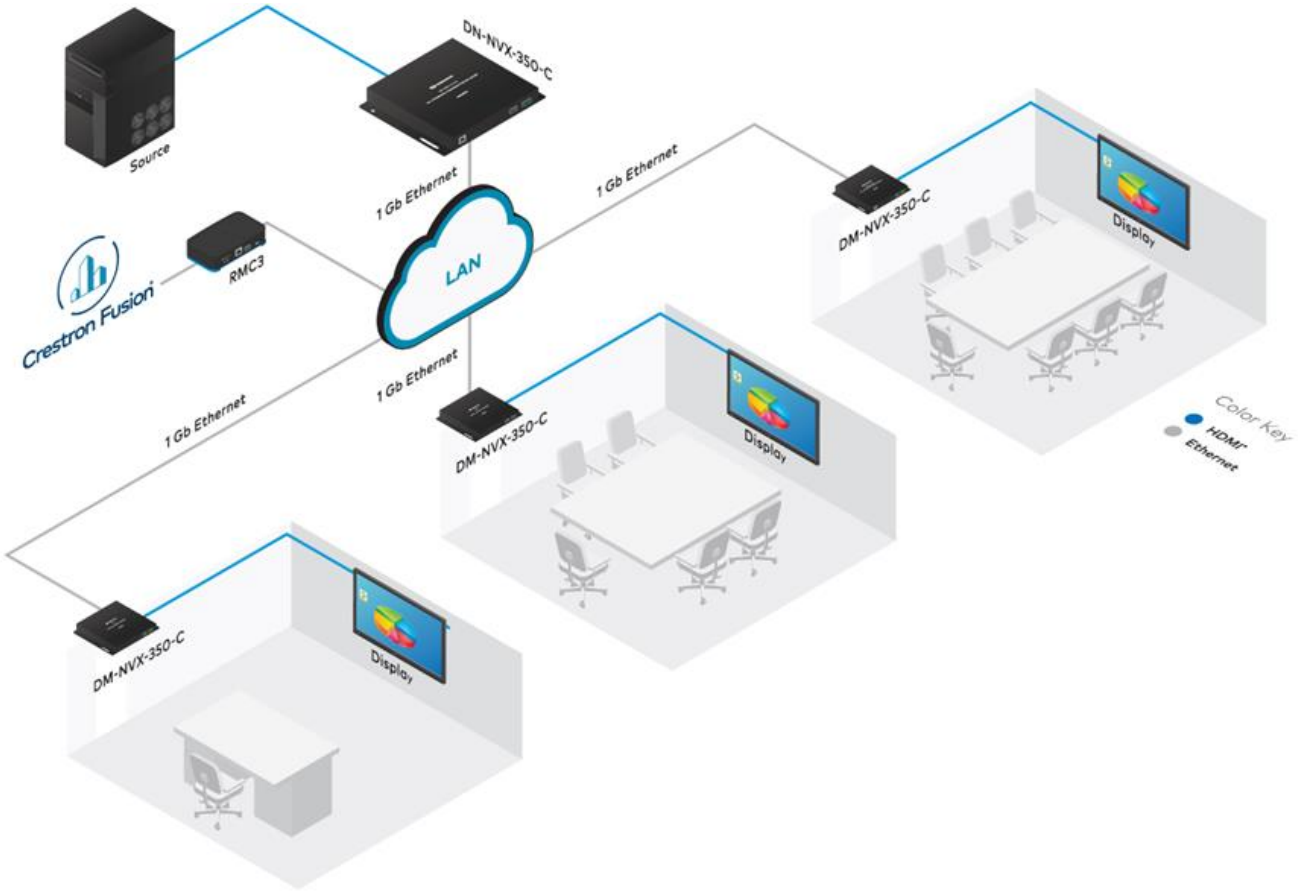
Switches report as ones witch to the NA tools

Some switches have dedicated stacking ports

Links are still the limitation



Example 3: Small Office



Space Programming

1 Conference room

2 meeting rooms

6 Huddle spaces

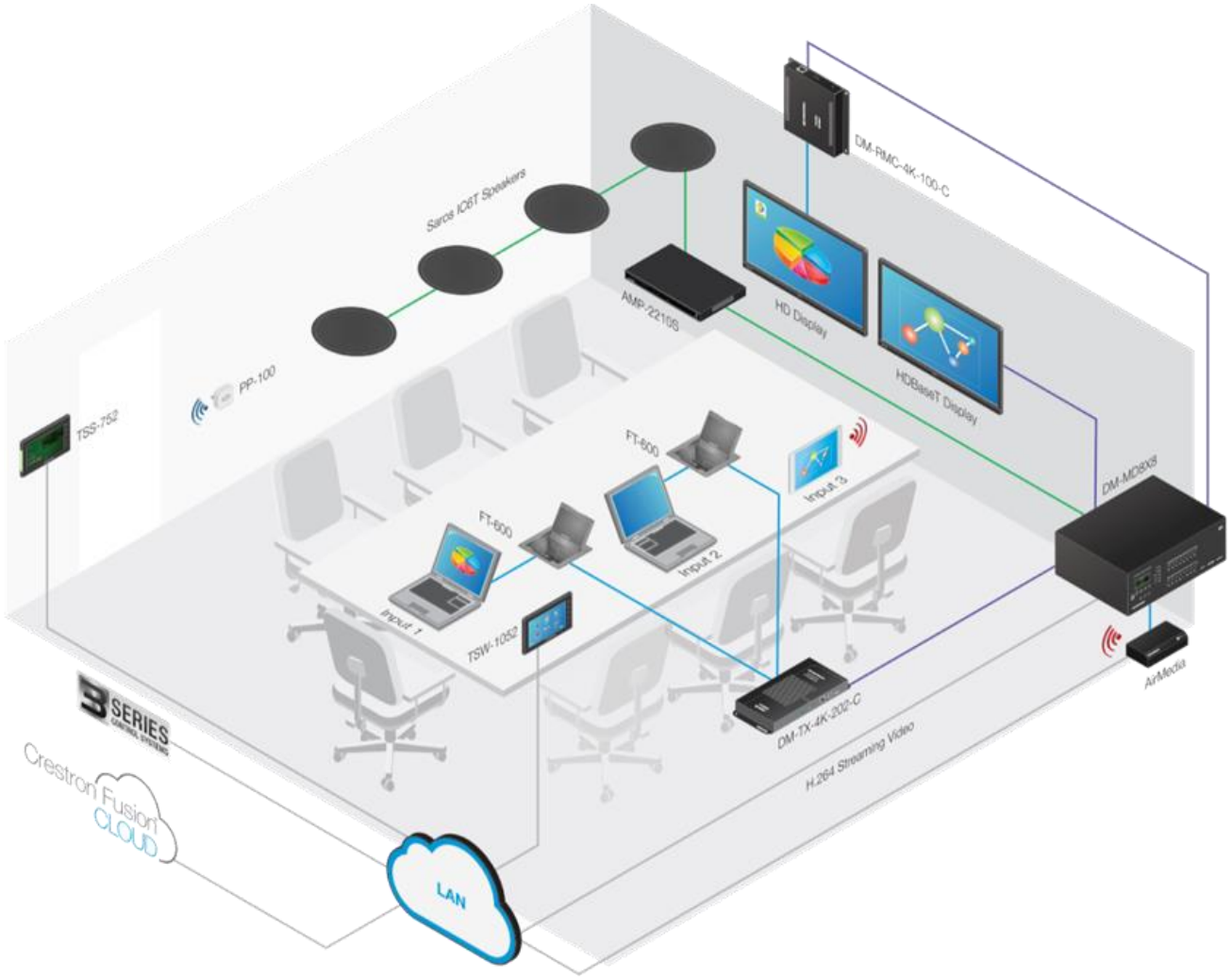
8 offices (management)

40 workstations

- (employees)

1 Utility

Example 3: Small Office



Conference Room

IP Video

- (5) Encoders, (3) Decoders

PC

- (3) courtesy ports from DM NVX™ endpoints

Other

- (2) Display's
- (1) Control system
- (1) Flex C100
- (1) AirMedia® presentation system
- (2) Touch screen's

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Example 3: Small Office

Meeting Room

IP Video

- (2) Encoders (2) Decoders

PC

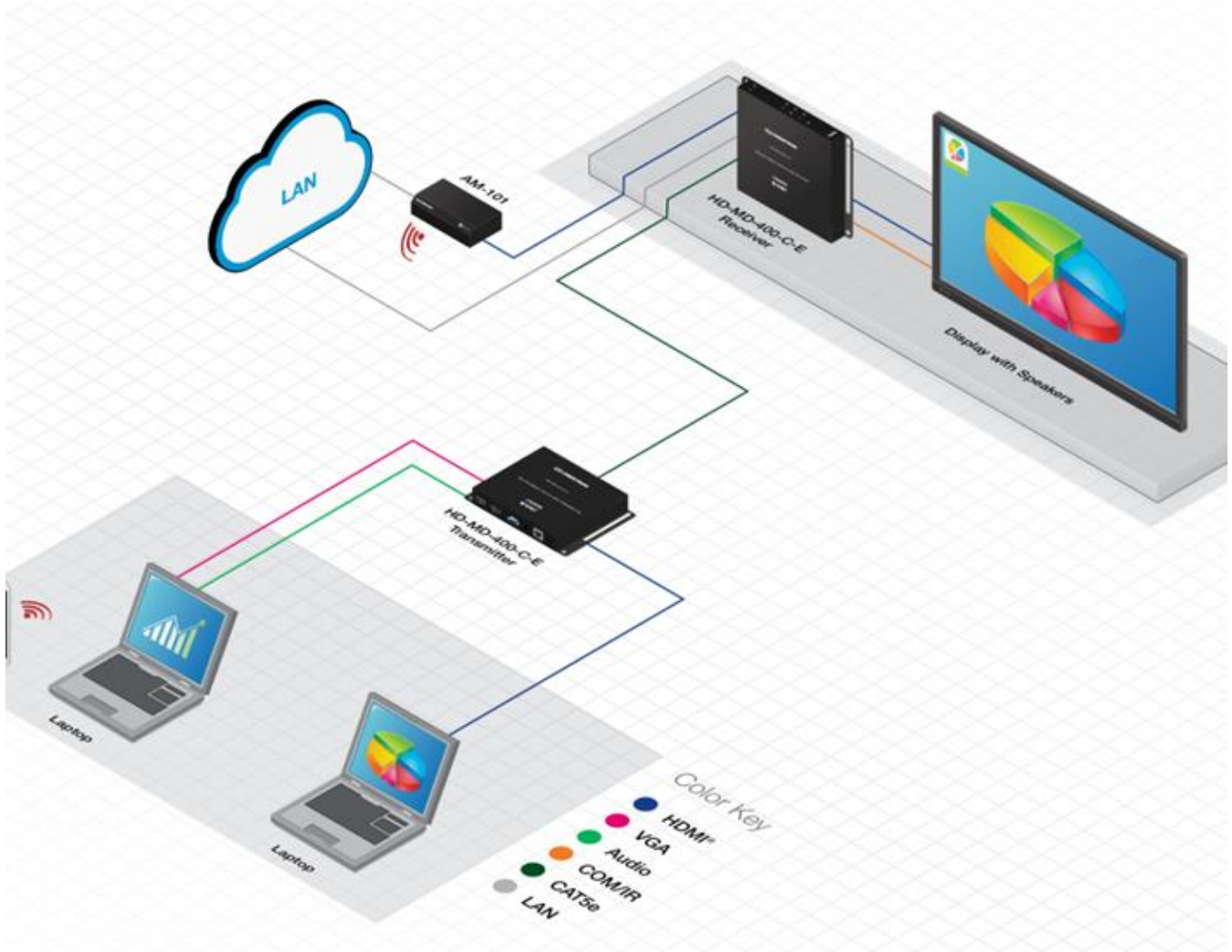
- (2) courtesy from DM NVX™ enpoints

Other

- (1) Display
- (1) Control system
- (1) Flex M150
- (1) AirMedia® presentation system
- (1) Touch screen’s

CRESTRON

Example 3: Small Office



Huddle Space

IP Video

- (1) Encoder (1) Decoder

PC

- (1) courtesy from DM NVX™ endpoint
- Wireless

Other

- (1) Display
- (1) Control system
- (1) AirMedia® presentation system

CRESTRON

Example 3: Small Office

(8) Offices

Each office to have:

- (3) drops
  - (1) Phone
  - (1) PC
  - (1) printer

Utility area

Equipped with the following:

- (6) Drops print / fax

(40) Work Stations

Each work station to have:

- (2) Drops
  - (1) Phone
  - (1) PC

Other

- (4) Access Points (1) Controller
- (2) Servers
- (1) ISP connection
- (1) Phone Gateway
- (1) DM NVX Director™ virtual switching appliance
- (1) Control system

Example 3: Summary

Conference Room
(15) total drops

Meeting Room(s)
(9) drops each

- (18) total drops

Huddle spaces
(5) drops each

- (30) drops total

Offices
(3) drops each

- (24) drops total

Workstations
(2) drops each

- (80) drops total

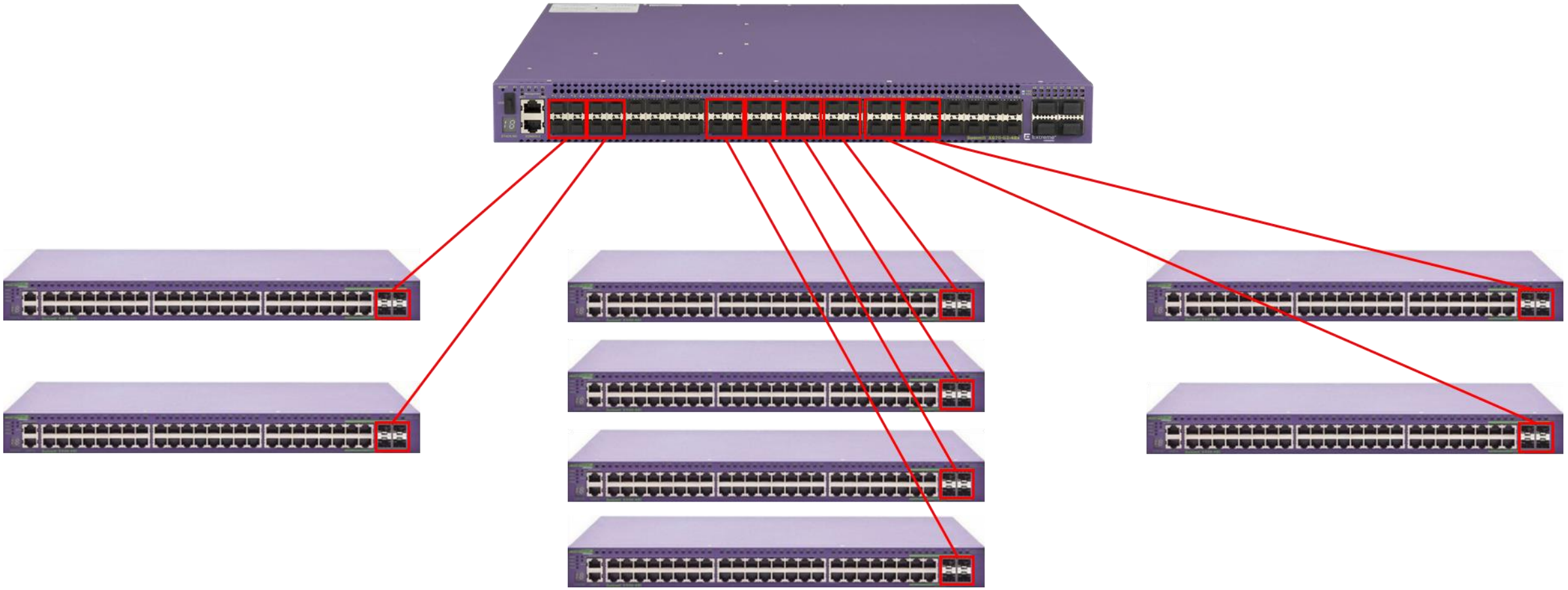
Utility area
(6) drops total

Additional Equipment
(10) drops total

Grand Total: 183 drops

Example 3: Summary – Daisy Chain

Example 3: Summary – Core / Access



Example 3: Summary – Modular