Partnering with the IT Pro

Course Objectives

Terminology

Networking basics

- Foundation of a network
- Addressing
- Components
- Network Topologies

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Terminology

Access Switch:

Access switches are those switches situated closest to the network host's or nodes, in networks utilizing a layered or hierarchical topology. They are typically placed at the outer "edge" of a network and are also known as edge switches. Network-enabled devices gain access to the larger network by connecting to an access switch, which—in turn—is uplinked to a higher-layer switch. Access switches are often less capable than distribution/core switches and may or may not have layer 3 (routing) capabilities.

Broadcast:

Broadcast transmissions are one-to-all, UDP-based transmissions. A device sending a broadcast message transmits the message to its (sub)network's broadcast address, for example: 192.168.1.255 in a 192.168.1.0/24 network. A network switch will replicate UDP broadcast messages to all ports/hosts in the (sub)network, except for the port through which the broadcast entered the switch.

Terminology

Broadcast Domain:

A broadcast domain constrains broadcast traffic to those hosts within the broadcast domain. Hosts within the same broadcast domain will receive broadcast messages from one another, but will not receive broadcasts from hosts in other broadcast domains. Separate and distinct broadcast domains are created whenever a network is physically or logically subdivided into multiple subnetworks. In practice, each unique VLAN on a network will have its own, individual broadcast domain.

Core Switch:

A core switch is one situated at the center—or core—of a multi-layered, hierarchical network. In a core/distribution/access topology, the core layer services the distribution layer, which services the access layer and its attached devices. In smaller networks utilizing a condensed, 2-layer model, the “core” switch would also perform the duties normally performed by switches in the distribution layer.

Terminology

Distribution Switch:

Distribution layer switches are situated between the access layer and core layer of multi-layered network. The distribution layer is responsible for routing traffic between subnets/VLANs, applying QoS (Quality of Service) to prioritize essential traffic, and is the layer at which network policy is applied to filter and manage traffic.

Ethernet (IEEE 802.3):

Ethernet is a family of networking technologies and specifications that helps define the behavior, rules, and infrastructure standards of modern, wired, Ethernet-based networks (e.g. LANs, WANs, etc.). Ethernet standards are concerned with the physical (layer 1) and data link layers (layer 2) of the OSI model. Ethernet-based devices communicate over Ethernet networks by sending and receiving Ethernet frames. In addition to the actual data that devices wish to exchange, each transmitted frame contains a source MAC address and destination MAC address.

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. The same host can act as a server and as a client, depending on the nature of the device.

Internet Protocol (IP) Address:

An IP address is a binary number that represents an IP host's unique, logical address on an IP-based network. An IP address includes two pieces of information. It includes the address of the network on which a host resides, known as its network address, routing prefix, or network number. It also includes the host's own address on that network, known as the host address, host identifier, or host number.

Terminology

Local Area Network (LAN):

A local area network defines a private computer network whose operational scope is confined to a limited or local area, such as an individual residence or office building.

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.

Network:

A computer network is a digital telecommunications network that allows computers and other devices to share resources and communicate with one another.

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.

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. This is done for the sake of convenience and for security. Subnets streamline network administration, allowing administrators to partition the network into smaller, more manageable networks.

Terminology

Subnet Mask:

A subnet mask—or a bitmask—is a 32-bit number that, when applied to an IPv4 address, designates which portion of the 32-bit IPv4 address represents a host's network address (or network prefix, routing prefix, etc.). The remaining portion (or bits) of the IPv4 address not claimed for network addressing is used to represent a host's address on the network in question. By adjusting the number of bits used for network addressing (or the length of the bitmask), network administrators can grow or shrink the size of a given subnetwork and the amount of host addresses available within the subnet.

Uplink:

Switch uplinks are high speed networks ports intended to facilitate switch-to-switch communication. A switch's total uplink capacity defines how much data it is able to transfer to and receive from other, uplinked switches.

Terminology

Virtual Local Area Network (VLAN):

An 802.1q VLAN is 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.

Wide Area Network (WAN):

A wide area network defines a computer network that spans regions, countries, or the entire planet. WANs may be private (e.g. a corporation's enterprise network) or they may be public (e.g. the Internet).

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Networking Basics

Foundations of a network

OSI Model

Host Addressing

- Where are you

Network Components

- Switches/Routers/Etc.

Network Topologies

- Network architecture

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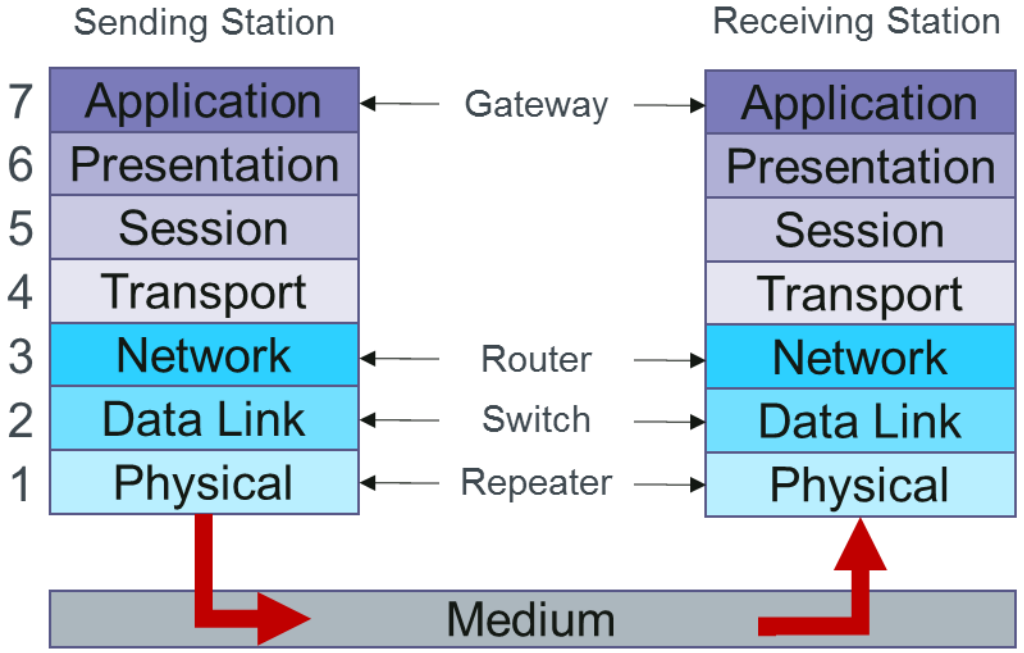
The OSI Model - Overview

Open system interconnection

Standardize network communications

Compartmentalize who is responsible for what

Please	1. Physical
Do	2. Data Link
Not	3. Network
Throw	4. Transport
Sausage	5. Session
Pizza	6. Presentation
Away	7. Application



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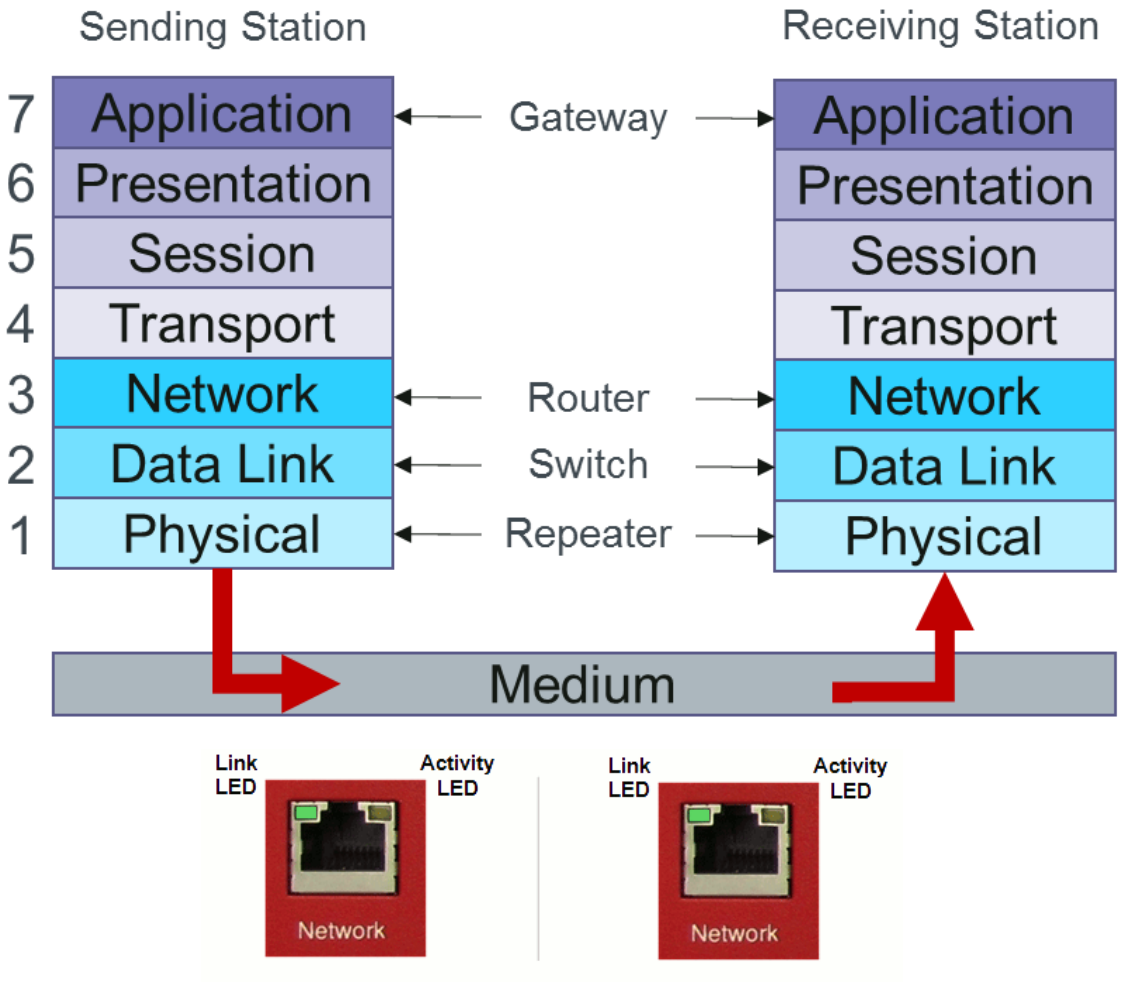
The OSI Model - Overview

Physical – Layer 1

Electrical and physical specifications for the networking media.

- Examples: Ethernet, RS-232



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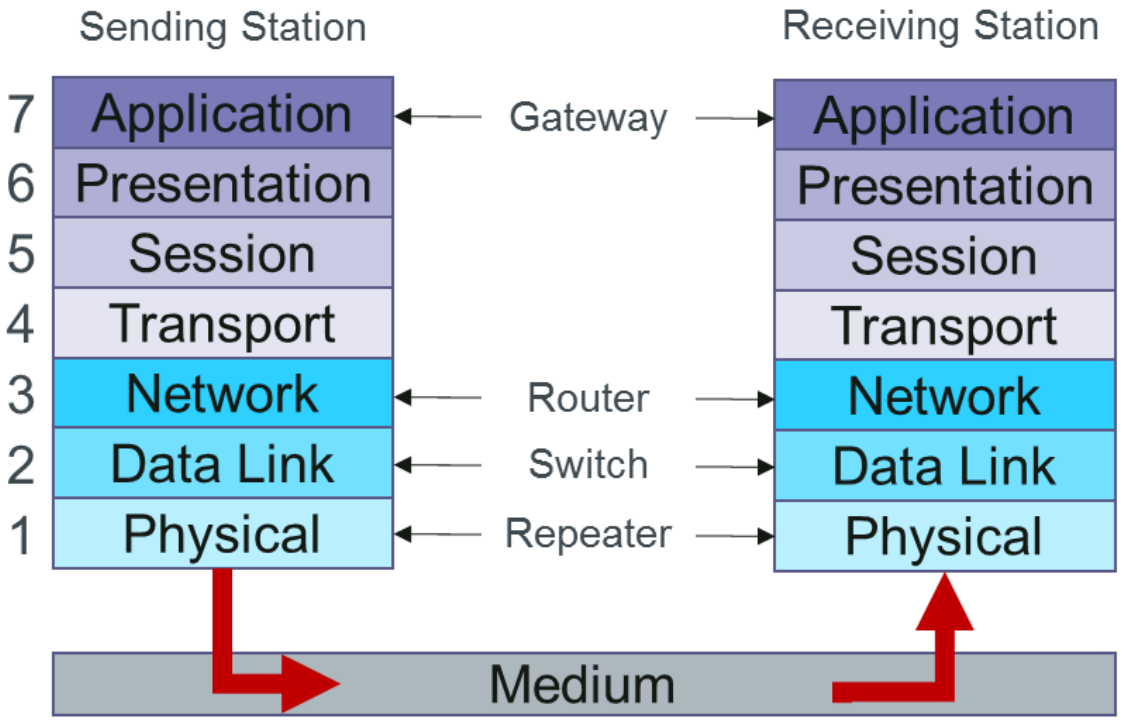
The OSI Model - Overview

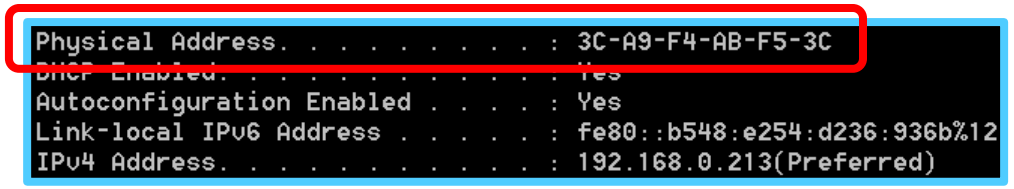
Data Link – Layer 2

Linkages and mechanisms used to move data about the network.

Topologies that deal with the ways in which data is reliably transmitted.

- Examples: Ethernet, MAC, LLDP, VLAN, and STP





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The OSI Model - Overview

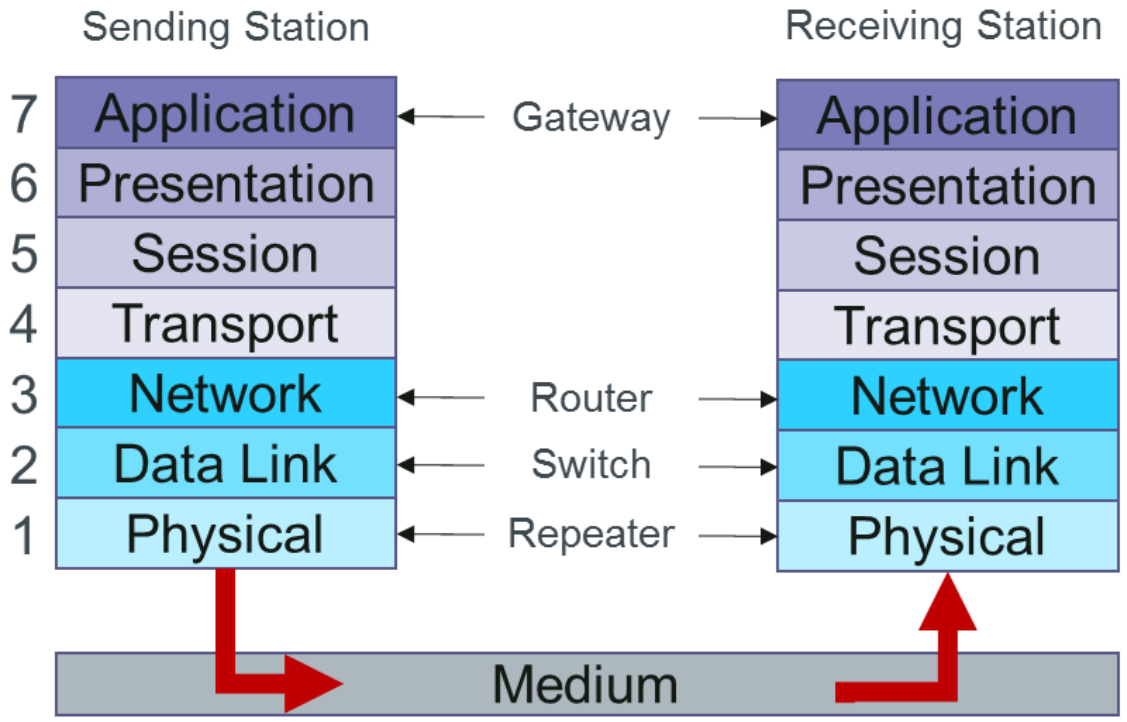
Network – Layer 3

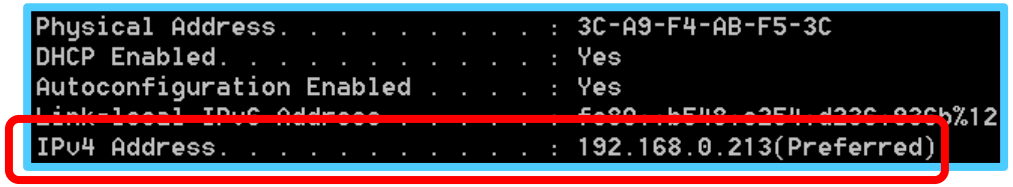
Routing.

Defines the processes used to route data across the network

Defines the structure and use of logical addressing.

- Examples: IPv4, IPv6, IGMP, PIM





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The OSI Model - Overview

Transport – Layer 4

Disassembly and assembly of the data before and after transmission.

- Examples: TCP, UDP, RTSP

Session – Layer 5

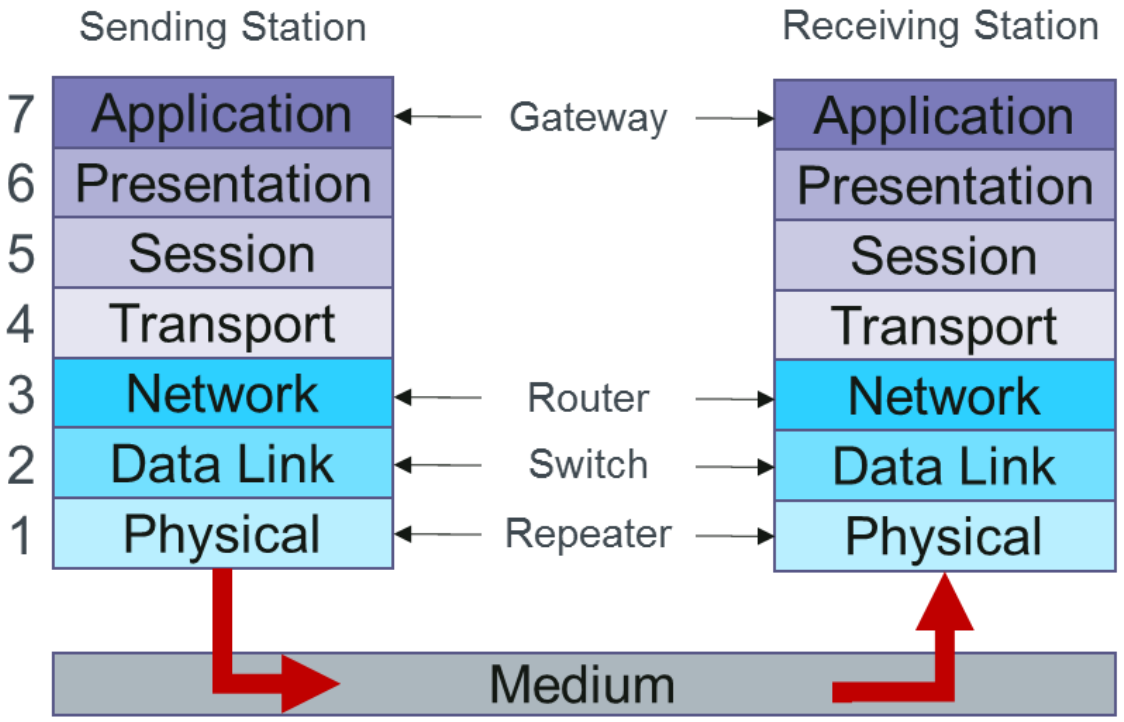
Establishes, maintains, and manages the communication between computers.

Presentation – Layer 6

Data representation and code formatting.

Application – Layer 7

Application and user interaction



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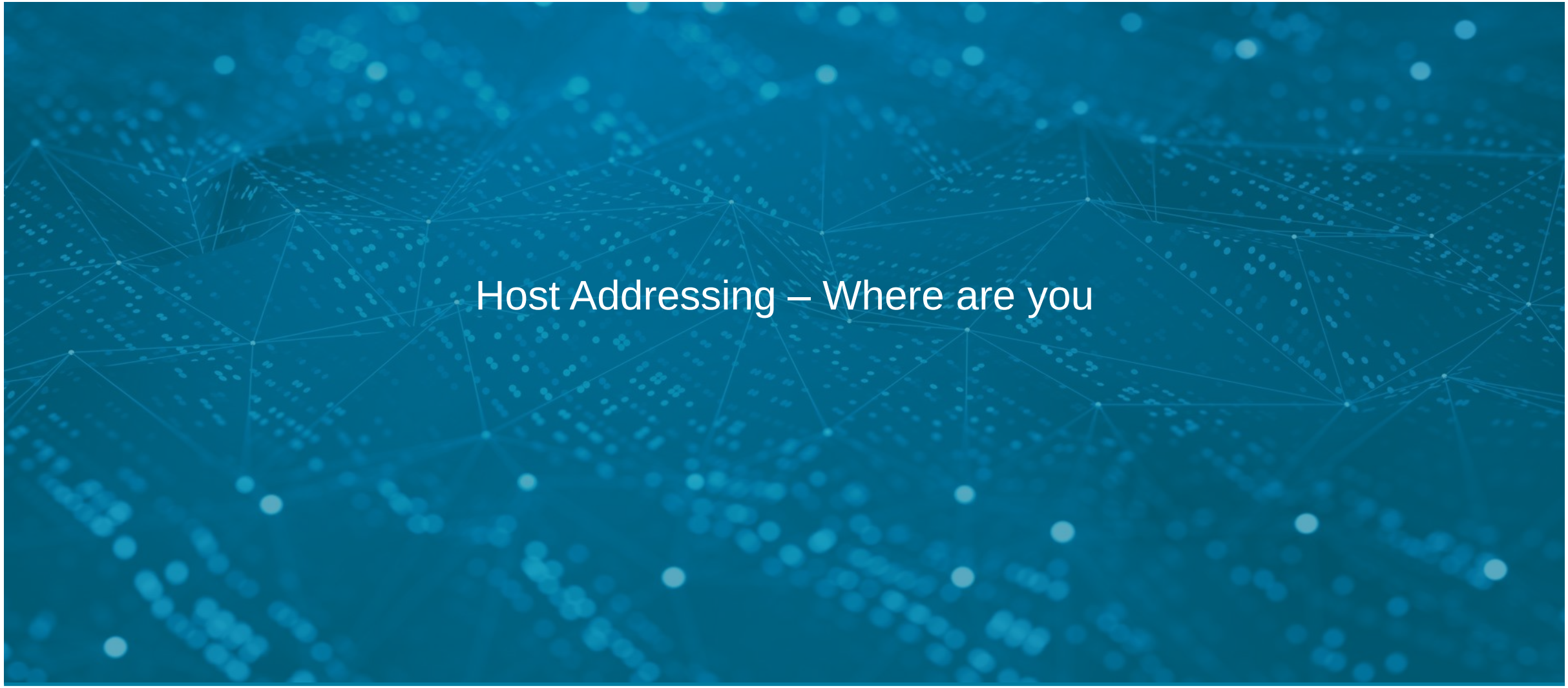


Host Addressing – Where are you

Host Identification Addresses

MAC Address

IP Address / Subnet Mask

Network Management

Subnetting

Virtual Local Area Network (VLAN)

Host Addressing – Where are you

MAC Address

Layer 2 of the OSI model

Associated with a device's NIC (Network Interface Card)

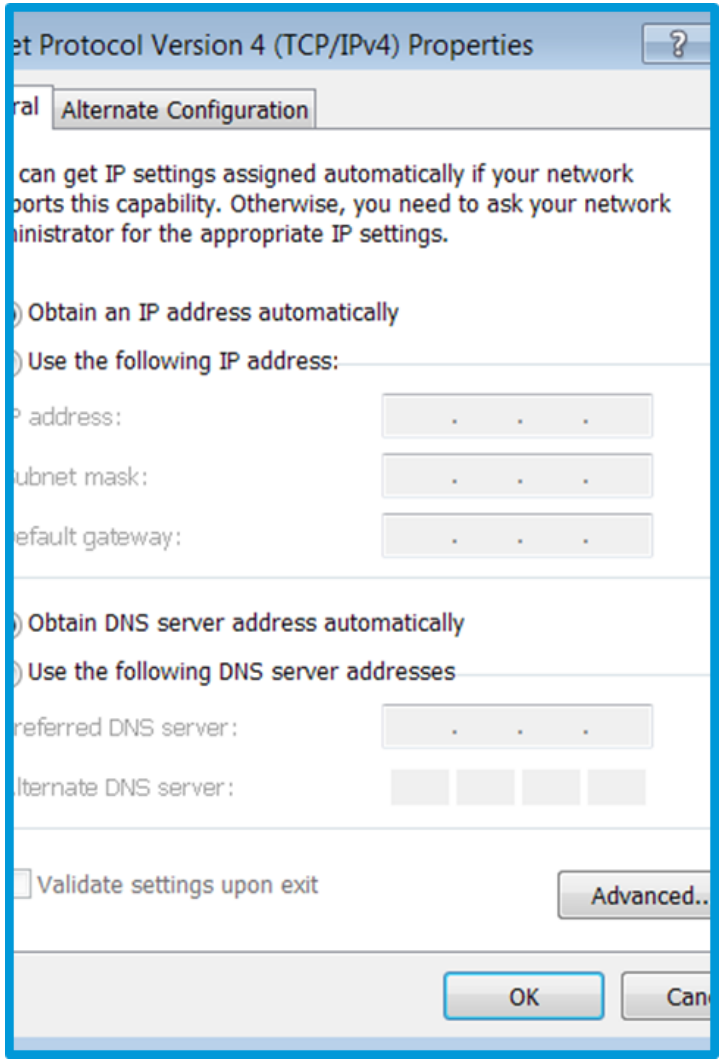
Set by the manufacturer

- Crestron – 00:10:7f:xx:xx:xx

MAC address = physical address

Uses hexadecimal notation

Host Addressing – Where are you



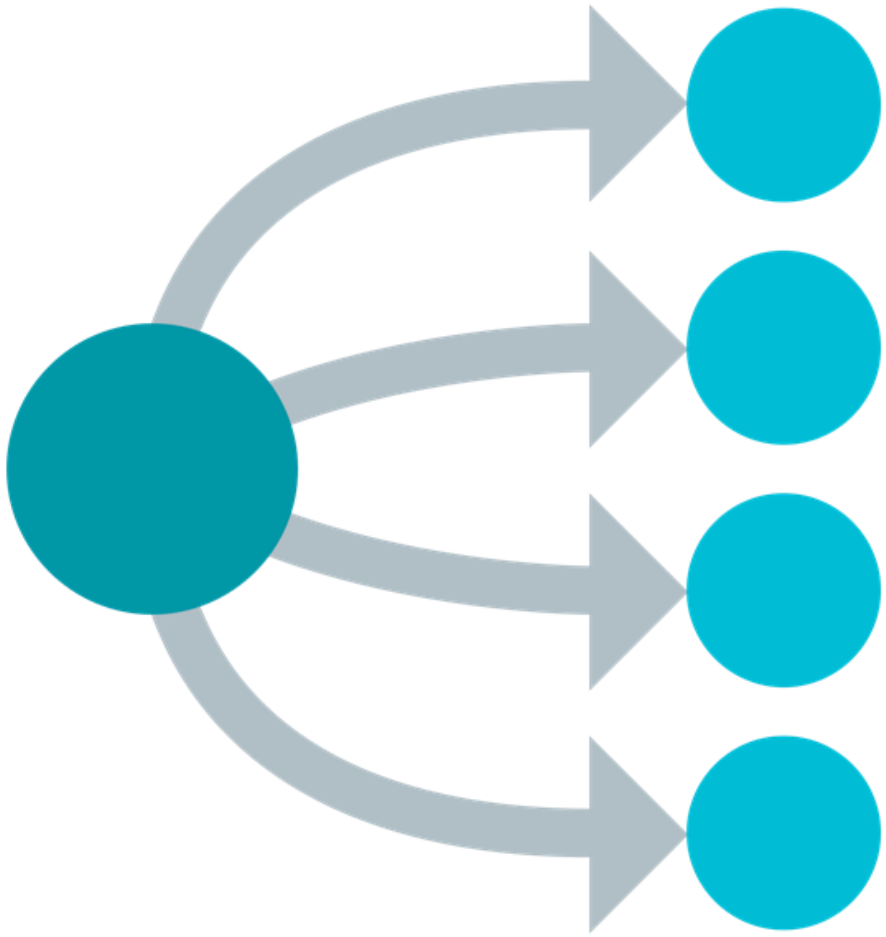
IP Address

Layer 3 of the OSI model

IP address = logical address

- Uses dot-decimal notation

Host Addressing – Where are you



IP Address

We see = 192.168.1.155

The network sees

- 11000000101010000000000110011011

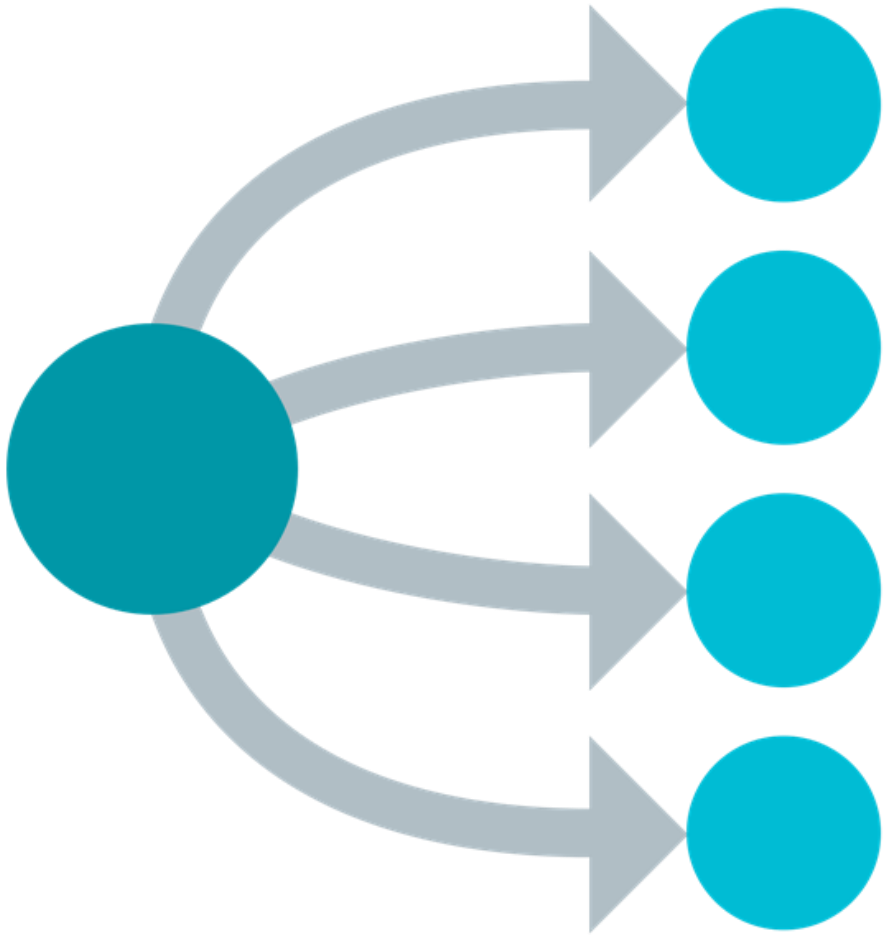
This 32-bit sequence of 0’s and 1’s is divided into four groups of 8 bits or octets

11000000(.)10101000(.)00000001(.)10011011

Each octet holds a decimal value from 0 to 255

An IP address hold both the network address and the host address.

Host Addressing – Where are you



Subnet Mask

We see = 255.255.255.0

The network sees

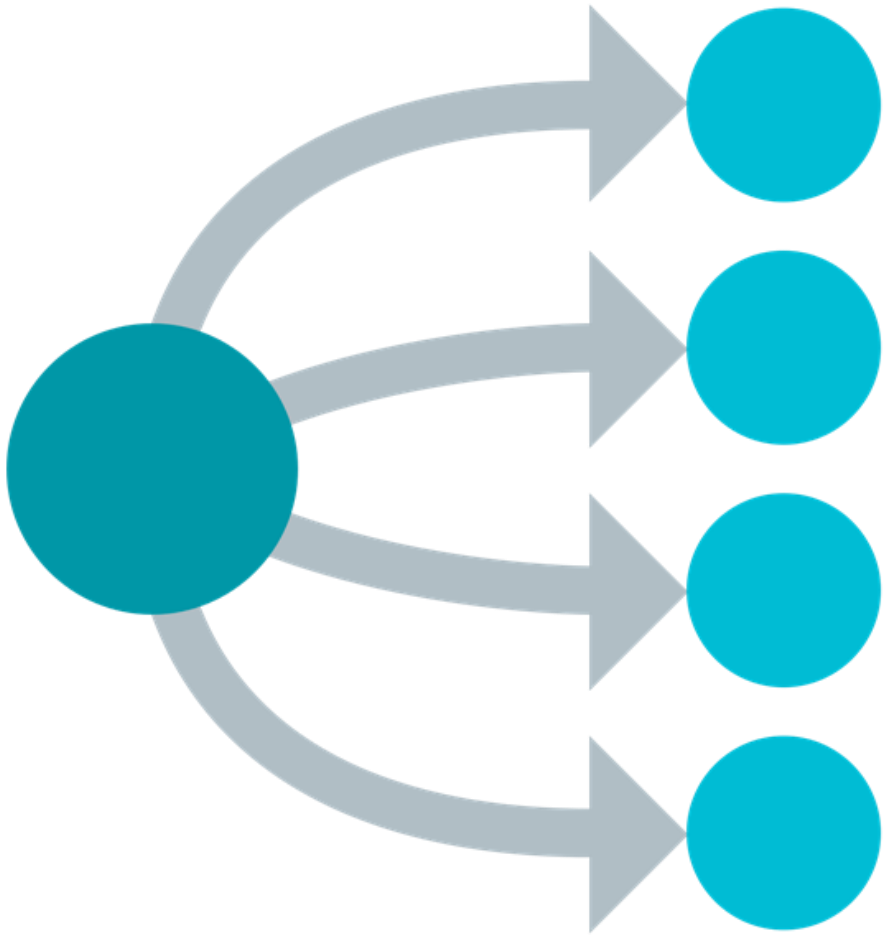
- 11111111111111111111111100000000

This 32-bit sequence of 0's and 1's is divided into four groups of 8 bits or octets

11111111(.)11111111(.)11111111(.)00000000

- Mask bits with a value of 1 set aside bits in the corresponding IP address for network addresses
- Mask bits with a value of 0 set aside bits in the corresponding IP address

Host Addressing – Where are you



Putting Address Together

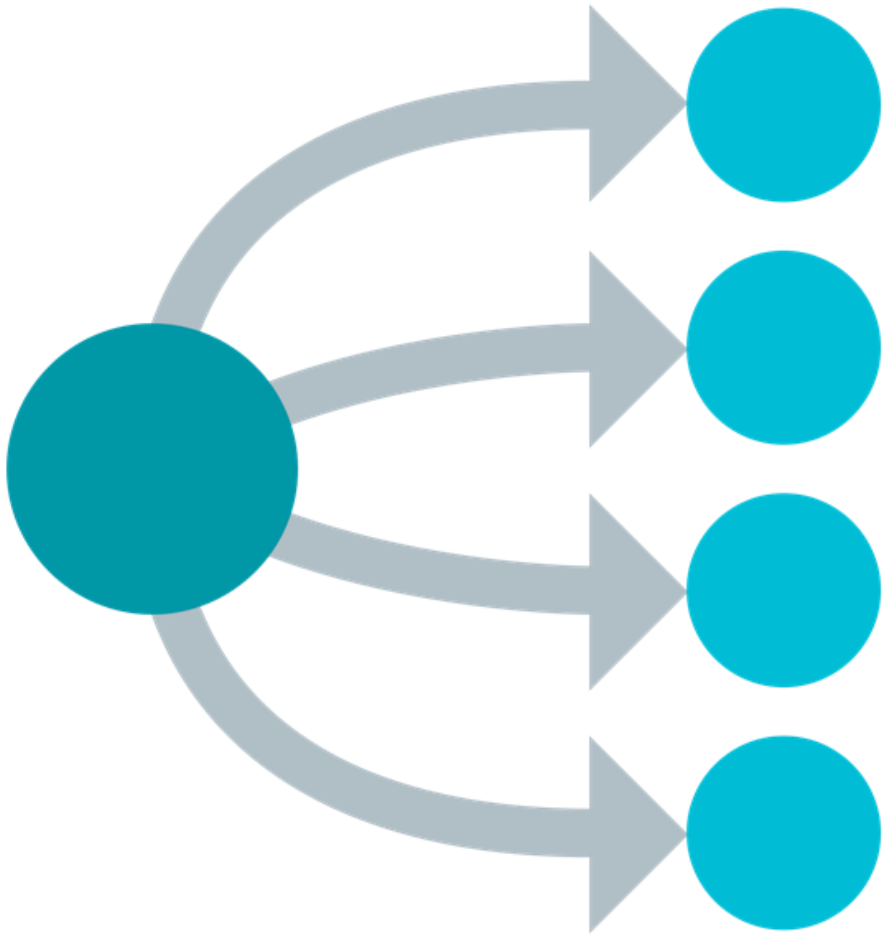
Our Example

- IP Address 192.168.1.155
- Subnet Mask 255.255.255.0

192.168.1.X is the network the host resides on

155 is the address of the host itself

Host Addressing – Where are you



Virtual Local Area Network (VLAN)

Host Management

VLAN's are a way to group network switch interfaces (ports) into smaller networks for management purposes.

Example

- Video
- Audio
- Lighting
- Control

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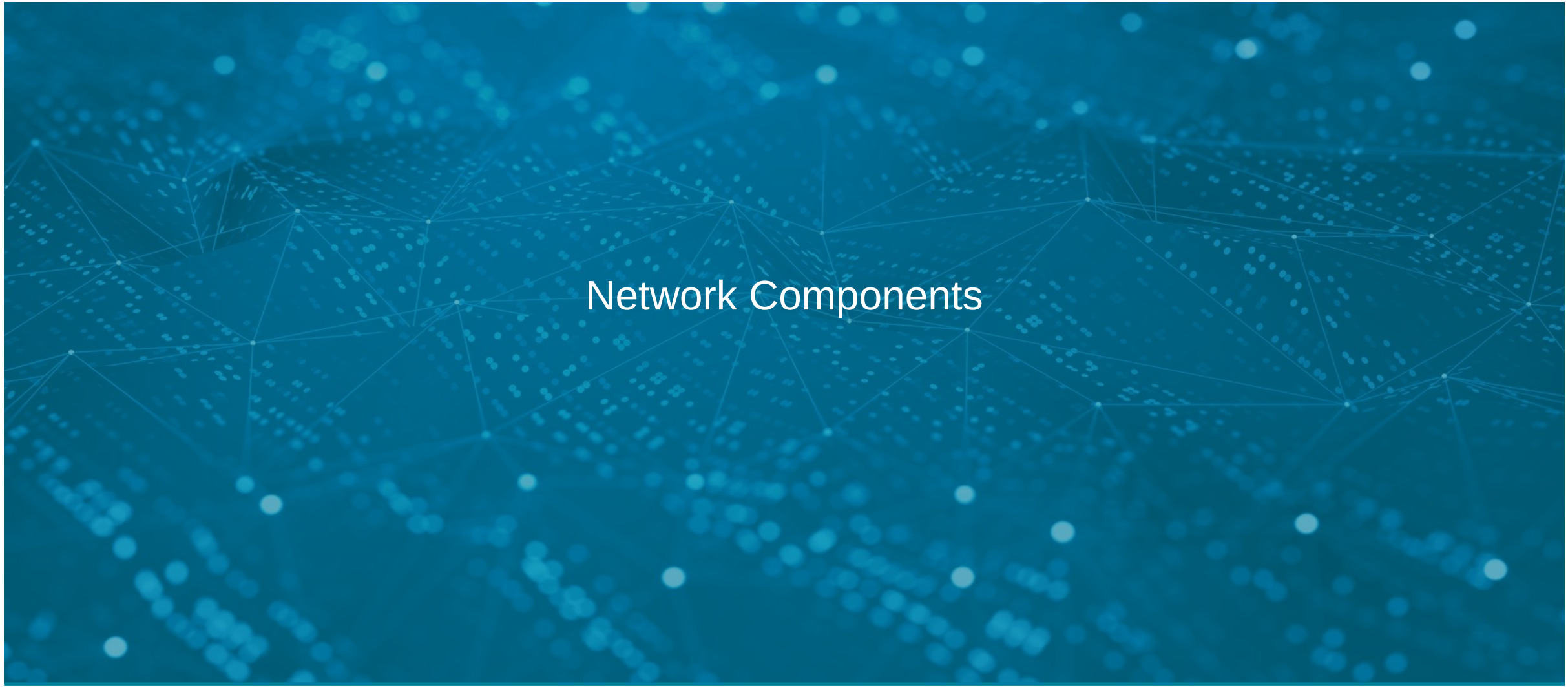


Network Components - Switches

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

Network Components - 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.

Network Components - Switches

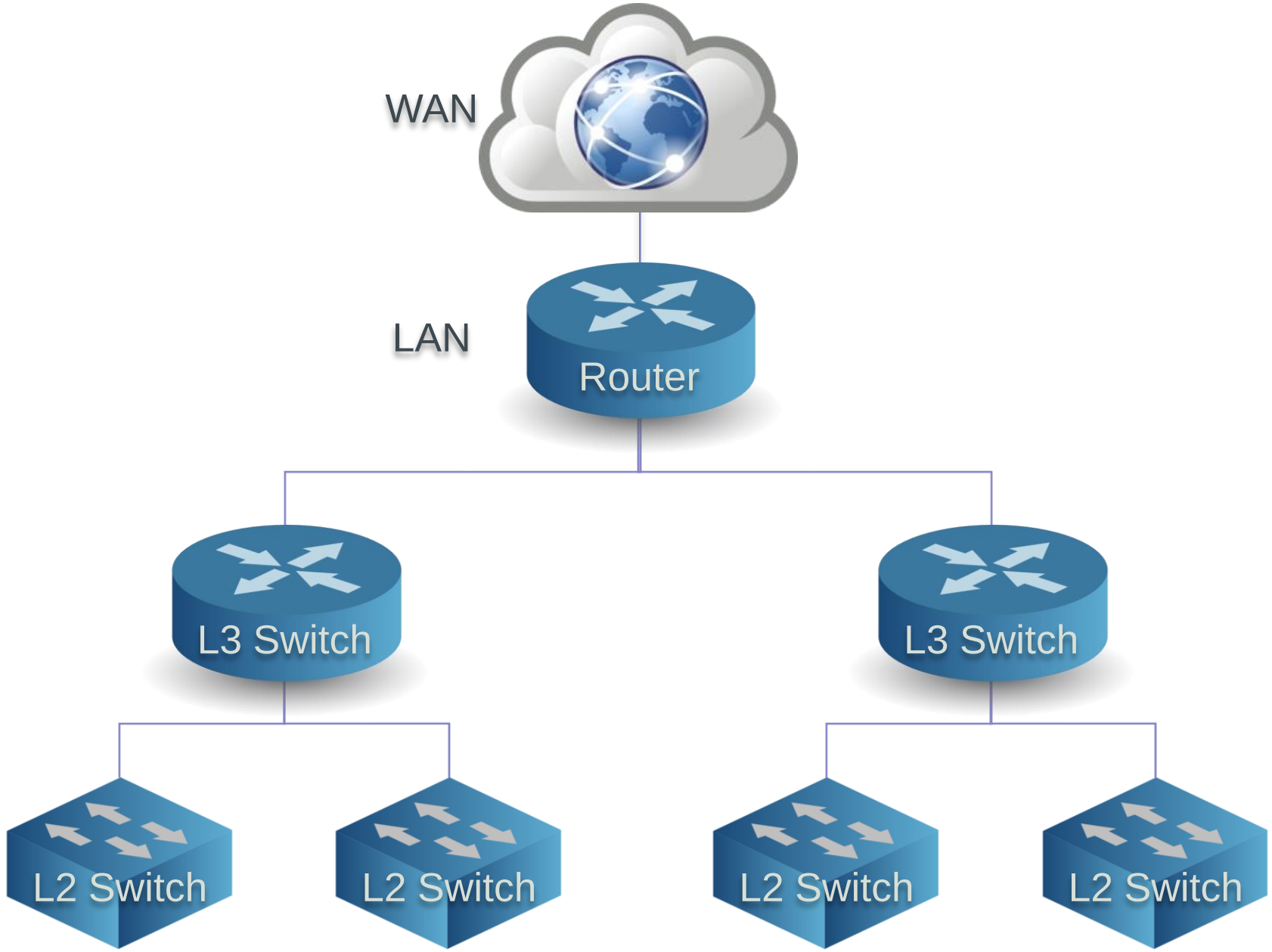
Layer 2 vs. Layer 3

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


WAN
LAN
Router
L3 Switch
L3 Switch
L2 Switch
L2 Switch
L2 Switch
L2 Switch

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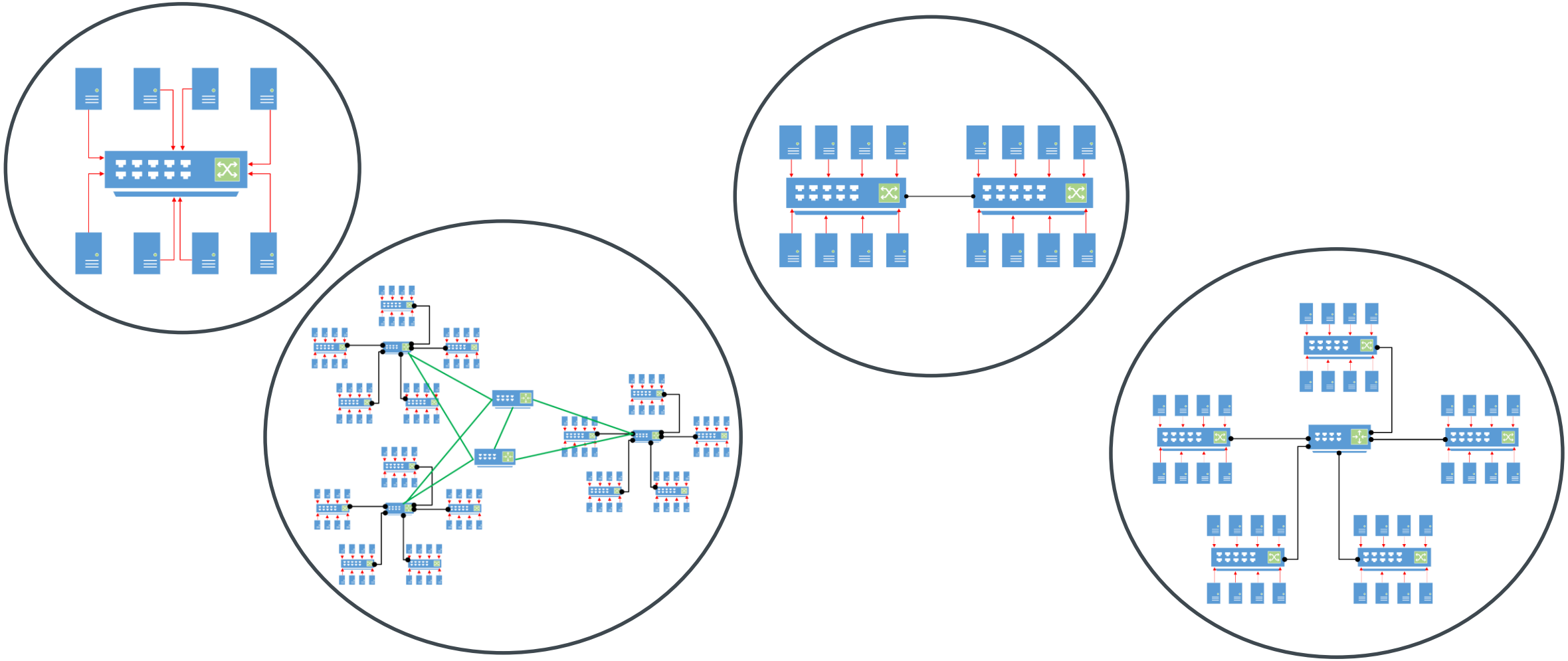
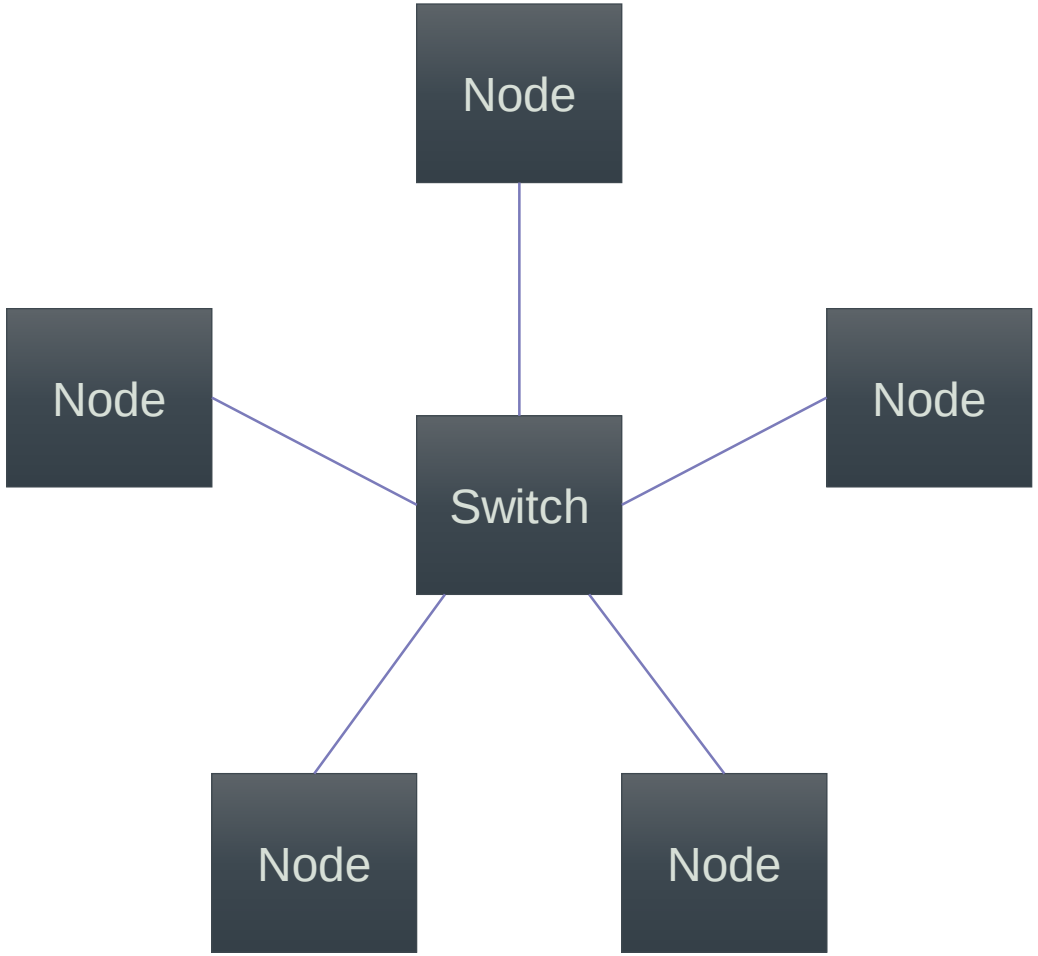
Network Topologies

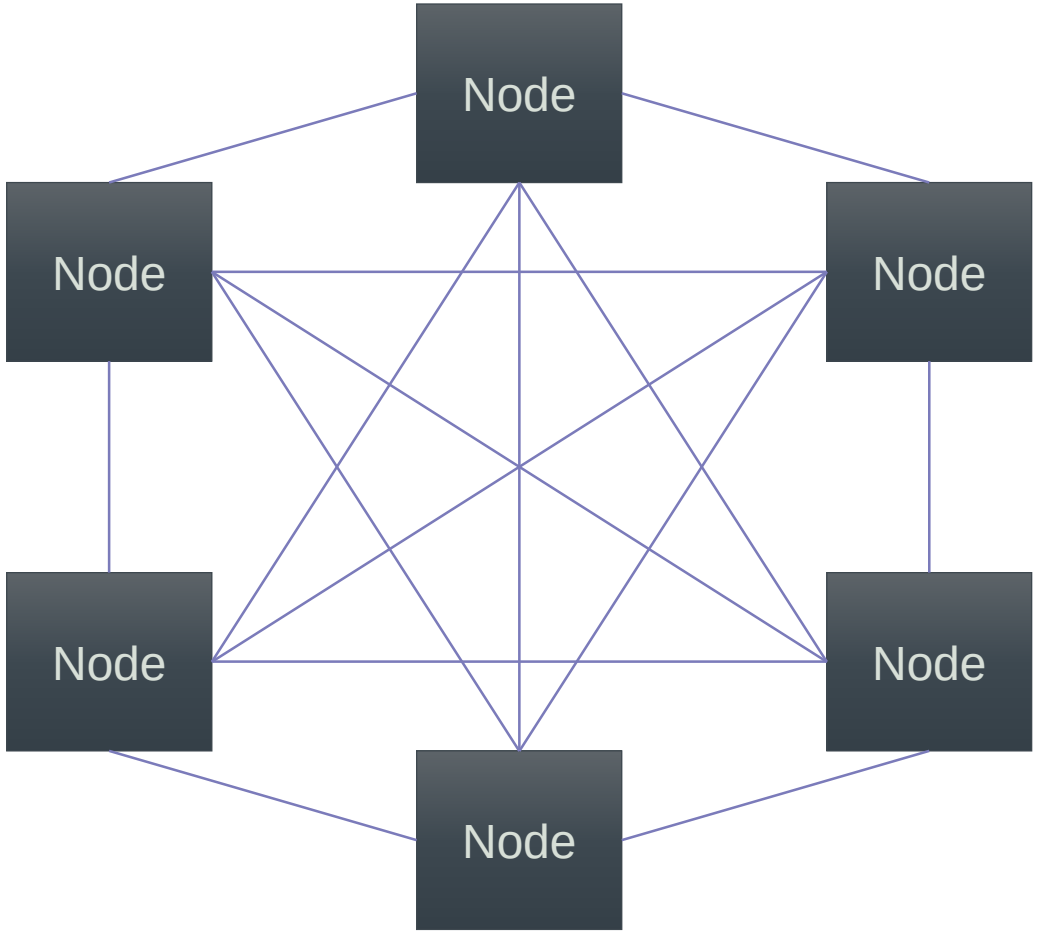


Network Topologies – Point-to-point

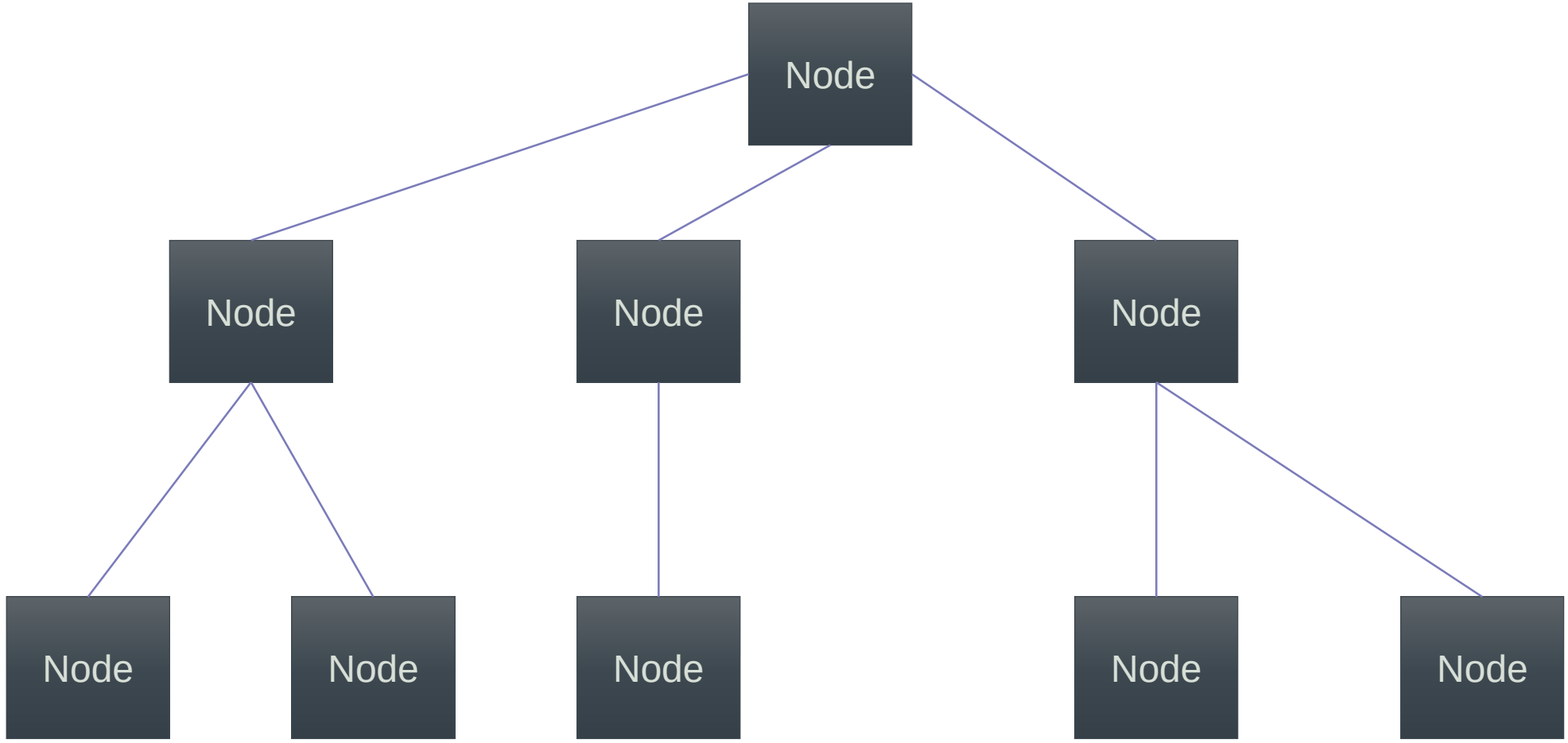
Network Topologies – Star

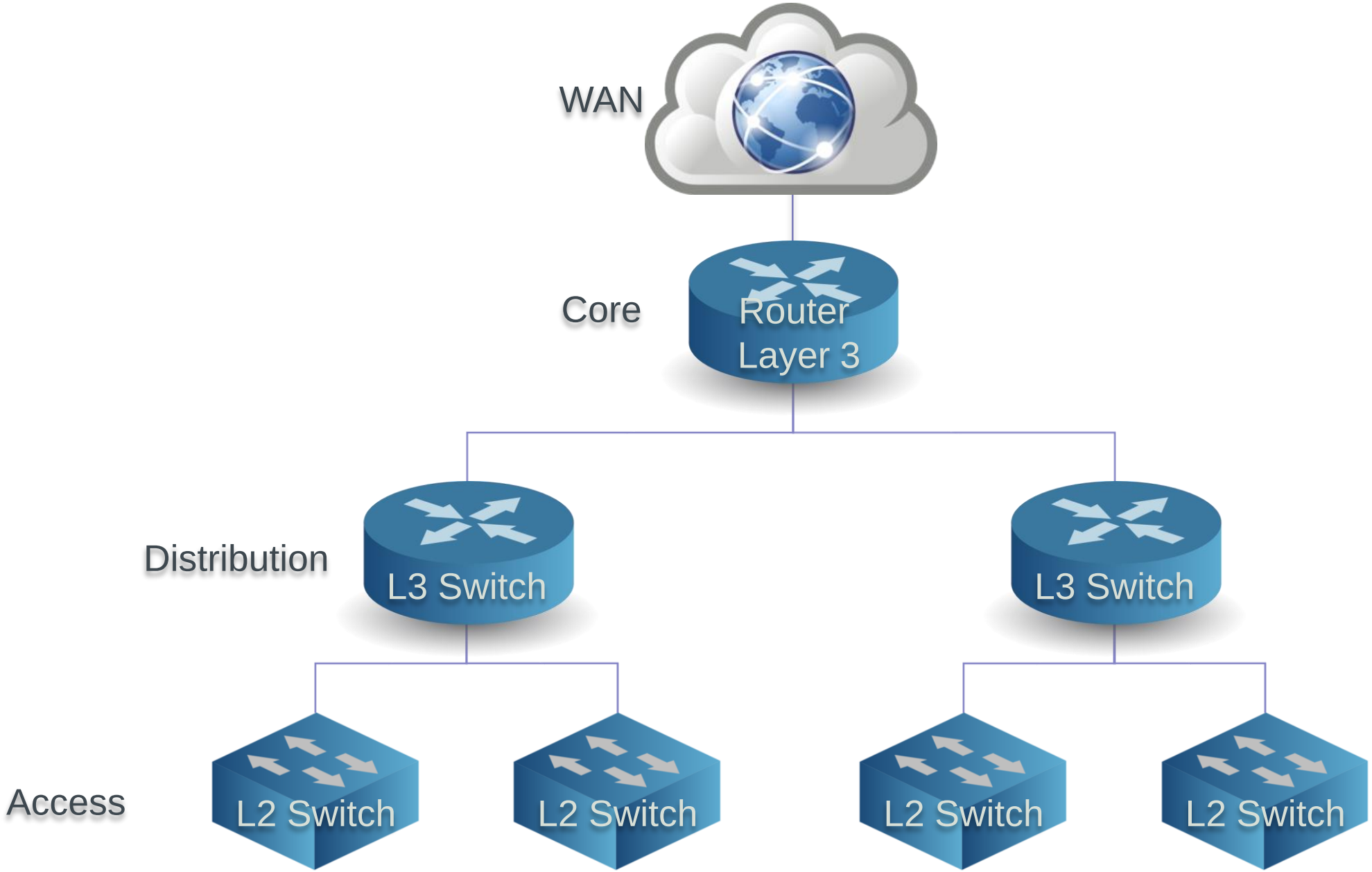


Network Topologies – Mesh



Network Topologies – Tree (Hierarchy)




WAN
Core
Router
Layer 3
Distribution
L3 Switch
L3 Switch
Access
L2 Switch
L2 Switch
L2 Switch
L2 Switch

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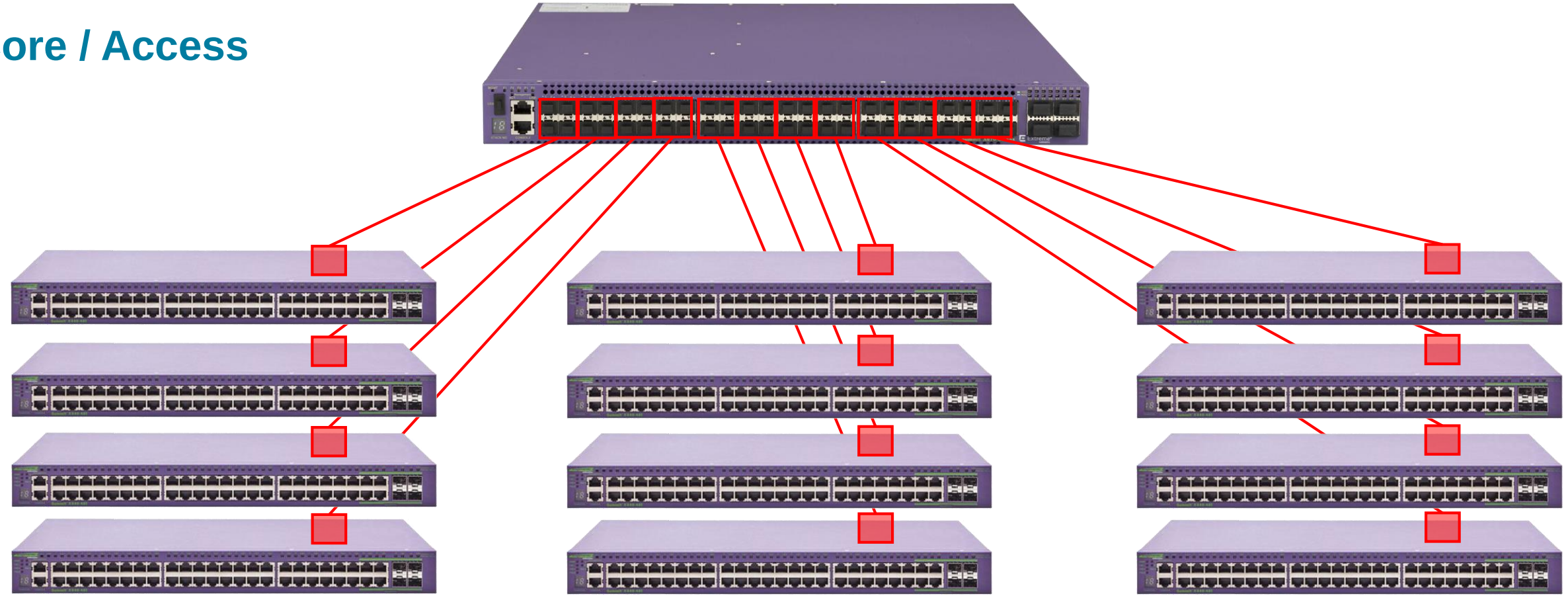
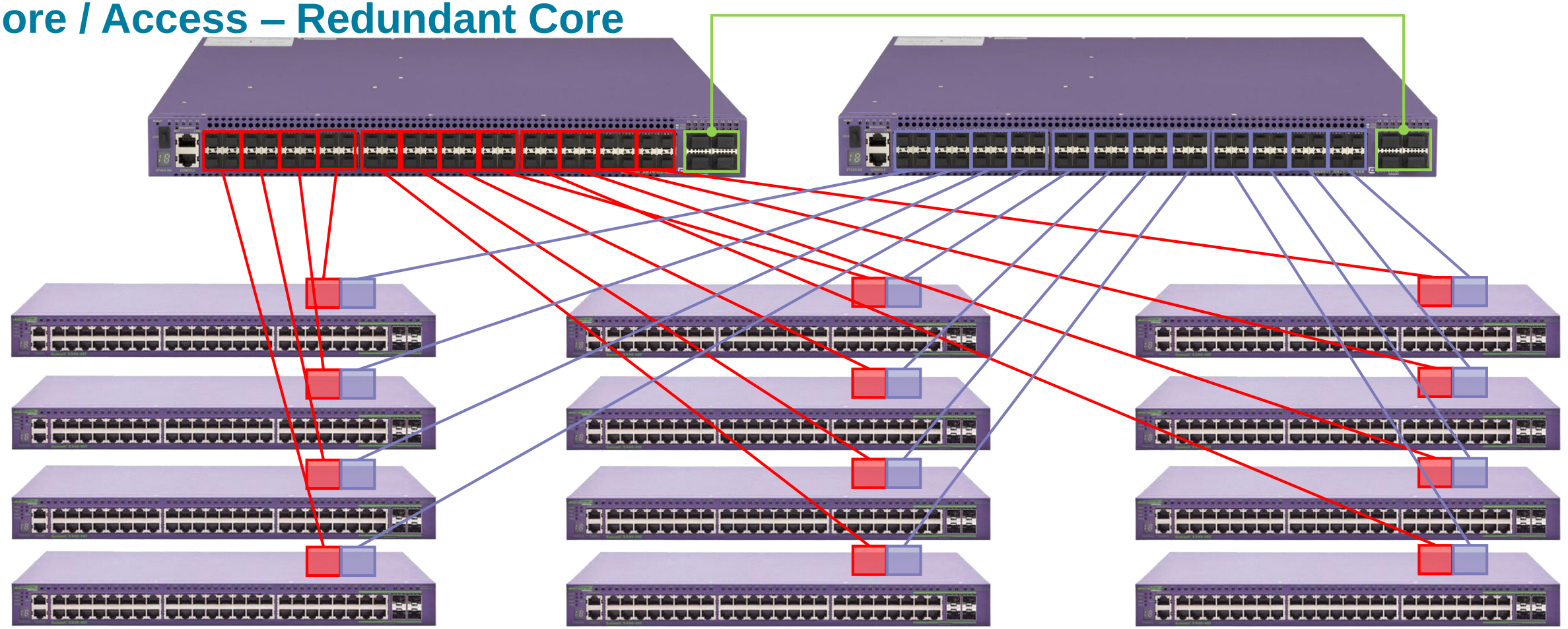
Network Topologies

Core / Access

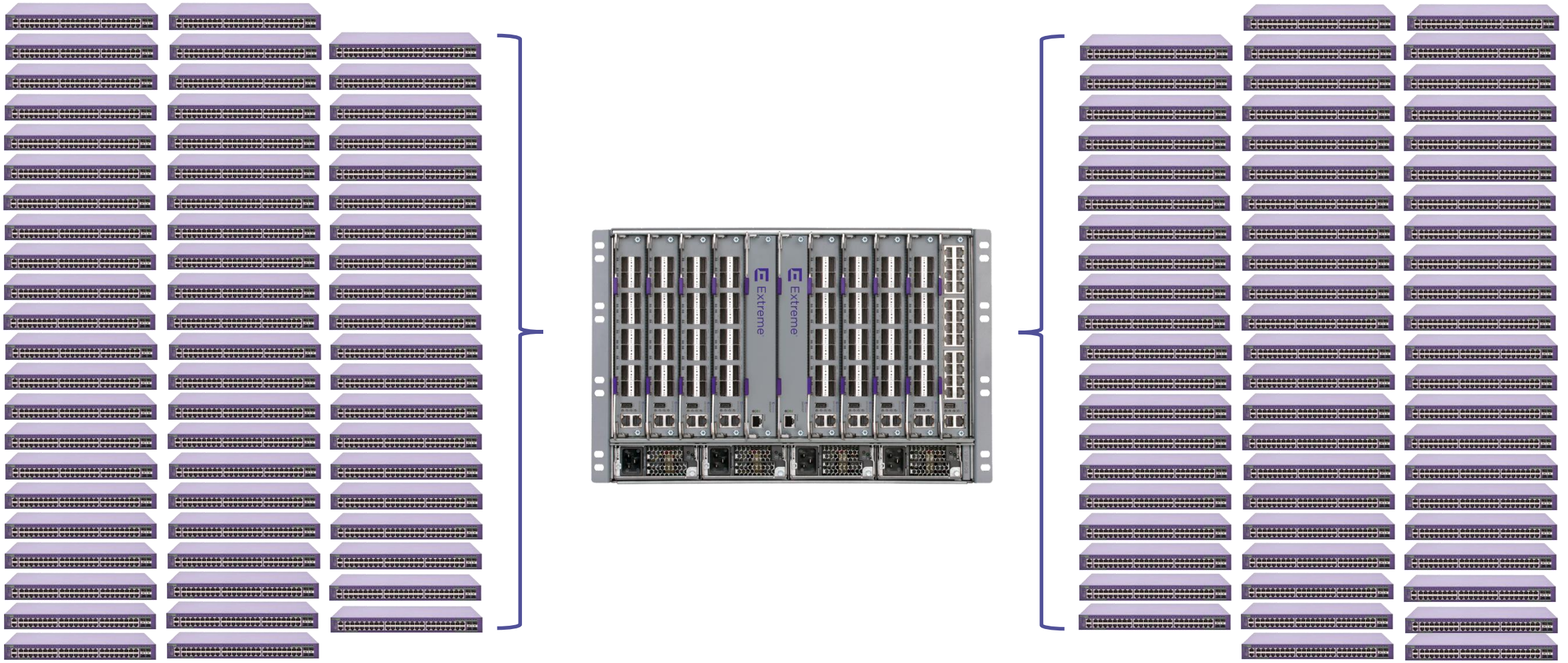


Network Topologies

Core / Access – Redundant Core



Network Topologies



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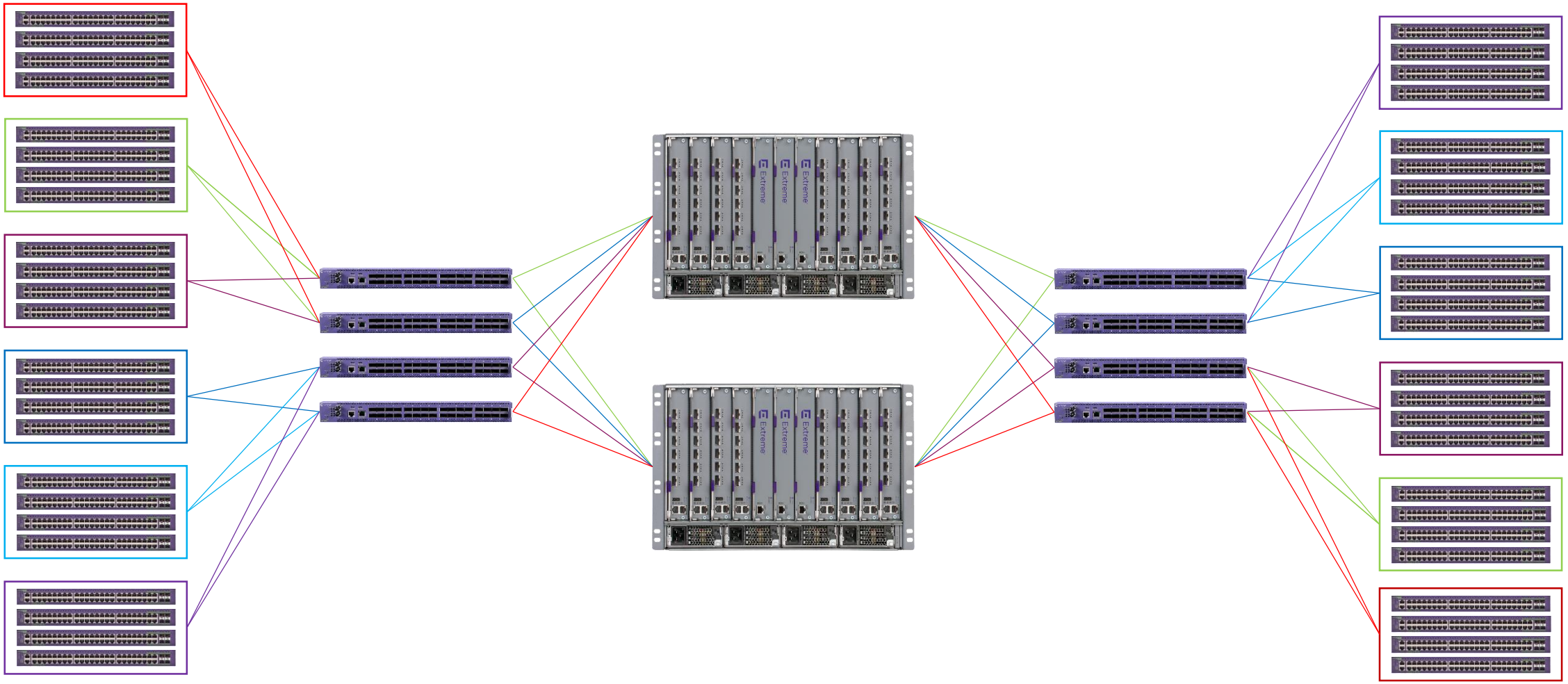
Network Topologies



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Success comes from organization

How many connections

IP Scheme

VLAN’s

Control System(s)

Most important

TALK TO IT!!!!!!!!!!!!!