February 24, 2021
11:30AM to 12:30PM

Training Series

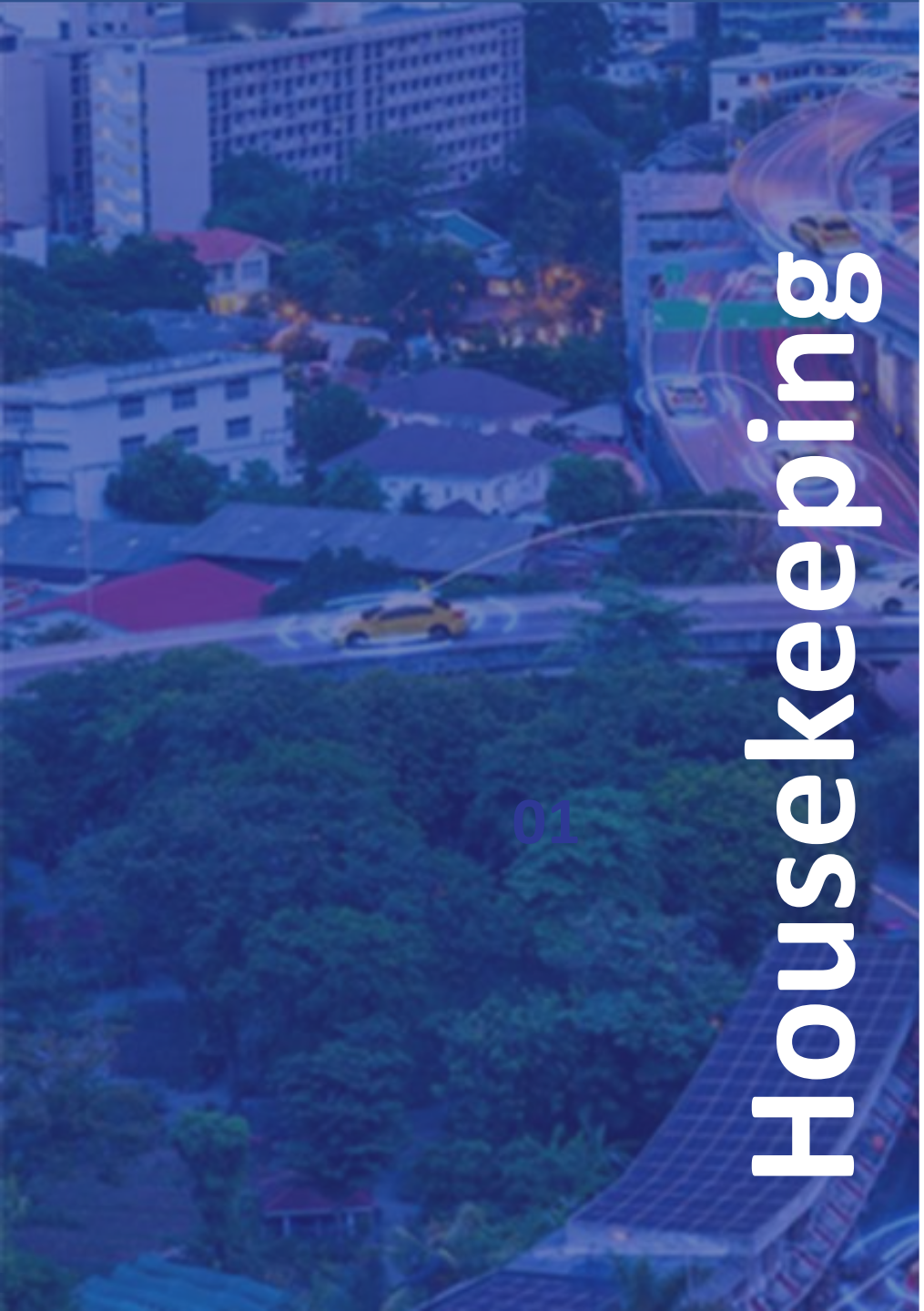
ITE Southern California Presents

"Introduction to ITS Networking"

Learn network communications best practices and how to interconnect devices with different types of communication media. In addition to technology, real world hands-on examples of how companies connect their devices will be provided.

Agenda:

- Networking Basics: Media Types, MAC Addressing VLANs and IP Addressing
- Network Best Practices



Housekeeping

01 Please input questions in the “Questions”

02 Q&A may be available at the end as time permits

03 Responses to questions unanswered will be emailed

04 Copy of recording will be available

Quick Poll!

Introduction to ITS Networking

EtherWAN
When Connectivity is Crucial

AGENDA

01 OSI Layer
- How does networking work and where is it in ITS?

02 Media
- Things you need to know about fiber, copper, and wireless

03 Layer 2
- The specification calls for a Layer 2 switch but what does it mean?

04 Best Practices

Meet the **Presenters**

Shub Gupta
Network Sales Engineer

Jei Mercado
Regional Sales Manager

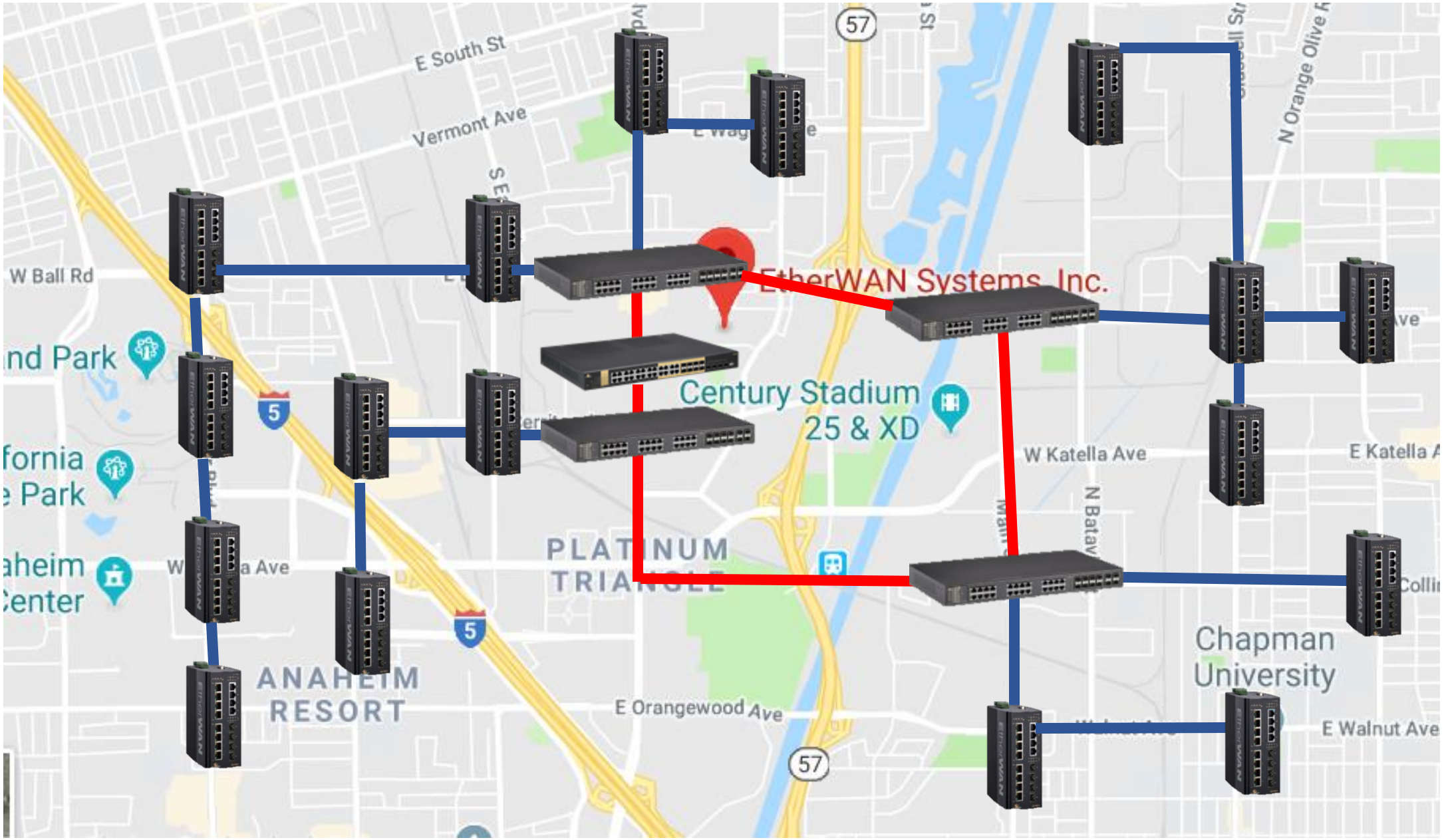
What is ITS Networking?

What is our ITS Networking Experience ?

- Communication Infrastructure Upgrade
- Fixing Intermittent Issues
- Mixed Vendor Network
- Redundant Network Design
- Broadcast Storm – Signal Flash
- Video Wall and Video Management Systems
- Network Analysis (Network Utilization and Vulnerabilities)
- Network Migration
- Security Management

What is ITS Networking to us?

1. The ability to communicate to devices in the field and configure or monitor their statuses without having to open a traffic cabinet.
2. To securely and reliably maintain connectivity despite unforeseen issues.
3. To have the ability to scale and adapt to new technologies.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Vermont Ave
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PLATINUM
TRIANGLE
ANAHEIM
RESORT
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Chapman
University
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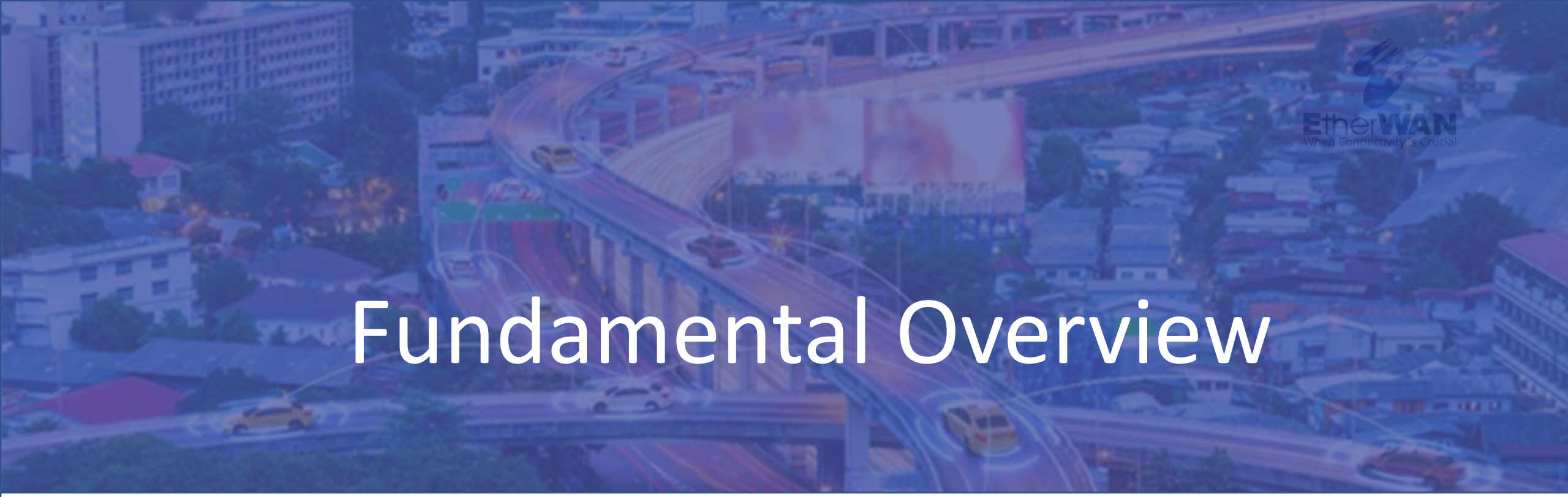


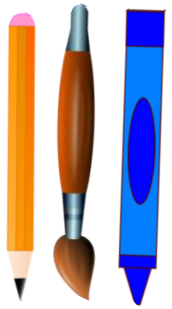
Fundamental Overview

OSI Model Overview

Story	OSI Layer	Layer Name	Examples
Paper	7	Application	Web, Telnet, Email
Writing Tool	6	Presentation	Text, Pictures, Video
Envelope	5	Session	Handshaking Connection
Stamp	4	Transport	TCP, UDP
Zip Code	3	Network	IPv4, IPv6, ICMP, APSec, MPLS, ARP
Address	2	Data Link	802.1x, Ethernet, MAC Addresses
Truck	1	Physical	Cables, Connectors, 10Base Standards, VDSL, ISDN, 802.11

Mailing a Letter Compared to Networking

Layer 7
Application
(Paper)



Layer 6
Presentation
(Writing Tool)

Layer 5
Session
(Envelope)

Layer 4
Transport
(Stamp)

Layer 3
Network
(Zip Code)

Layer 2
Data Link
(Address)

Layer 1
Physical
(Truck)

Example of OSI Model

Sender

Application
Presentation
Session
Transport
Network
Data link
Physical

Neighborhood

Switch

Data link
Physical

Post Office

Router

Network
Data link
Physical

Neighborhood

Switch

Data link
Physical

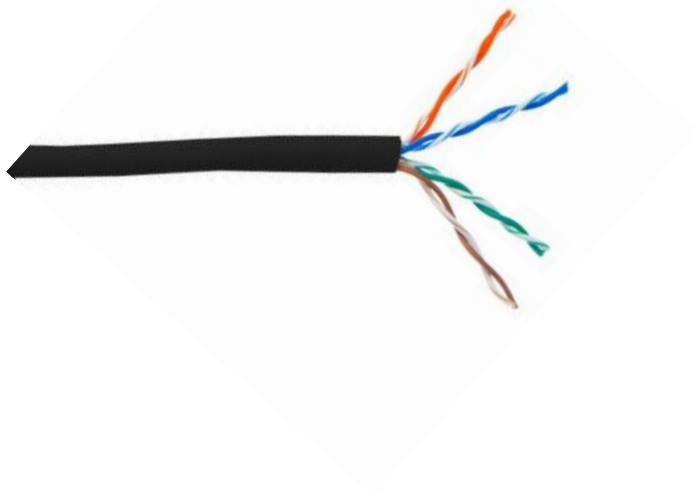
Receiver

Application
Presentation
Session
Transport
Network
Data link
Physical

Layer 1 Physical Layer

Layer 1 – Physical Layer

Copper Interconnect

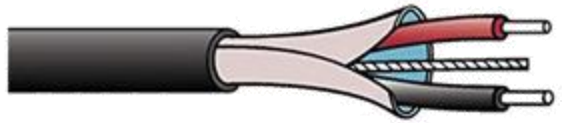


Fiber

Wireless/Cellular

Option #1 Deploying Fiber

Ethernet Extender over Copper, Coax and Alarm Cable

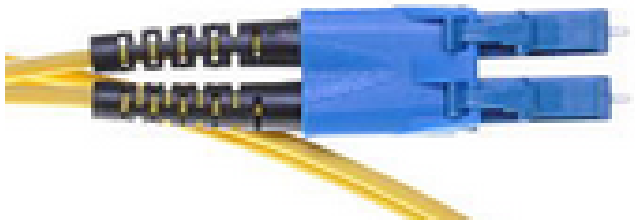


100 meters
(328 feet)
MAX

Fiber with SFP's (or Fixed Fiber)

Layer 1 – Types of Fiber Connectors

SC

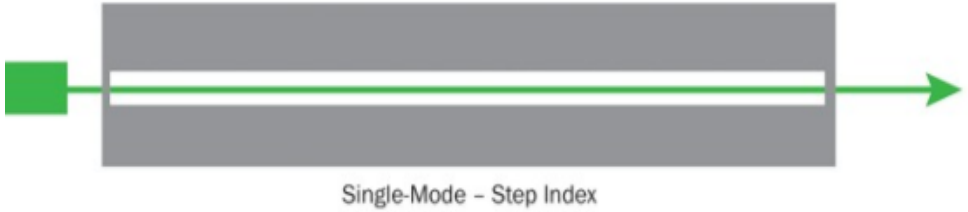


LC

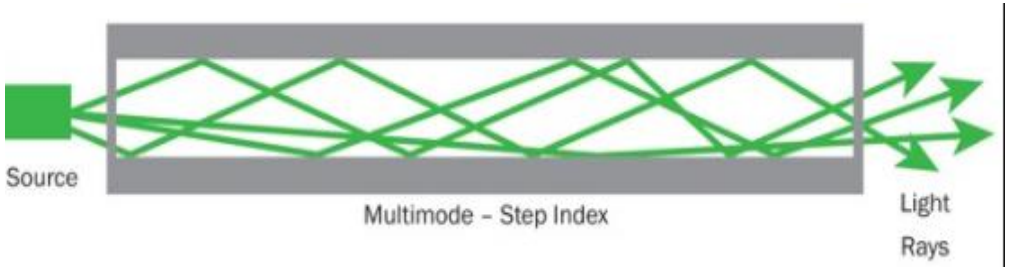
ST

Layer 1 – Types of Fiber

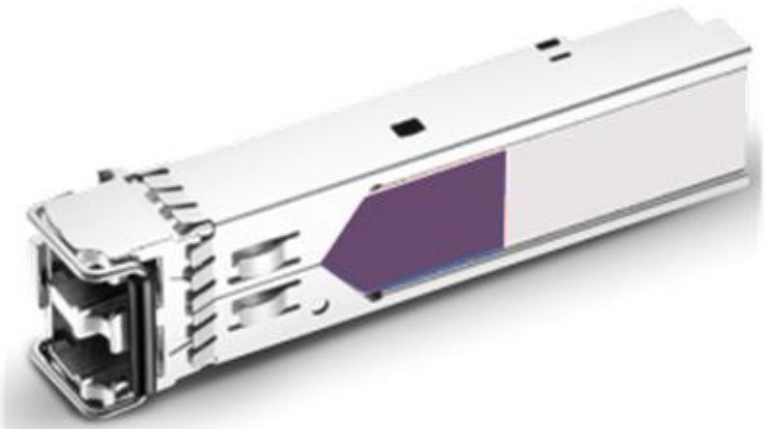
Single-Mode Fiber: Single ray of laser light



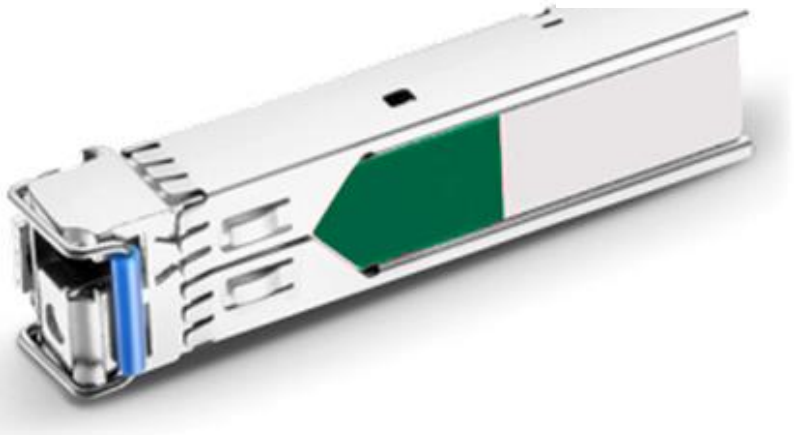
Multimode Fiber: Multiple rays of light with different reflection angles



Layer 1 – Simplex vs Duplex



Duplex SFP



Simplex SFP (BiDi)

Dual fiber port

Single fiber port

Layer 1 – Fixed vs SFP

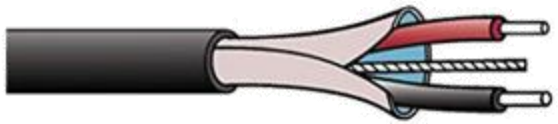
If fixed fiber fails, replace switch

Layer 1 – SFP Overview

- **S**mall **F**orm factor **P**luggable transceiver
  - Transceivers that have the fiber optics built-in
  - SFPs allow for ease of scalability due to the fact that SFPs can be swapped out for a different speed, distance, and type
  - SFPs also provide a low cost method of maintaining systems by allowing user to replace the SFPs rather than replacing the switch

Option #2: Use existing Copper Interconnect Cable

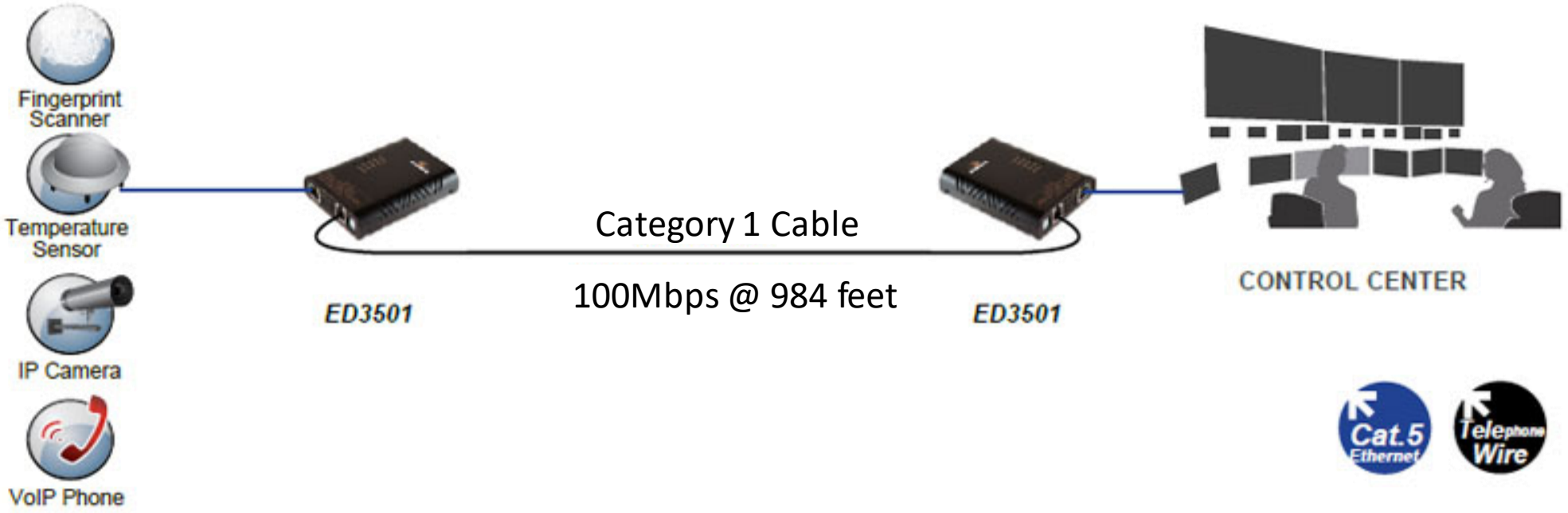
Ethernet Extender over Copper Interconnect



100 meters
(328 feet)
MAX

Fiber with SFP's (or Fixed Fiber)

Retrofitting with VDSL (Very-high-bit-rate digital subscriber line)

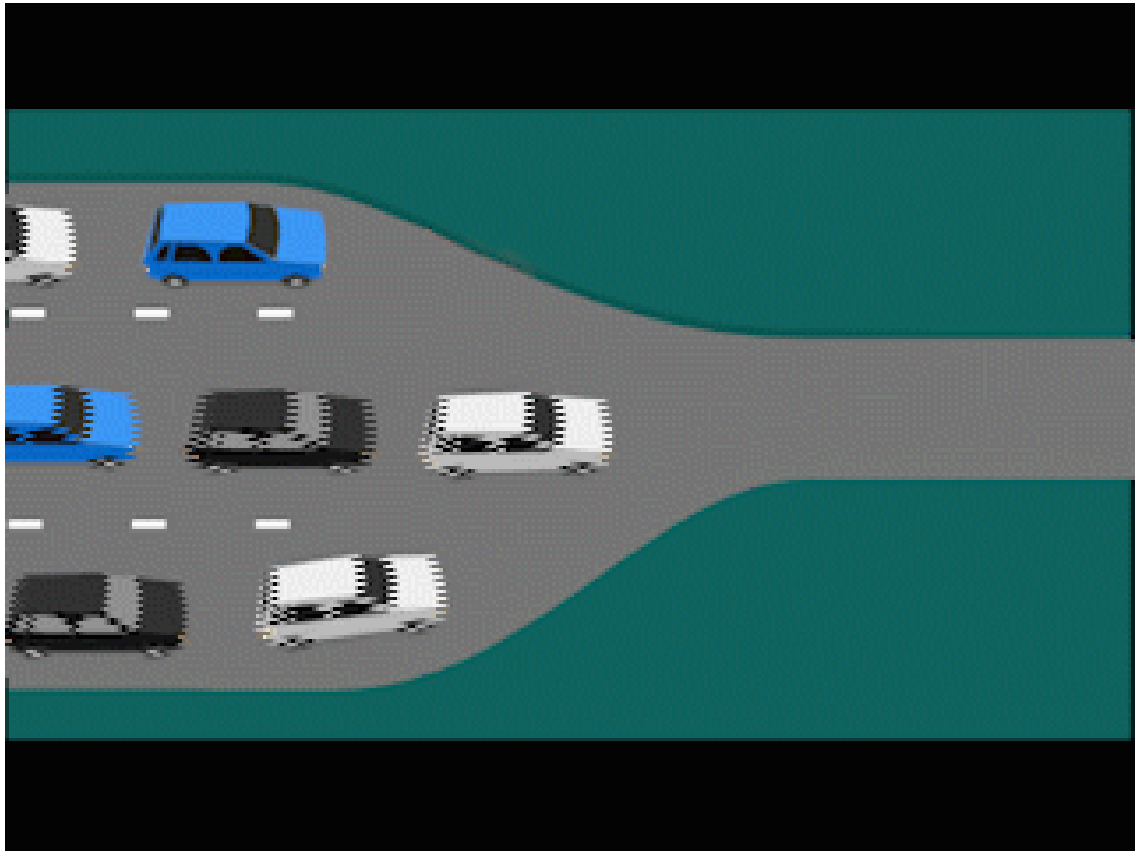


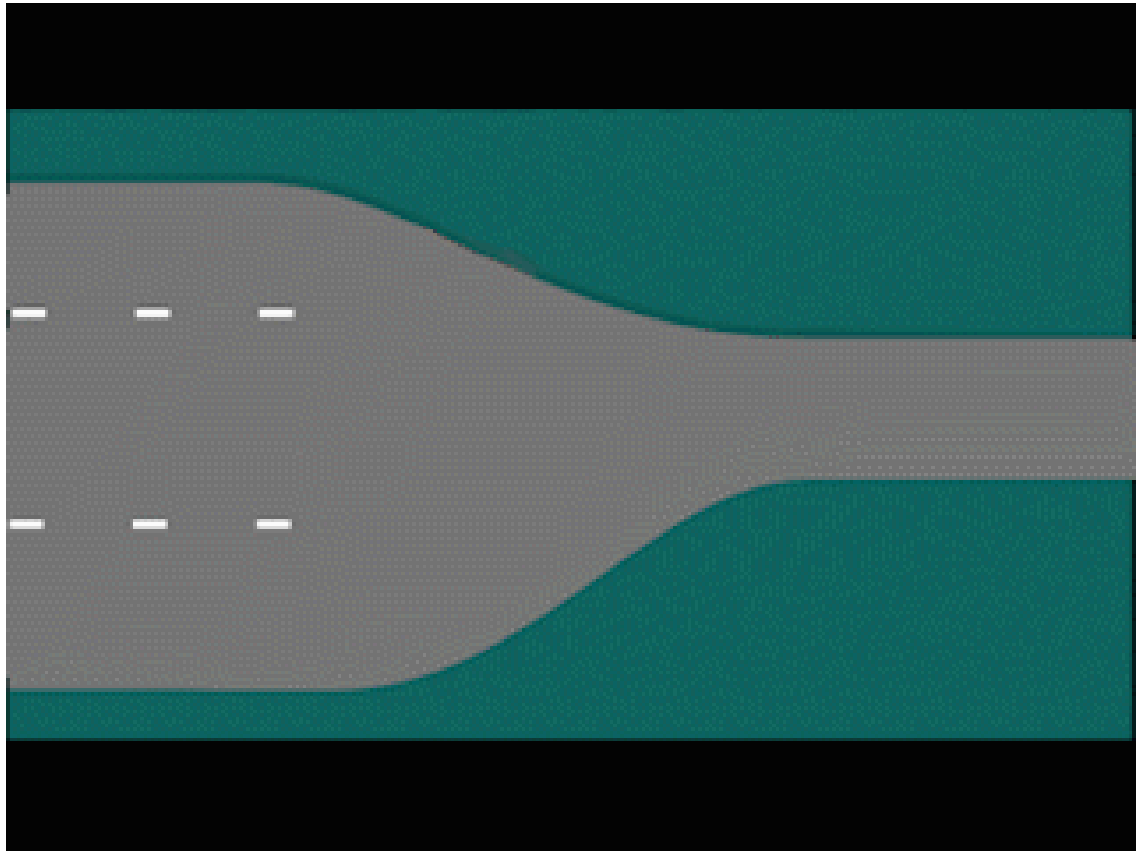
Quick Poll!

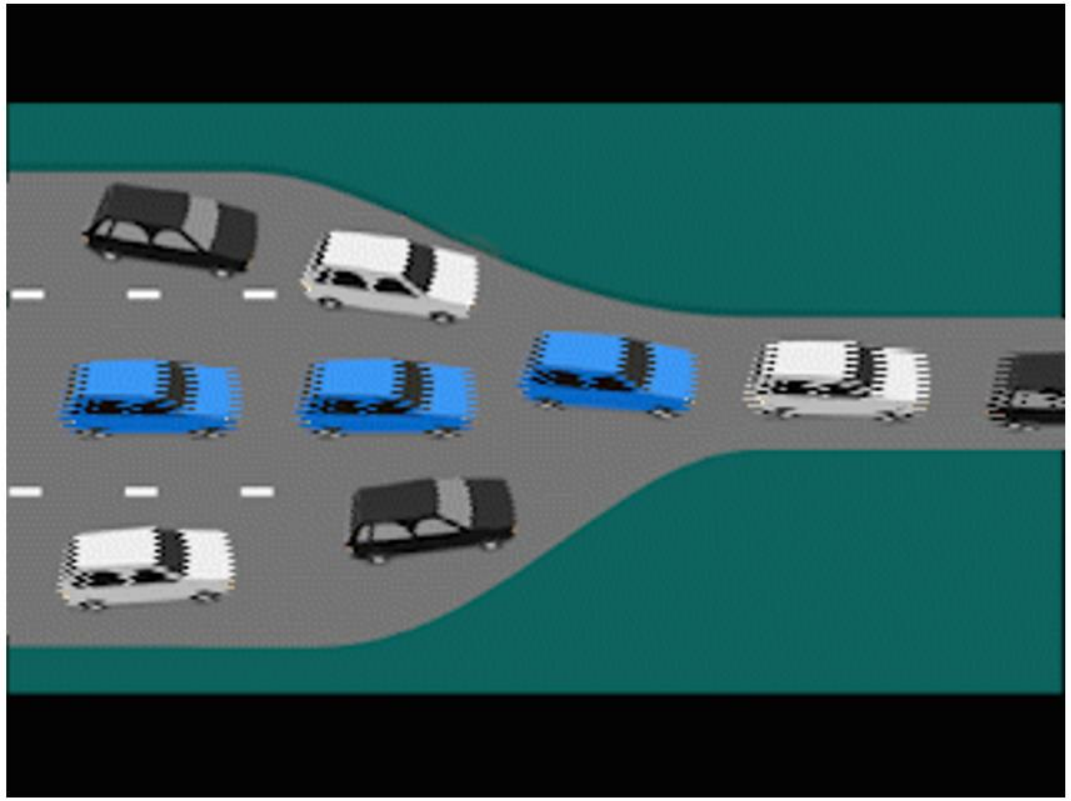
Bandwidth vs Throughput

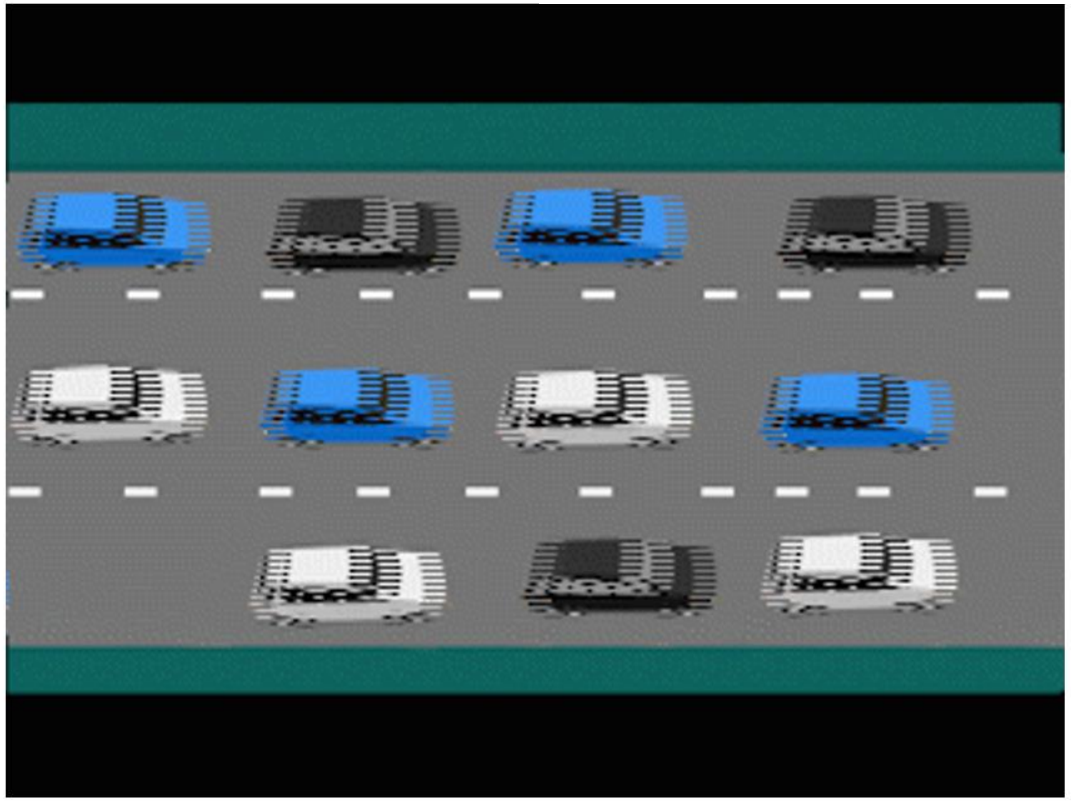
- **BANDWIDTH**- theoretical speed of data on the network
  THROUGHPUT- is the actual speed of data on the network.
- How does bandwidth affect your network?

Bottleneck in Action



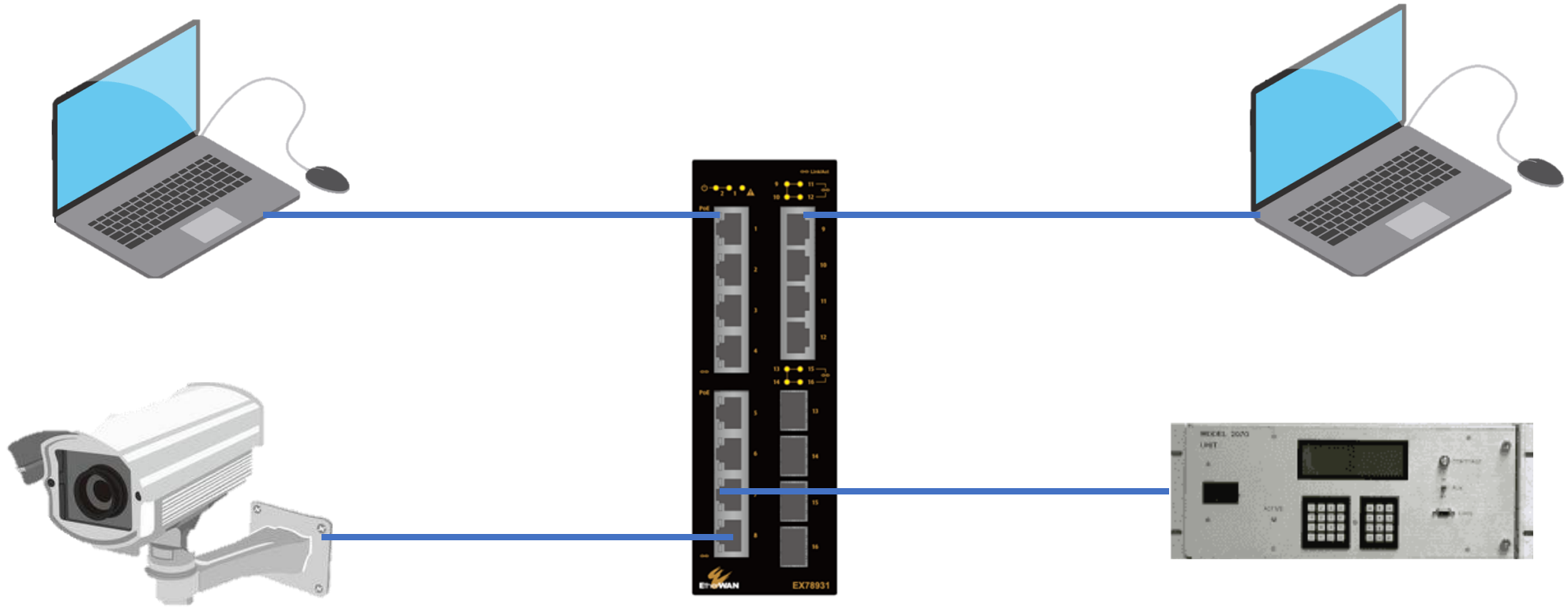




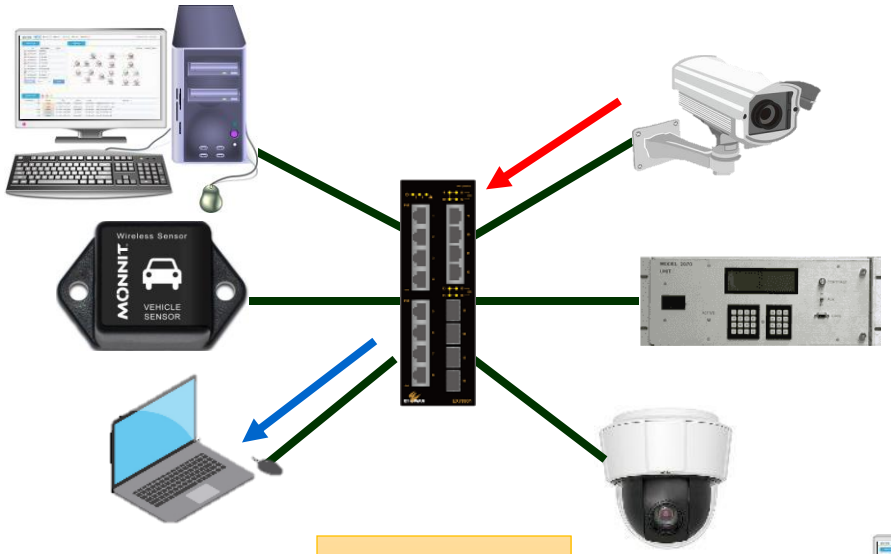


Layer 2 Datalink Layer

What does a switch do?

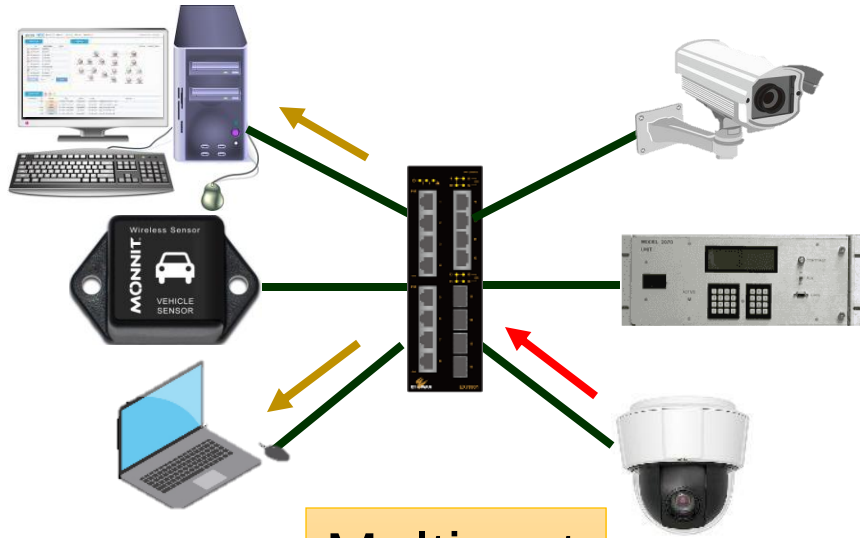


Unicast, Multicast, and Broadcast

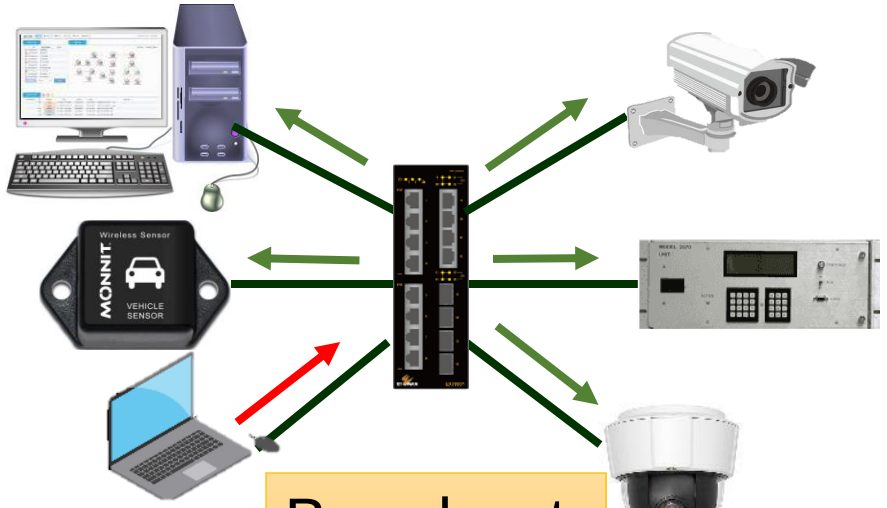


Unicast

Why is this important?



Multicast

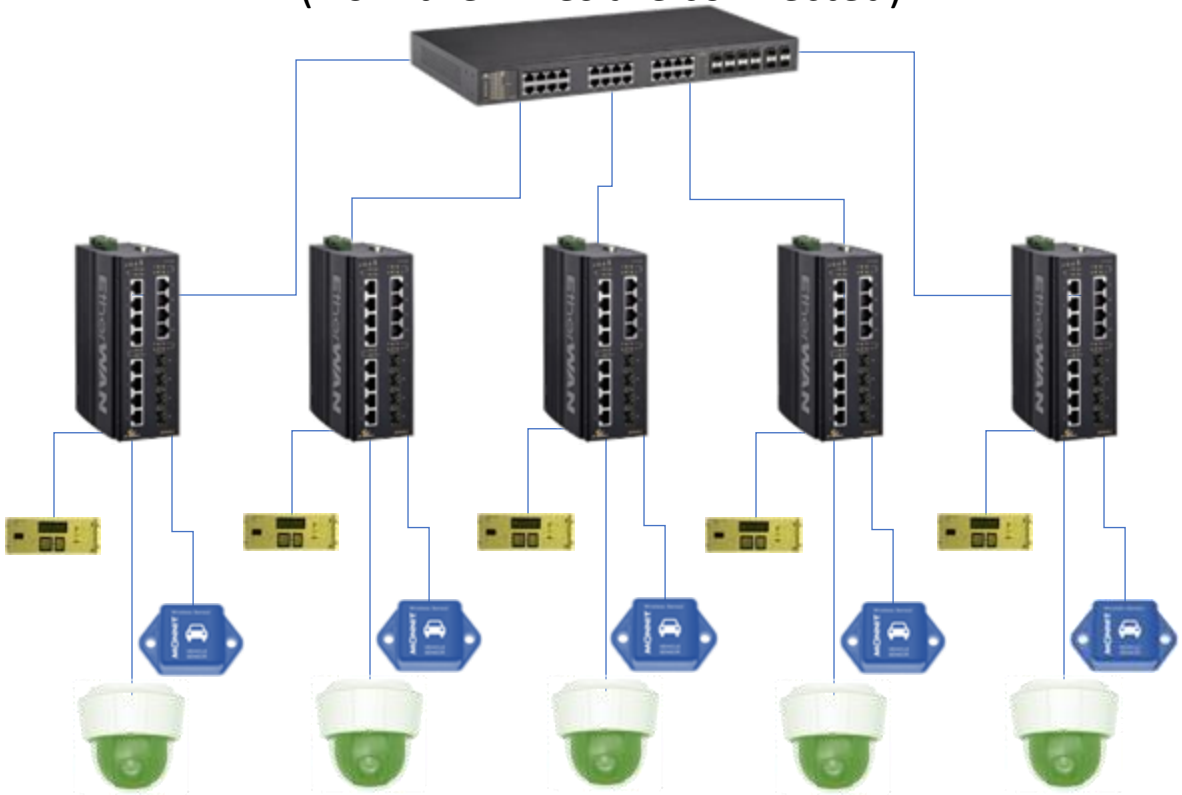


Broadcast

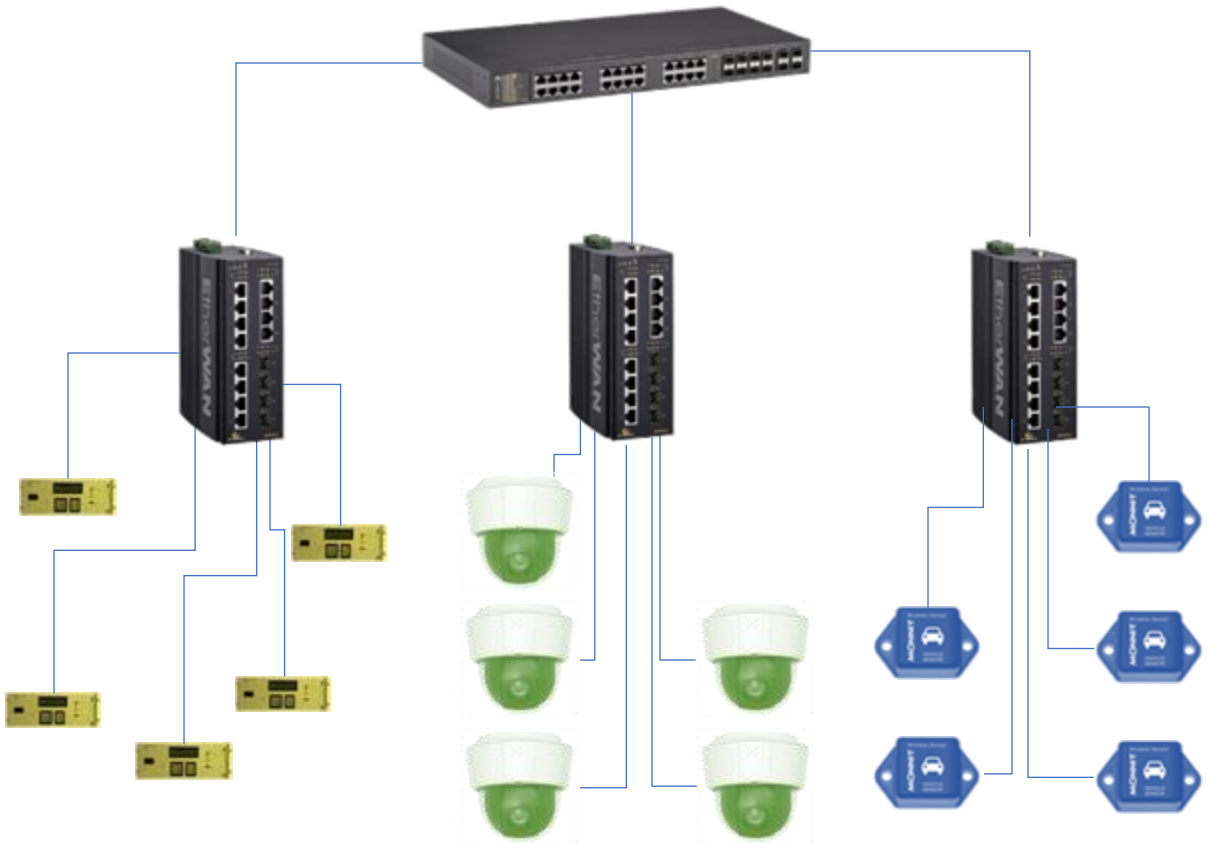
1. It helps you determine the scalability of your network
2. It helps determine the issues in your network
3. It helps allow you to optimize your connection especially for video applications

Physical vs Logical

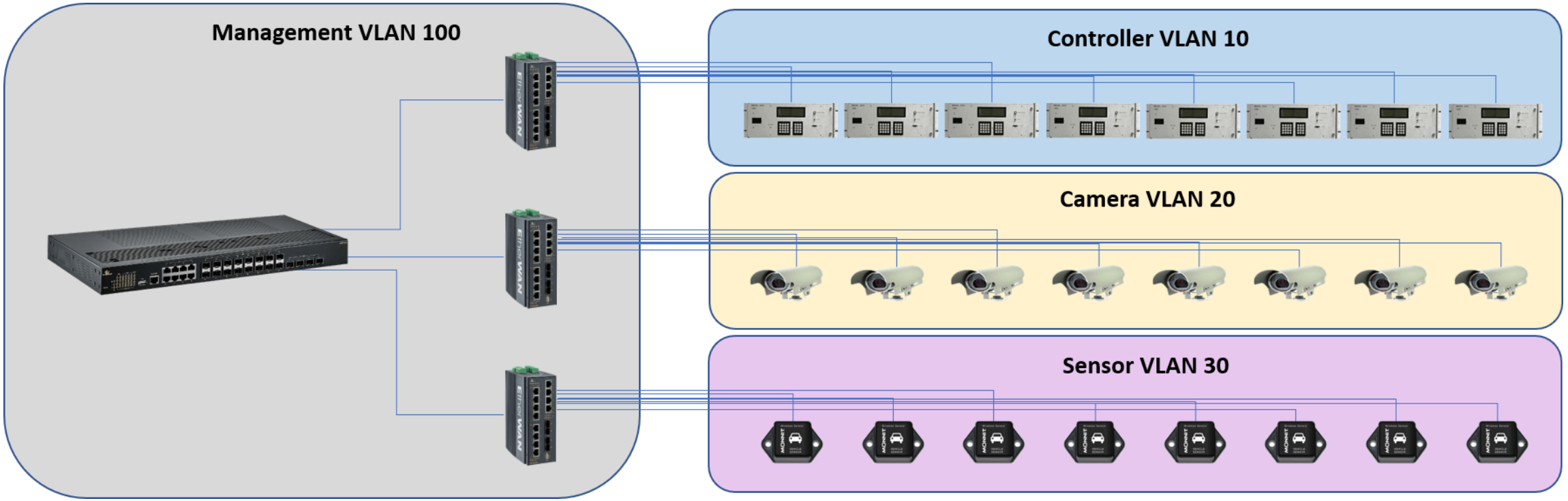
Physical Network
(How the wires are connected)



Logical Network
(How the devices act)



Growth: VLANs (L2)



As the network grows, it becomes necessary to segment it and add hardware to improve performance and reliability…

Benefits of VLANs

- VLANs reduce broadcast traffic by sending to smaller number of devices
- VLANs provide security by separating portions of the network from each other
- VLANs allow for simpler management by grouping like devices together
- VLANs help to standardize addressing of devices
- VLANs allow your network to GROW

VLANs – Port Standardization

VLAN **10** ports

Controller 1

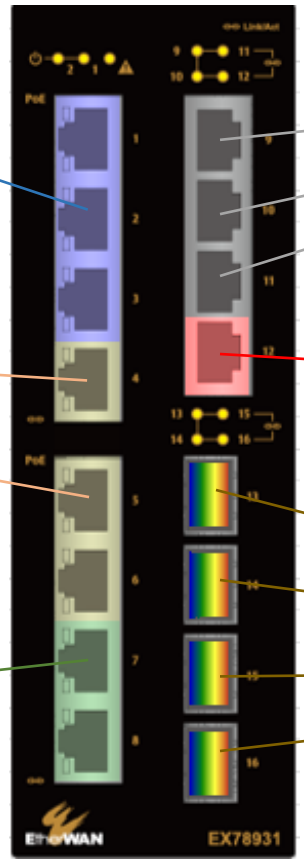
VLAN **20** ports

PTZ

Video Detection

VLAN **30** ports

Battery Back Up



Additional VLANs as needed

Management VLAN **100** port

Trunk Ports

These ports carry all VLANS

Layer 3 Network Layer

What is an IP Address? (v4)

- An IP address includes two parts:
  - Network ID:
    - **Identifies a network**
  - Host ID:
    - **Identifies a host on a network**

Best Practice Considerations

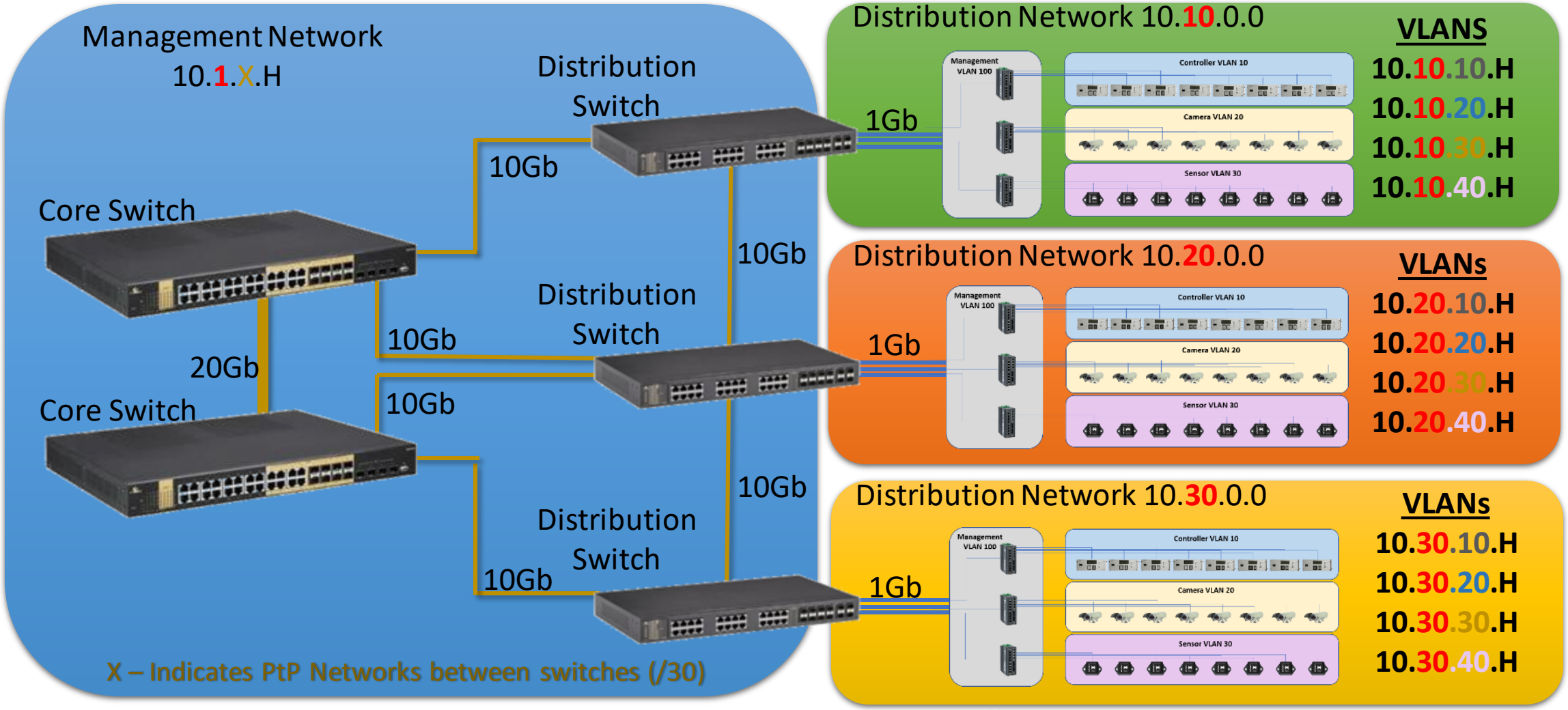
- Logical IP Scheme
- Redundant Network
- Secure Network
- Scalability

IP: 172.Q.V.H/24

Q: Quadrant (Location)
V: VLAN (Device)
H: Host ID (Controller ID)

Quick Poll!

High Level Topology



- Broadcasts are isolated to each network, reducing background traffic
- All connections between switches in the management network can adapt to traffic flow

Best Practices

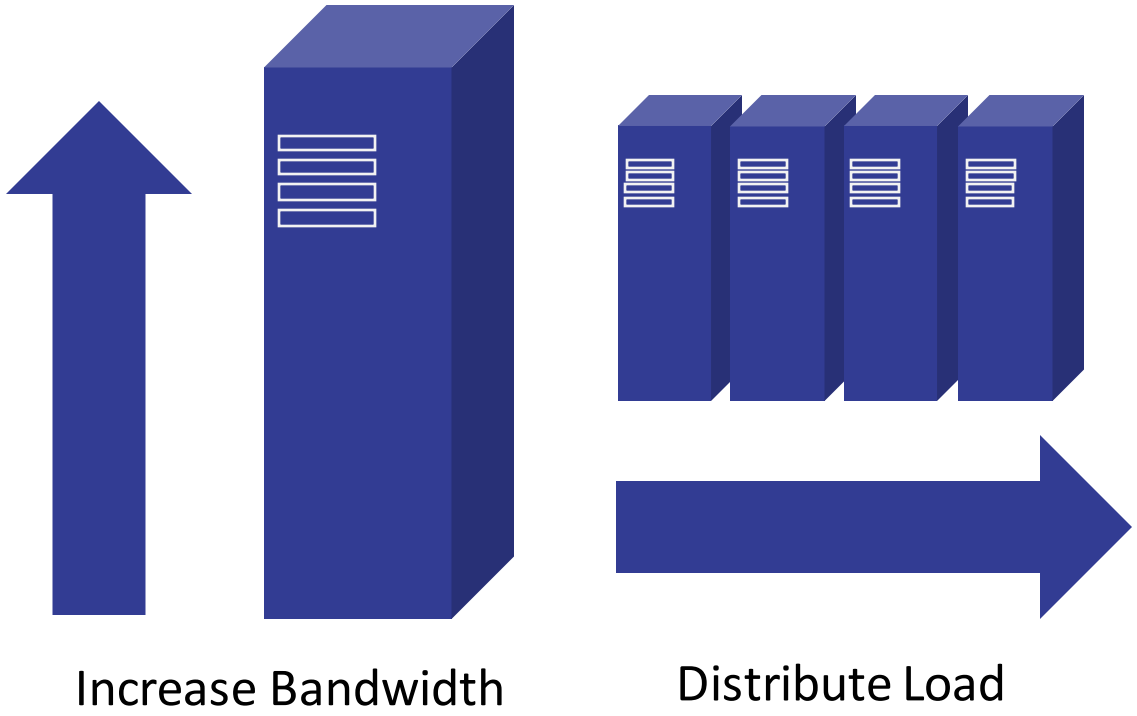
Questions and Considerations

Communication Project Questions

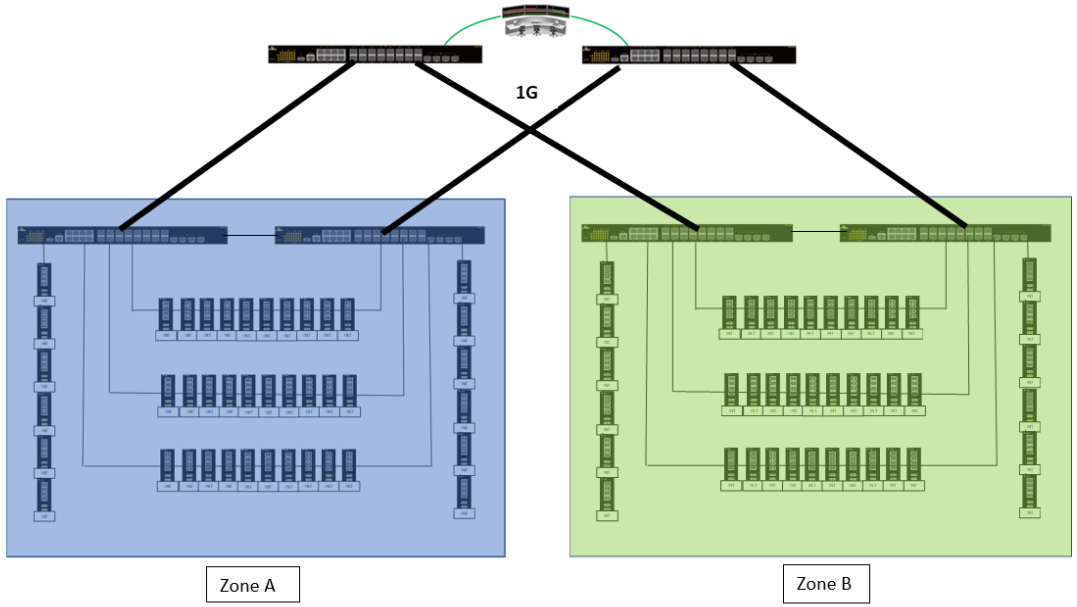
- Stakeholder Management (Who is involved?)
  - Roles and Responsibilities
- Scope of Work (What do I need to do for the city holistically?)
  - Current Projects
  - Future Projects
  - Overall City Goals
- Products (What products do I need to communicate to?)
- Current Topologies (What does your network look like today?)
- Current IP Scheme (How is your network organized?)
- ITS Master Plan

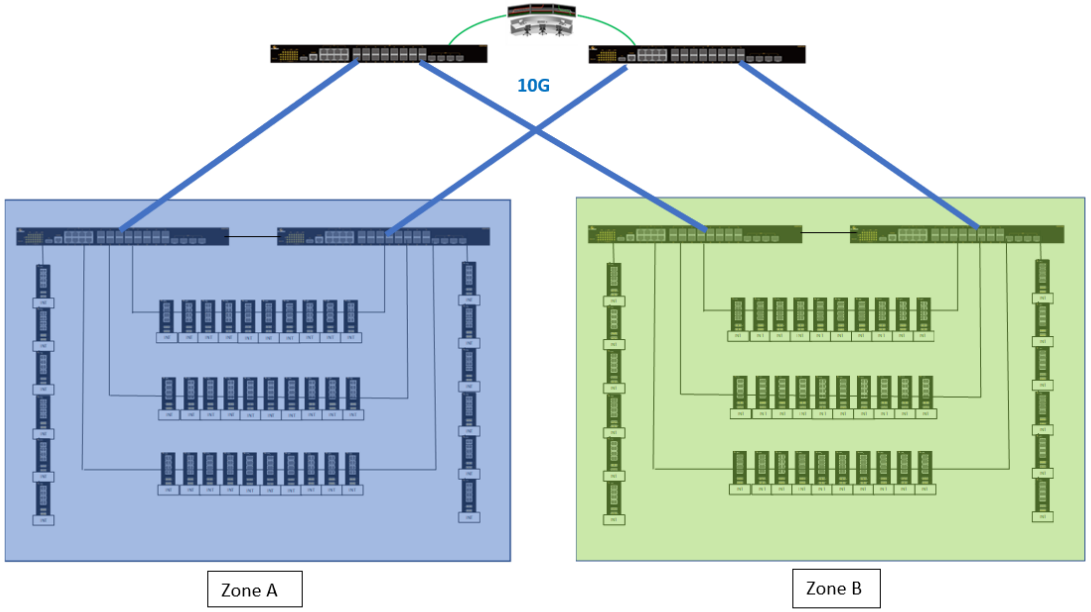
Scalable Theory

- Vertical Scale
  - 100mbps -> 1000mbps -> 10Gbps
- Horizontal Scale
  - Layer 2 RSTP
  - Layer 3 OSPF/RIP
  - Layer 3 VRRP



Vertical Scaling





Horizontal Scaling

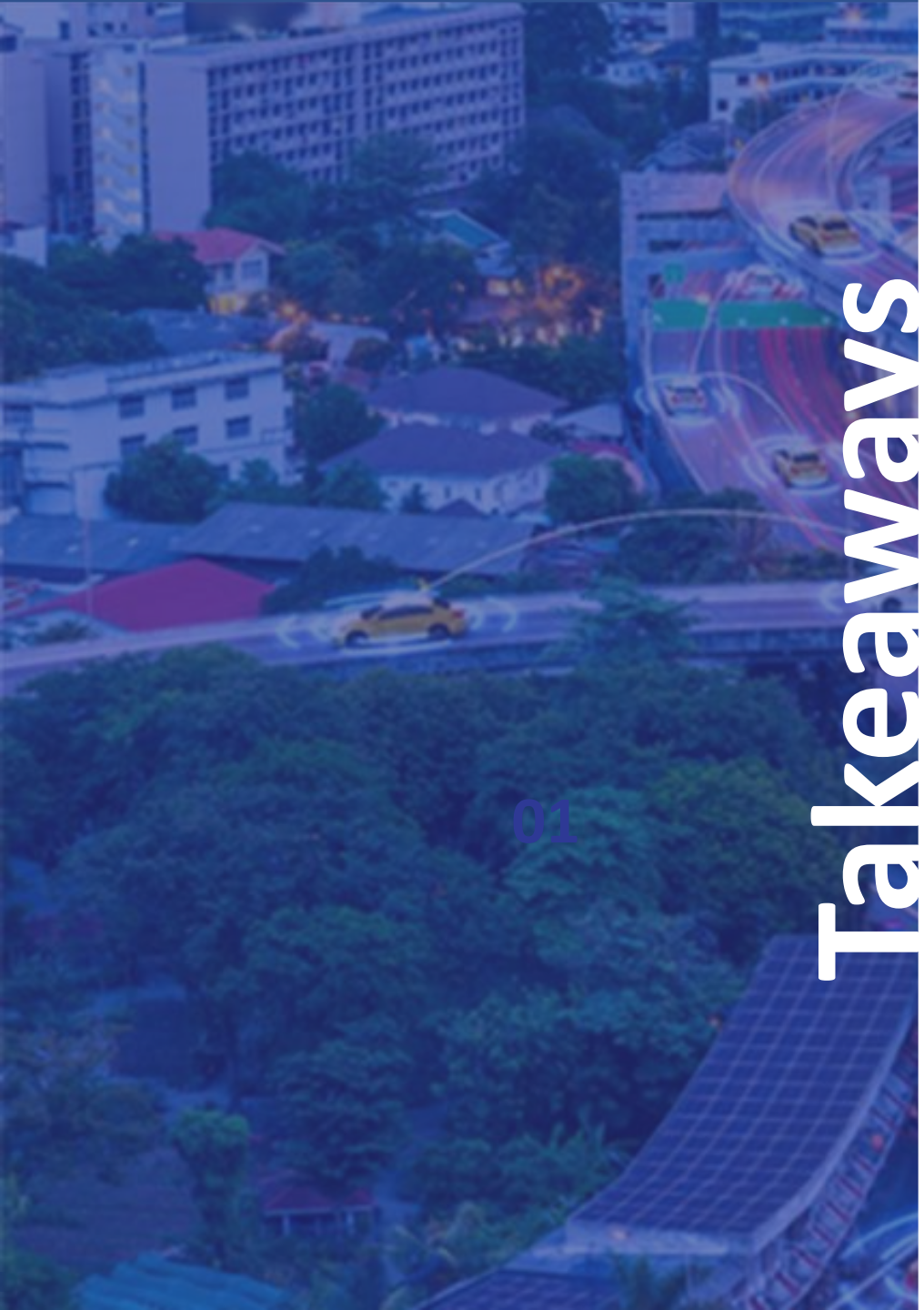
Different Redundancy Paths

Multiple Fiber Connections in Same Conduit

Multiple Fiber Connections in Different Conduit

Multiple Fiber Connections via Wireless

tvcinc.com
Peplink Forum



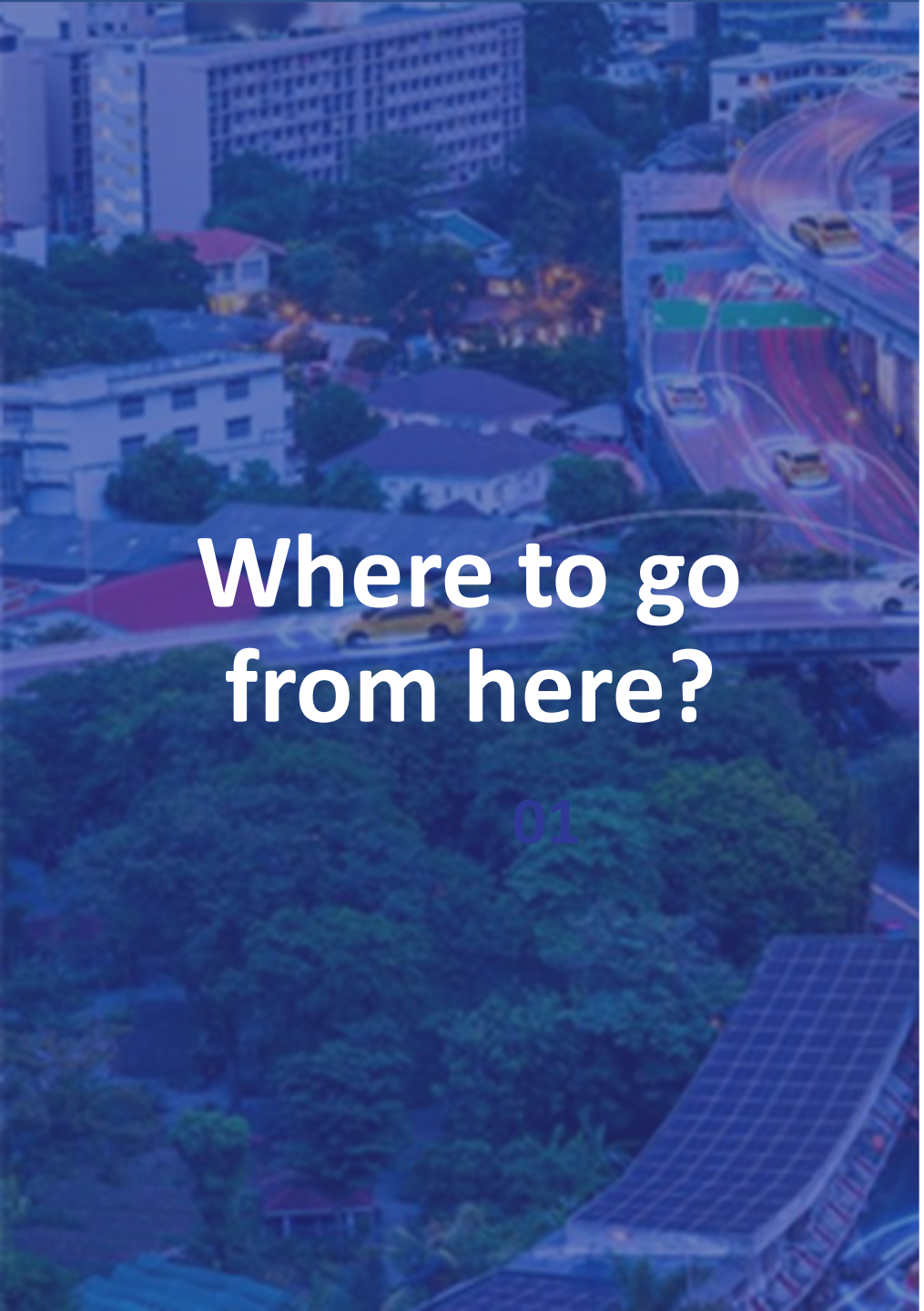
Takeaways

01 Understanding the limitations of your current media and if it can support your future network requirements

02 VLANs help you logically organize your network device and maintain a limited broadcast domain

03 Logical IP Schemes is key for scalability and inter-departmental collaboration

04 Proper documentation and understanding of network needs the network become more scalable



Where to go from here?

01

01 Redundancy Methods

02 Security Risks and Mitigation

03 ITS Project Challenges and Solutions

04 What is actually Layer 3

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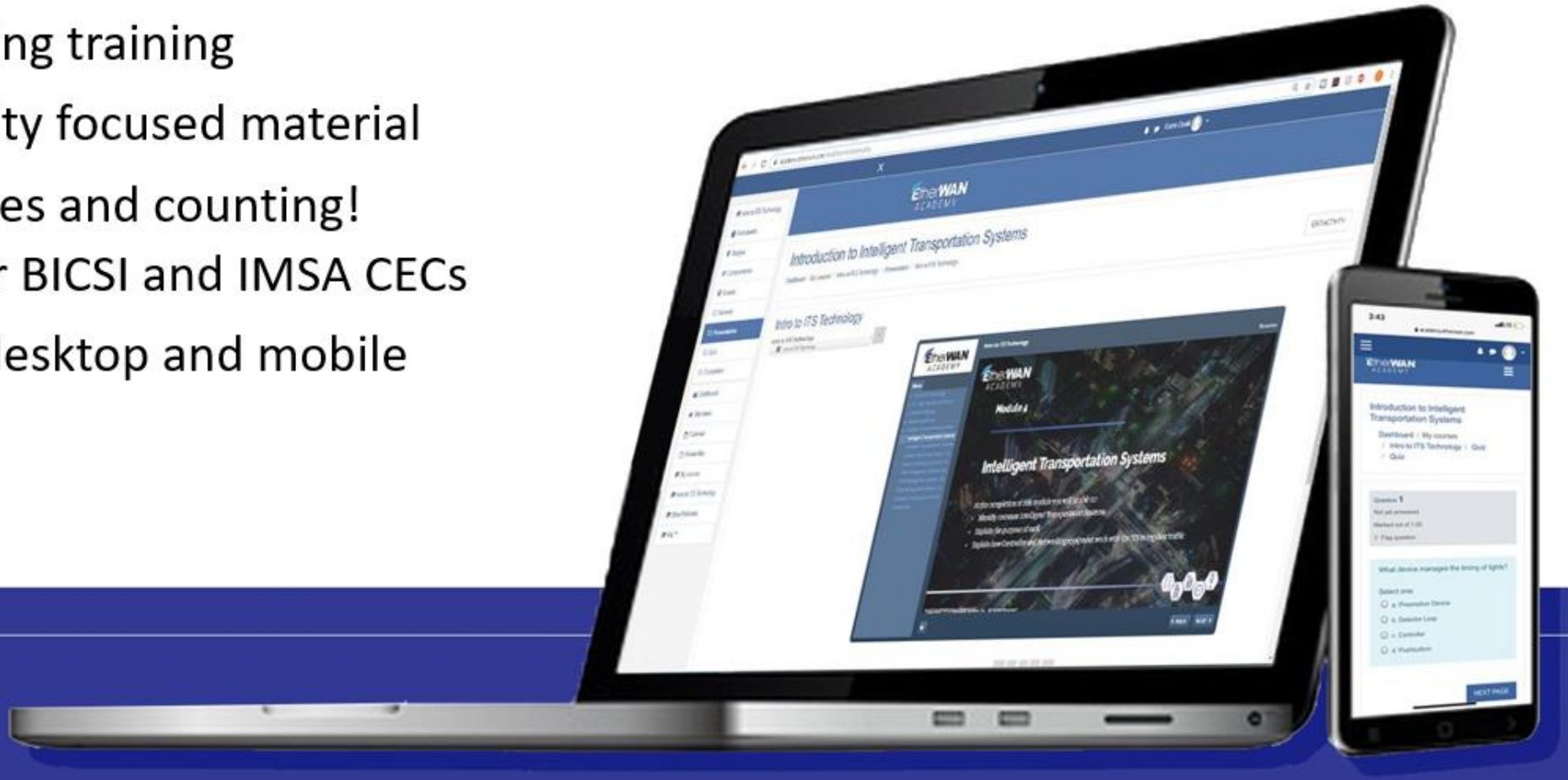

THANK YOU

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