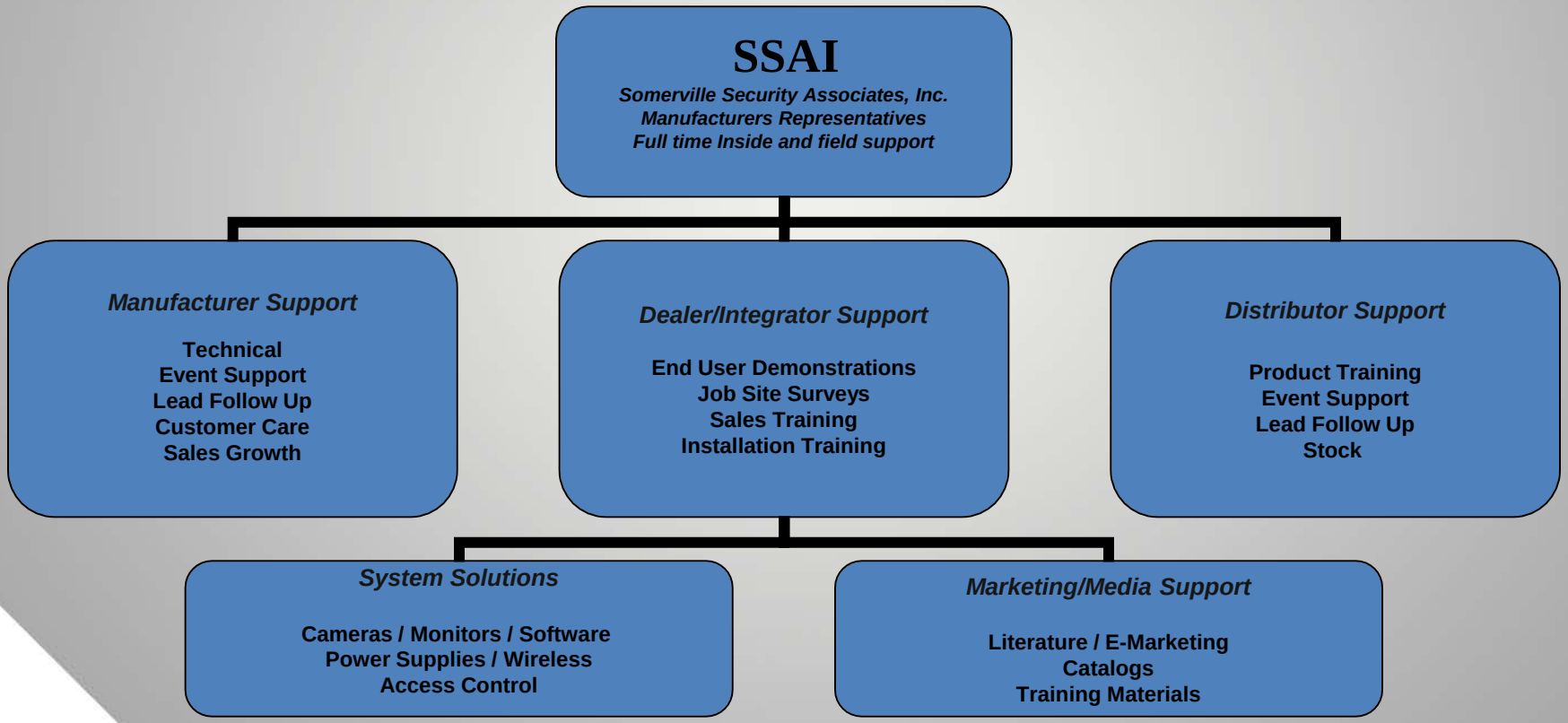
Networking Essentials

We Are Here to HELP



Resources

- www.whatis.com – IT Terminology
- www.compTIA.com – CompTIA serves the IT industry as the world's largest developer of vendor neutral IT certifications.

Objective

- Help you understand basic computer networking terminology and knowledge necessary for implementing IP Video Surveillance Systems.

Overview

- What is network?
- How does data move, and how to make it move efficiently?
- Power over Ethernet [PoE]
- Network Organization
- Network Terms

What is a network?

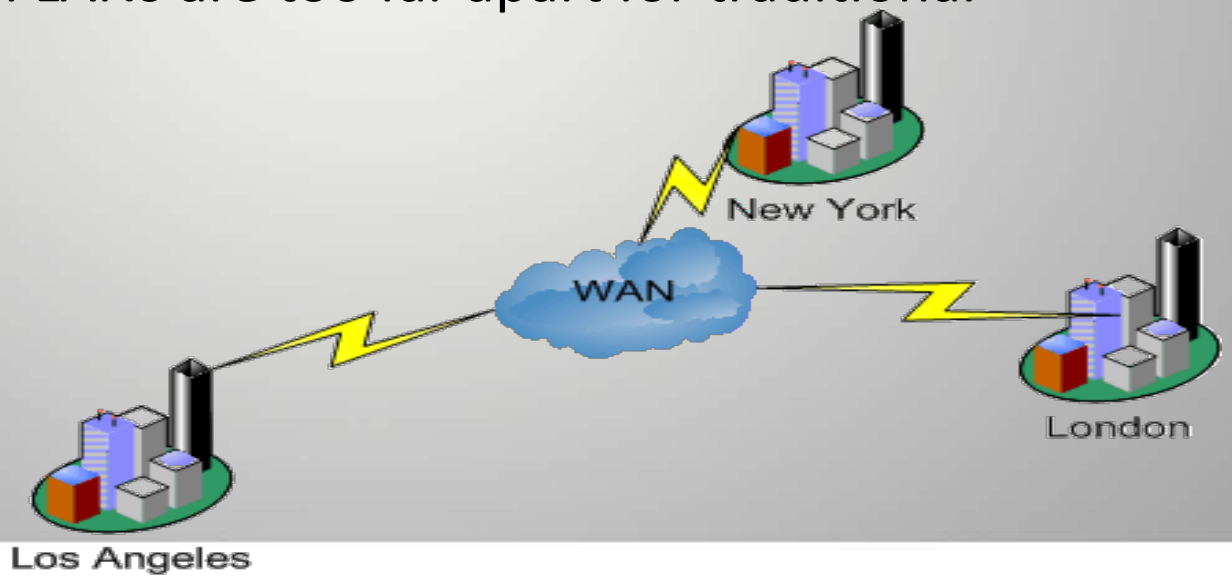
- Two or more computers connecting to share resources
  - Files
  - Printer
  - Internet connection
- A network makes its computers powerful because they can share information and resources
- Primary components of network are:
  - Workstations
  - Servers
  - Hosts
- A cluster of stand-alone computers communicating with one another is a Basic Network

Network Categories

- **LAN (Local Area Network)**
  - Confined to a relatively small geographic area
    - Building
    - Office
    - Department
  - Number of computers ranges from two to thousands
- **MAN (Metro Area Network)**
  - Connects distant entities
    - Buildings
    - Campus
    - Offices in geographically separate areas
  - Range from 1 to 30 miles radius

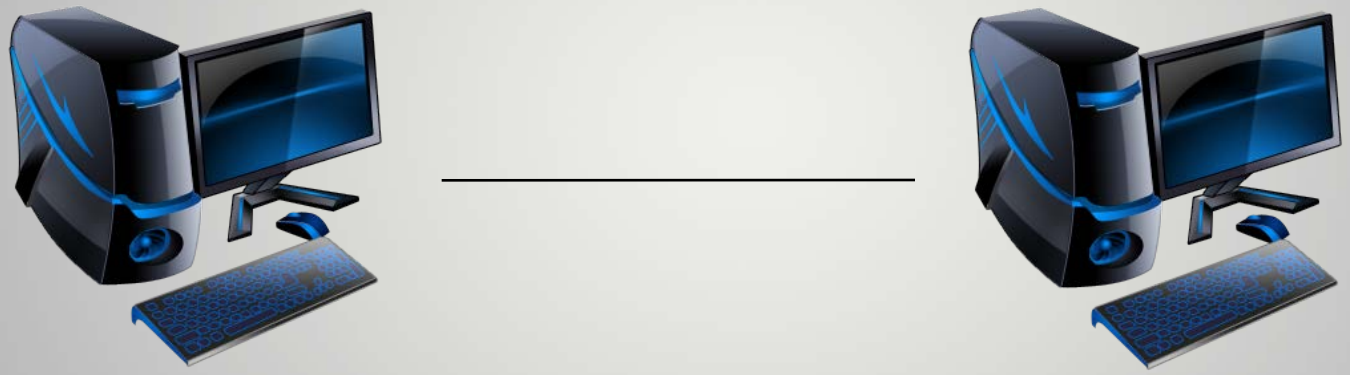
Network Categories

- **WAN (Wide Area Network)**
  - Connects geographically disbursed areas.
  - Large scale network
  - Connecting multiple LANs via public carriers.
  - Used when LANs are too far apart for traditional cabling.



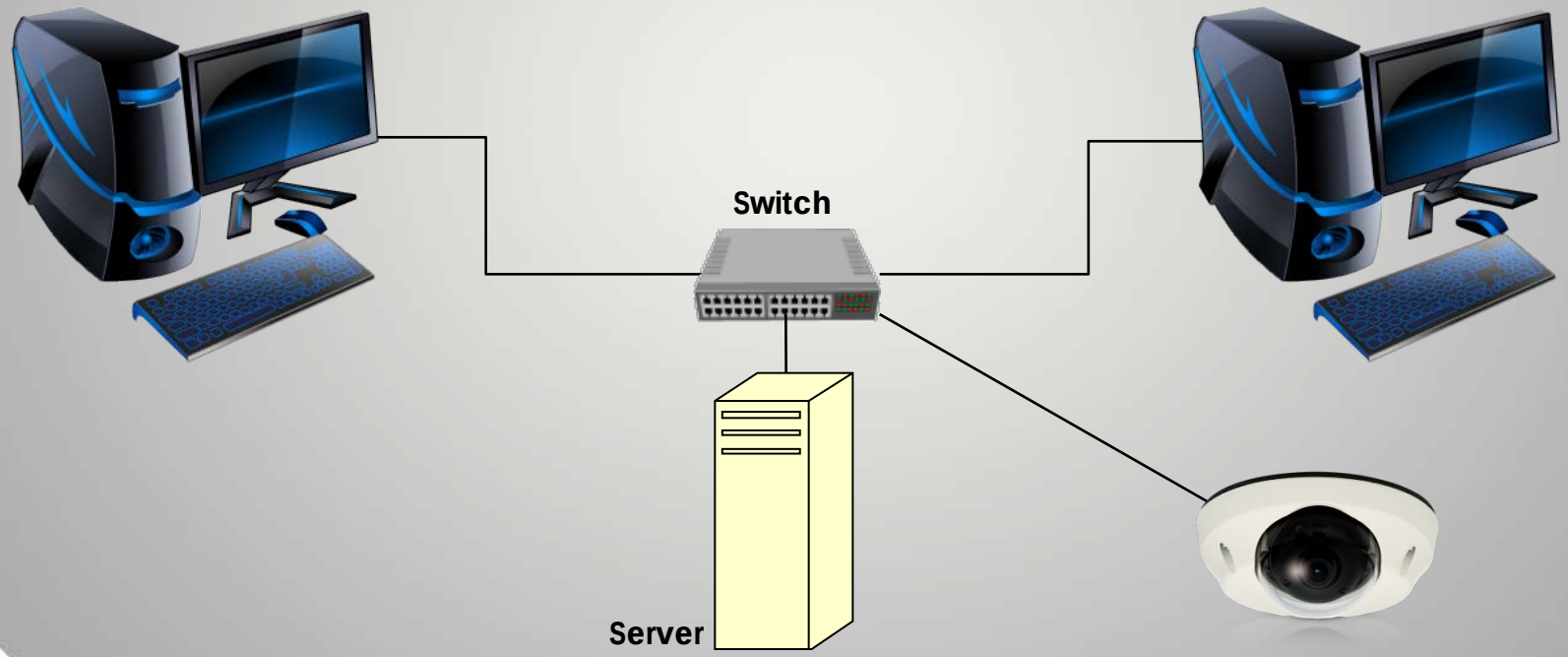
A Simple Network

Peer-to-Peer Network, easy to share files



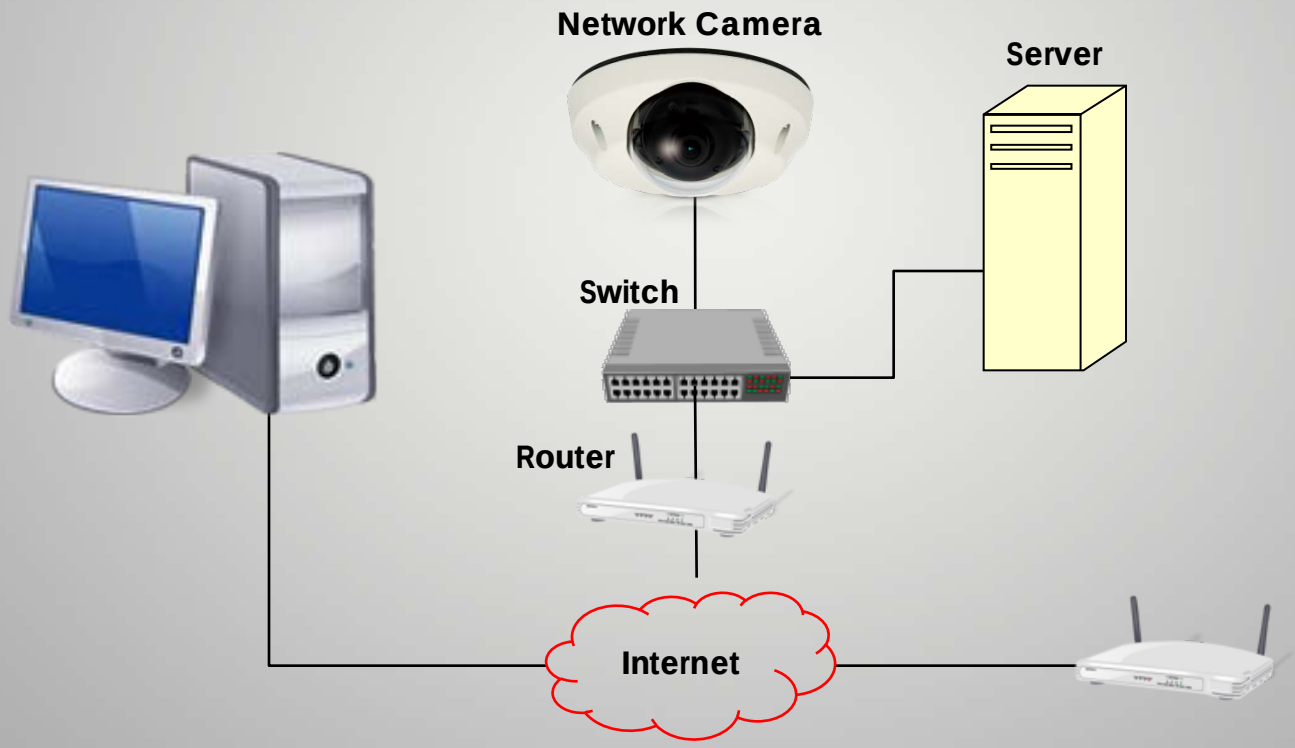
A Simple Network

Simple network with file server for shared files and IP camera.



Common IP Camera & Data Network

Common network with IP cameras local and remotely.



FIRST THING'S FIRST!

UNDERSTANDING IT TERMINOLOGY

What is IT and IP?

- ***IT*** = Information Technology
- ***IP*** = Internet Protocol
  - Also known as TCP/IP (Transmission Control Protocol/Internet Protocol)
  - Basic communication language (protocol) of the Internet

Bandwidth in Computer Networks

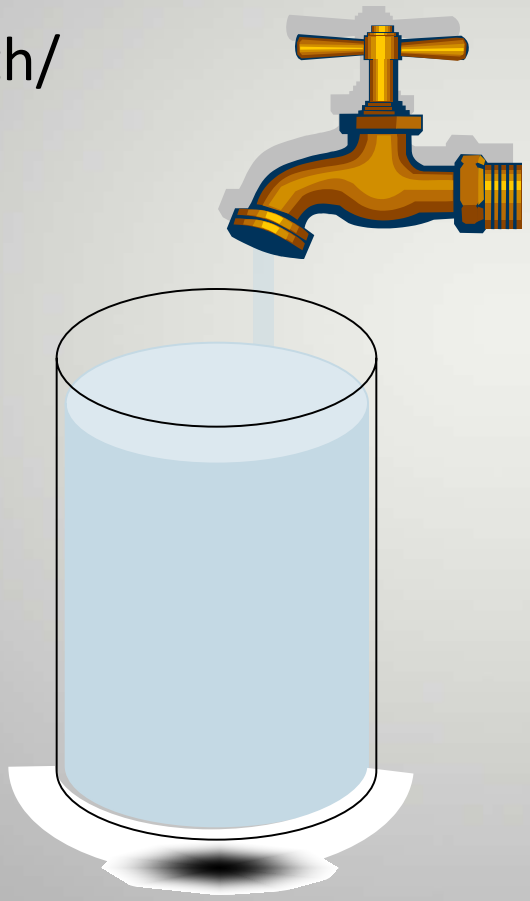
- Used as a synonym for data transfer rate
- The amount of data that can be carried from one point to another in a given time period
- Expressed in bits per second (bps)

Basic Terminology

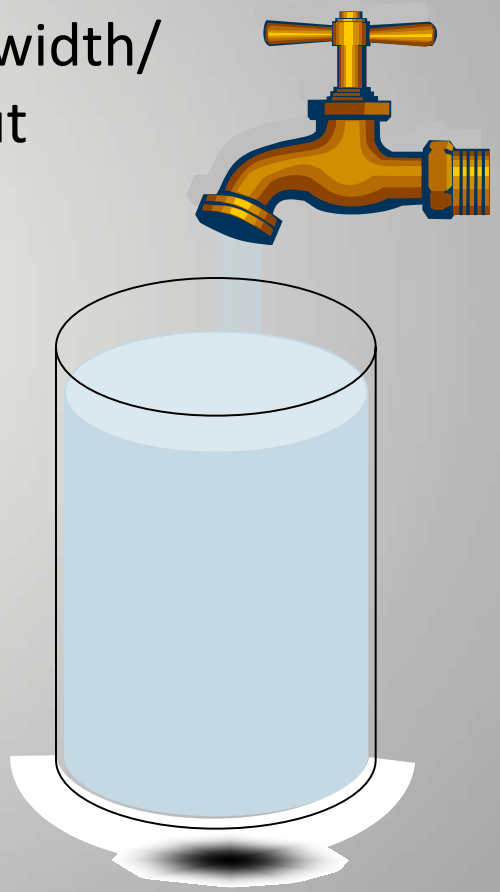
- **Bits-** determine data transfer rates
  - 56Kbps phone line modem/ 1.5Mbps cable modem
- **Bytes-** describe capacity or storage
  - 512MB of RAM/ 250GB HD
- There are **8 bits** in a **byte**
- Usually,
  - Kb, Mb, & Gb= For bits
  - MB, GB, & TB= For bytes
- Bps = bits per second
- Kbps = Kilobits per second (thousand bits per second)
- Mbps = Megabits per second (million bits per second)
- Gbps = Gigabits per second (billion bits per second)

Bandwidth / Throughput

Low Bandwidth/
Throughput



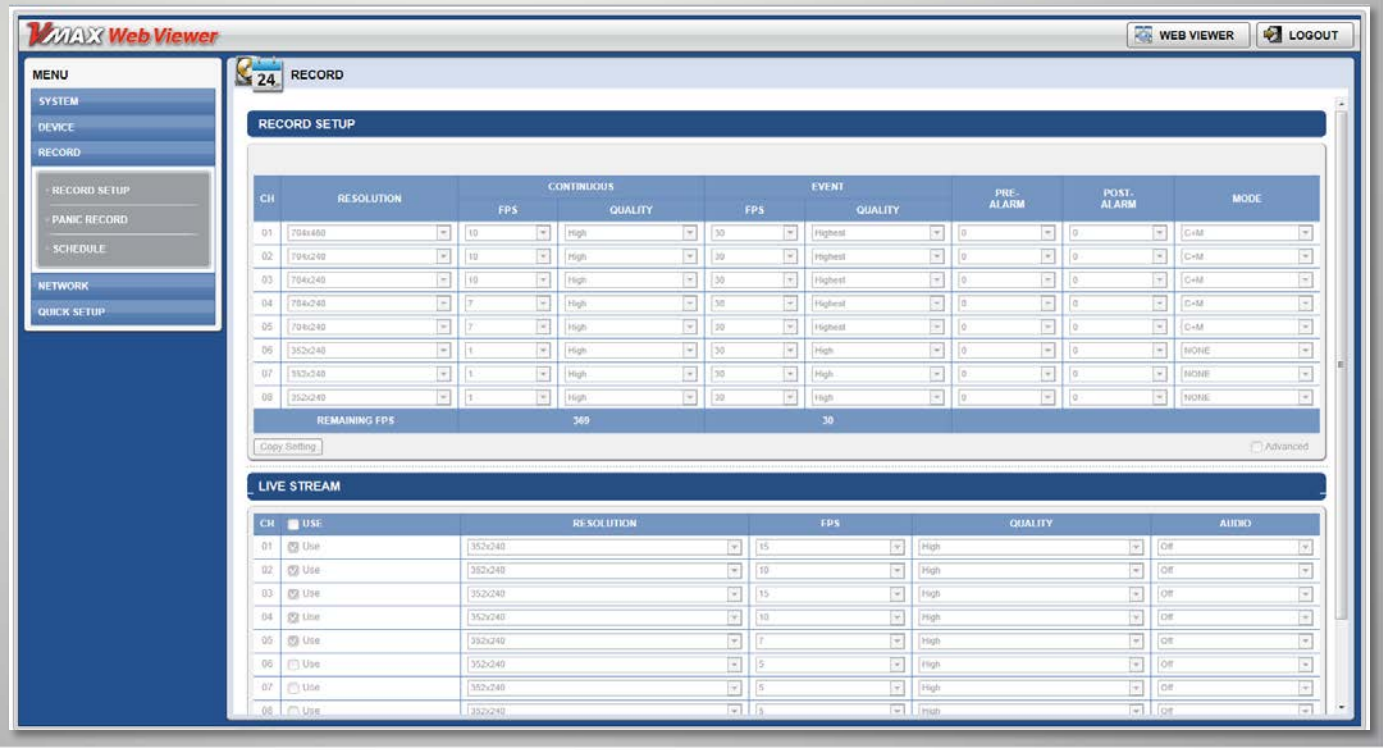
High Bandwidth/
Throughput



VMAX Flexibility

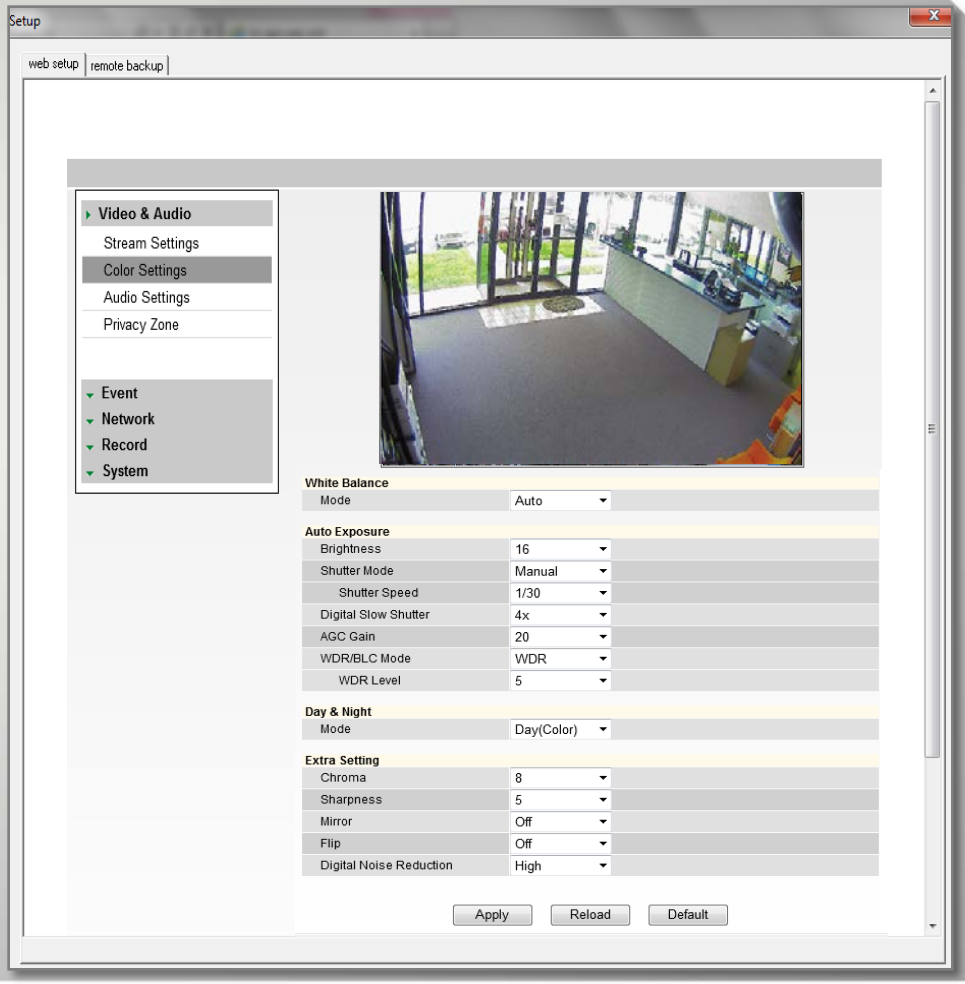
Record rates and resolution separate from live stream!

Bandwidth Throttle



IP Camera Flexibility

- Go beyond factory default
- Impact Bandwidth & Storage
- Change settings to fit the application
- What are you trying to accomplish?



IP Address, Subnet Mask, and Gateway

Obtained from a Network Administrator or internet service provider (ISP).

- IP Address:
  - Unique to each device (node) on the network
  - Dynamic or Static
- Subnet Mask
  - Identifies the subnet to which an IP address belongs
- Gateway
  - An entrance point to another network
  - Usually the IP address of the router
  - Necessary when accessing a network remotely

Network Segments & Subnets

- Segments physically separate related computers into groups.
- Improve network performance and security.
- Only computers on the same segment receive packets broadcasted between themselves
- Network segments and subnets serve similar purposes
  - Both create a grouping of computers. The difference is:
  - **A segment is the physical network construction**
  - **A subnet is a higher-level software configuration**

Subnets and Subnet Masks

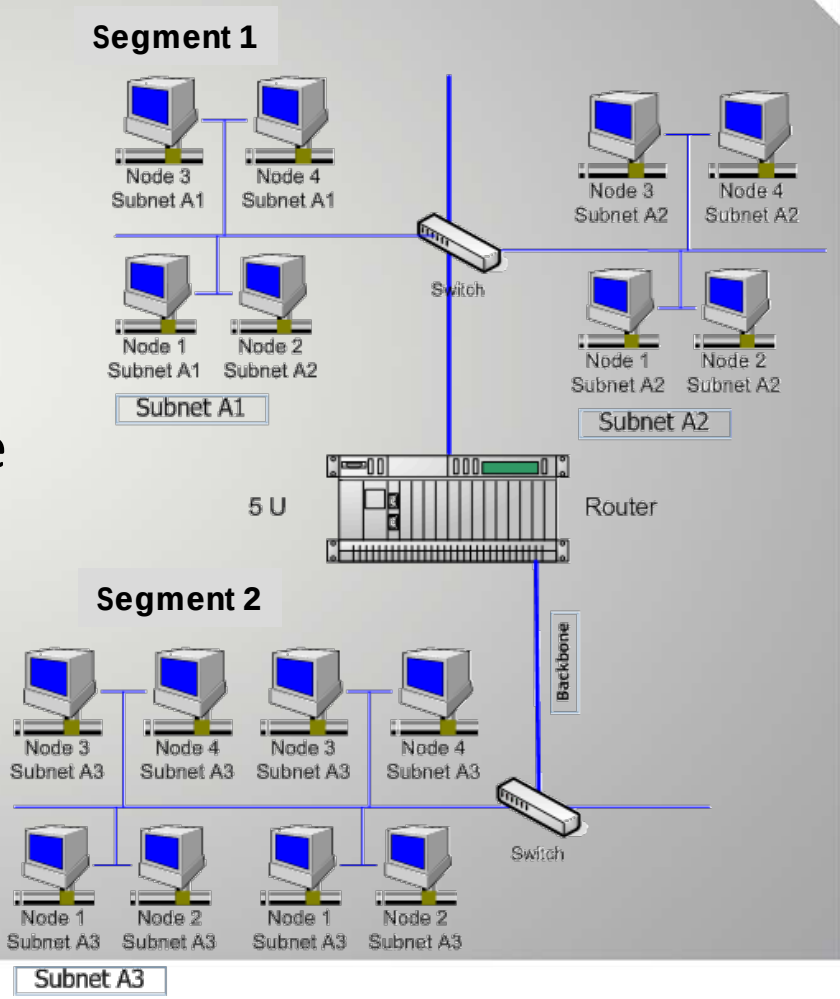
- Divides the network into smaller sections.
- Makes it easier to administer the network and the equipment in it.
- Increase security.
- Enhances performance.

Segment

- A part of the network that has common characteristics and connections.
- “Segmenting the Network” simply means dividing it into smaller parts”.
- A segment is typically bounded by routers and switches.
- The most common practice to increase available bandwidth.
- If segmented correctly, most of the traffic from a segment will stay within the segment.

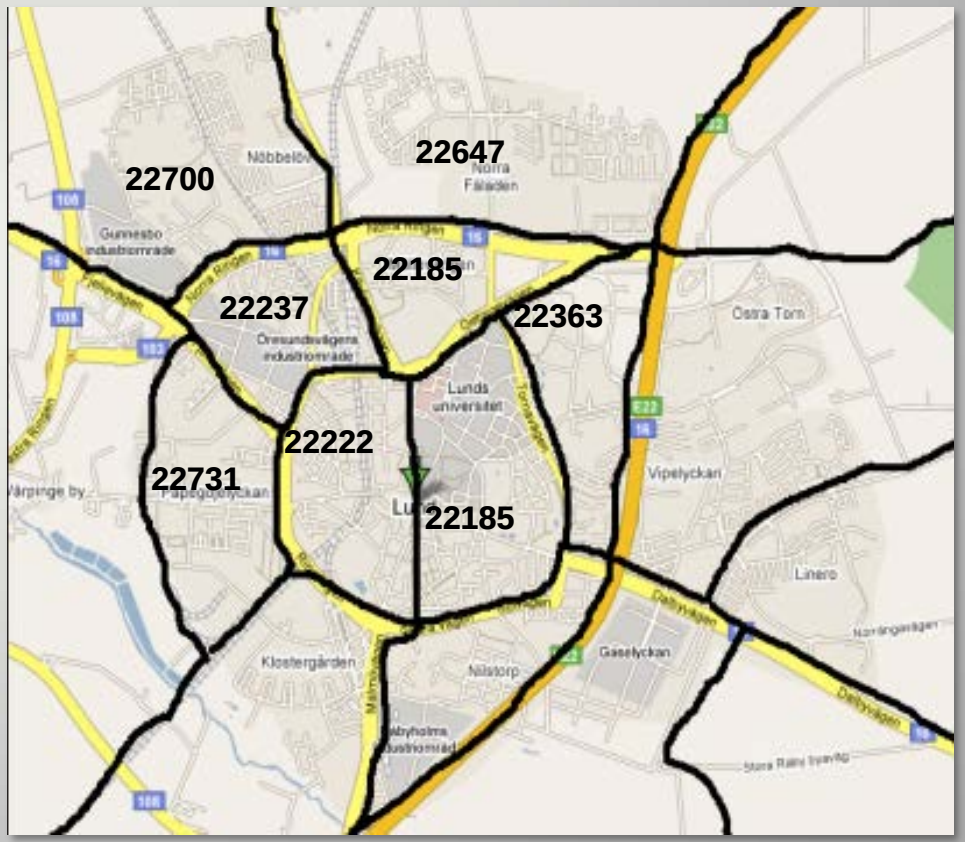
Subnetting an IP Address

- Dividing a network into smaller, manageable parts
- Advantages of Subnetting:
  - Performance Enhancement
  - Restrict data transfer on the subnet to increase security.
- Example: Separation between Video and Office Network
- A subnet is to a network what a network is to the Internet



Subnet and Subnet Masks

- A subnet mask can be compared to a zip code- the part of the address that defines an area or specific region of the network



IP Addresses

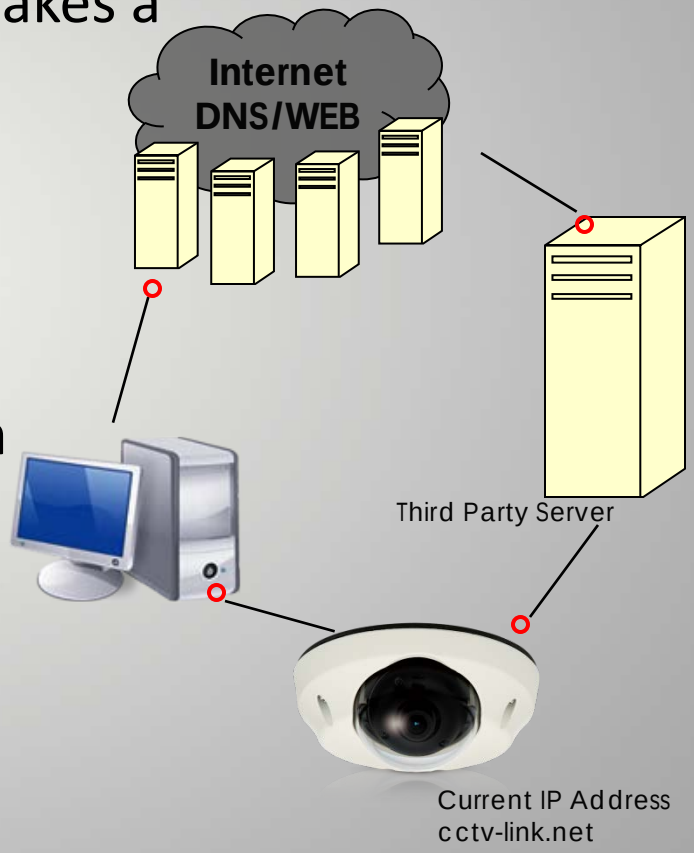
- **Static IP-** assigned to a computer by an ISP or a Network Administrator as a permanent address
- **Dynamic IP-** received for a duration of the session on the network or a specified time period. (Ex. Temporary phone number)
- **DHCP** (Dynamic Host Configuration Protocol) lets network administrators manage and automate IP assignment in a network.

DNS (Domain Name System) &
DDNS (Dynamic Domain Name System

- **DNS-**
  - Assigns names (URLs) to IP addresses
  - (Ex. www.google.com versus 72.125.224.243)
- **DDNS-**
  - Free or charges a small fee
  - Allows IP based products to remotely connect with a dynamic IP address

DDNS

1. Using a web browser a workstation makes a request: http://joespizza.cctv-link.net
2. The request hits the internet DNS servers
3. DNS Server sends request to DDNS
4. DDNS Server receives the information from the remote device, redirecting the client to the proper IP address
5. Workstation can view video



Dynamic DNS Services

- no-ip.com
- Tzo.com
- dynDNS.org
- **Digital Watchdog – http://dwddns2.net/**

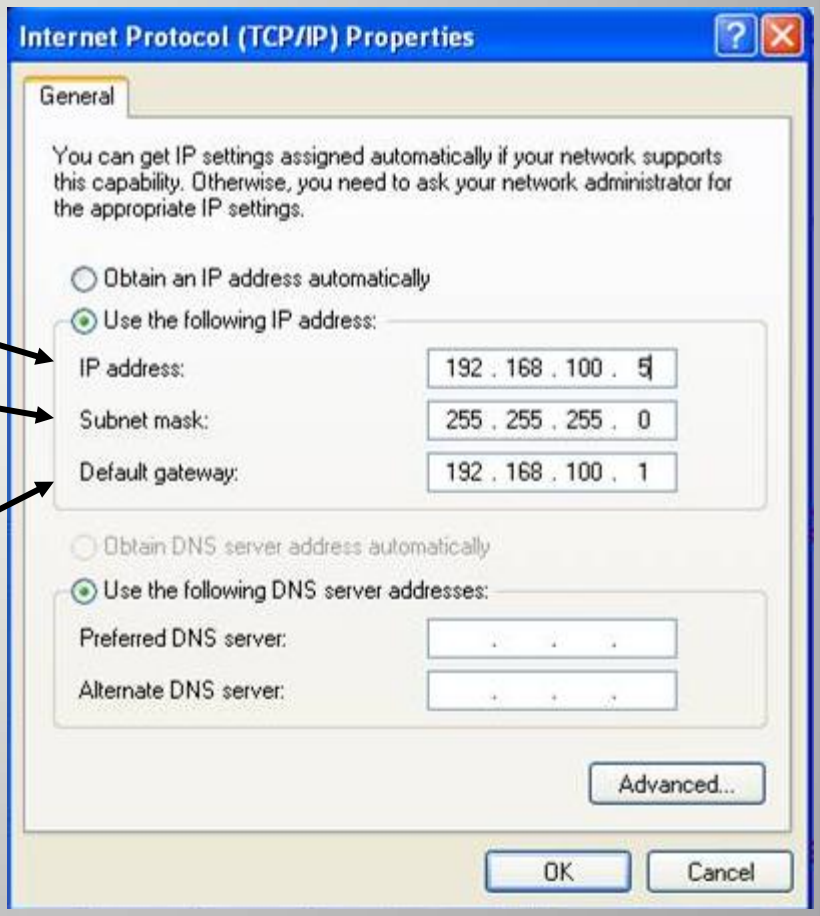
Setting of IP-address

Static Setting in Windows XP

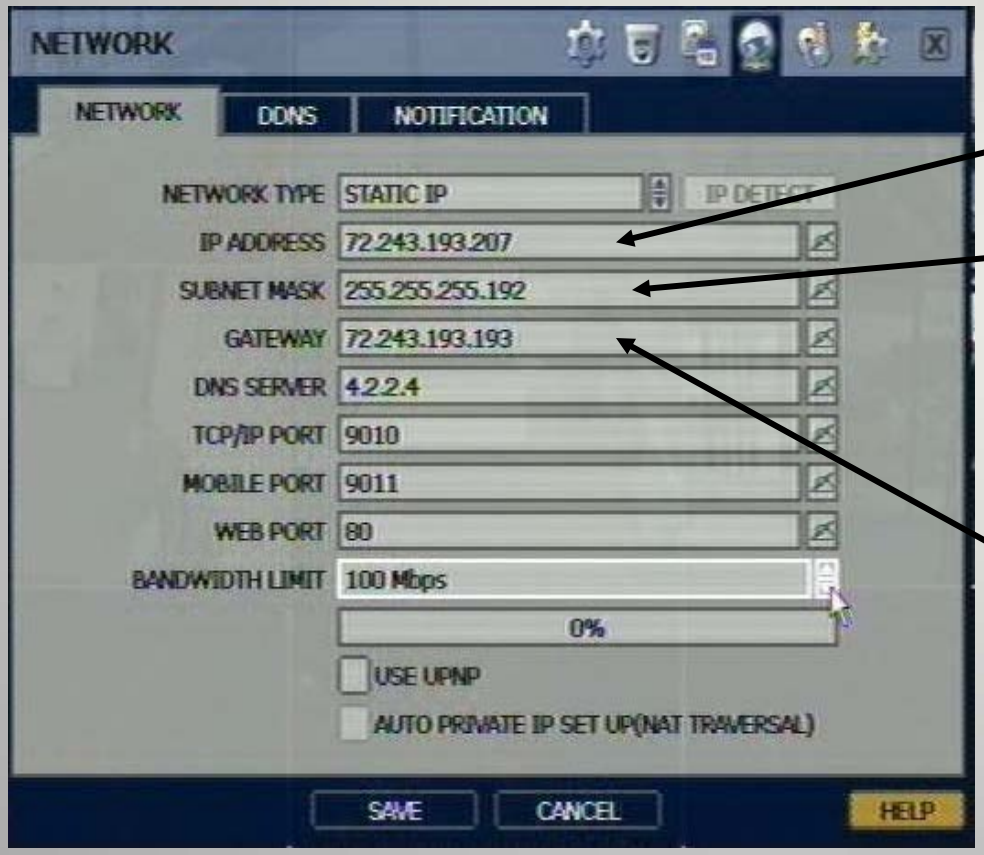
IP-address

Subnet mask

Standard gateway



Static setting on DW‘s DVR



IP-address

Subnet mask

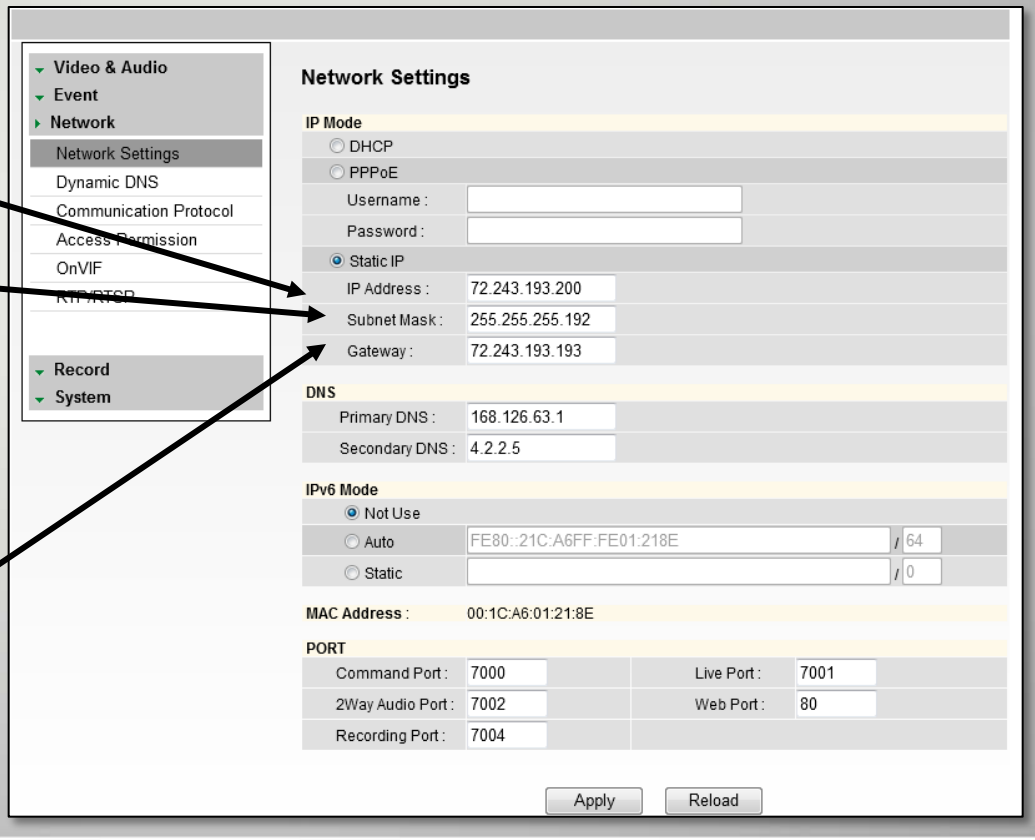
Standard gateway

Static setting on DW‘s MEGApix

IP-address

Subnet mask

Standard gateway



Setting Up a Linksys Router

Login to router via Internet Browser. Typically 192.168.1.1*

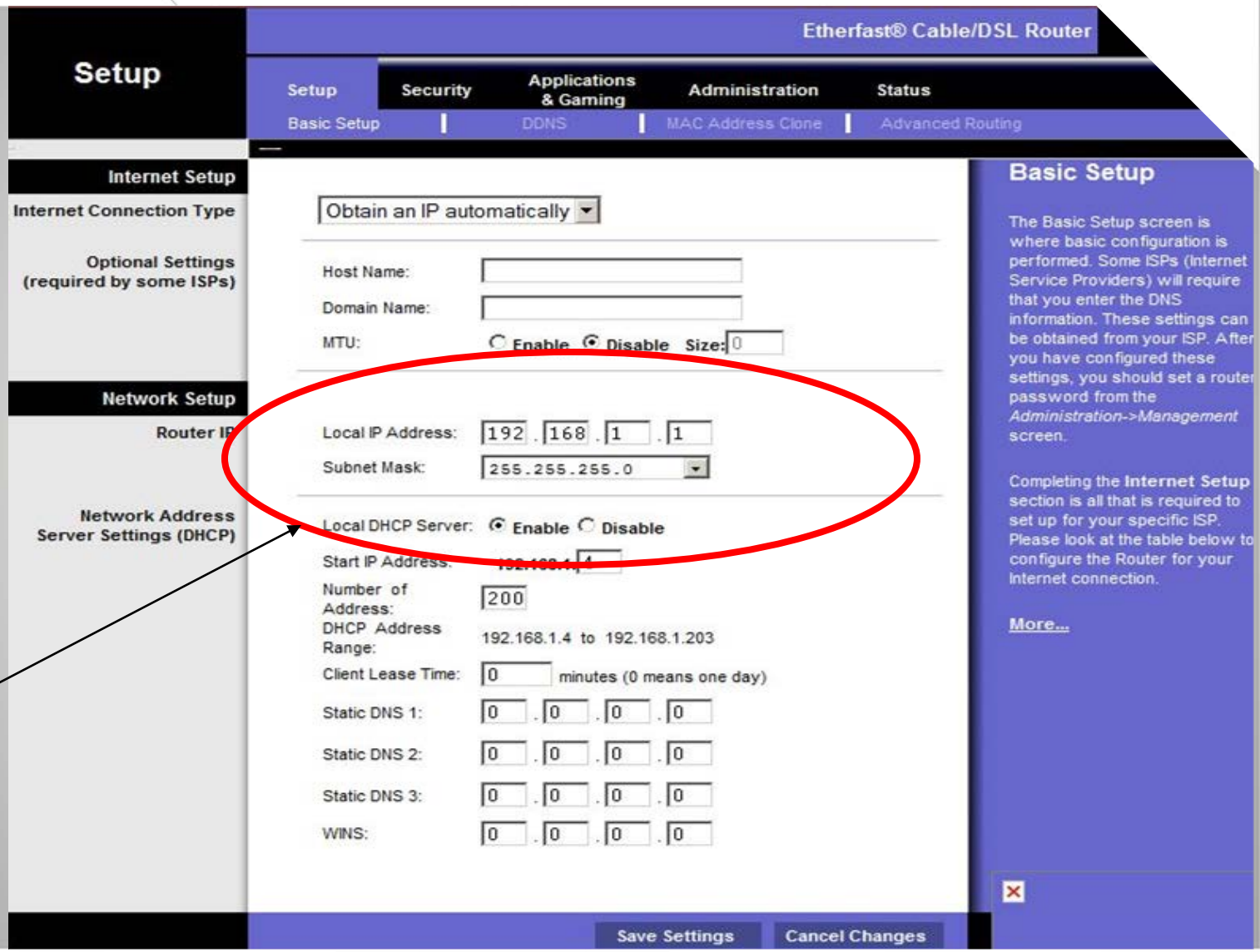
*Setup Process may vary by Router Make & Model

Logging in to the Router

This may be blank

Default password is “admin”

*Setup Process may vary by Router Make & Model



DHCP Range

*Setup Process may vary by Router Make & Model

Setting Up Port Forwarding

- **Port Forwarding**
  - Referred to as port mapping
  - Forwarding a network port from one network node to another
  - Used to allow remote Internet access to a private IP address (inside a LAN)

Ports

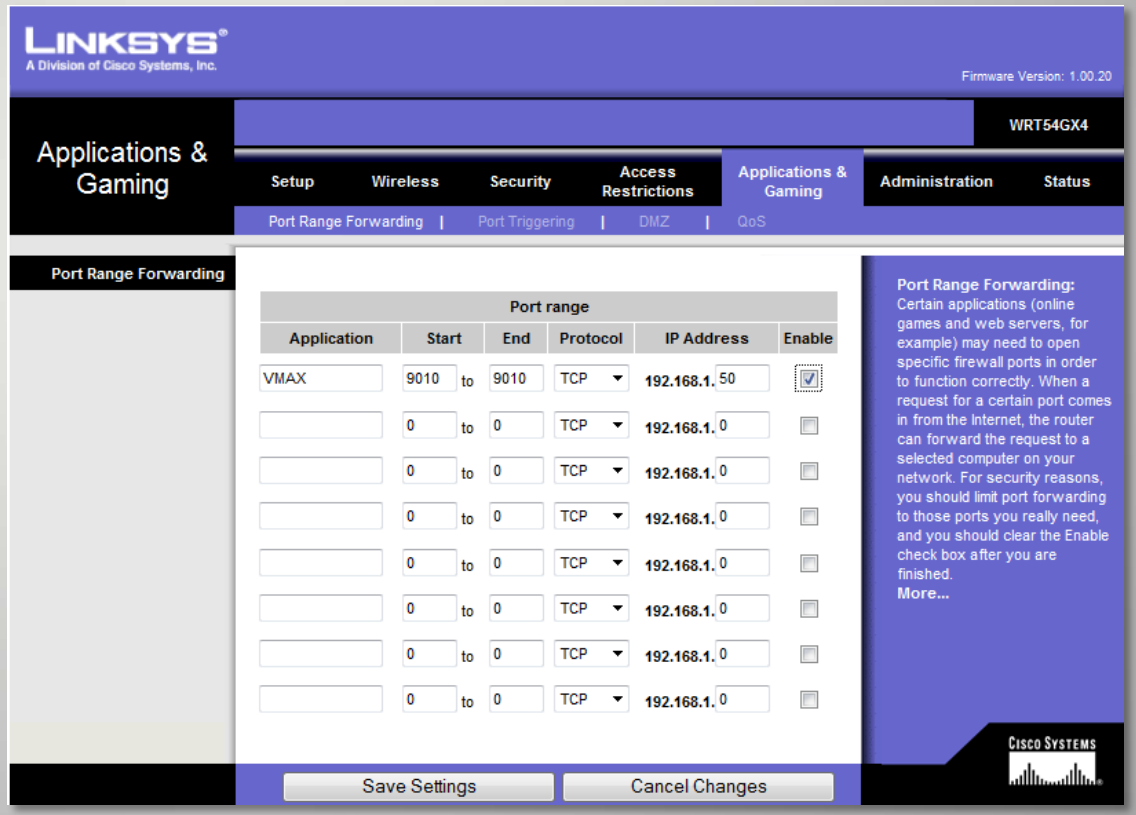
- A port is a virtual data connection allowing programs to exchange information directly
- **TCP** (Transmission Control Protocol) and **UDP** (User Datagram Protocol) **Ports** are the most common used on the Internet.
- Addressing a port is done by the "IP Address:Port Number." (Ex: 192.168.0.90**:80)**

Common Port Numbers

- 21: File Transfer Protocol (FTP)
- 80: Default Web Server - Hypertext Transfer Protocol (HTTP)
- 110: Post Office Protocol V3 (POP3)
- 25: Simple Mail Transfer Protocol (SMTP)

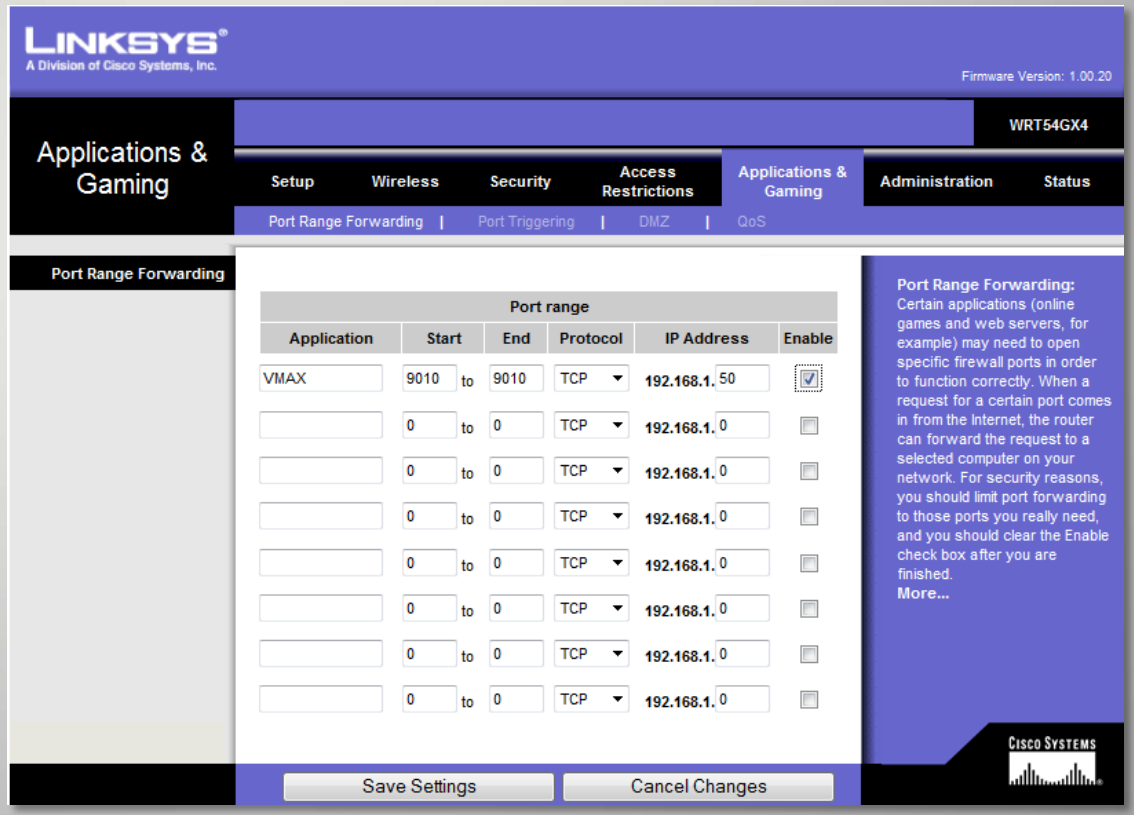
Setting Up Port Forwarding

1. Click Applications & Gaming
2. Set Port Range
3. Set IP Address

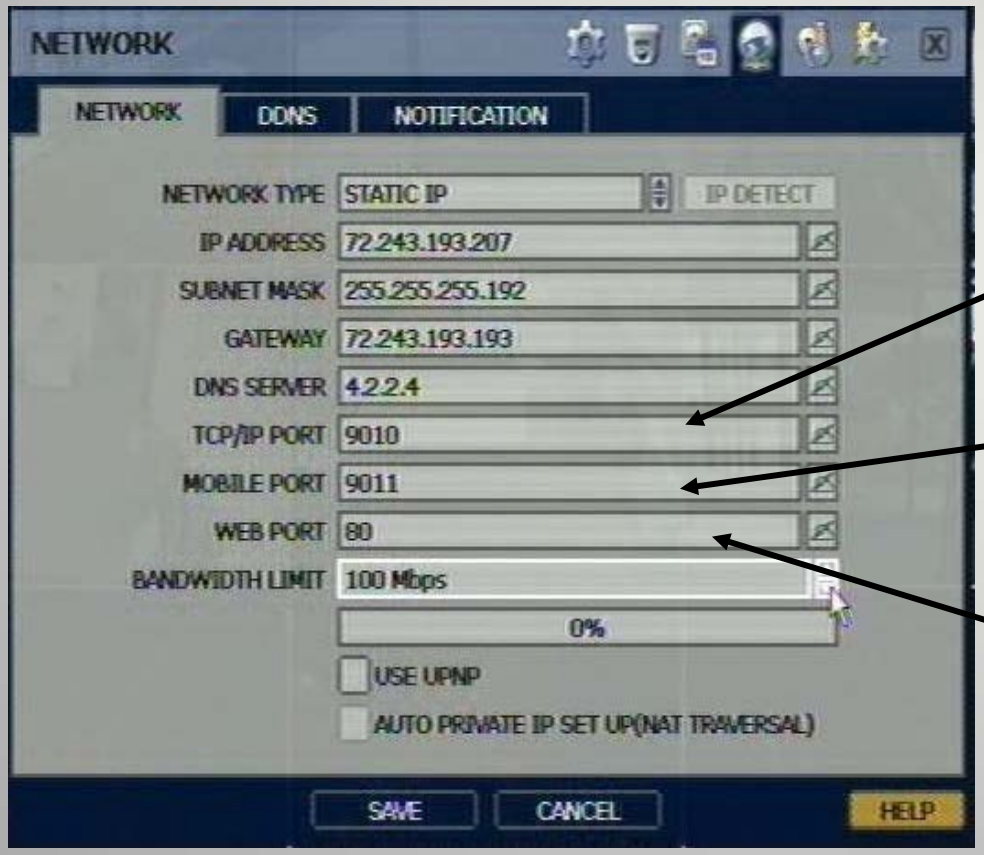


Applications & Gaming Tab

4. For each device, you will need to know:
   - IP Address
   - default ports



Check What Ports Need to be Open



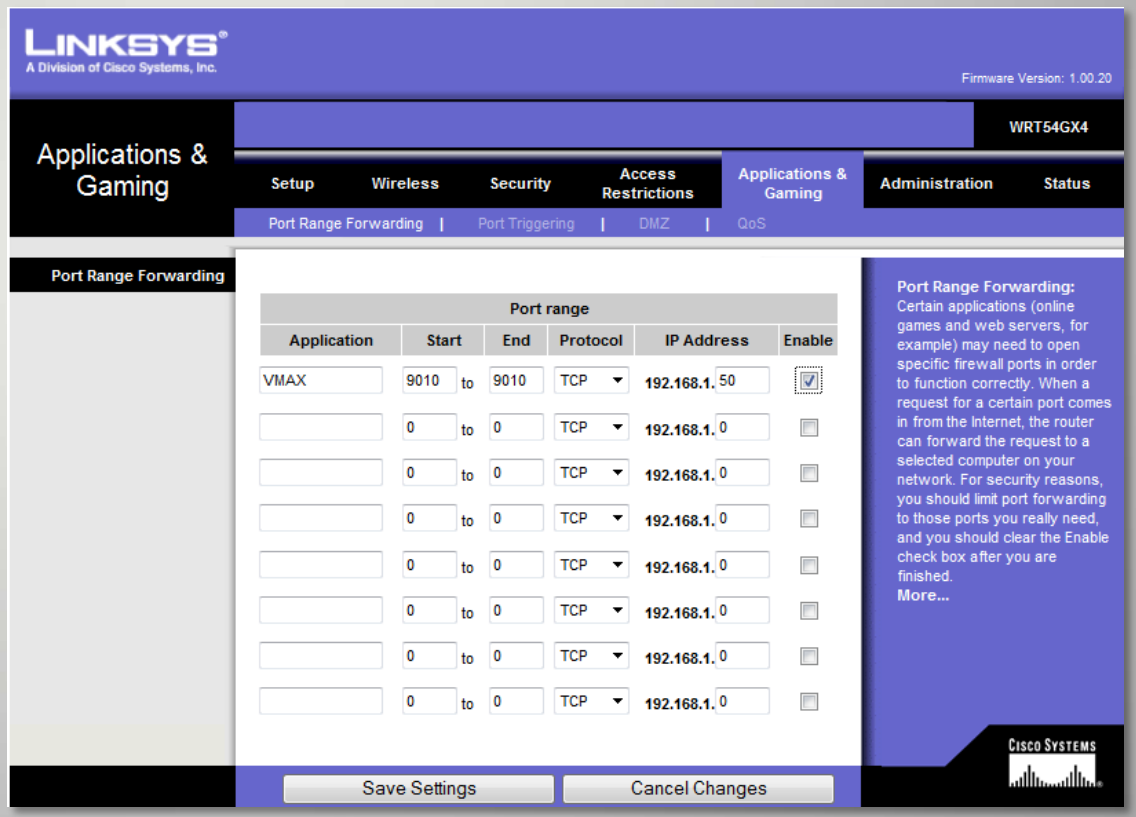
Remote Software

Moblie App Port

Web Port

Port Forwarding a Device

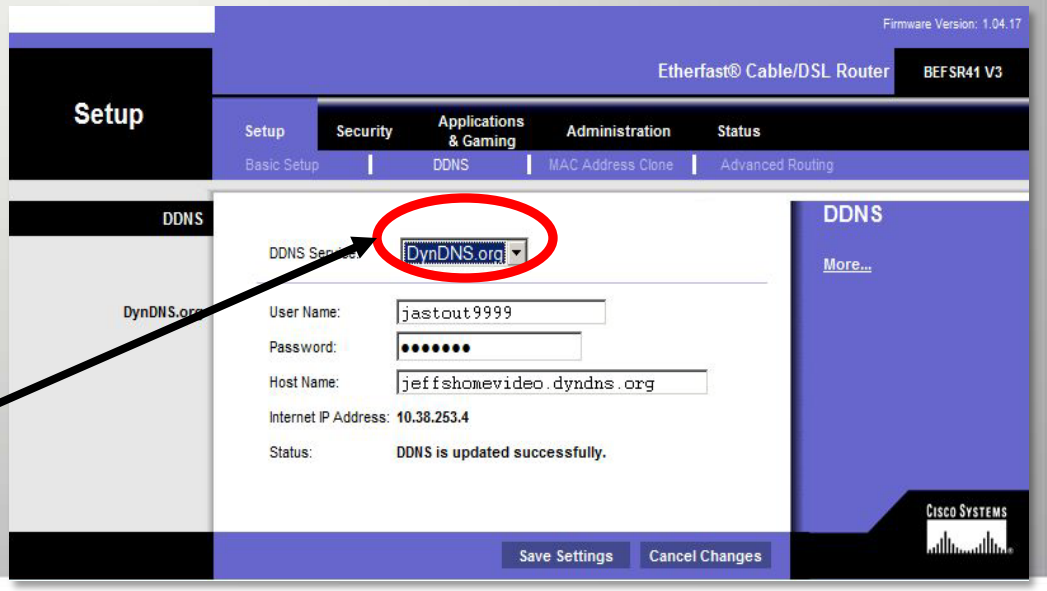
5. Enter a name for the DVR/Camera,
6. Enter starting & ending ports
7. Enter IP Address of the device
8. Check “Enabled”*



*Always click “Save Settings” to avoid losing all the information you have entered!

The DDNS Tab

- Set the router to work with services like TZO or DynDNS.com.
- To access the DVR from outside the network if DVR/ Camera does not host its own DDNS Server

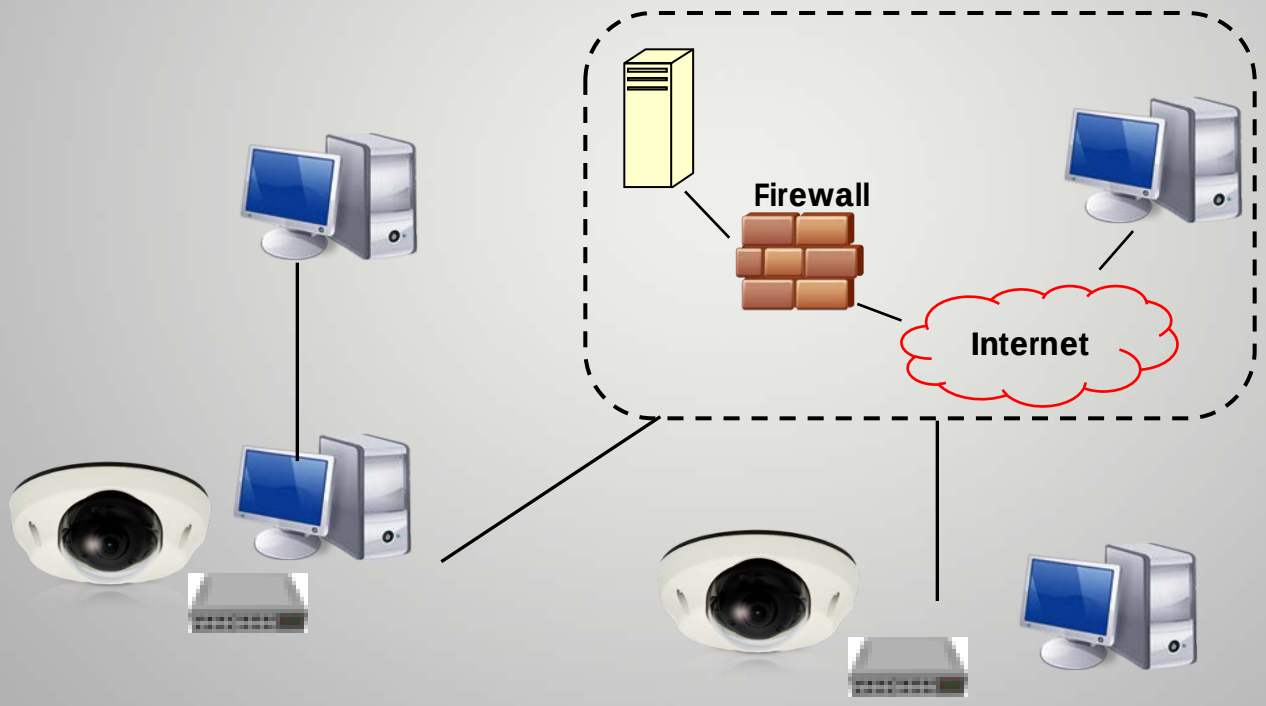


OTHER NETWORK TERMINOLOGY

Firewall

- Hardware and and/ or Software
- Control Incoming and outgoing data
- Between LAN and Internet
- Prevent forbidden communications
  - Blocks IP Addresses in the private network
  - Limit and control application ports
  - Built-in into the router
- Needs to be configured to open ports for communications

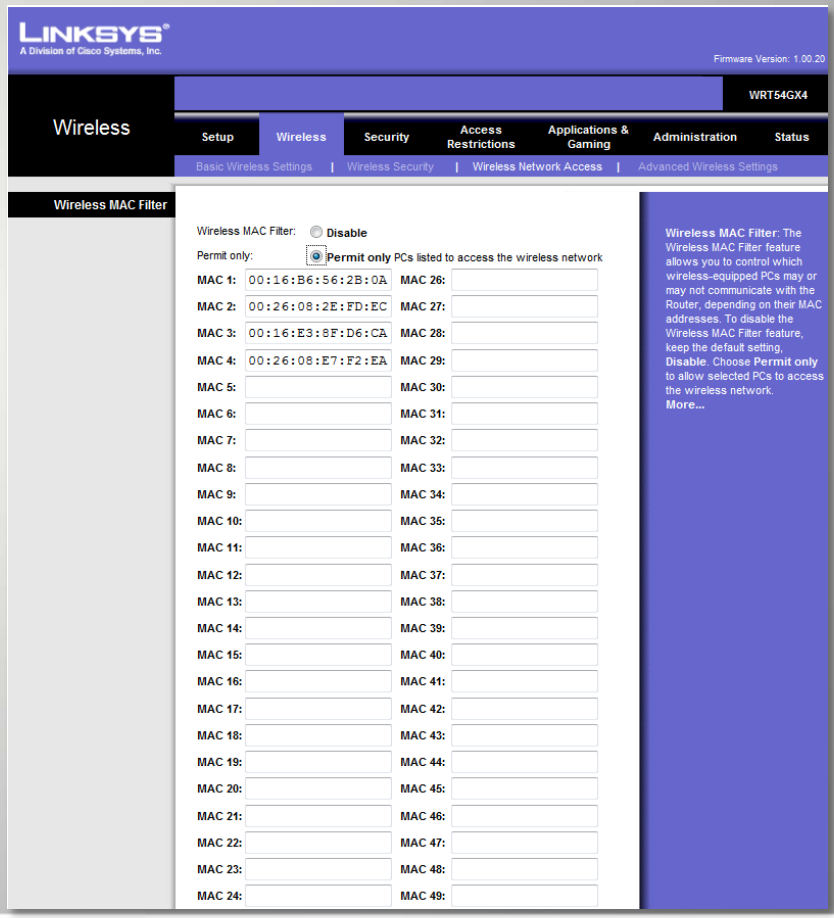
Firewall



Linksys Router Setup

Additional Access Restrictions:

Permit only PC within a specific IP Range or MAC Addresses.



Network Interface Card

- Physically connects a device to a network
- All NICs have a MAC (Media Access Control) Address t
  - Assigned by the manufacturer of NIC
  - Contains 12 hexadecimal digits.
  - First 6 hex digits are the manufacturer's ID,
  - Last 6 are the devices unique ID and serial number
  - Provided by a governing body.
- Ex: 00 – AD – 34 – 50 -0B – 80

MFG ID Unique ID

Network Addresses / Identities

Each network device must have an individual MAC Address.

Ex: 00:1C:A6:01:22:D7

Organizationally Unique Identifier (OUI) Assigned by IEEE

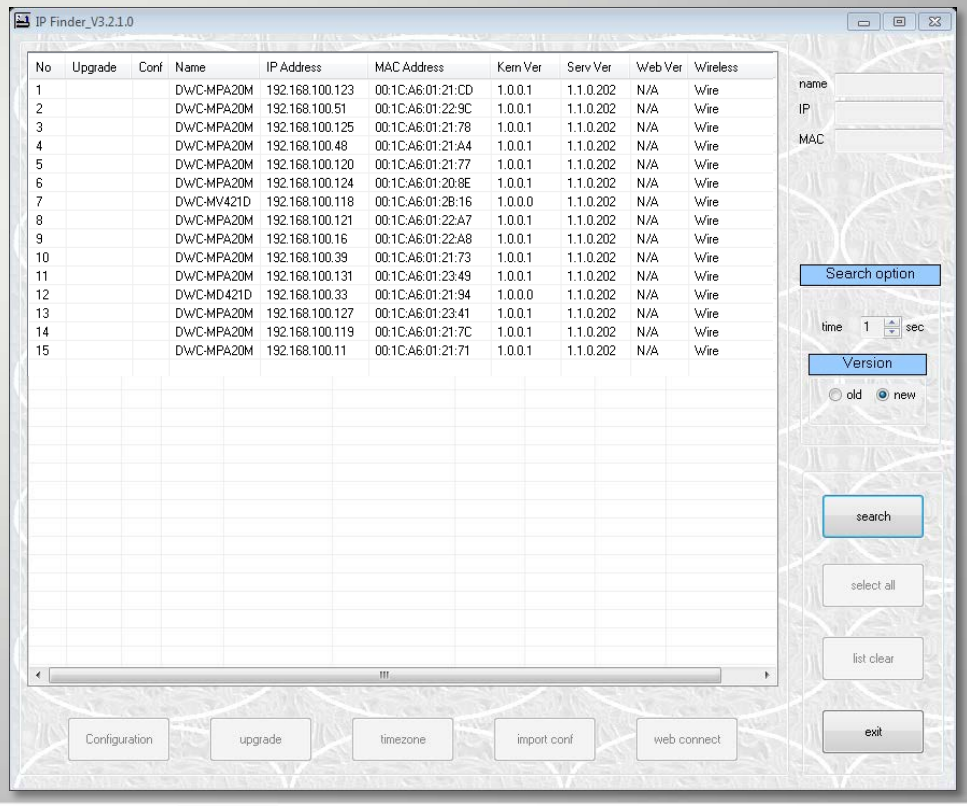
Product Unique Identifier Assigned by Manufacturer

MAC Address & Serial Number

Digital Watchdog IP Finder

Easy to use

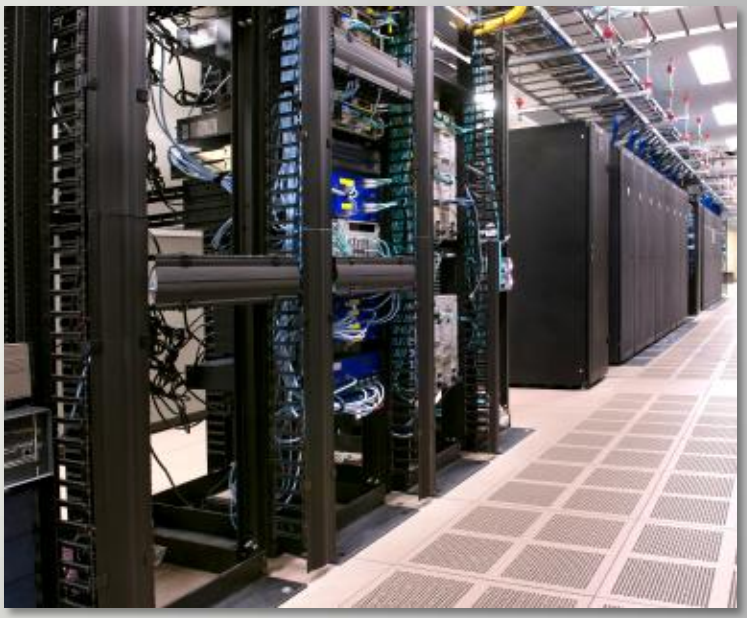
Scans local subnet for Digital Watchdog's IP cameras



Infrastructure and Active Components

LET’S GET PHYSICAL!

The Network Infrastructure



Network-Structured Cabling

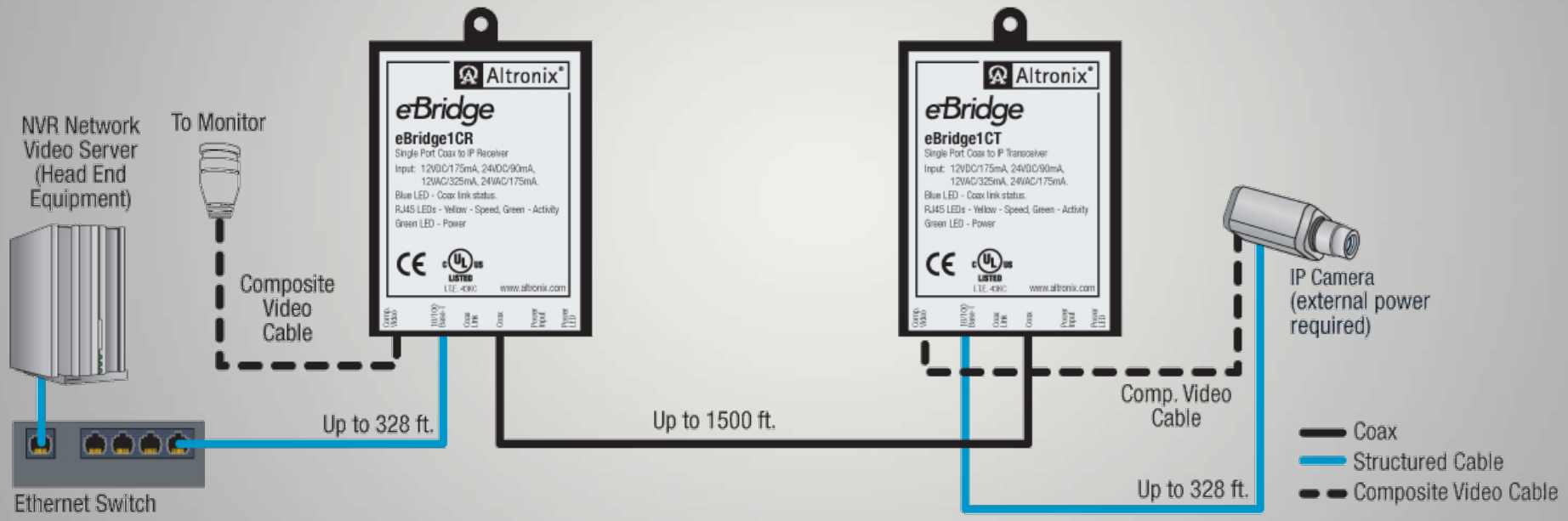
- **CAT-5** (Category 5)
  - Network cabling
  - 4 copper twisted pairs, terminated by RJ45 connectors
  - Up to 100 Mbps (100Base-T & 10Base-T networking).
- **CAT-5e** (Category 5 enhanced)
  - More stringent standards than CAT-5.
  - Recommended for all new installations
  - Up to 1000Mbps (gigabit) per second (Gigabit Ethernet).
- **CAT-6**
  - Higher price
  - Better performance

Ethernet Over Coax (eBridge Ethernet Adapter)

- Transmit IP video & data over coax 1500ft with no repeaters
- Retrofit Digital IP cameras in analog CCTV installation
- Works with Megapixel, HD720, HD1080
- Extend Network distance
- Upgrade CCTV Coax to a digital network for Retail, Casinos, Airports, Schools, Hospitals, etc.
- Simultaneously use Composite Video for monitor display & control, & digital IP for the NVR camera recording

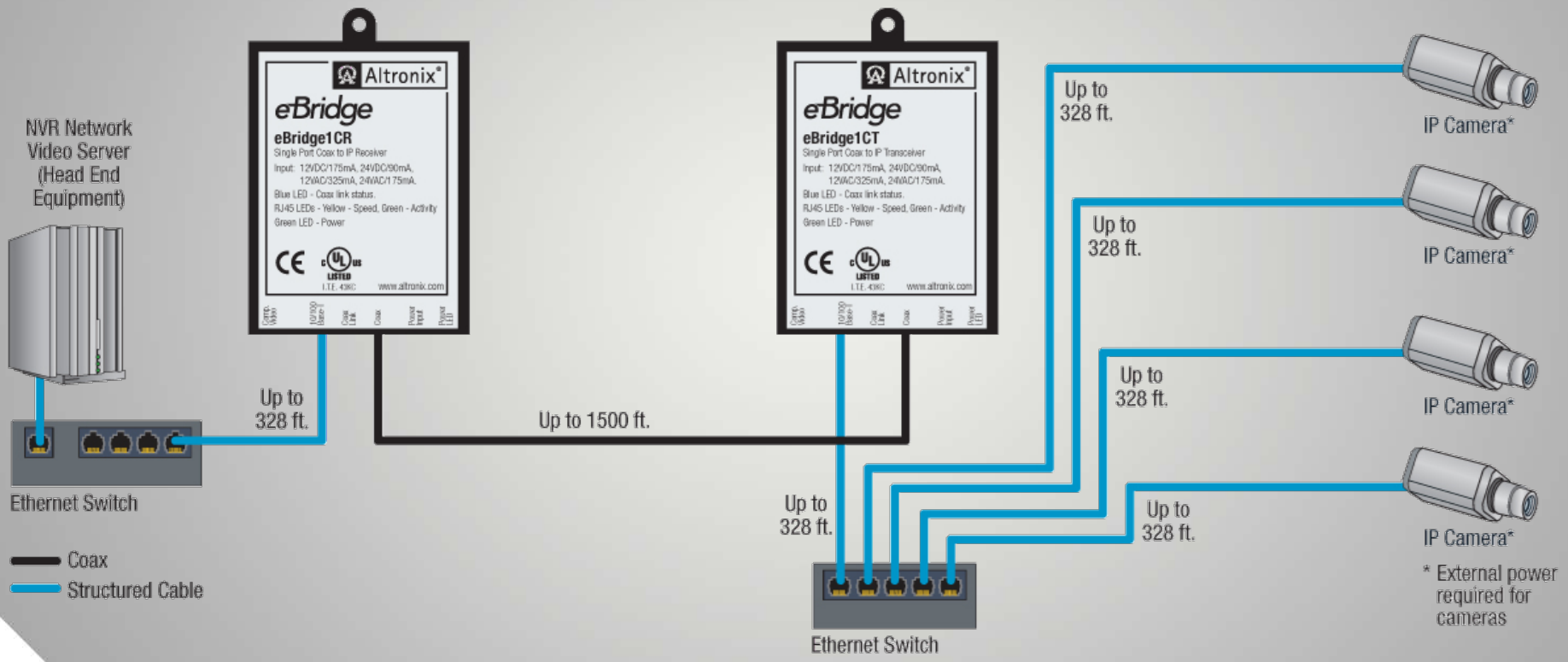
eBridge™ c UL us

Ethernet Over Coax (eBridge Ethernet Adapter)



eBridge™ c UL us

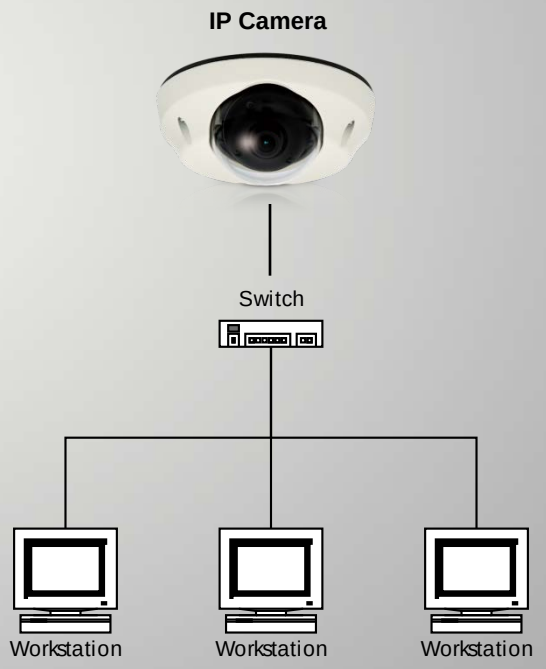
Ethernet Over Coax (eBridge Ethernet Adapter)



Note: Multiple cameras require higher bandwidth and processing speed. It is recommended to test this configuration. eBridge is rated to pass 25mbps of data up to 1500 ft. With proper head end equipment, multiple Megapixel cameras can be used.

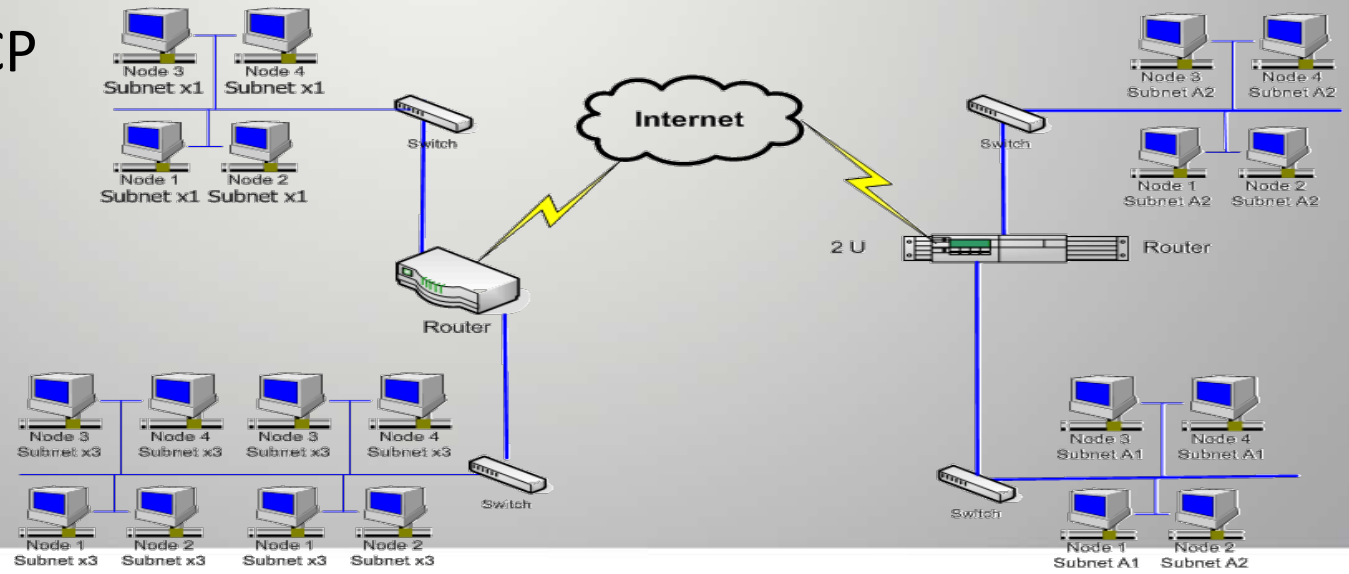
Switch

- Forwards incoming packets to their appropriate ports
- Larger Networks:
  - Core switches
  - Edge switches
- Smaller Networks:
  - Single Switch
- Features:
  - Security & IP addressing
  - Power management
  - bandwidth control



Router

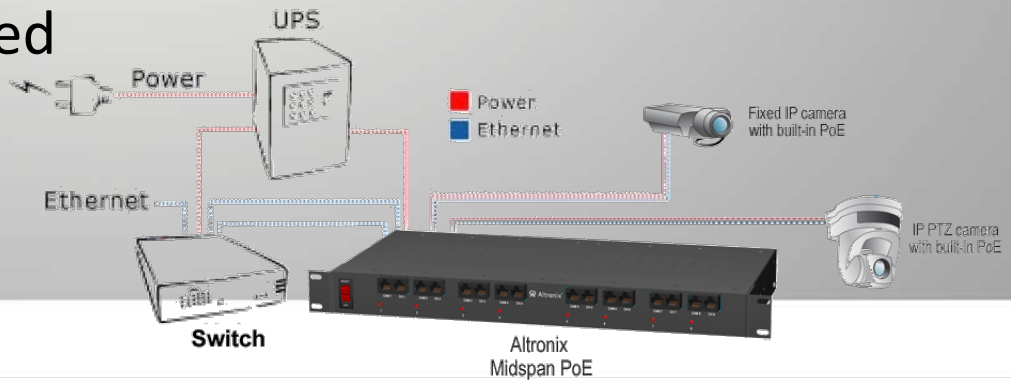
- Forwards packets between networks
- Connects LANs to the Internet
- Operates as a firewall
- Assigns IP Addresses internally
- Manages DHCP



POE - POWER OVER ETHERNET

What is Power over Ethernet?

- Using the same cable to provide network devices power and network connection
- Data & Power over a single Ethernet cable
- Very useful for places where it may be too expensive to power a device from a power outlet
- Transmitting safe and uninterrupted power (15W, 48V) over existing LAN infrastructure
- IEEE 802.3af Standard-Based



PoE Technology Overview

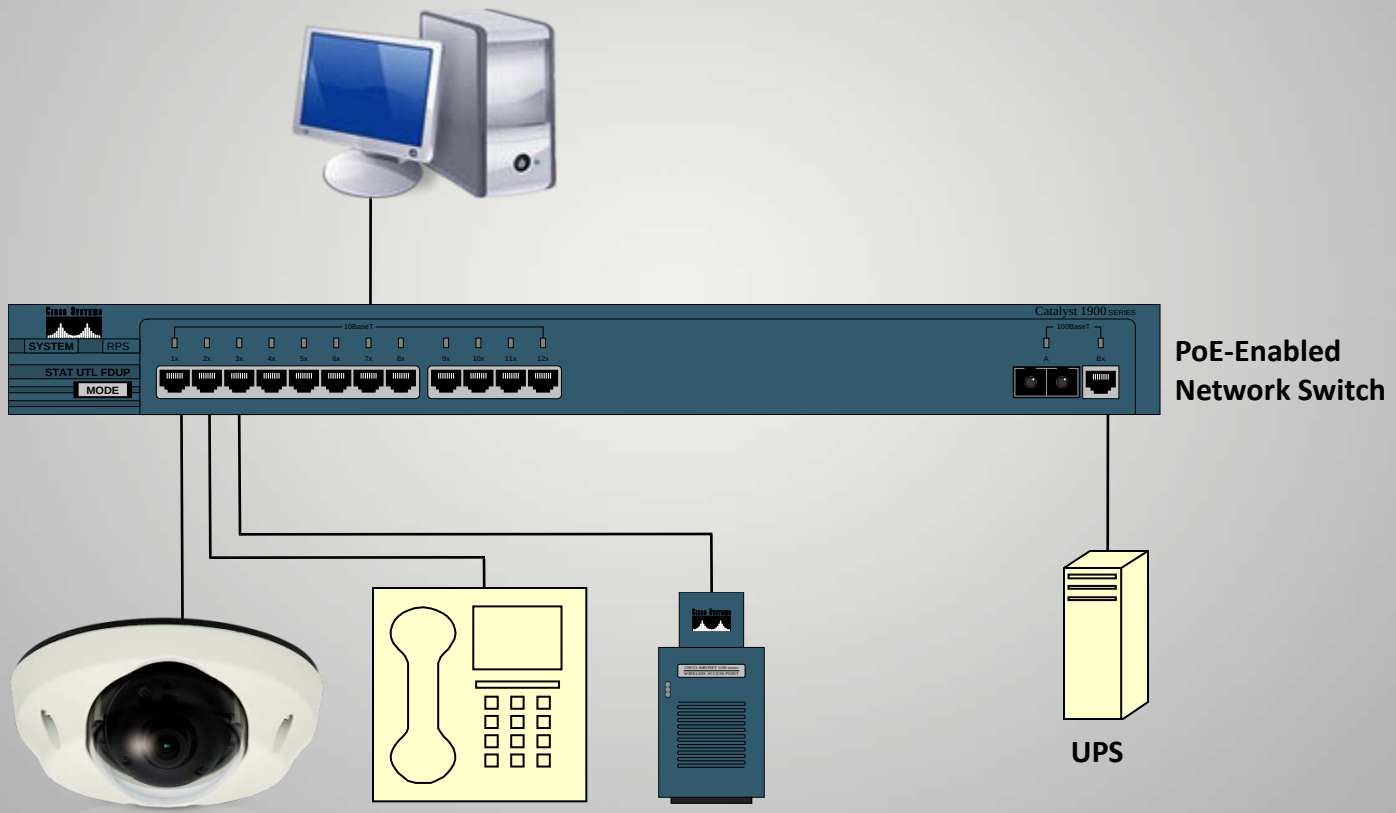
- Current standard- **802.3af**.*
  - 48 VDC, 15.4W max on the switch/mid-span side (PSE – Power Sourcing Equipment)
  - 12.95W on the device's side (PD – Powered Device)
- No effect on data transmission or cable length
- Backwards Compatible
- **Hi-PoE** standard- **802.3at**.
  - 48 VDC, 30W max on the switch or mid-span side (PSE)
  - 24W on the device/camera side (PD)

*This accounts for the voltage drop after 100m

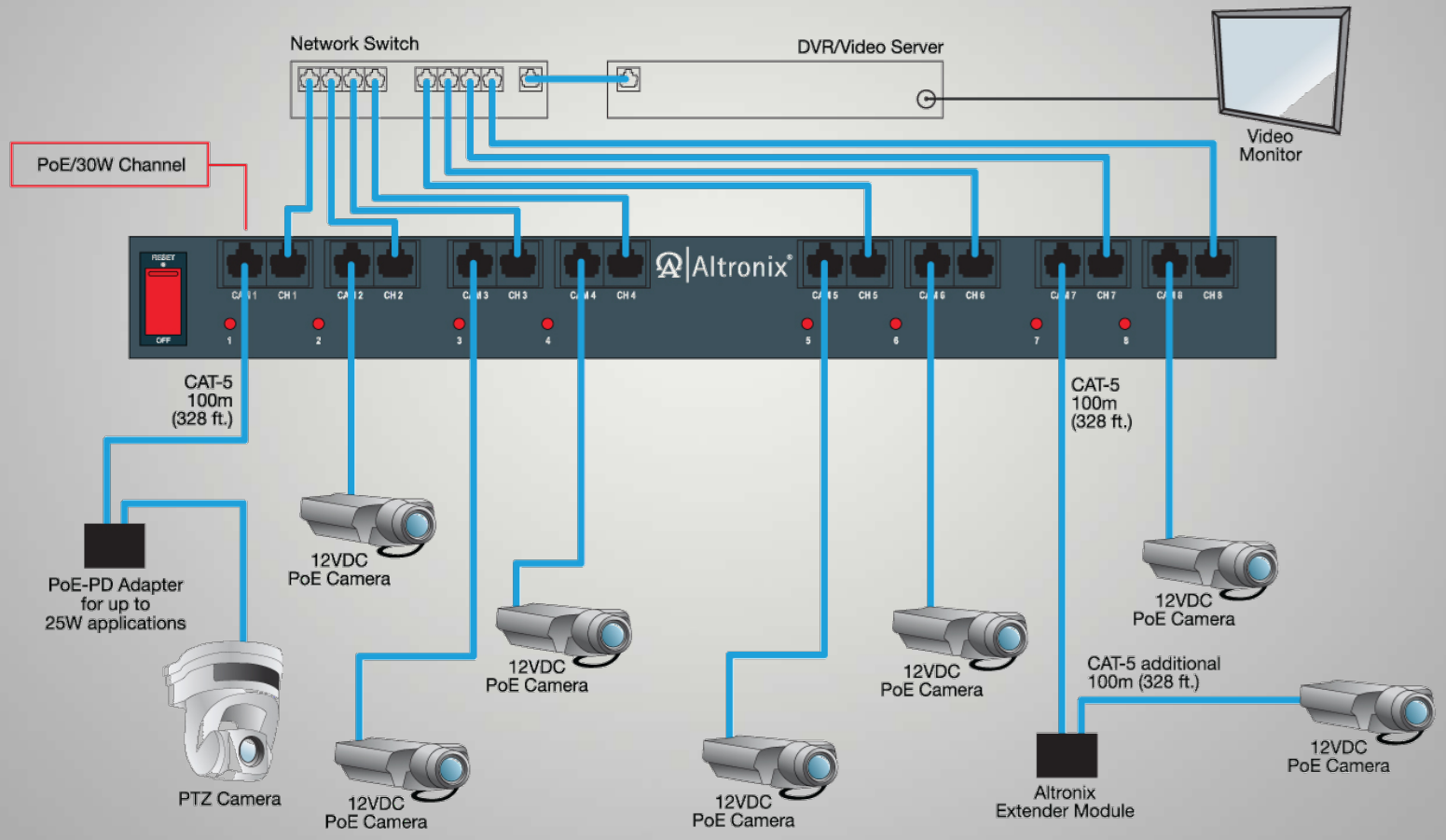
Advantages of PoE

- More Flexibility, Better Profit Margins
- Alternate mounting locations & adding more cameras
- Fast installation & integration
- Easy to provide UPS on application server & PoE switch
- Centralize mid-spans
- LEDs verify state of devices
- Cost Savings
  - No new AC power cables and outlets needed
  - No need for a certified electrician
  - Fewer safety approvals

Using PoE Switch (End-span)



Using PoE Mid-span & Switch

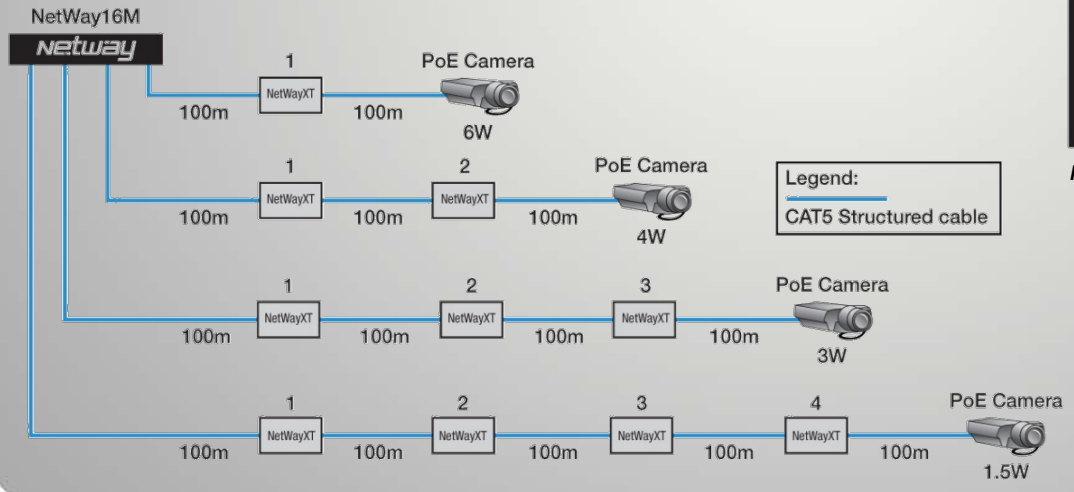


PoE Extender

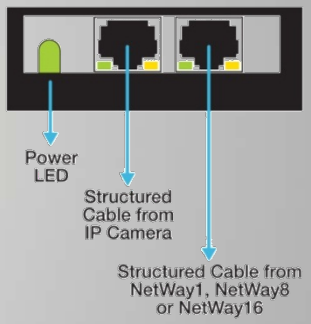
Repeater- extends data for NetWay mid-spans and injectors.

NetWayXT Repeater:

- Extends data 100m (328 ft.) per port.
- Multiple units may be used to extend range.*



NetWayXT



# of NetWayXTs	Range	Available Power (current)
1	200m	6W
2	300m	4W
3	400m	3W
4	500m	1.5W

*Quantity based on device current draw.

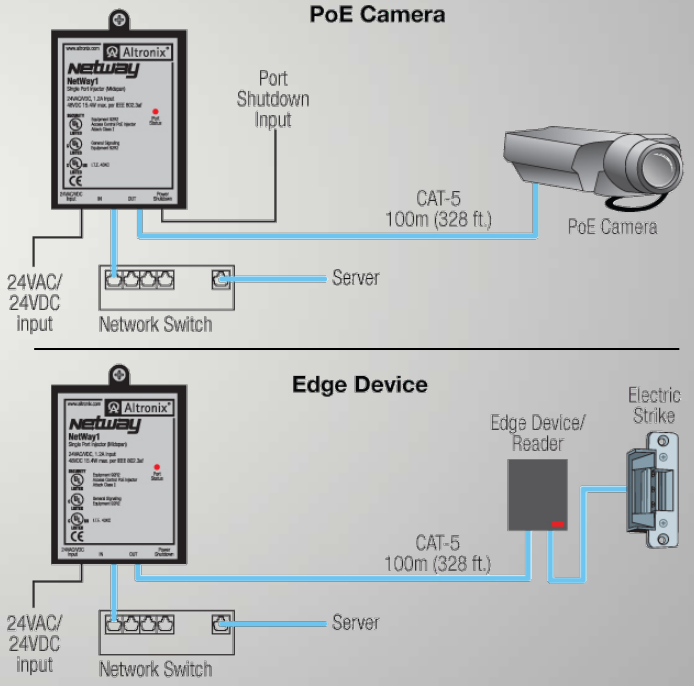
Single Port PoE

Midspan injector- provides power for IP surveillance cameras.

NetWay1*

- One (1) port rated @ 15.4W max.
  IEEE 802.3AF
- Port status LED indicator
- PoE shutdown feature Operates at
  24VAC/24VDC

NetWay1

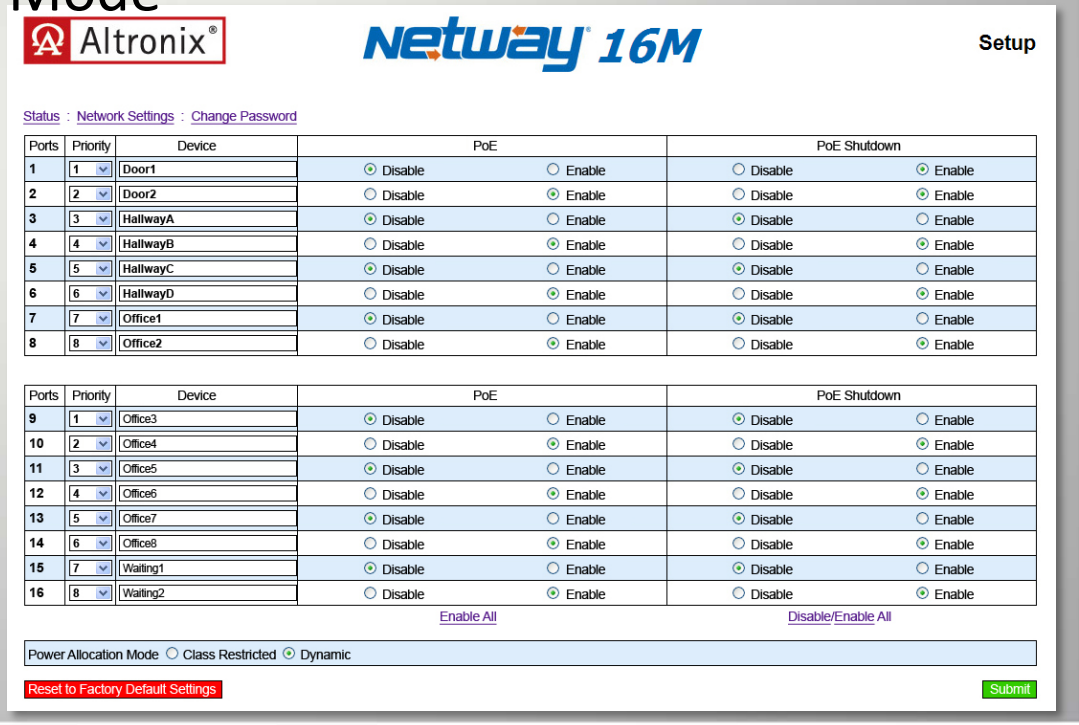


*UL/CUL Listed for IT Equipment (UL 60950-1). UL Listed for Access Control Systems (UL 294). CUL Listed – CSA Standard C22.2 No.205-M1983, Signal Equipment.

Managed PoE

NetWayM Setup Screen:

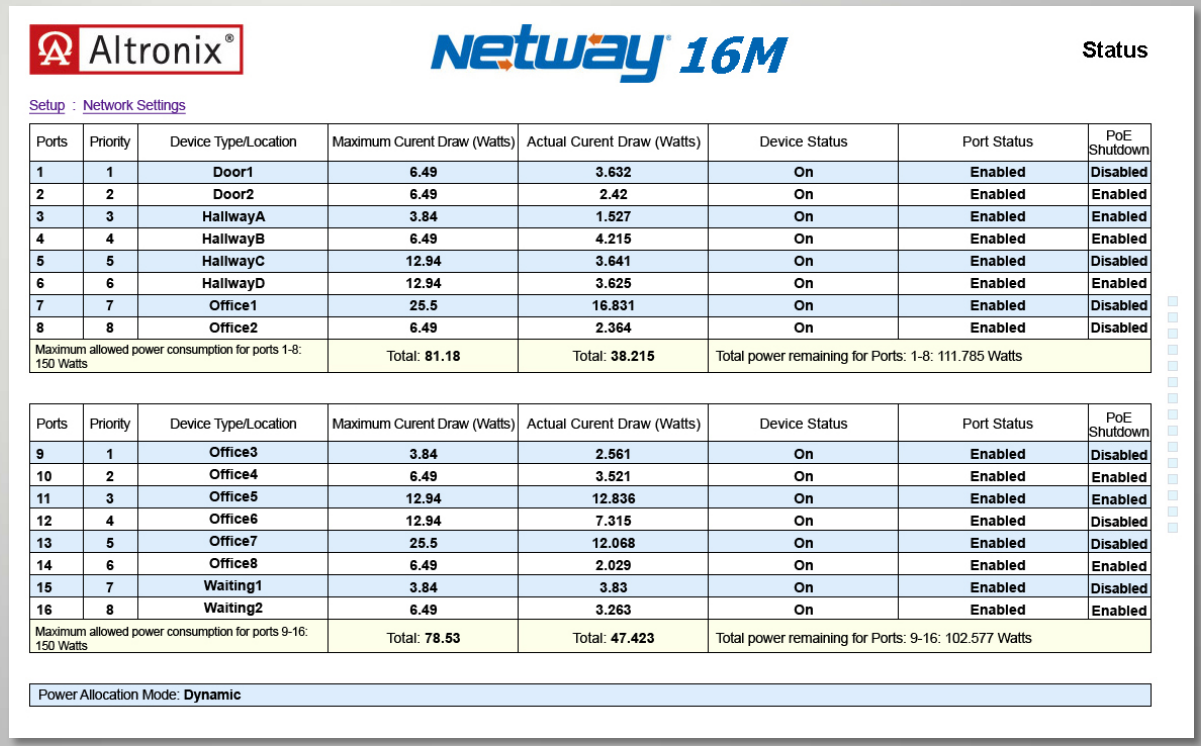
Port priority, I.D. & Enable/Disable, Power Allocation Mode - Class Restricted or Dynamic Mode



Managed PoE

NetWayM Status Screen:

Port Priority, Current Draw & Status, Device I.D. & Status, PoE Shutdown Status



Altronix®

Netway 16M

Status

Setup : Network Settings

Ports	Priority	Device Type/Location	Maximum Curent Draw (Watts)	Actual Curent Draw (Watts)	Device Status	Port Status	PoE Shutdown
1	1	Door1	6.49	3.632	On	Enabled	Disabled
2	2	Door2	6.49	2.42	On	Enabled	Enabled
3	3	HallwayA	3.84	1.527	On	Enabled	Enabled
4	4	HallwayB	6.49	4.215	On	Enabled	Enabled
5	5	HallwayC	12.94	3.641	On	Enabled	Disabled
6	6	HallwayD	12.94	3.625	On	Enabled	Enabled
7	7	Office1	25.5	16.831	On	Enabled	Disabled
8	8	Office2	6.49	2.364	On	Enabled	Disabled
Maximum allowed power consumption for ports 1-8: 150 Watts			Total: **81.18**	Total: **38.215**	Total power remaining for Ports: 1-8: 111.785 Watts		

Ports	Priority	Device Type/Location	Maximum Curent Draw (Watts)	Actual Curent Draw (Watts)	Device Status	Port Status	PoE Shutdown
9	1	Office3	3.84	2.561	On	Enabled	Disabled
10	2	Office4	6.49	3.521	On	Enabled	Enabled
11	3	Office5	12.94	12.836	On	Enabled	Enabled
12	4	Office6	12.94	7.315	On	Enabled	Disabled
13	5	Office7	25.5	12.068	On	Enabled	Disabled
14	6	Office8	6.49	2.029	On	Enabled	Enabled
15	7	Waiting1	3.84	3.83	On	Enabled	Disabled
16	8	Waiting2	6.49	3.263	On	Enabled	Enabled
Maximum allowed power consumption for ports 9-16: 150 Watts			Total: **78.53**	Total: **47.423**	Total power remaining for Ports: 9-16: 102.577 Watts		

Power Allocation Mode: **Dynamic**

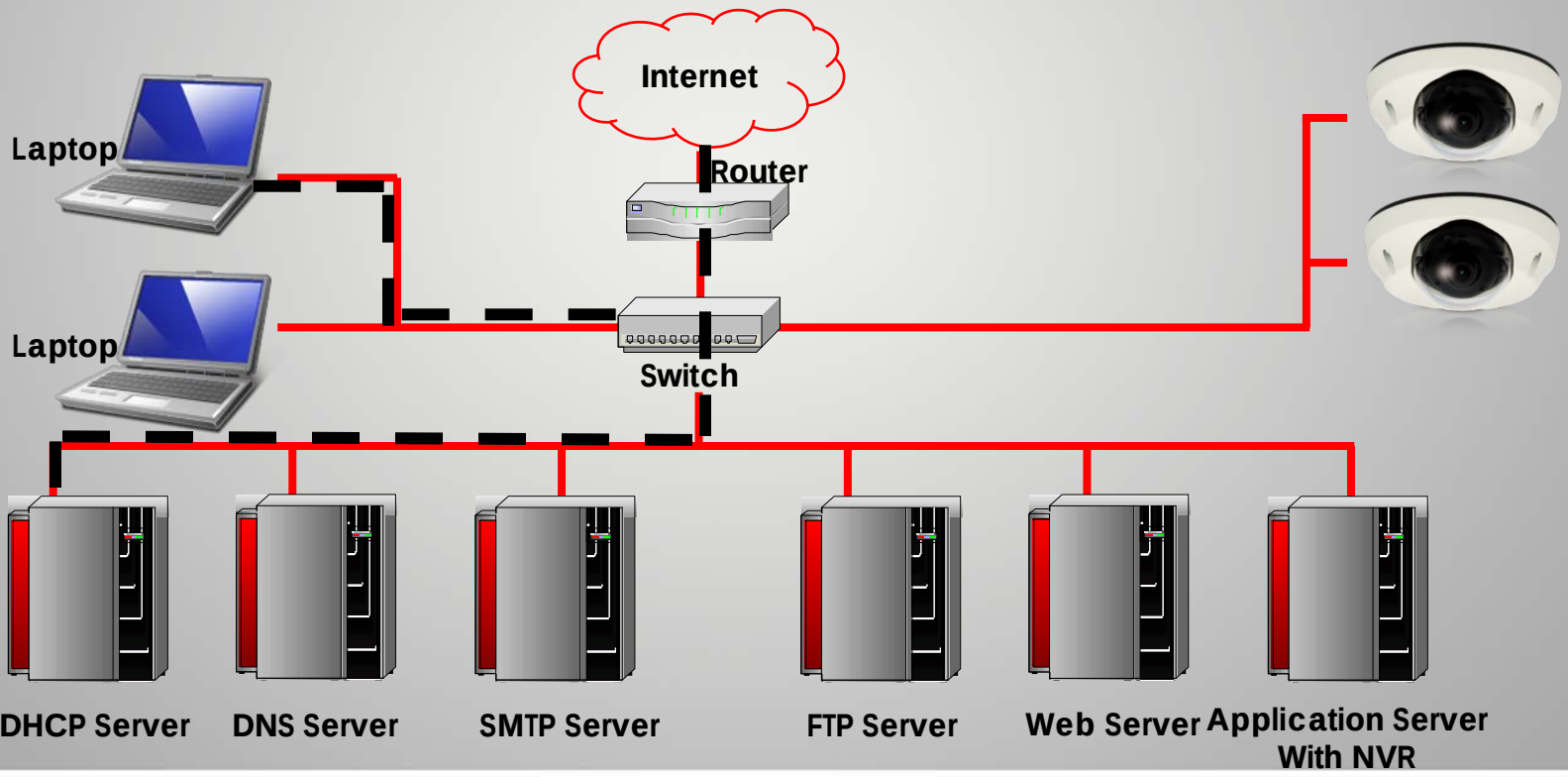
Servers, What are they?

- Application/ device performing services for connected clients
- Part of a client-server architecture
- What do servers “serve”?
  - E-mail Server→ manages e-mail traffic
  - Application Server → network server dedicated to running a particular application
  - Database Server →
  - FTP Server → File Transfer Protocol Server

DHCP Server (Dynamic Host Configuration Protocol)

- Assigns IP addresses, Subnet mask, Default router, & DNS server information
- Advantageous when deploying large number of devices
- Moving devices easy & seamless
- IP address is “leased” for a certain amount of time

DHCP Server


Internet
Router
Laptop
Laptop
Switch
DHCP Server
DNS Server
SMTP Server
FTP Server
Web Server
Application Server
With NVR

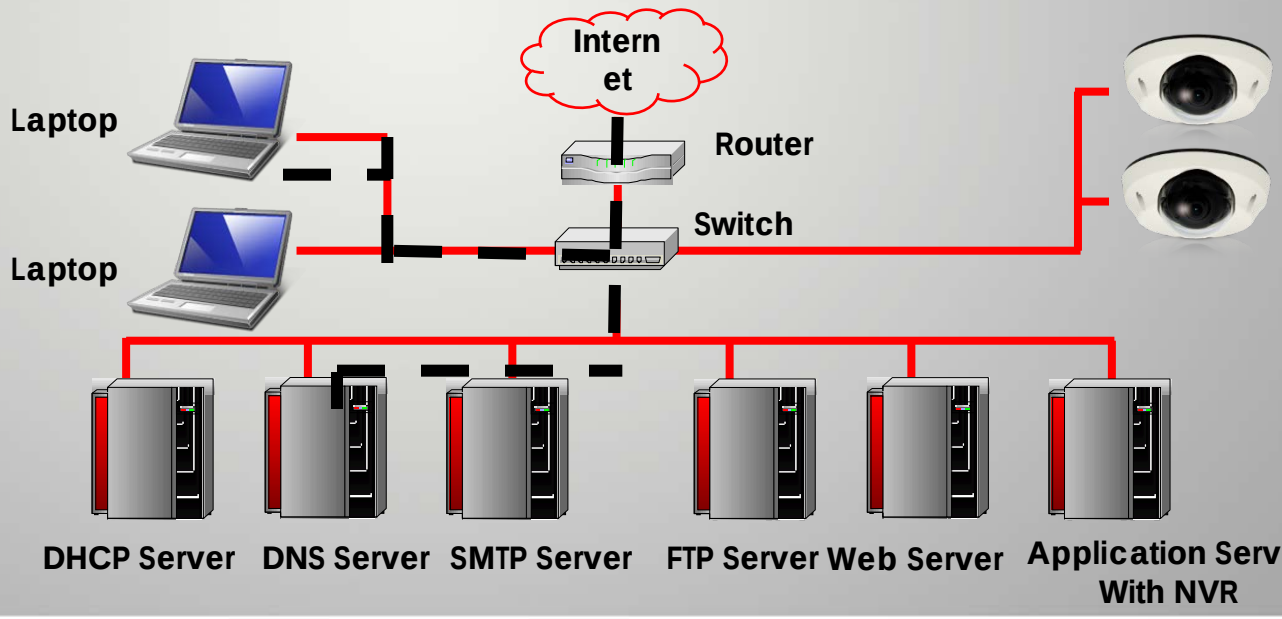
DNS & DDNS Servers

- **DNS (Domain Name Server)**
  - Resolves IP addresses to URL
  - Ex: 259.154.0.31 → www.camera.com
  - Can be used in a LAN for naming cameras
- **DDNS (Dynamic Domain Name Server)**
  - Allows dynamic IP to have an Internet address
  - Register a host name with a DDNS service provider
  - When IP changes, service provider updates DNS servers
  - Solution for small business or home users

DNS Server

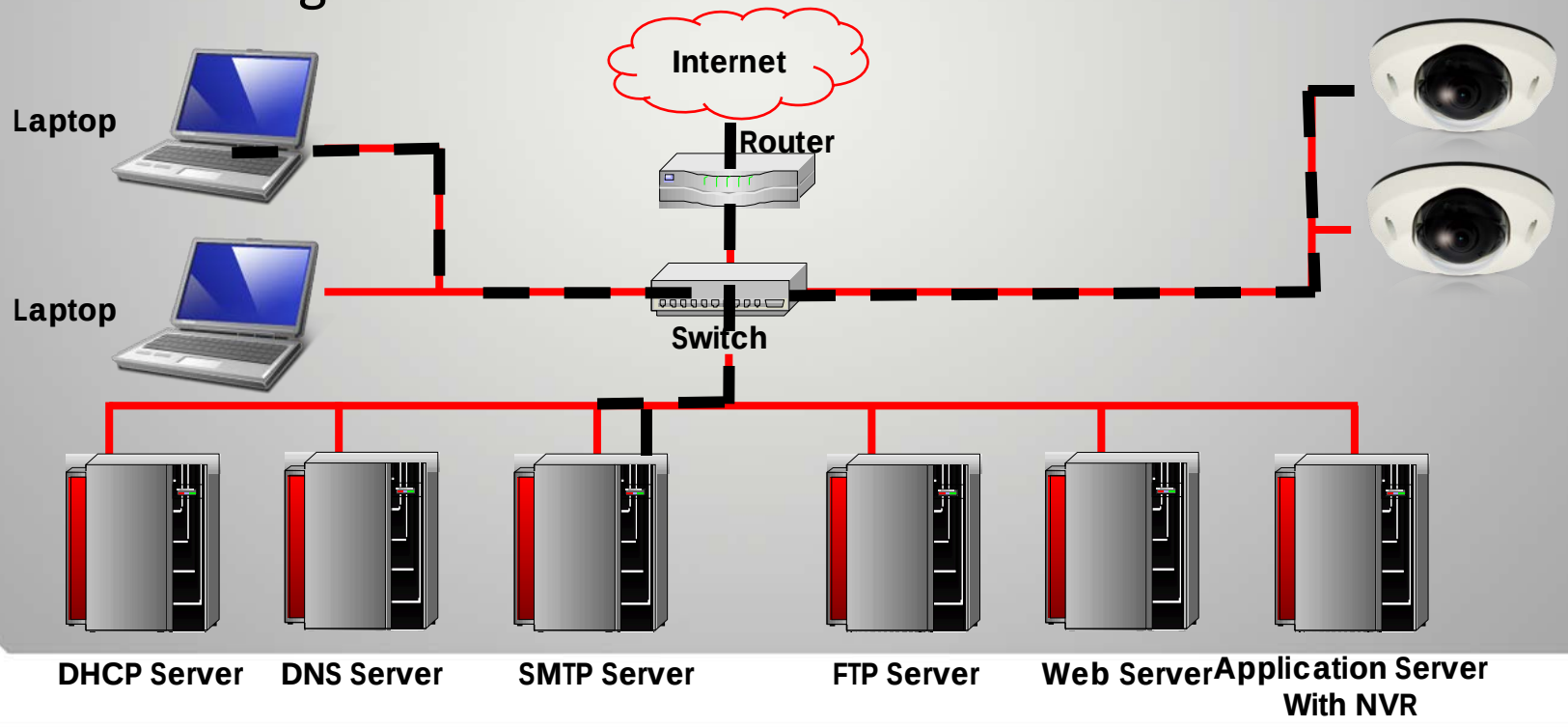
Types www.___.com into web browser.

DNS Server finds ".com" as "216.23.181.212" and forwards this information to the user.



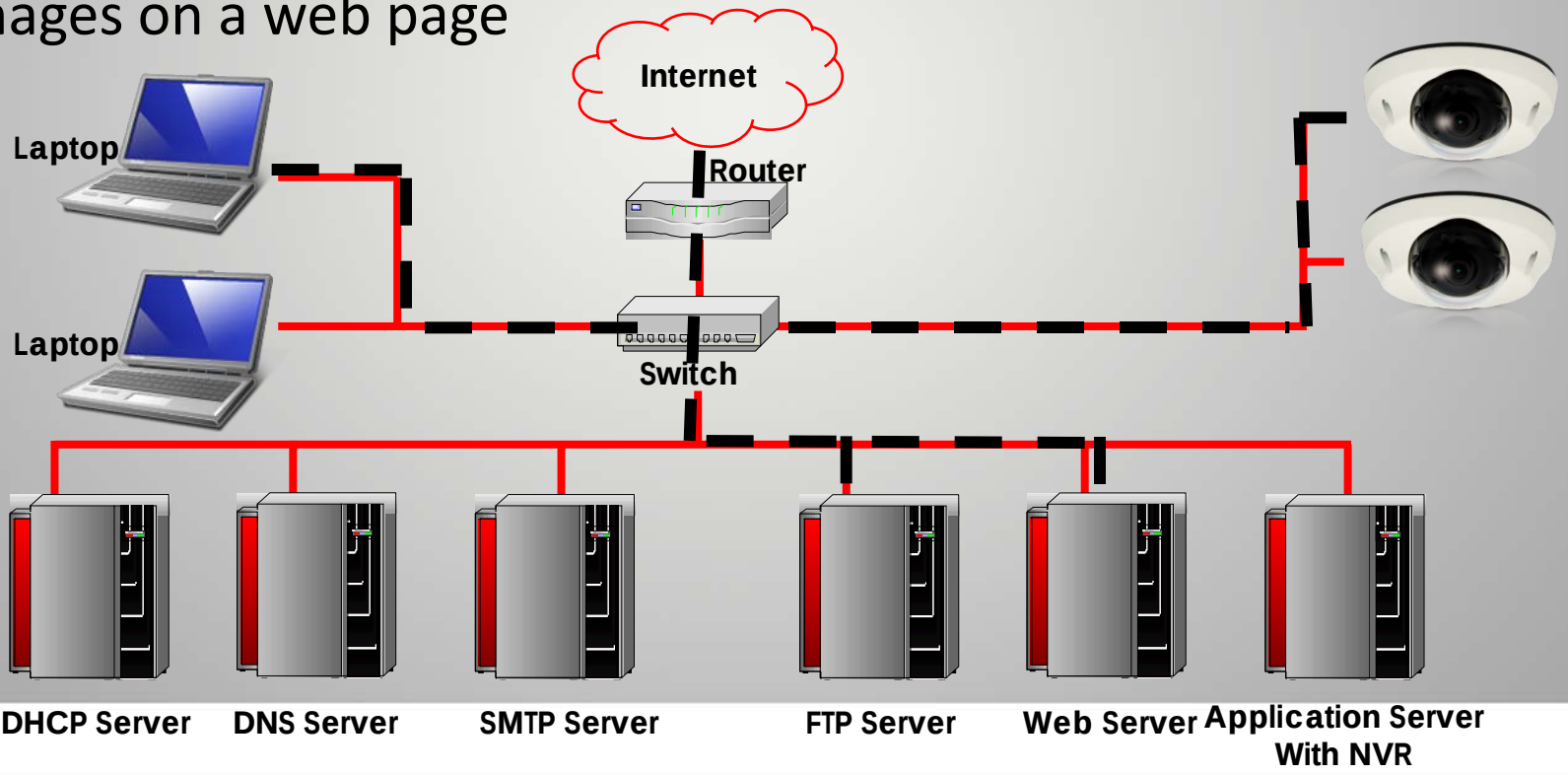
SMTP Server (Simple Mail Transfer Protocol)

- E-mail standard for transmission over the Internet
- IP Cameras do not send mail by themselves, but they send it through the SMTP server



FTP & Web Server (File Transfer Protocol)

- Transfer files between computers
- IP camera can transfer images to an FTP server to time lapse images on a web page



DW DIGITAL WATCHDOG

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THANK YOU

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