

NETWORKING FOR AVL TECHNICIANS 2

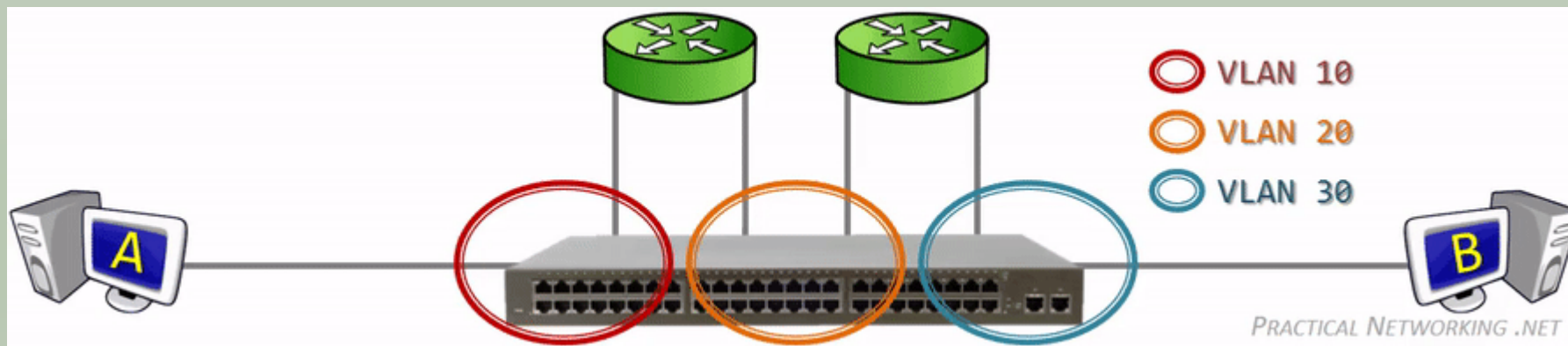
CFI Networking 102

101 Recap

- ISO & TCP/IP Models
- Layer 1 – Physical
 - Cables
 - UTP, STP – 100M or 330 ft length
 - Single Mode and Multimode Fiber
- Layer 2 – Data Link Layer
 - Mac Addresses
 - Switches and VLANs

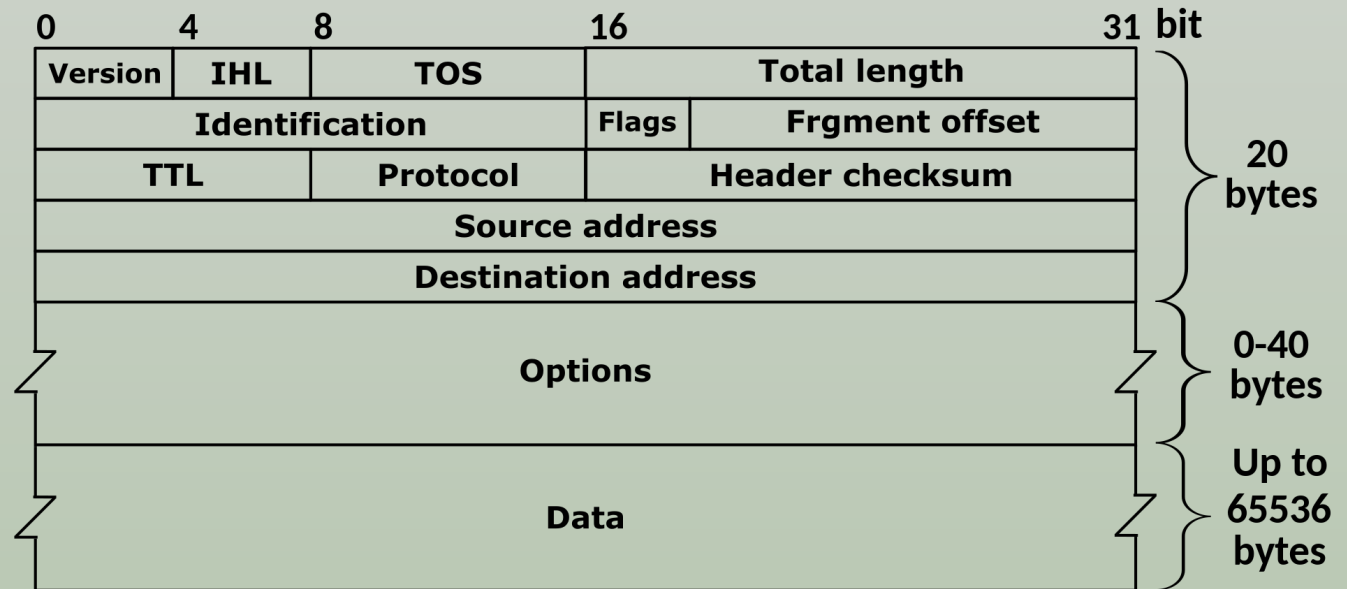
Layer 3 – Network Layer

- IP Protocol
 - Network layer communications protocol in the Internet protocol suite for relaying datagrams across network boundaries. Its routing function enables internetworking, and essentially establishes the Internet
 - Routing – between physical networks or subnets
 - Each network segment has a subnet with an IP range associated with it and a Gateway (router) address
 - A subnetwork or subnet is a logical subdivision of an IP network



Layer 3 – Network Layer

- IP Datagram (Packet)



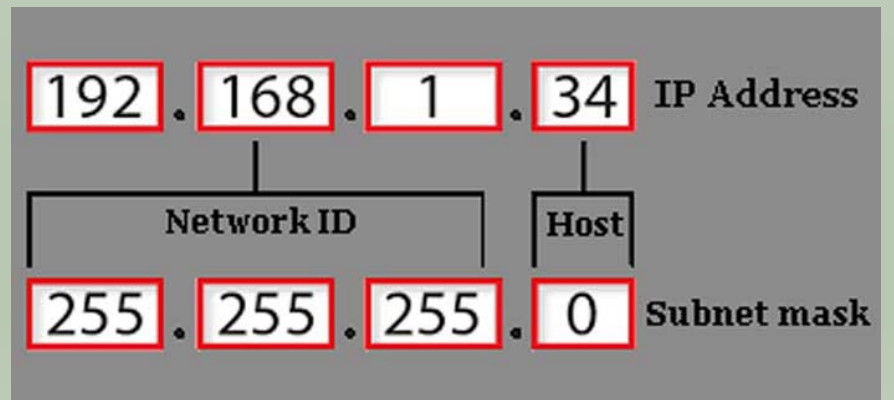
Layer 3 – Network Layer

- IPv4 Addressing
 - Host IP Address
 - A unique address that identifies a device on the internet or a local network
 - 32 bit address in 4 octets. Each octet can be 1-254
 - 0 is reserved for the network address
 - 255 is reserved for the broadcast address
 - 192.168.1.131 (this laptop)
 - Subnet Mask
 - Divides network and host addresses
 - 255.255.255.0
 - 255.255.255 represents the network ID
 - 0 represents the available host addresses
 - 192.168.1.34 with subnet mask 255.255.255.0
 - 192.168.1 is the network ID
 - 1-254 is the available IP addresses for hosts
 - .34 is the specific host
 - CIDR notation 192.168.1.0/24

Network Connection Details

Network Connection Details:

Property	Value
Connection-specific DNS S...	
Description	Intel(R) Wi-Fi 6 AX201 160MHz
Physical Address	B4-0E-DE-68-E1-92
DHCP Enabled	Yes
IPv4 Address	192.168.1.131
IPv4 Subnet Mask	255.255.255.0
Lease Obtained	Thursday, February 24, 2022 8:59:25 AM
Lease Expires	Friday, February 25, 2022 8:59:23 AM
IPv4 Default Gateway	192.168.1.1
IPv4 DHCP Server	192.168.1.1
IPv4 DNS Server	192.168.1.1



Layer 3 – Network Layer

- IP communication between hosts on a network occurs between hosts on the same network segment from host to host.
- If 2 hosts are on different network segments, then communications flows through the default gateway to bridge the networks together.
- Default Gateway:
- The node in a computer network using the Internet protocol suite that serves as the forwarding host (router) to other networks when no other route specification matches the destination IP address of a packet.

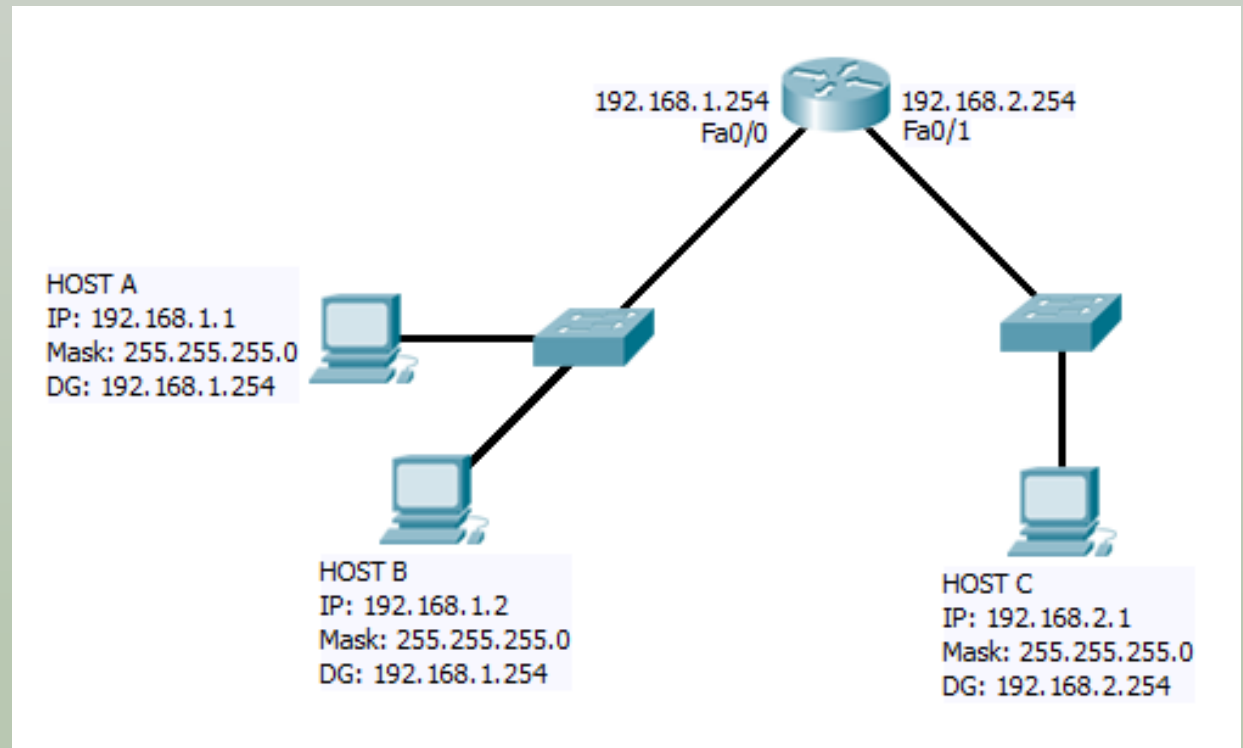
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Layer 3 – Network Layer

Hosts A and B can communicate with each other directly, however communication to Host C from either A or B must flow through the Default Gateway (router) at 192.168.1.254



Layer 3 – Network Layer

Public and Private addresses

- Ip addresses are divided into 2 types, public and private.
- Public IP addresses can be routed throughout the internet
- Private IP addresses cannot cross a router boundary.
 - 10.0.0.0 to 10.255.255.255 (Class A private addresses)
 - 172.16.0.0 to 172.31.255.255 (Class B private addresses)
 - 192.168.0.0 to 192.168.255.255 (Class C private addresses)
- Hosts with private ip addresses communicate with the internet by using NAT
 - NAT - Network Address Translation – maps a private ip to a public ip for communication
 - Usually happens at network boundary by firewall or router.
 - Home Internet routers offer services such as NAT, DHCP and Firewall services.

Layer 3 – Network Layer

Unicast, Multicast, and Broadcast

- Unicast connections send IP packets to a specific host on the network
 - Unicast requires bandwidth from sending host for each data stream
- Multicast sends IP packets to a group of hosts on the network that has subscribed to the multicast
 - Multicast only requires bandwidth of host to send one group of packets to group. Network switch sends copies of packets to all subscribers
 - Most often used to send video data because of size of data stream
 - Recommended for Dante data streams to 3 or more destinations
- Broadcast sends IP packets to all hosts on the network
 - DHCP and WOL are examples of broadcasts
 - Broadcasts are dropped at router border (non-routable)

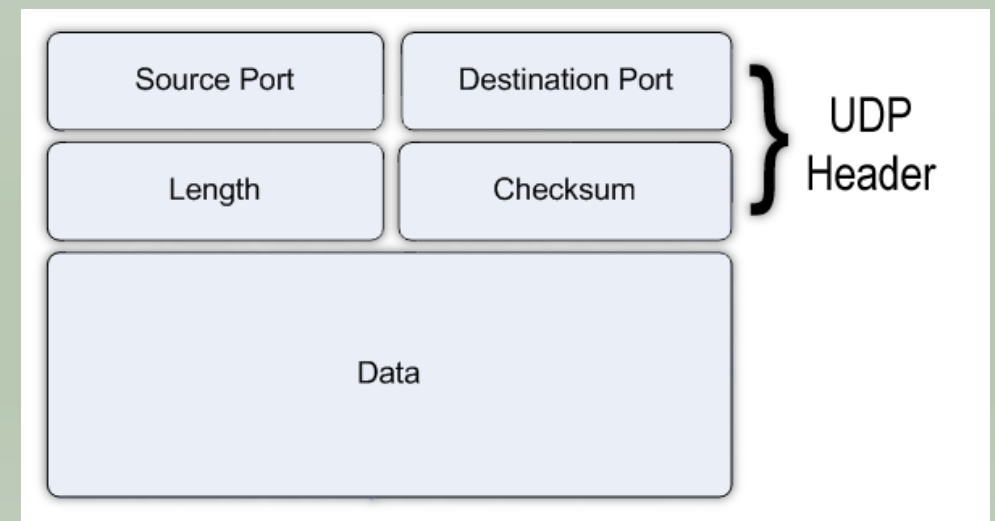
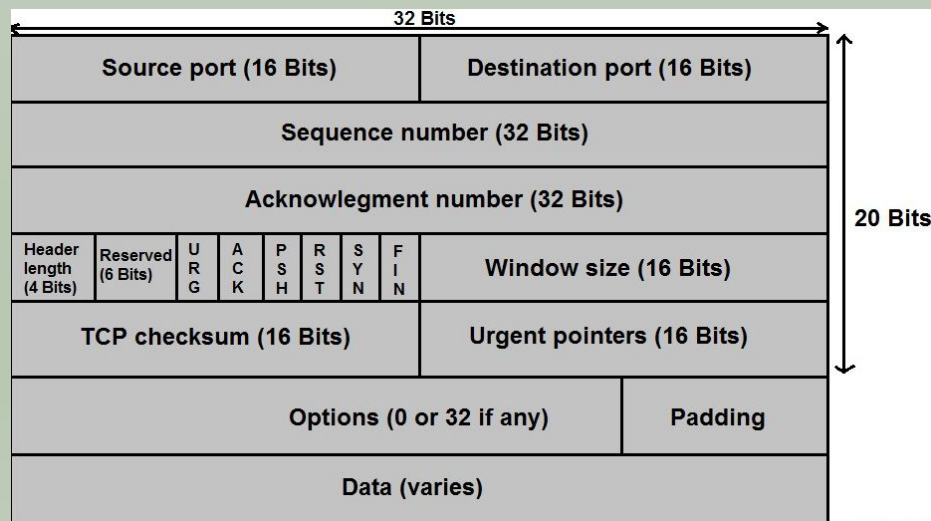
Layer 4 – Transport Layer

TCP – Transmission Control Protocol

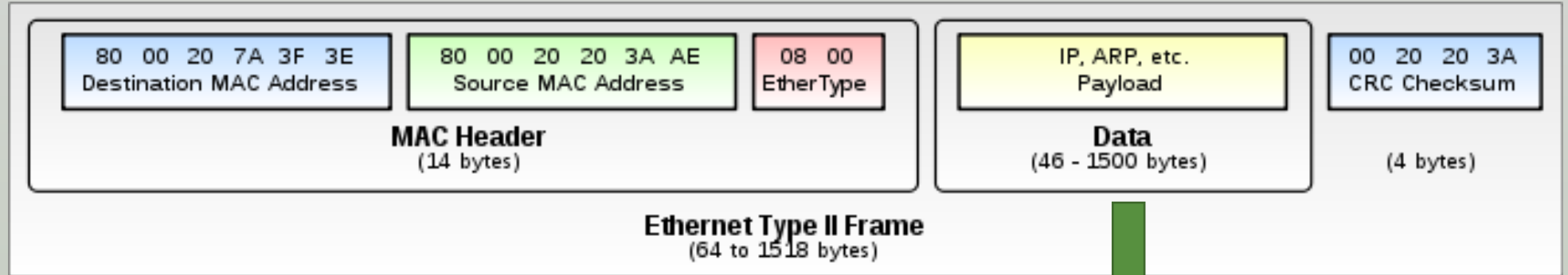
- Connection based
- Reliable, Ordered and Error Checked
- TCP Datagrams called Packets
- HTTP, FTP, SSH, SMTP

UDP – User Datagram Protocol

- Connectionless
- Fast – no error checking
- UDP Datagrams called Packets
- NTP, DHCP, VOIP, Media Transmission – (Dante Audio)

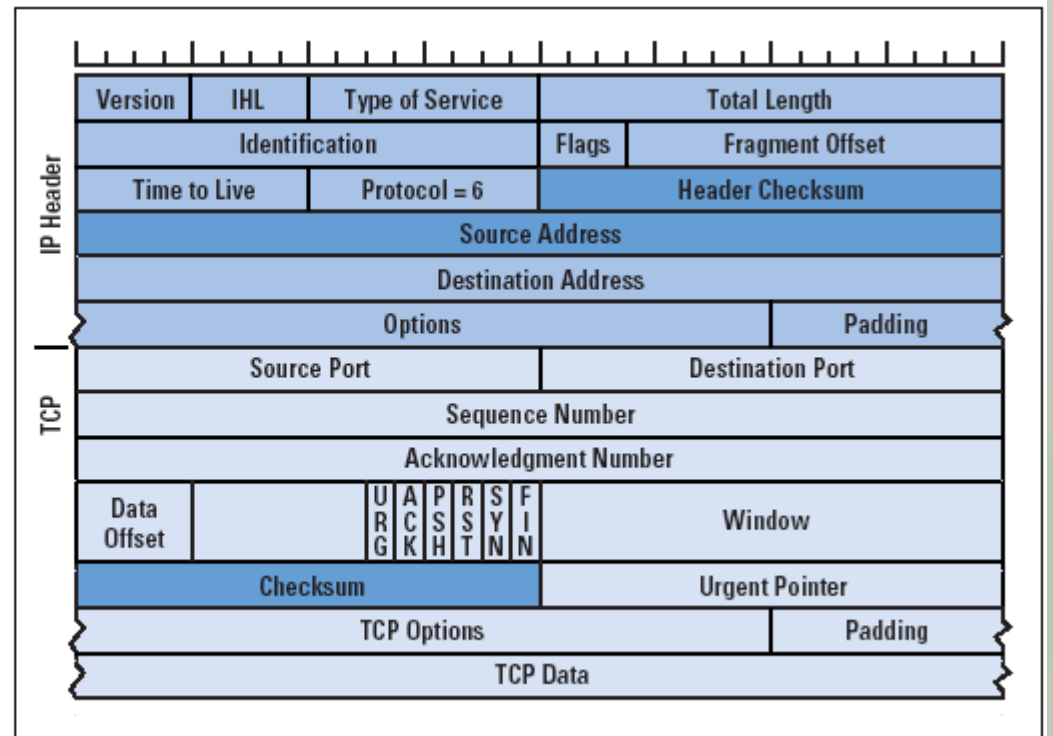


Ethernet Frame



IP Packet

Figure 1: TCP/IP Header
Fields Altered by NATs
(Outgoing Packet)



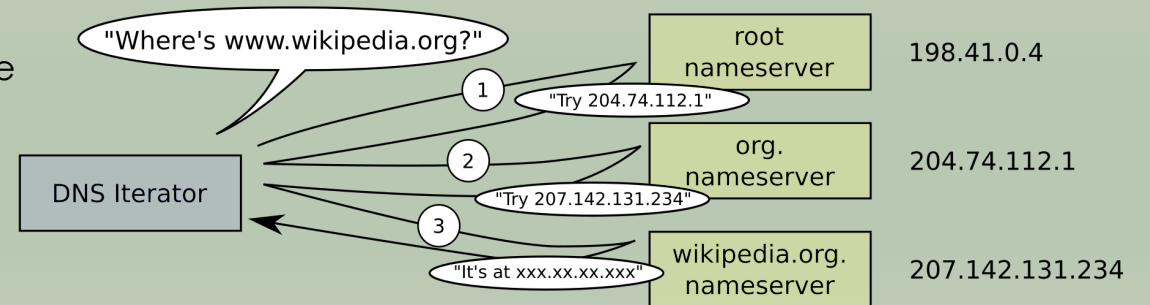
Layer 4 – Transport Layer

Packet Sizes

- MTU – Maximum Transmission Unit (Packet or Frame Size)
 - 1500 bytes – Standard Frame
 - 9000 bytes - Jumbo Frame
 - iSCSI – SANs –
 - If using jumbo frames all equipment must be configured to use them, (NICs, Switches, and SANs)

Common Protocols

- DHCP – Dynamic Host Configuration Protocol
 - Assigns an IP address to a host at startup of host
 - When a host joins the network it sends a broadcast to its network subnet asking for an IP address from a DHCP server.
 - Broadcasts are not routable so broadcasts stay within a particular network segment or subnet
 - DHCP servers allow for reservations to be made associating a mac address to a particular IP, so the host will always receive the same IP.
 - DHCP servers assign IPs for a range of time called the DHCP lease time
- DNS – Domain Name System
 - Translates IP addresses into human readable addresses
 - 198.61.250.137 = www.faylib.org
 - DNS names are resolved iteratively in reverse order of name
 - First stop is root DNS servers or "."
 - Second is org DNS servers (or com, co, us, gov, etc)
 - Third is Wikipedia DNS server
 - Fourth is webserver hosting www record for wikipedia



Common Protocols

- mDNS – multicast Domain Name System
 - Similar to DNS
 - Resolves IPs to hostnames
 - Local level vs. DNS global level
 - Used in Bonjour, Dante (without Dante Domain Manager), and Clearcom Helixnet
- Zeroconf (zero configuration networking)
 - Uses 169.254.0.0 /16 (169.254.0.0 through 169.254.255.255)
 - Link-local address
 - Within a broadcast domain (network segment) – not routable
 - automatic private IP addressing (APIPA)
 - Used in newer OS, and in Dante devices

Common Protocols

- EEE
 - Energy Efficient Ethernet
 - Reduces power consumption during periods of “low” activity
 - AKA Green Ethernet
 - Don't use with media applications (Dante, Video, Comms)

Quality of Service

- QoS is the ability of the network to prioritize certain types of network traffic to provide better service and lower latency
 - QoS Queues only take effect when there is network congestion
 - DSCP (Differentiated Services Code Point) (DiffServ = differentiated services)

Dante DSCP Values for QoS

Priority	Usage	DSCP Label	Hex	Decimal	Binary
High	Time critical PTP events	CS7	0x38	56	111000
Medium	Audio, PTP	EF	0x2E	46	101110
Low	(reserved)	CS1	0x08	8	001000
None	Other traffic	BestEffort	0x00	0	000000

Tips

- Separate networks where useful or required by AVL technology specifications
 - Dante doesn't work on same network with Clearcom Helixnet
 - Audinate recommends not using wireless on same network as Dante devices
 - If sending multicast video, the traffic will be quite large and may require separate network from data or voice
 - Extron NAV 1G Codecs ~ 800Mbps per multicast stream
 - Audinate recommends using separate dedicated switch for Dante Secondary redundancy and not VLANs
- Use minimum number of networks necessary – don't overburden yourself with too many networks
- Separation of AVL control data is recommended from AVL media data
 - Separation of control network from media networks is recommended
 - Connect control network to wireless network for wireless control of mixers, etc
 - ETC does not recommend connecting lighting network (ETCNet) to other networks, but can have advantages

Links

- <https://pro.focusrite.com/configuring-a-switch-for-dante>
- <https://www.audinate.com/learning/cisco-switch-configuration-guide>
- https://www.clearcom.com/DownloadCenter/technicaldocs/HelixNet_IP_Networking_Guide.pdf
- https://support.etcconnect.com/ETC/Networking/General/Network_Design
- <https://www.audinate.com/learning/training-certification/dante-certification-program>
- <https://www.smpte.org/smpte-st-2110-faq>
- <https://www.ndi.tv/>
- <https://avnu.org/>

Thanks for joining us!

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