CompTIA A+ Core 1 Exam 220-1101

Lesson 5

Configuring Network Addressing and Internet Connections

Objectives

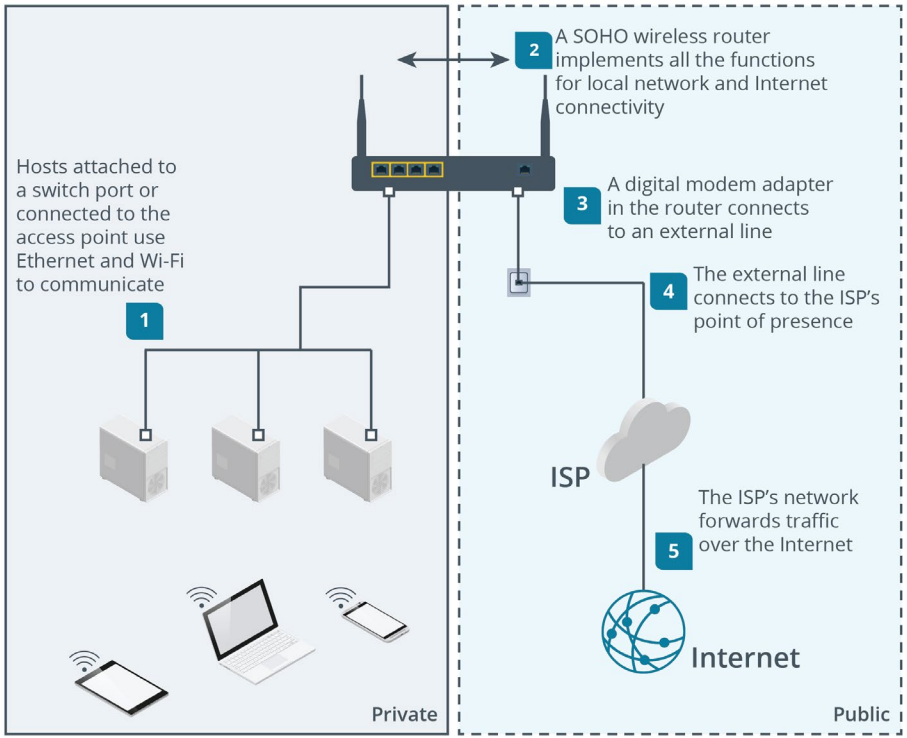
- Compare Internet connection types
- Use basic TCP/IP concepts
- Compare protocols and ports
- Compare network configuration concepts

Lesson 5

Topic 5A

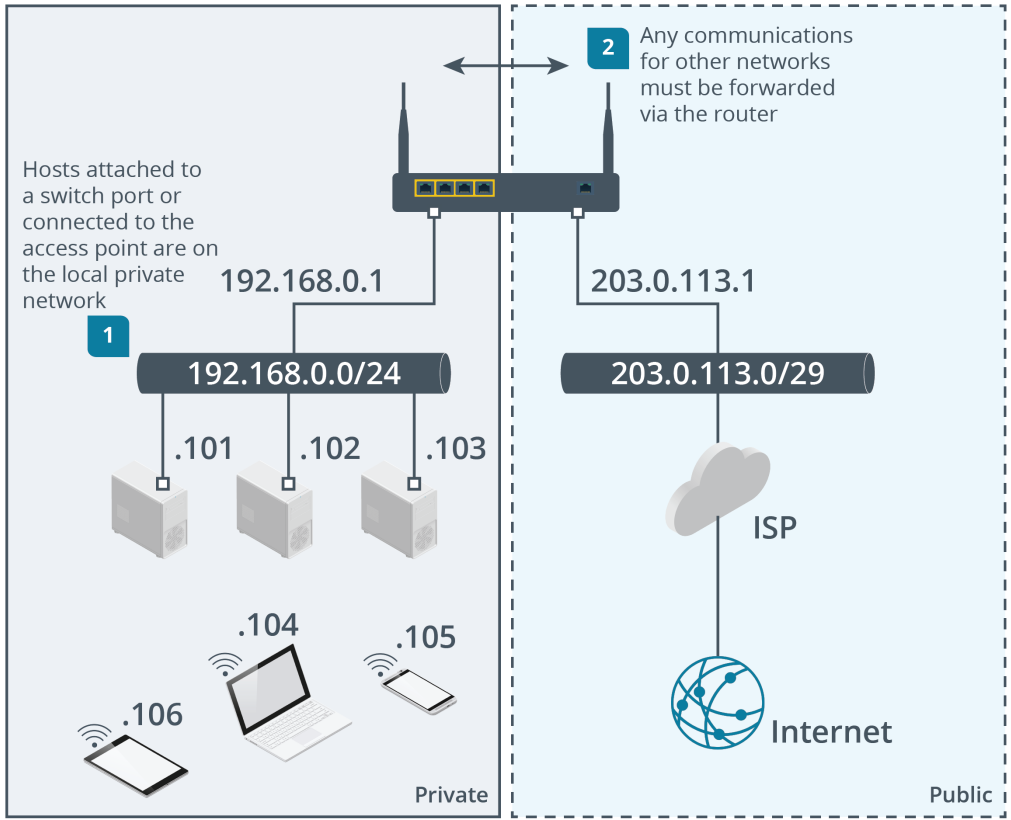
Compare Internet Connection Types

Internet Connection Types and Modems (Slide 1 of 2)



- The Internet
  - Internet eXchange Points (IXPs)
  - Internet Service Providers (ISPs)
- Point of presence (PoP)
  - Point-to-point WAN links
  - Digital modem types
- Routers versus modems

Internet Connection Types and Modems (Slide 2 of 2)



Digital Subscriber Line Modems

- Broadband Internet access over last mile copper telephone wiring
- Asymmetrical DSL (ADSL)
  - Faster downlink than uplink
- Symmetric DSL
- DSL modem
  - RJ-45 cable to router
  - RJ-11 cable to phone point
  - Splitters to filter voice calls

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Cable Modems

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- Cable access TV (CATV) networks
  - Hybrid fiber coax (HFC)
  - Data Over Cable Service Interface Specification (DOCSIS)
- Cable modem
  - RJ-45 cable to router
  - Coax cable with F-type connector to external port

Fiber To the Curb and Fiber to the Premises

- Fiber to the curb (FTTC)
  - Service provider runs fiber to a street cabinet
  - Very high bit rate DSL (VDSL) over last 300m or 100m
- Fiber to premises (FTTP) or “full fiber”
  - Passive optical network (PON) serves multiple subscribers
  - Fiber is run to optical network terminal (ONT) installed at customer premises
  - ONT converts optical to electrical and is connected to customer router

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Fixed Wireless Internet Access

- Geostationary orbital satellite Internet access
  - High latency
  - Digital Video Broadcast Satellite (DVB-S) modem
- Low Earth orbital satellite Internet access
  - Antenna alignment
- Wireless Internet service provider (WISP)
  - Point-to-point microwave

Cellular Radio Internet Connections

- 3G
  - Global System for Mobile Communication (GSM) providers
    - Subscriber Identity Module (SIM) card
  - Code Division Multiple Access (CDMA) providers
- 4G
  - Long Term Evolution (LTE) converged standard using SIM cards
- 5G
  - Connection through array of massive MIMO antennas
  - Roaming and fixed access

Routers

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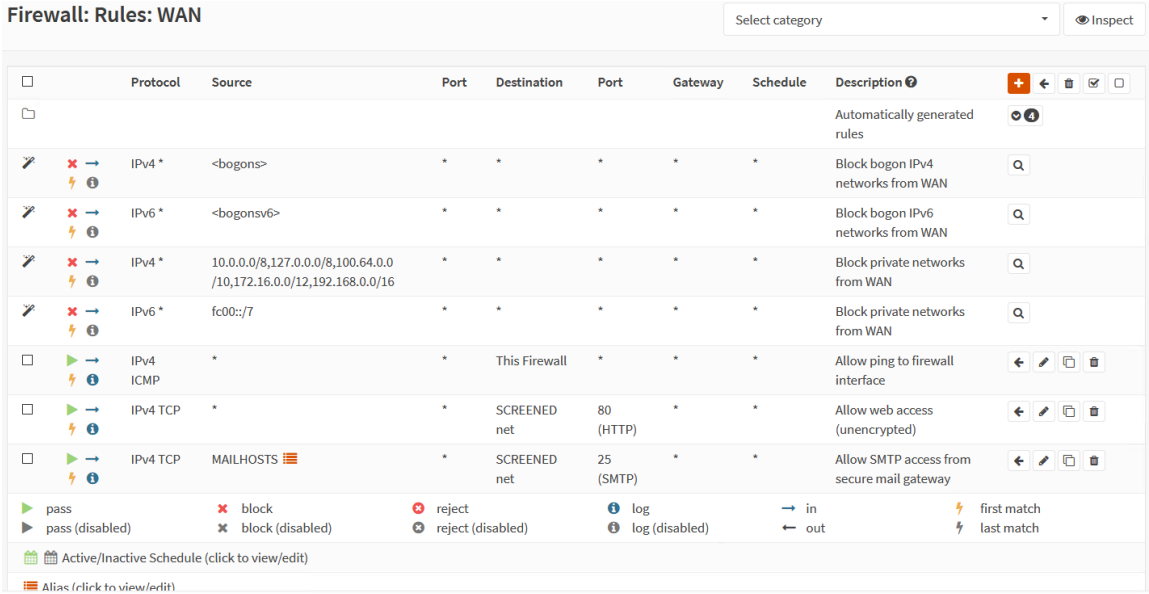
- Logical network addressing and forwarding in an internetwork
- LAN router
  - Establish logical subnetworks
- WAN router
  - Connect LANs to the Internet
  - Connect LANs across public/service provider networks

Firewalls

- Enforce rules for allowed and blocked traffic
- Network access control list (ACL)
  - Source and destination network addresses
  - Protocol types and ports
  - Allow versus block
- Implementation
  - Dedicated appliance
  - Built in function of router
  - Network firewalls versus personal/host firewalls



Screenshot used with permission from OPNsense

Review Activity: Internet Connection Types

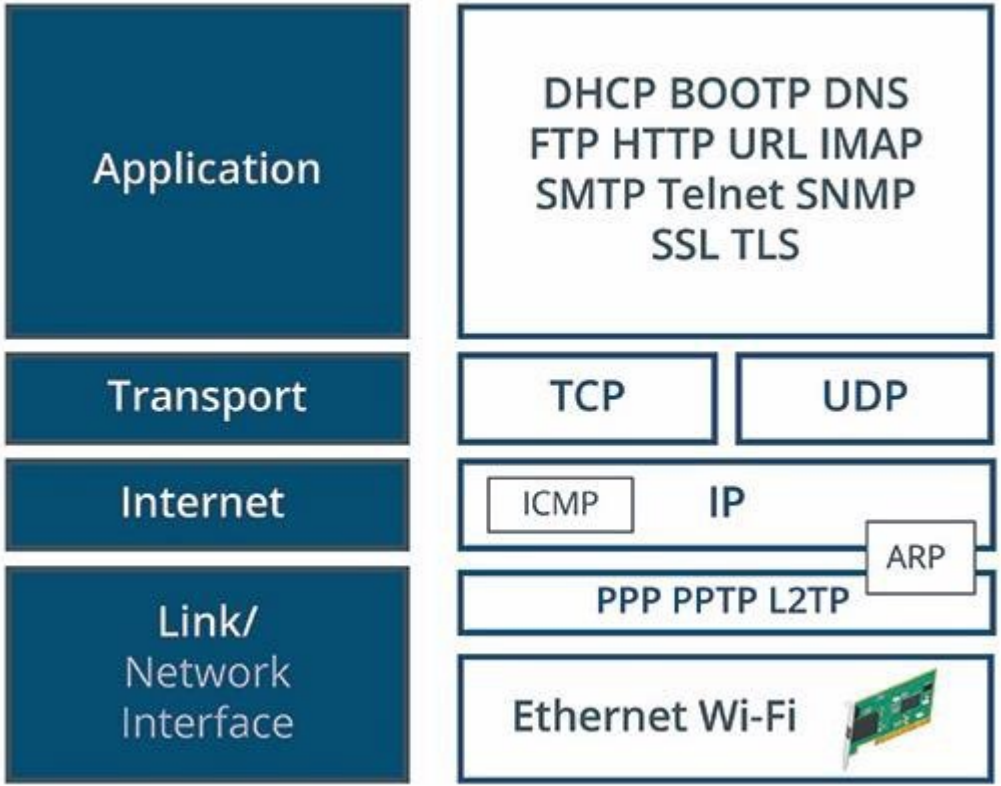
- Internet Connection Types and Modems
- Digital Subscriber Line Modems
- Cable Modems
- Fiber to the Curb and Fiber to the Premises
- Fixed Wireless Internet Access
- Cellular Radio Internet Connections
- Routers
- Firewalls

Lesson 5

Topic 5B

Use Basic TCP/IP Concepts

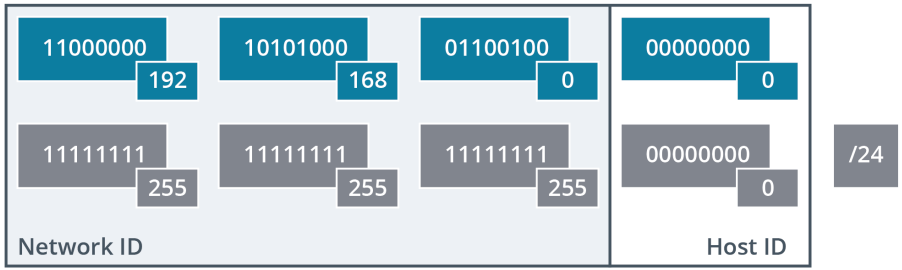
TCP/IP


Application
Transport
Internet
Link/
Network
Interface
DHCP BOOTP DNS
FTP HTTP URL IMAP
SMTP Telnet SNMP
SSL TLS
TCP
UDP
ICMP
IP
ARP
PPP PPTP L2TP
Ethernet Wi-Fi

IPv4 Addressing

- 32 binary digits
  - 11000000101010000000000000000001
- Divide into four octets
  - 11000000 10101000 00000000 00000001
- Express each octet as decimal value (dotted decimal)
  - 192 . 168 . 0 . 1

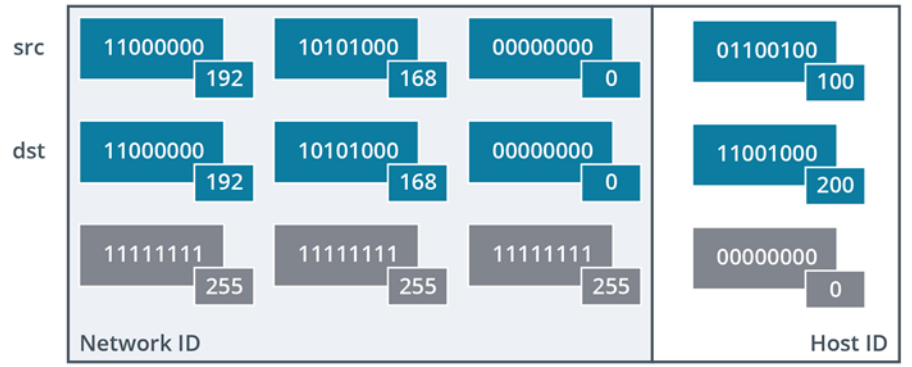
Network Prefixes

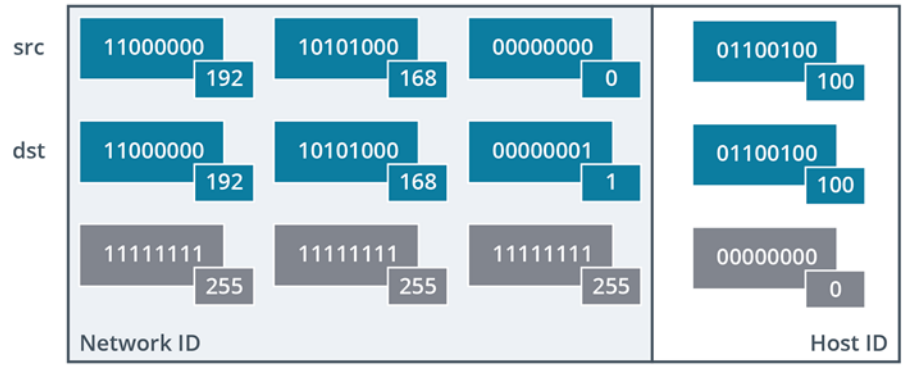


- IPv4 address encodes two values
  - Network number (network ID)
  - Host number (host ID)
- Portions are distinguished by a network prefix
  - Bits in prefix set to 1 represent network ID—for example, 24 bits
    - 11111111 11111111 11111111 00000000
  - Written in slash notation as /24
  - Can be expressed as subnet mask in dotted decimal
    - 255.255.255.0

IPv4 Forwarding

- Host must determine whether destination address is on the same network as its source address
- Uses mask to compare network ID in source IP address and destination IP address
- Most hosts send traffic for other networks to the router configured as a default gateway



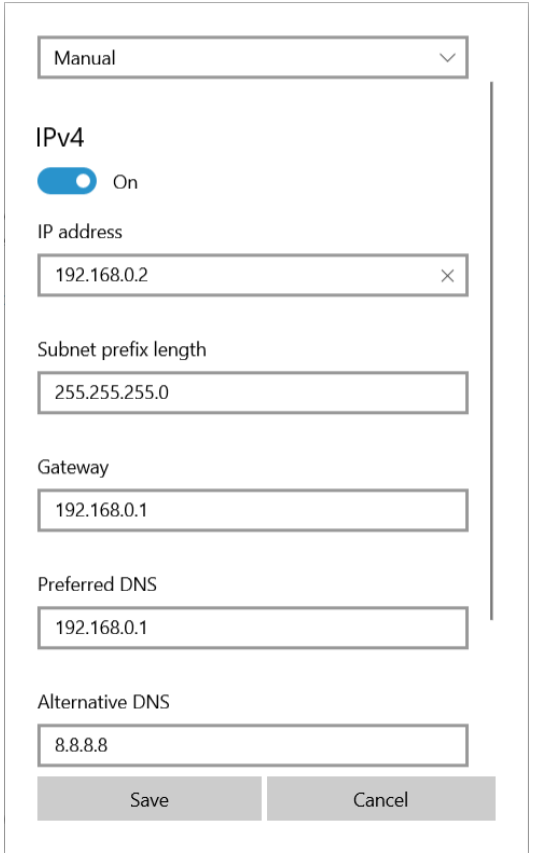


Public and Private Addressing

- Public addresses are routable across the Internet
- Private addresses are restricted to local networks
  - 10.0.0.0/8 (255.0.0.0)
  - 172.16.0.0/12 (255.240.0.0)
  - 192.168.0.0/16 (255.255.0.0)
- Address classes and default subnet masks
- Internet access for privately addressed hosts
  - Network address translation (NAT)
  - Proxy service

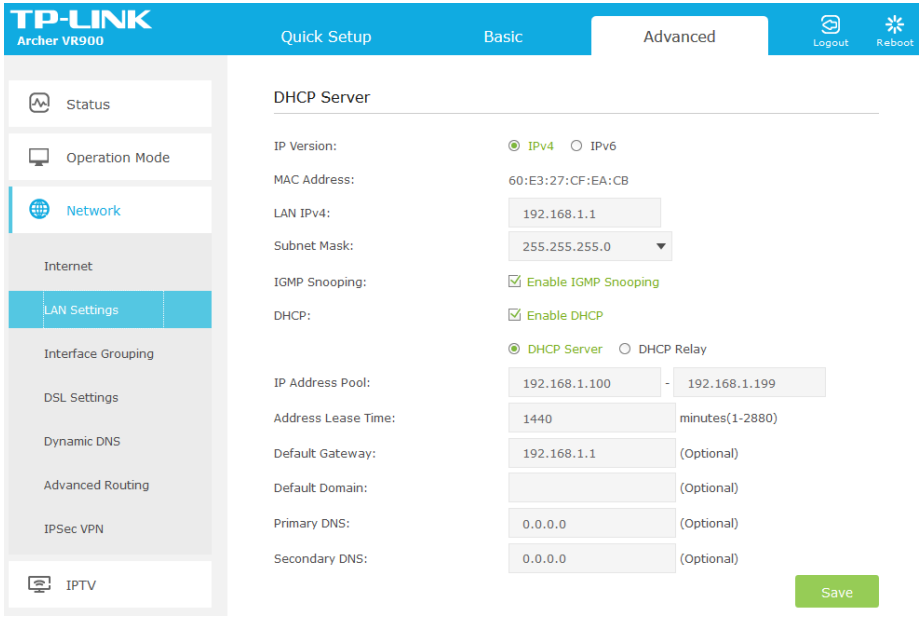
IPv4 Host Address Configuration

- IPv4 address and subnet mask
  - First IP in range is network address
  - Last IP is broadcast addresses
  - Hosts can be assigned addresses in-between
- Default gateway
- Domain Name System (DNS) server addresses



Screenshot courtesy of Microsoft

Static versus Dynamic Host Address Configuration

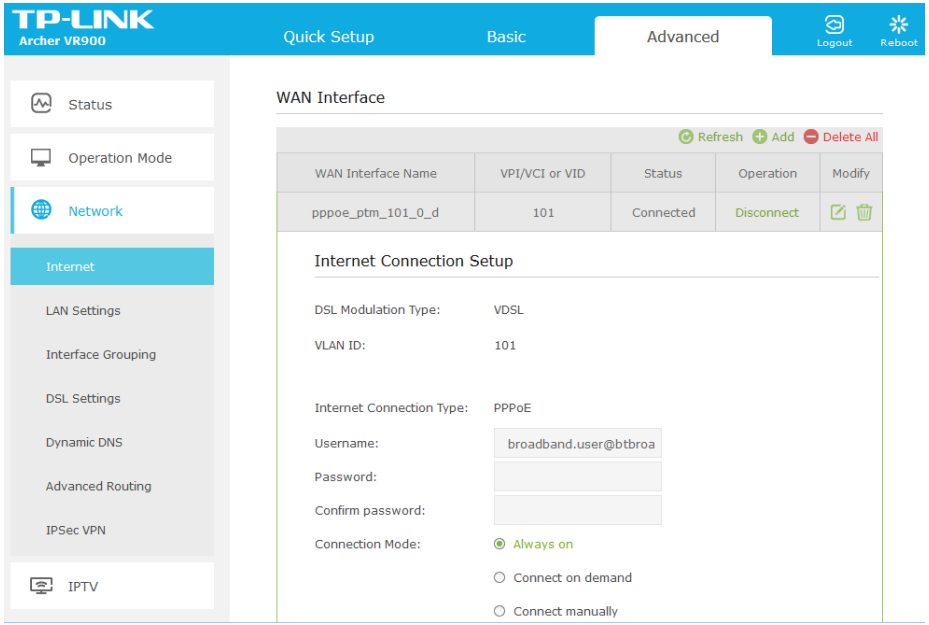


Screenshot courtesy of TP-Link

- Uses and disadvantages for static addressing
- Dynamic Host Configuration Protocol (DHCP)
- Automatic Private IP Addressing (APIPA)
  - 169.254.x.y

SOHO Router Address Configuration

- Router's LAN interface
  - Web management interface
- Administrator password
- Router's public/WAN interface
  - Static versus dynamic addressing
  - Line protocol settings and monitoring



Screenshot courtesy of TP-Link

IPv6 Addressing

- IPv6 address format
  - Hex digits and canonical notation
- Network prefixes
  - Fixed-length 64-bit host identifier
  - Network prefix masks first 64 bits

- Global and link-local interface addresses
  - Global addressing (start with 2 or 3)
  - Link-local addressing (fe80::)
- Static address assignment versus StateLess Address Auto Configuration (SLAAC)
- Dual-stack hosts operate both IPv6 and IPv4 at the same time

Review Activity: Basic TCP/IP Concepts

- IPv4 Addressing
- Network Prefixes
- IPv4 Forwarding
- Public and Private Addressing
- IPv4 Host Address Configuration
- Static Versus Dynamic Host Address Configuration
- SOHO Router Configuration
- IPv6 Addressing

Lab Activity

- Assisted Lab: Configure a SOHO Router
  - Use the GNS3 network simulator to configure a home network

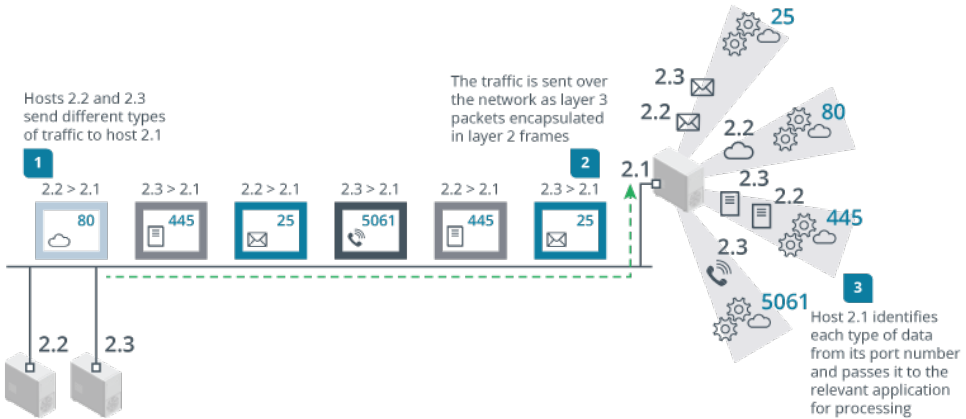
Lesson 5

Topic 5C

Compare Protocols and Ports

Protocols and Ports

- Transport layer
  - Identify each application protocol
  - Track sessions
- Protocol ports
  - Server port
  - Client port



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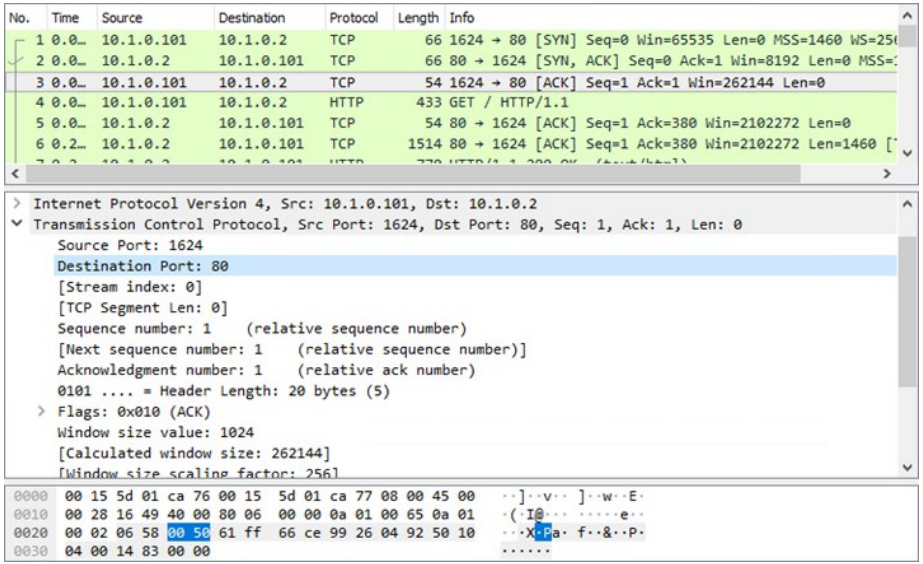
Transmission Control Protocol

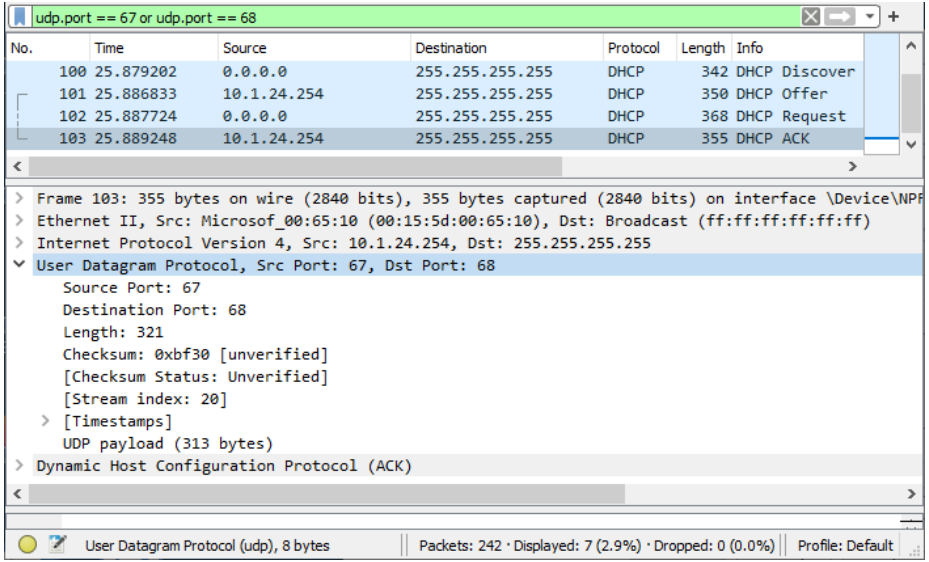


Screenshot courtesy of Wireshark

- Connection-oriented transport protocol
  - Establish connection
  - Assign each packet sequence number
  - Allow the receiver to acknowledge (ACK)
  - Allow the receiver to send a negative acknowledgement (NACK)
  - Allow the graceful termination of a session
- TCP-based application protocols
  - HyperText Transfer Protocol Secure (HTTPS)
  - Secure Shell (SSH)

User Datagram Protocol

- Connectionless, unreliable delivery
- Smaller header
- UDP-based application protocols
  - Dynamic Host Configuration Protocol (DHCP)
  - Trivial File Transfer Protocol (TFTP)



Screenshot courtesy of Wireshark.

Well-known Ports

Networking	DNS UDP/53 TCP/53	DHCP UDP/67 UDP/68	NBT UDP/TCP 137-139	SNMP UDP/161 UDP/162	LDAP TCP/389
Remote access	SSH TCP/22	Telnet TCP/23	RDP TCP/3389		
File transfer	FTP TCP/20 TCP/21	HTTP TCP/80	HTTPS TCP/443	SMB TCP/445	
Email	SMTP TCP/25	POP3 TCP/110	IMAP TCP/143		

Review Activity: Protocols and Ports

- Protocols and Ports
- Transmission Control Protocol
- User Datagram Protocol
- Well-known Ports

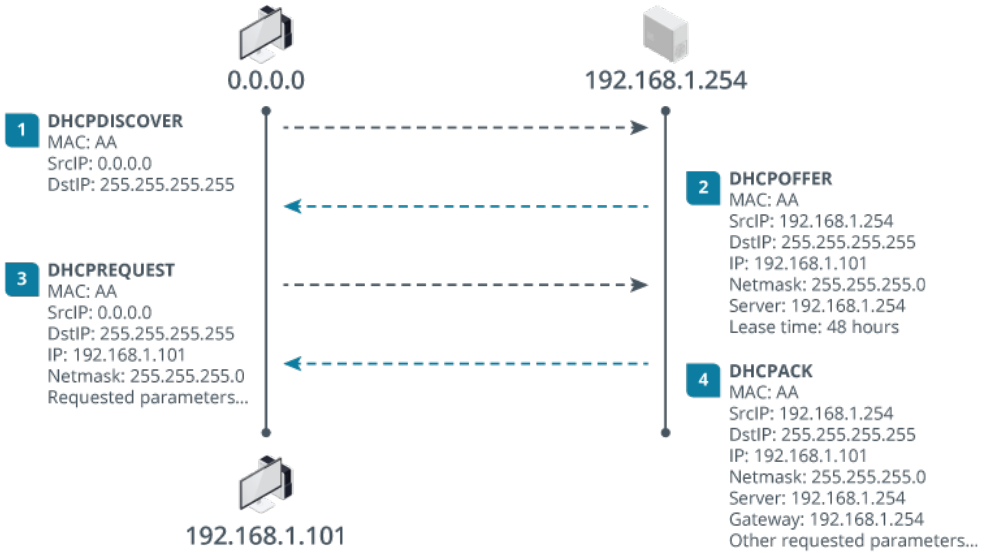
Lesson 5

Topic 5D

Compare Network Configuration Concepts

Dynamic Host Configuration Protocol

- DHCP scope
  - Range of addresses in a subnet offered by the server as leases
- DHCP leases
  - Discover, Offer, Request, Acknowledge (DORA)
  - UDP/67 server port and UDP/68 client port
- DHCP reservations
  - Lease the same IP address based on client's MAC address or other interface identifier



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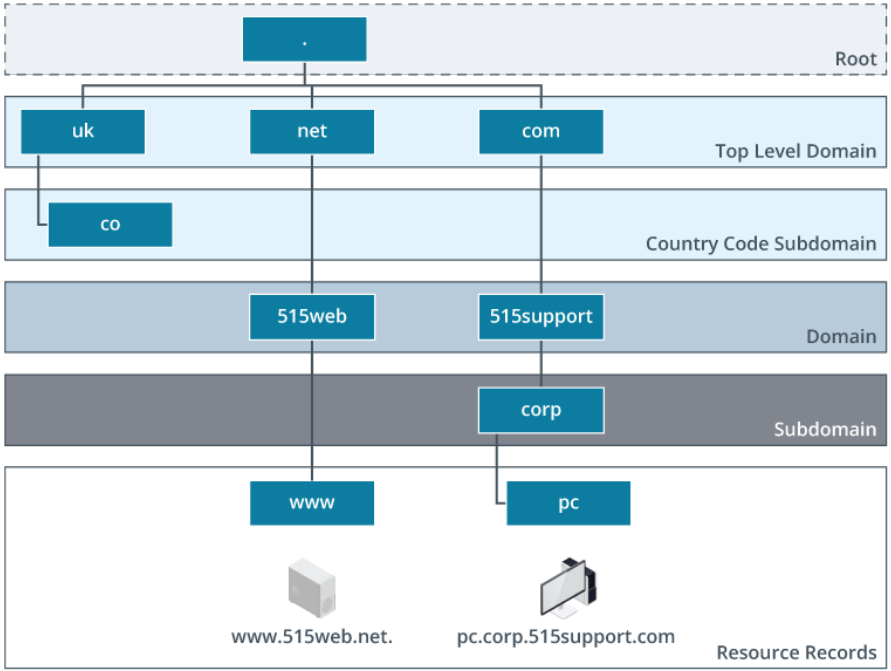
Domain Name System



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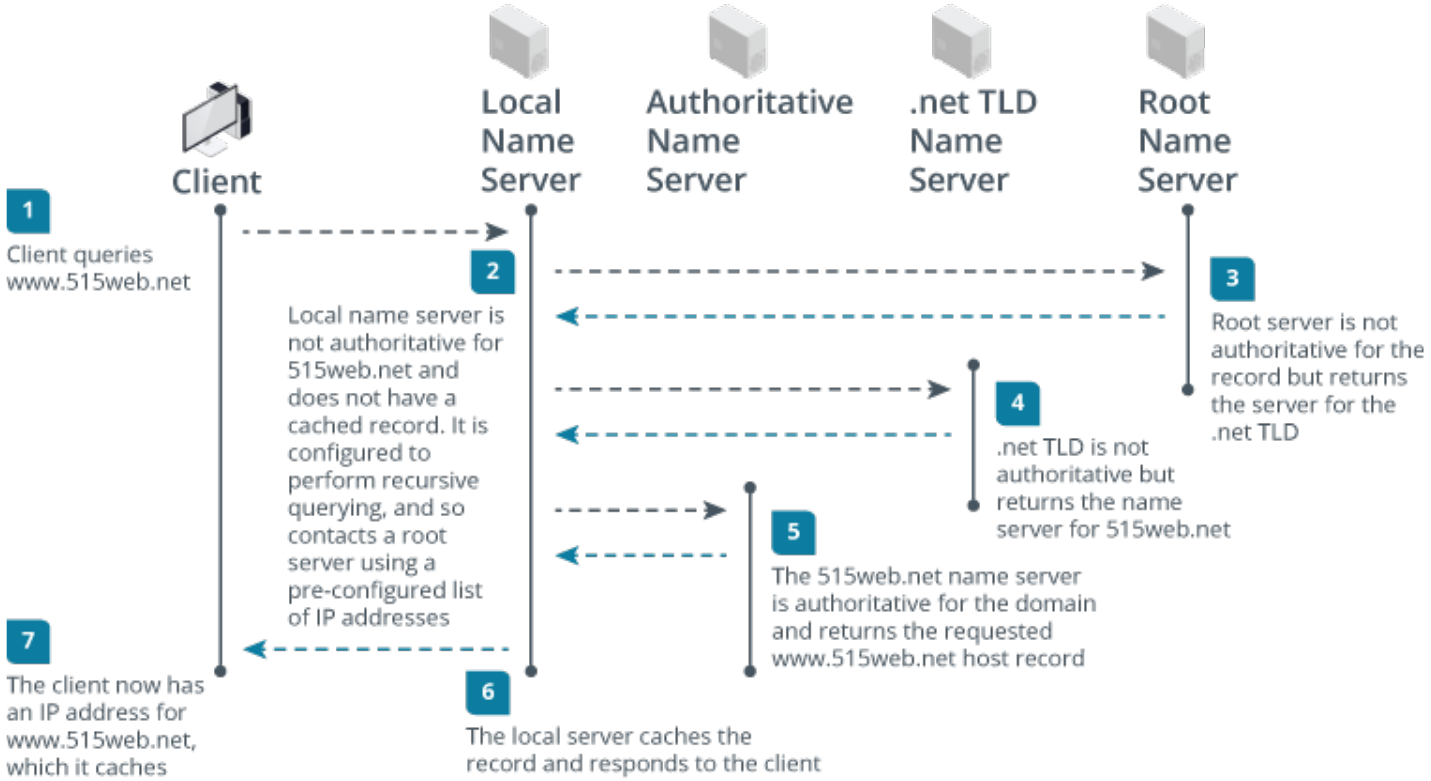
- Resolve “friendly” names assigned to hosts to IP addresses
  - Host name
  - Fully Qualified Domain Name (FQDN)
- DNS hierarchy
  - Root servers
  - Top Level Domains (TLDs)
  - Domain names

DNS Queries



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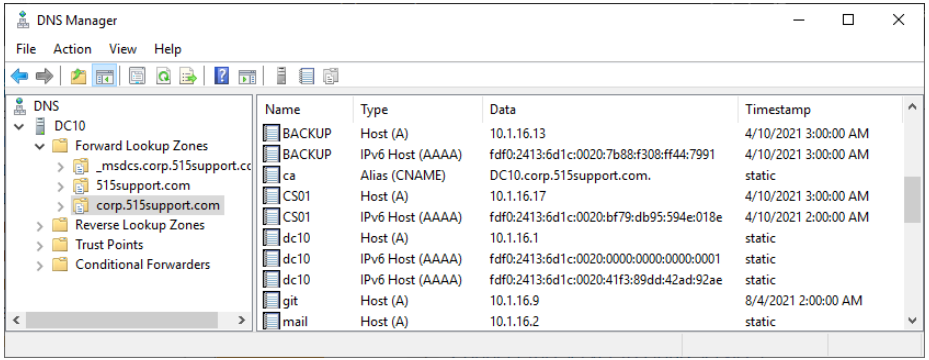
DNS Record Types

- Address records
  - A records resolve to an IPv4 address
  - AAAA records resolve to an IPv6 address
- Mail Exchanger (MX) records
  - Identify address record providing mail services
  - Can create multiple records with priority values (lowest numbered is highest priority)



Screenshot courtesy of Microsoft

DNS Spam Management Records

- Text (TXT) records store free form text to support services
- DNS can record authentication data for the domain's mail servers
- Recipients can check these records to block unwanted and spoofed messages (spam management)
- Sender Policy Framework (SPF)
  - Identifies hosts authorized to send mail
- DomainKeys Identified Mail (DKIM)
  - Uses cryptography to allow validation of mail source
- Domain-based Message Authentication, Reporting, and Conformance (DMARC)
  - Framework to ensure that SPF and DKIM are being utilized effectively

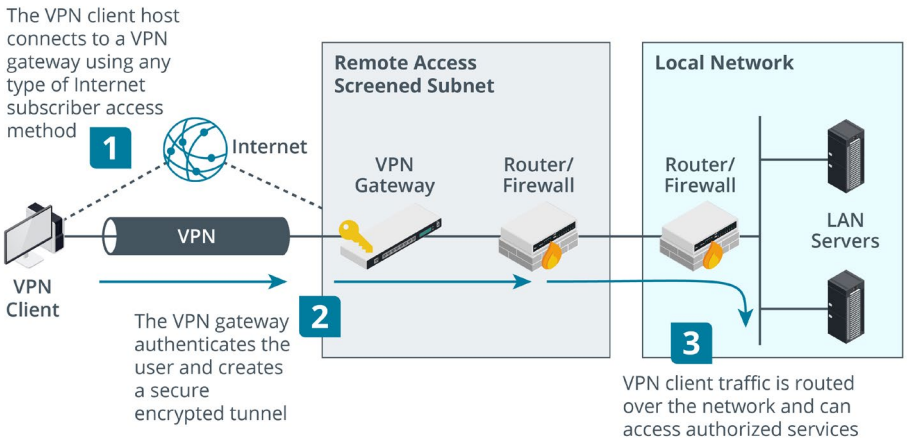
Virtual LANs

```
interface swp5
  bridge-access 100

interface swp6
  bridge-access 100

interface swp7
  bridge-access 100

interface swp8
  bridge-access 100

interface swp9
  bridge-access 200

interface swp10
  bridge-access 200

interface swp11
  bridge-access 200

interface swp12
  bridge-access 200

interface bridge
  bridge-ports swp5 swp6 swp7 swp8 swp9 swp10 swp11 swp12
  bridge-vids 10 100 200
  bridge-vlan-aware yes
```

- Divide local network into separate broadcast domains
- Configured on managed switches
  - Each switch port can be configured with a VLAN ID from 2 to 4094
  - Switch ports with same ID are in the same VLAN and broadcast domain
  - Unconfigured switch ports default to VLAN ID #1
- Traffic between VLANs must be sent via routers

Virtual Private Networks

- Join a local network from a remote location
- Local network traffic is tunneled over a public/untrusted network
- Uses authentication and encryption to prevent unauthorized access



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Review Activity: Network Configuration Concepts

- Dynamic Host Configuration Protocol
- Domain Name System
- DNS Queries
- DNS Record Types and Spam Management Records
- Virtual LANs
- Virtual Private Networks

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Lesson 5

Summary