5- Routers

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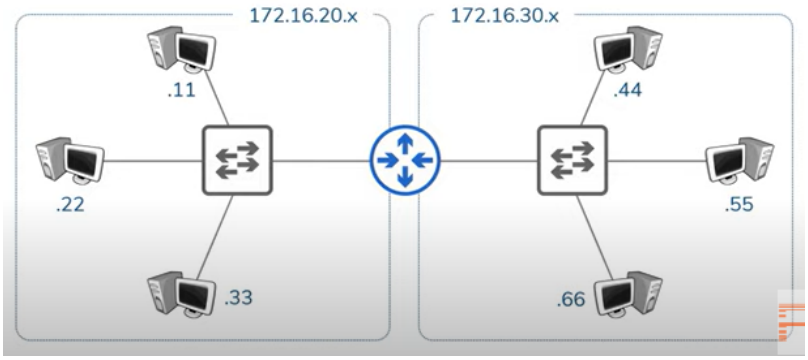
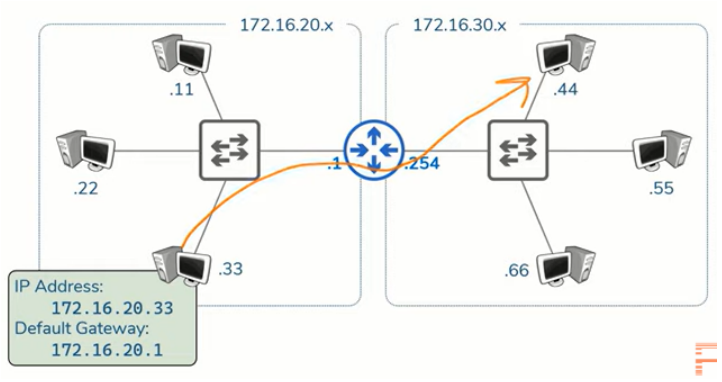
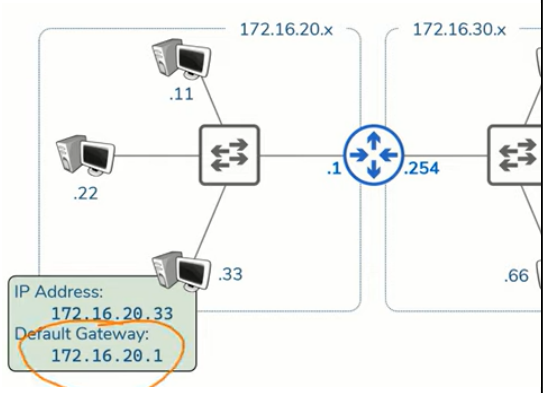
intro

Routers

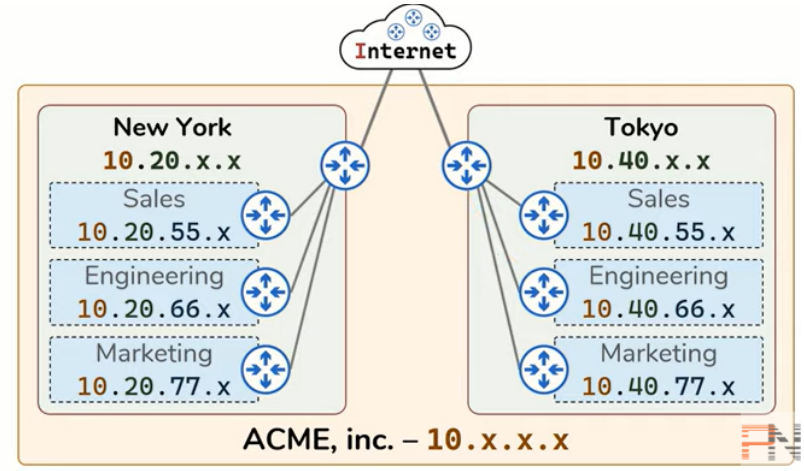


- ! Routers facilitate communication between networks.
- Provides a traffic control point (security, filtering, redirecting).
- Routers learn which networks they are attached to
- Known as Routes - stored in a routing table.
- ! Routing-table - all networks a Router knows about.
- Have IP address in the Networks they are attached to.
- ! Gateway - each host's way out of their local Network.





- Create the Hierarchy in Networks and the entire Internet.



- ! Routing is the process of moving data between networks
  - ! A router is a device whose primary purpose is Routing

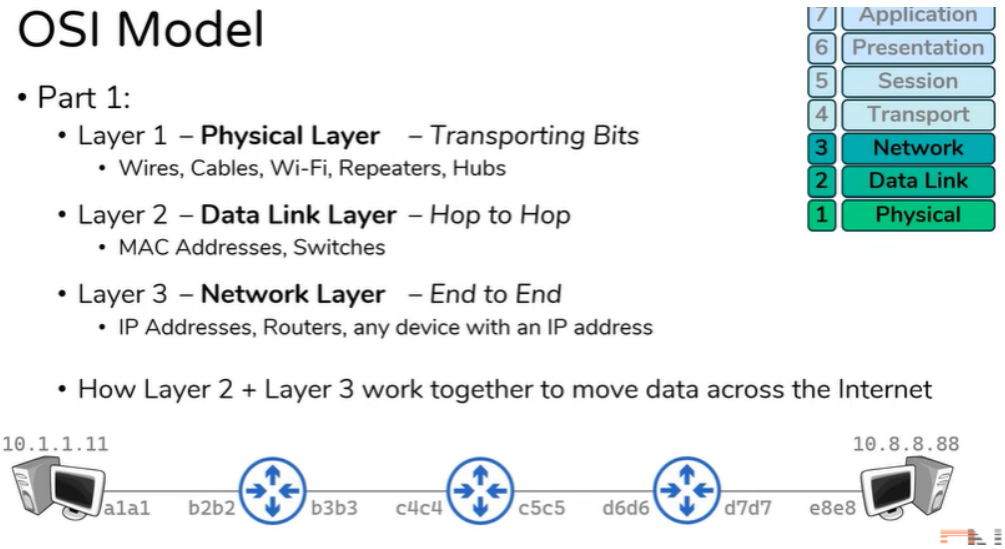
- ! Switching is the process of moving data within networks
  - ! A switch is a device who's primary purpose is Switching.

Layer 2 MAC Address vs Layer 3 IP addresses

- ! There is a protocol which ties or links the two layers (2 and 3) called ARP Address Resolution Protocol.

OSI Model

- Part 1:
  - Layer 1 – **Physical Layer** – *Transporting Bits*
    - Wires, Cables, Wi-Fi, Repeaters, Hubs
  - Layer 2 – **Data Link Layer** – *Hop to Hop*
    - MAC Addresses, Switches
  - Layer 3 – **Network Layer** – *End to End*
    - IP Addresses, Routers, any device with an IP address
  - How Layer 2 + Layer 3 work together to move data across the Internet



Part A

Hosts vs Routers

- Routers are connected to a network
  - Routers have an IP address and a MAC address on each Interface

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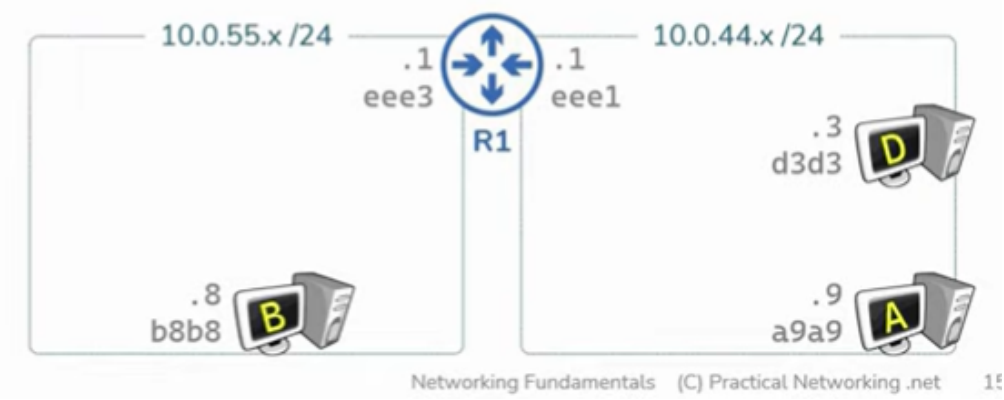
TERMINOLOGIES

- ! node - a device that implements IPv6 or IPv4
- ! router - a node that forwards IP packets not explicitly addressed to itself
- ! host - any node that is not a router.

- Routers forward packets not destined to themselves (unlike hosts)
- Routers maintain a map of all the networks they know about
  - Routing table



Routing Table

- Routing table can be populated via three methods
  - Directly connected - Routes for networks which are attached.
  - Static Routes - Routes manually provided by an administrator.
  - Dynamic Routes - Routes learned automatically from other Routes.

Part B

- Routers have IP and MAC for each Network they are connected to.
- Routers have Routing tables - map of every network
  - populated with Directly connected, Static Routes, Dynamic Routes.
- Routes also have ARP tables - mapping of L3 and L2 address.
  - Everything with an Ip address has an ARP table.
  - ! Start Empty - populated as needed with network traffic.

Each Router

- Looks up destination IP in Routing Table to determine Next-Hop IP
- Adds a L2 header with Destination MAC next Router's MAC
  - Performs ARP as necessary.

Part C

Hierarchy Routes

- Hierarchy allows for Route Summarization.
  - Reduce number of Routes in Routing Table.
  - Default Route - ultimate route summary.

    - 0.0.0.0/0 - every IPv4 address.
    - “for everything else, go here”.

- Easier to scale.
- More consistent connectivity