Network Concepts

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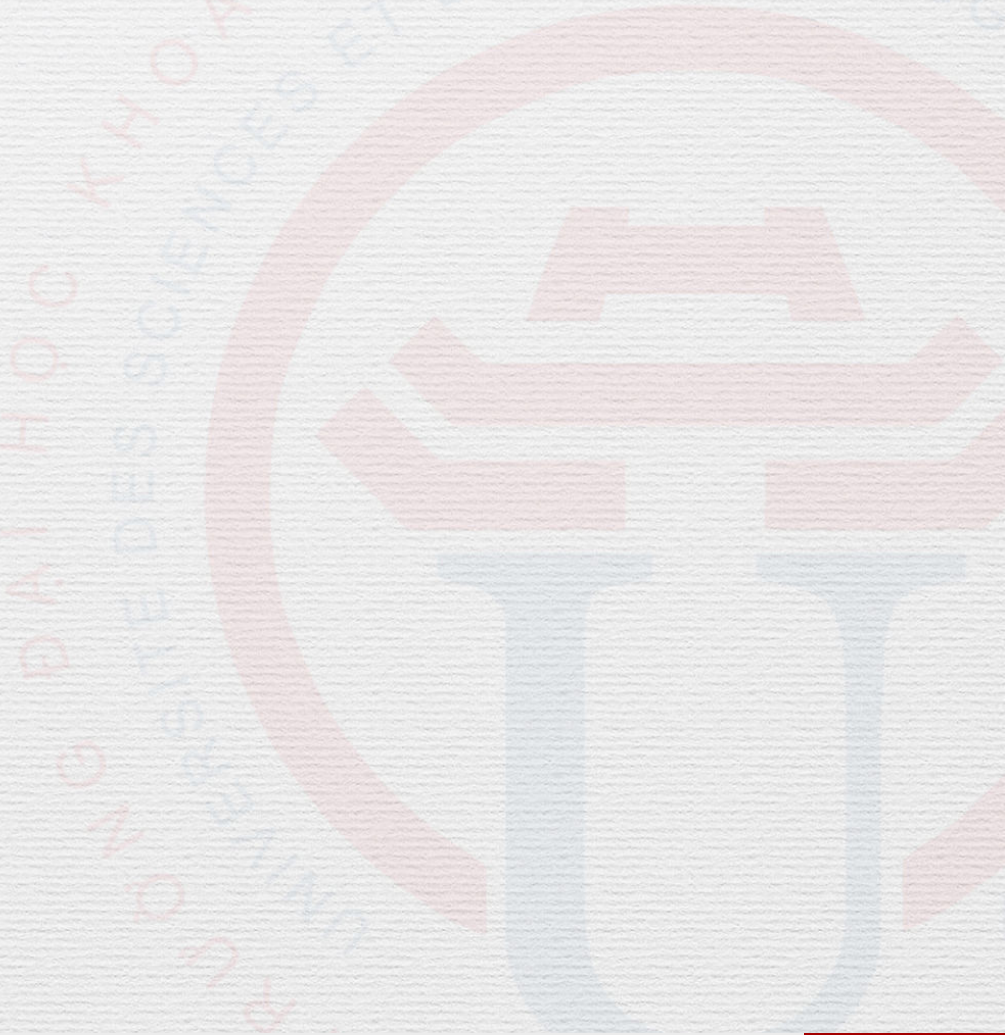
Contents

- What's a network?
- Routing
- Network Services

What?

What?

- Collection of nodes and links that connect them
  - Hosts: endpoints



What?

- Collection of nodes and links that connect them
  - Hosts: endpoints (laptop, phone, PC, game console. . .)

What?

- Collection of nodes and links that connect them
  - Hosts: endpoints (laptop, phone, PC, game console. . .)
  - Links: cables

What?

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  - Hosts: endpoints (laptop, phone, PC, game console...)
  - Links: cables (fiber, copper, radio...)

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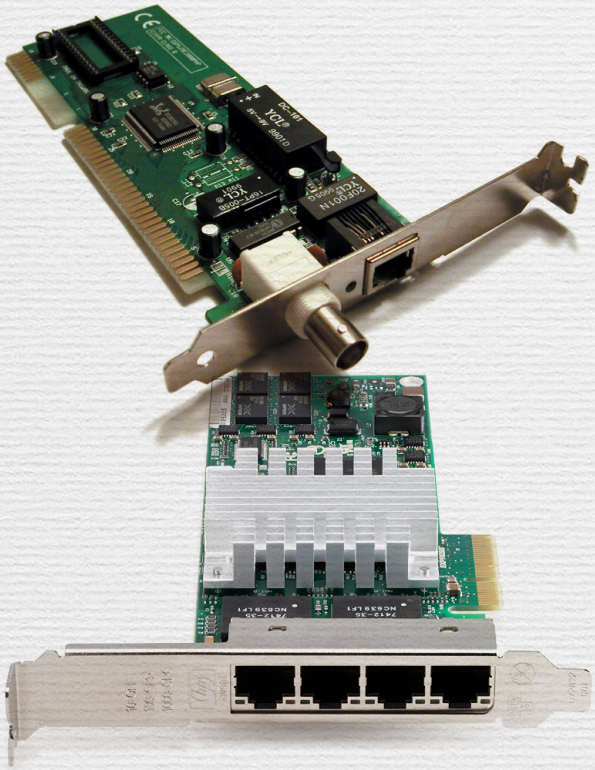
- Collection of nodes and links that connect them
  - Hosts: endpoints (laptop, phone, PC, game console...)
  - Links: cables (fiber, copper, radio...)
  - Packet switches: forward data (switches, routers...)
- A network can belong to another network

What?

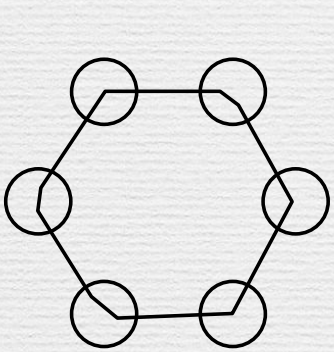
- Network interface controller
  - Enables a host to transfer data
  - Examples
    - Ethernet card
    - Infinibard card
    - USB WiFi
    - WiFi card

What: NIC examples

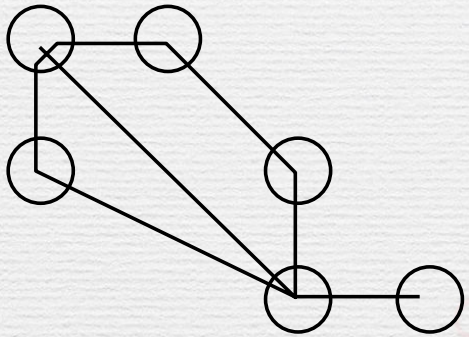


What: Network topology

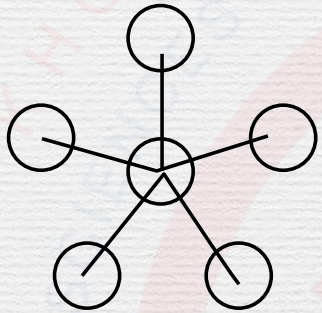
Layout and organization of nodes



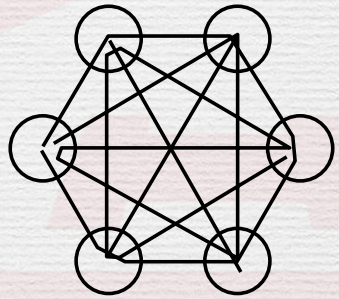
Ring



Mesh

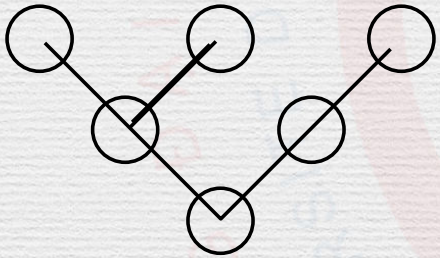


Star

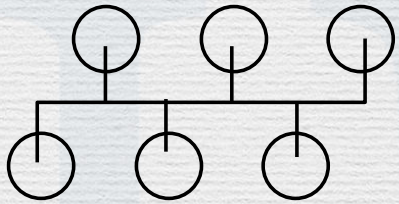


Fully Connected

Line



Tree



Bus

What?

Different scales

- Personal...
- Local...
- Metropolitan...
- Wide...

... Area Network

What?

Different scales

- Personal...
- Local...
- Metropolitan...
- Wide...

... Area Network

- Inter-net

The Internet

- An inter-net: a network of networks
  - A set of networks that are connected with each other
  - Networks are connected using routers that support communication in a hierarchical fashion
  - Often need other special devices at the boundaries for security, accounting, ...
- A common set of rules for Inter-operation

Why?

- Keep connected with other people
  - Facebook
  - Flickr
  - Youtube
- Larger set of information

Why?

- "Combine" a set of separated resources to make something bigger
- Super computers

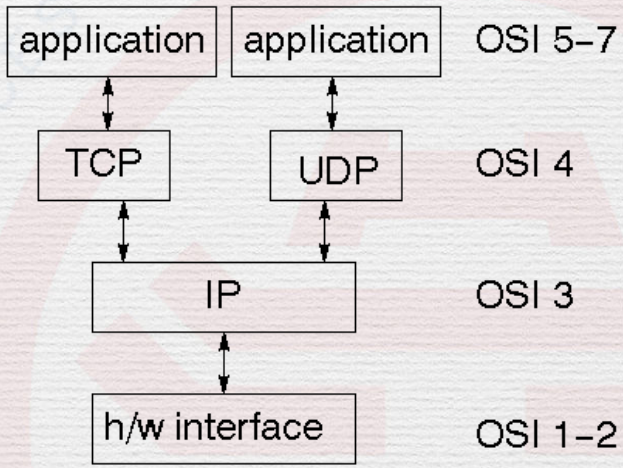
A bit of history

- Who first created it?
  - Military Radar System «Semi Automatic Ground Environment»
  - Early initiatives in 1950s
- ARPANET
  - The base of Internet
  - IP Protocol

Routing

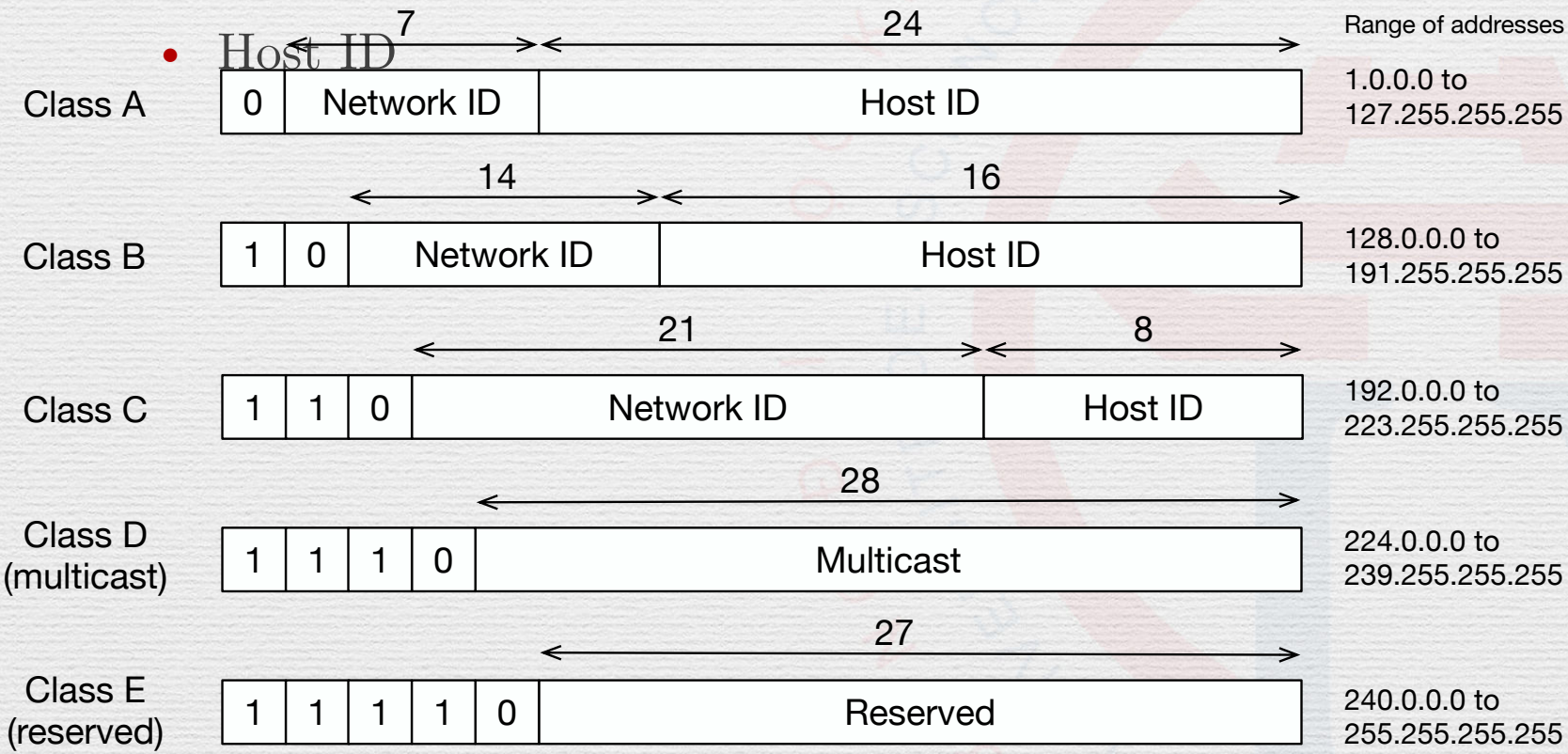
Basic Concept

- Main concepts:
  - MAC Address
  - IP Address: v4 / v6
  - IP Protocols: TCP / UDP
- Routing is transparent



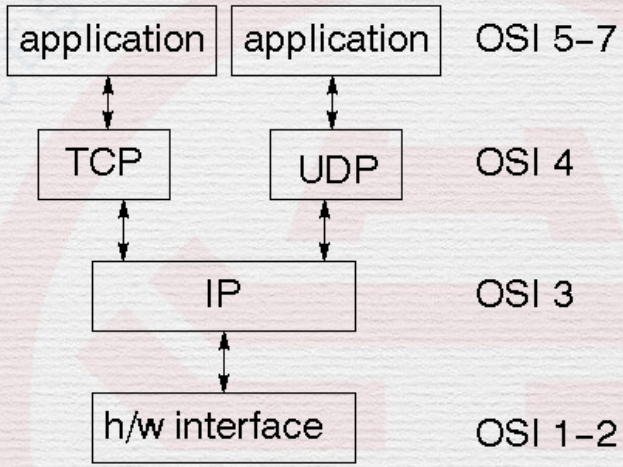
Basic Concept: IPv4

- 32-bit addresses, split to 4 bytes (0-255 each)
- Two parts:
  - Network ID
  - Host ID



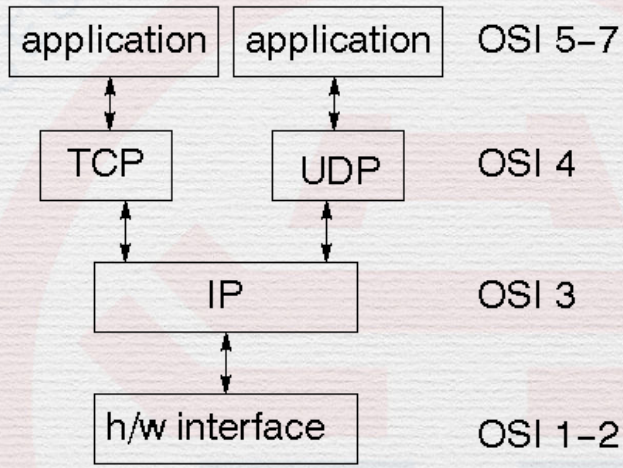
Basic Concept: UDP

- User Datagram Protocol
- Just like any post letter
  - no acknowledgements
  - no retransmissions
  - possible out of order and/or duplicates
  - connectionless: each packet needs destination



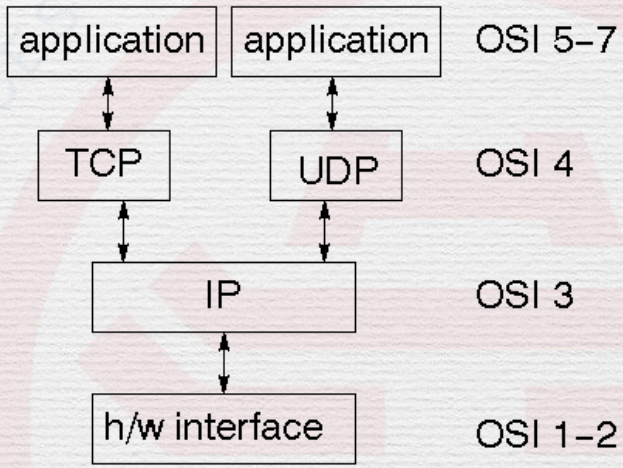
Basic Concept: TCP

- Transmission Control Protocol
- Like a phone call
  - connection-oriented: needs a «connection establish» step
  - bidirectional
  - reliable byte-stream channel
  - in order
  - all arrive
  - no duplicates
- Similar to file access



Basic Concept: TCP vs UDP

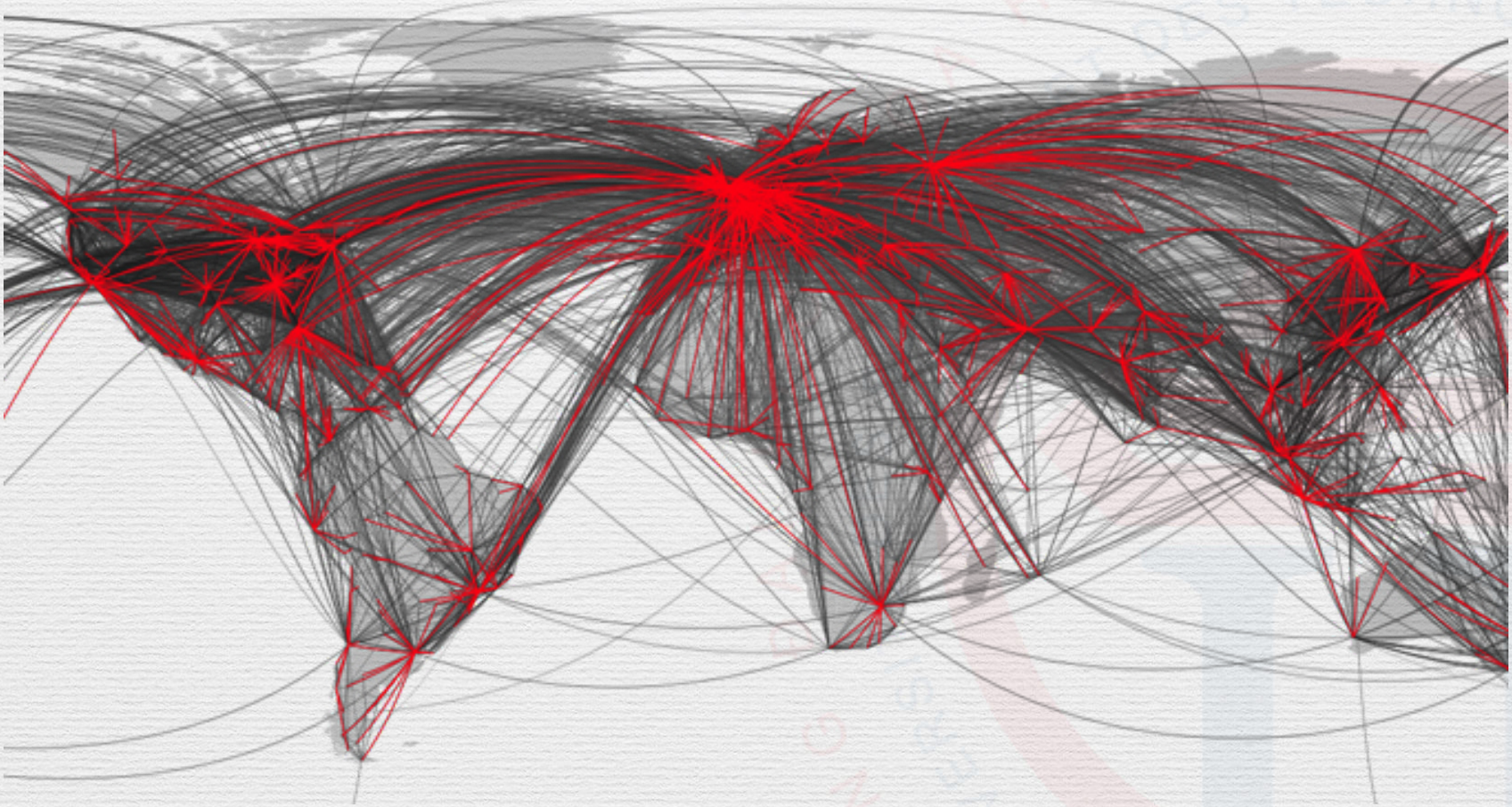
- TCP: slower, suitable for
  - Large data
  - Persistent connection
  - Reliable
- UDP: faster, suitable for
  - Quick lookup
  - Single use query-reply



Routing: What, Why and How

- What: Process of selecting path for a network packet
- Why: Without routing, one cannot send/receive message to another host
  - No direct communication link
- How?
  - Packet forwarding
  - Routing table
- Routing vs Bridging?

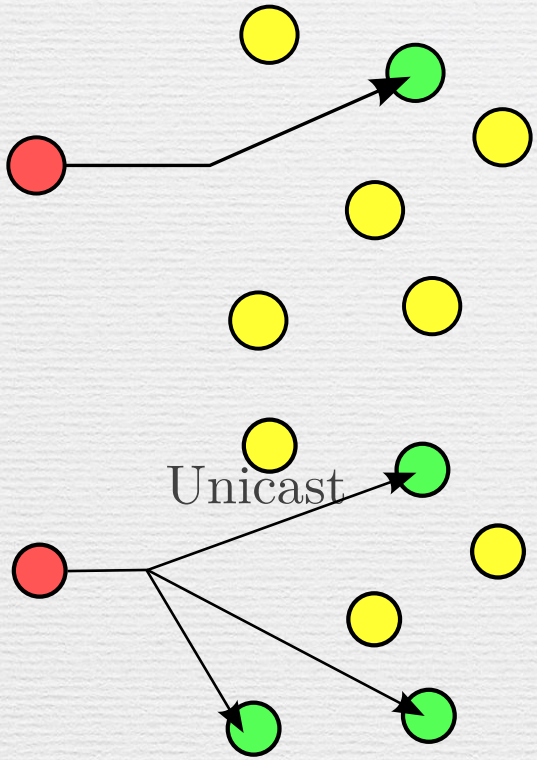
Routing



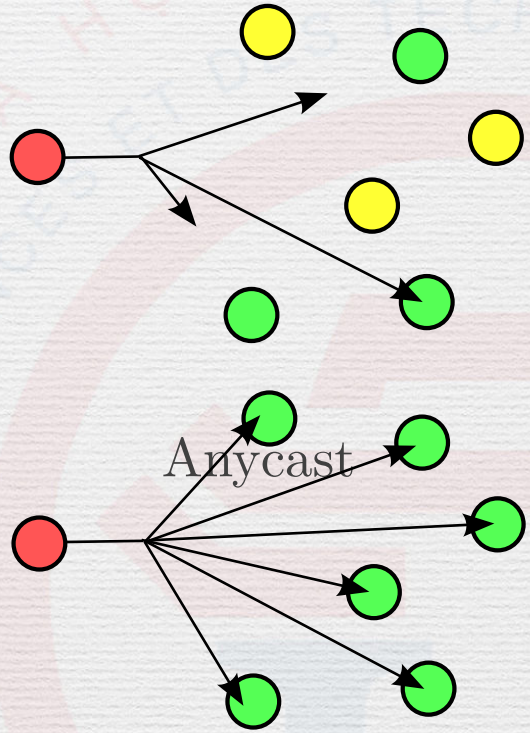
How: Routing Schemes

- Unicast: to a single node
- Anycast: conditional to anyone, typically closest nodes
- Multicast: to many nodes
- Broadcast: to all nodes

How: Routing Schemes



Unicast

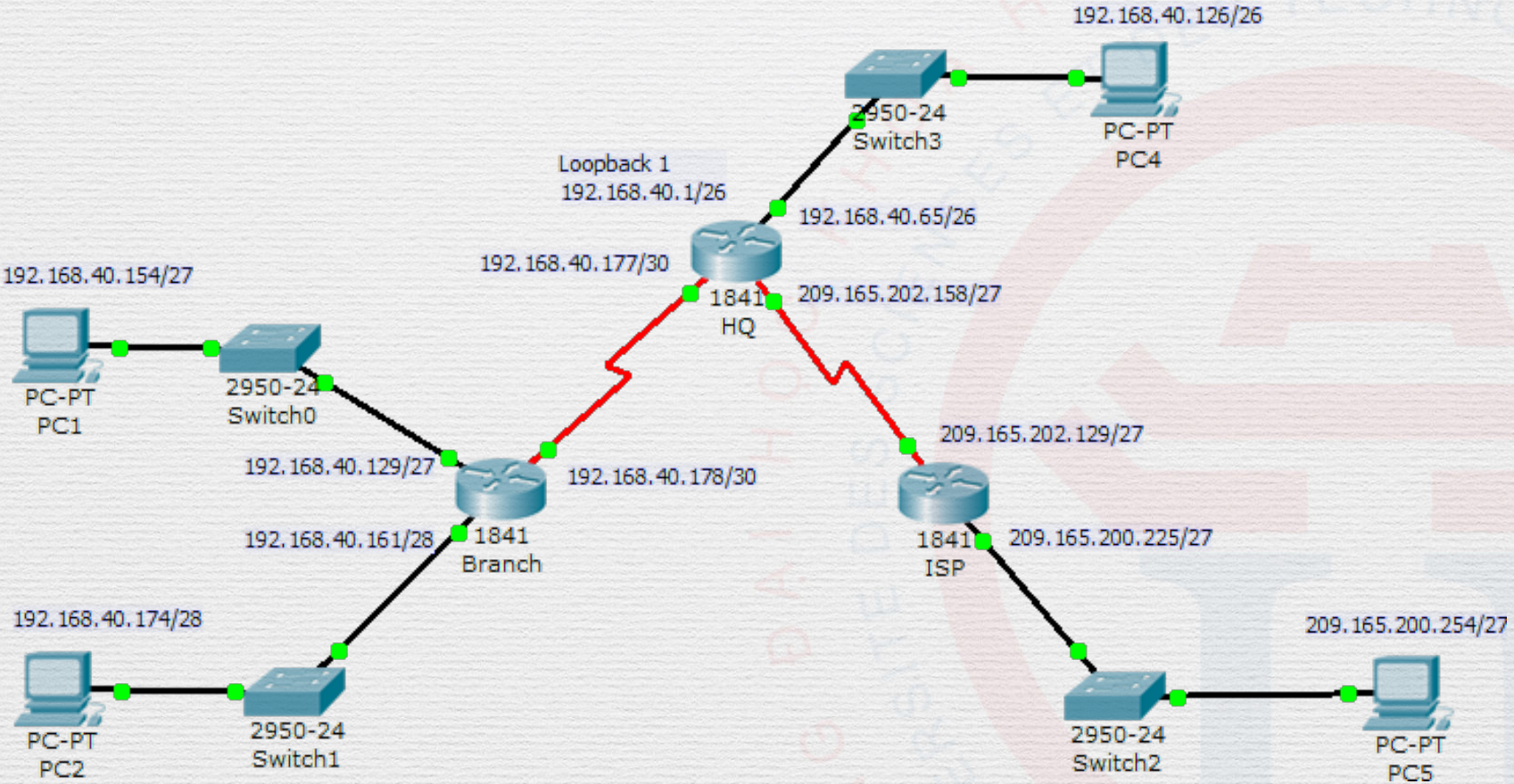


Anycast

Multicast

Broadcast

Example


192.168.40.126/26
2950-24
Switch3
PC-PT
PC4
Loopback 1
192.168.40.1/26
192.168.40.65/26
192.168.40.177/30
1841
HQ
209.165.202.158/27
192.168.40.154/27
PC-PT
PC1
2950-24
Switch0
192.168.40.129/27
192.168.40.178/30
209.165.202.129/27
192.168.40.161/28
1841
Branch
1841
ISP
209.165.200.225/27
192.168.40.174/28
209.165.200.254/27
PC-PT
PC2
2950-24
Switch1
2950-24
Switch2
PC-PT
PC5

Practical Work 1: VPS Setup & Routing

- Create an account at cloudsigma.com
- Register for a **free** VPS, enable a 7-day free trial
- Setup a Debian or Ubuntu Server VPS using the CloudSigma web interface
- Create a new report named «01.practical.work.vps.routing.tex»
  - LaTeX is required

Practical Work 1: VPS Setup & Routing

- Write your commands & their corresponding outputs to your report for the following tasks
  - Connect to your shiny & beautiful VPS with `ssh`
  - Install `traceroute` tool
  - Check if `usth.edu.vn` is up or not with `ping` (5 times only)
  - Use `traceroute` tool to find the route from your VPS to `usth.edu.vn`
    - How many hops do you have?
  - Try `traceroute` again, but from your own computer
    - How many hops do you have?
- Push your report to corresponding forked Github repository