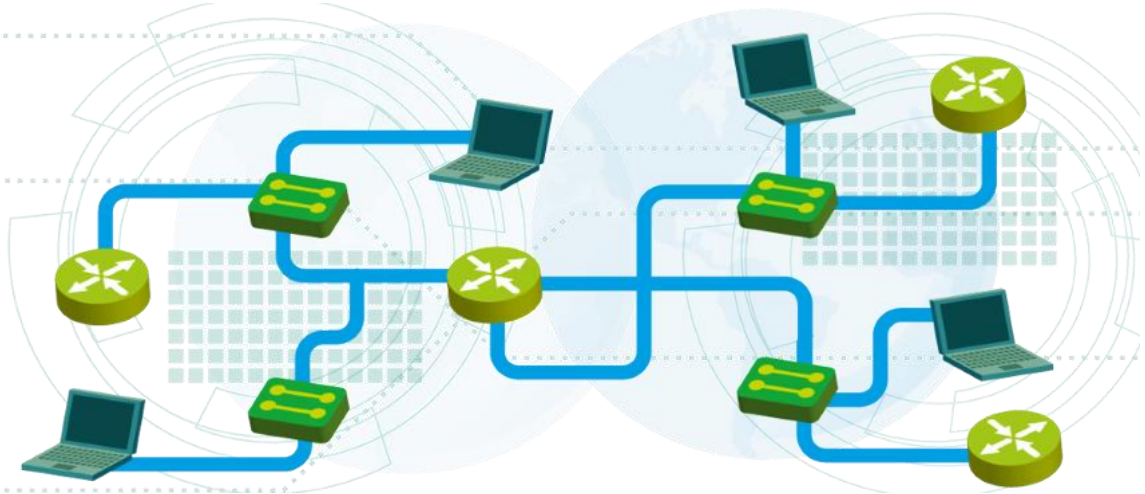
Course summary and exam preparation

Lecture 9



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Technical Trainers

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http://softuni.bg

Questions

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#CNF

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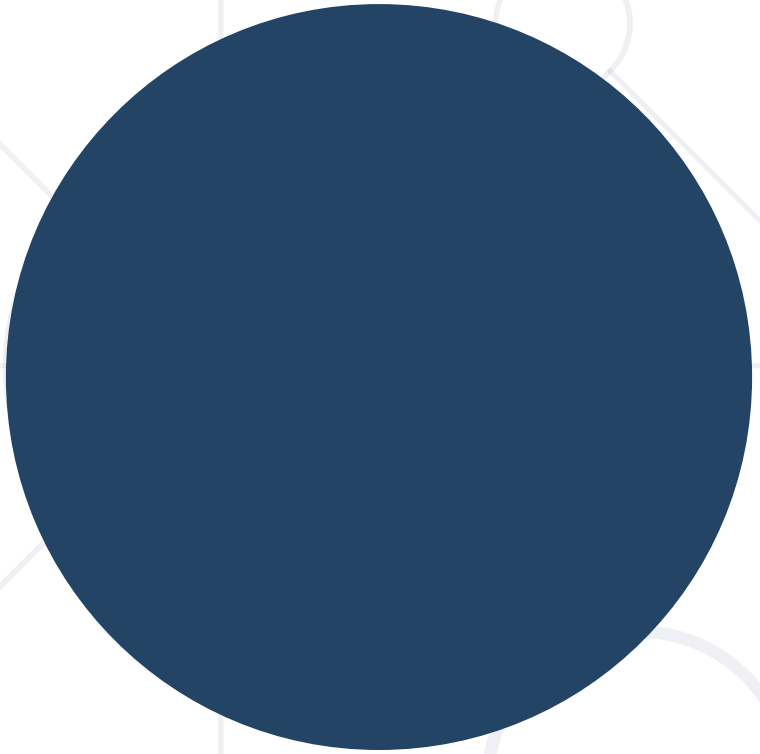

Basic networking concepts

Back to ToC

What is a computer network?

- Multiple computers linked together
- Why? To communicate and share resources

How did it start?

- ARPANET - The Advanced Research Projects Agency NETwork
- Established in 1969
- It is the first packet switching network which will use TCP/IP
- It was designed for scientific purposes and to share computer resources
- ARPANET's purpose was more academic than military

Common Types of Computer Networks

- Local Area Network (LAN)
- Wide Area Network (WAN)
- Wireless Local Area Network (WLAN)
- Storage Area Network (SAN)
- Home Area Network (HAN)

Common Types of Networking Devices

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- Hub (obsolete, not secure and very slow)
- Switch
- Router
- Modem
- Firewall
- Bridge (like a Switch, fewer ports)
- Repeater (like a Hub, it just amplifies the signal)
- Access point

What is a (network) protocol?

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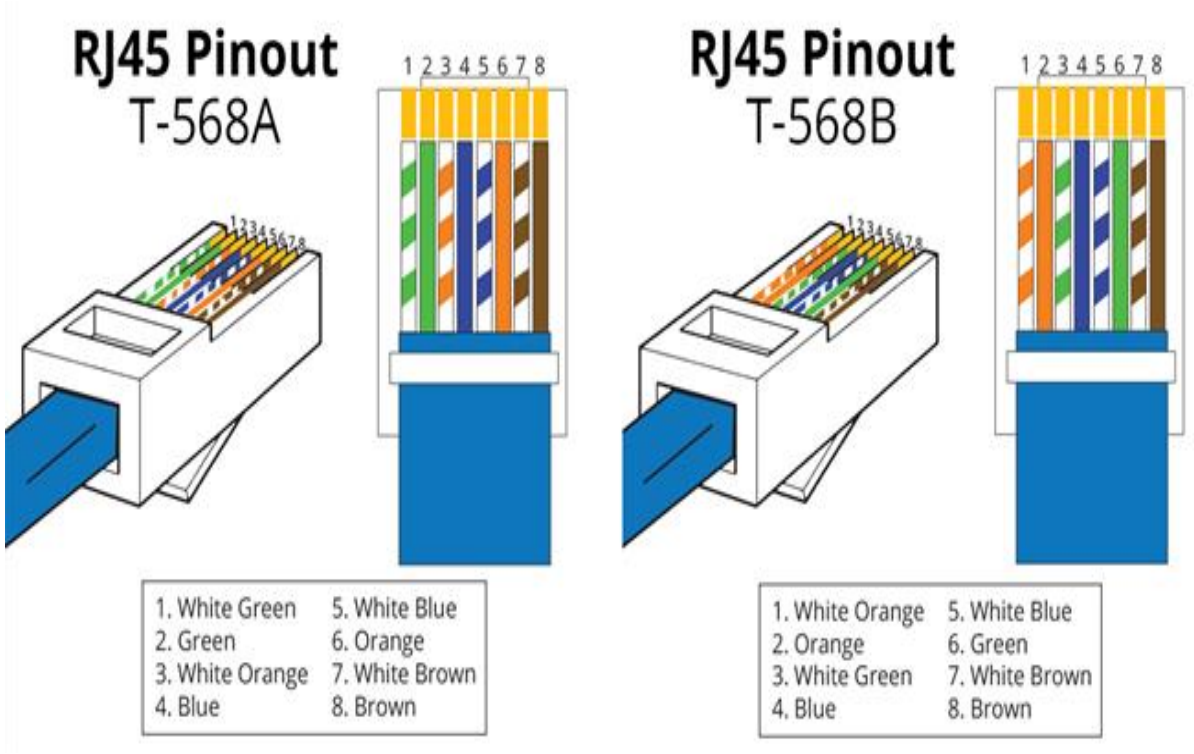
- Protocol: A general term, typically defining a system of rules and acceptable behavior
- Can be used in politics, diplomacy, science, medicine, etc.

What is a network protocol?

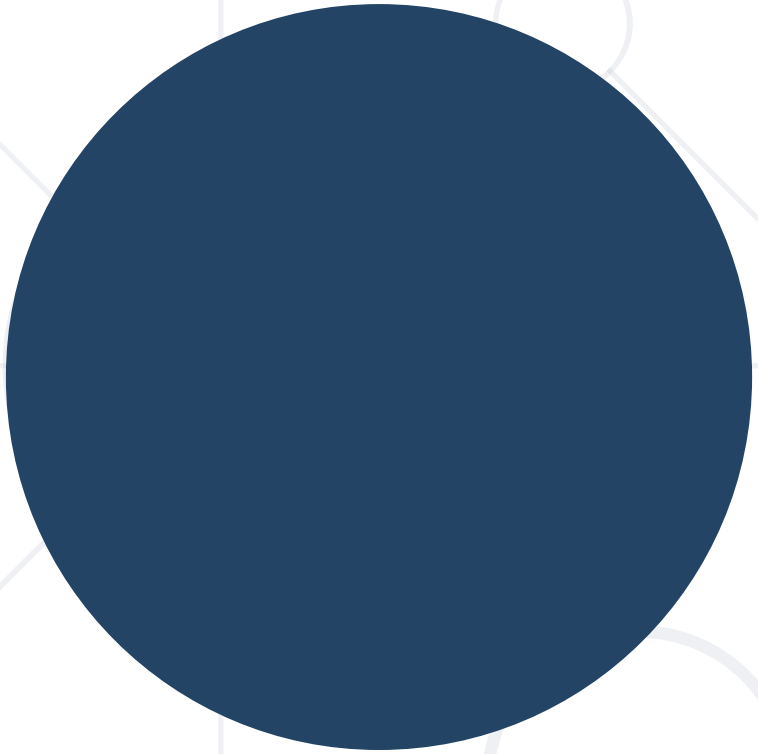
CLOUDFLARE

In networking, a protocol is a set of rules for formatting and processing data. Network protocols are like a common language for computers. The computers within a network may use vastly different software and hardware; however, the use of protocols enables them to communicate with each other regardless.

EIA/TIA Standards

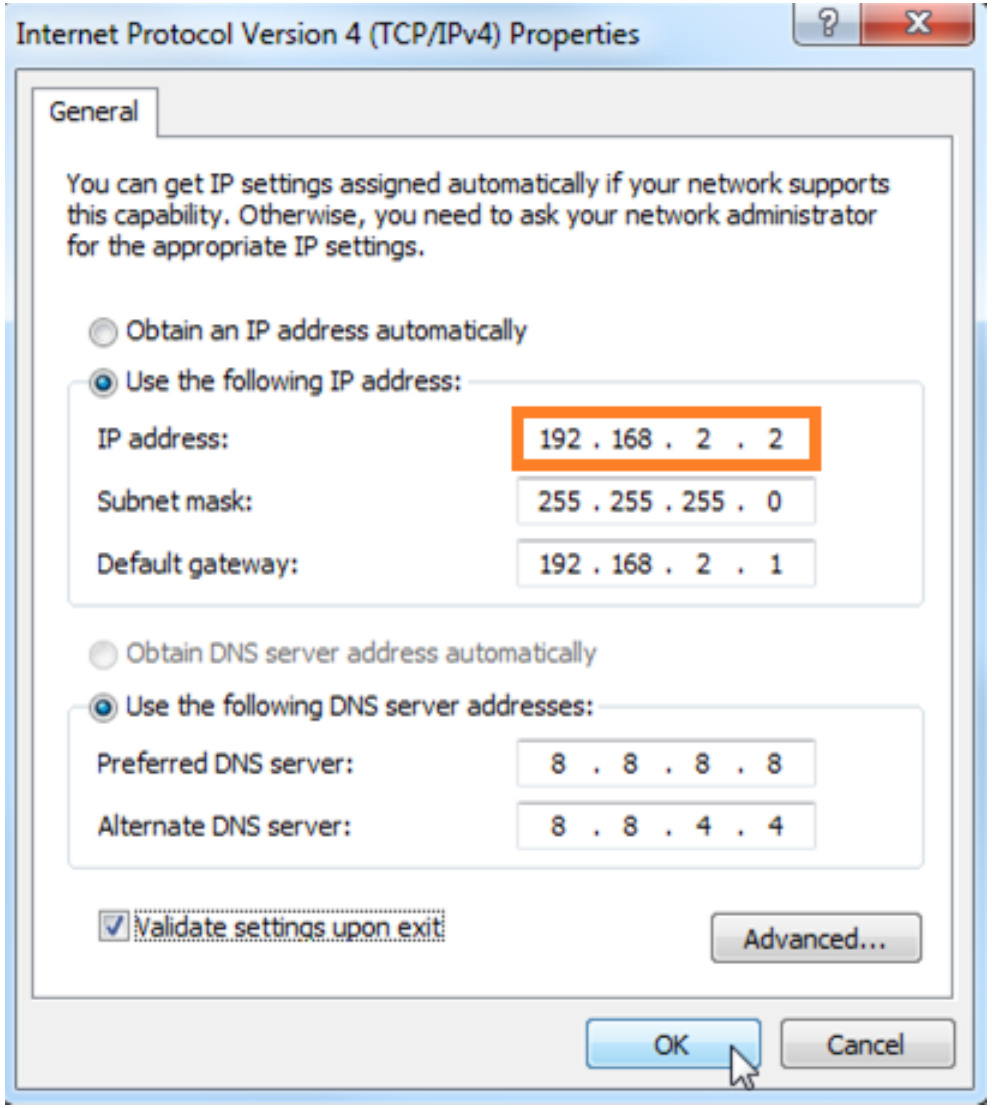


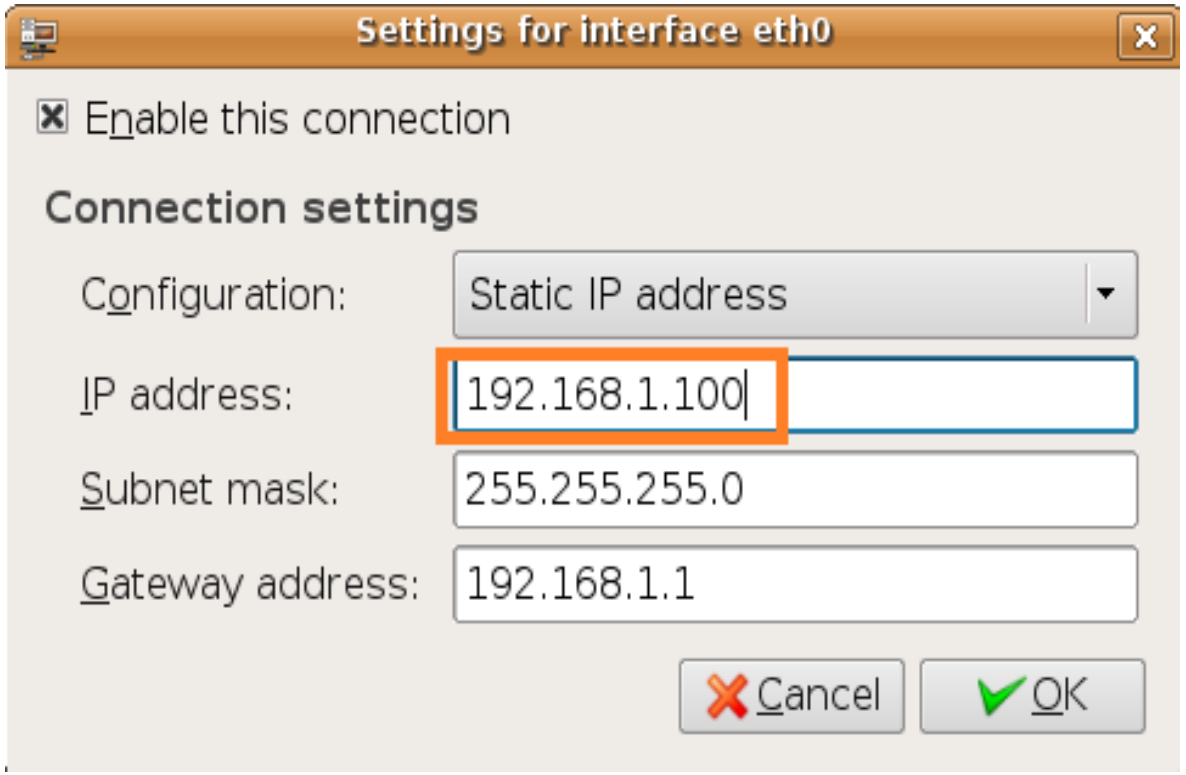
- EIA = Electronic Industries Alliance
  TIA = Telecommunications Industry Association
- T568B is most frequently used



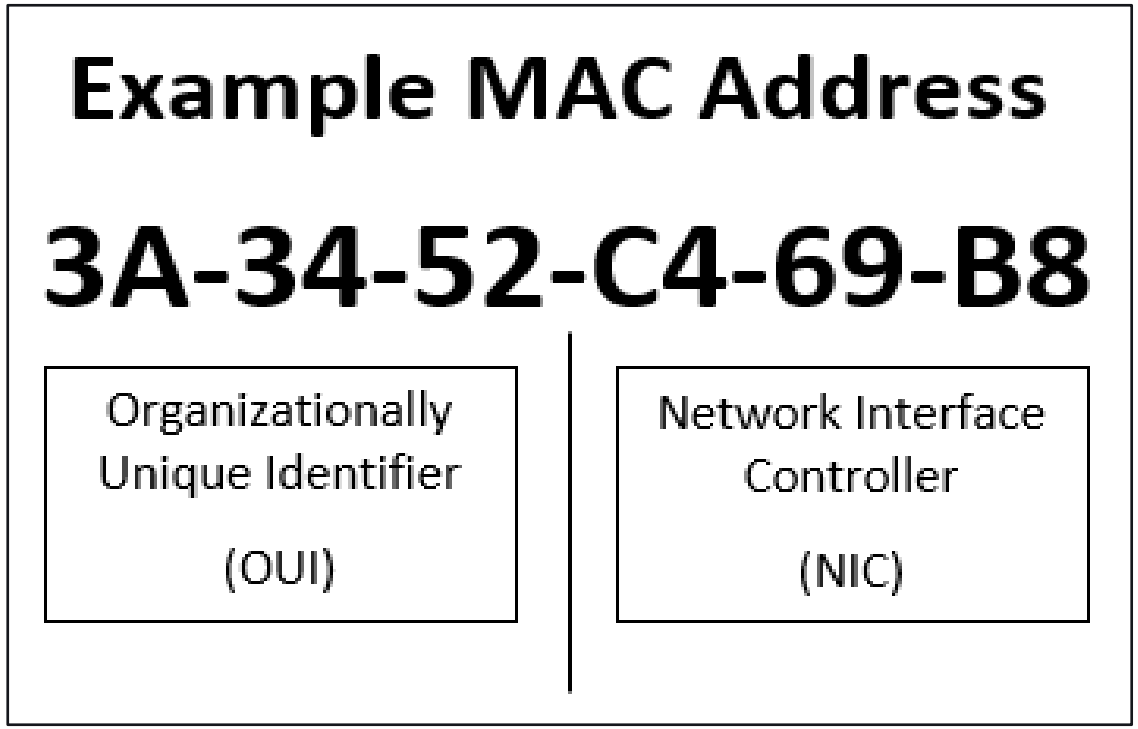
IP and MAC addresses

IP Addresses (2)

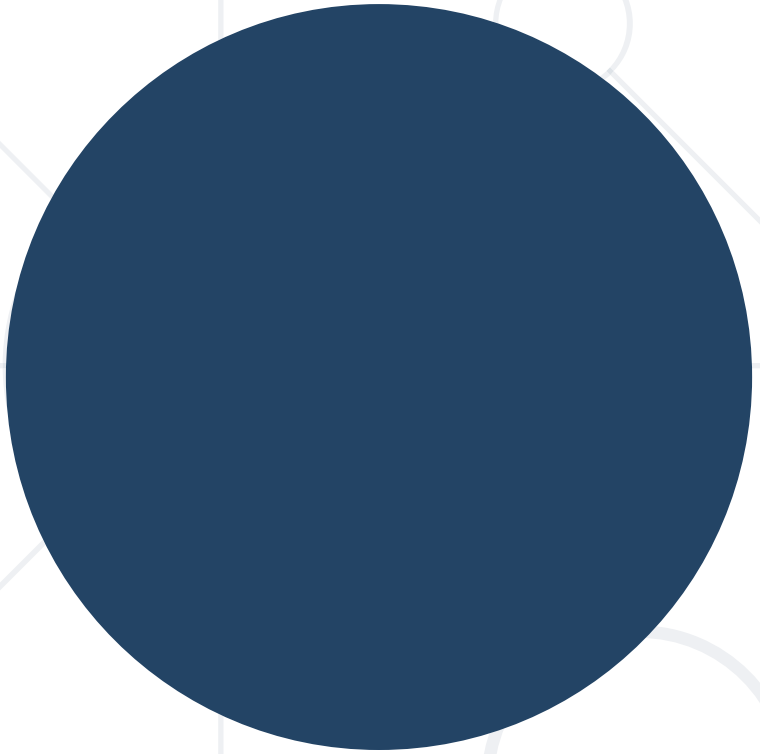




MAC Addresses



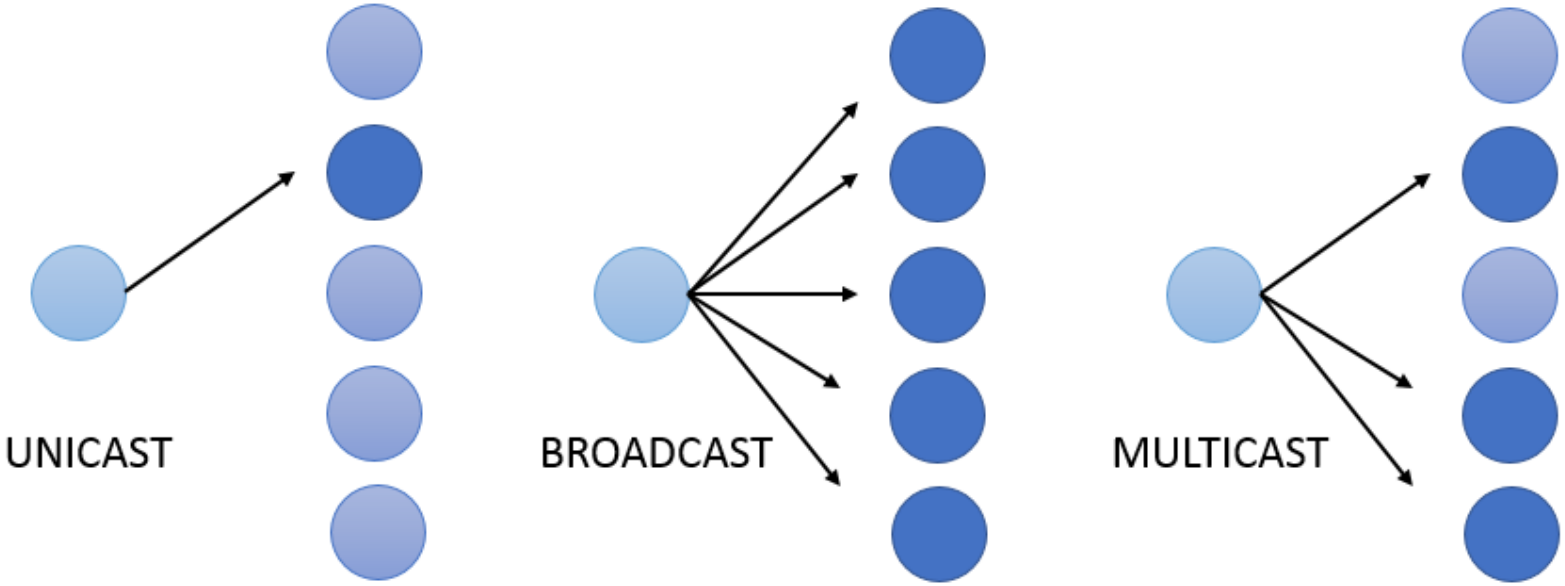
- Known as physical address
- Unique identifier assigned to network interfaces
- 48 bits or 6 bytes in a hexadecimal format (discussed later in the course)
- Can you change it?

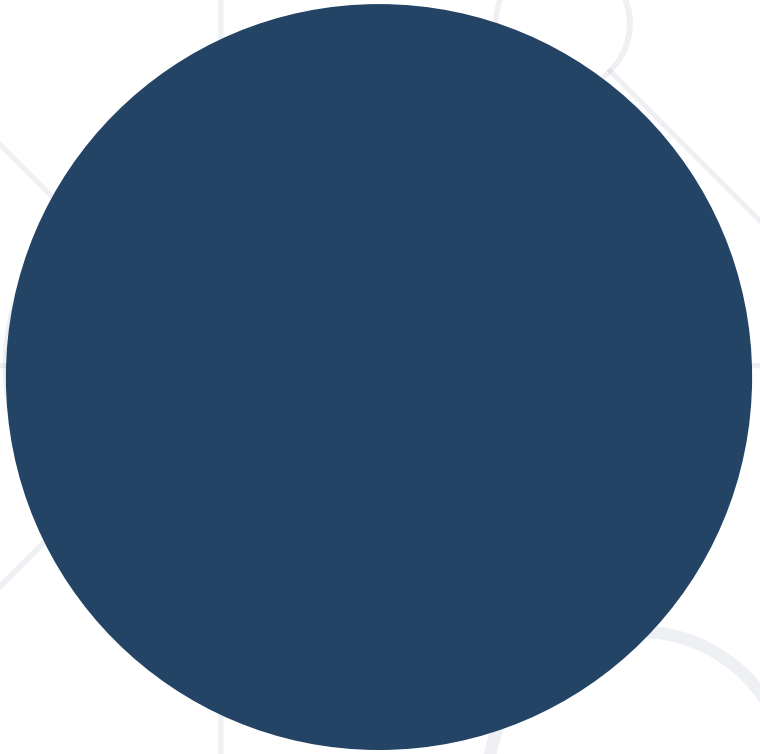


Traffic types

Types of traffic

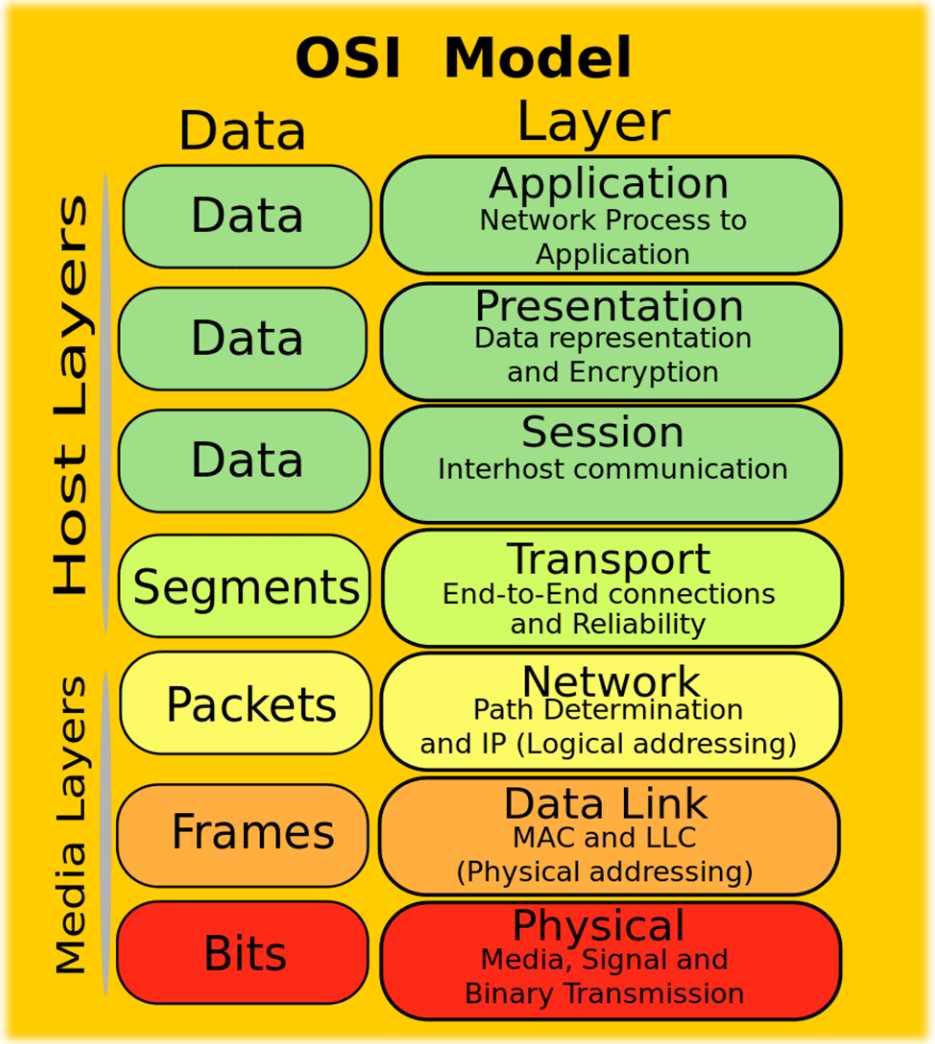
- ONE TO ONE (UNICAST)
- ONE TO ALL (BROADCAST)
- ONE TO SEVERAL (MULTICAST)





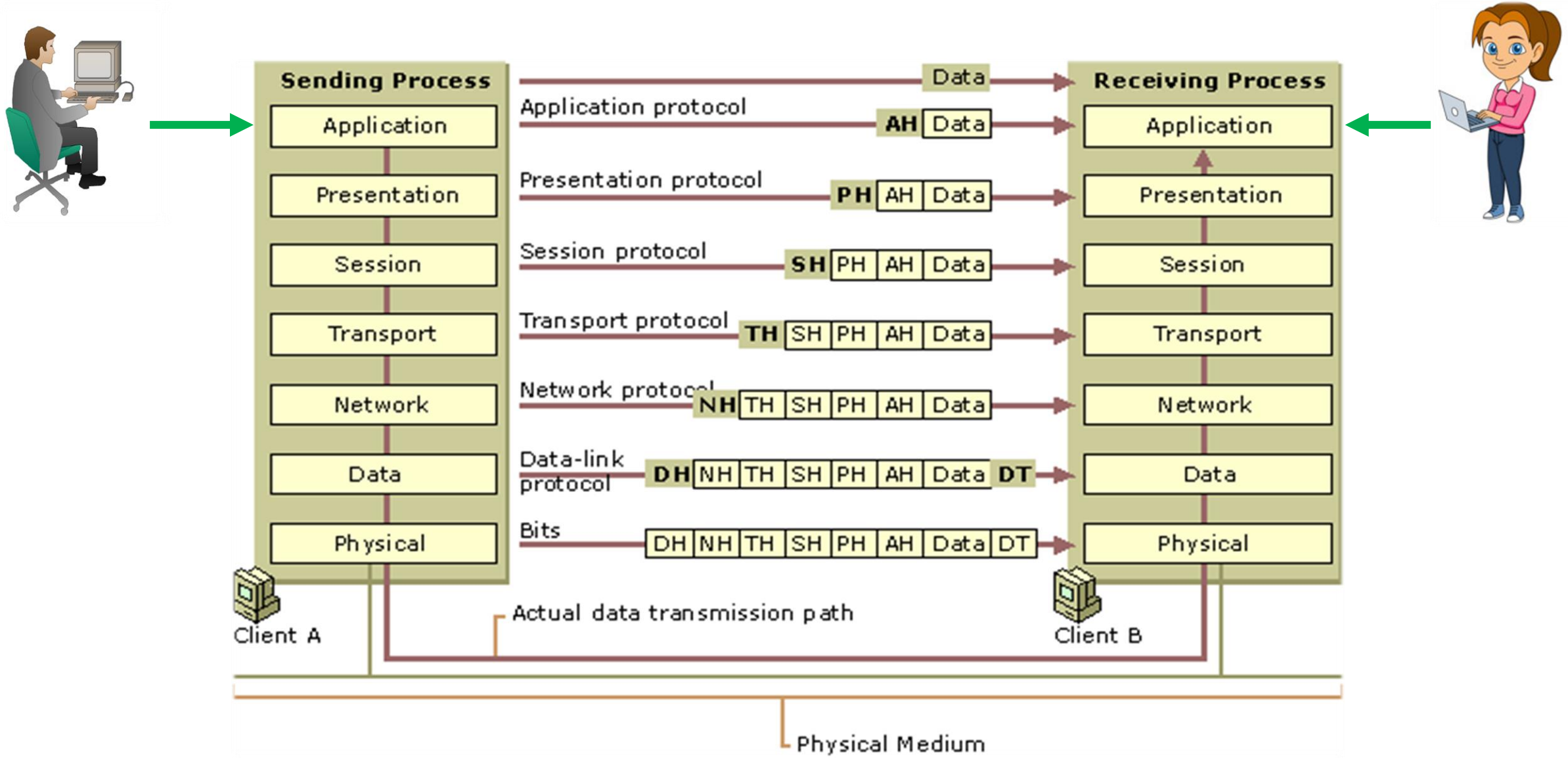
OSI and TCP/IP models

OSI Model

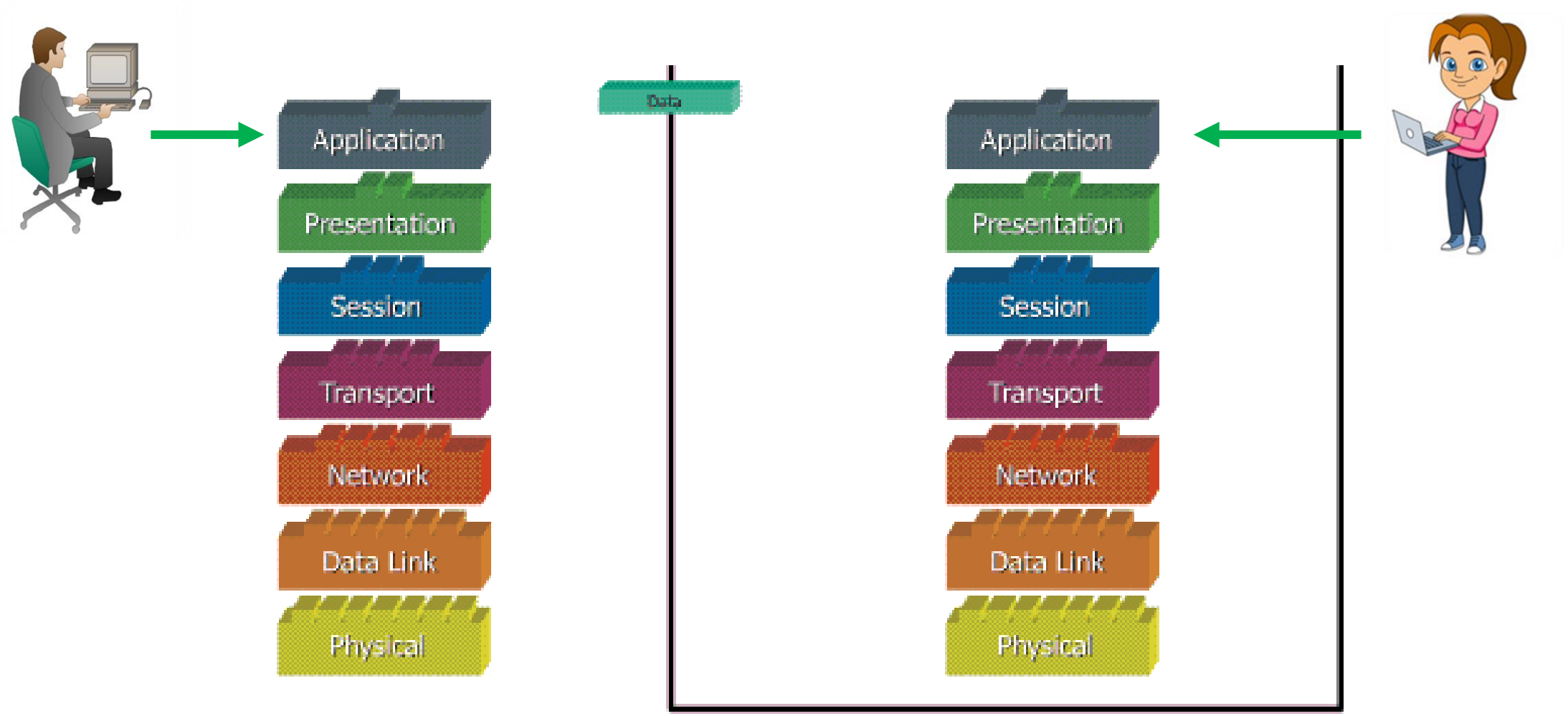


- OSI = Open Systems Interconnection
- Why?
  - Organizes the information
  - Simplifies learning
  - Standards for the vendors
  - Easier troubleshooting
- Protocol Data Unit (PDU) – different data format at each layer

Data Flow in the OSI Model

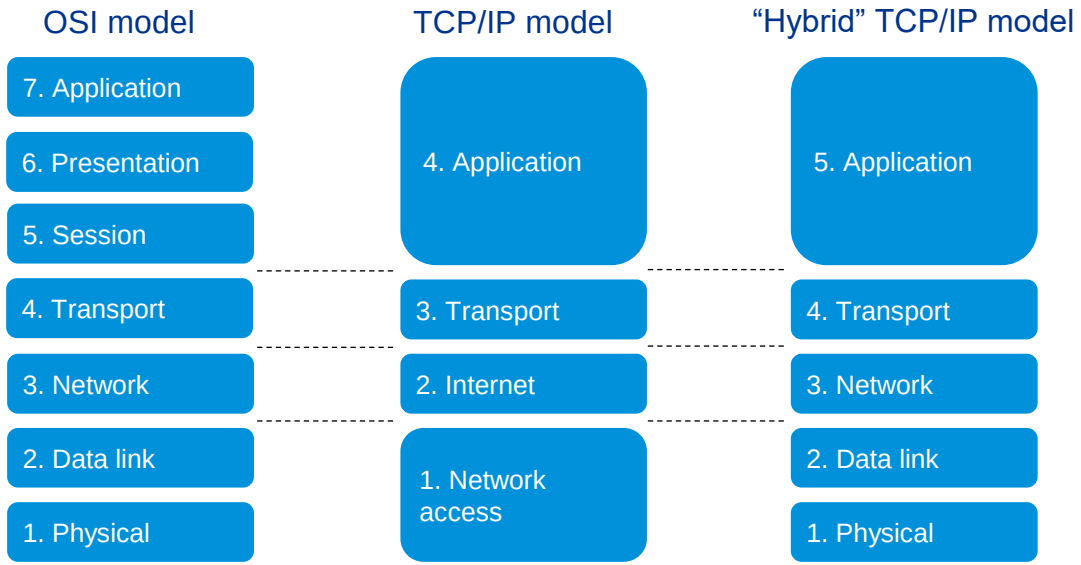


Data Flow in the OSI Model (2)

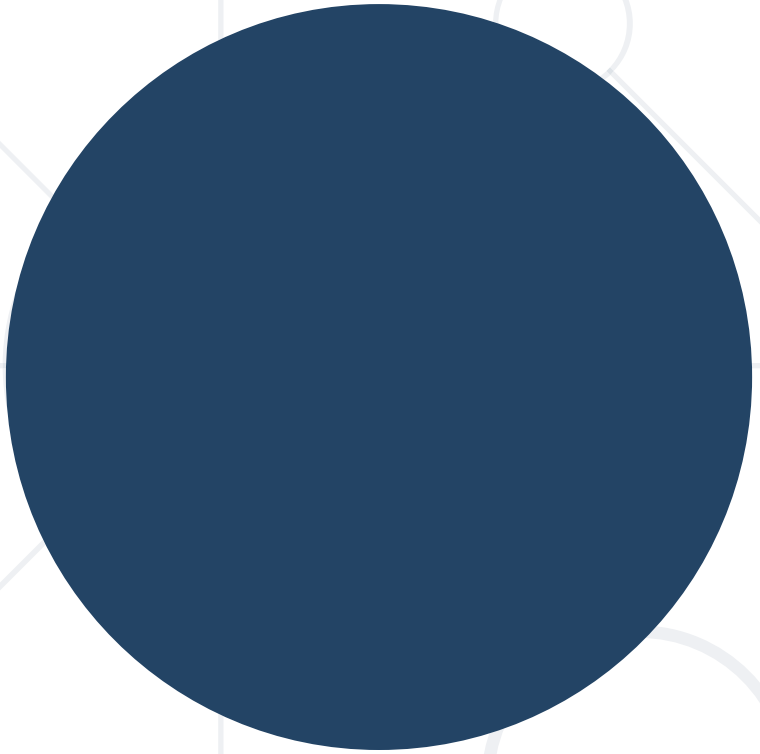


OSI and other networking models

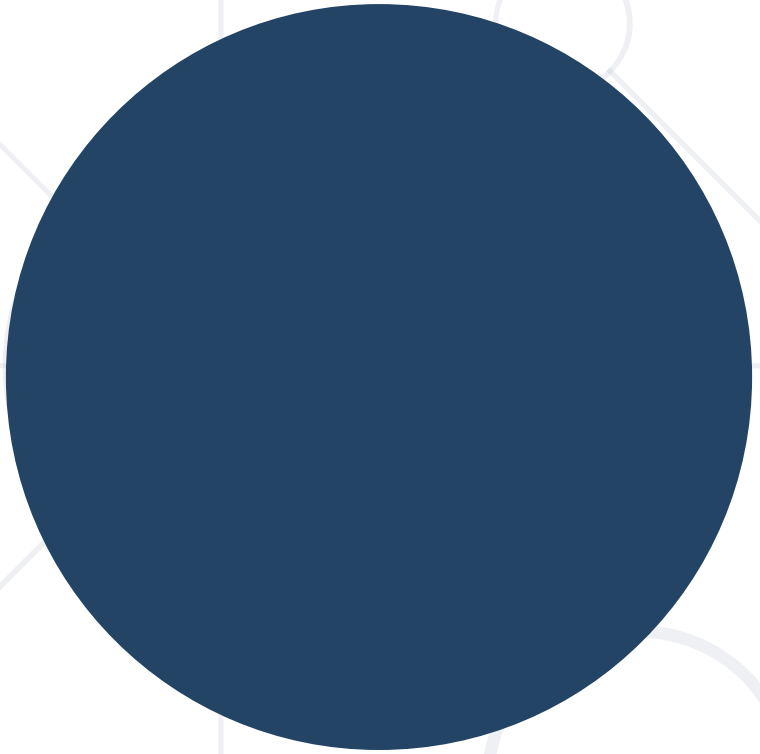
- Originally, the “TCP/IP model” was developed before the OSI model
- Later on, multiple other models were created
- The “hybrid TCP/IP model” is considered as one of the most practical models today



Wikipedia: Internet protocol suite



Cisco Packet Tracer - Introduction



Binary, decimal and hexadecimal numbers

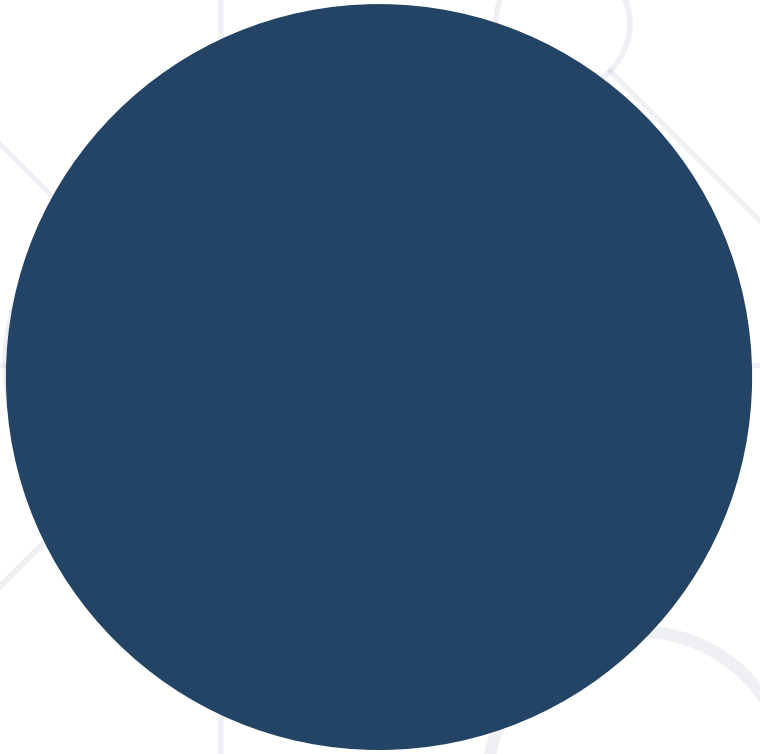
Back to ToC

Different numeral systems

Hexadecimal	Binary	Decimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12
D	1101	13
E	1110	14
F	1111	15

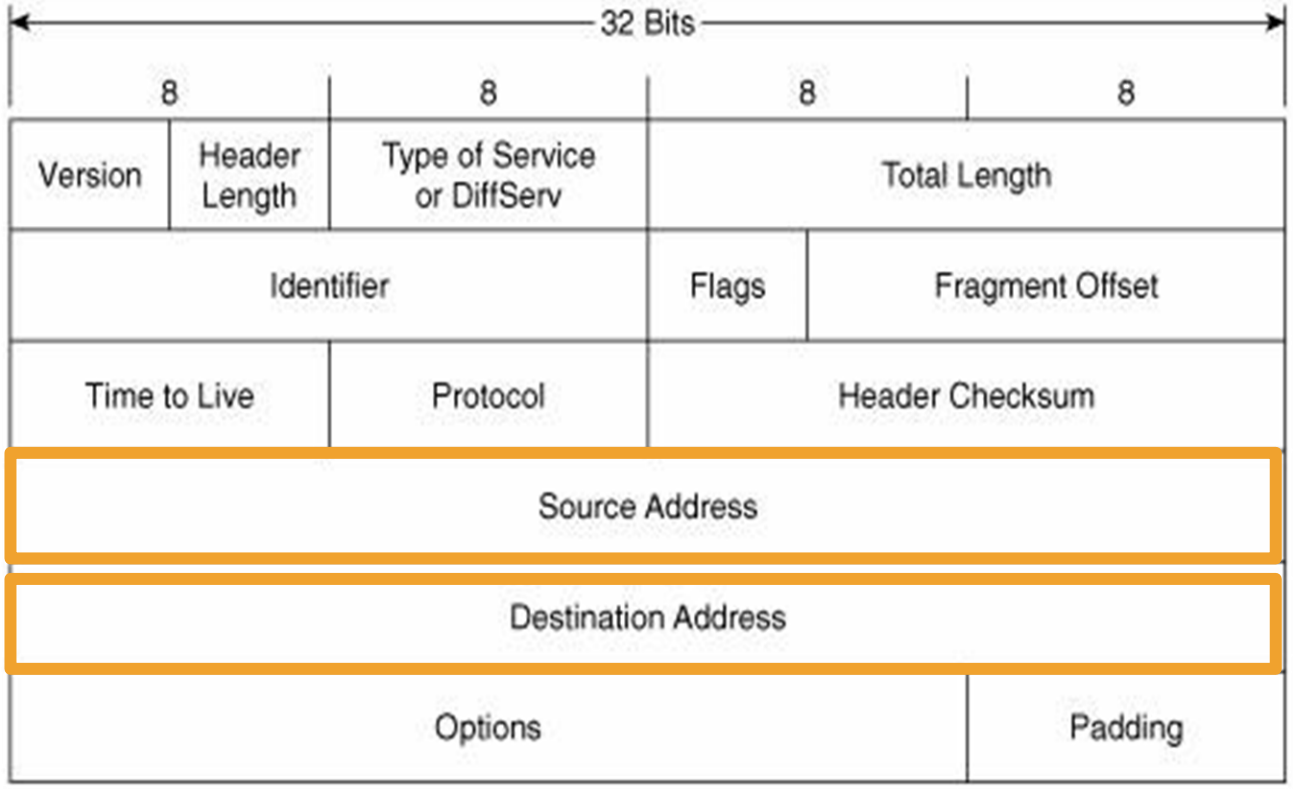
Common Numeral Systems in computer networking:

- Decimal
- Binary
- Hexadecimal



IPv4

IPv4 Address



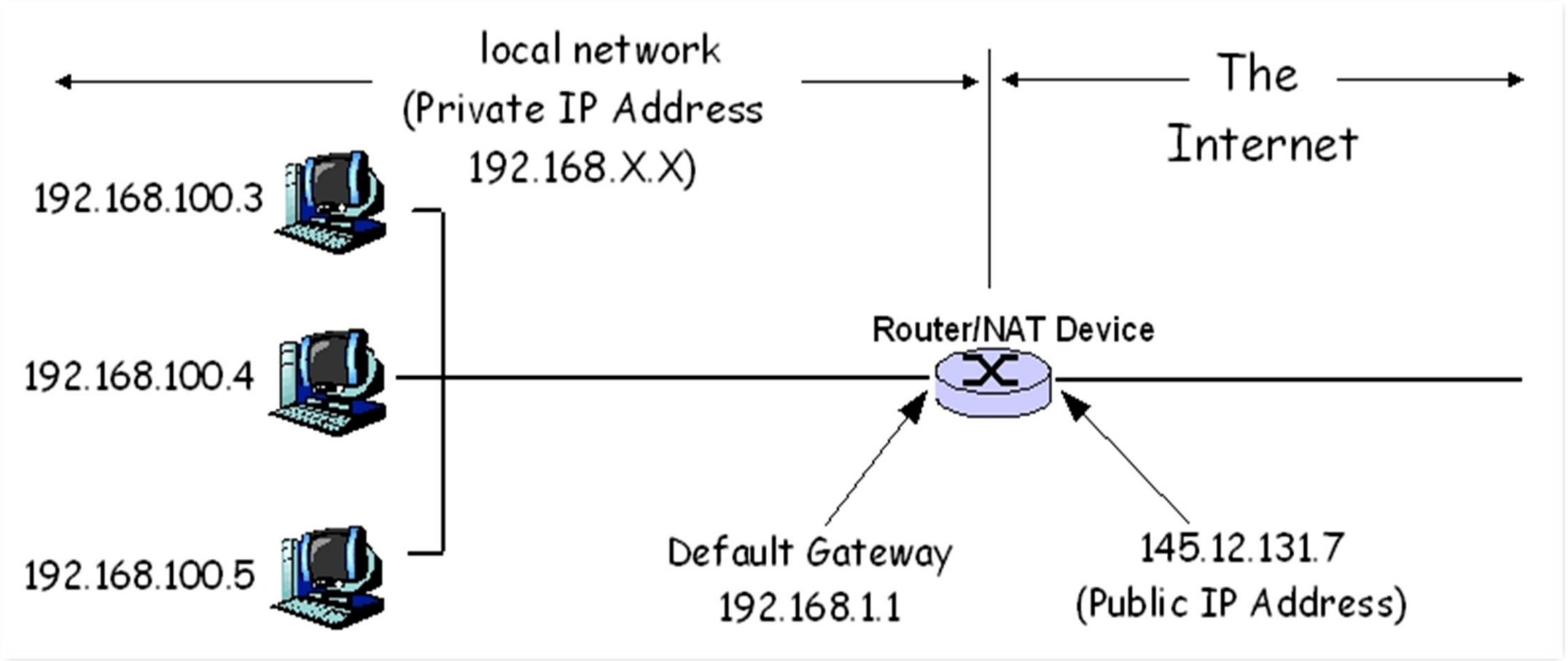
- Plays important role for device connectivity
- It is a 32-bit address
- There are
  4 294 967 296
  IP addresses (2^{32})

Private IP addresses

Class	Start of range	End of range
A	10.0.0.0	10.255.255.255
B	172.16.0.0	172.31.255.255
C	192.168.0.0	192.168.255.255

- Used for addressing internal networks (offices, HQs etc.)
- Not routable on the Internet
- Can be reused in many networks
- Range of private addresses for each class (classes are discussed later)

NAT – Network address translation



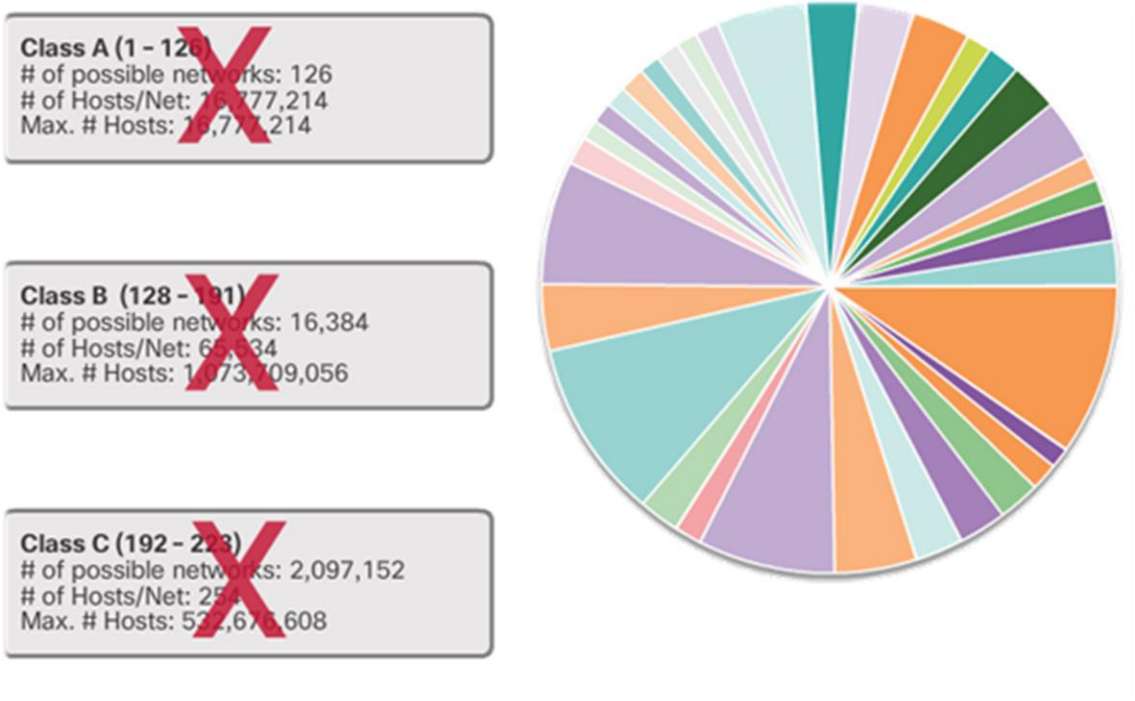
Network masks

IP address: 50.211.197.5
Subnet Mask: 255.0.0.0

	IP network	Host Addresses		
IP address	**50.**	211.	197.	5
Subnet Mask	**255.**	0.	0.	0

- Define the border between the network and the hosts part
- Segment the network

Introduction to CIDR



- CIDR = Classless Inter-Domain Routing
- Ignores the concept Network Address Classes
- Reduces the amount of route advertisements

Without VLSM and CIDR:

10.1.1.0 /24 will be “seen” as 10.0.0.0 /8

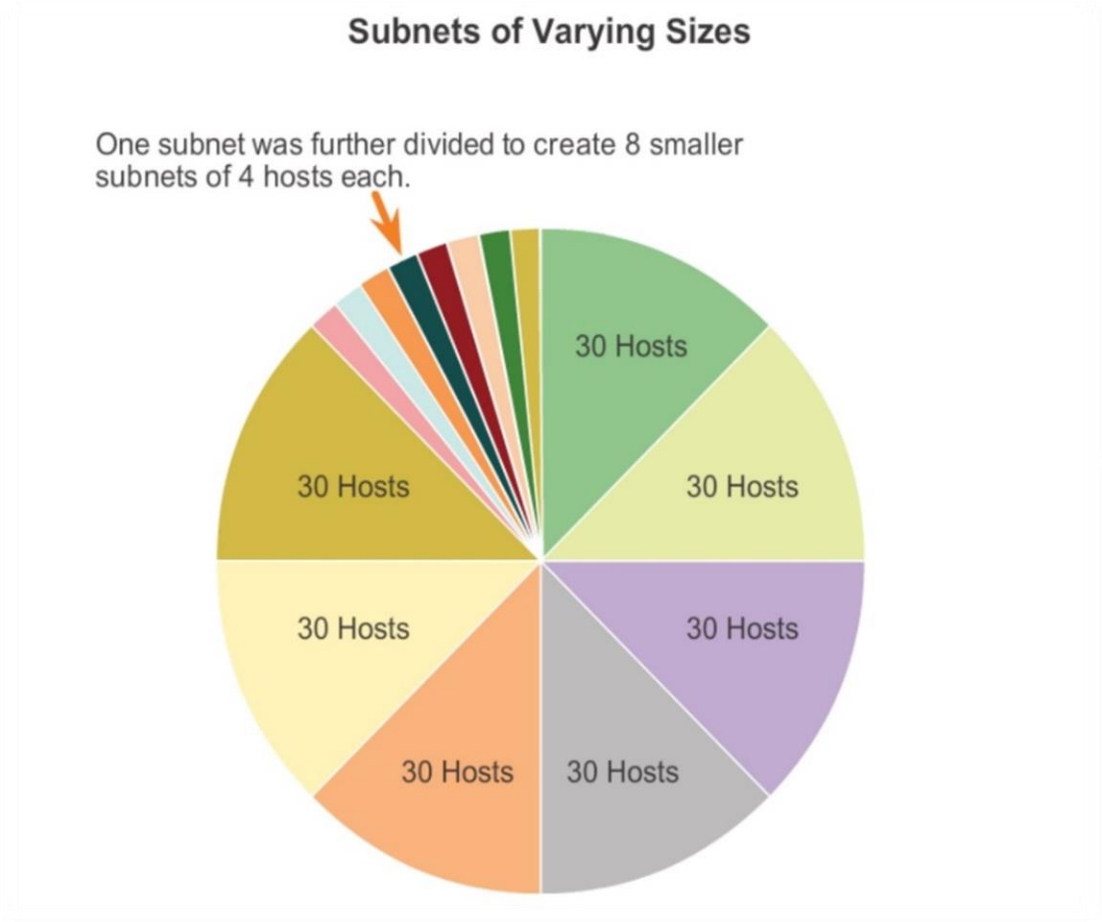
(because /8 is default for Class A)

With VLSM and CIDR:

10.1.1.0 /24 is “seen” as it is

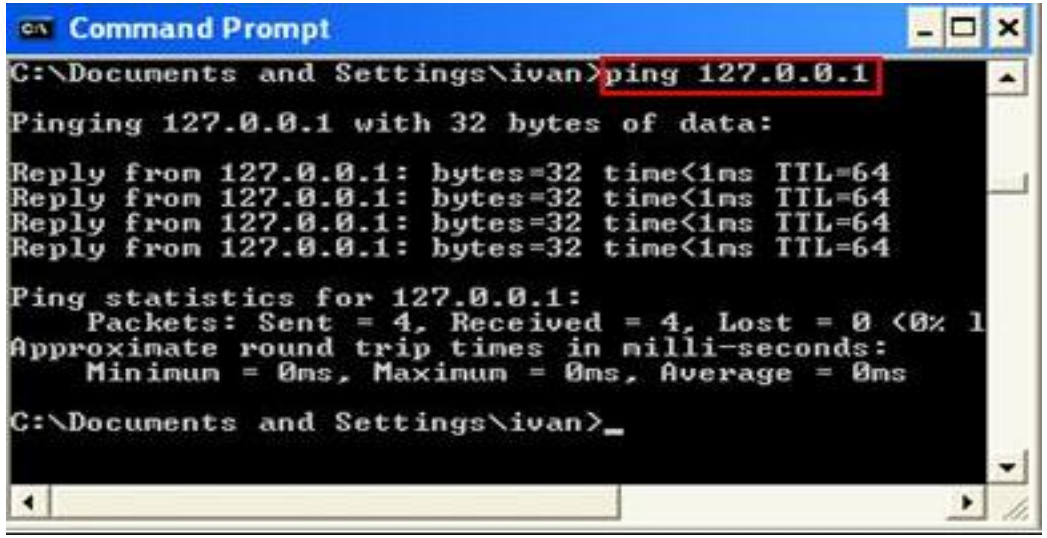
(although the mask is NOT the default)

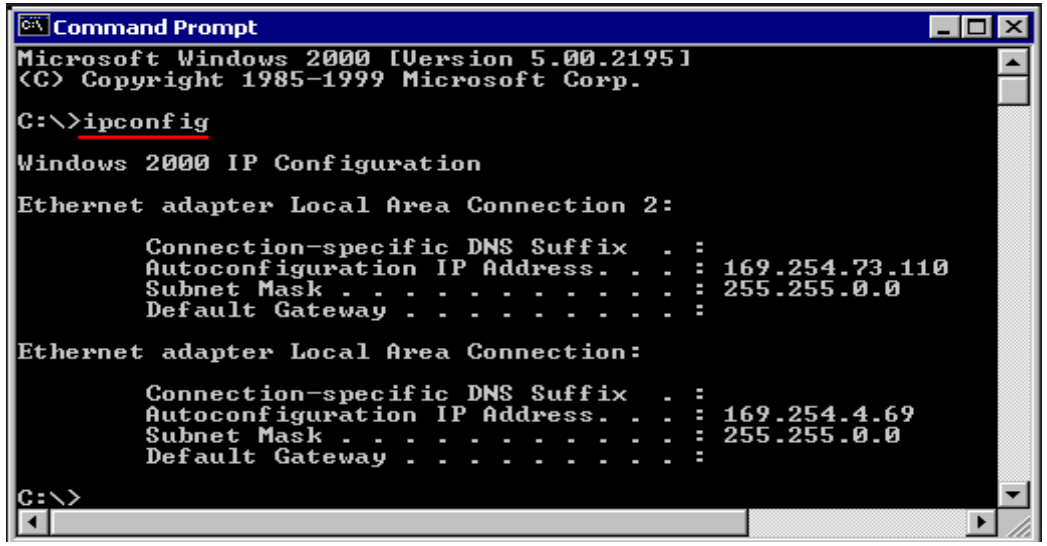
Introduction to VLSM



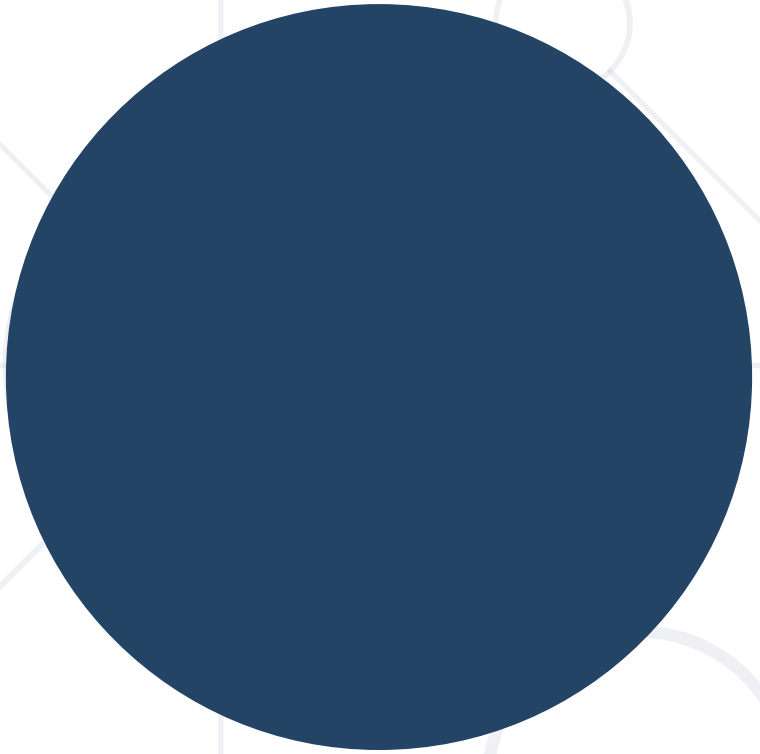
- VLSM: Variable-Length Subnet Masking
- Breaks the IP address classes idea
- “Subnetting of subnets”

Reserved/Special IP addresses





- There are some special IP addresses. For example:
  - 127.0.0.1 /8
    - Known as loopback address
    - On most computer systems, "localhost" resolves to the IP address 127.0.0.1
  - 169.254.X.X /16
    - When DHCP is not reachable
    - Known as APIPA (Microsoft)

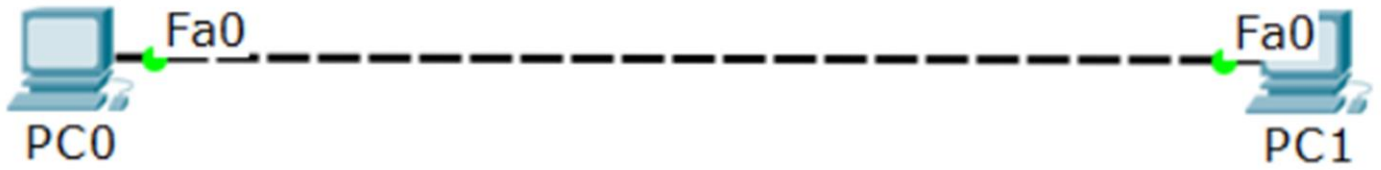


Host-to-host communication without routers

Four addresses required

- There are 4 addresses needed for Ethernet communication:

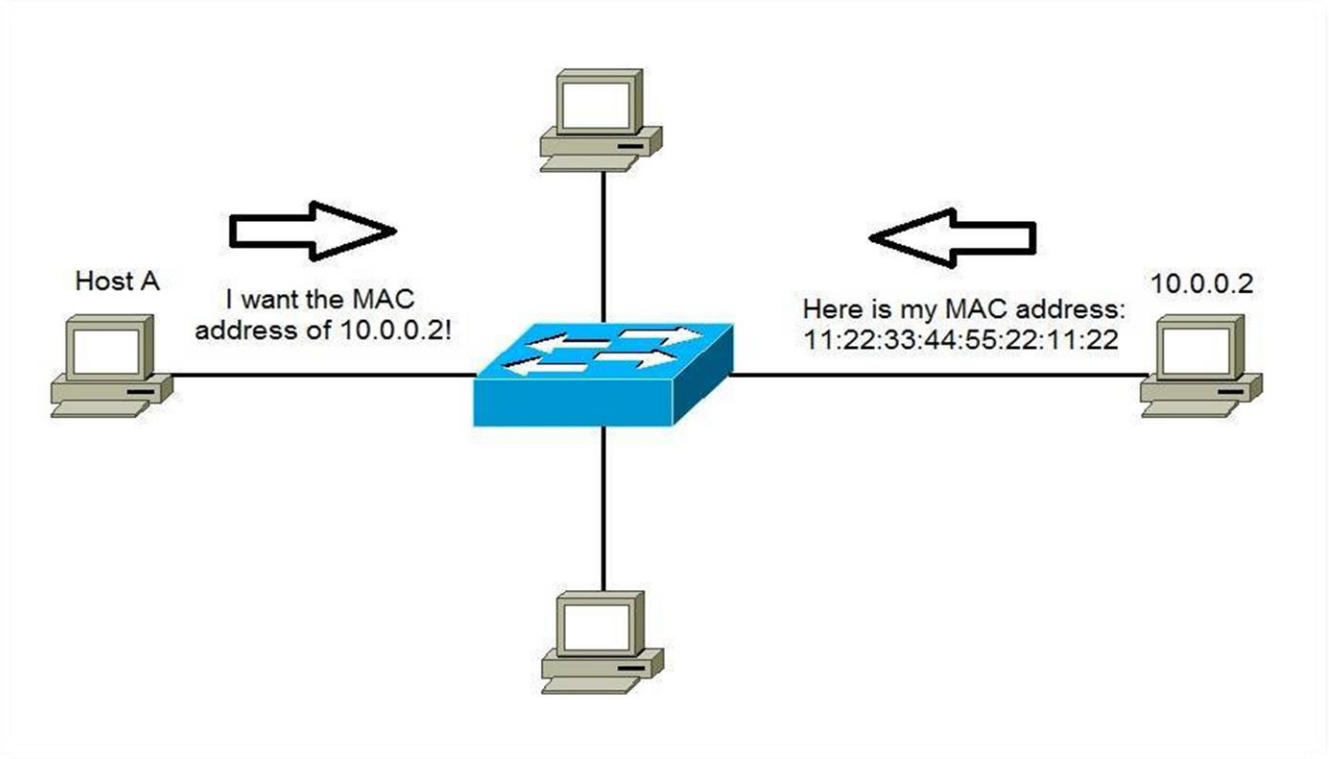
▪ Source IP	▪ Destination IP
▪ Source MAC	▪ Destination MAC



MAC Address: 00E0.F792.0D43
IP Address: 10.0.0.1/24

MAC Address: 000C.CF77.1713
IP Address: 10.0.0.2/24

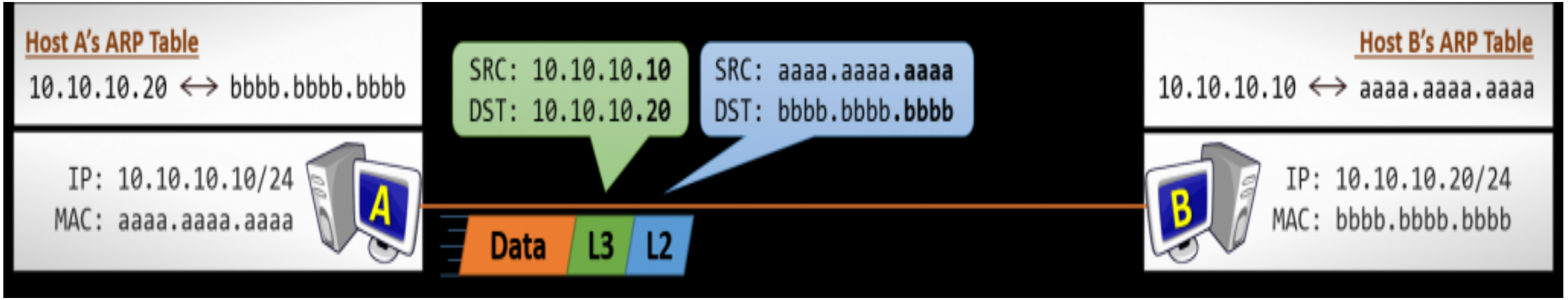
ARP: Address Resolution Protocol



- Used to find the MAC address of the destination
- Uses Broadcast

Direct communication (without router)

- Source and destination MAC addresses are constant
- Source and destination IP addresses are constant



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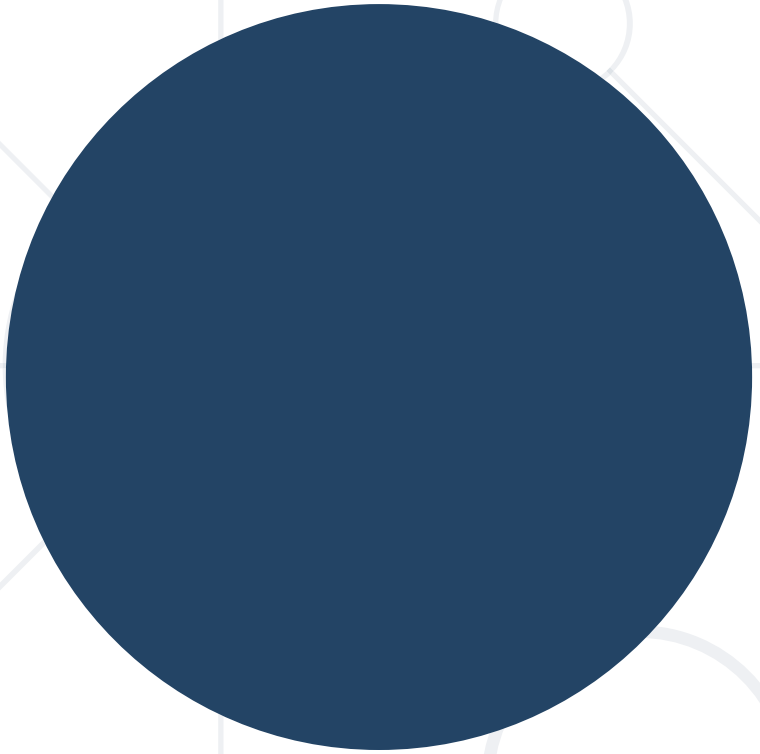

Basic connectivity checks

Basic Connectivity Checks

- Ping (Layer 3)
- Traceroute (Layer 3)
- LLDP (Layer 2)
- CDP (Layer 2)

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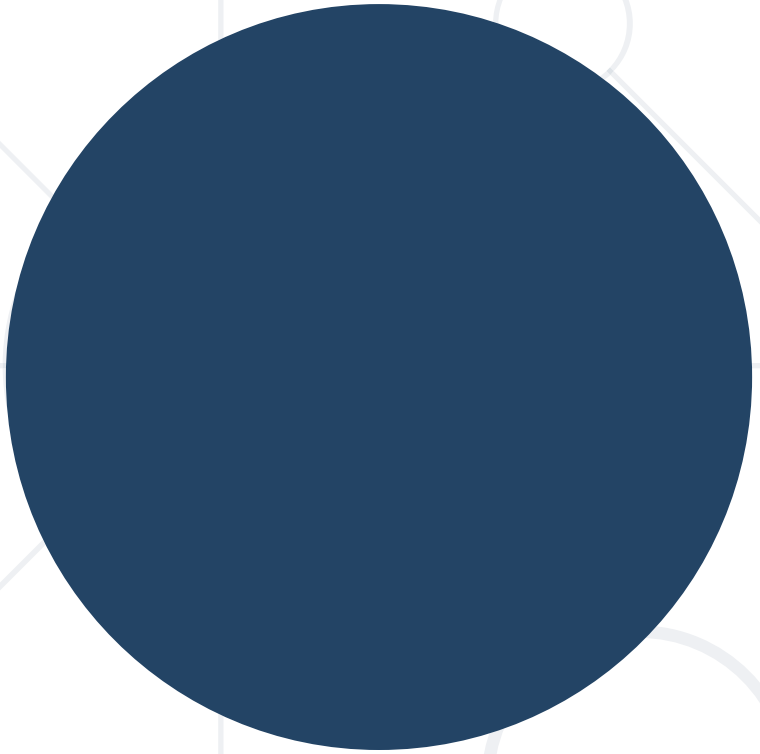
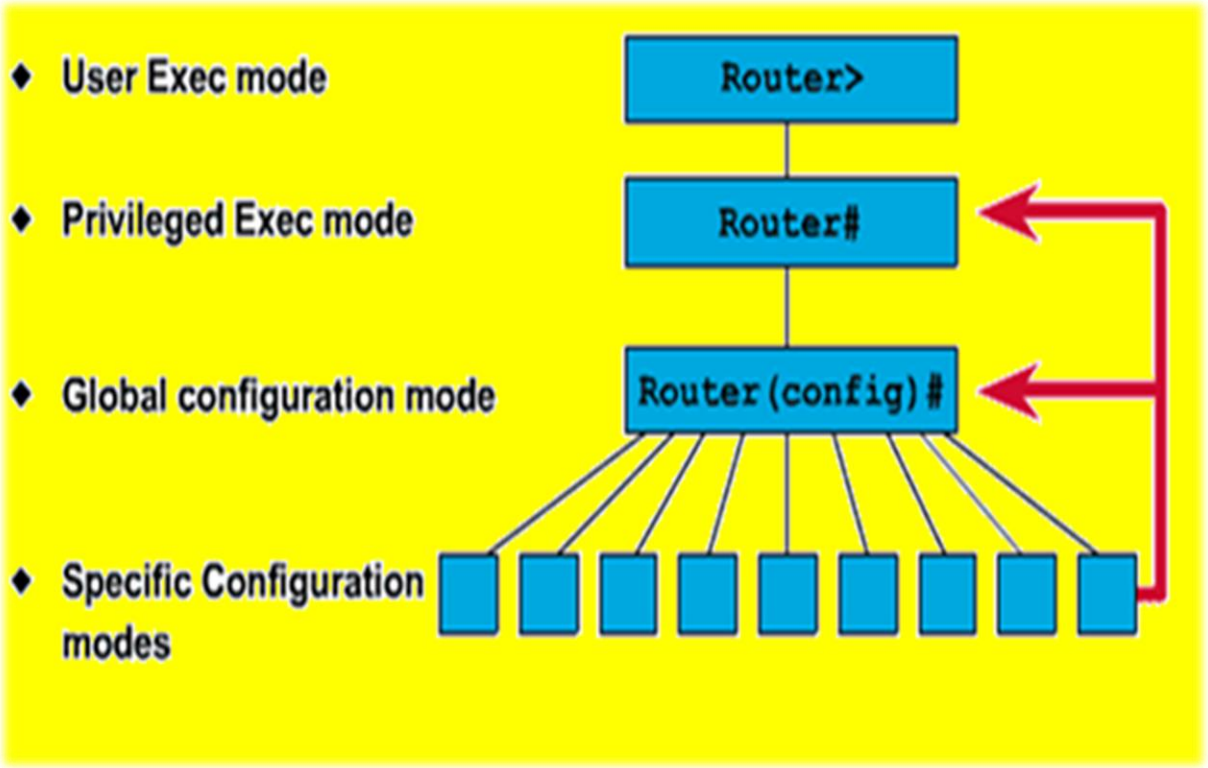
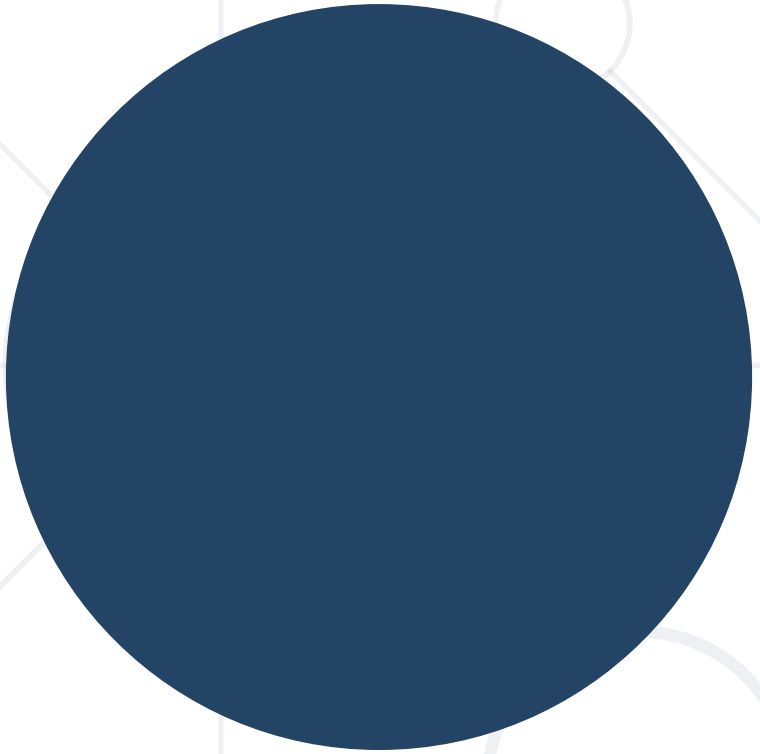


The command line

Command line introduction



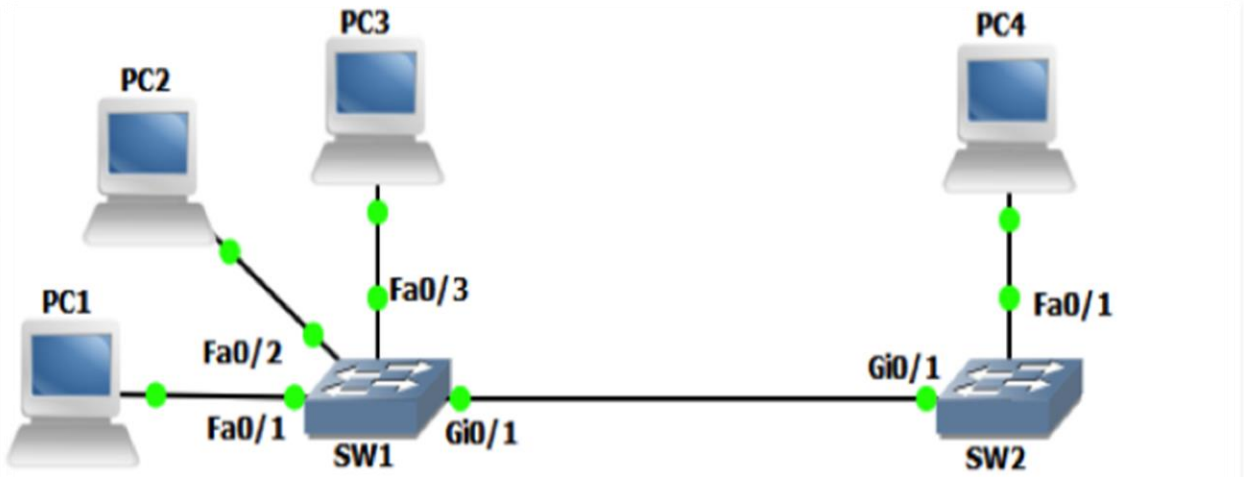
- Different vendors use different names but the logic is similar
- Typical CLI modes:
  - Read-only (User)
  - Read-write (Privilege)
  - Configuration (Global config)
  - Sub-configuration



Switch MAC address table

Back to ToC

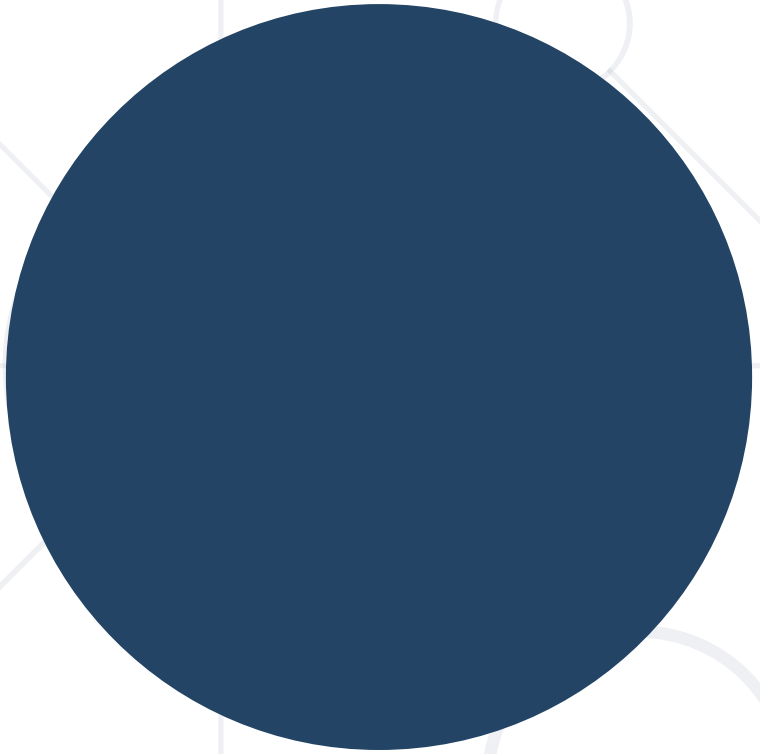
The MAC address table




```
SW1# show mac address-table dynamic
        Mac Address Table
------------------------------------------
Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
  20    0200.1111.1111    DYNAMIC     Fa0/1
  20    0200.2222.2222    DYNAMIC     Fa0/2
  20    0200.3333.3333    DYNAMIC     Fa0/3
```

```
SW2# show mac address-table dynamic
        Mac Address Table
------------------------------------------
Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
```

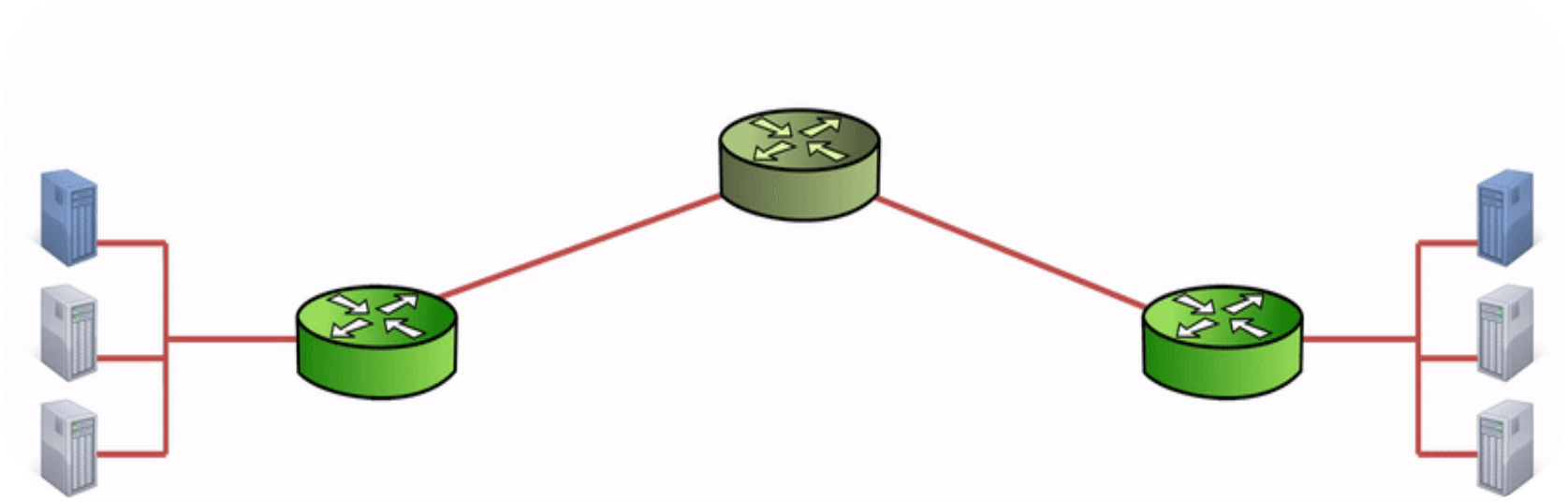
- It is a (dynamic) table that maps MAC addresses to ports
- Used to find the proper interface when the switch forwards a packet

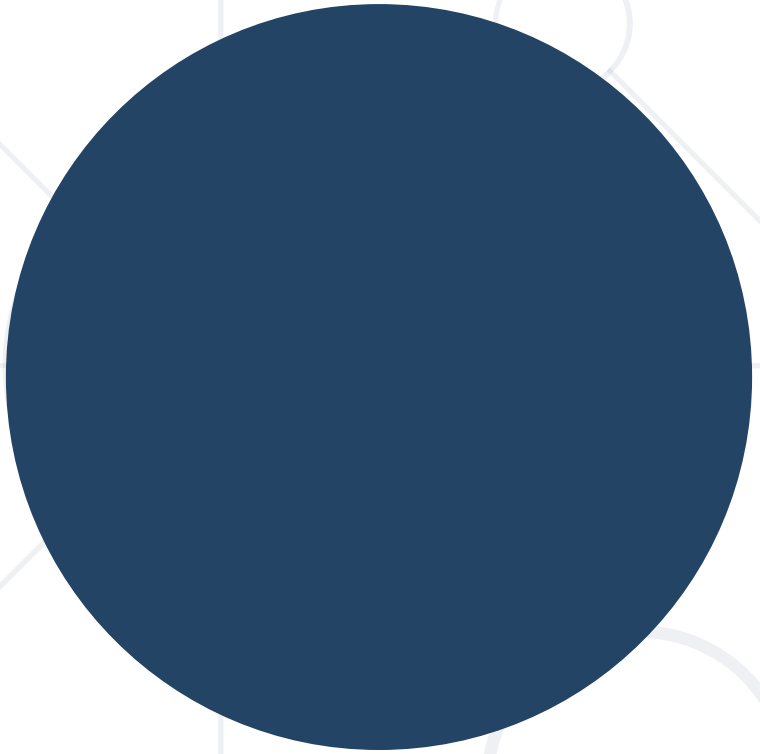


Host-to-host communication with routers

Host-to-host communication with routers

- Source and destination MAC addresses are changed at every hop (router)
- Source and destination IP addresses are constant
  (if we do not use NAT)





Device memory components

Main memory components in a network device

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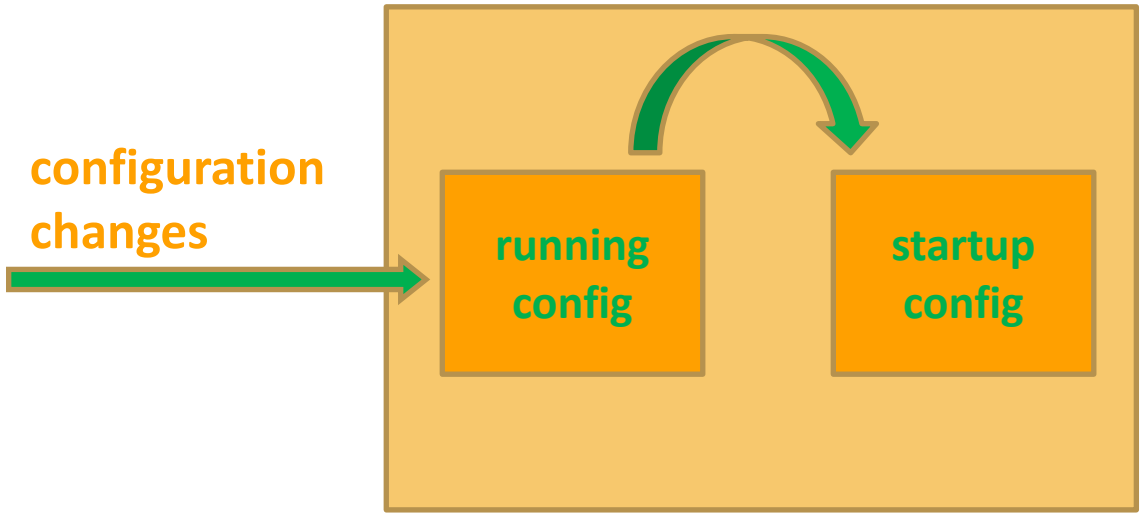
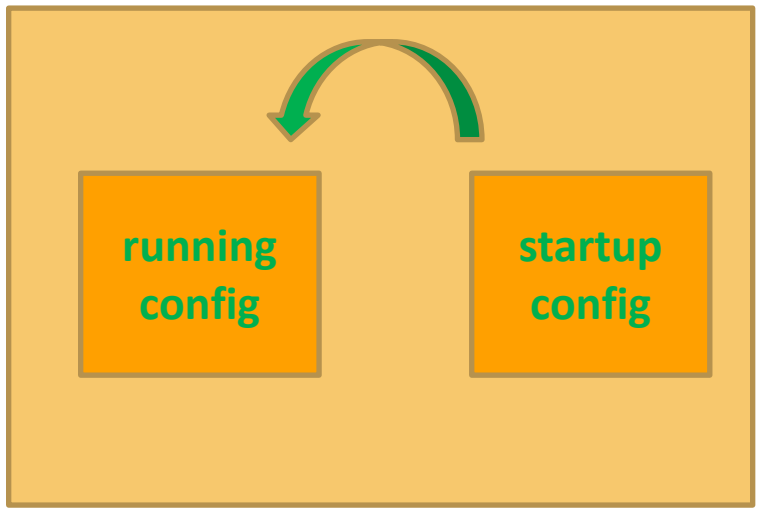
- RAM (Random Access Memory)
  - stores the running configuration file
  - loses content when the power goes down
- NVRAM (NonVolatile RAM)
  - stores the startup configuration file
  - retains content when the power goes down
- Flash memory
  - stores the device image (operating system)
  - retains content when the power goes down
- ROM (Read-Only Memory)
  - maintains instructions for power-on self test (POST) diagnostics
  - Stores bootstrap program and basic operating system software
  - retains content when the power goes down

Saving the configuration

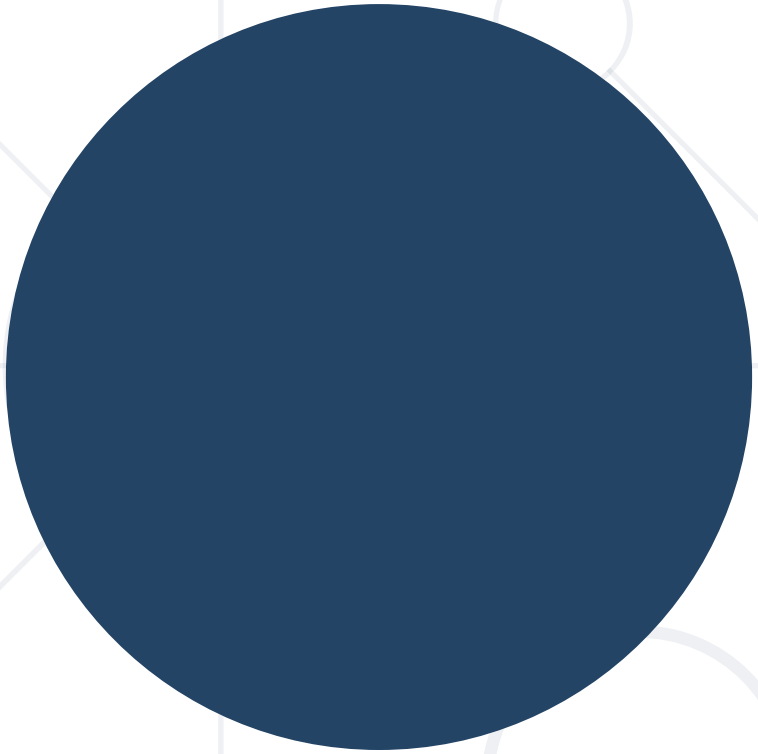


- The configuration file must be saved to survive reboot
- To save the running configuration file (stored in RAM) to the startup configuration file (stored in NVRAM), use either:
  - copy run start
  - write memory

Loading the configuration



- The saved configuration file (startup config file) will go in the RAM (the running config file) when:
  - the device is restarted
  - a copy start run command is executed



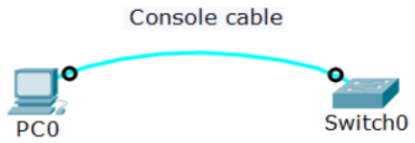
Accessing network devices

Back to ToC

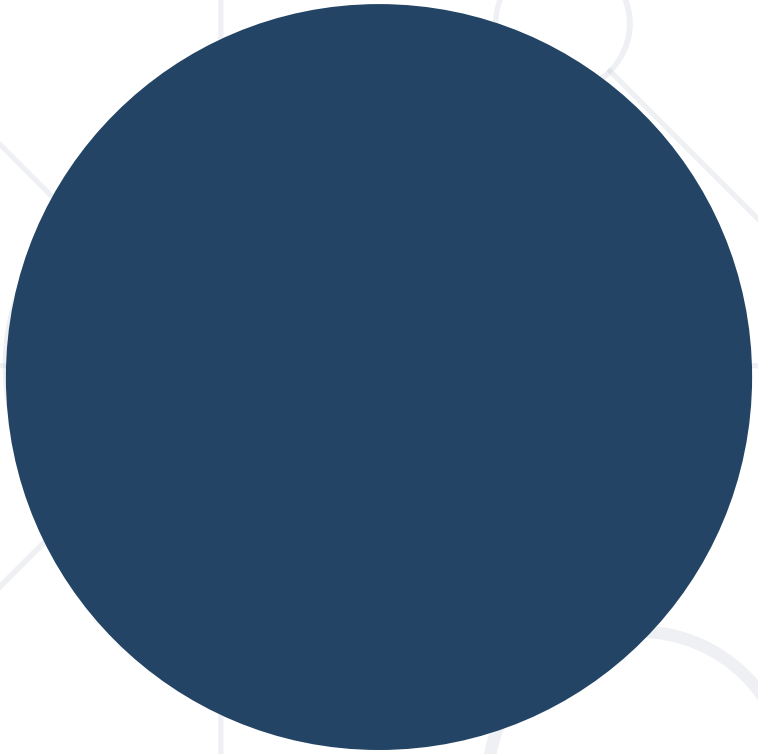
Out-of-band vs in-band management

- Out-of-band:
  - Management traffic uses separate path from the user traffic
  - Typical protocol: Console
- In-band management
  - Management traffic travels the same path as user traffic
  - Typical protocols: Telnet, SSH, SNMP, Web

Out-of-band management



- Dedicated channel for management only
- Needs terminal emulator software (Putty, SecureCRT, etc.)
- No IP addresses are required
- More secure & reliable for management
- Traffic is local and not routed



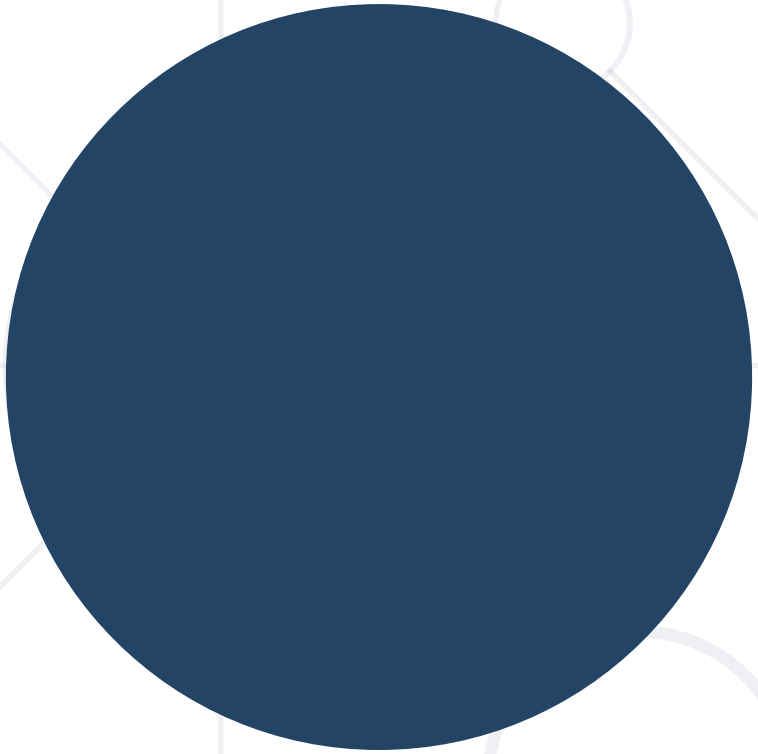
Securing network device access

(Lecture 4)

Secure access - best practices

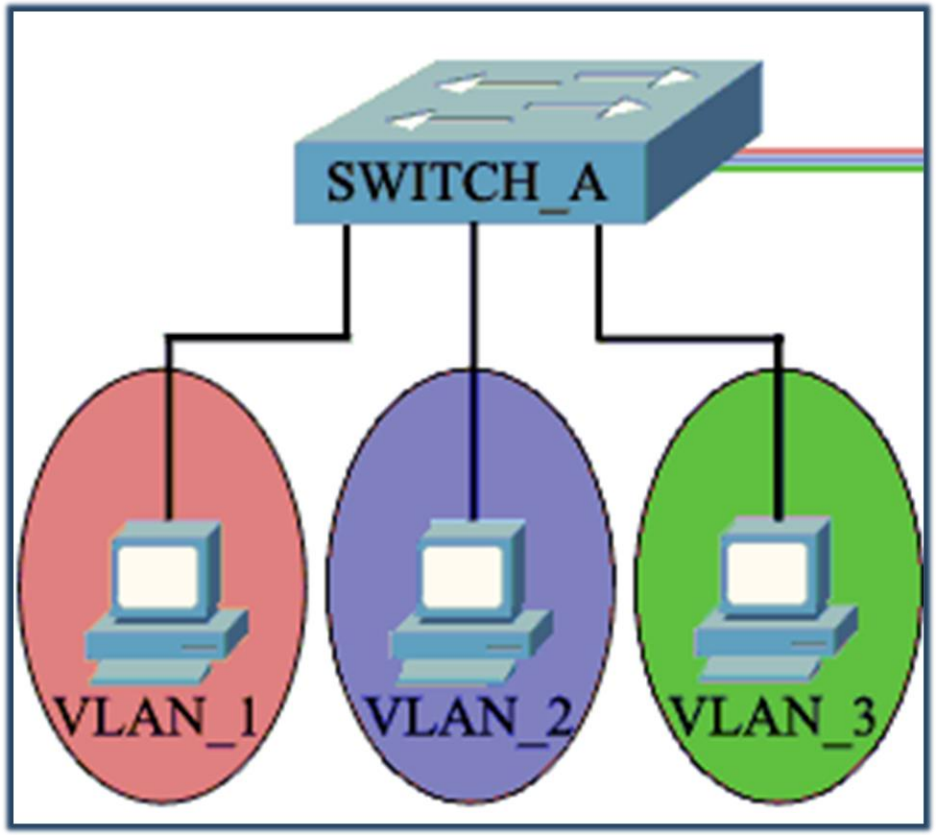
Software University

- Physically secure the devices
- Use SSH instead of Telnet
- Use SNMPv3 instead of v1 or v2
- Use HTTPS instead of HTTP
- Out-of-band management (console) is considered more secure than in-band management
- Create strong passwords for each privilege level and method of access (console, VTY)



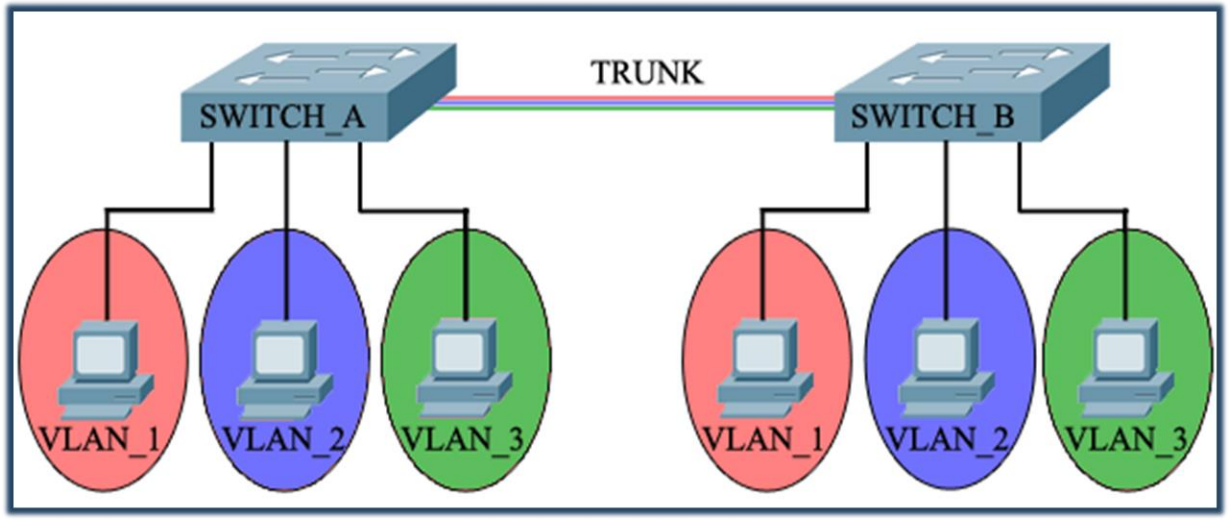
Introduction to VLANs

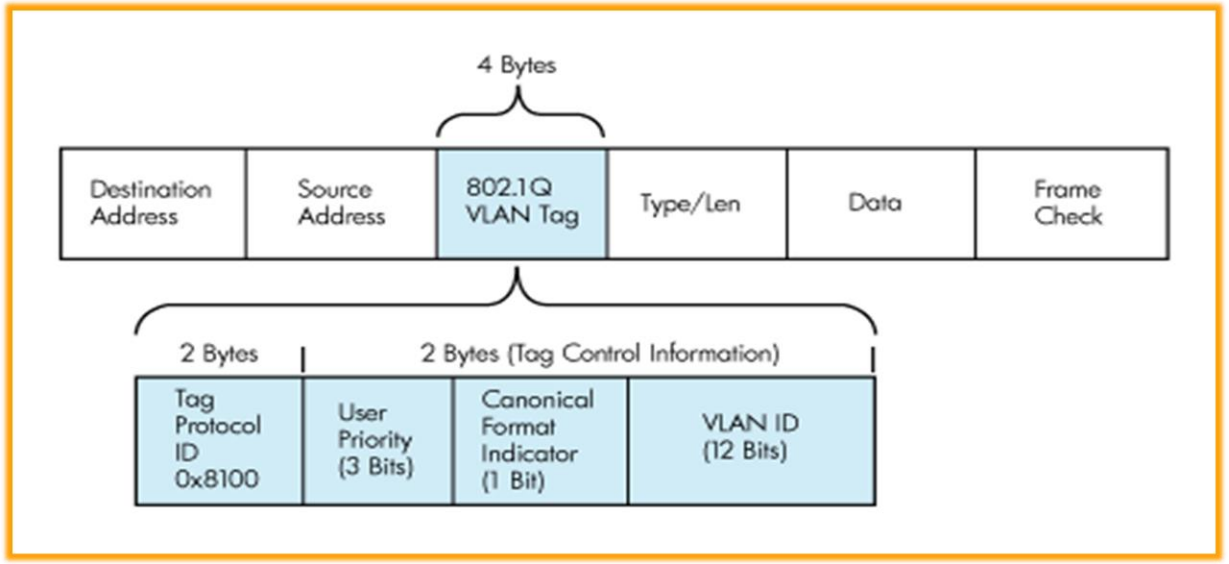
Access (untagged) ports



- Used to connect to end-user devices
- Can be associated with only one VLAN
- Uses the “normal” ethernet frame where there is no VLAN information - no VLAN tag

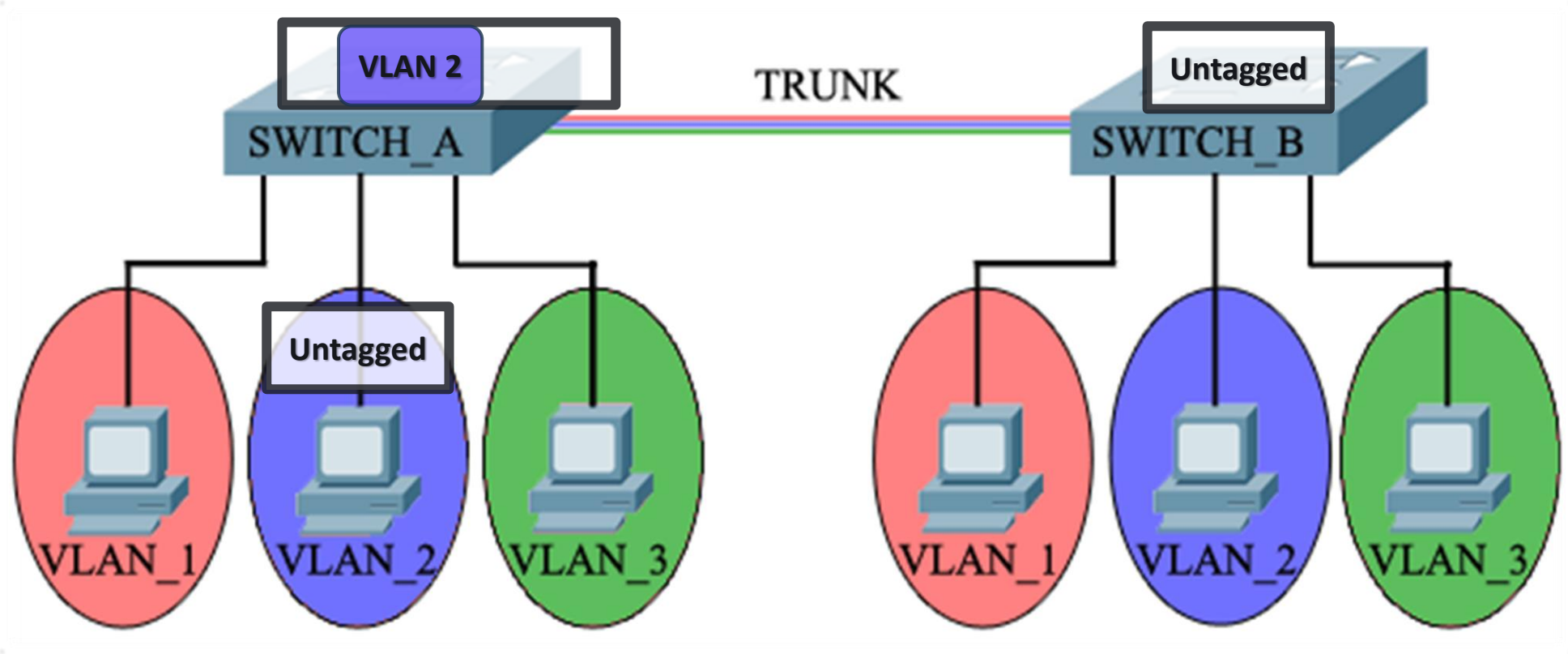
Trunk (tagged) ports

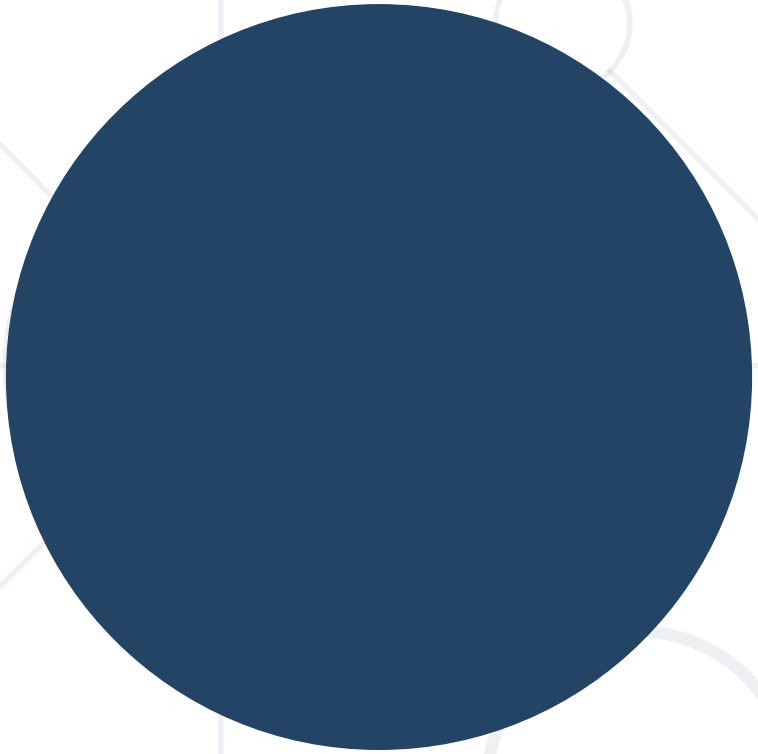




- Used to connect between switches
- Can carry information from/to multiple VLANs
- Uses the 802.1Q tagged frame

Tagging between switches

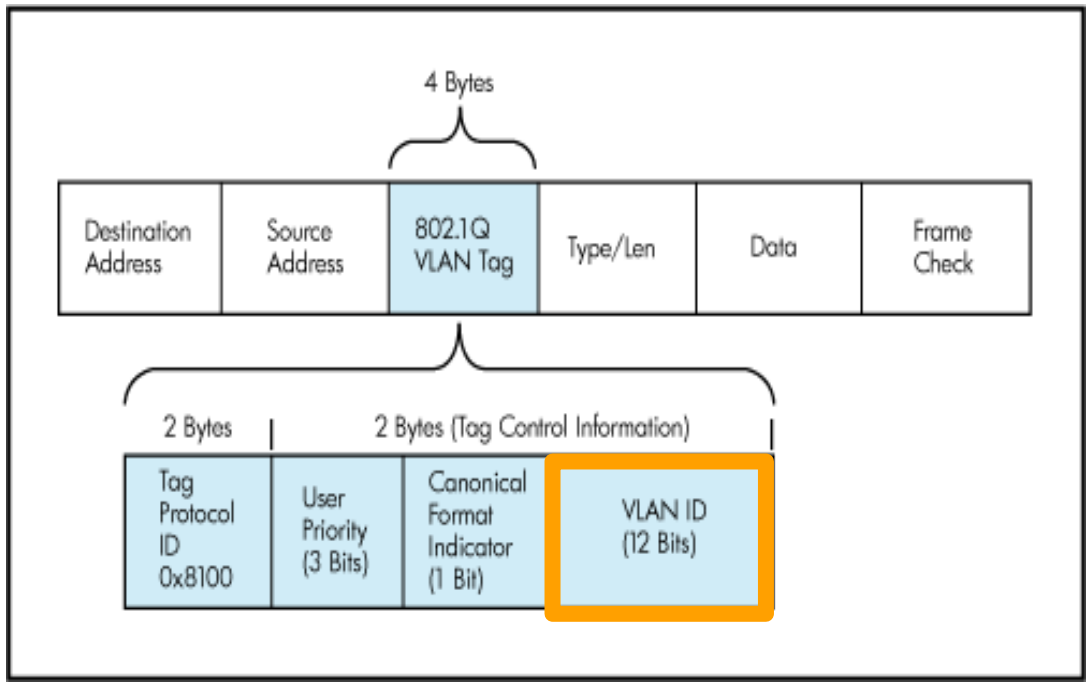




VLAN details

(Lecture 4)

Trunk port details



- Uses IEEE 802.1Q tag to identify each frame
- A trunk carries multiple tagged VLANs and (maximum) one untagged VLAN
- The untagged VLAN on a trunk is called:
  - Native VLAN (Cisco)
  - PVID (HPE Comware)
  - Untagged VLAN (HPE Provision)

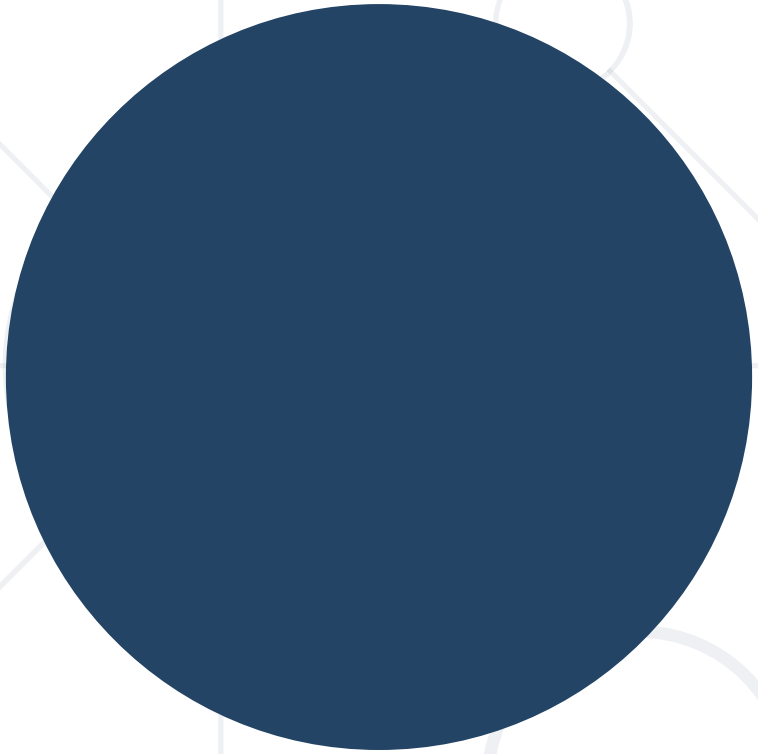
Trunk port details (2)

- When a port is configured as a trunk port, different vendors may have different default behavior:
  - All VLANs are automatically allowed on the trunk - Cisco
  - None of the VLANs (except VLAN 1) are auto-allowed on the trunk - HPE Comware

- The configuration can be changed to overwrite the default behavior depending on your needs

Inter-VLAN routing

- Traffic is transferred from one VLAN to another via routing
- Layer 3 device with IP address in each VLAN is required
- Do I have Layer 3 support on my switch?
  - Cisco – L3 default state depends on the device
  - HPE Comware - L3 is always on
  - HPE Provision - need to manually turn on the ip routing



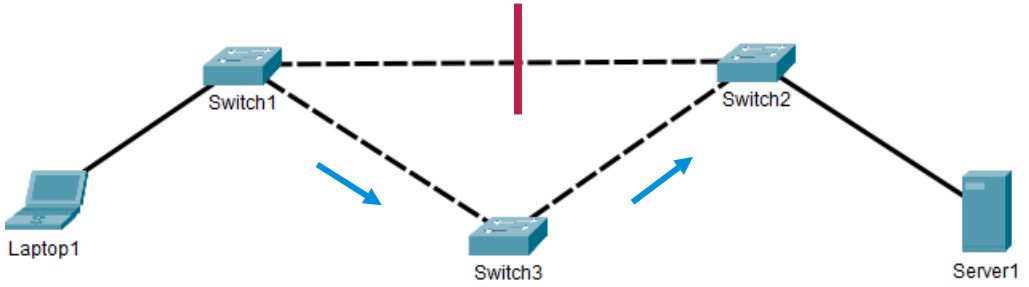
Spanning Tree Protocol (STP)

Back to ToC

Layer 2 networks and redundancy

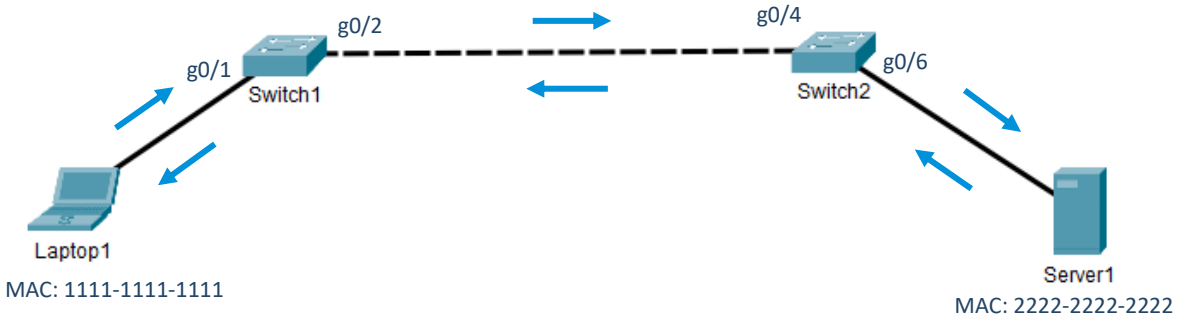
- No redundancy for the link between Switch1 and Switch2
  - If the link fails, the communication stops

- With redundancy - two paths between Switch1 and Switch2
  - If one path fails, the communication can continue over the other



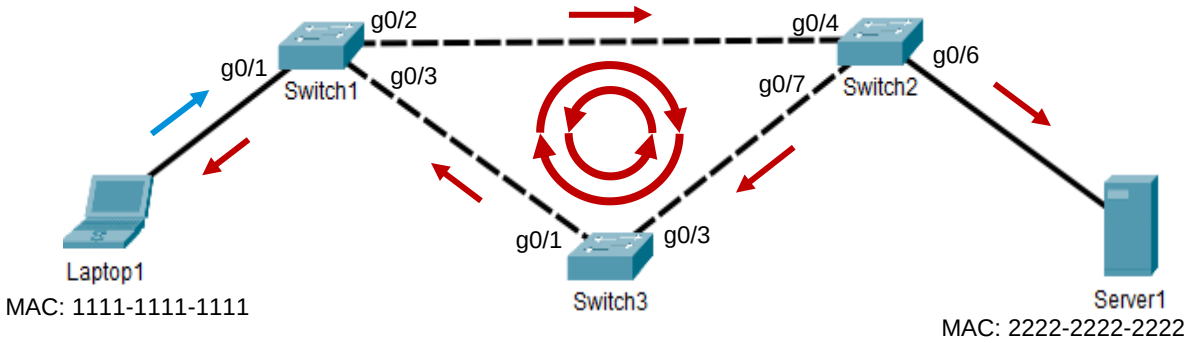
The problem with layer 2 network redundancy

- Normally, the switches will build and use MAC address tables to help them with the forwarding decisions
- When redundant paths are present, the switches are confused and will forward the received packet everywhere
  - Their MAC address tables become unstable
  - Multiple copies of the same frame (data) are received by all devices, endlessly
  - The links are overloaded
  - This is known as **Layer 2 loop and is very bad situation!**



Switch2 MAC Table

MAC address	Port
1111-1111-1111	g0/4
2222-2222-2222	g0/6

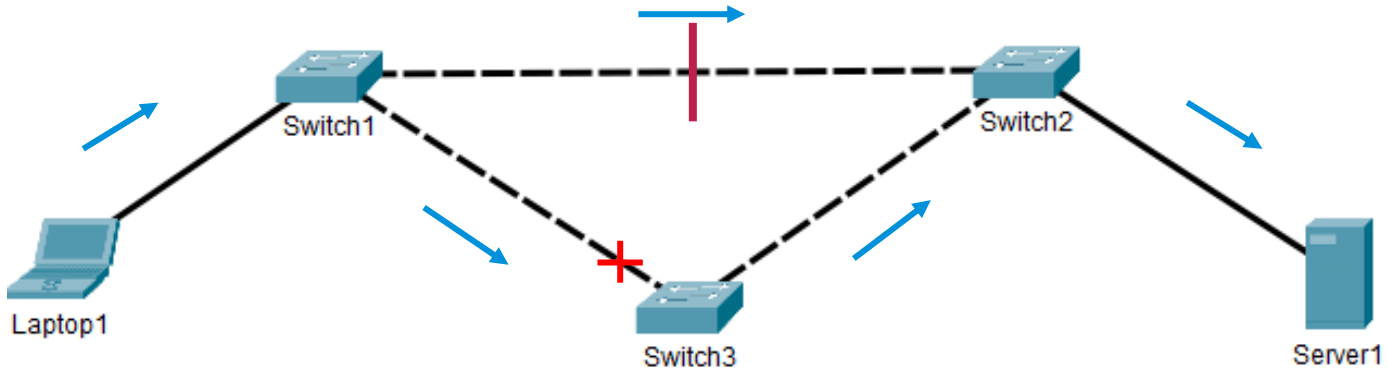


Switch2 MAC Table

MAC address	Port
1111-1111-1111	~~g0/4~~, ~~g0/7~~, ~~g0/4~~…?
2222-2222-2222	~~g0/6~~, ~~g0/7~~, ~~g0/4~~…?

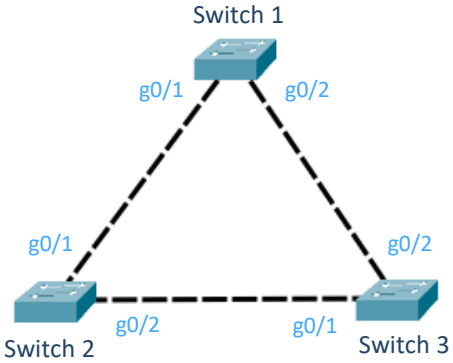
What is Spanning Tree Protocol (STP)?

- STP helps the network switches to deal with a problem which they can not handle alone – the Layer 2 loops
- STP will logically block a port (or multiple ports) in a redundant topology and will leave only one active path at a time
- If the active path is broken, STP will automatically unblock the port(s) to restore the connectivity



The STP algorithm

1. Elect the Root switch (a.k.a. Root bridge or just Root)
   - This is the switch with the lowest BID (Bridge ID)
   - BID = Switch Priority and MAC
   - Default priority = 32768
2. Select the root ports
   - They have the best (lowest) cost to the Root
   - Selected per switch – maximum one
   - Only the non-Root switches have root ports
3. Select the designated ports
   - They have the best (lowest) cost to the Root
   - Selected per segment (connection) – exactly one
4. All other ports go to blocking state
   - The role of these ports is called “alternate”



The STP tie-breakers

- If there is a tie situation - the same path cost via different paths, use the following tie-breakers:
  - When selecting Root port or Designated port, chose the neighboring switch which has the lowest Bridge ID
  - If the Bridge ID is the same, select the lowest Port ID (PID)
- Port ID = Port priority and port number

BPDUs, Bridge ID and Priority

- Switches communicate with each other by exchanging BPDUs (Bridge Protocol Data Units) - this is how they "talk the STP language"
- One piece of information that the BPDU contains is the Bridge ID (BID) = 8 byte value
- BID = Priority (2 bytes) and "system ID" / MAC address (6 bytes)
- STP Priority:
  - A number between 0 and 61440
  - Must be configured in increments of 4096
  - Default is 32768 (+ the VLAN ID)
  - The switch with the lowest priority will become the Root
- If equal values for priority -> lowest MAC address wins (BID = Priority and MAC)

The priority field

- Initially, the priority field allowed for 65536 different values (2^{16})

Priority (16 bits)															
(32768)	(16384)	(8192)	(4096)	(2048)	(1024)	(512)	(256)	(128)	(64)	(32)	(16)	(8)	(4)	(2)	(1)

- Later it was realized that some changes are required
- Nowadays, the priority field looks like this:

Priority (4 bits)				Extended system ID (12 bits)												
(32768)	(16384)	(8192)	(4096)	(2048)	(1024)	(512)	(256)	(128)	(64)	(32)	(16)	(8)	(4)	(2)	(1)	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	= 0
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	= 4096
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	= 8192 (2x4096)
.....																
																Default
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	= 32768 (8x4096)
.....																
1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	= 61440 (15x4096)

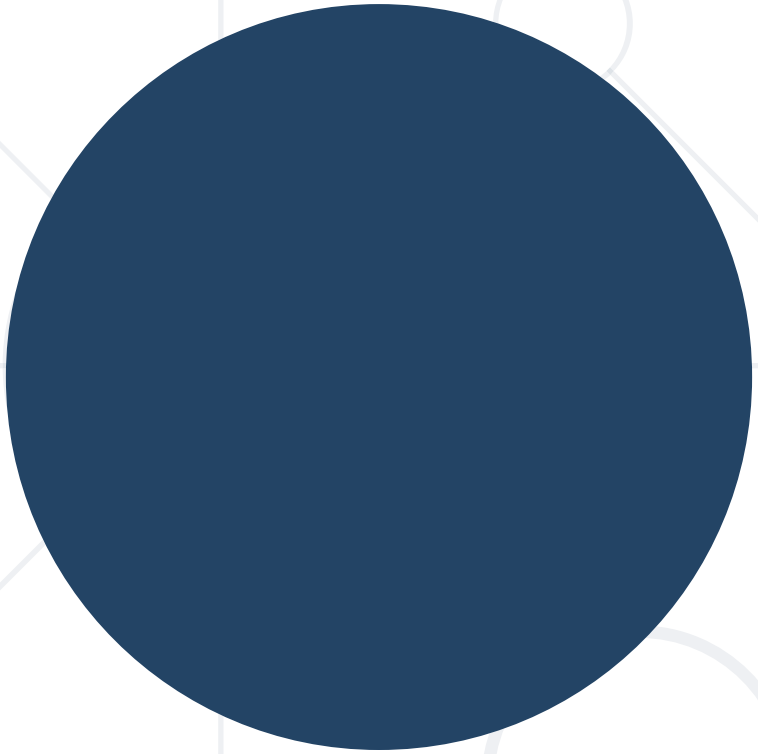
Link costs (path costs)

- This is the cost to get to the Root
- Calculated from the cost of a port and the number of links
- Higher port speed -> lower port cost
- The default values can be changed by administrator

Ethernet Speed	IEEE Cost: 1998	IEEE Cost: 2004
10 Mbps	100	2,000,000
100 Mbps	19	200,000
1 Gbps	4	20,000
10 Gbps	2	2,000
100 Gbps	N/A	200
1 Tbps	N/A	20

Spanning Tree Protocol – Main Flavors

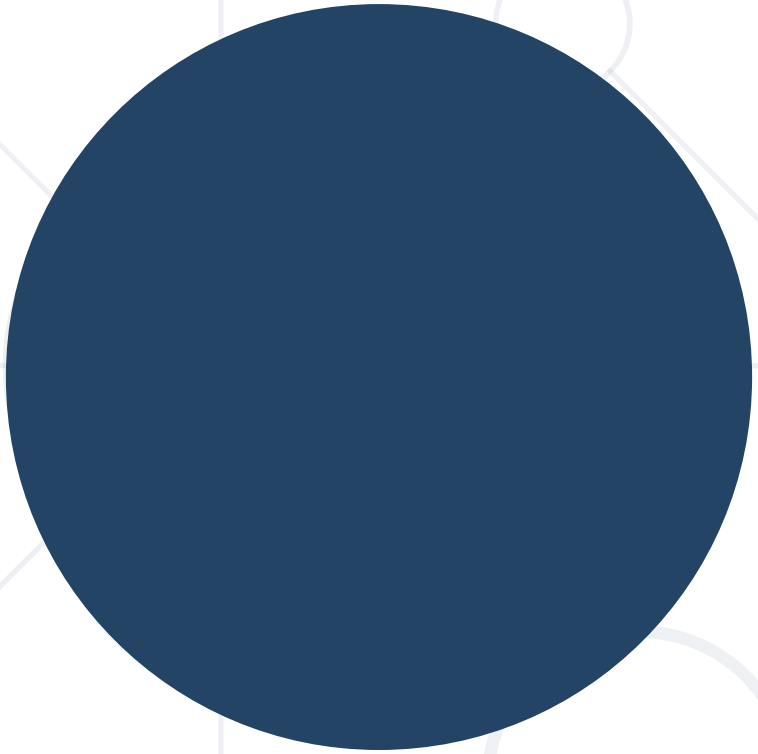
- STP - Spanning Tree Protocol, IEEE 802.1D
- RSTP - Rapid STP, IEEE 802.1W
- MSTP - Multiple STP, IEEE 802.1S (802.1Q-2005)
- PVST+ - Per-VLAN STP, Cisco proprietary



Rapid STP (RSTP)

RSTP (the faster STP)

- Rapid STP
- The industry standard name is IEEE 802.1W
- Much faster convergence than STP
- Introducing Edge port – a port which is connected to an end device
- RSTP uses the same algorithm as STP
- Port states:
  - Discarding
  - Learning
  - Forwarding

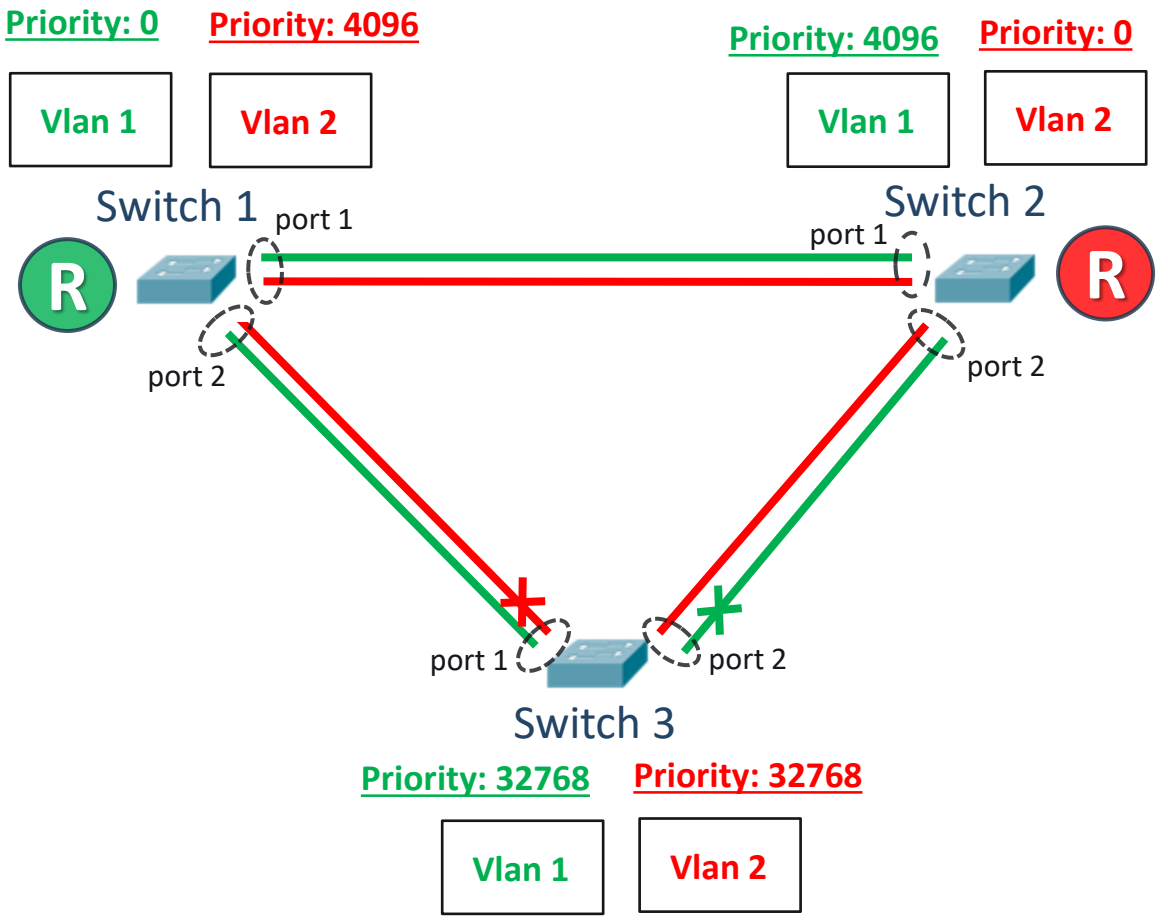


Per-VLAN STP plus (PVST+)

PVST+

- Per-VLAN Spanning Tree is Cisco protocol
- Why? It has a similar idea as MSTP - to distribute the load
- Creates a spanning tree topology for each VLAN separately
- PortFast in PVST+ is similar to Edge port in STP/RSTP

PVST+ (3)


Priority: 0
Priority: 4096
Vlan 1
Vlan 2
Switch 1
port 1
port 2
Priority: 4096
Priority: 0
Vlan 1
Vlan 2
Switch 2
port 1
port 2
R
R
port 1
port 2
Switch 3
Priority: 32768
Priority: 32768
Vlan 1
Vlan 2

The good and the bad about PVST+

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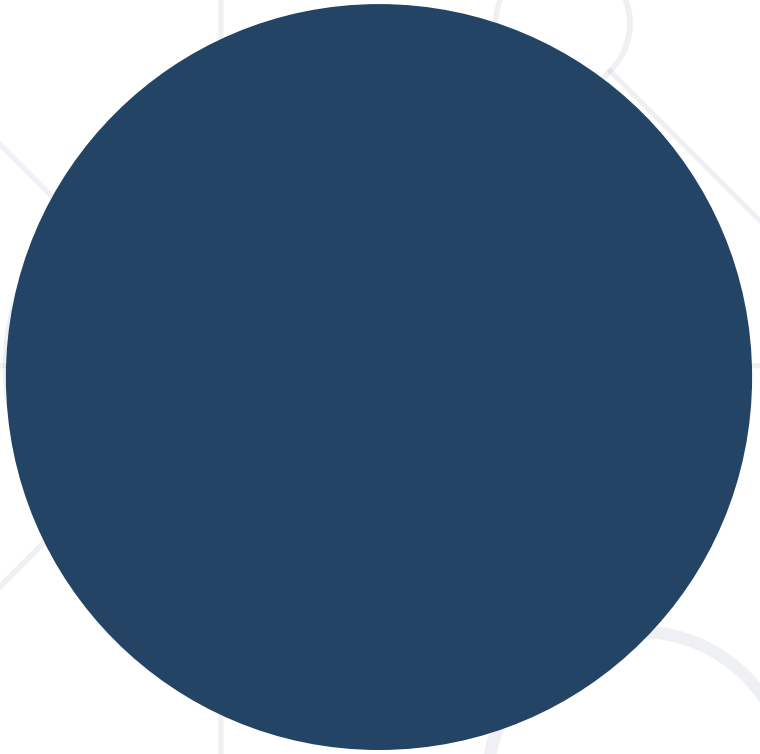
- PVST+ advantages:
  - triggers STP calculation only if there is a potential loop in a particular VLAN
  - detailed "look" of the network – does not block ports when there is no loop on the trunks for a given VLAN
- PVST+ disadvantages
  - generates a lot of overhead in the network
  - proprietary protocol



IP services: DHCP and DNS

Back to ToC

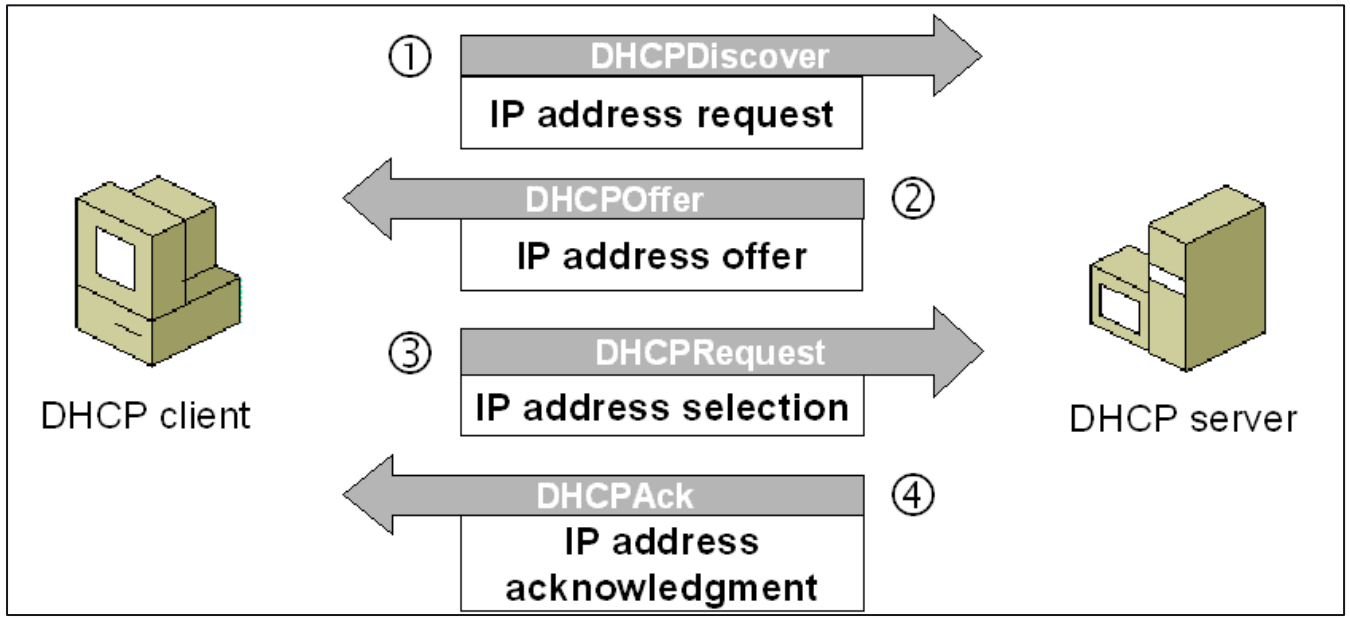
What is DHCP?

- DHCP: Dynamic Host Configuration Protocol
- Provides automatic distribution of IP addresses and other networking parameters such as:
  - Subnet mask
  - Default gateway
  - DNS servers
  - More…
- Industry standard

DHCP Components

- Server
  - DHCP scope - range of addresses (pool), lease time, reservations, etc.
  - Uses port UDP 67
- Client
  - Must be configured to use DHCP
  - Uses port UDP 68
- (Relay agent)
  - Used to serve multiple (V)LANs with a single DHCP server

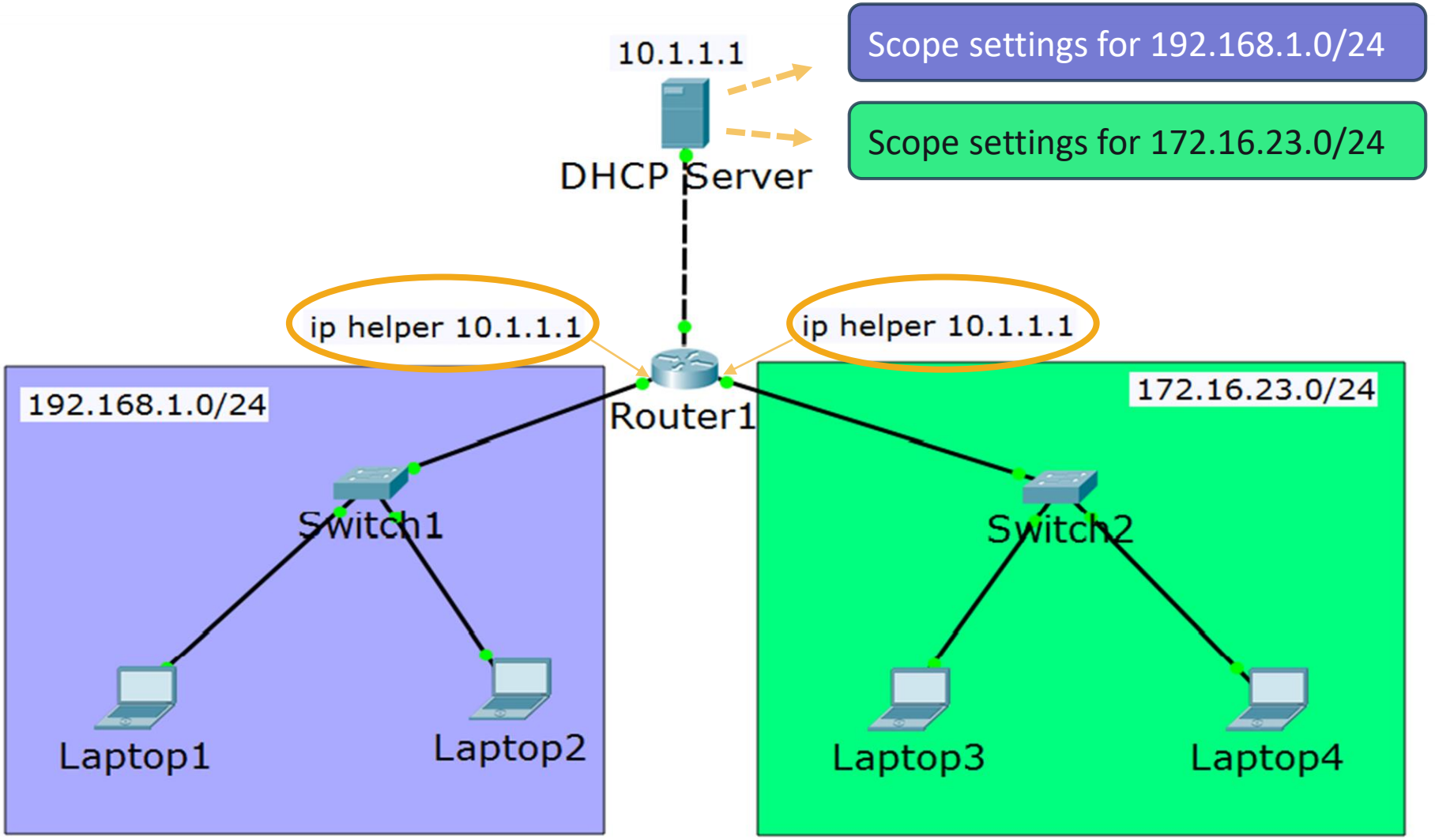
The DHCP Process



- "DORA"
  - Discover
  - Offer
  - Request
  - Acknowledge

All messages use broadcast (IPv4)

DHCP Relay (2)


10.1.1.1
DHCP Server
Scope settings for 192.168.1.0/24
Scope settings for 172.16.23.0/24
ip helper 10.1.1.1
ip helper 10.1.1.1
Router1
192.168.1.0/24
172.16.23.0/24
Switch1
Switch2
Laptop1
Laptop2
Laptop3
Laptop4

DNS Introduction

- DNS: Domain Name System
- DNS Usage:
  - To translate names to IP addresses
  - To translate IP addresses to names
  - To find a particular service in the network

*DNS will be discussed in more details in the advanced course

DNS “A” Records

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- One of the most commonly used records in DNS
- Matches a hostname (or FQDN) to an IP address
- Examples:
  - pc1 -> 192.168.1.1
  - pc2 -> 192.168.1.2
  - server -> 192.168.1.100
  - www.abv.bg -> 194.153.145.104

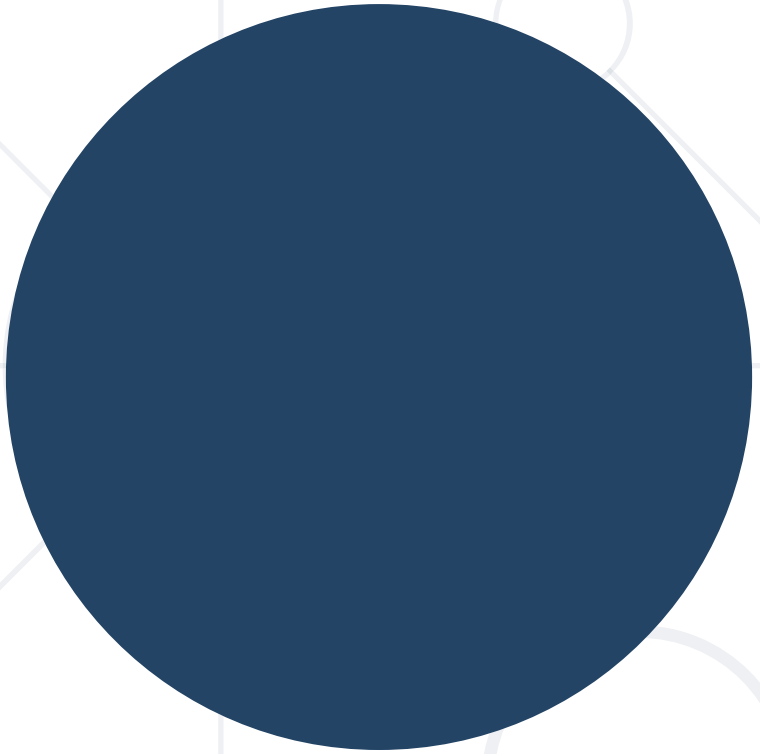
*FQDN = Fully Qualified Domain Name

DNS: Client-to-Server Communication

- The clients need to know the address of their DNS server(s)
- It can be either:
  - Statically configured

  OR

  - Dynamically received from a DHCP server
- DNS uses server port 53 (both UDP and TCP)



Introduction to routing

Switching vs Routing

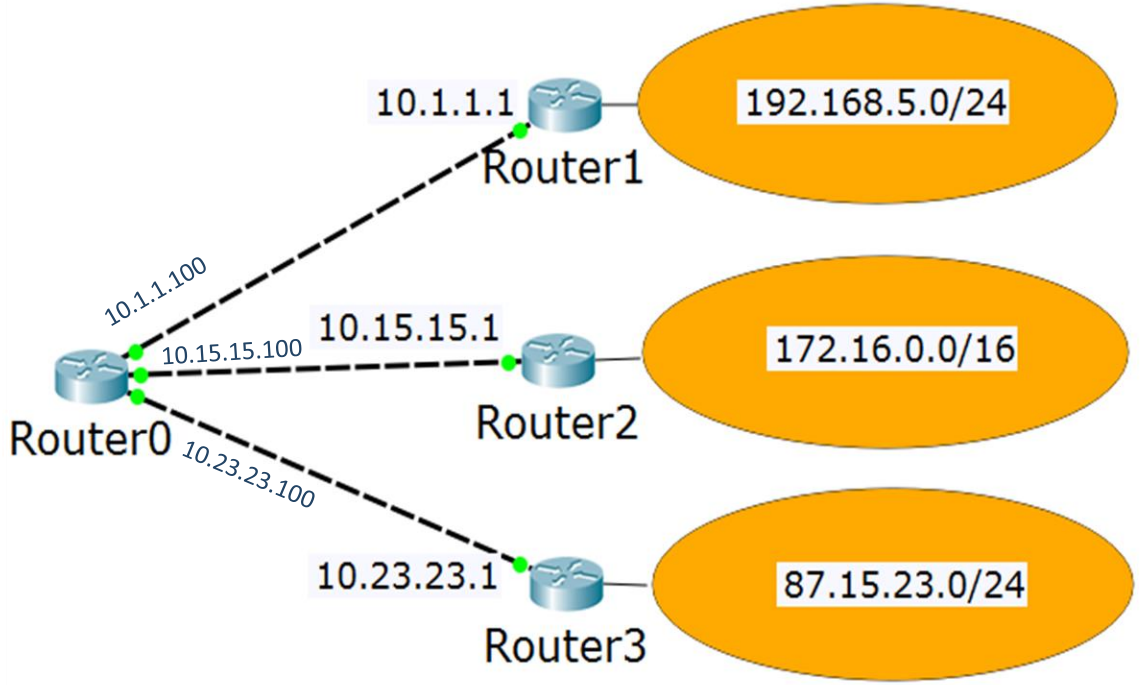
- Switches:
  - Use Layer 2 information (MAC addresses)
  - Forwarding decisions based on the MAC address tables
  - Not scalable for big networks
- Routers:
  - Use Layer 3 information (IP addresses)
  - Forwarding decisions based on the routing tables
  - Scalable for large networks

The Routing Table

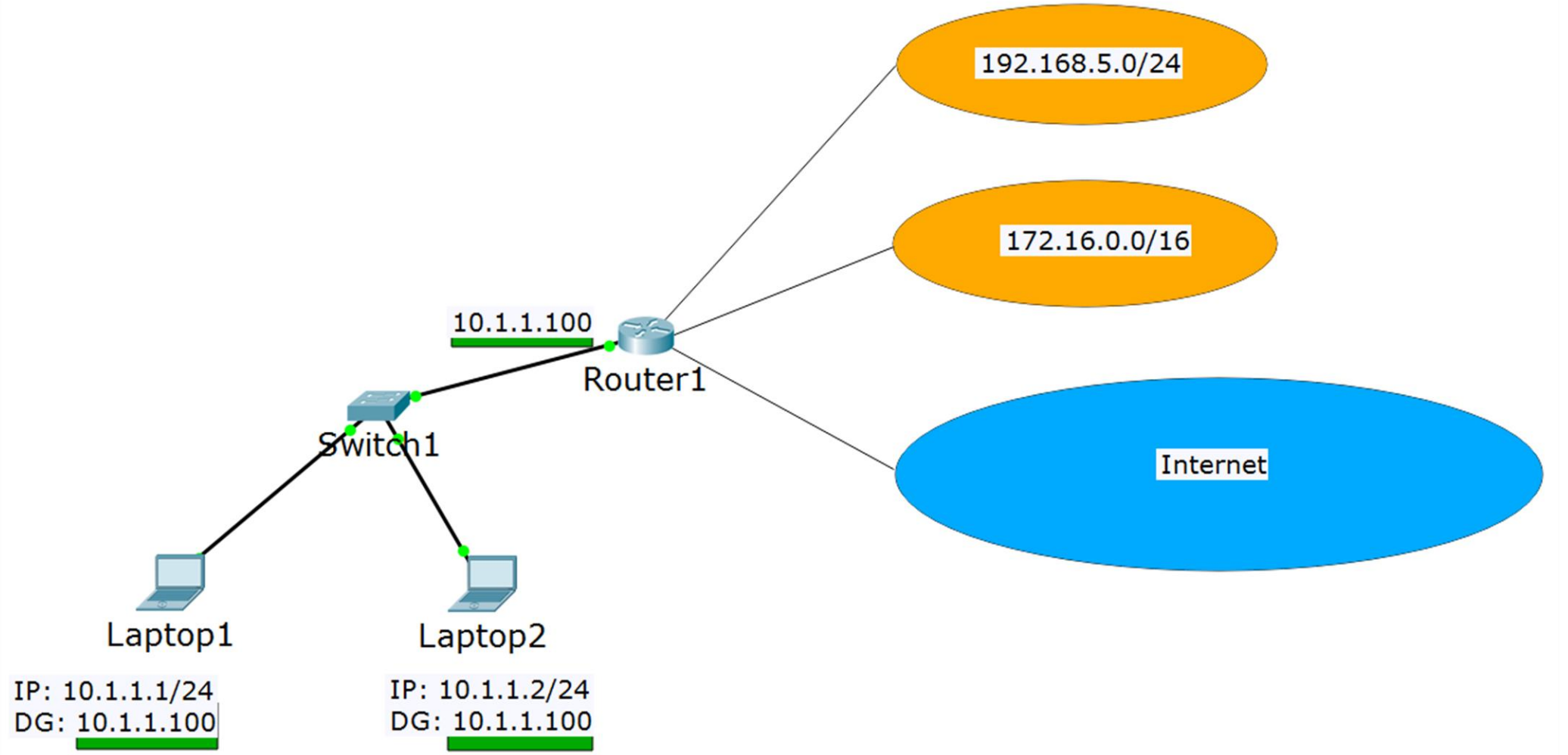
All masks are /24

My routing table:

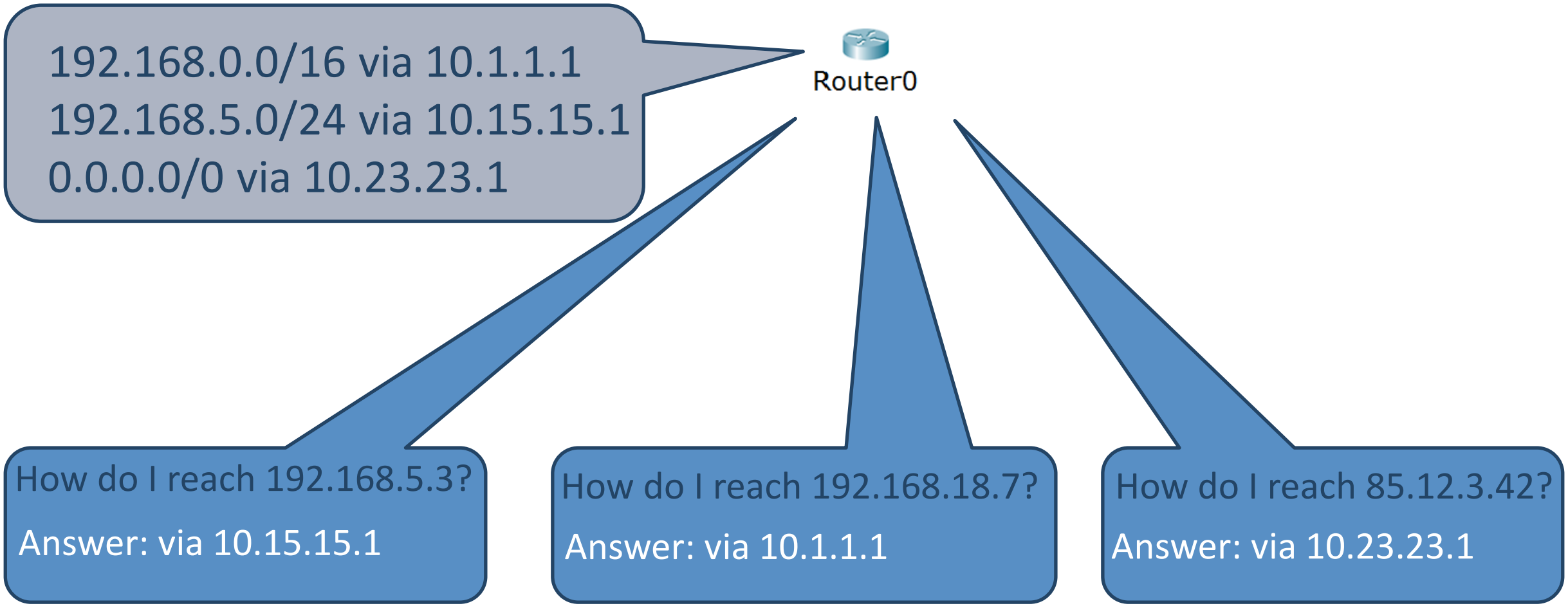
192.168.5.0/24 via 10.1.1.1
172.16.0.0/16 via 10.15.15.1
87.15.23.0/24 via 10.23.23.1
10.1.1.0/24 is connected
10.15.15.0/24 is connected
10.23.23.0/24 is connected

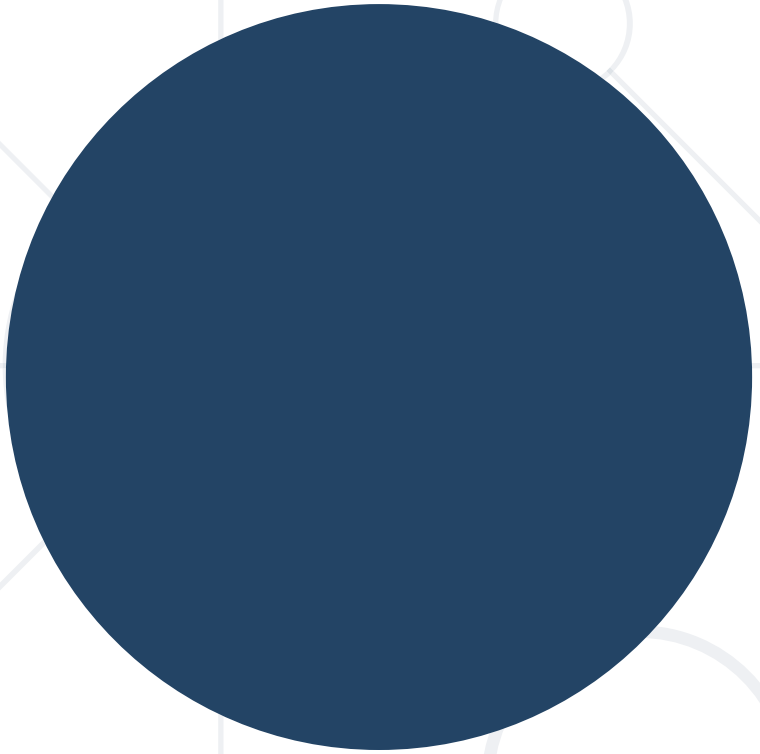


Default Gateway



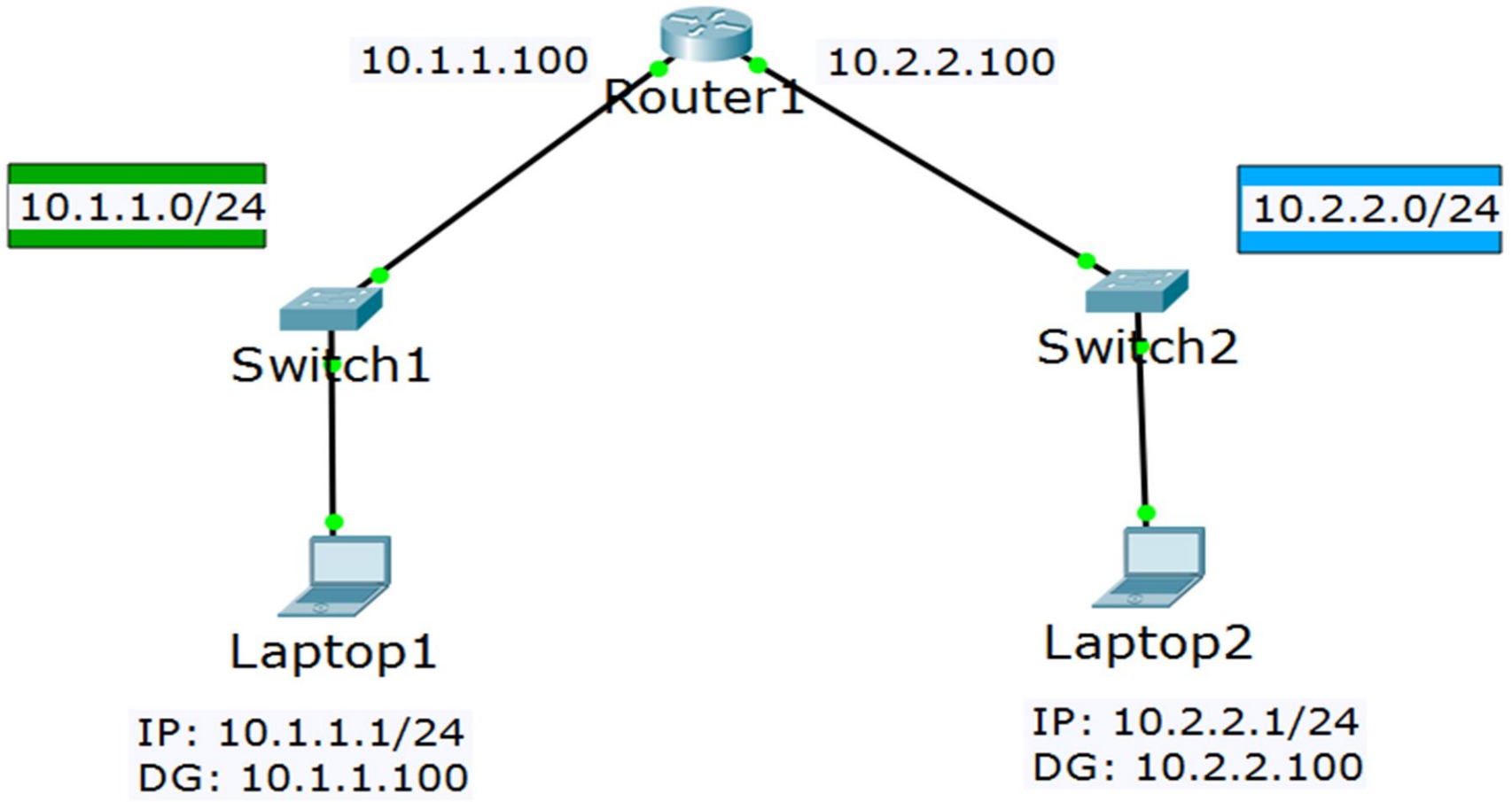
The Rule of the Longest Match

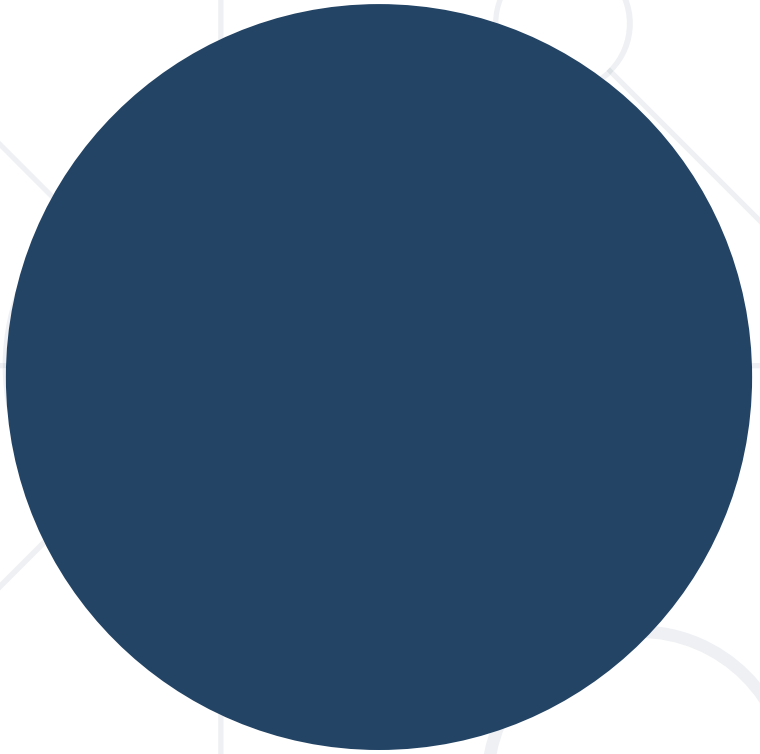




Direct routing

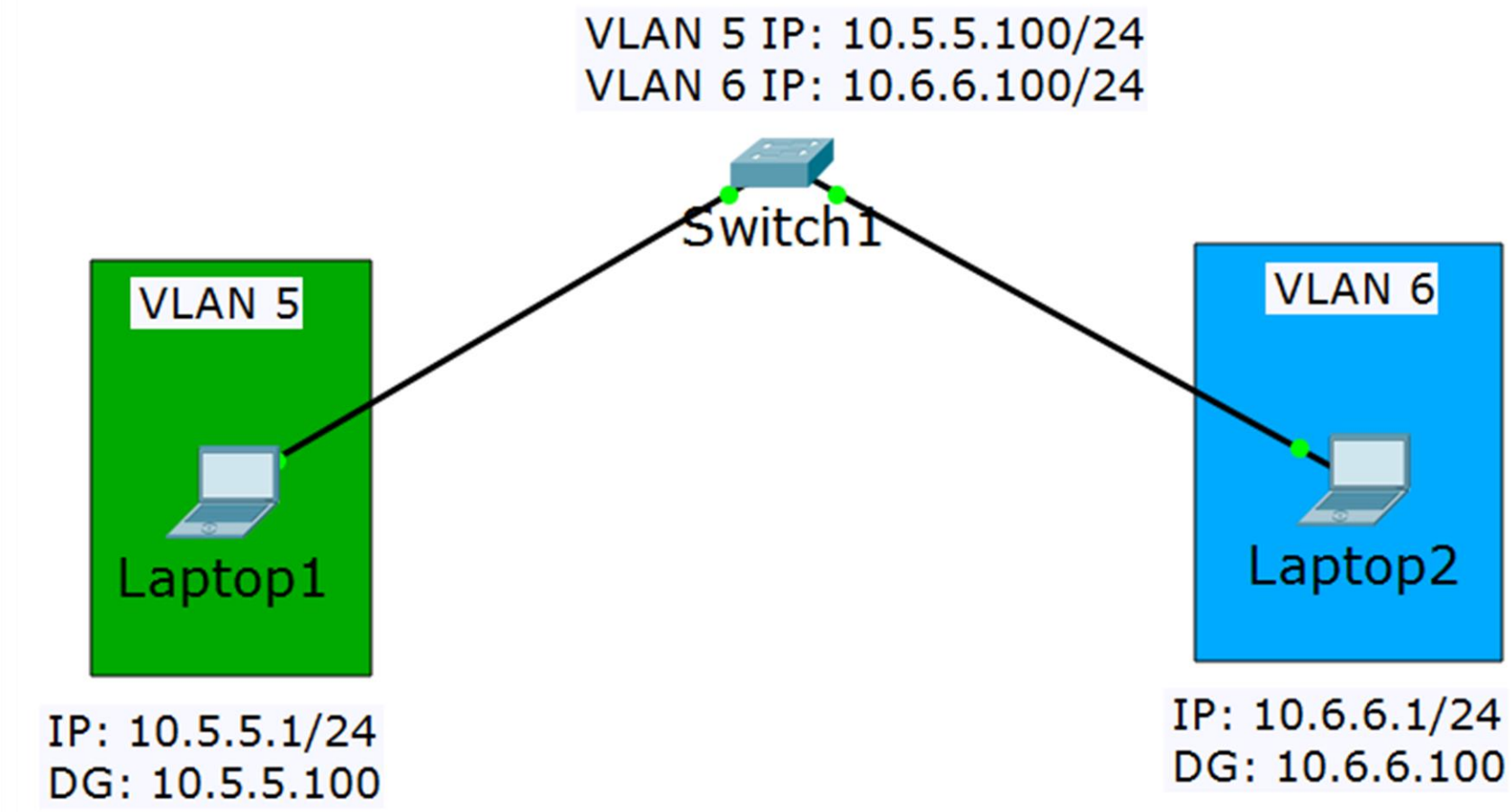
Direct routing



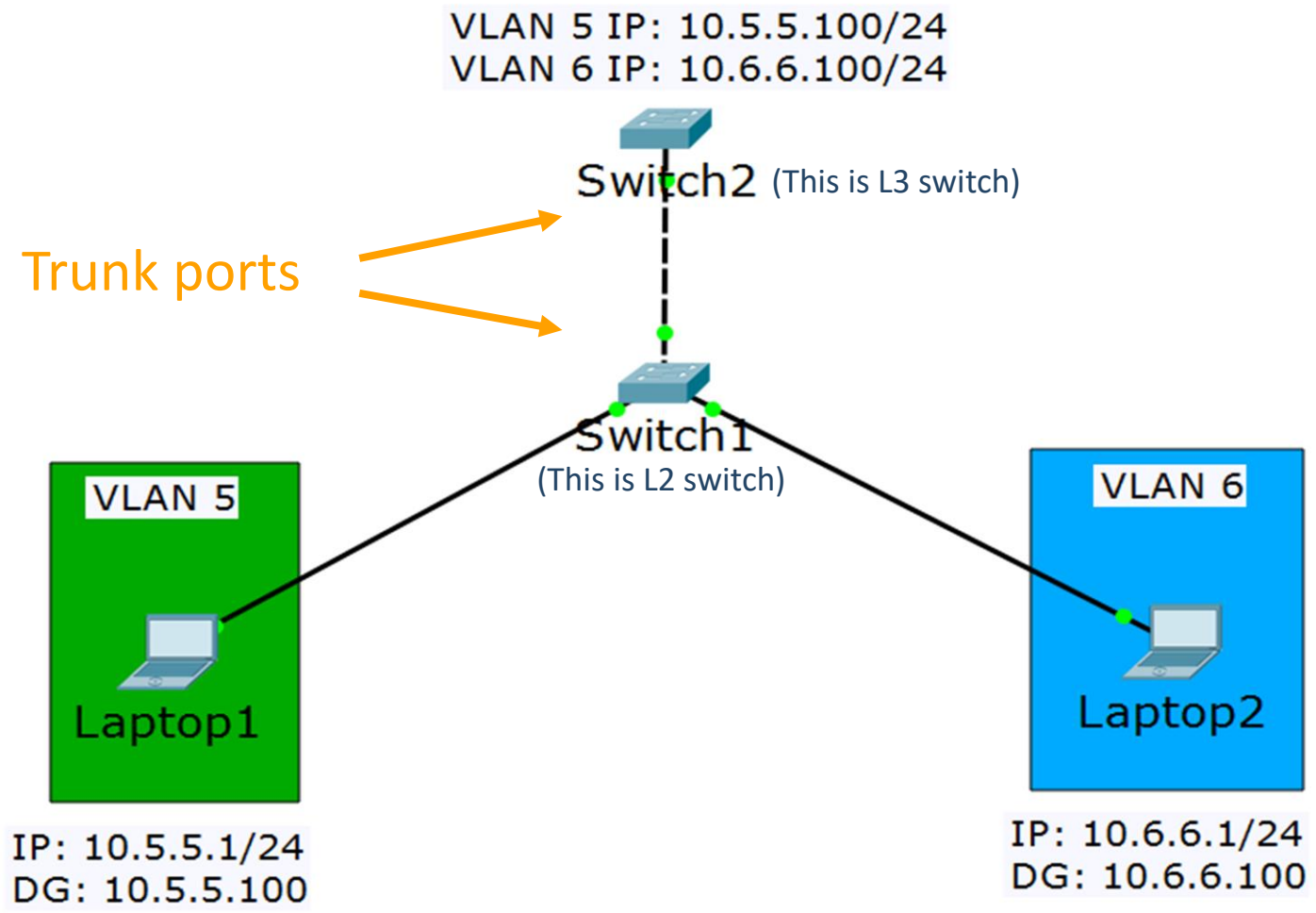


Inter-VLAN routing

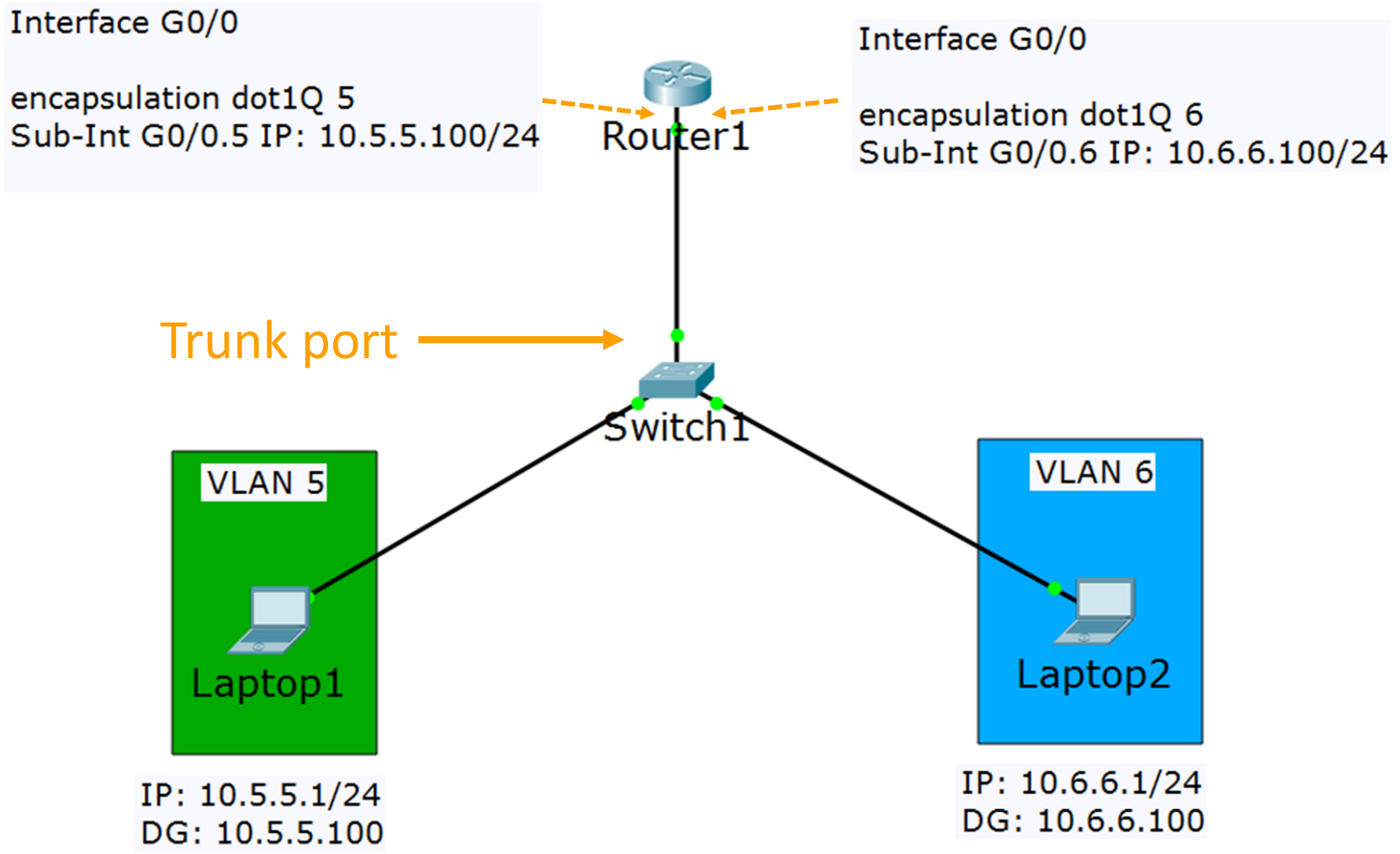
Inter-VLAN Routing Using the Same Switch

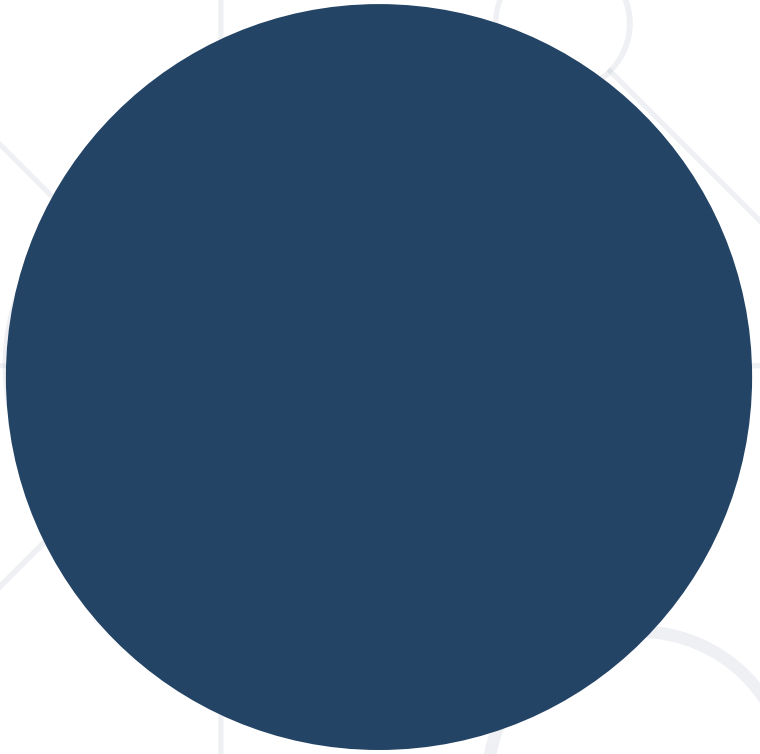


Inter-VLAN Routing Using External Switch



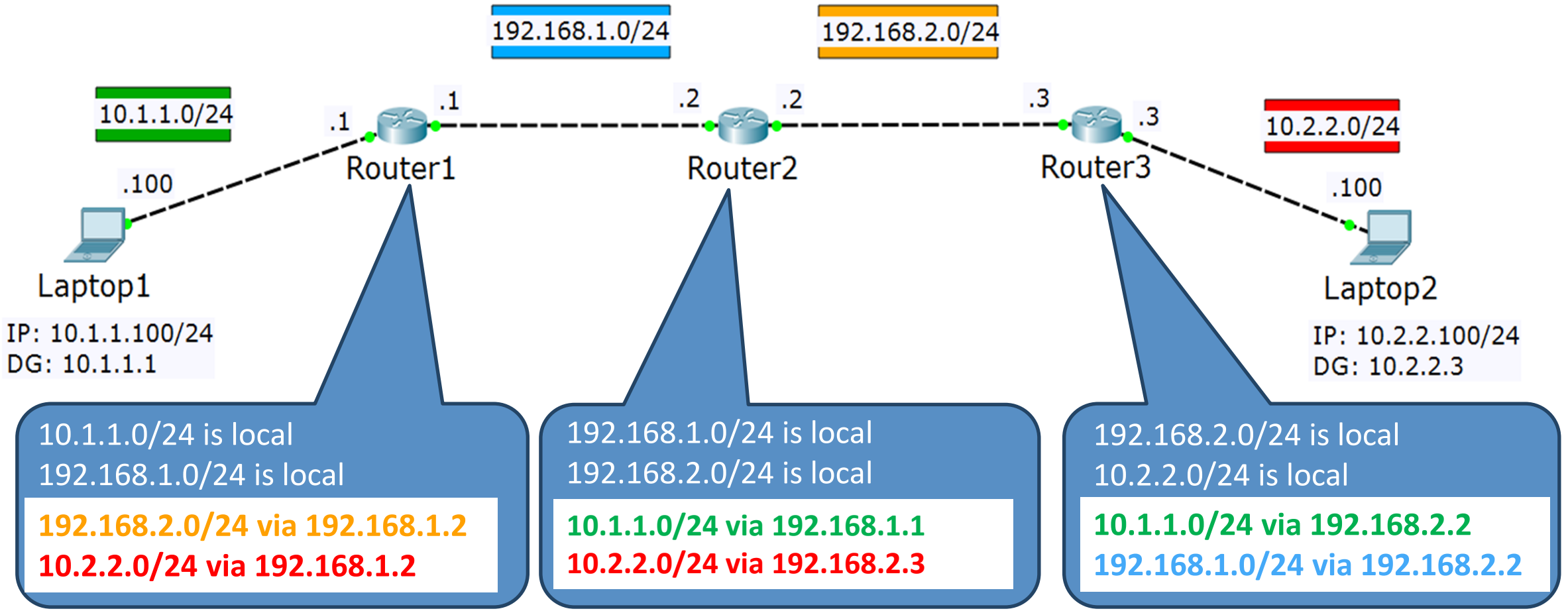
Inter-VLAN Routing Using External Router (2)

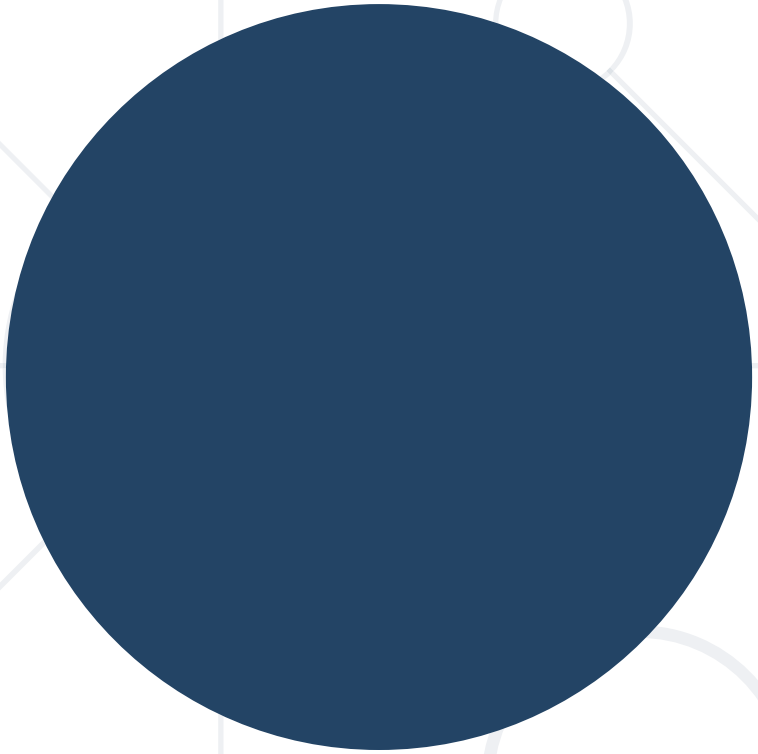




Static routing

Static Routes



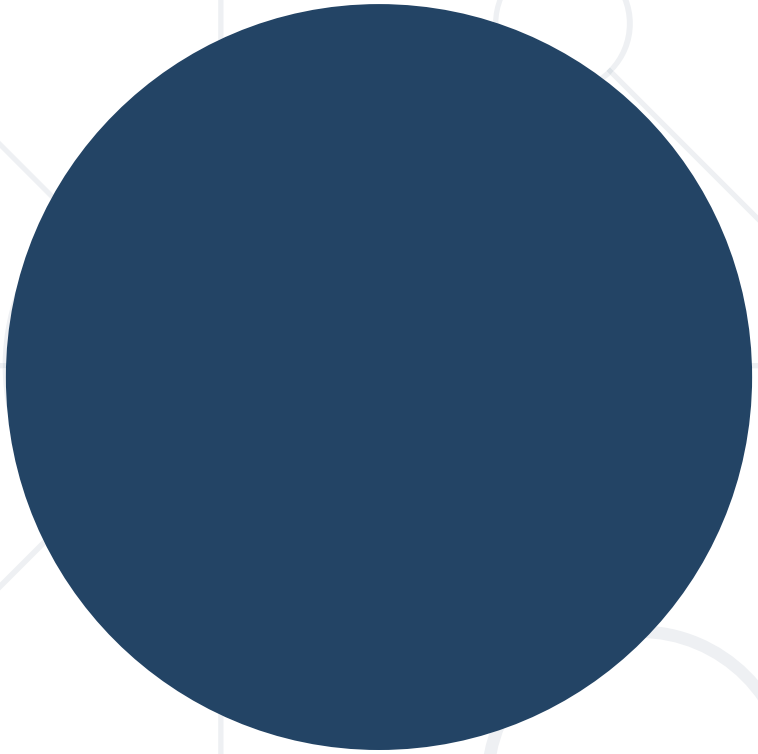


Routing demonstrations

Back to ToC

Practice

- Wireshark demonstration
- Packet Tracer demonstrations:
  - Static routing
  - The rule of the longest match
  - SVI (Switch Virtual Interface) vs. IP address on a physical port
  - L2 vs L3 (**no switchport**) interface on a Layer 3 switch
  - **ip route 0.0.0.0 0.0.0.0** vs. **ip default-gateway**
  - Static routing and administrative distance
  - ECMP (Equal Cost MultiPath)
  - Administrative distance vs. the rule of the longest match



Introduction to dynamic routing

Back to ToC

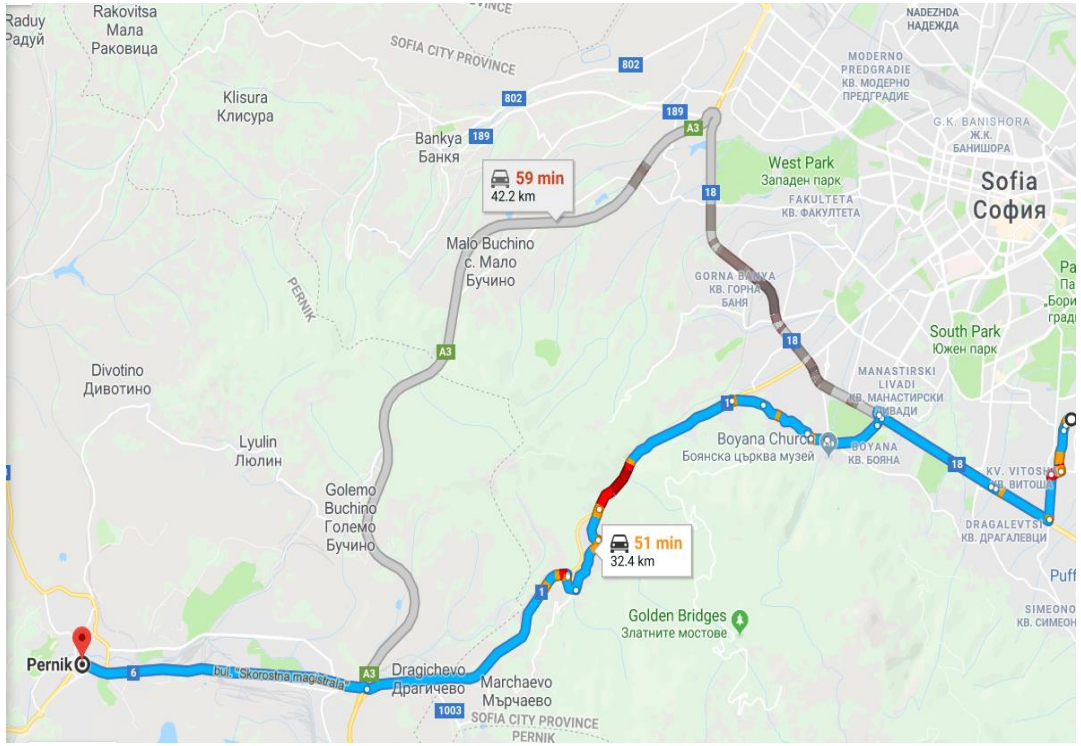
Static vs dynamic routing

- **Static routing**:
  - Routes to destination networks configured manually
  - Routing tables not updated if there is better route or lost network
  - Big administrative overhead, hard to manage
- **Dynamic routing**:
  - Routers dynamically exchange the networks they know about
  - Routing tables are created with the best routes to destinations
  - Routing tables dynamically create or remove entries

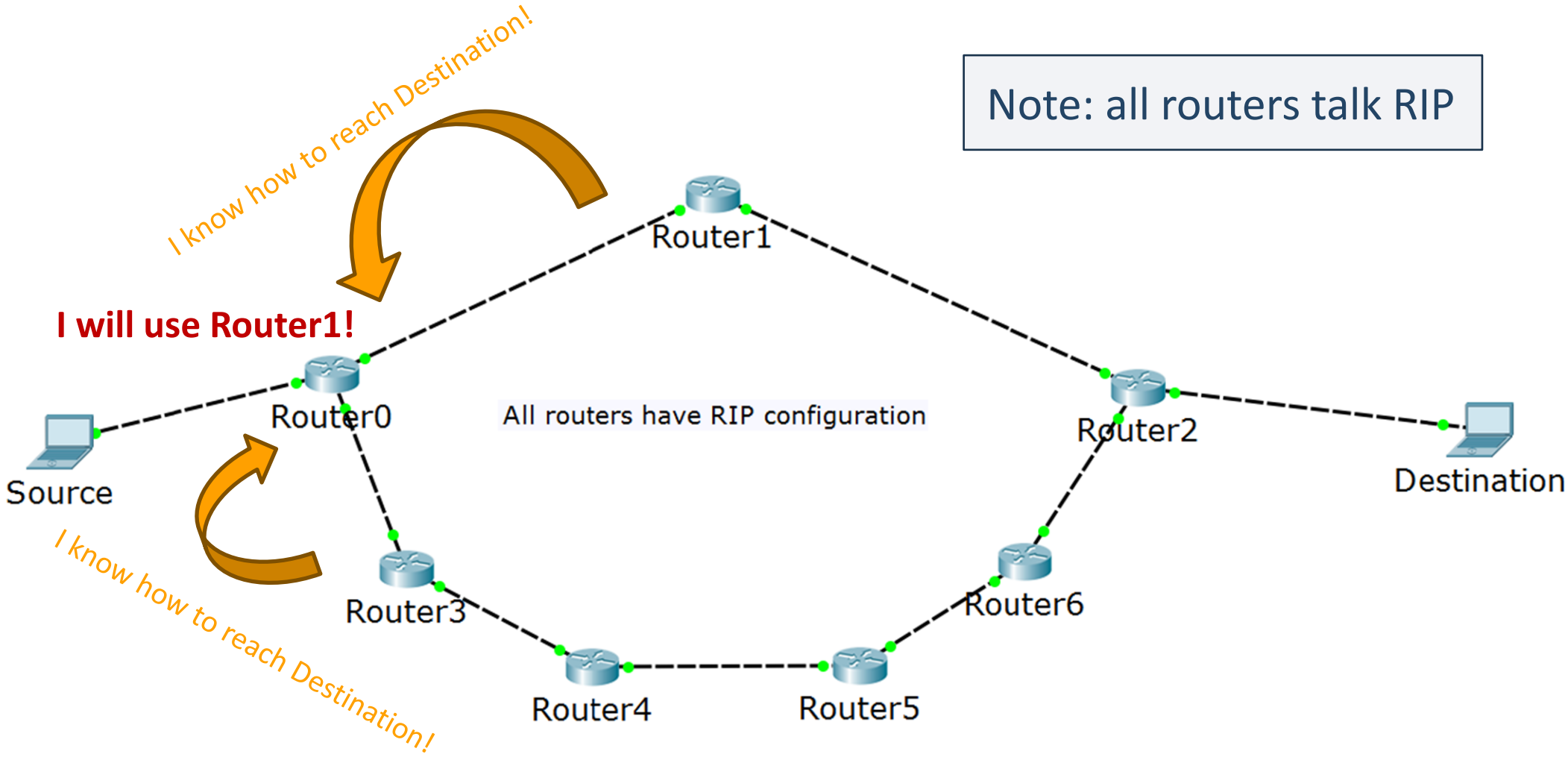
Distance-vector vs link-state protocols

- Distance-vector protocols

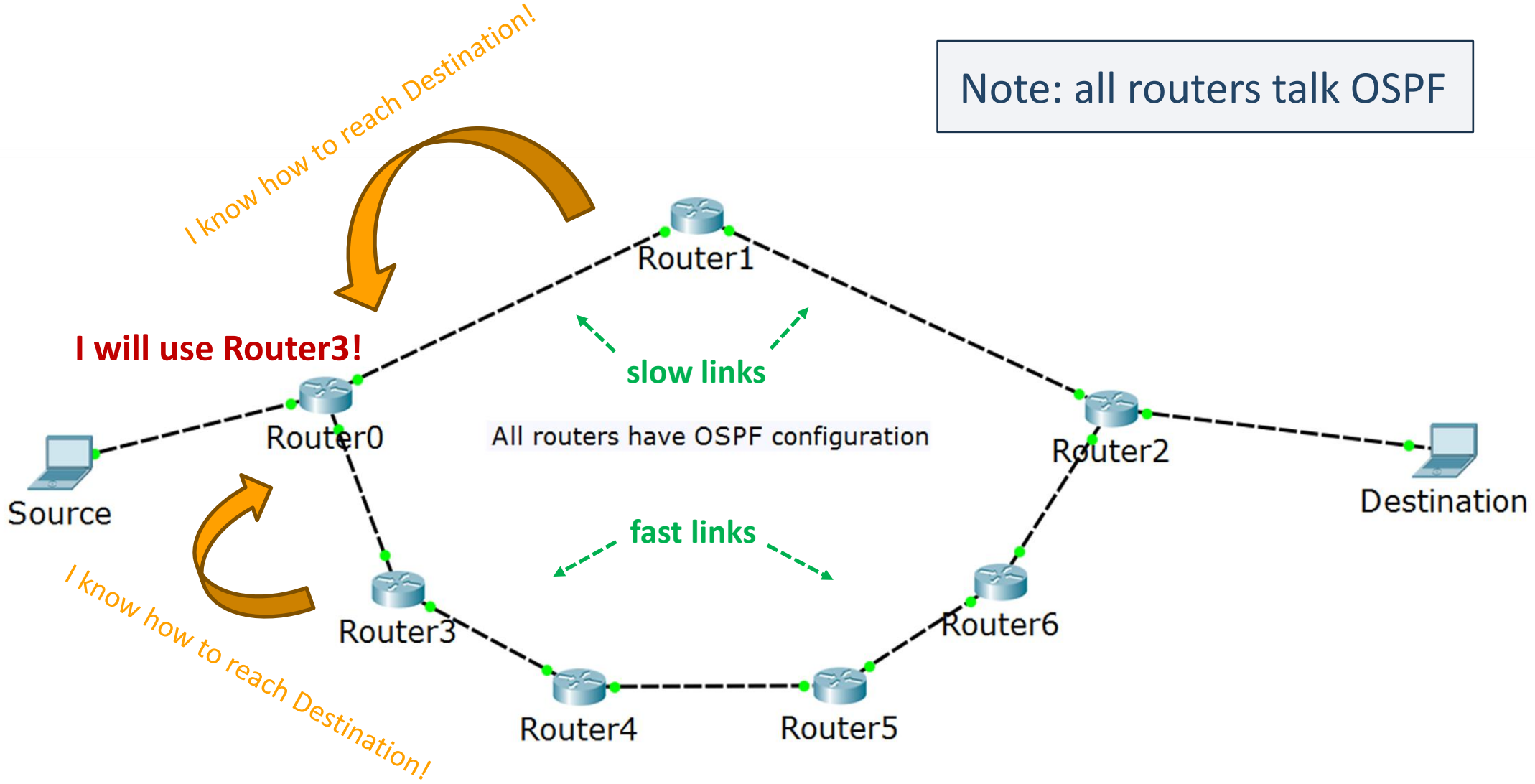
- Link-state protocols



RIP Metric: hop count



OSPF Metric: cost



Multiple protocols in the same network

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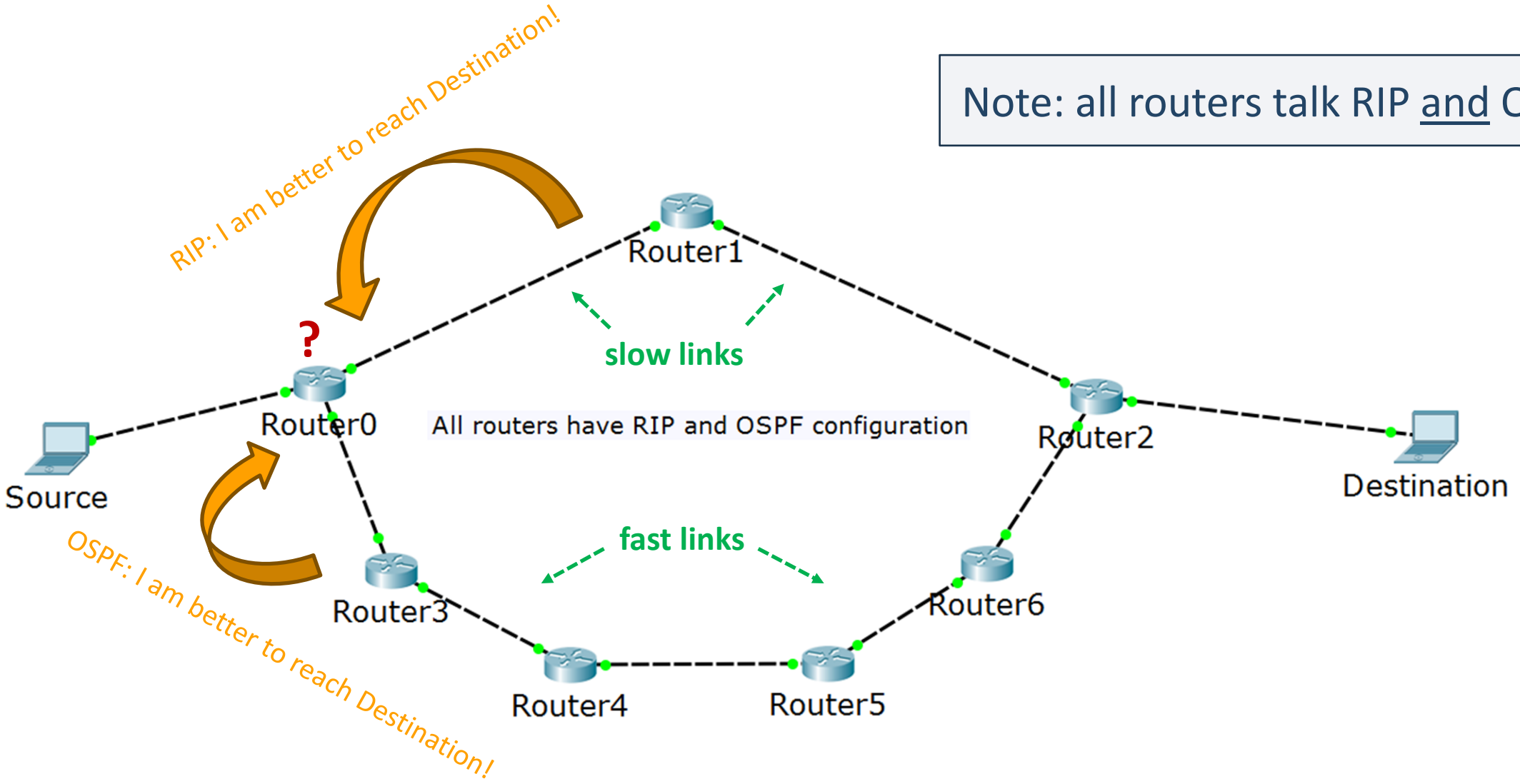
Note: all routers talk RIP and OSPF



Administrative distance

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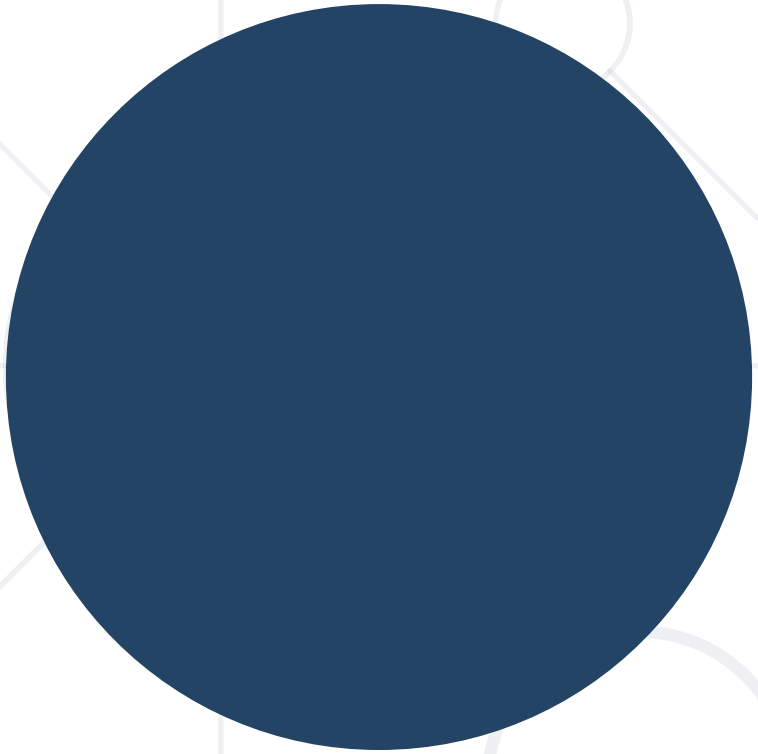
Route Source	Default Distance	Routing Table Entry
Connected interface	0	C
Static route out an interface	0	S
Static route to a next-hop address	1	S
EIGRP summary route	5	D
External BGP	20	B
Internal EIGRP	90	D
IGRP	100	I
OSPF	110	O
IS-IS	115	i
RIPv1, RIPv2	120	R
Exterior Gateway Protocol (EGP)	140	E
ODR	160	O
External EIGRP	170	D EX
Internal BGP	200	B
Unknown	255	



OSPF introduction

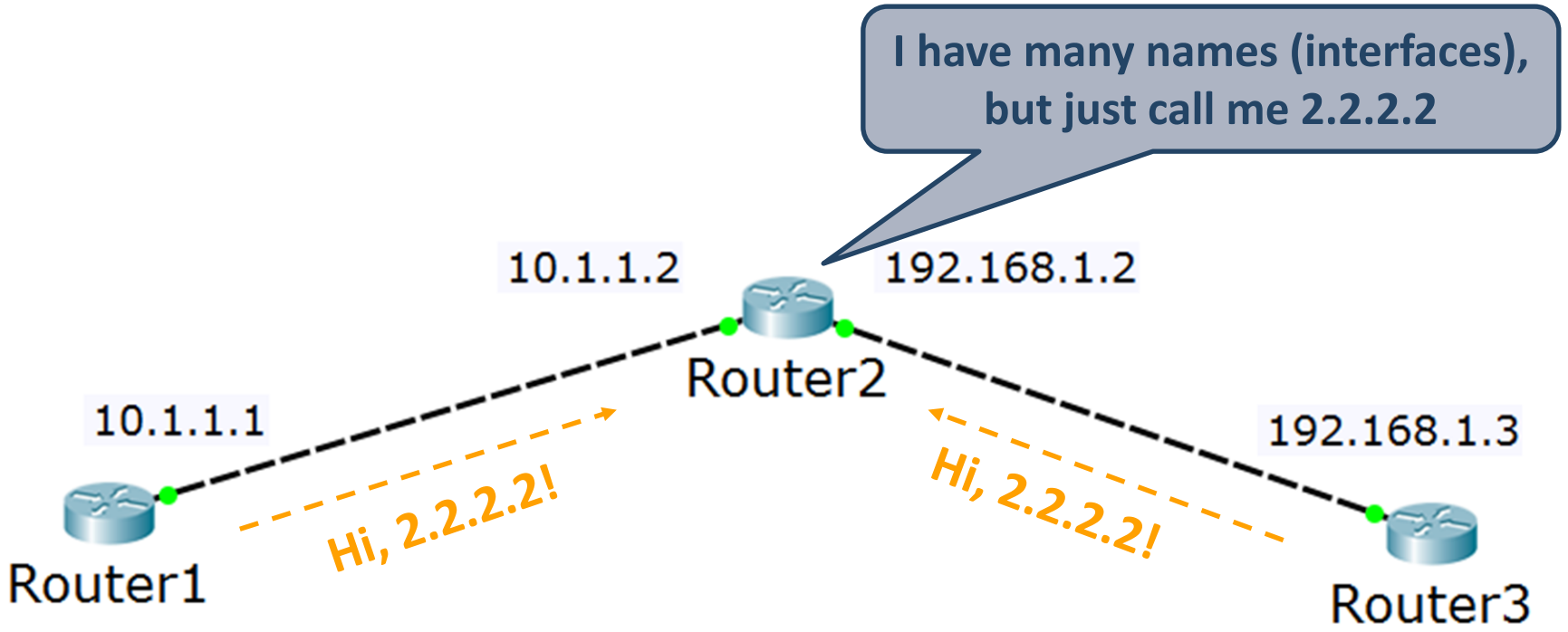
OSPF advantages

- Fast convergence with triggered updates
- Hierarchical structure (areas)
- VLSM support (classless protocol)
- Efficient communication with neighbors
- Uses intelligent metric (cost)
- Open standard

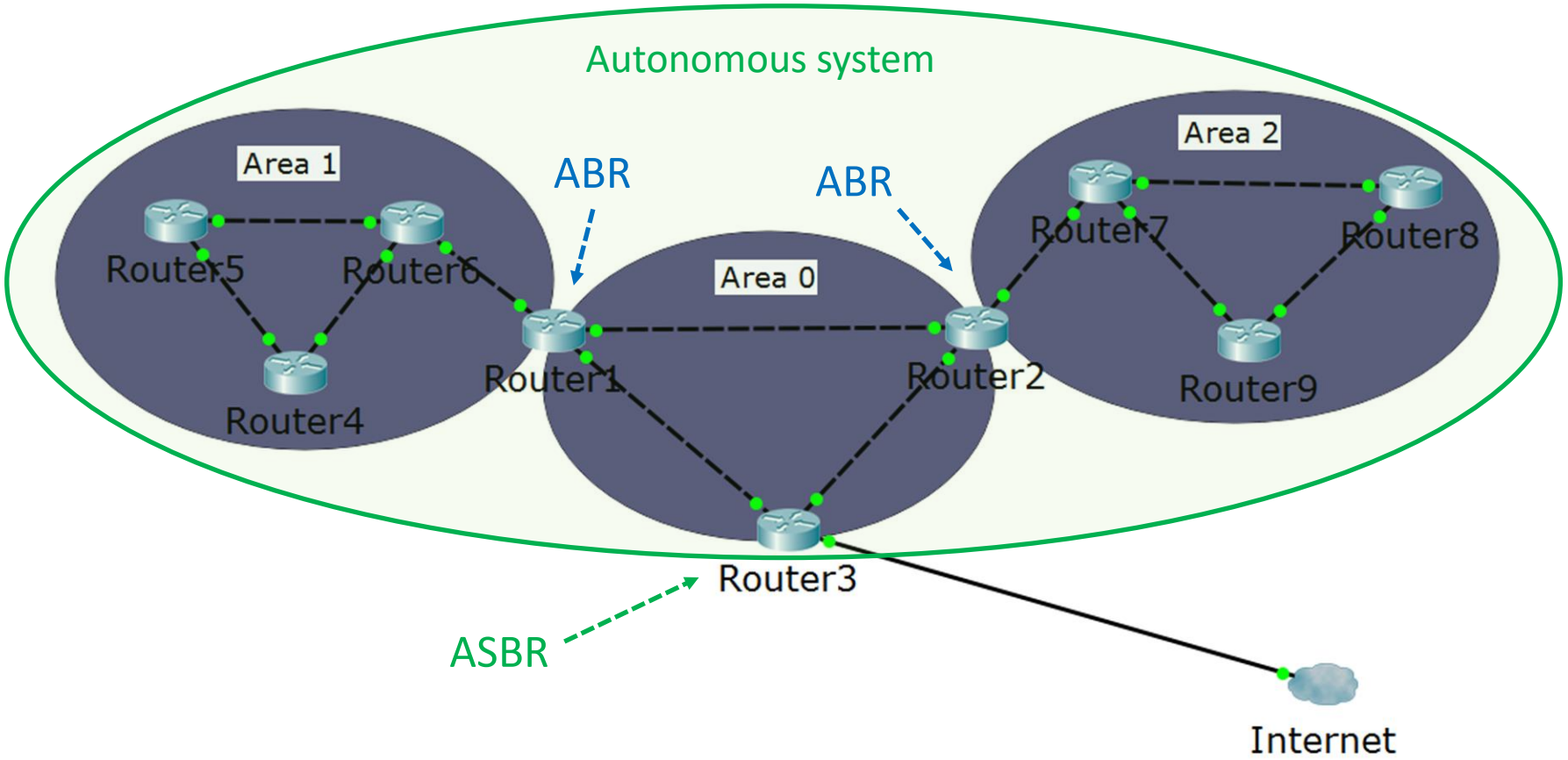
Wildcard masks

- In the subnet masks, 1 means “do care” and 0 means “don’t care”
- Examples:
  - 192.168.1.0 255.255.255.0 -> refers to 192.168.1.0 network
  - Loopback address: 10.1.1.1 255.255.255.255 -> exact IP address
- In the wildcard masks, 0 means “do care” and 1 means “don’t care”
- Examples:
  - 192.168.1.0 0.0.0.255 -> refers to 192.168.1.0 network
  - Loopback address: 10.1.1.1 0.0.0.0 -> exact IP address

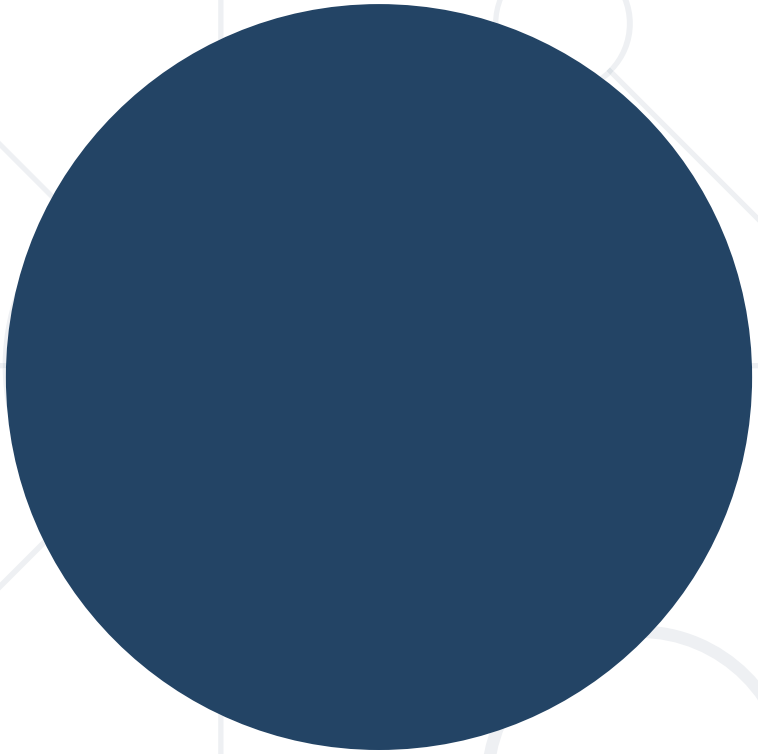
OSPF terms: router ID



OSPF terms



Area 0 = the backbone area



Single area OSPF configuration

Single area OSPF configuration

- Minimum configuration:
  - **router ospf *process_id***
  - **router-id *number*** (optional)
  - **network A.B.C.D *wildcard_mask* area *number***
- Example:
  - **router ospf 1**
  - **router-id 1.1.1.1** (optional)
  - **network 192.168.1.0 0.0.0.255 area 0**
  - **network 10.0.0.0 0.0.0.255 area 0**

OSPF passive interface

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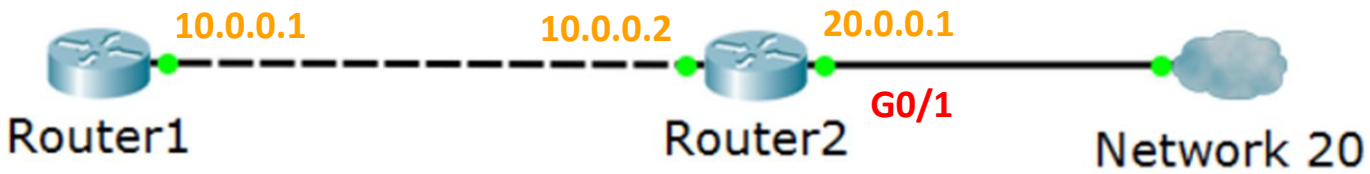
- The “network” command advertises the network AND sends hello messages out of the interface
- What if there is non-OSPF device on the other end of the link?
  - The Hello packets will be useless
  - Represents security issues
- One solution: use passive interfaces

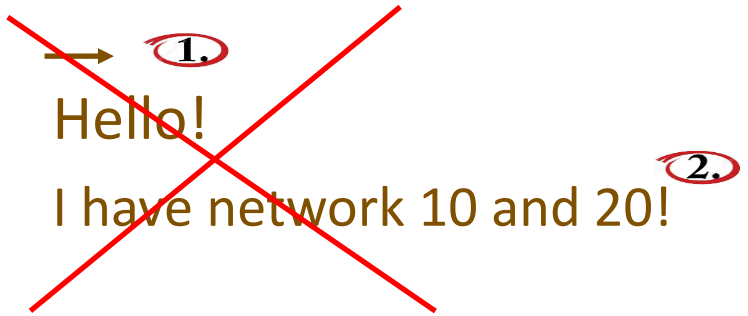
OSPF passive interface (2)

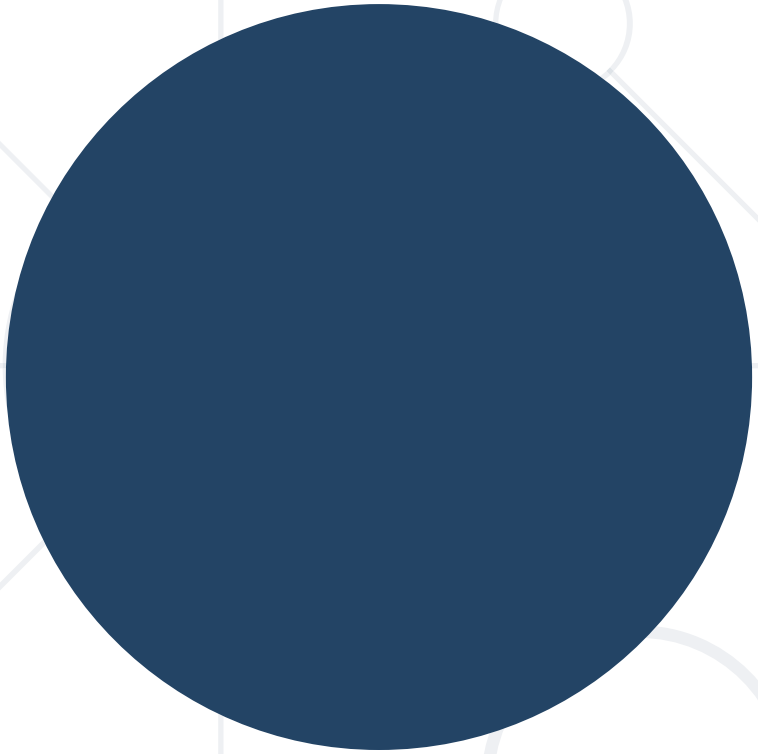
R1:
network 10.0.0.0 0.0.0.255

R2:
network 10.0.0.0 0.0.0.255
network 20.0.0.0 0.0.0.255

passive-interface G0/1

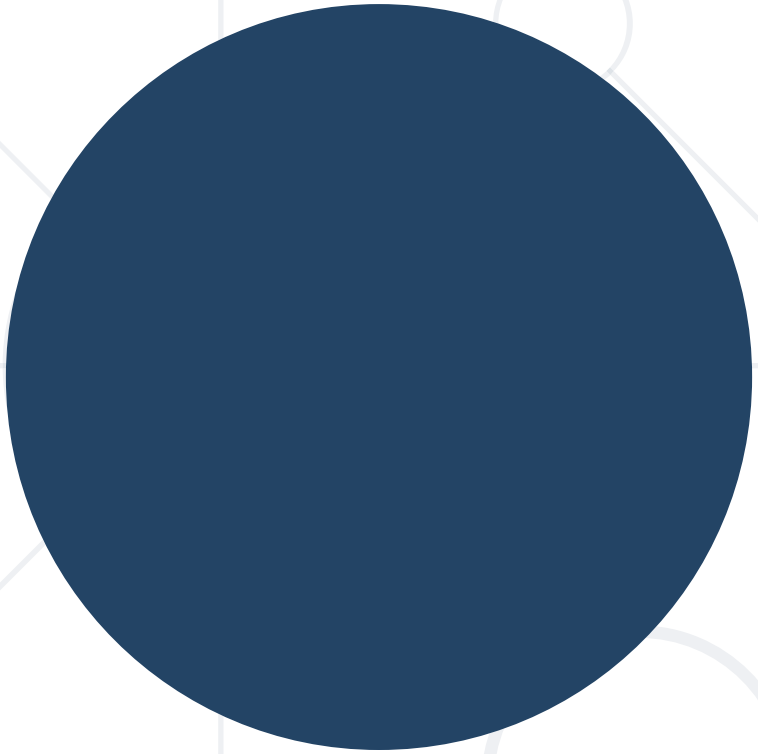






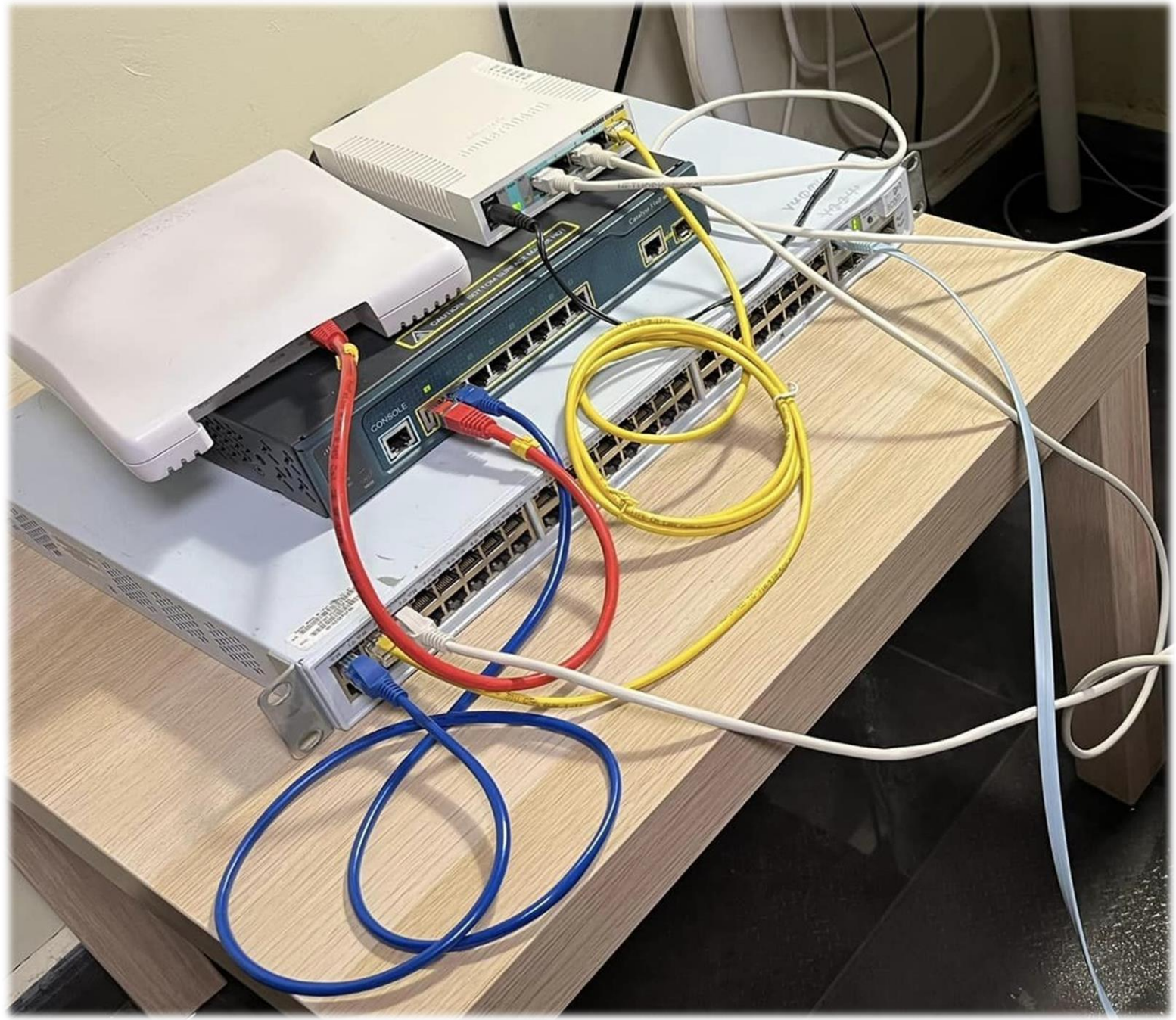
Course summary and exam preparation

Back to ToC



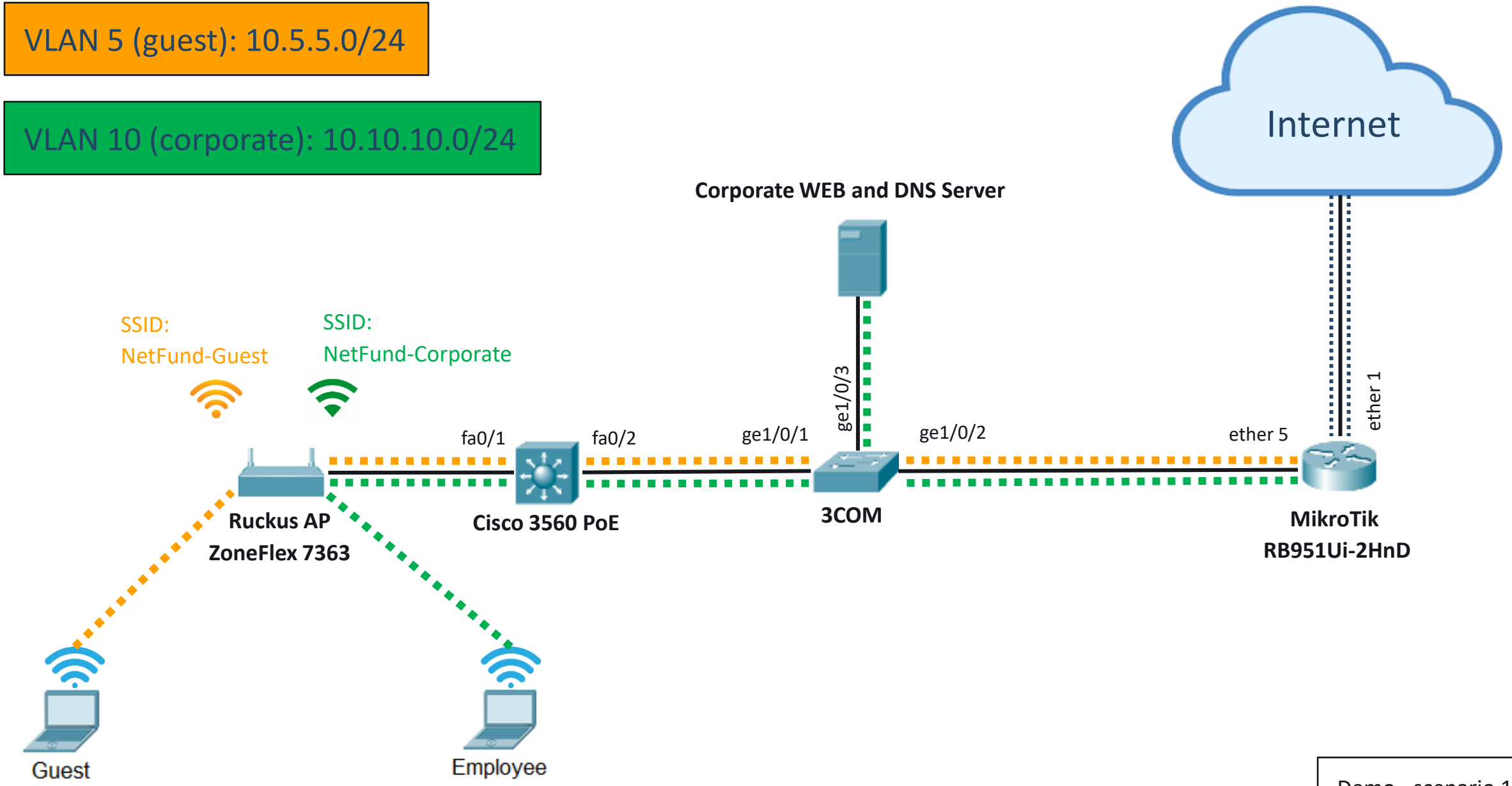
Building LAB with physical devices - scenario 1

Back to ToC


CONSOLE

VLAN 5 (guest): 10.5.5.0/24

VLAN 10 (corporate): 10.10.10.0/24



Demo - scenario 1

Topology details – scenario 1

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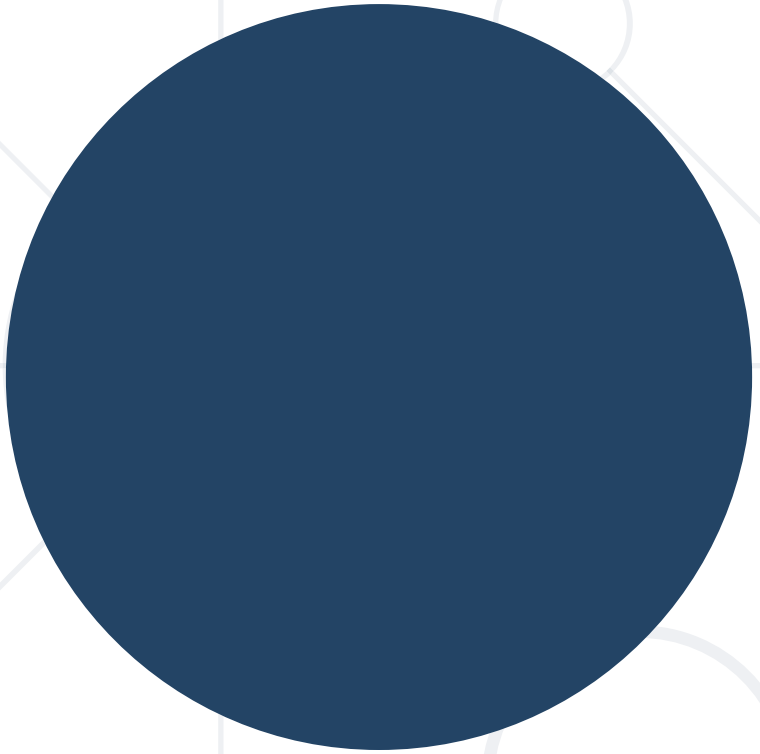
- DHCP server for both VLANs is the Cisco device
- MikroTik is routing the VLANs and making NAT to “outside”

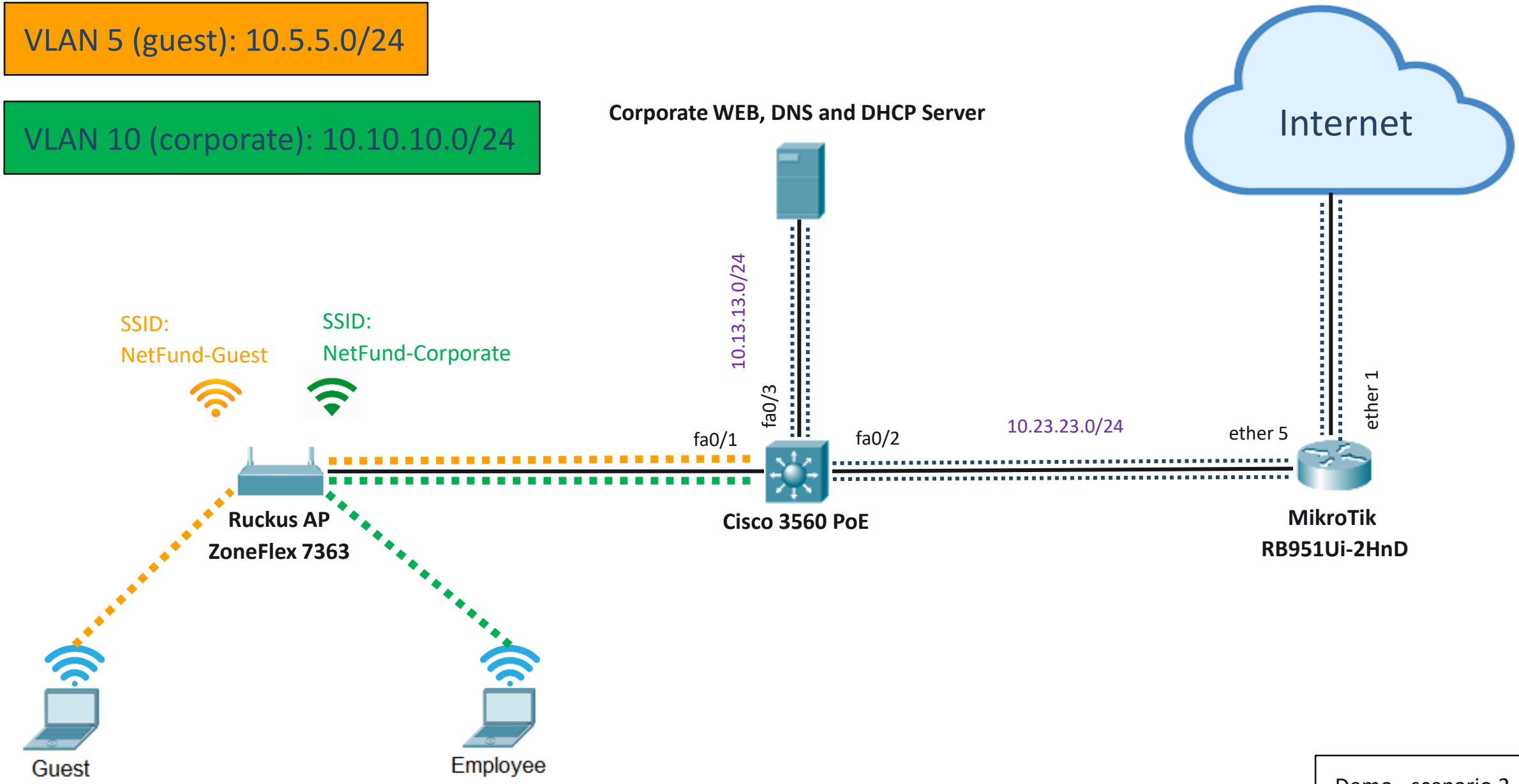
Device, interface	IP address
Cisco, VLAN 5	10.5.5.3
Cisco, VLAN 10	10.10.10.3
HP, VLAN 5	(10.5.5.2)
HP, VLAN 10	(10.10.10.2)
Corporate server (Web and DNS)	10.10.10.101
MikroTik, VLAN 5	10.5.5.1
MikroTik, VLAN 10	10.10.10.1



Building LAB with physical devices - scenario 2

VLAN 5 (guest): 10.5.5.0/24

VLAN 10 (corporate): 10.10.10.0/24



Demo - scenario 2

Topology details – scenario 2

- DHCP server for both VLANs is the (Windows) Server
- Cisco is routing the VLANs, MikroTik is making NAT to “outside”

Device, interface	IP address
Cisco, VLAN 5	10.5.5.3
Cisco, VLAN 10	10.10.10.3
Cisco, fa0/3	10.13.13.3
Cisco, fa0/2	10.23.23.3
Corporate server (Web and DNS)	10.13.13.101
MikroTik, ether 5	10.23.23.1

Summary

1. Introduction to networking
2. IP addresses and host-to-host communication – part 1
3. IP addresses and host-to-host communication – part 2
4. Network access, security and VLANS
5. Layer 2 redundancy – Spanning Tree Protocol
6. IP services and basic routing
7. Routing demonstrations
8. Dynamic routing with OSPF
9. Course summary and exam preparation
10. Building LAB with physical devices

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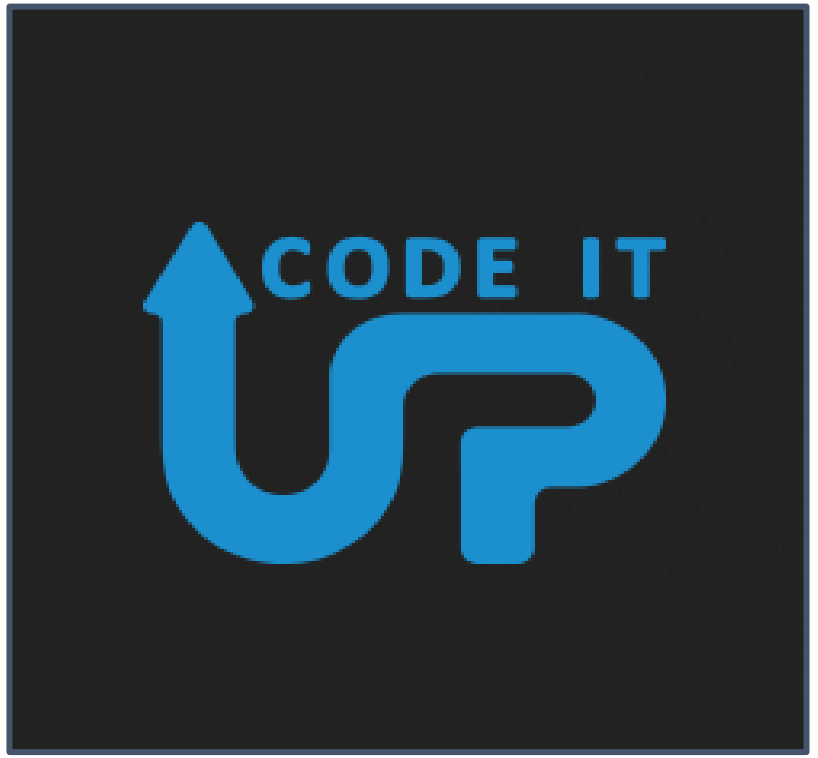
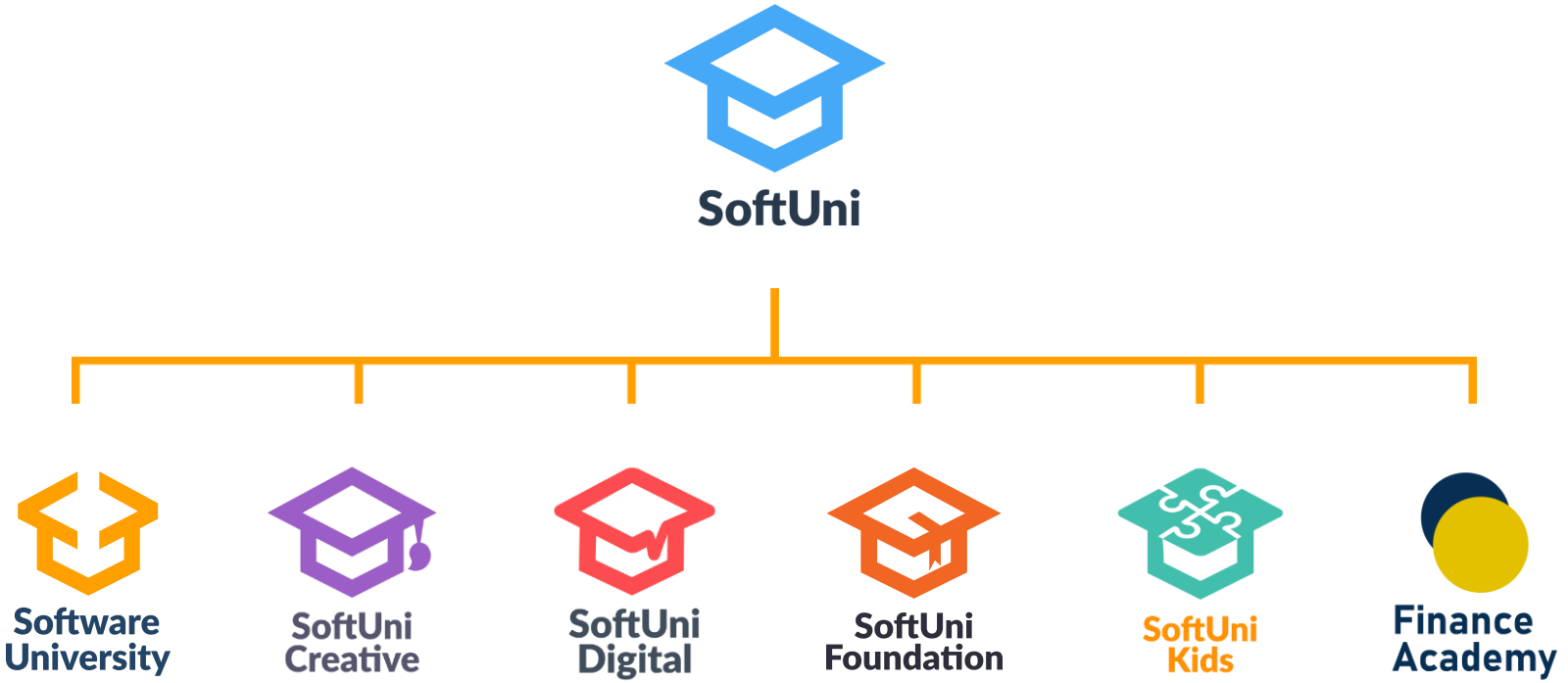


Questions?



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