

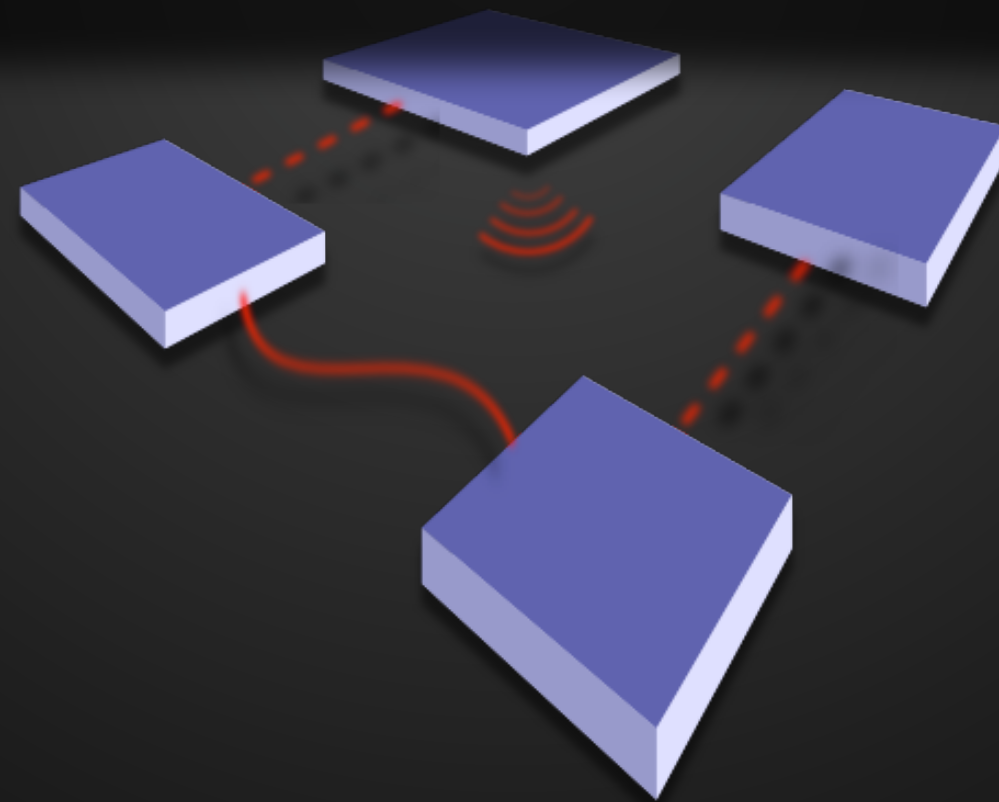
CS-435

spring semester 2020

Network Technology & Programming Laboratory

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Computer Science Department

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CS-435

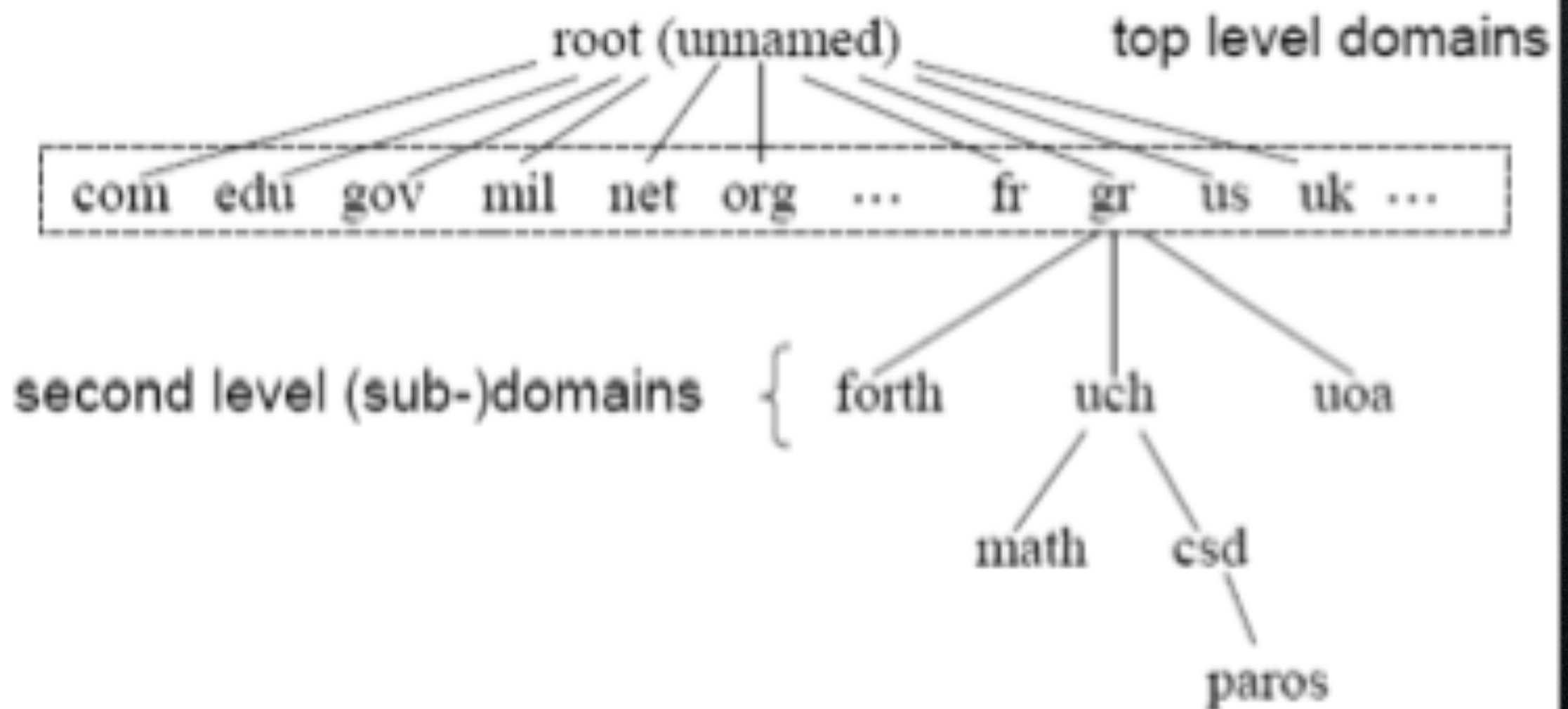
Lecture #6 preview

- Domain Name System (DNS)
- Virtual LAN (VLAN)
- Routing Tables

Domain Name System

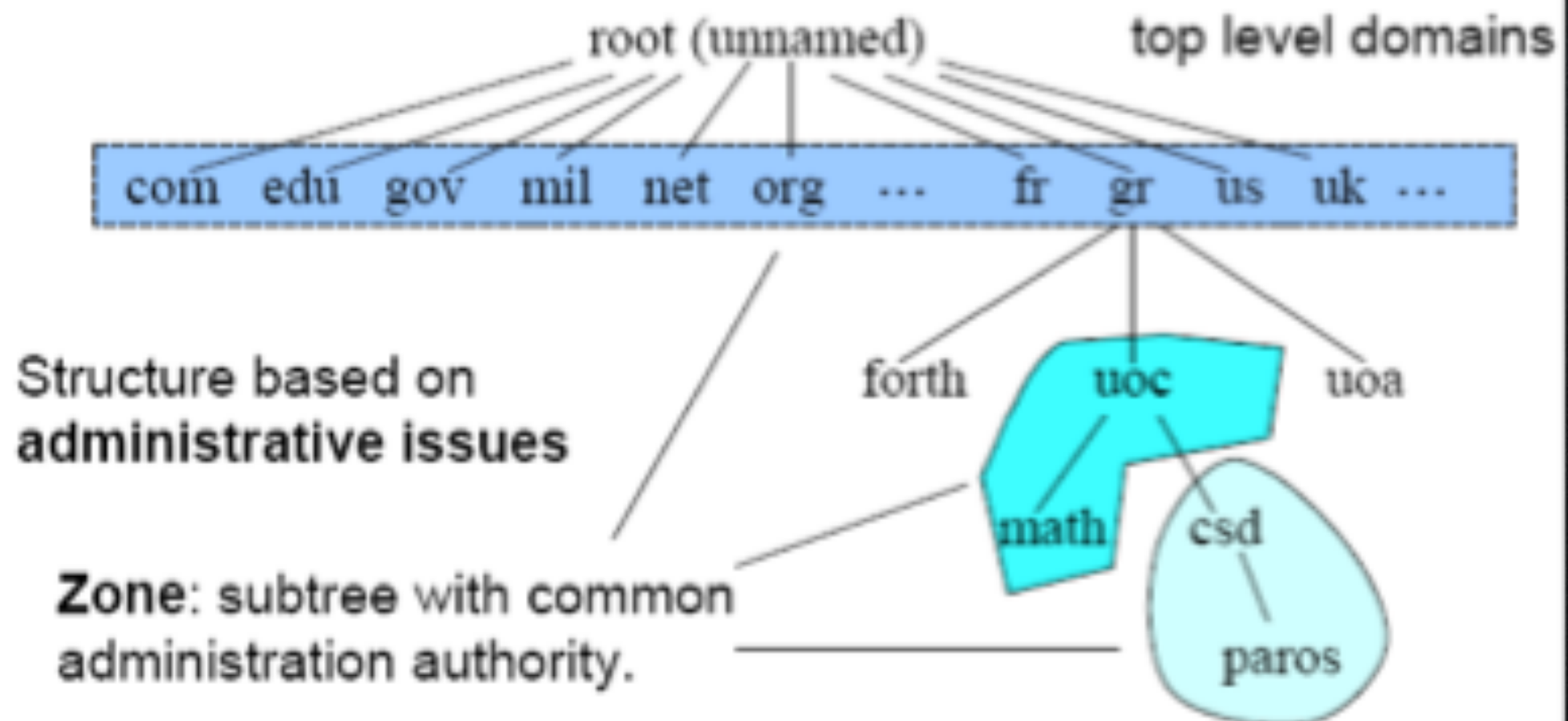
- Domain Name System (DNS)
 - Hierarchical naming space
 - Name-granting authorities
 - DNS servers and name resolution
 - DNS: name to IP address translation
 - ARP: IP address to LAN address translation
 - Why both? Names are memorizable, flexible:
 - e.g. `www.csd.uoc.gr` → `147.52.16.5`
 - Names of Variable-length
 - Many names for a single IP address
 - Change address doesn't imply change name
- Domain Name Registrars
 - Internet Corporation for Assigned Names and Numbers (ICANN) -> Top Level Domains

Naming Tree



bgio2

Naming Tree



Name Servers & Resolution Process

- Name Servers:
 - Contain Name-to-IP address mapping, or:
 - IP address of authoritative name server
 - Each NS is responsible for a zone.
- Name resolution: map names to IP addresses
- client: a process running on a host.
- Request: “give me IP address of lala.papa.xyz”.
- Response: “A.B.C.D” (IP address of X)
- or: “contact NS W.X.Y.Z to get the address of lala.papa.xyz”

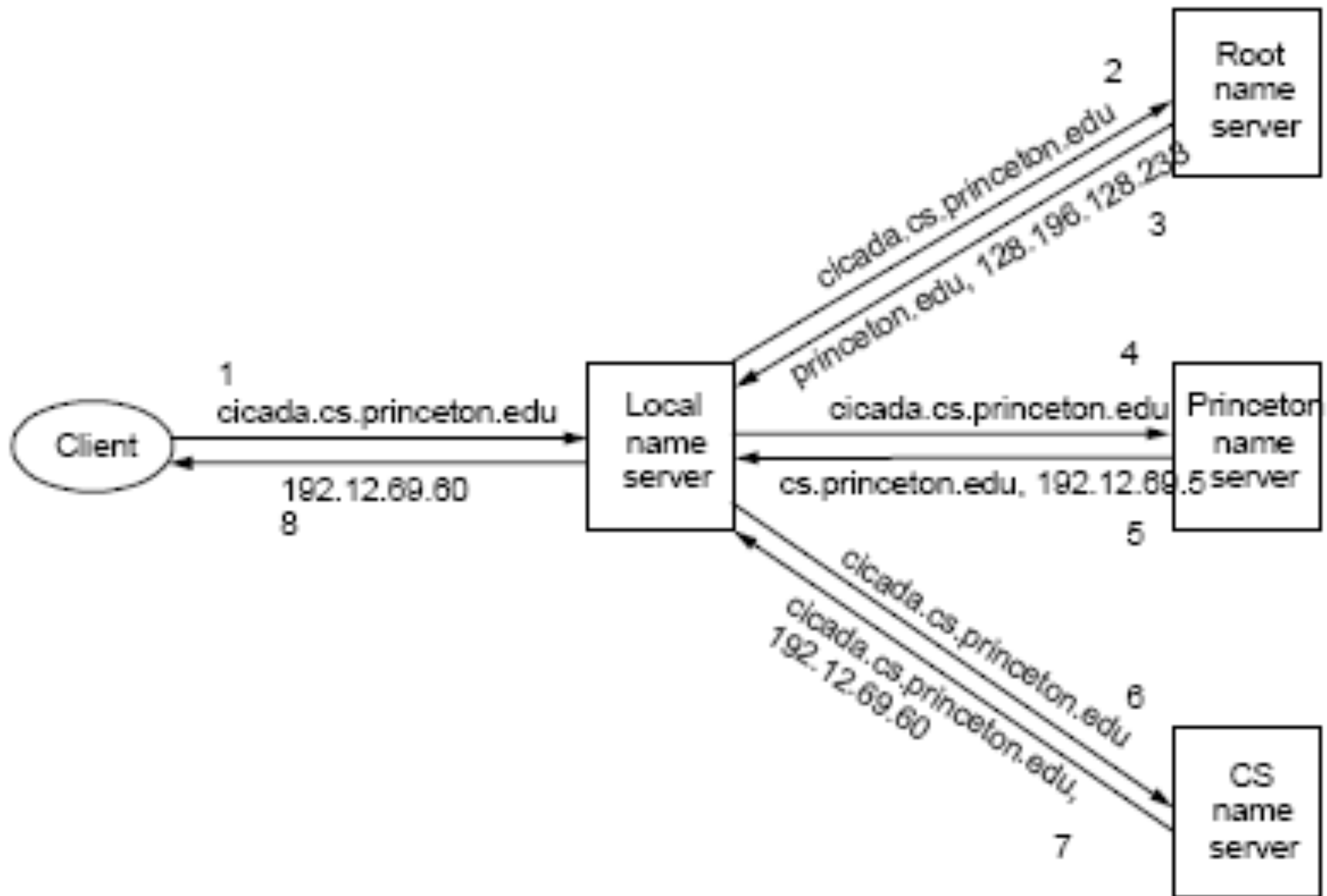
Name Servers

- NSs are duplicated for reliability
- Each host knows the IP address of the local NS
- Each NS knows the IP addresses of all root NSs
- Non-recursive / recursive query
- Caching is used

Name Servers

- Record Types (partial list):
 - A : IPv4 address record
 - AAAA: IPv6 address record
 - CERT: Certificate record
 - CNAME: Canonical name record (alias to another name)
 - LOC: Location record
 - MX: Mail exchanger record
 - NS: Name Server record (authoritative)
 - PTR: Pointer record (to canonical name - reverse lookup)
 - SOA: Start of authoritative record (authoritative information about a DNS zone)

Name Resolution



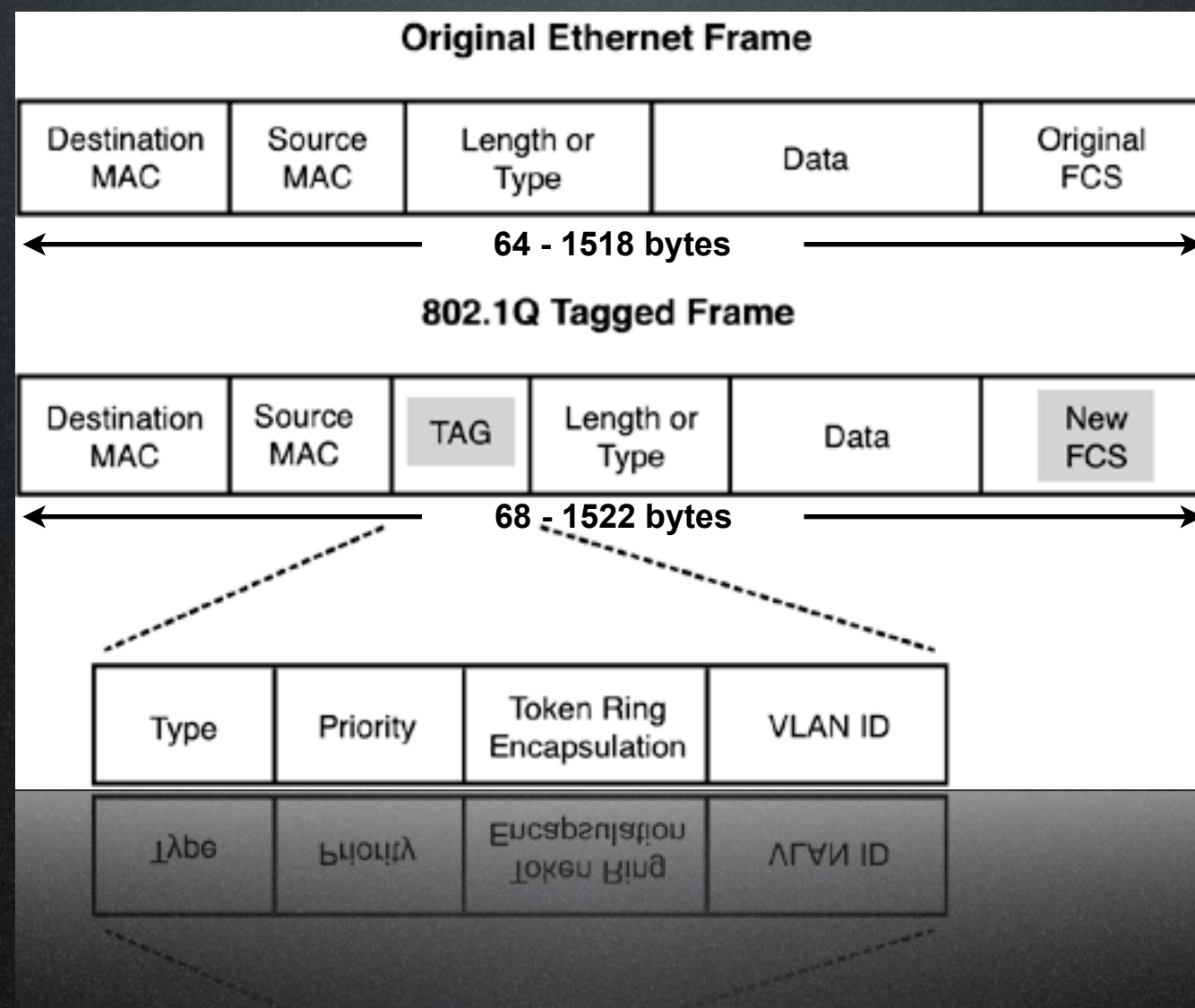
Virtual LANs

- Hubs: Define a Collision Domain
- Switches: Segment Collision Domains
- Routers: Define Broadcast Domains
- Virtual LAN: Segment Broadcast domains

Virtual LANs

- Types of VLANs
 - Layer 1: interface port based
 - Layer 2: VLAN membership based on MAC address
 - 802.1Q standard
 - Layer 3: use network layer protocol/addresses
 - Higher layer: e.g. application/port

802.1Q



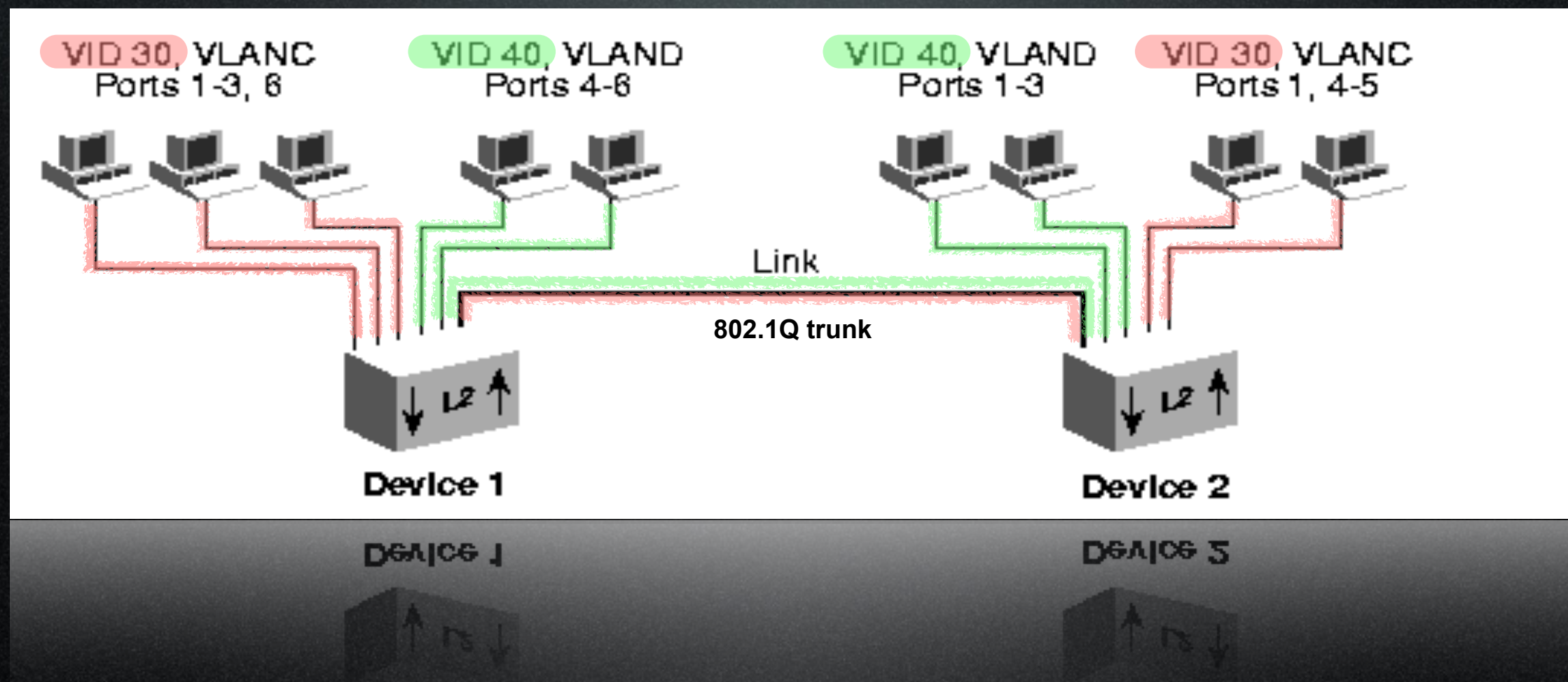
802.1Q

- Layer 2
- 32bit/4byte

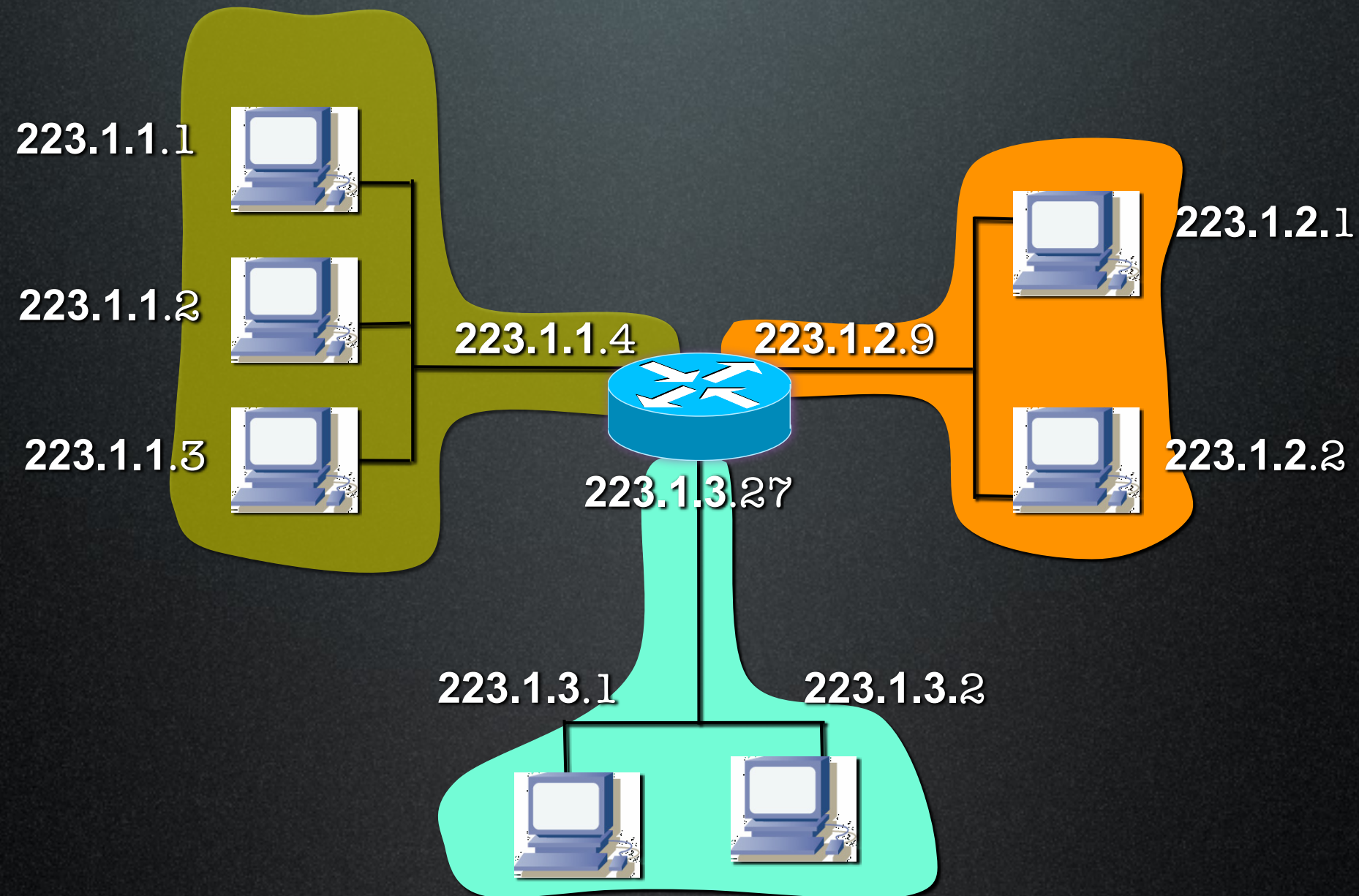
16bit	3bit	1bit	12bit
TPID	PCP	DEI	VID

- Tag Protocol Identifier (TPID) == 0x8100
- Priority Code Point (PCP)
- Drop Eligible Indicator (DEI) - Canonical Format Indicator (CFI)
- VLAN Identifier (VID) (reserved: 0x000, 0xFFF)
- PCP == 802.1p

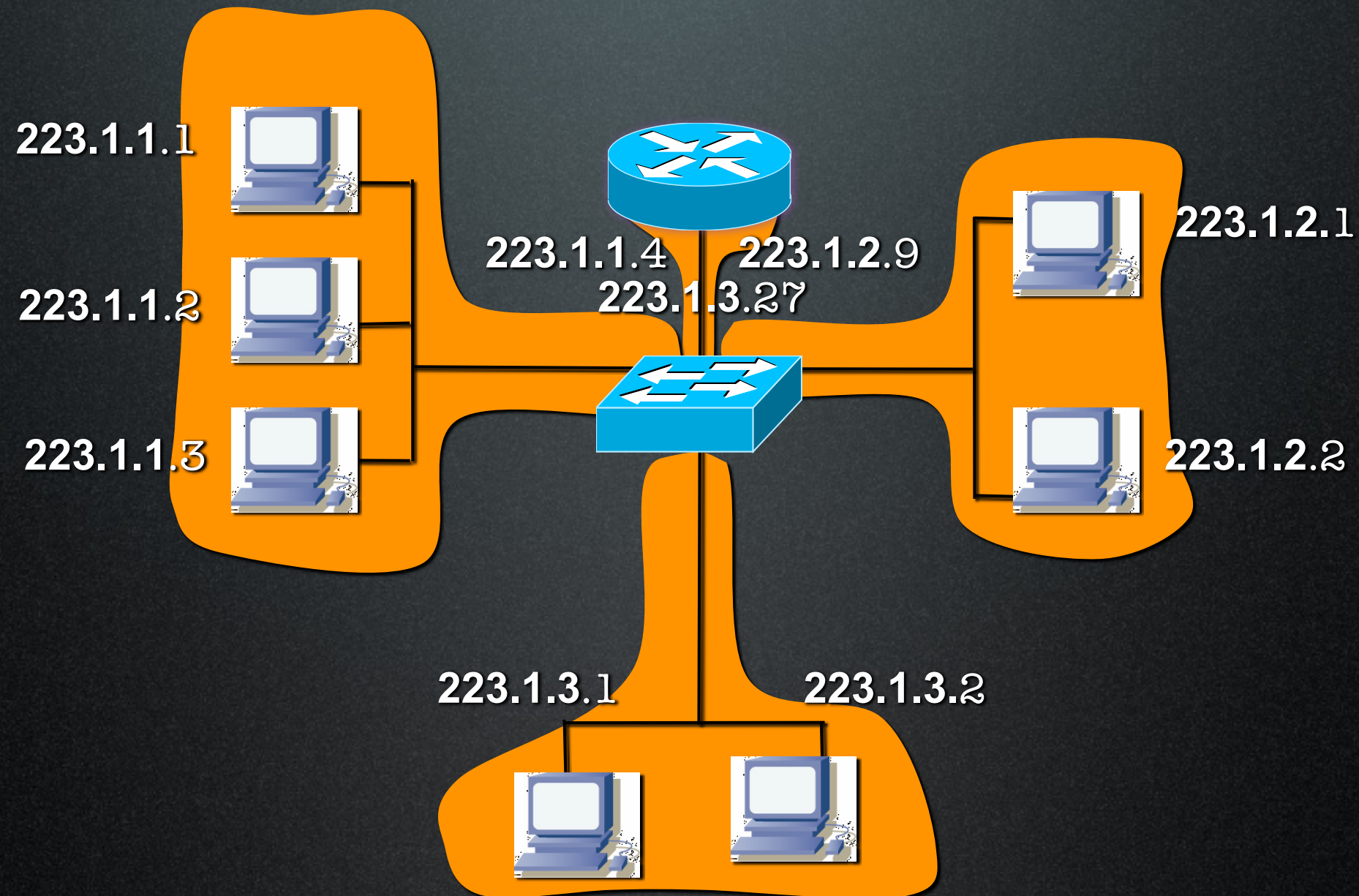
Virtual LANs



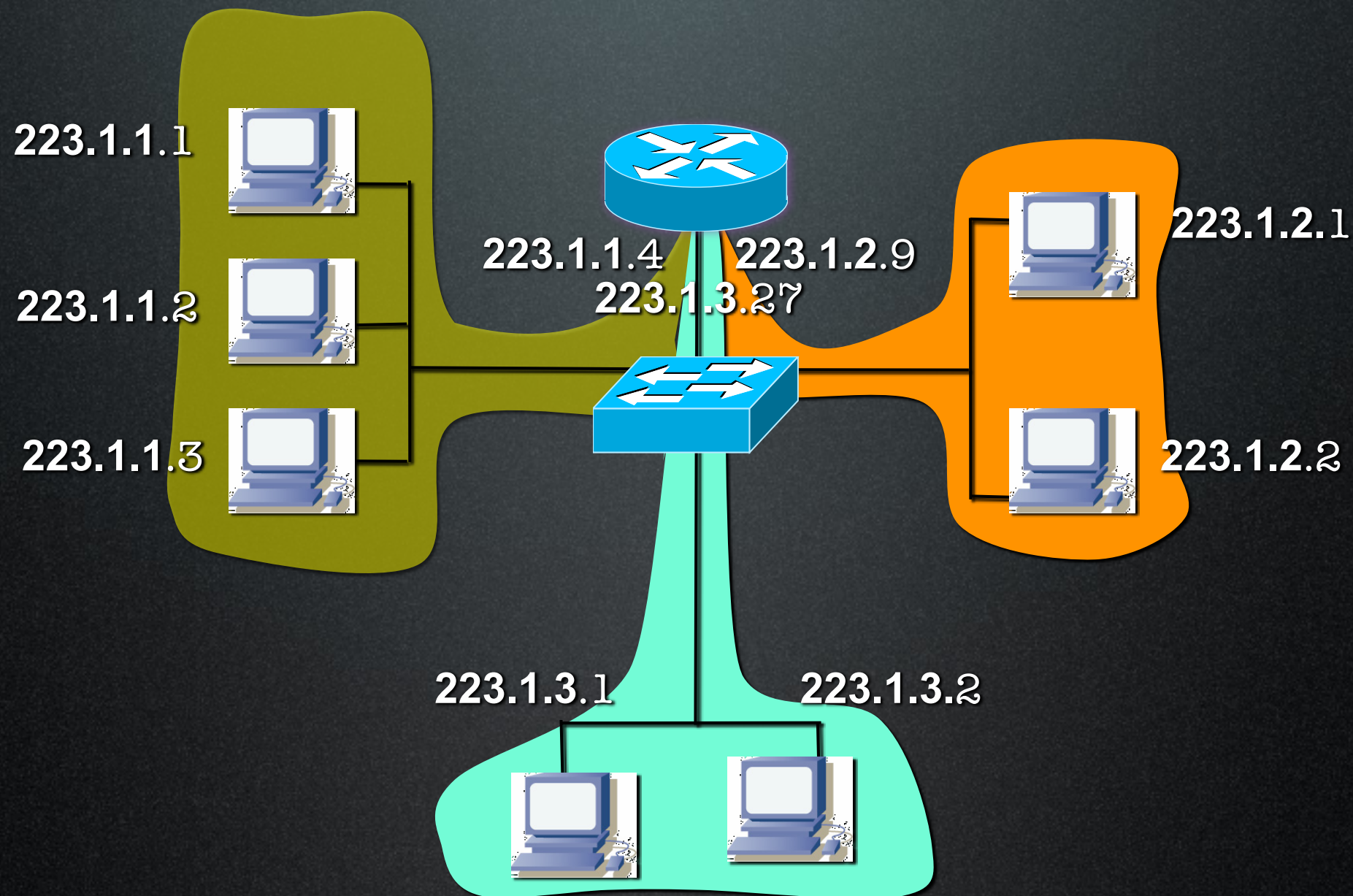
Subnets & LANs



Subnets & LANs



Subnets & VLANs

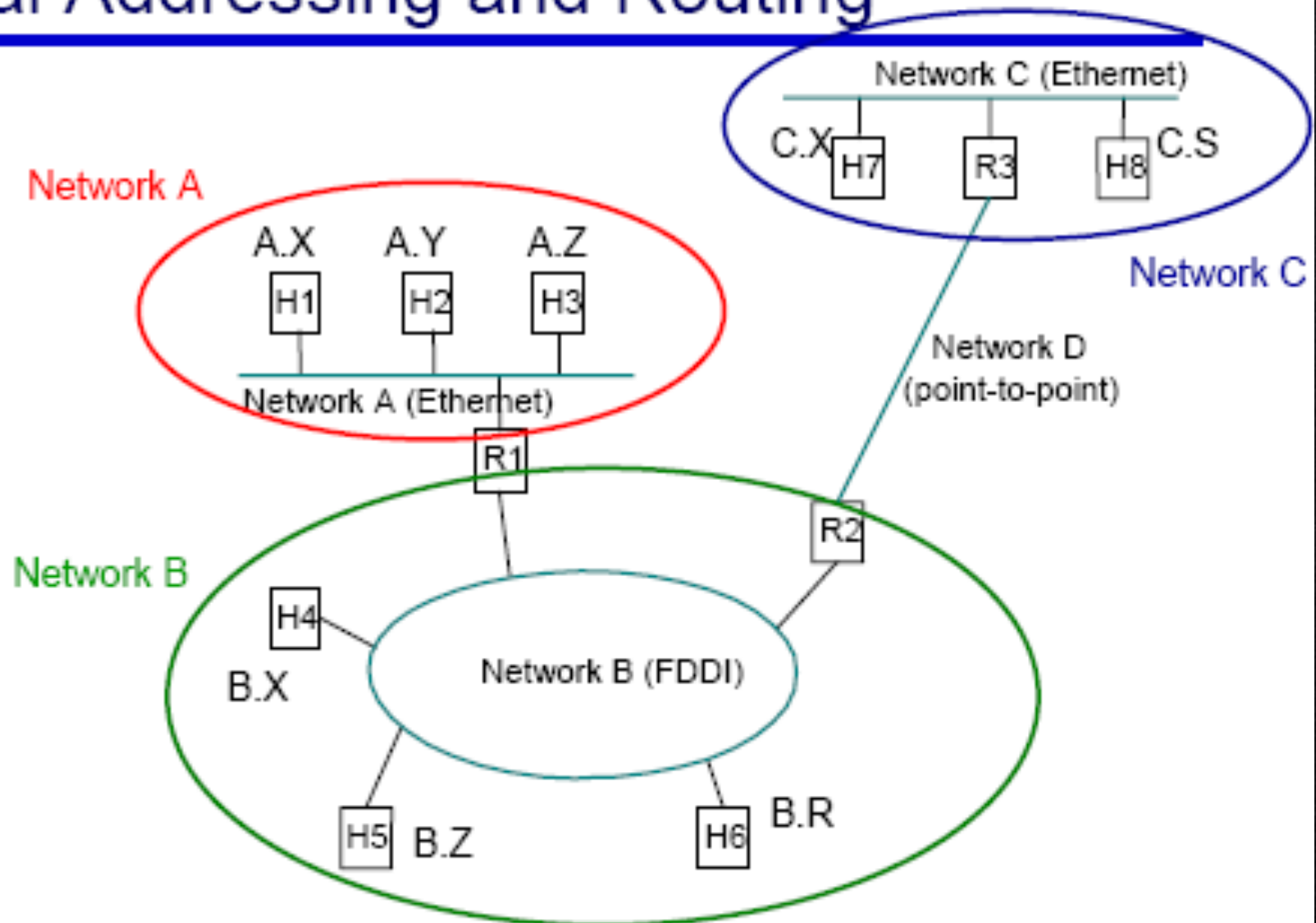


Datagram Forwarding & routing tables

- Every datagram contains destination's address
- Check destination network address
- if directly connected to destination network, then forward to host
- if not directly connected to destination network, then forward to next hop router
- Forwarding table maps network number into next hop
- Each host has a default router
- Each router maintains a forwarding table

Datagram Forwarding & routing tables

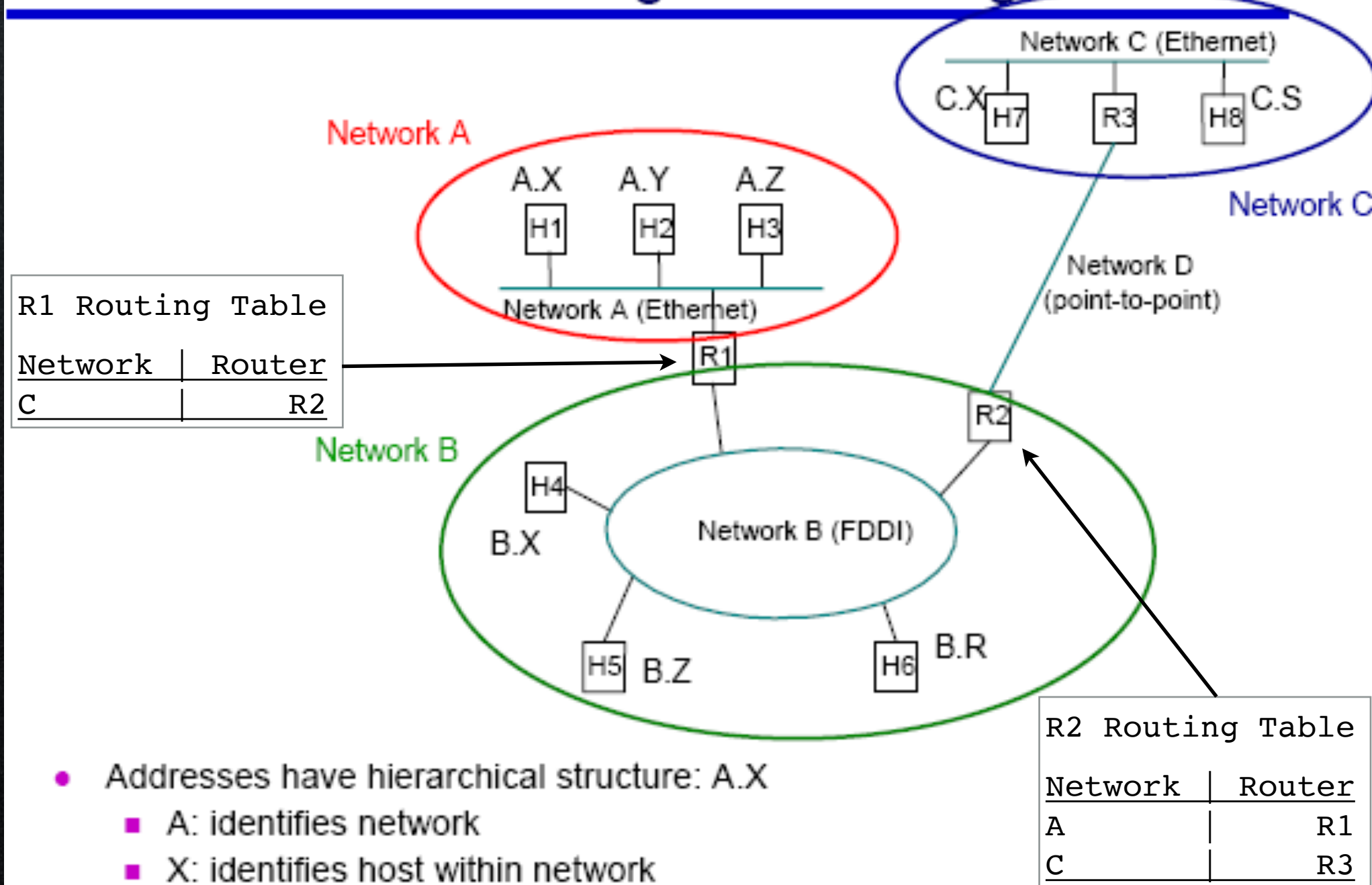
Hierarchical Addressing and Routing



- Addresses have hierarchical structure: A.X
 - A: identifies network
 - X: identifies host within network

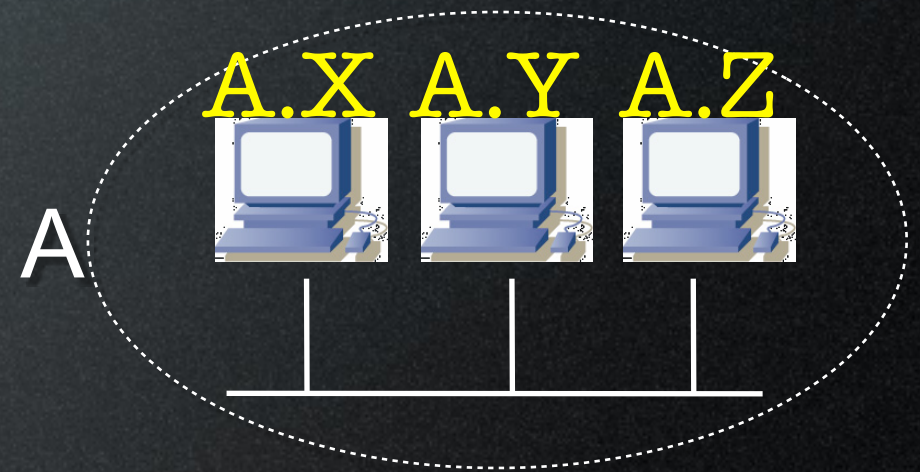
Datagram Forwarding & routing tables

Hierarchical Addressing and Routing



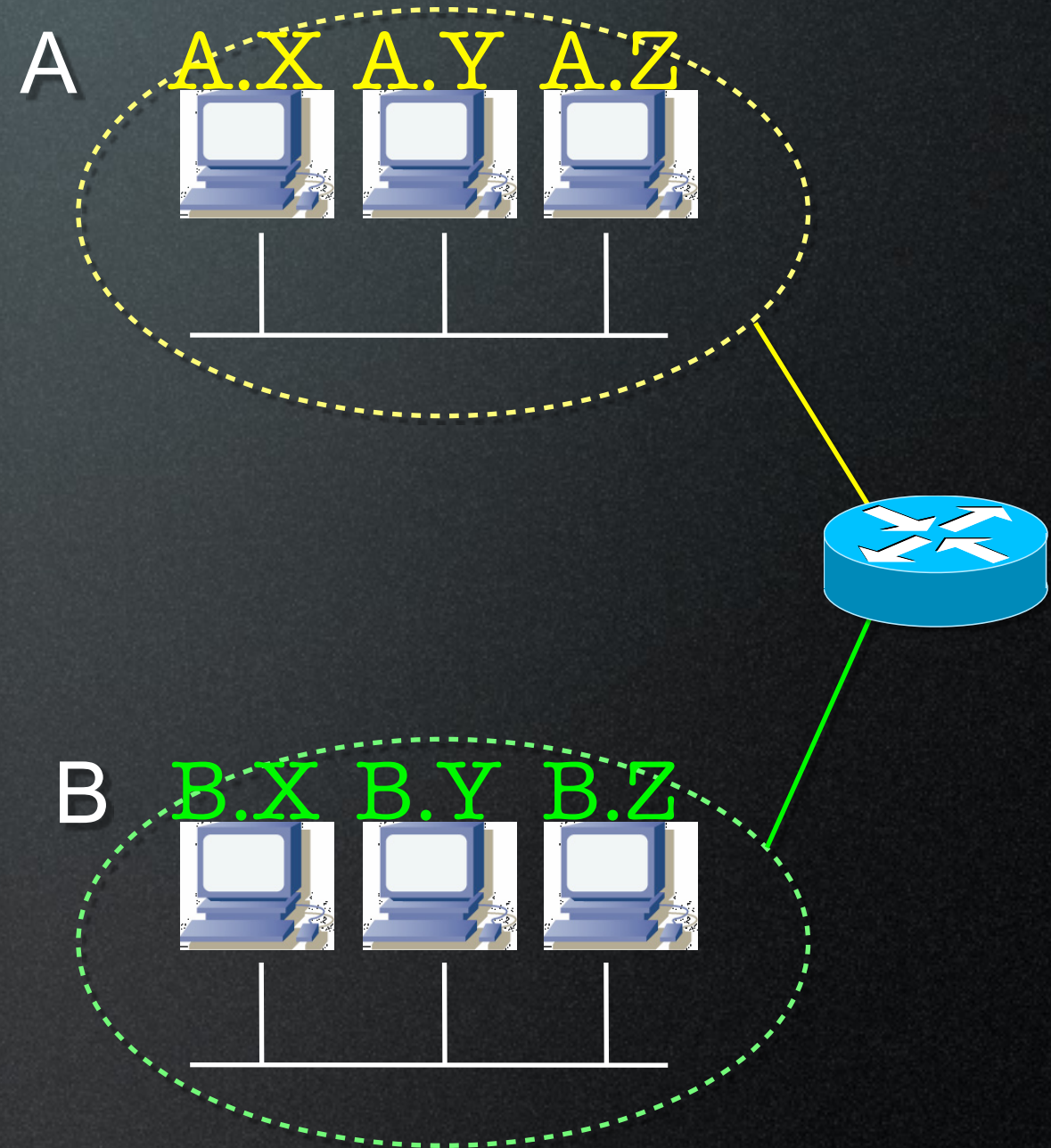
Datagram Forwarding when Src/Dst on Same Network

- Host A.X has a packet for Host A.Z
- Compares network number of destination address with its own: match ($A?=A$)
- Use ARP to find Ethernet address of A.Z
 - Check ARP table
 - Broadcast query if not in table
- Send Ethernet frame with destination from previous step.



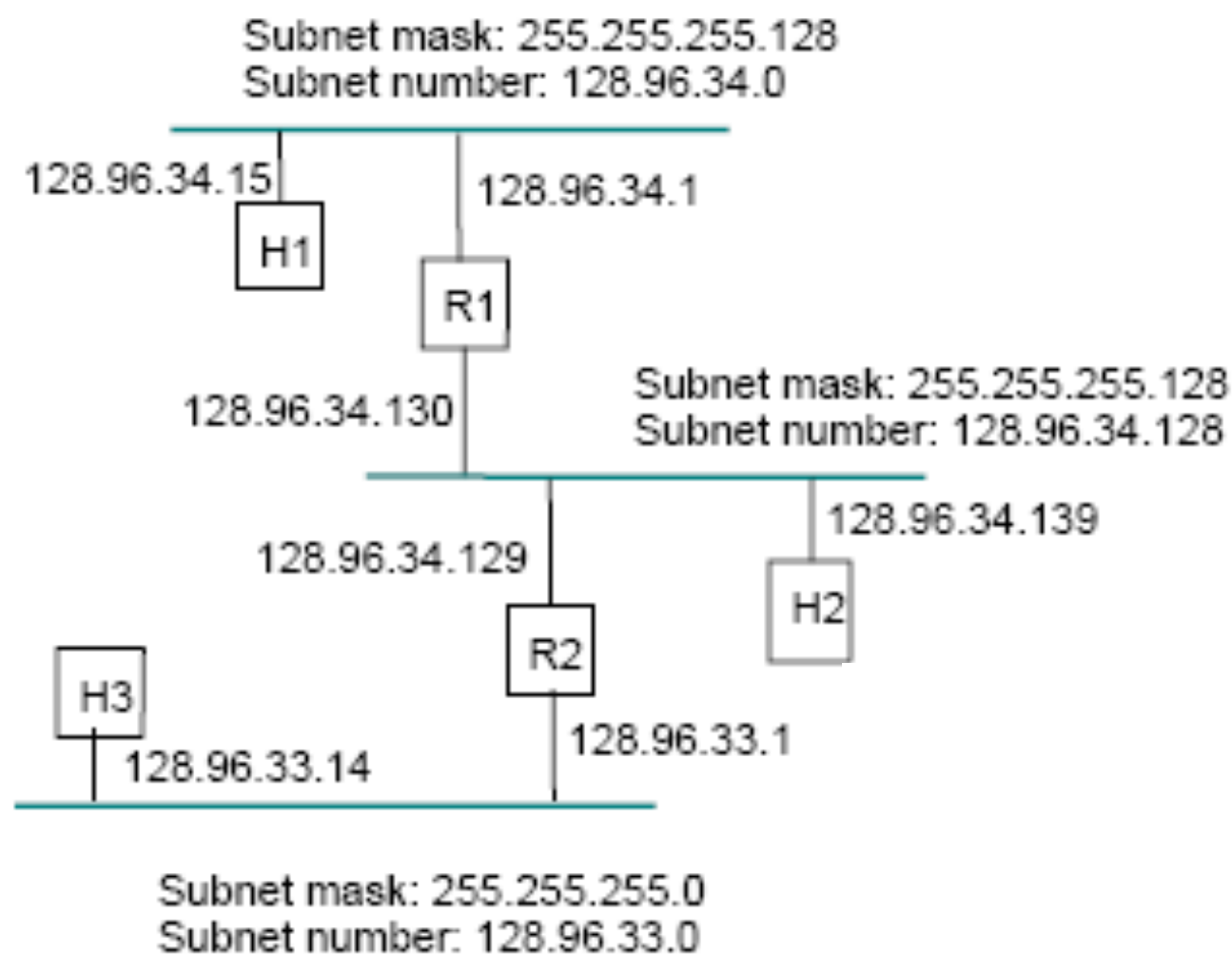
Datagram Forwarding when Src/Dst NOT on Same Network

- Host A.X wants to send datagram to B.X
- Compares network number of destination address with its own: no match ($A \neq B$)
- Find next hop (default router) from its table: R1
- Use ARP to find Ethernet address of R1
 - Check ARP table
 - Broadcast query if not in table
- Send Ethernet frame with destination from previous step
- R1 receives frame, looks up IP destination address (B.X):
 - Send to interface 1
 - Use ARP to find Ethernet address of B.X



The Routing Tables

Subnet Example



The Routing Tables

```
=====
Interface List
```

```
0x1 ..... MS TCP Loopback interface
0x2 ...00 1c 23 13 1c d9 ..... Broadcom NetXtreme 57xx Gigabit Controller - Pac
ket Scheduler Miniport
0x3 ...00 13 e8 ae 6a 49 ..... Intel(R) Wireless WiFi Link 4965AGN - Packet Sch
eduler Miniport
=====
```

```
=====
Active Routes:
```

Network	Destination	Netmask	Gateway	Interface	Metric
	0.0.0.0	0.0.0.0	192.168.1.1	192.168.1.6	20
	127.0.0.0	255.0.0.0	127.0.0.1	127.0.0.1	1
	192.168.1.0	255.255.255.0	192.168.1.6	192.168.1.6	20
	192.168.1.6	255.255.255.255	127.0.0.1	127.0.0.1	20
	192.168.1.255	255.255.255.255	192.168.1.6	192.168.1.6	20
	224.0.0.0	240.0.0.0	192.168.1.6	192.168.1.6	20
	255.255.255.255	255.255.255.255	192.168.1.6	192.168.1.6	1
	255.255.255.255	255.255.255.255	192.168.1.6	3	1

```
Default Gateway: 192.168.1.1
=====
```

```
Persistent Routes:
```

```
None
```


Supernetting

- Instead of using first few bits to identify class, additional parameter (length) identifies network part, e.g. `<192.4.16/20>`
- Might be case that destination address matches more than one router entries
- eg: Address 192.4.17.5 matches both `<192.4.16/20>` and `<192.4/16>`

Forwarding table

Subnet Number	Next Hop
192.4.16/20	R1
192.4/16	R2

- Longest prefix match used (192.4.17.5 forwarded to R1)