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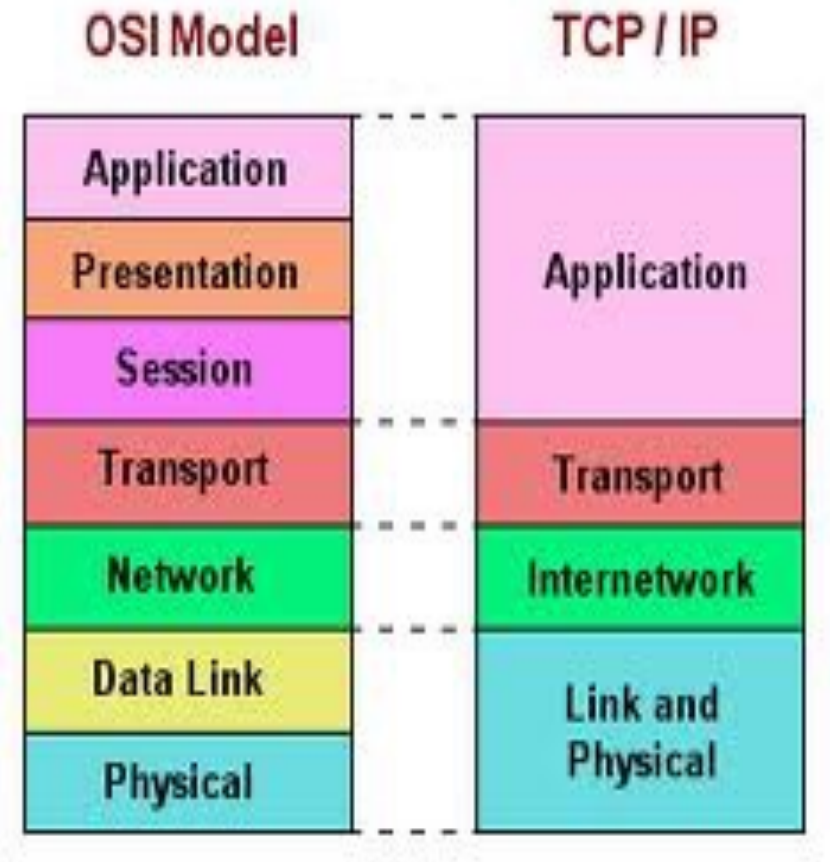
CA169
Networks & Internet

Network Devices

Devices and the Stack!



Servers + Applications

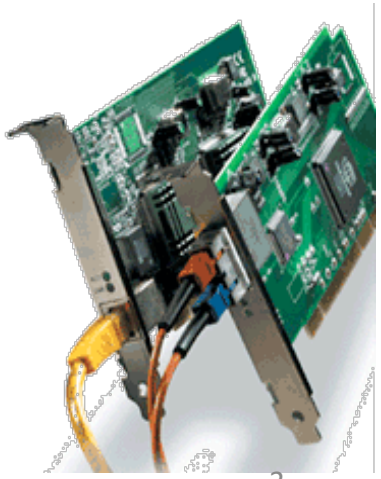
Routers + Gateways

Switches + Hubs

Network Interface Card (NIC)

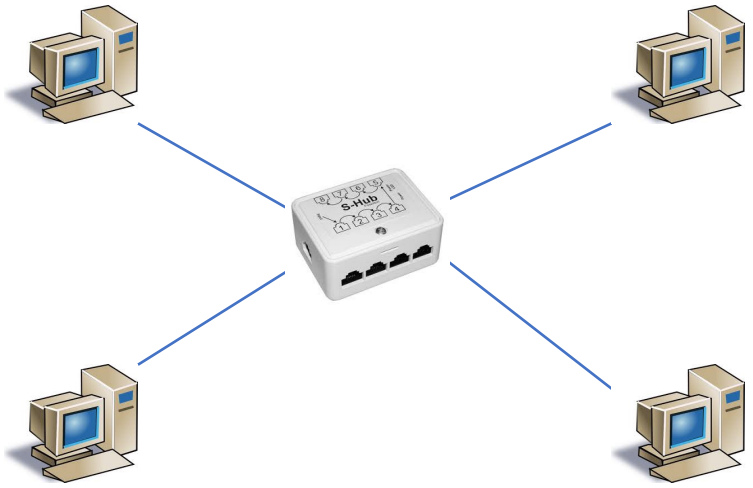
Network Interface Card (NIC)

- Layer 1 device
- This the first point of contact to the network.
- Every connected device has at least one network interface card.
- This is on the physical layer and deals with the medium on which data will be sent.
- Every Network Interface Card (NIC) has a unique media access control **address** (**MAC address**)
  - A 48 bit number
  - Represented as a 12 Hexadecimal digits in the form *FF:FF:FF:FF:FF:FF*
  - E.g., *AF-61-04-3B-45-D2*



Hub

- Layer 1 device. The hub is a connecting device
- Each device is connected into a **port** (physical) or **interface** on the device
- Any signal that is inputted into an interface gets broadcast on all the other interfaces
- Creates a single **collision domain**



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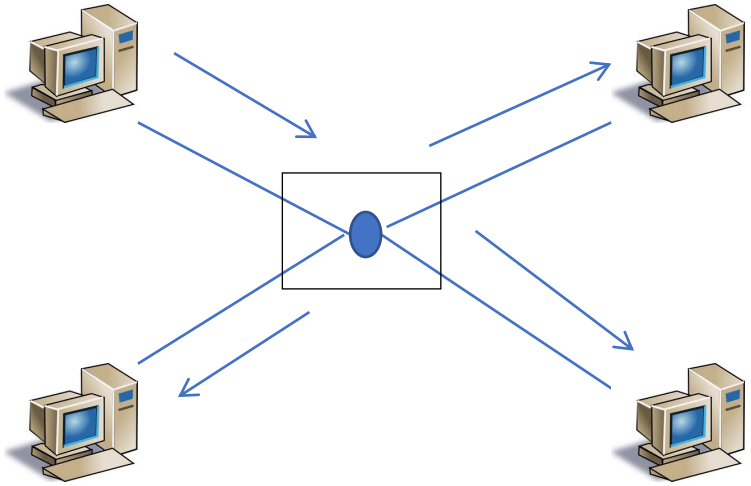

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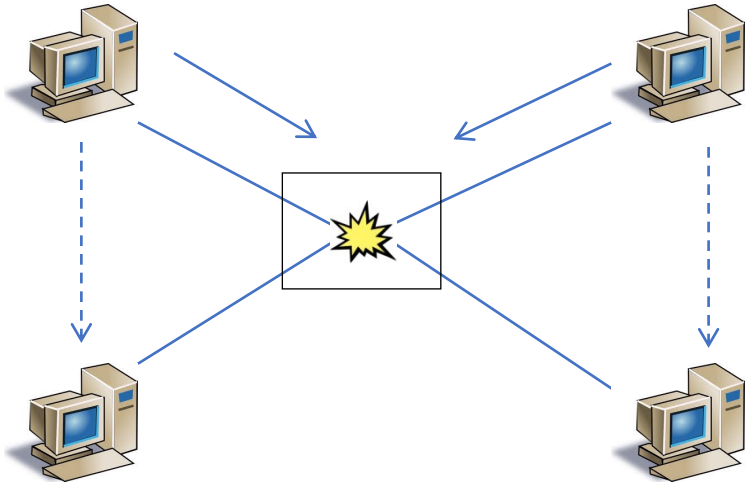

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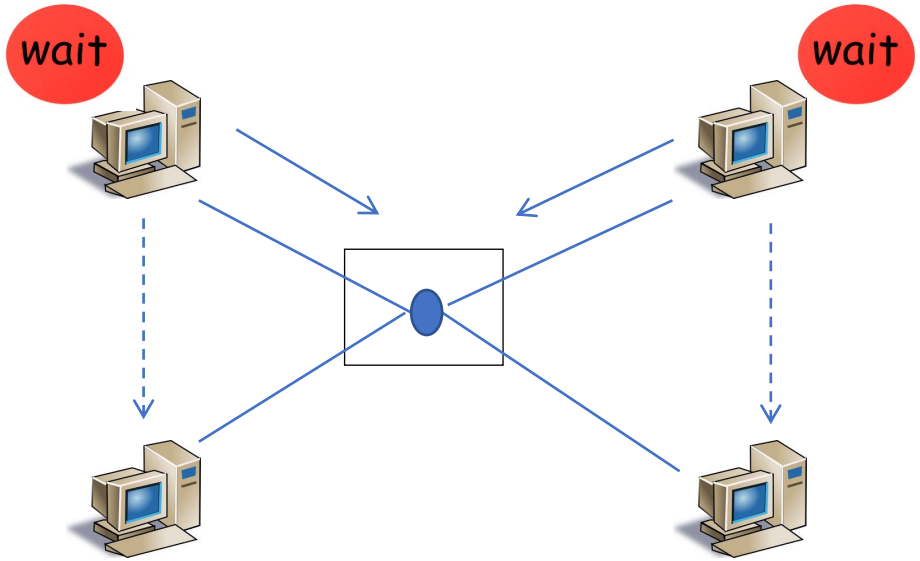
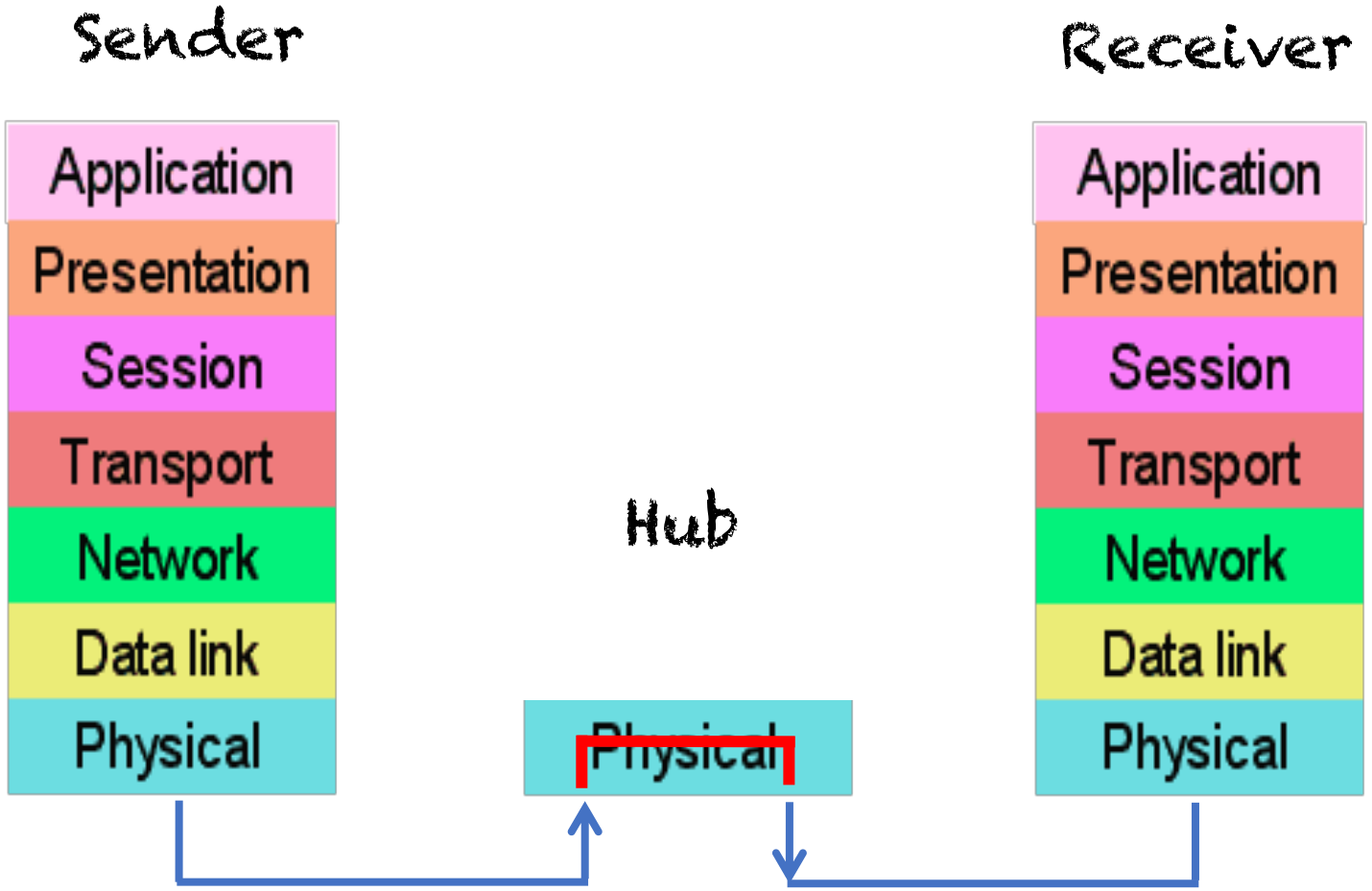


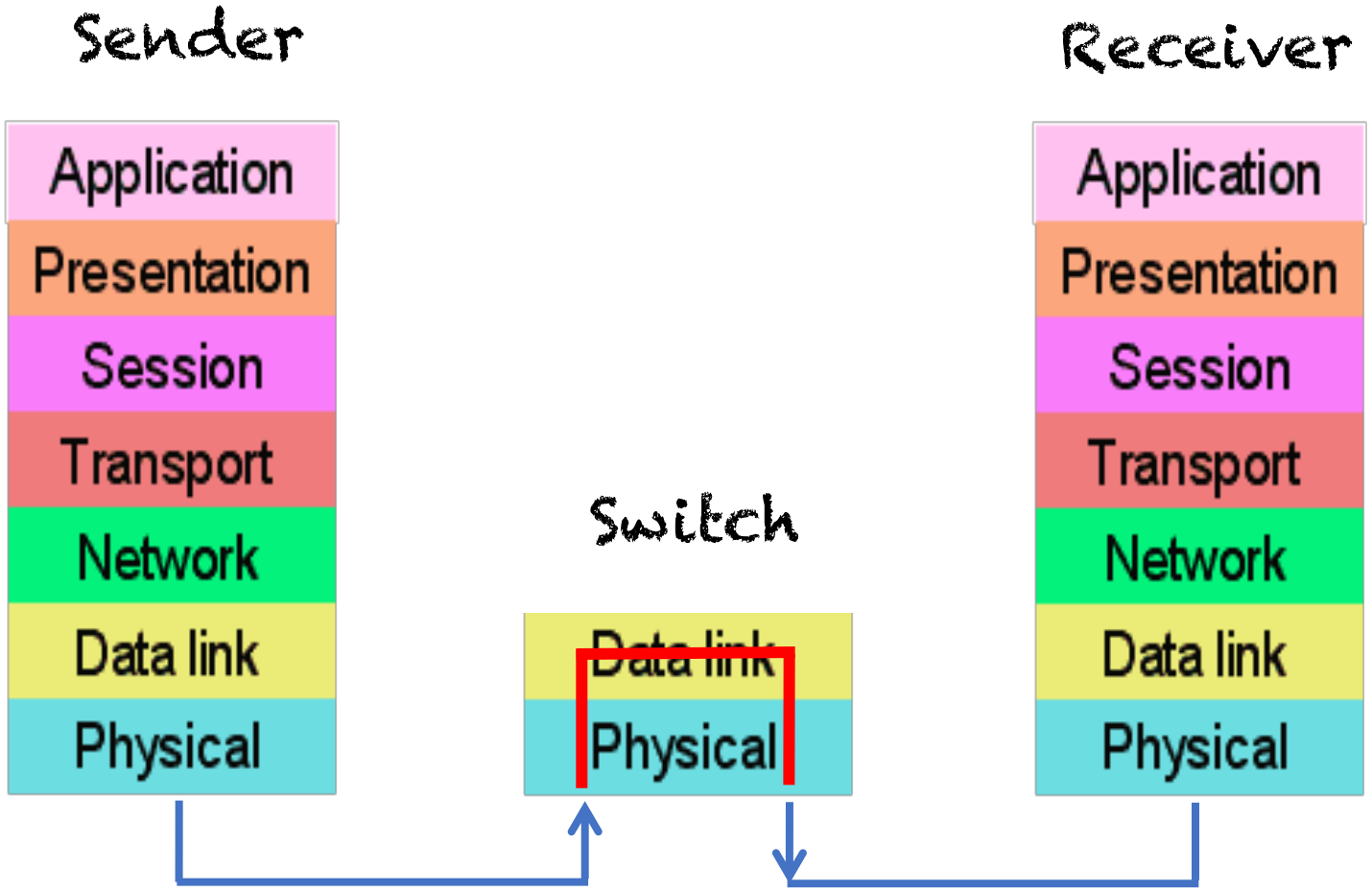
Hub


Sender
Receiver
Application
Presentation
Session
Transport
Network
Data link
Physical
Hub
Physical
Application
Presentation
Session
Transport
Network
Data link
Physical

Switch

- Layer 2 Device
- Connects machines on the same **Broadcast Domain**
- Can inspect the Layer 2 frame and determine intended destination (Next Hop Address)
- Separates **collision domains**

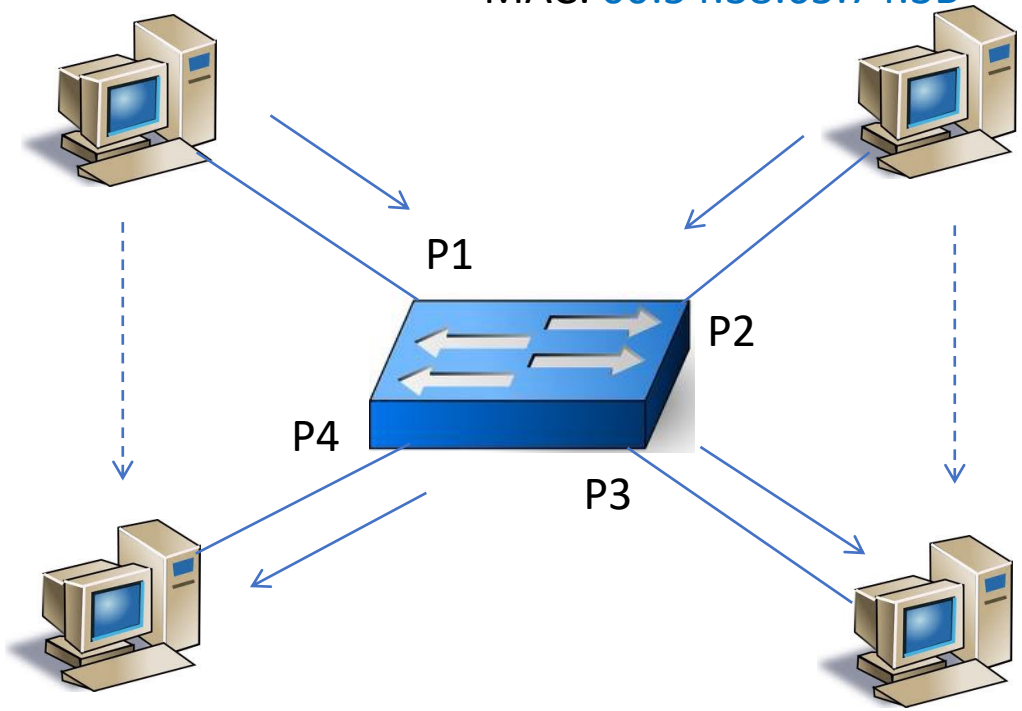
Switch


Sender
Receiver
Application
Presentation
Session
Transport
Network
Data link
Physical
Switch
Data link
Physical
Application
Presentation
Session
Transport
Network
Data link
Physical

Switch

MAC: 00:A9:98:D9:25:4A

MAC: 00:54:38:65:74:3B



MAC: 00:3C:96:4D:68:5D

MAC: 00:2F:45:94:26:5C

Port	MAC
P1	00:A9:98:D9:25:4A
P2	00:54:38:65:74:3B
P3	00:2F:45:94:26:5C
P4	00:3C:96:4D:68:5D

Switch

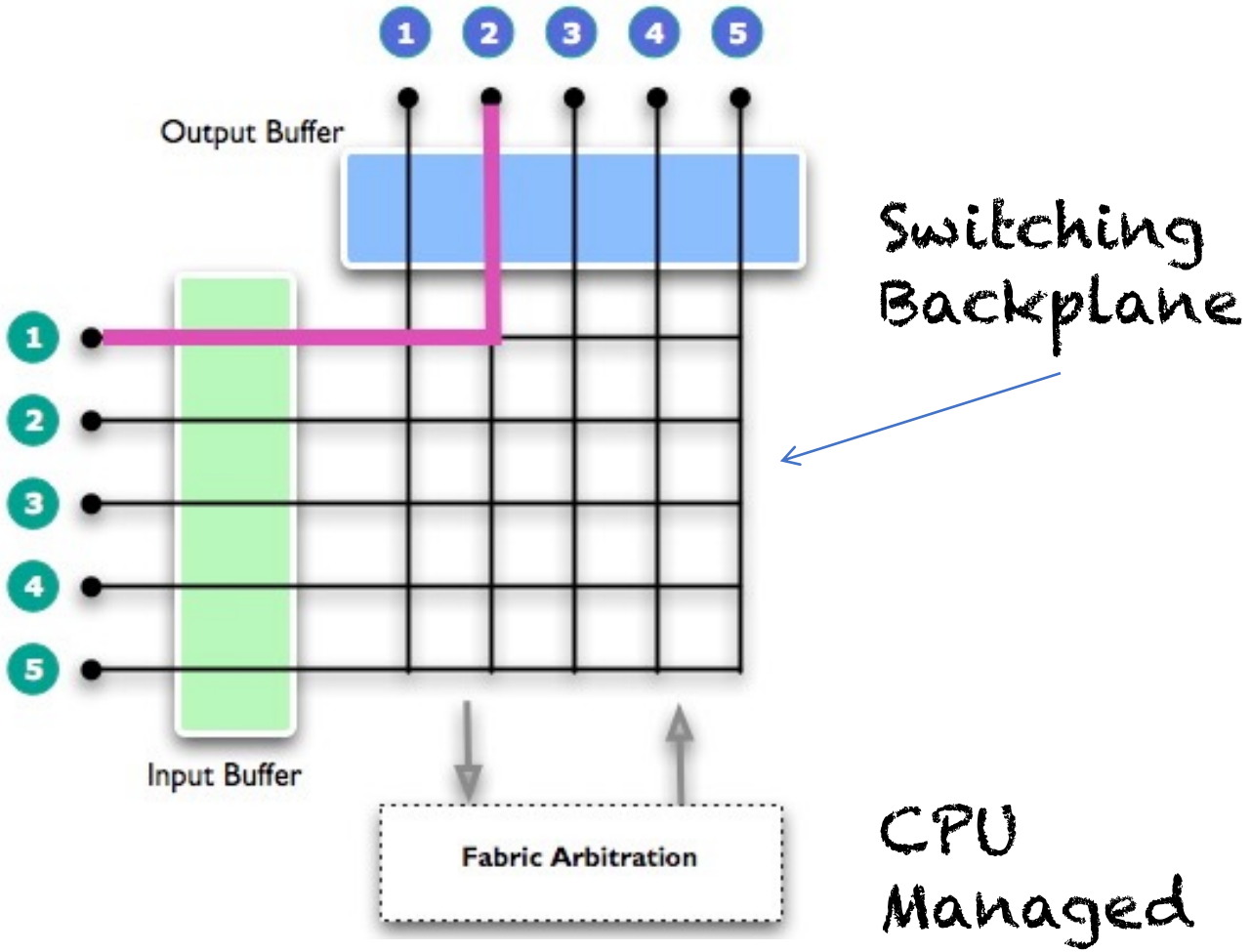
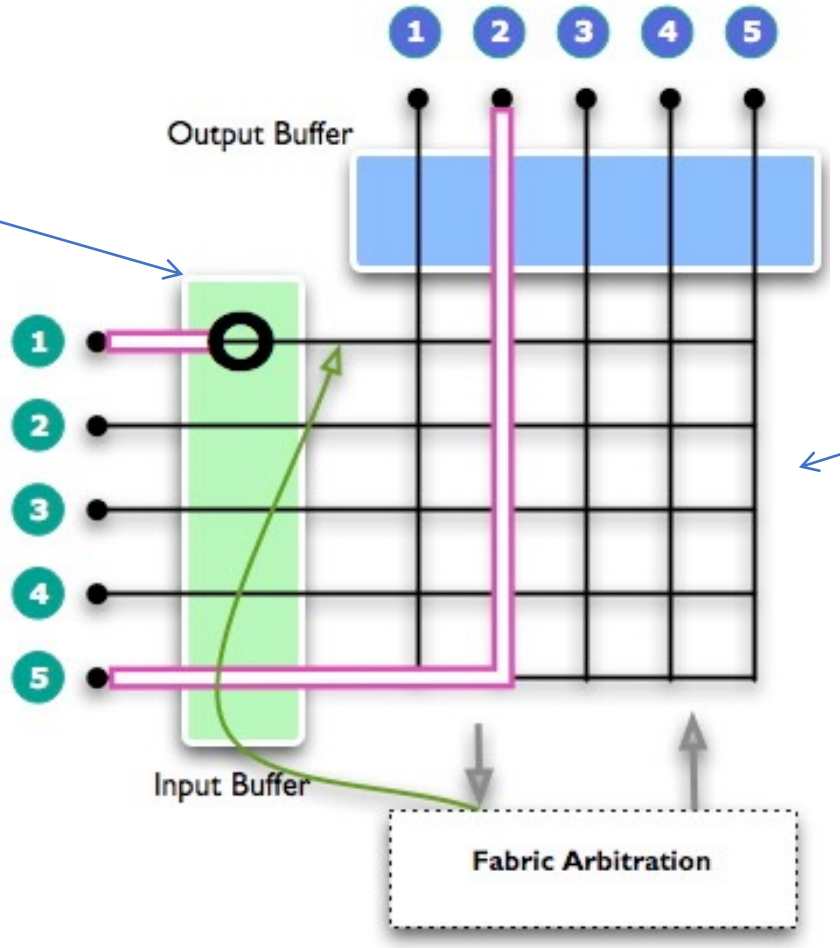


Image: http://etherealmind.com

Switch



Queuing Mechanics can be complex

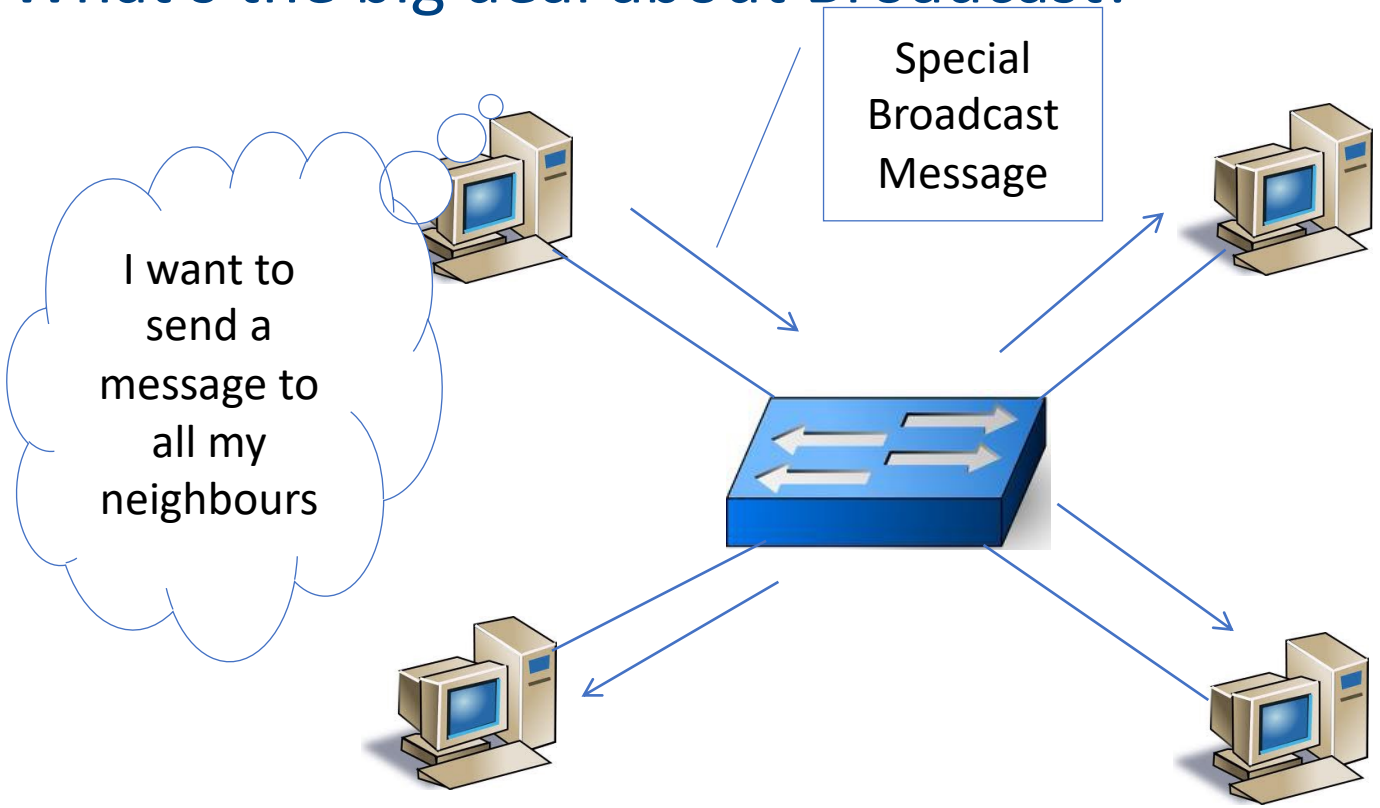
Switching Backplane

CPU Managed

Image: http://etherealmind.com

Switch

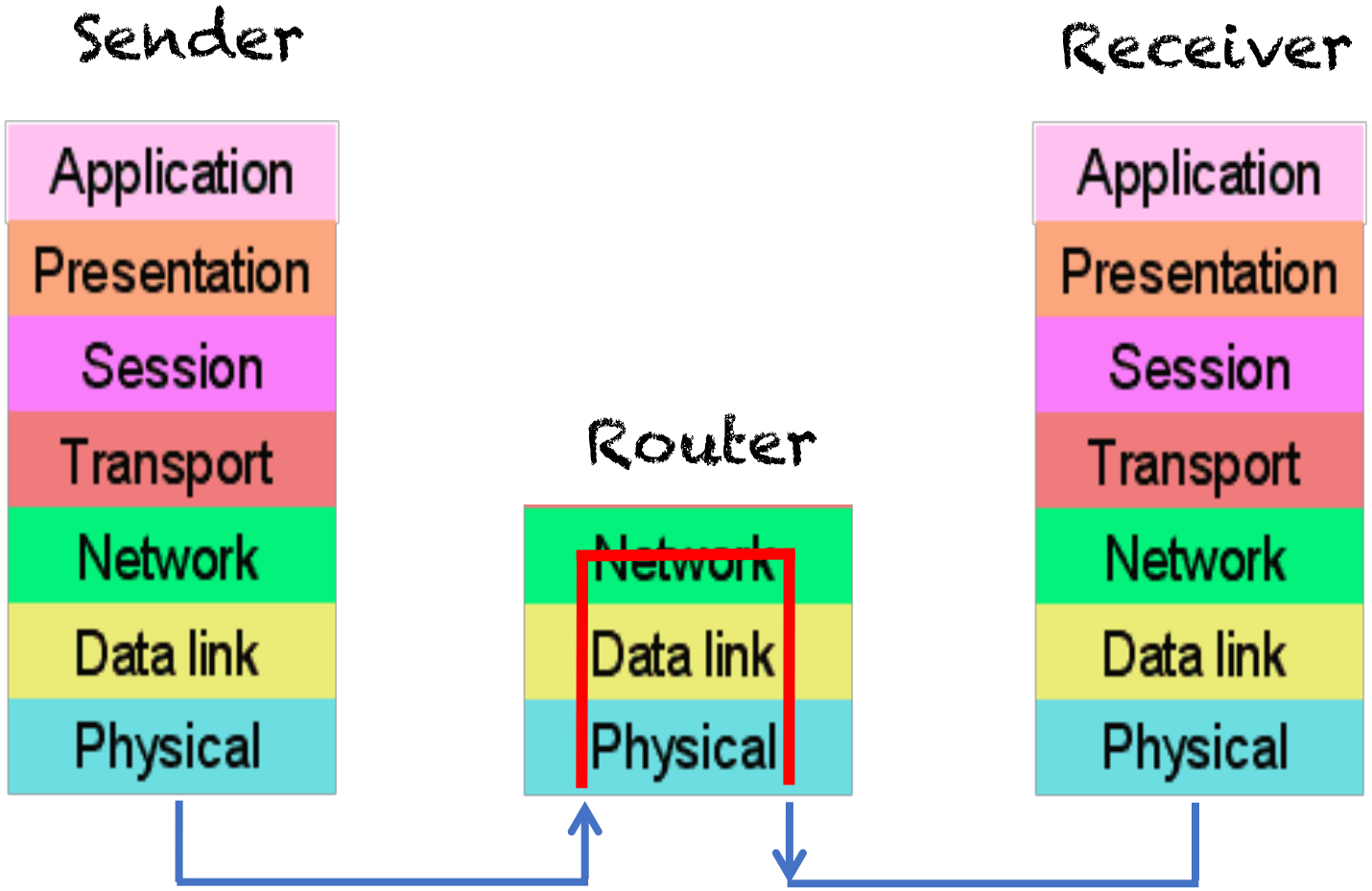
- What's the big deal about Broadcast!



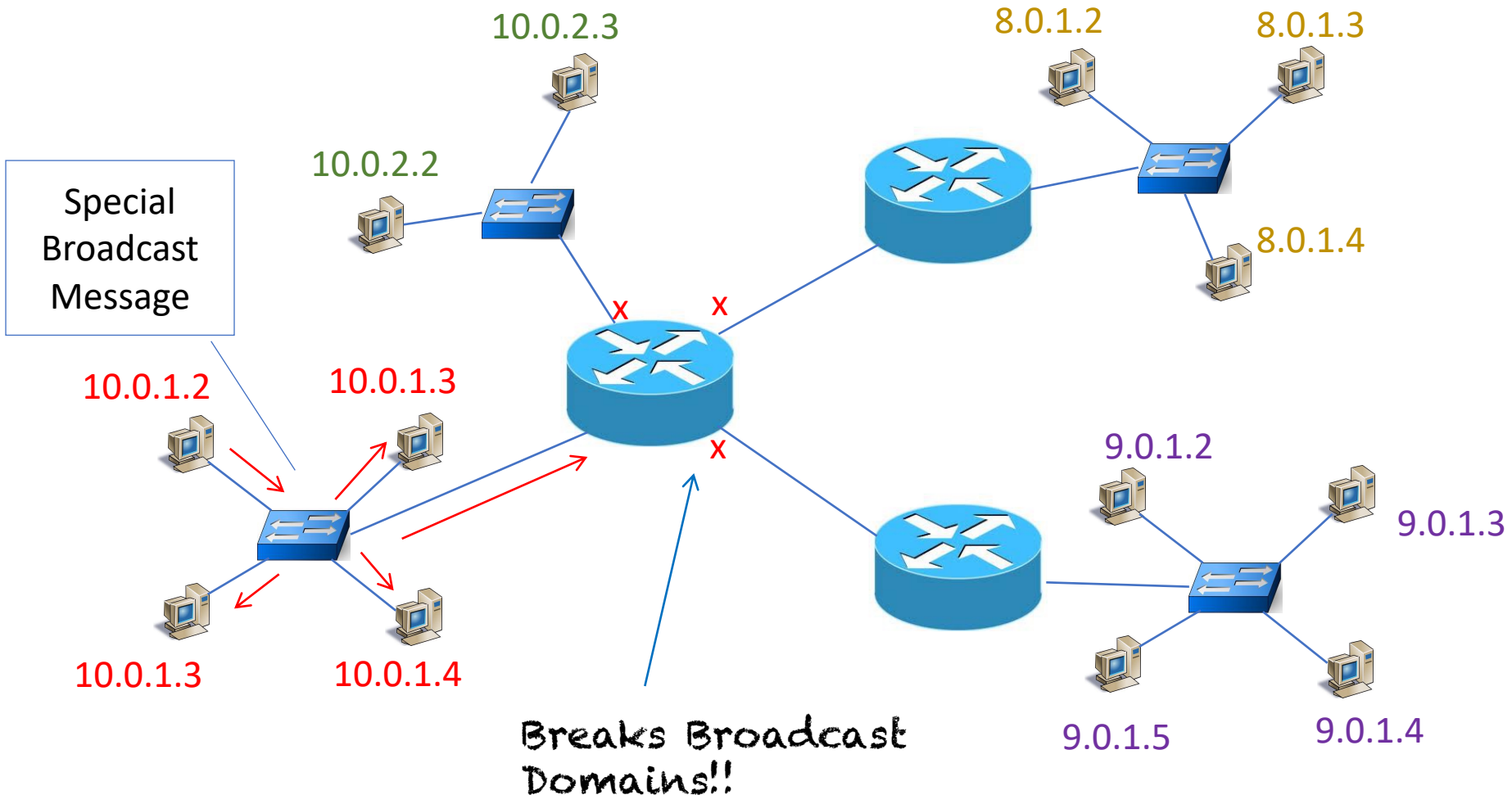
Router

- Layer 3 Device
- Routers connect different Broadcast domains together
- Inspect the **IP packet** (End-to-End Address)
  - IP address is a 32 bit number
  - Represented as 4 decimal numbers from 0 to 255
  - E.g., *192.168.1.15*
- Make a decision on the best direction for the packet

Router

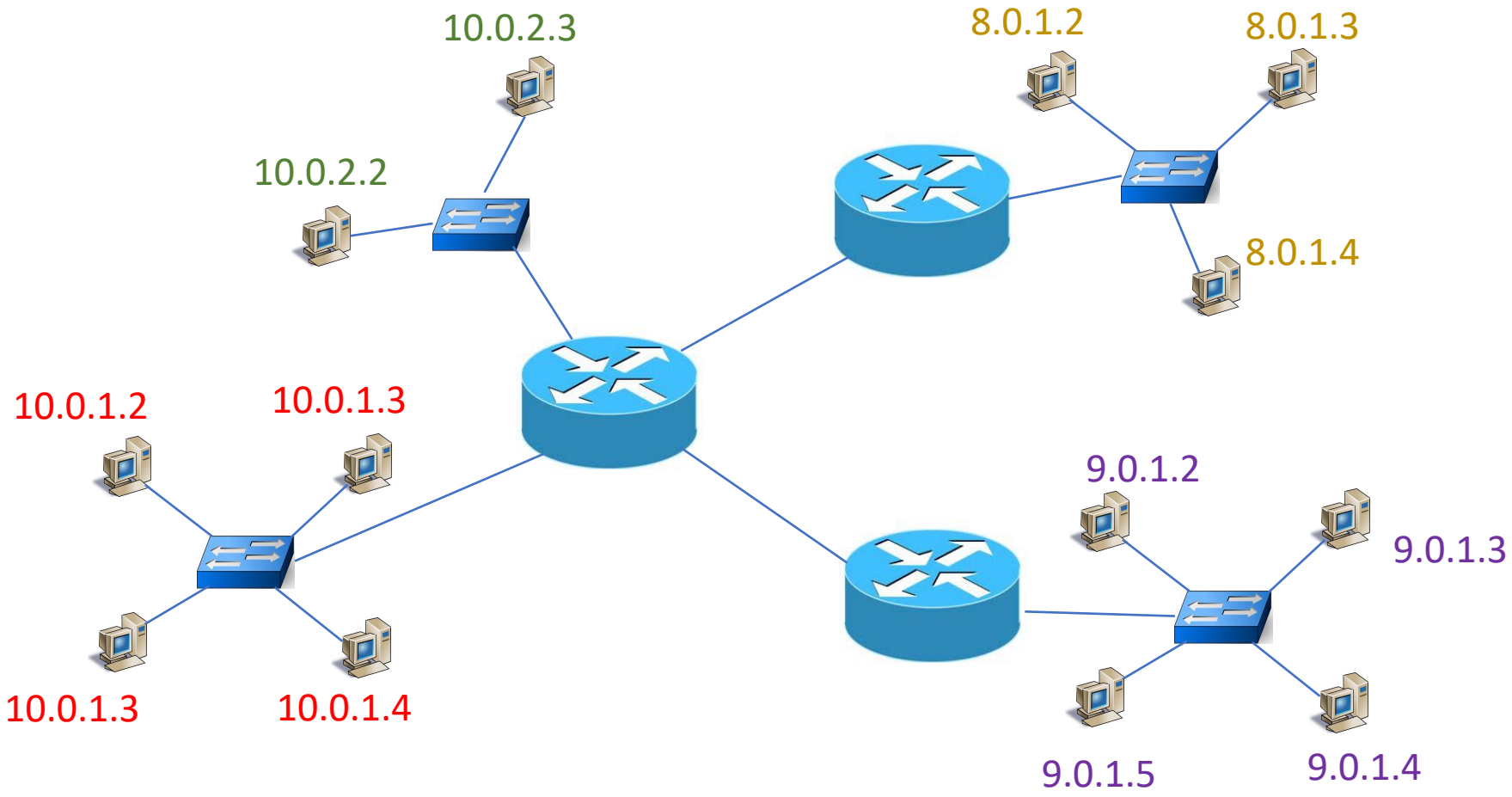

Sender
Receiver
Application
Presentation
Session
Transport
Network
Data link
Physical
Router
Network
Data link
Physical
Application
Presentation
Session
Transport
Network
Data link
Physical

Router

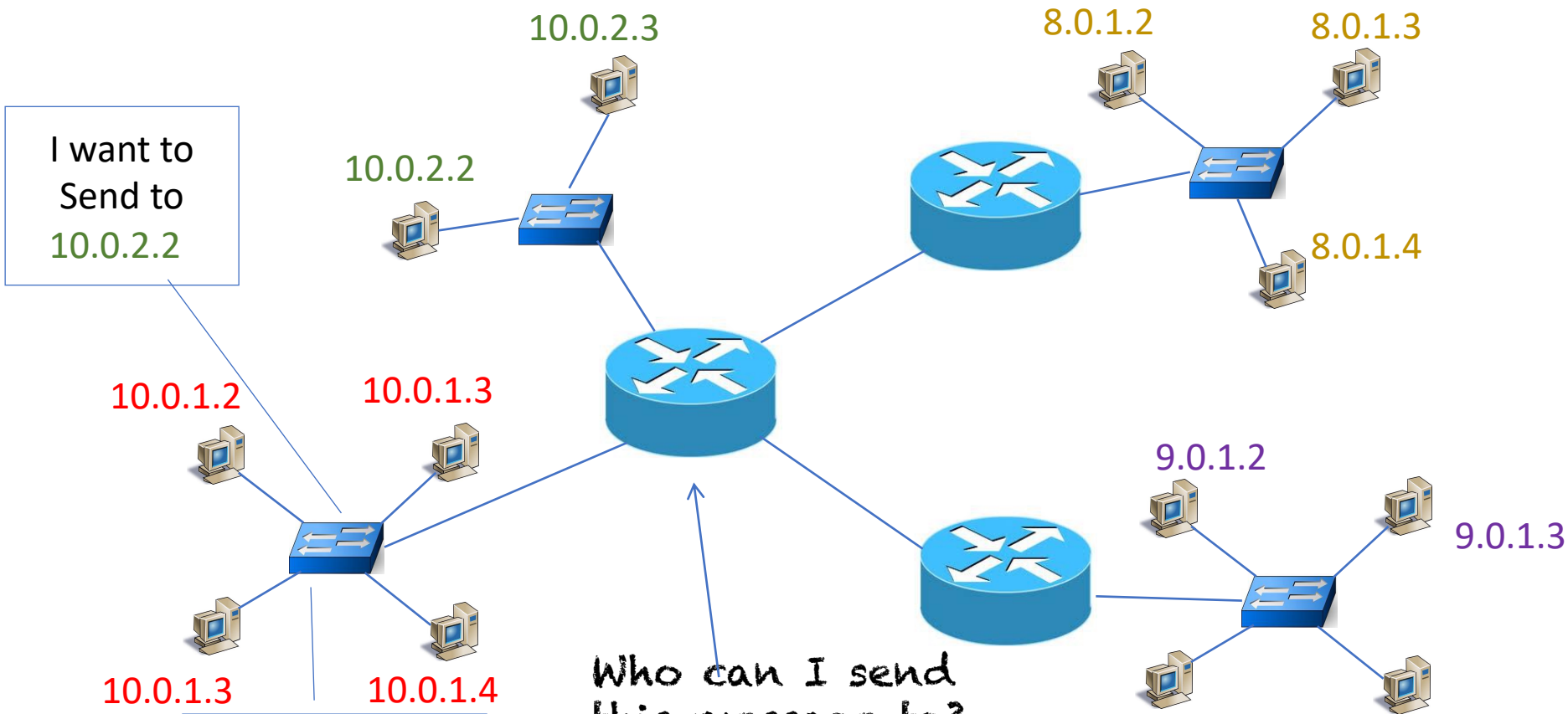

10.0.2.3
8.0.1.2
8.0.1.3
10.0.2.2
Special Broadcast Message
8.0.1.4
x
x
10.0.1.2
10.0.1.3
x
9.0.1.2
9.0.1.3
10.0.1.3
10.0.1.4
Breaks Broadcast Domains!!
9.0.1.5
9.0.1.4

Router

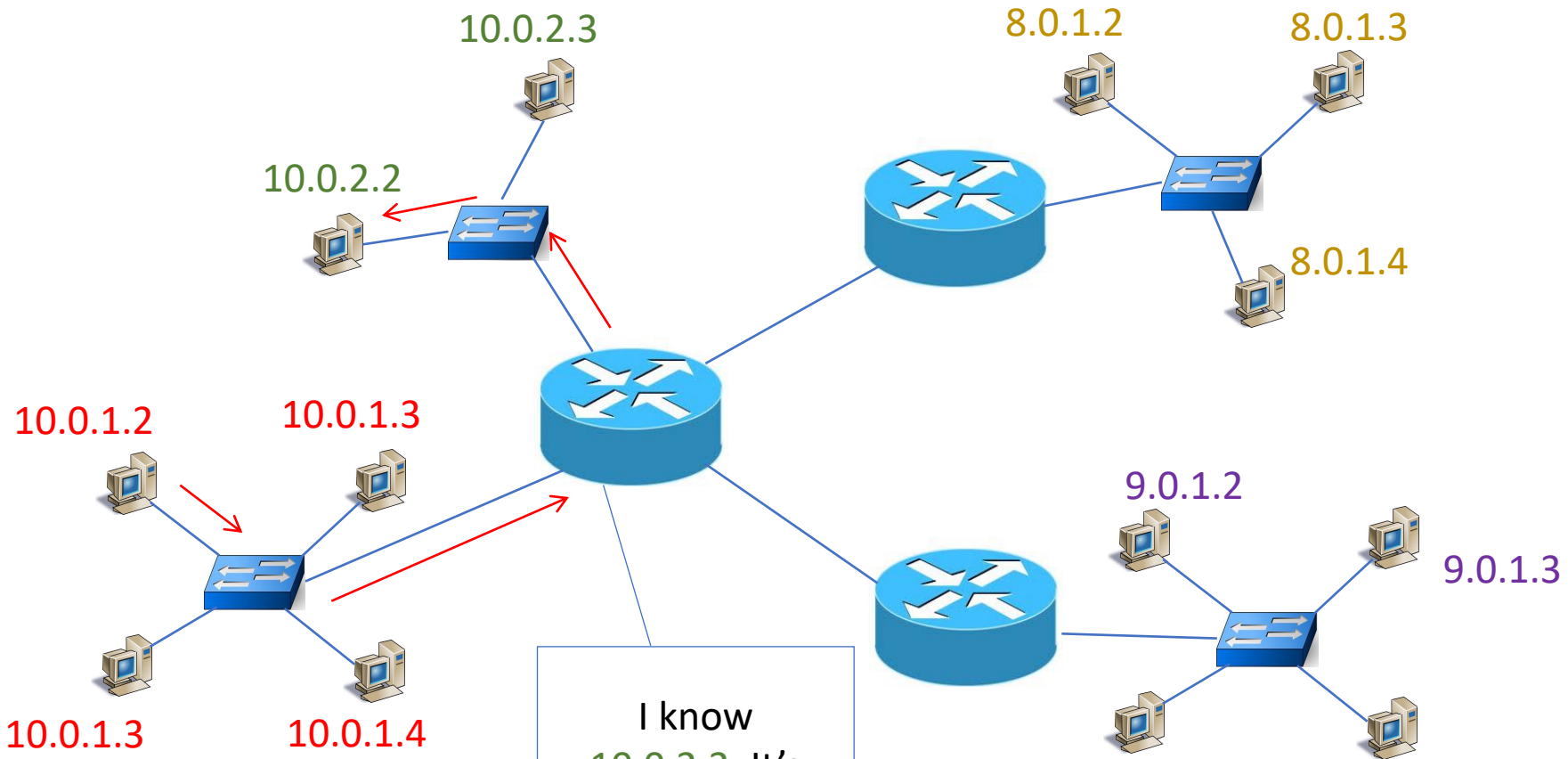
Add Global Addresses!
End-to-End



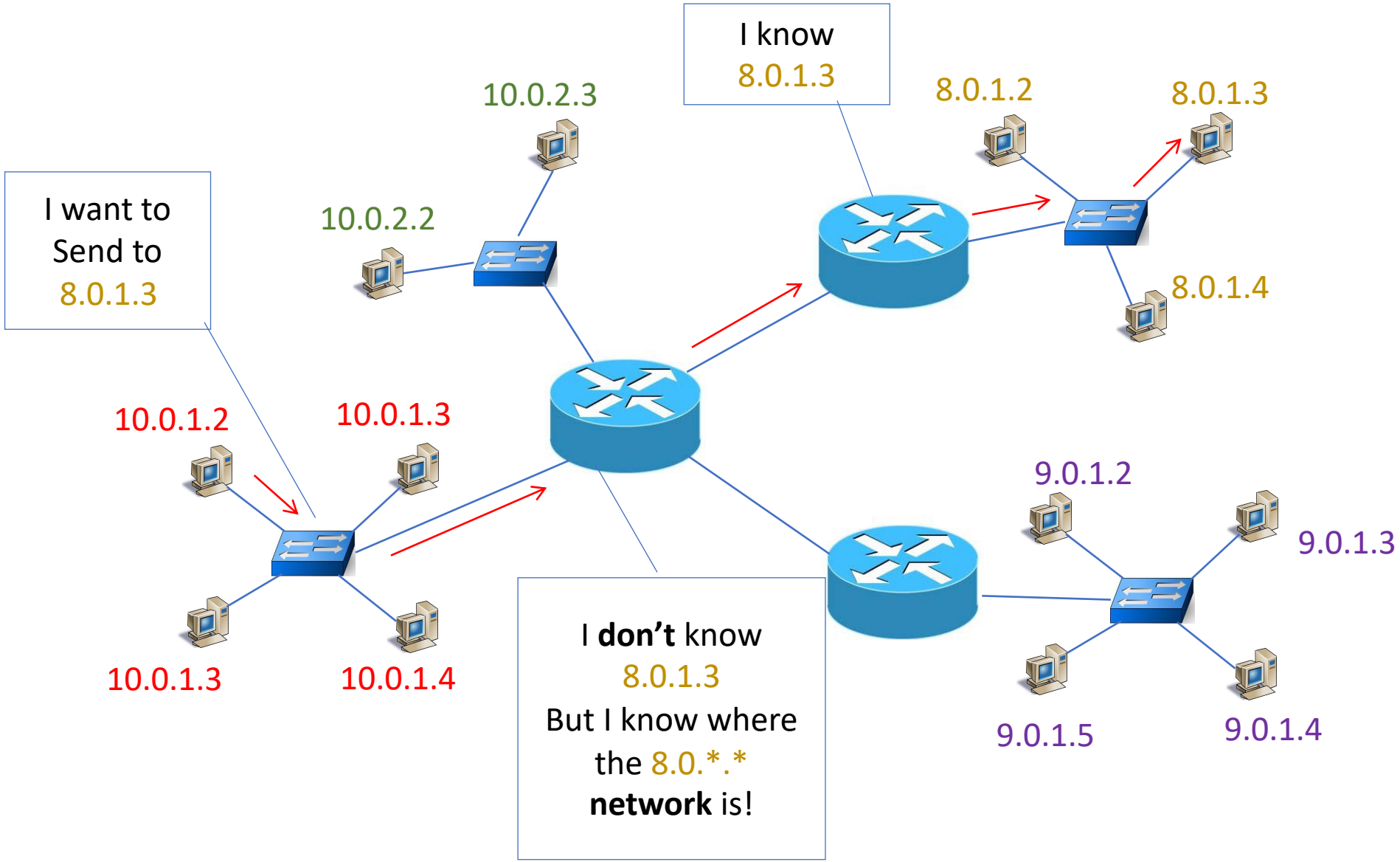
Router


10.0.2.3
8.0.1.2
8.0.1.3
I want to
Send to
10.0.2.2
10.0.2.2
8.0.1.4
10.0.1.2
10.0.1.3
9.0.1.2
9.0.1.3
10.0.1.3
10.0.1.4
I don't know
10.0.2.*
network
Who can I send
this message to?
My Local In/out Point
- my local Router:
Default Gateway
9.0.1.5
9.0.1.4

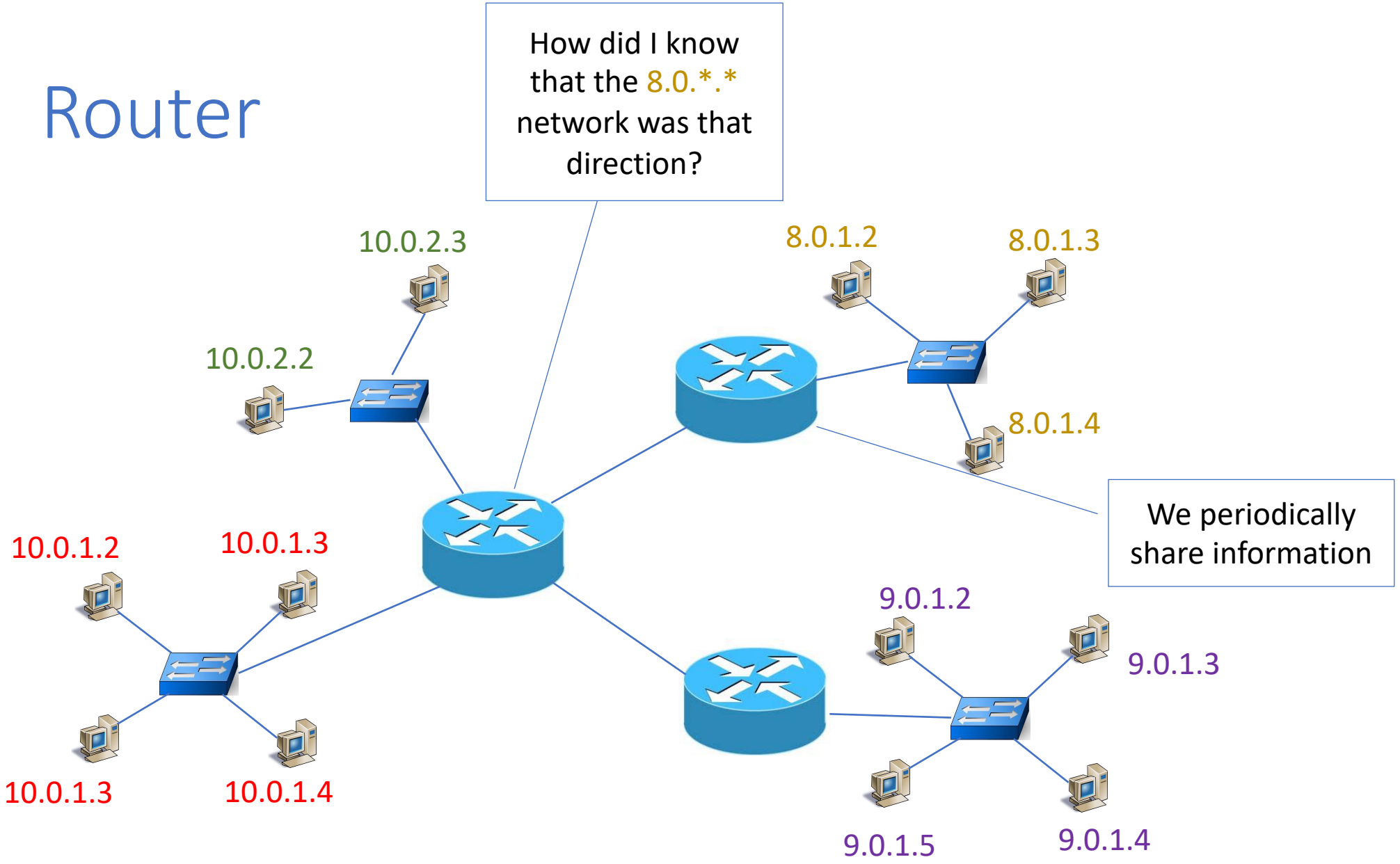
Router


10.0.2.3
10.0.2.2
8.0.1.2
8.0.1.3
8.0.1.4
10.0.1.2
10.0.1.3
10.0.1.3
10.0.1.4
9.0.1.2
9.0.1.3
9.0.1.5
9.0.1.4
I know 10.0.2.2. It's directly attached to me

Router


I know
8.0.1.3
10.0.2.3
8.0.1.2
8.0.1.3
I want to
Send to
8.0.1.3
10.0.2.2
8.0.1.4
10.0.1.2
10.0.1.3
9.0.1.2
9.0.1.3
10.0.1.3
10.0.1.4
I **don't** know
8.0.1.3
But I know where
the 8.0.*.*
network is!
9.0.1.5
9.0.1.4

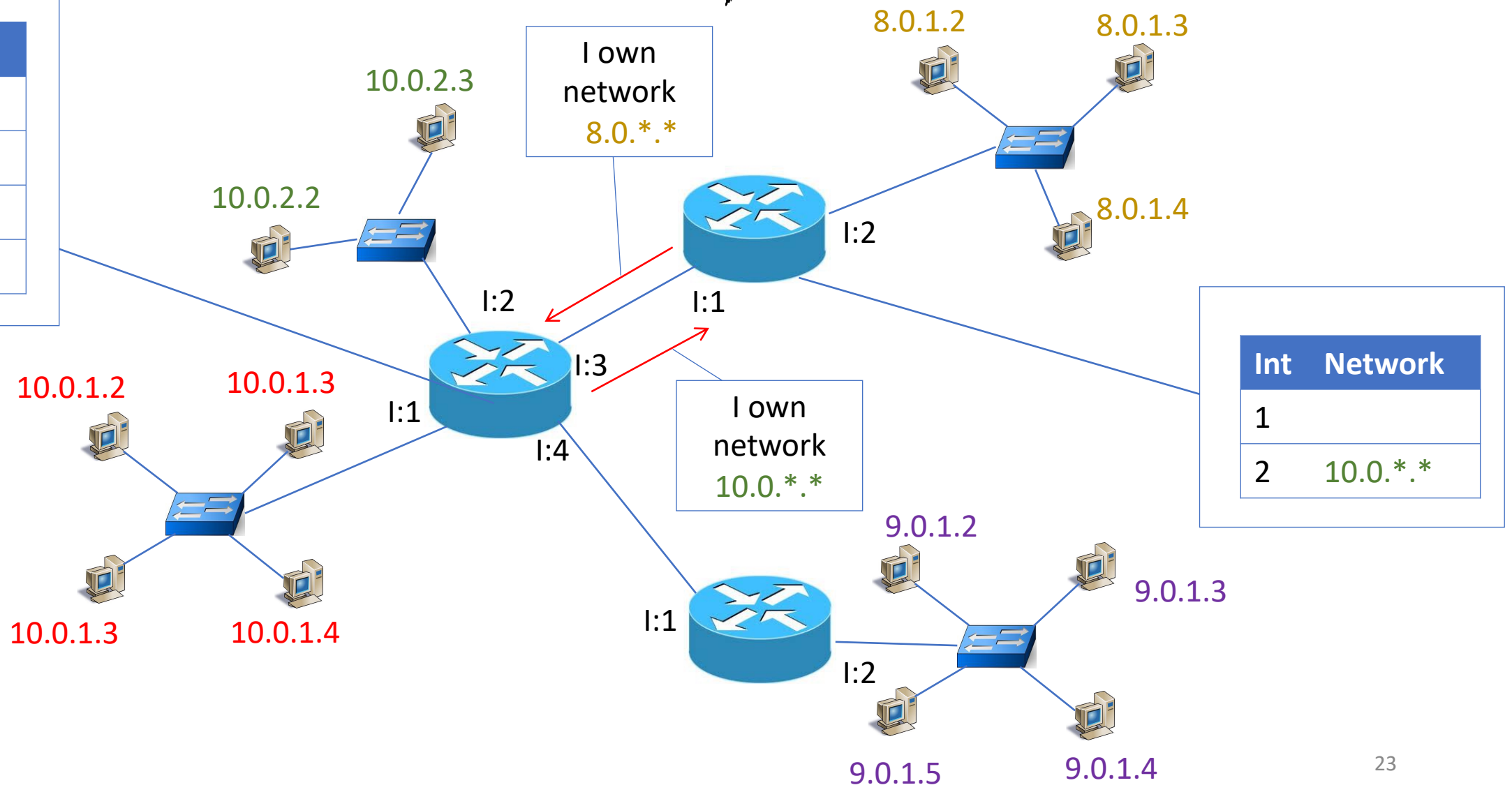
Router


How did I know that the 8.0.*.* network was that direction?
10.0.2.3
10.0.2.2
8.0.1.2
8.0.1.3
8.0.1.4
We periodically share information
10.0.1.2
10.0.1.3
10.0.1.3
10.0.1.4
9.0.1.2
9.0.1.3
9.0.1.5
9.0.1.4

Router

A router's port is called an Interface

Int	Network
1	
2	
3	8.0.*.*
4	

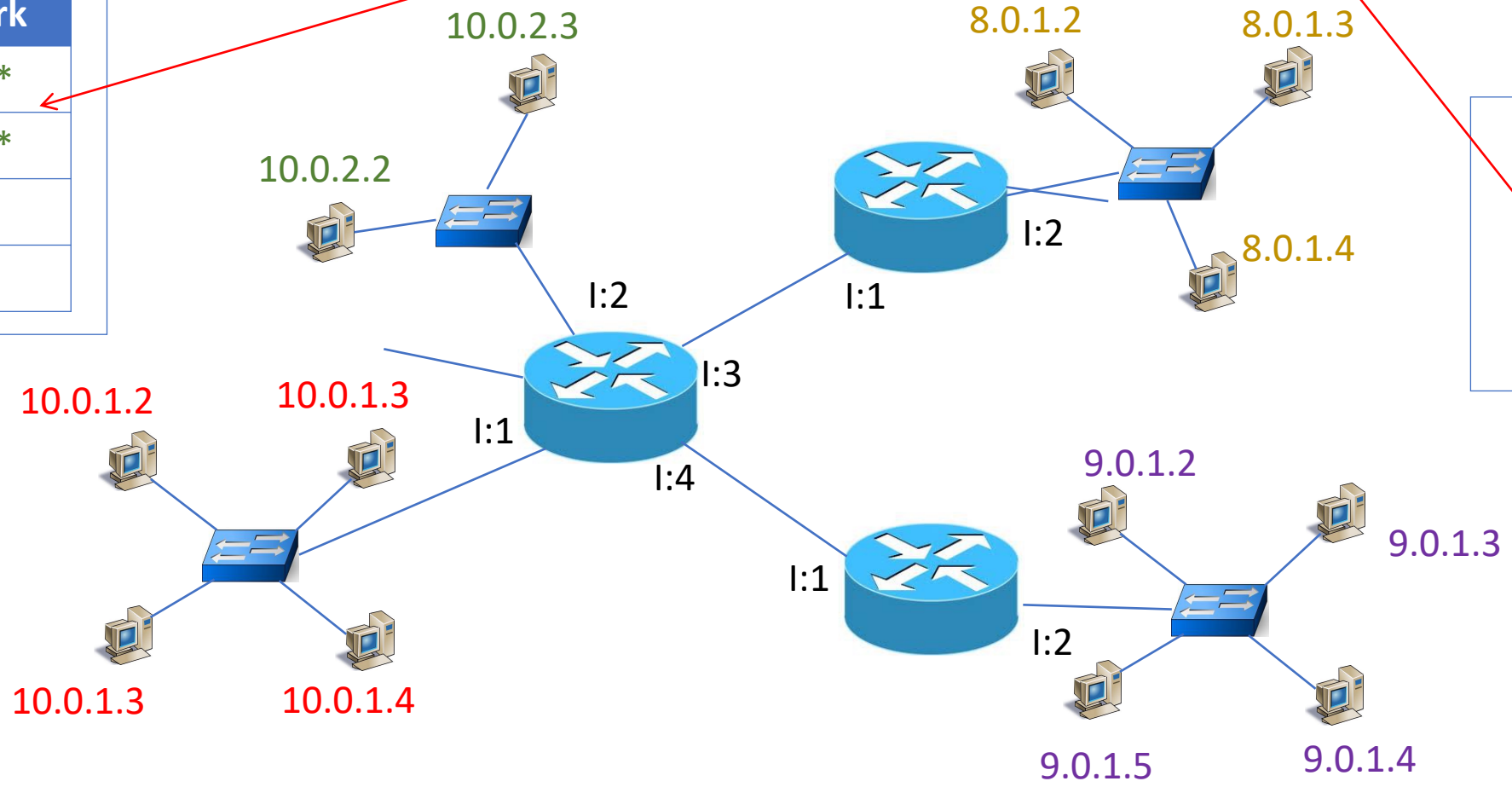


Int	Network
1	
2	10.0.*.*

Router

Static Assignment: by the Administrator

Int	Network
1	10.0.1.*
2	10.0.2.*
3	8.0.*.*
4	

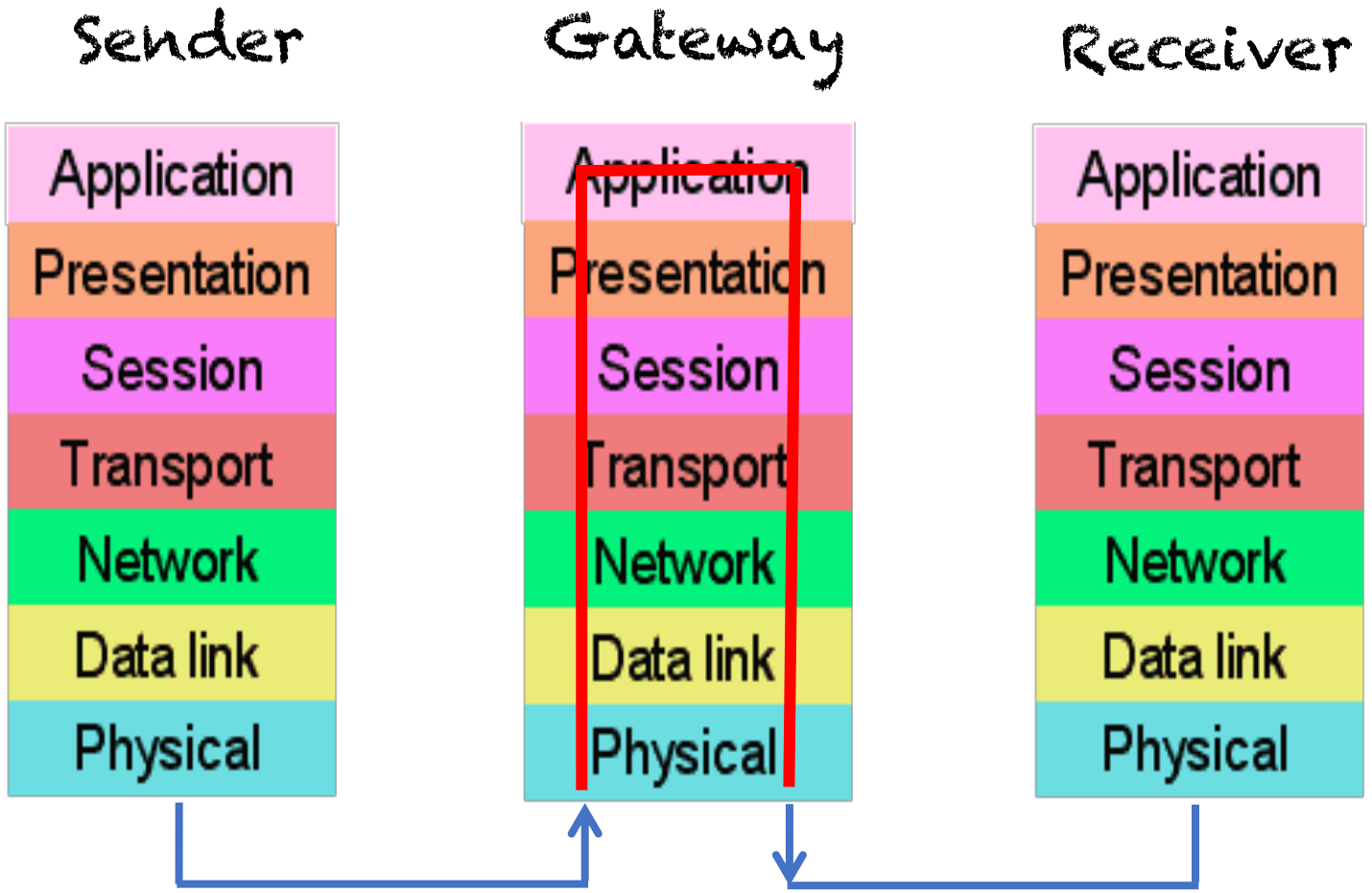


Int	Network
1	8.0.*.*
2	10.0.*.*

Gateway

- Usually a router on a network ownership border.
- Administers' traffic policy!
- Can inspect the whole packet.

Gateway


Sender
Gateway
Receiver
Application
Presentation
Session
Transport
Network
Data link
Physical
Application
Presentation
Session
Transport
Network
Data link
Physical
Application
Presentation
Session
Transport
Network
Data link
Physical

Servers

- Servers support Applications
- They deliver services on the internet.
  - Web page services
  - File transfer
  - Media Streaming