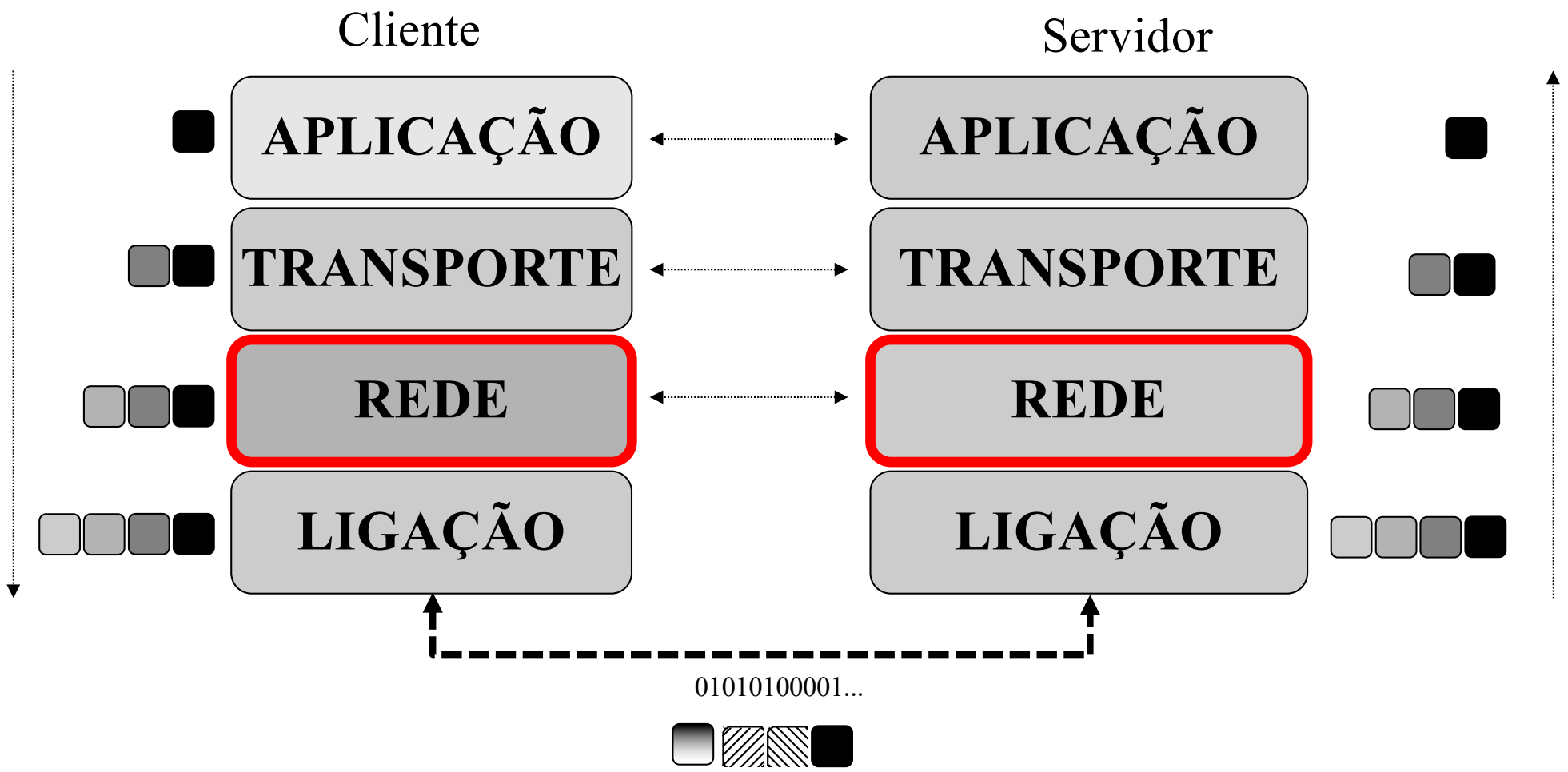
REDES DE COMPUTADORES

Mário Antunes
mario.antunes@ipleiria.pt

Outubro de 2019

REVISÃO

Modelo de comunicação TCP/IP

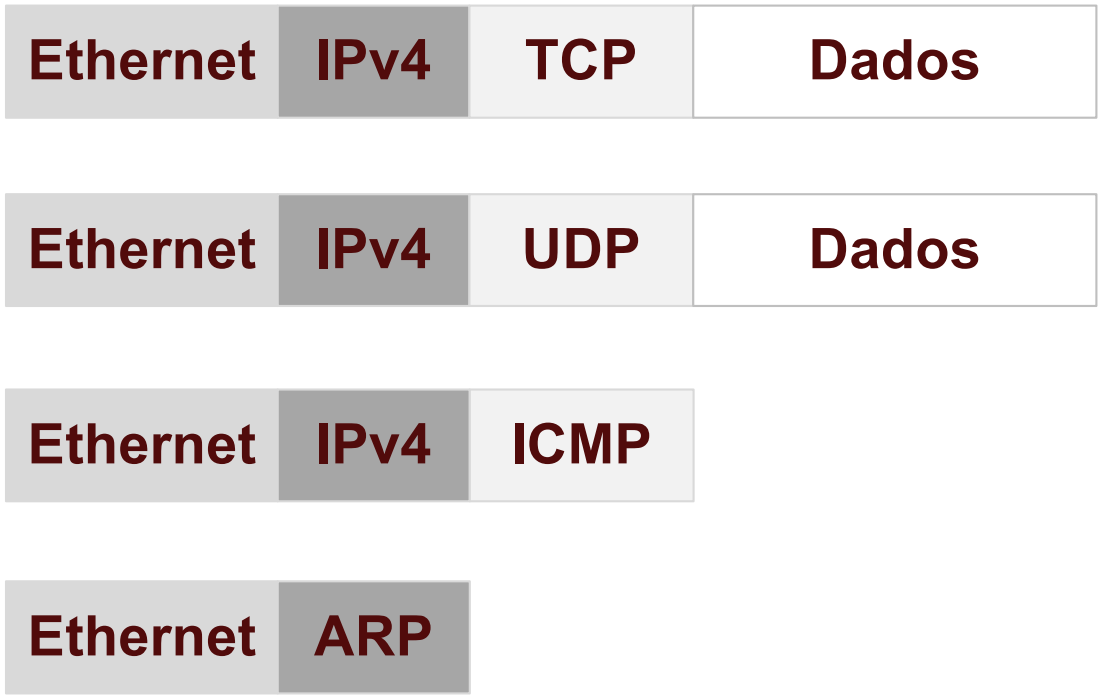


ENCAPSULAMENTO

REVISÃO

Modelo de comunicação TCP/IP

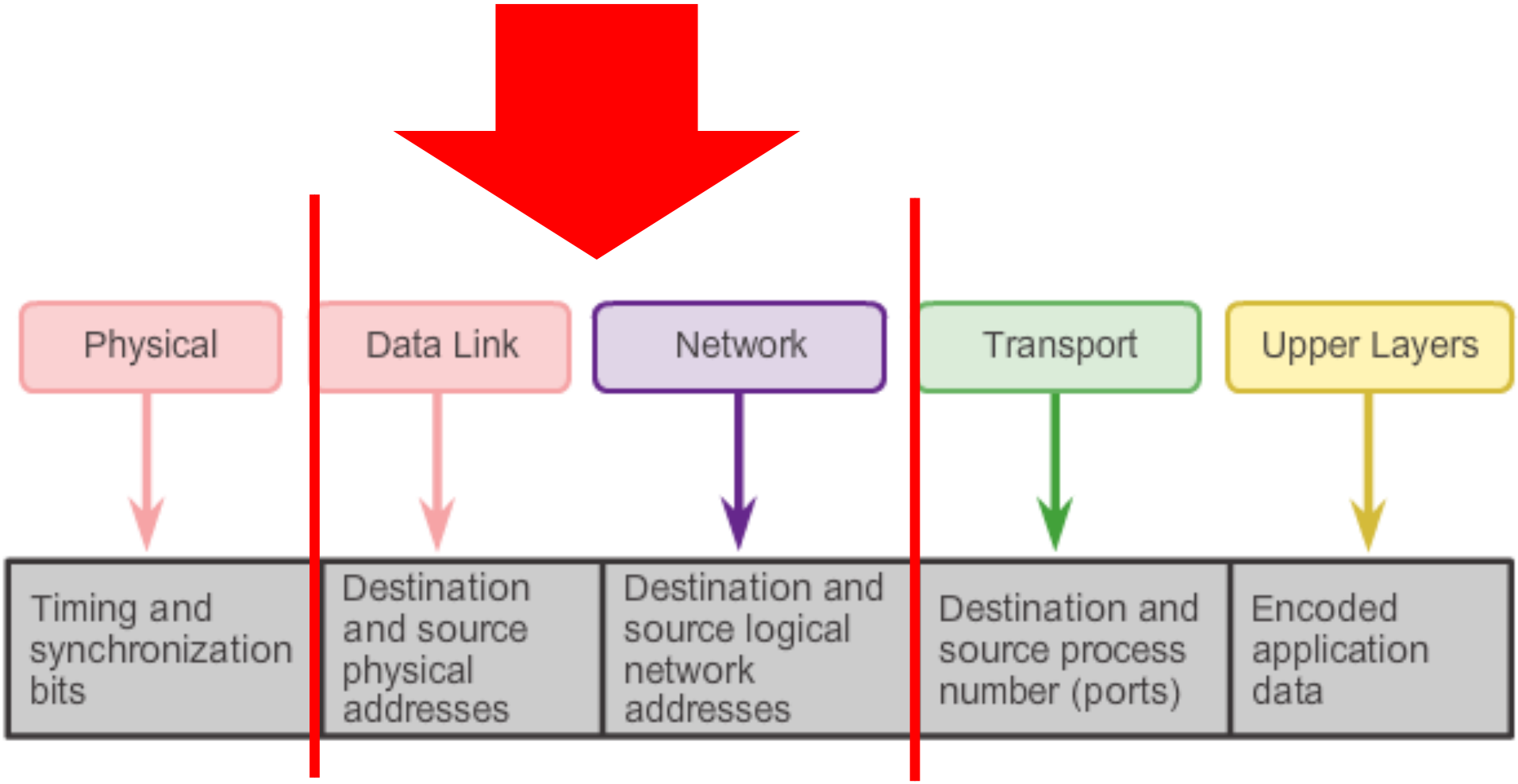
Exemplos de encapsulamentos comuns:



REVISÃO

Moving Data in the Network

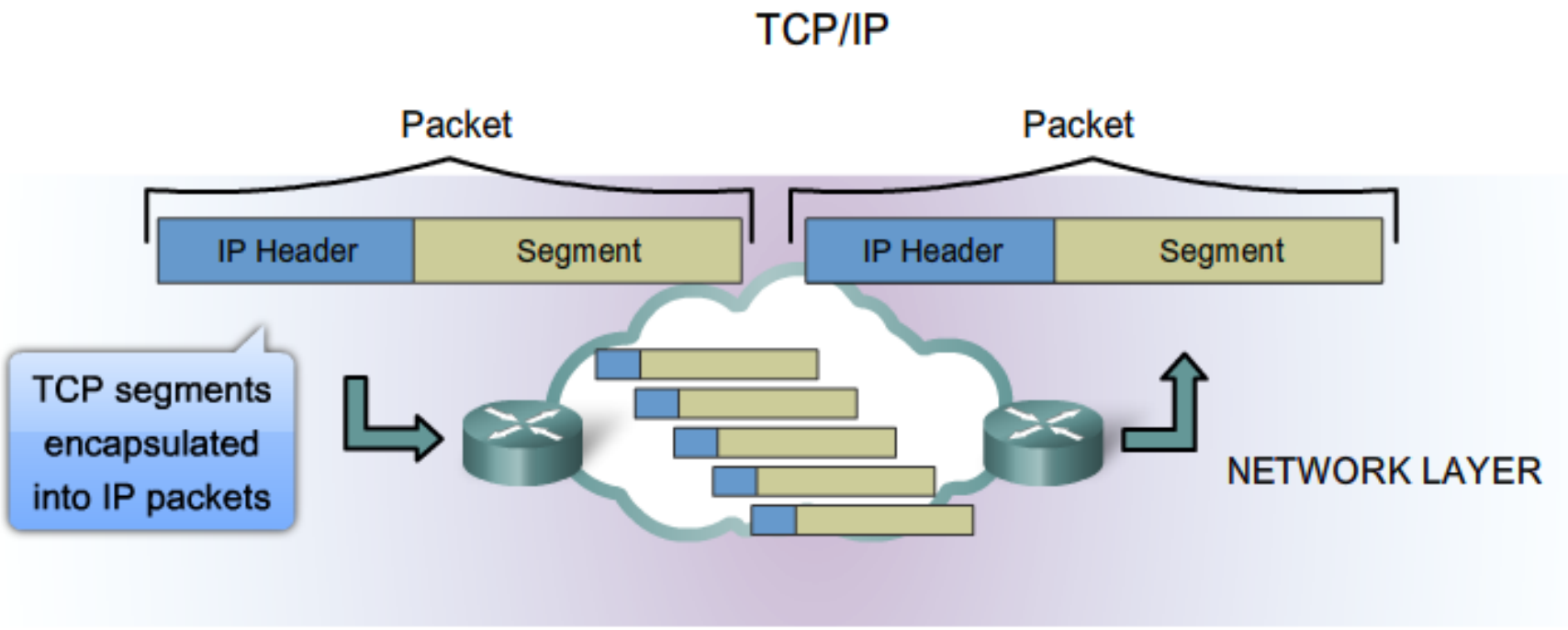
Accessing Local Resources



Funções da camada de rede

- Endereçamento lógico dos dispositivos
- Encapsulamento
- Encaminhamento
- Reconstituição

IP Components

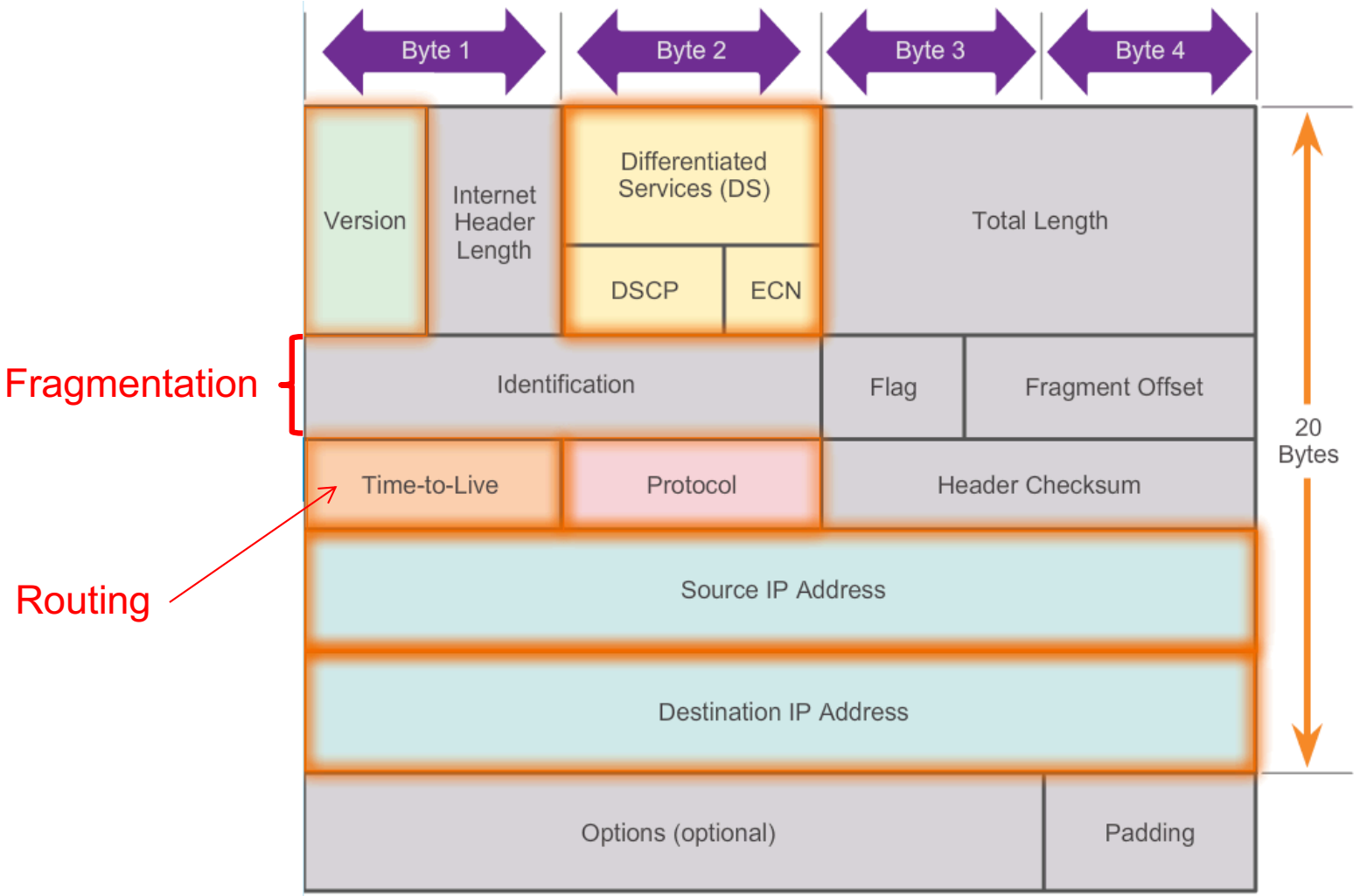


IP Packets flow through the internetwork.

- Connectionless - No connection is established before sending data packets.
- Best Effort (unreliable) - No overhead is used to guarantee packet delivery.
- Media Independent - Operates independently of the medium carrying the data.

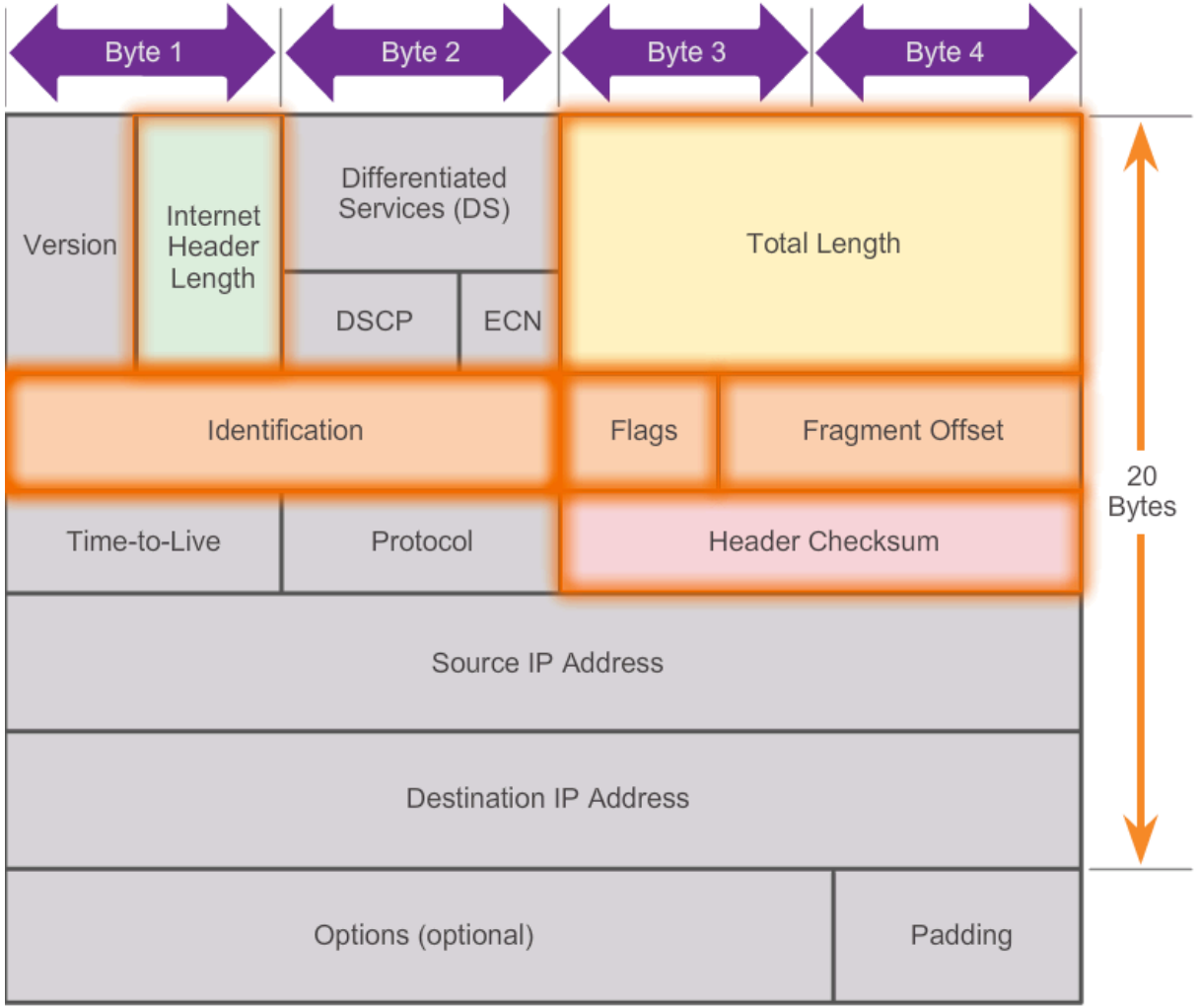
IPv4 Packet Header

Contents of the IPv4 packet header



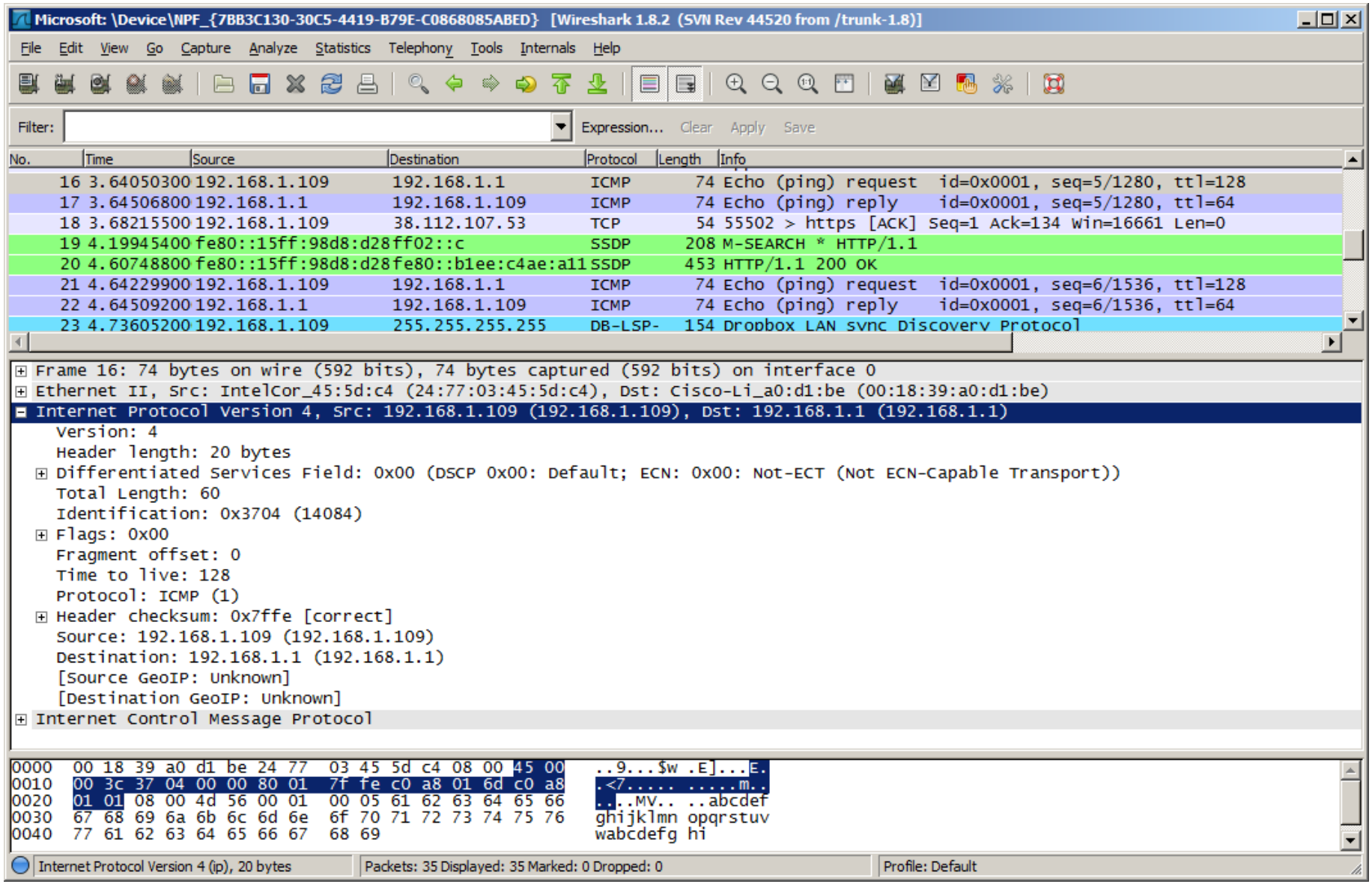
IPv4 Header Fields

Contents of the IPv4 header fields



IPv4 Packet

Sample IPv4 Headers

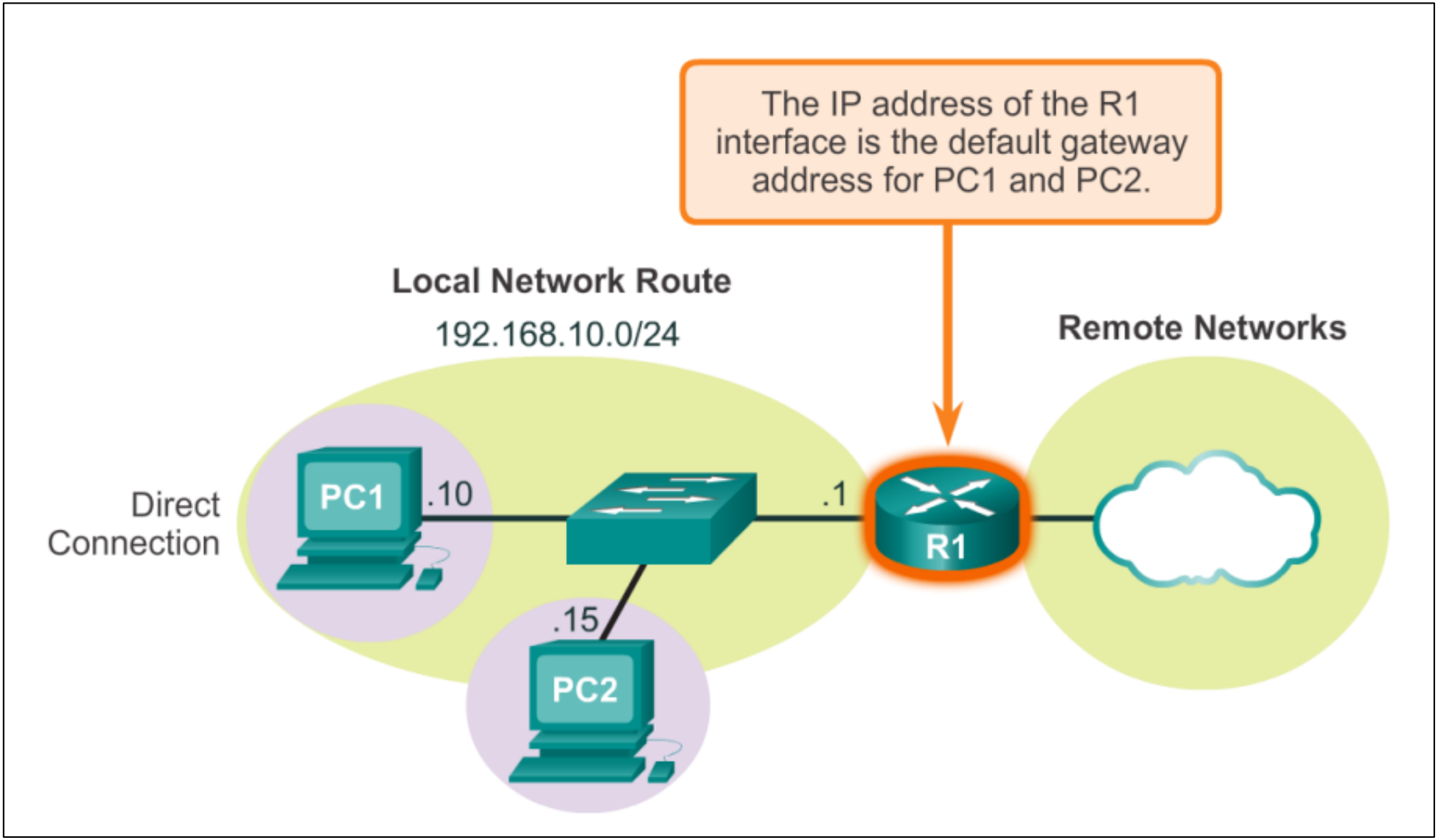


Limitations of IPv4

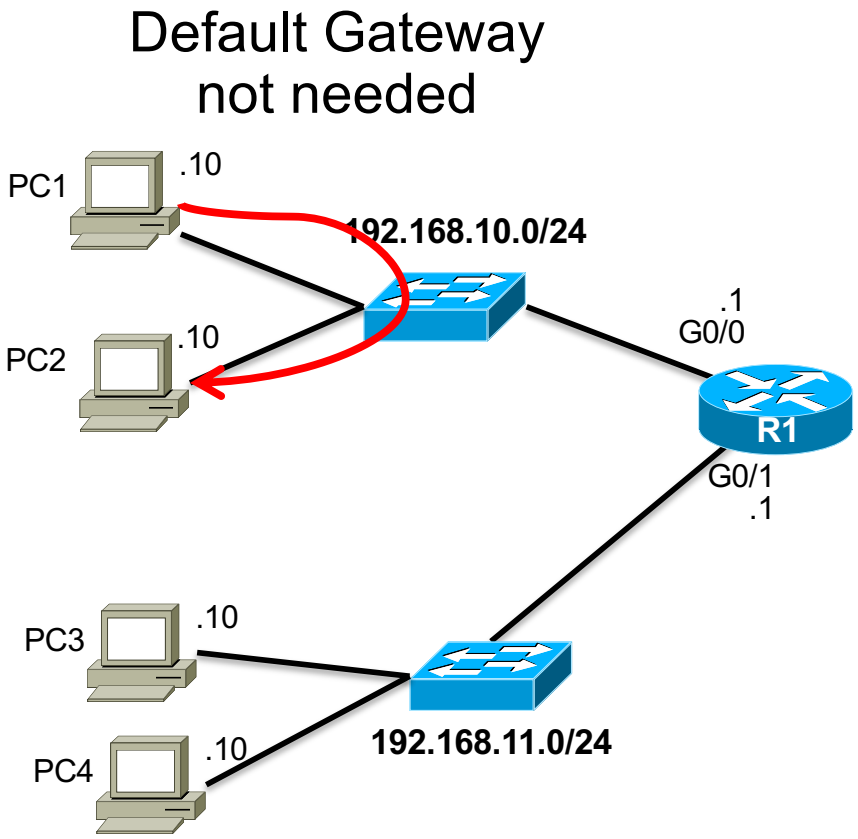
- IP Address depletion
- Internet routing table expansion
- Lack of end-to-end connectivity

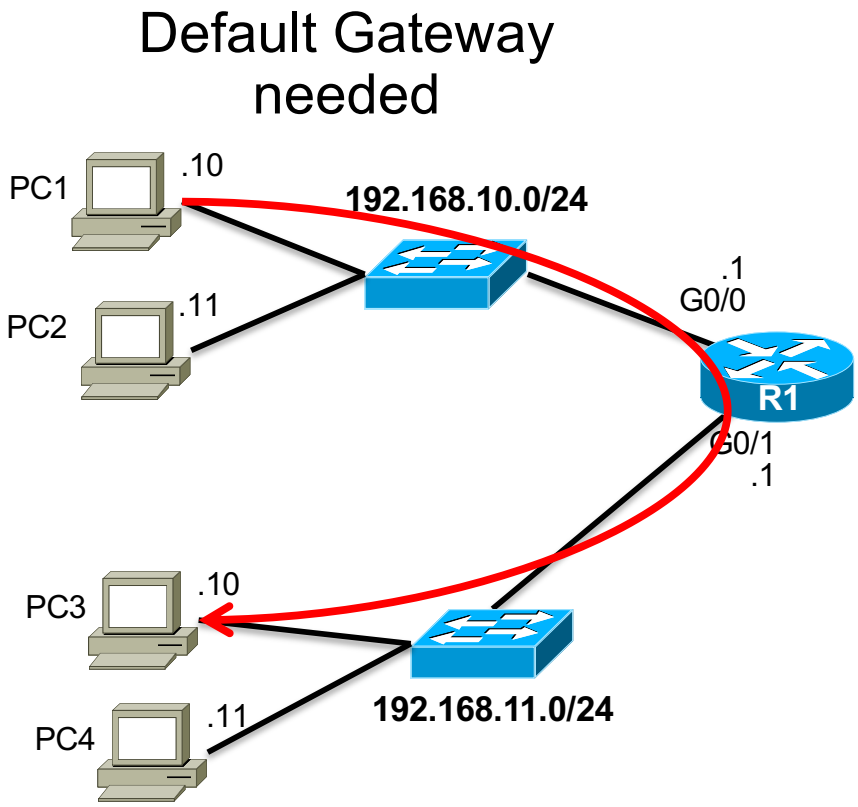
IPv6

Host Packet Forwarding Decision

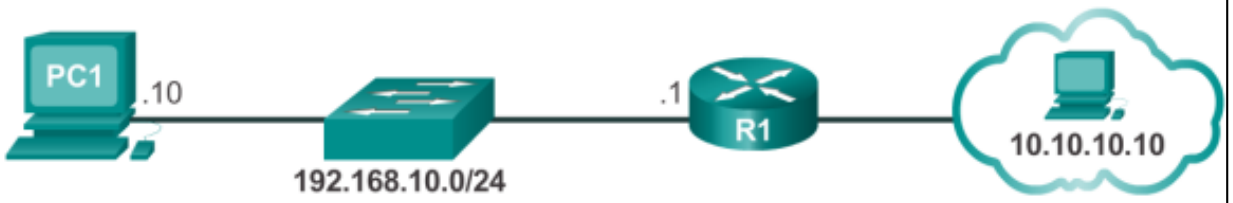


Default Gateway on a Host



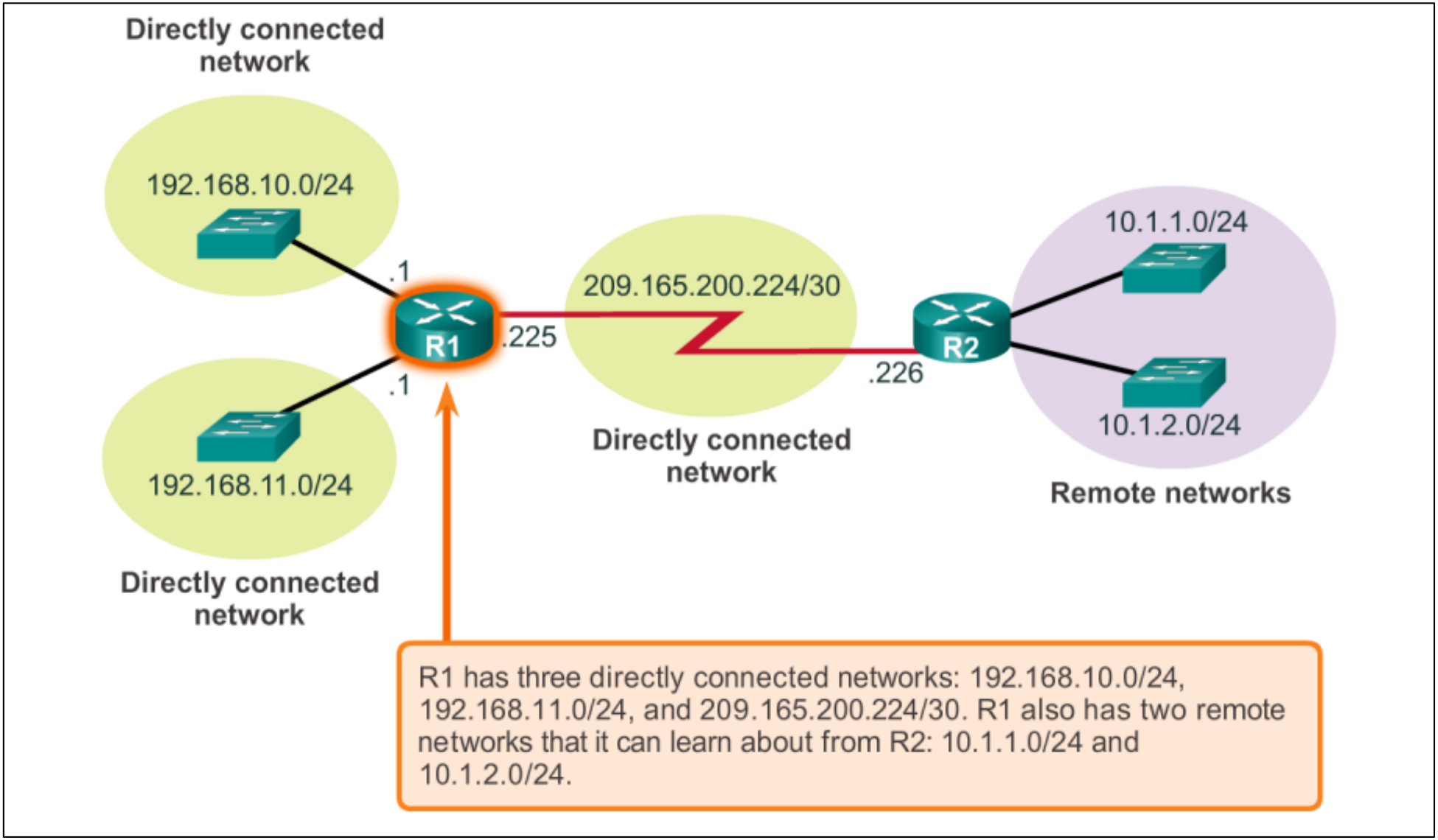


Sample IPv4 Host Routing Table

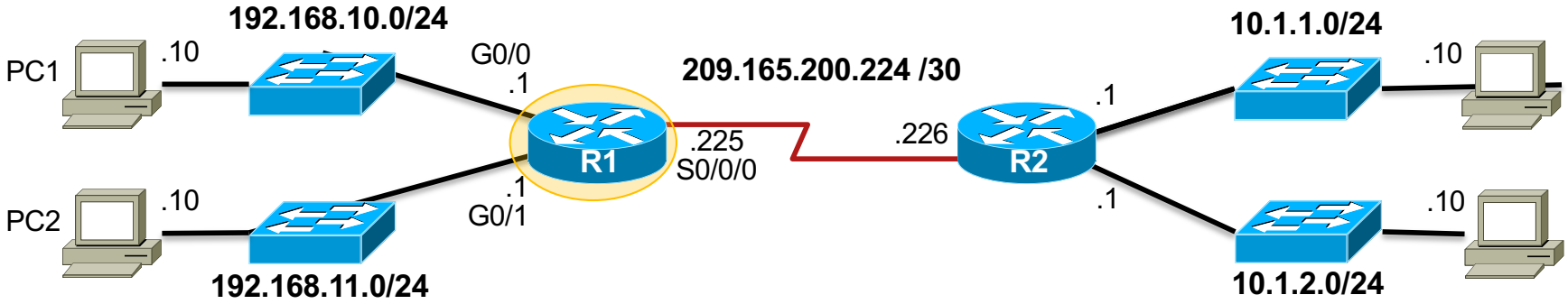



```
C:\Users\PC1> netstat -r

<Output omitted>

IPv4 Route Table
===========================================================================
Active Routes:
Network Destination        Netmask          Gateway       Interface Metric
          0.0.0.0          0.0.0.0    192.168.10.1  192.168.10.10     25
        127.0.0.0        255.0.0.0         On-link       127.0.0.1    306
        127.0.0.1  255.255.255.255         On-link       127.0.0.1    306
  127.255.255.255  255.255.255.255         On-link       127.0.0.1    306
    192.168.10.0    255.255.255.0         On-link  192.168.10.10    281
   192.168.10.10  255.255.255.255         On-link  192.168.10.10    281
  192.168.10.255  255.255.255.255         On-link  192.168.10.10    281
        224.0.0.0        240.0.0.0         On-link       127.0.0.1    306
        224.0.0.0        240.0.0.0         On-link  192.168.10.10    281
  255.255.255.255  255.255.255.255         On-link       127.0.0.1    306
  255.255.255.255  255.255.255.255         On-link  192.168.10.10    281
===========================================================================

<Output omitted>
```

Router Packet Forwarding Decision



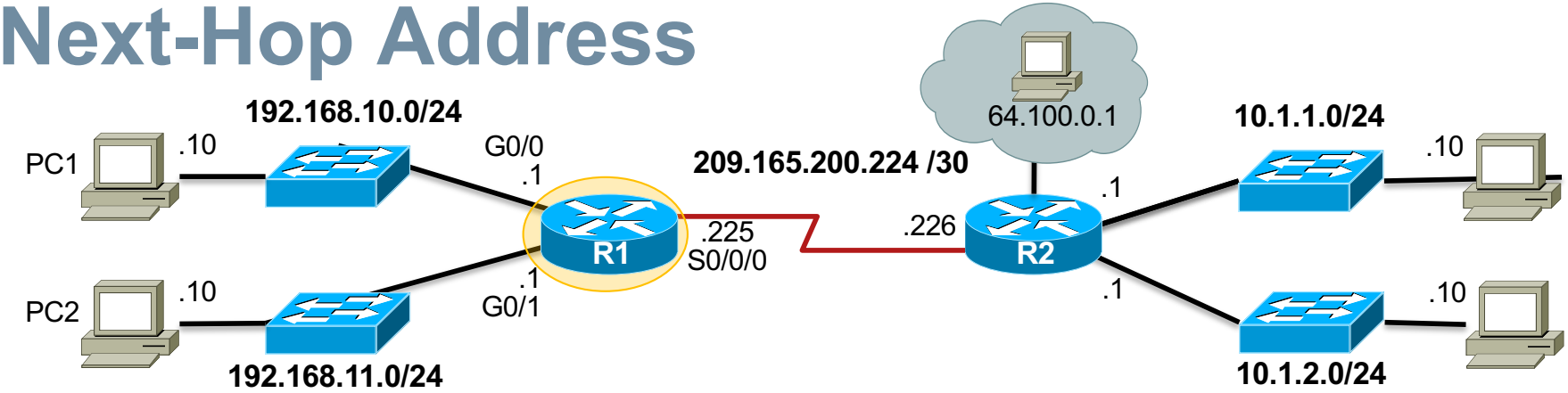
IPv4 Router Routing Table




```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D       10.1.1.0/24 [90/2170112] via 209.165.200.226, 00:00:05, Serial0/0/0
D       10.1.2.0/24 [90/2170112] via 209.165.200.226, 00:00:05, Serial0/0/0
     192.168.10.0/24 is variably subnetted, 2 subnets, 3 masks
C       192.168.10.0/24 is directly connected, GigabitEthernet0/0
L       192.168.10.1/32 is directly connected, GigabitEthernet0/0
     192.168.11.0/24 is variably subnetted, 2 subnets, 3 masks
C       192.168.11.0/24 is directly connected, GigabitEthernet0/1
L       192.168.11.1/32 is directly connected, GigabitEthernet0/1
     209.165.200.0/24 is variably subnetted, 2 subnets, 3 masks
C       209.165.200.224/30 is directly connected, Serial0/0/0
L       209.165.200.225/32 is directly connected, Serial0/0/0
R1#
```

Router Routing Tables

Next-Hop Address




```
R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
D       10.1.1.0/24 [90/2170112] via 209.165.200.226, 00:00:05, Serial0/0/0
D       10.1.2.0/24 [90/2170112] via 209.165.200.226, 00:00:05, Serial0/0/0
     192.168.10.0/24 is variably subnetted, 2 subnets, 3 masks
C       192.168.10.0/24 is directly connected, GigabitEthernet0/0
L       192.168.10.1/32 is directly connected, GigabitEthernet0/0
     192.168.11.0/24 is variably subnetted, 2 subnets, 3 masks
C       192.168.11.0/24 is directly connected, GigabitEthernet0/1
L       192.168.11.1/32 is directly connected, GigabitEthernet0/1
     209.165.200.0/24 is variably subnetted, 2 subnets, 3 masks
C       209.165.200.224/30 is directly connected, Serial0/0/0
L       209.165.200.225/32 is directly connected, Serial0/0/0
R1#
```

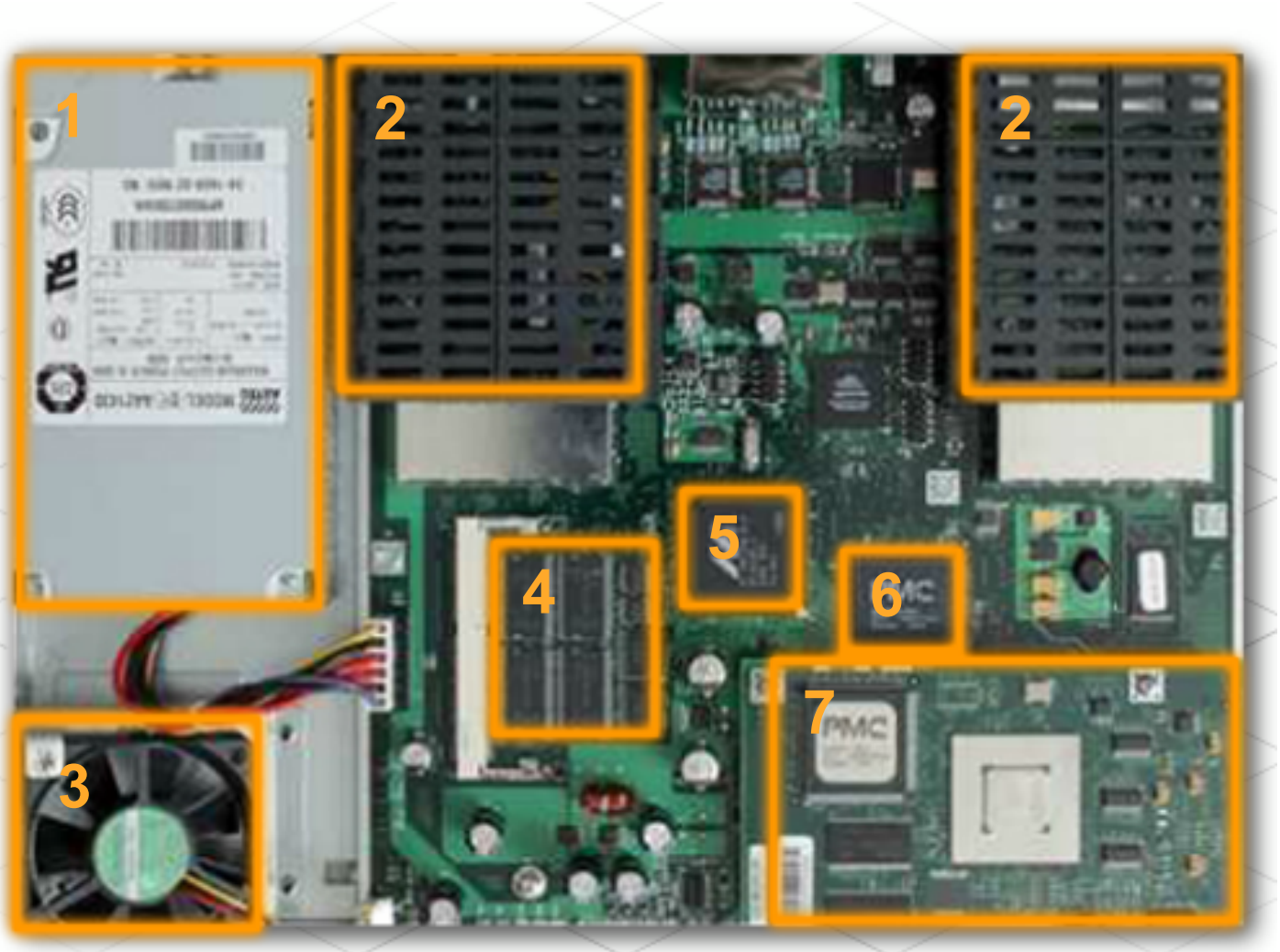
A Router is a Computer

Router Memory

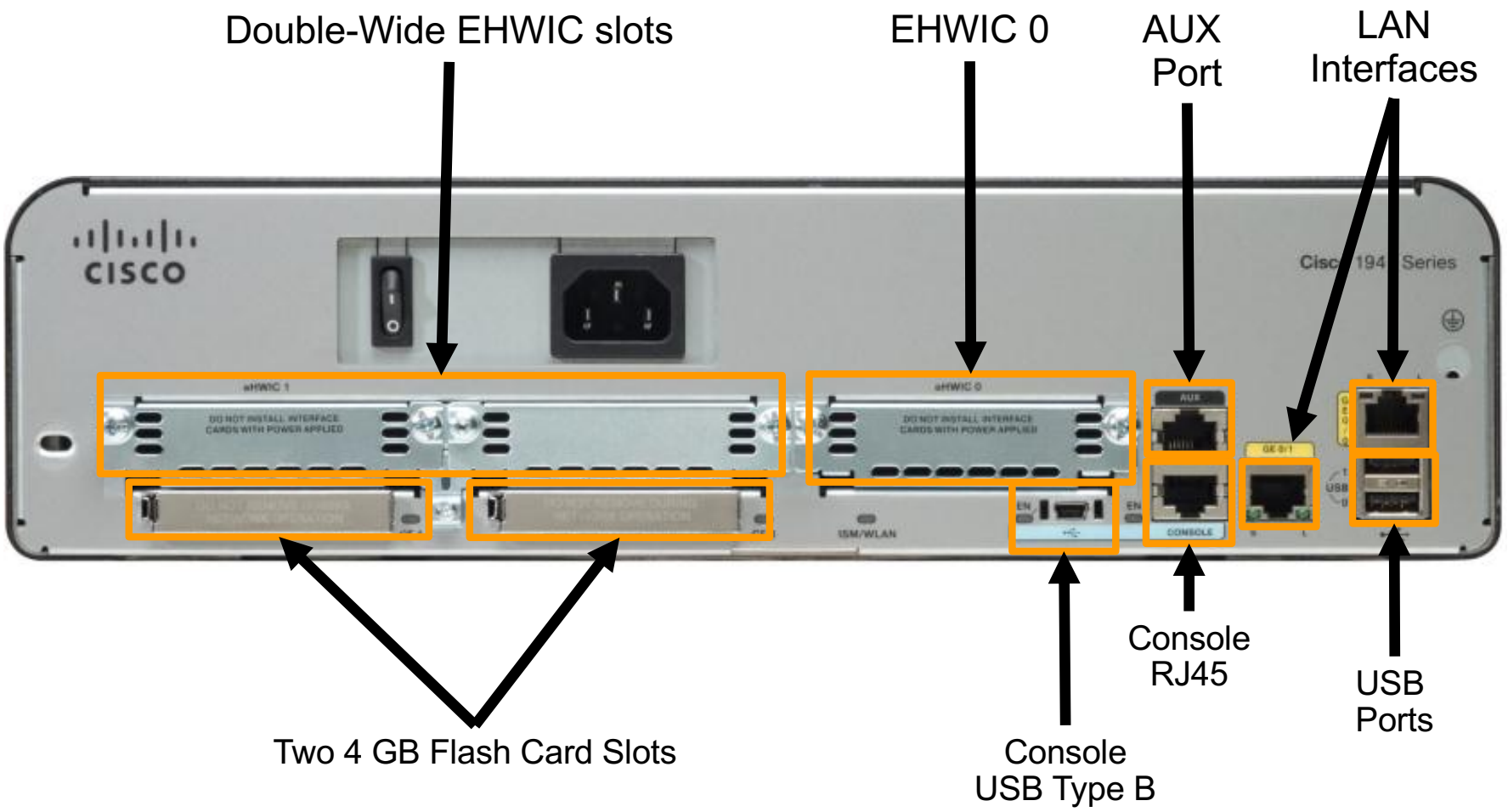
Memory	Volatile / Non-Volatile	Stores
RAM	Volatile	• Running IOS • Running configuration file • IP routing and ARP tables • Packet buffer
ROM	Non-Volatile	• Bootup instructions • Basic diagnostic software • Limited IOS
NVRAM	Non-Volatile	• Startup configuration file
Flash	Non-Volatile	• IOS • Other system files

Inside a Router

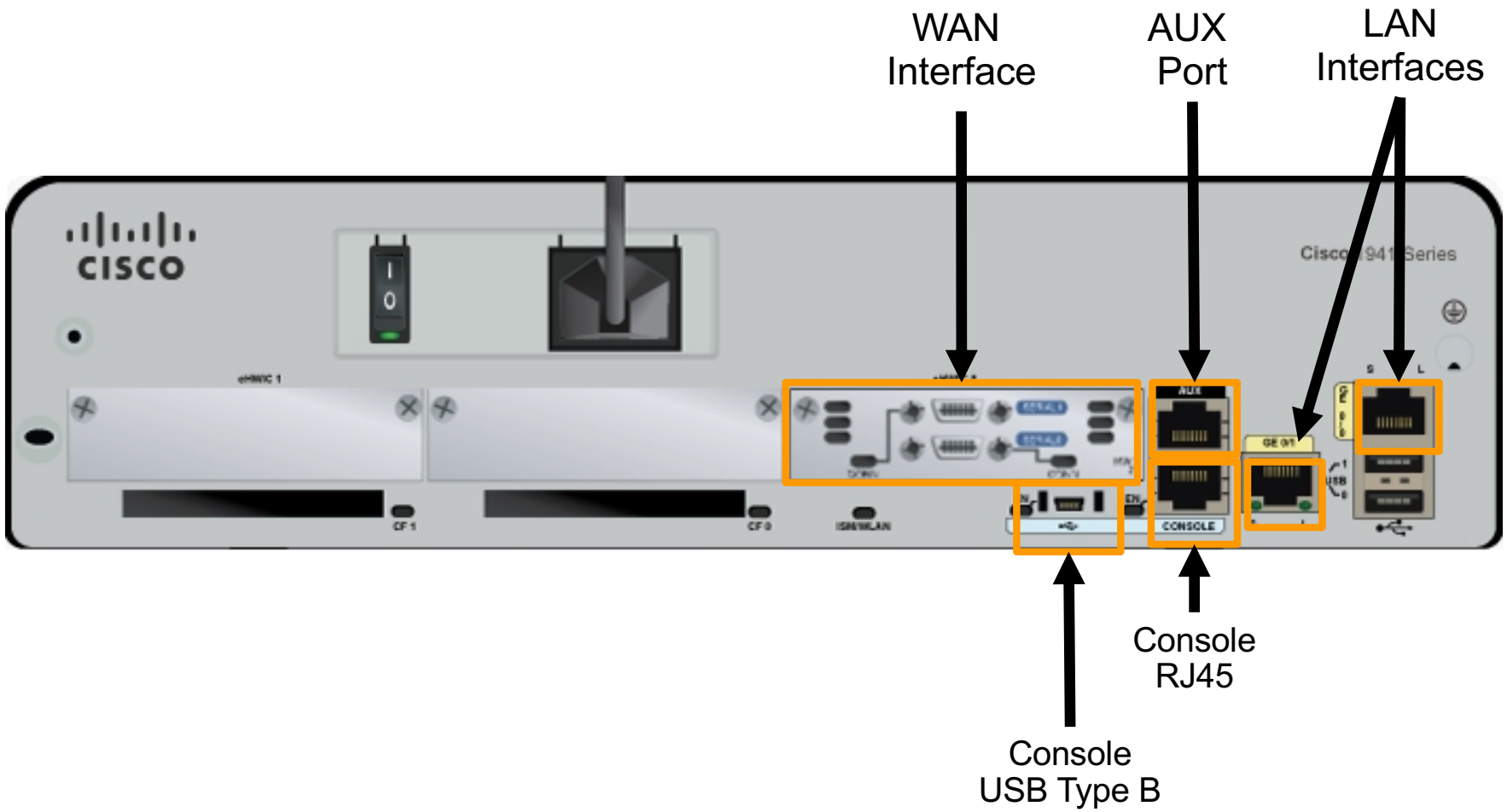
1. Power Supply
2. Shield for WIC
3. Fan
4. SDRAM
5. NVRAM
6. CPU
7. Advanced Integration Module (AIM)



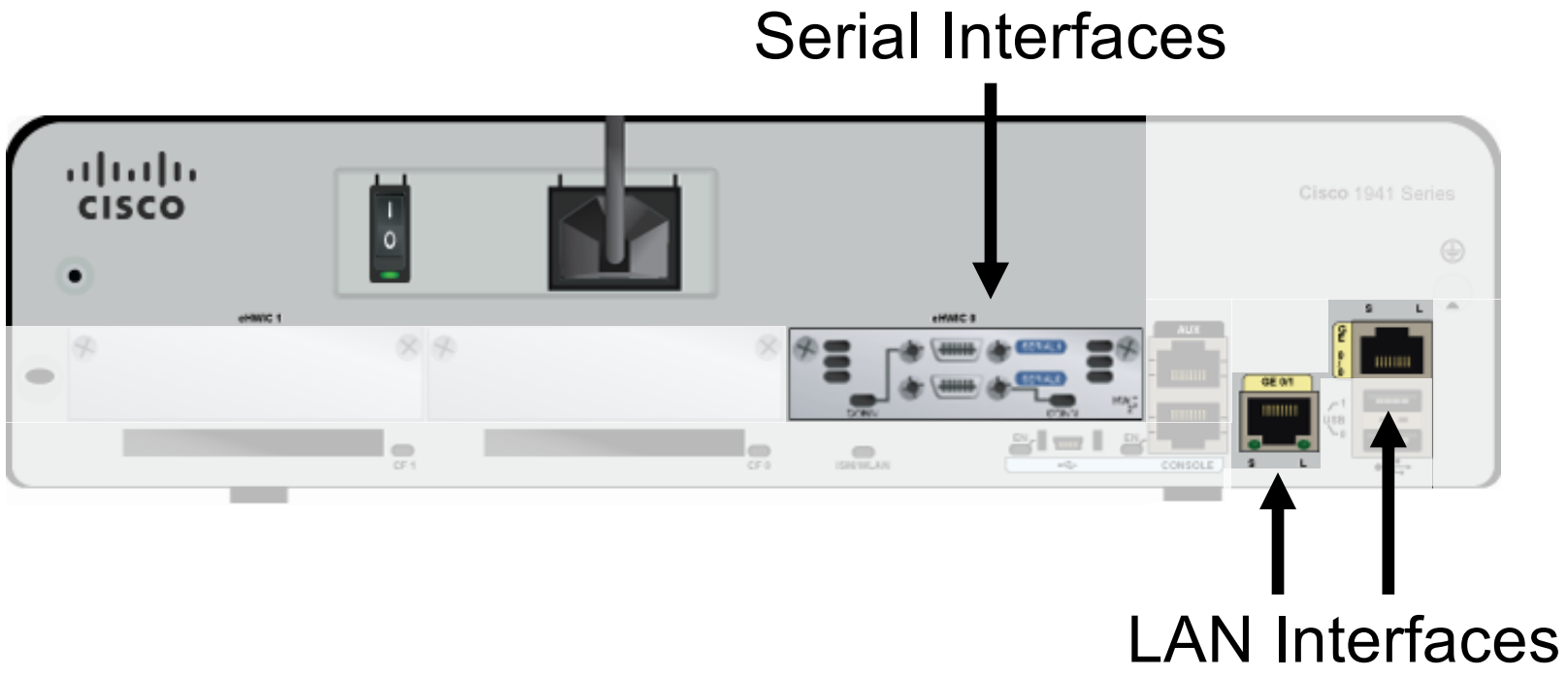
Router Backplane



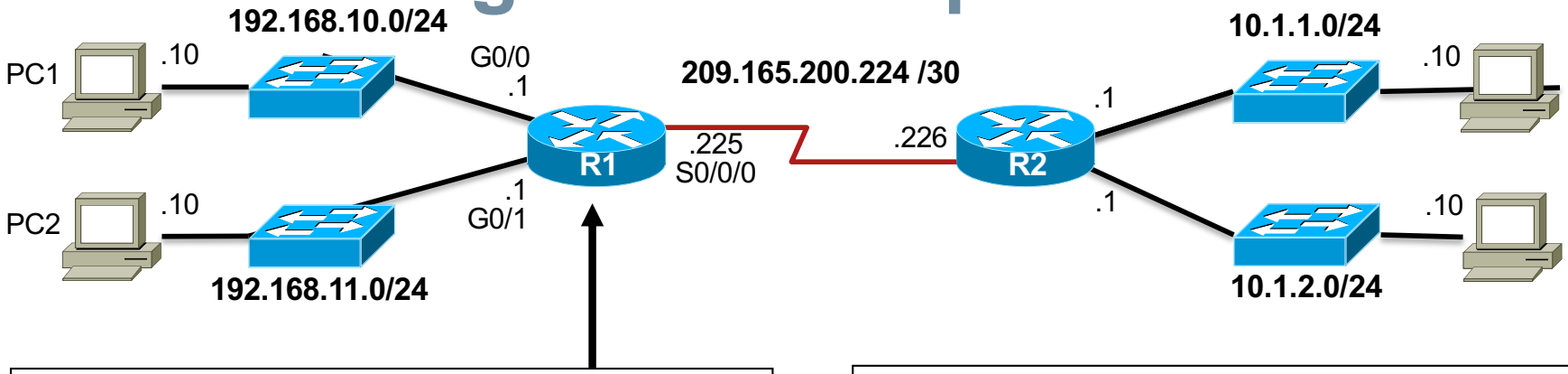
Connecting to a Router



LAN and WAN Interfaces



Router Configuration Steps




```
Router> enable
Router# configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Router(config)# hostname R1
R1(config)#
```

OR

```
Router> en
Router# conf t
Enter configuration commands, one per line.
End with CNTL/Z.
Router(config)# ho R1
R2(config)#
```

```
R1(config)# enable secret class
R1(config)#
R1(config)# line console 0
R1(config-line)# password cisco
R1(config-line)# login
R1(config-line)# exit
R1(config)#
R1(config)# line vty 0 4
R1(config-line)# password cisco
R1(config-line)# login
R1(config-line)# exit
R1(config)#
R1(config)# service password-encryption
R1(config)#
```

```
R1(config)# banner motd #
Enter TEXT message.  End with the character '#'.
    **********************************************
      WARNING: Unauthorized access is prohibited!
    **********************************************
#

R1(config)#
```

```
R1# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
R1#
```