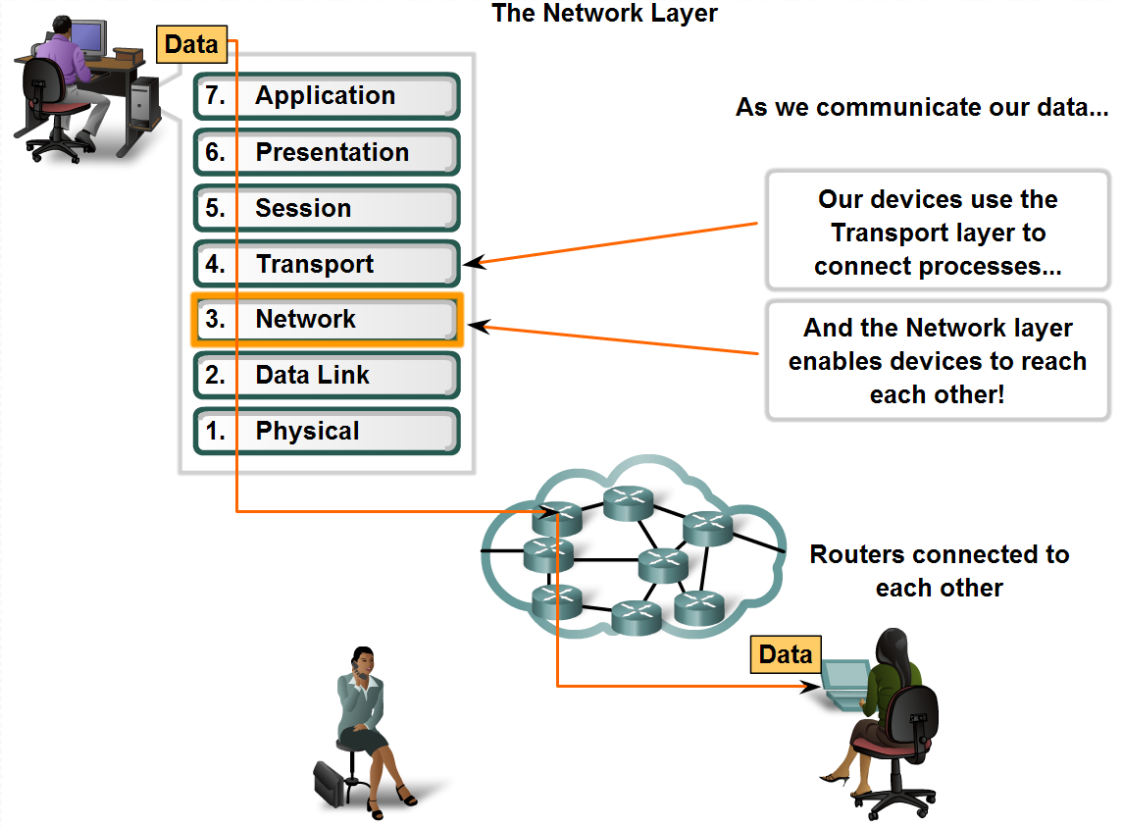
RAČUNARSKE MREŽE

06 – Mrežni sloj

Uvod

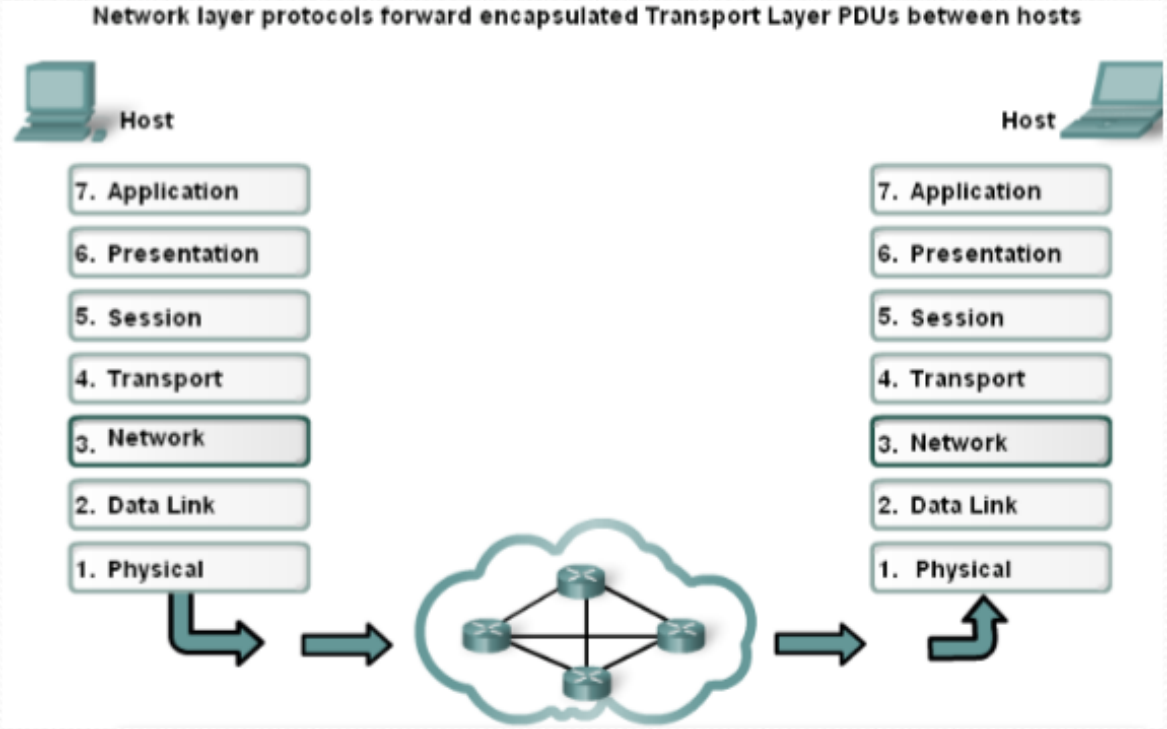
- omogućava razmjenu podataka preko mreže između identifikovanih krajnjih uređaja



Uvod (2)

- Koristi 4 osnovna procesa:

1. Adresiranje
2. Enkapsulacija
3. Rutiranje
4. Dekapsulacija



Protokoli mrežnog sloja

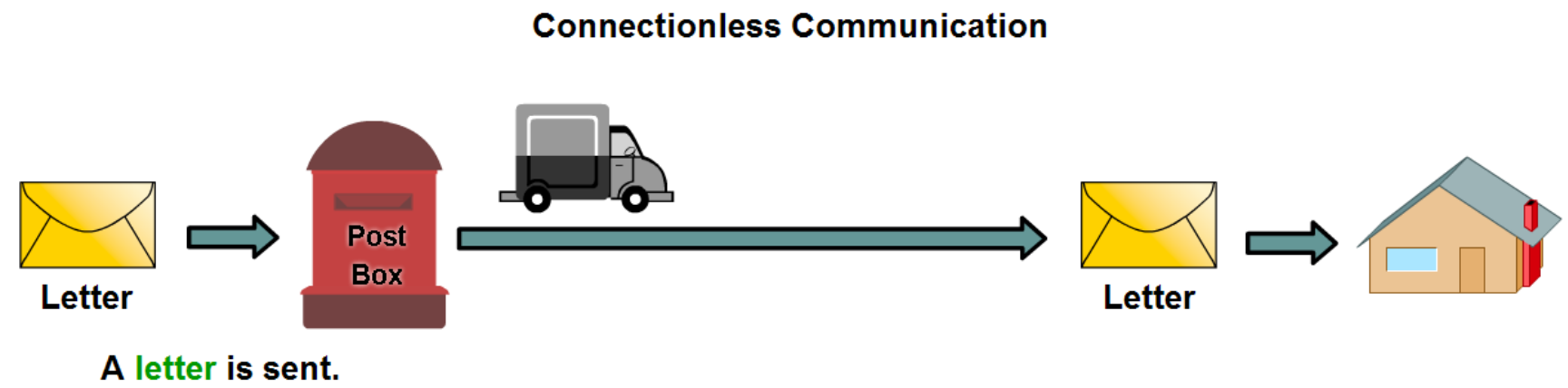
- IPv4, IPv6, Novell, AppleTalk, CLNS/DECNet
- IPv4 – jedini protokol za prenos podataka preko Interneta
- IPv6 – protokol budućnosti

- Osnovne karakteristike IPv4:

1. *Connectionless* – ne uspostavlja se veza prije slanja
2. *Best effort* (nepouzdan) – nema potvrde o prijemu
3. Nezavisnost od medijuma – nezavisnost od nižih slojeva, osim u slučaju fragmentacije (MTU)

- Protokoli viših slojeva zaduženi za korekciju grešaka

IPv4 - *connectionless*



The sender doesn't know:

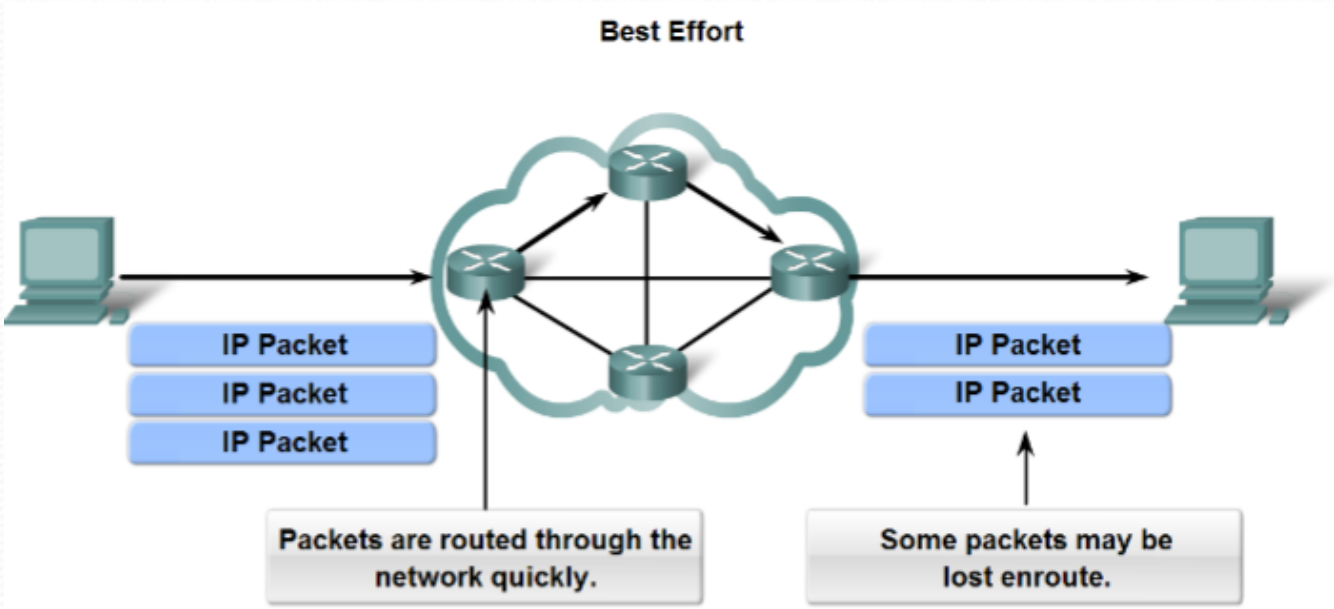
- if the receiver is present
- if the letter arrived
- if the receiver can read the letter

The receiver doesn't know:

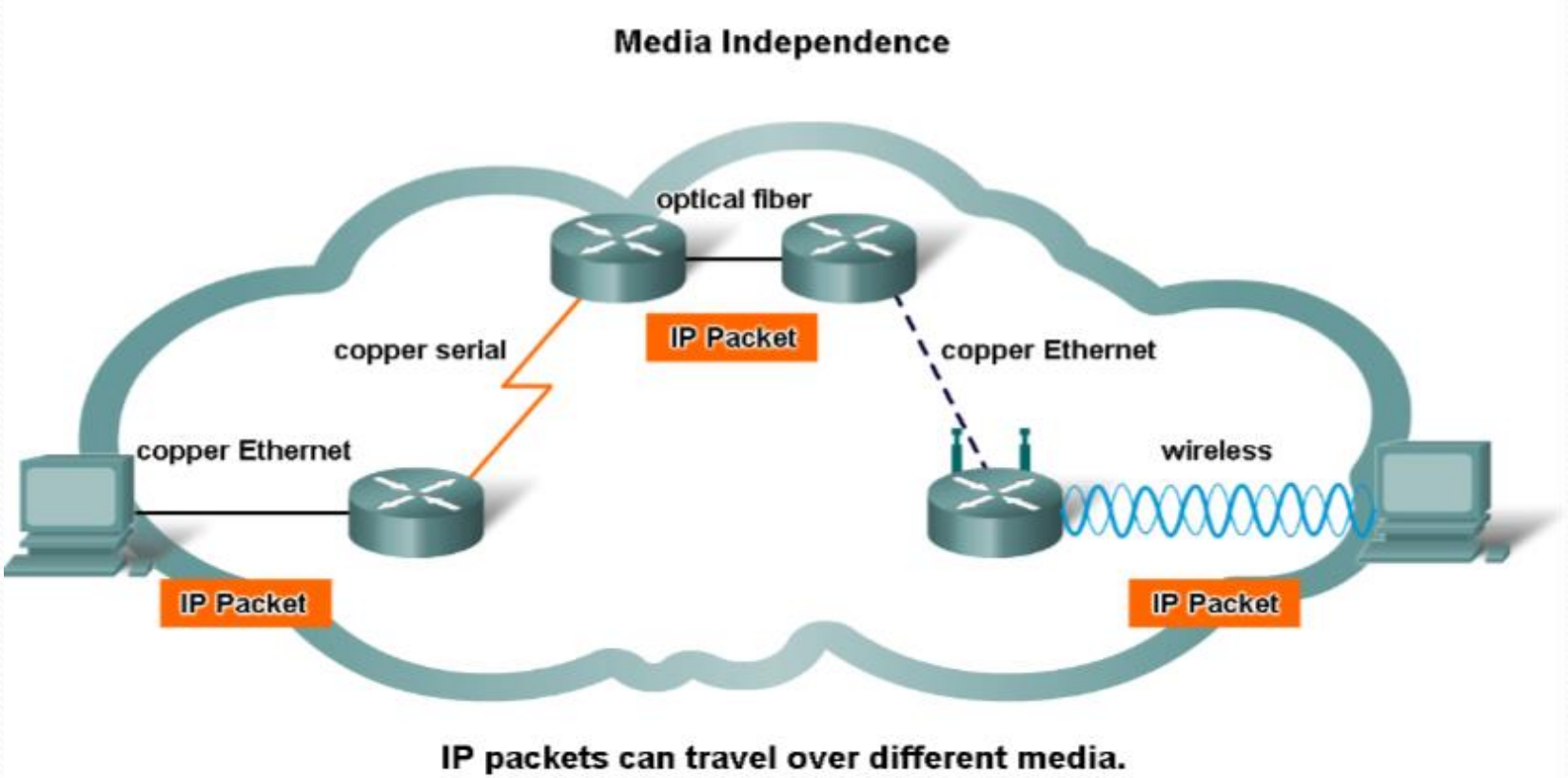
- when it is coming

IPv4 – *best effort*

- Manji header => manje opterećenje i kašnjenje



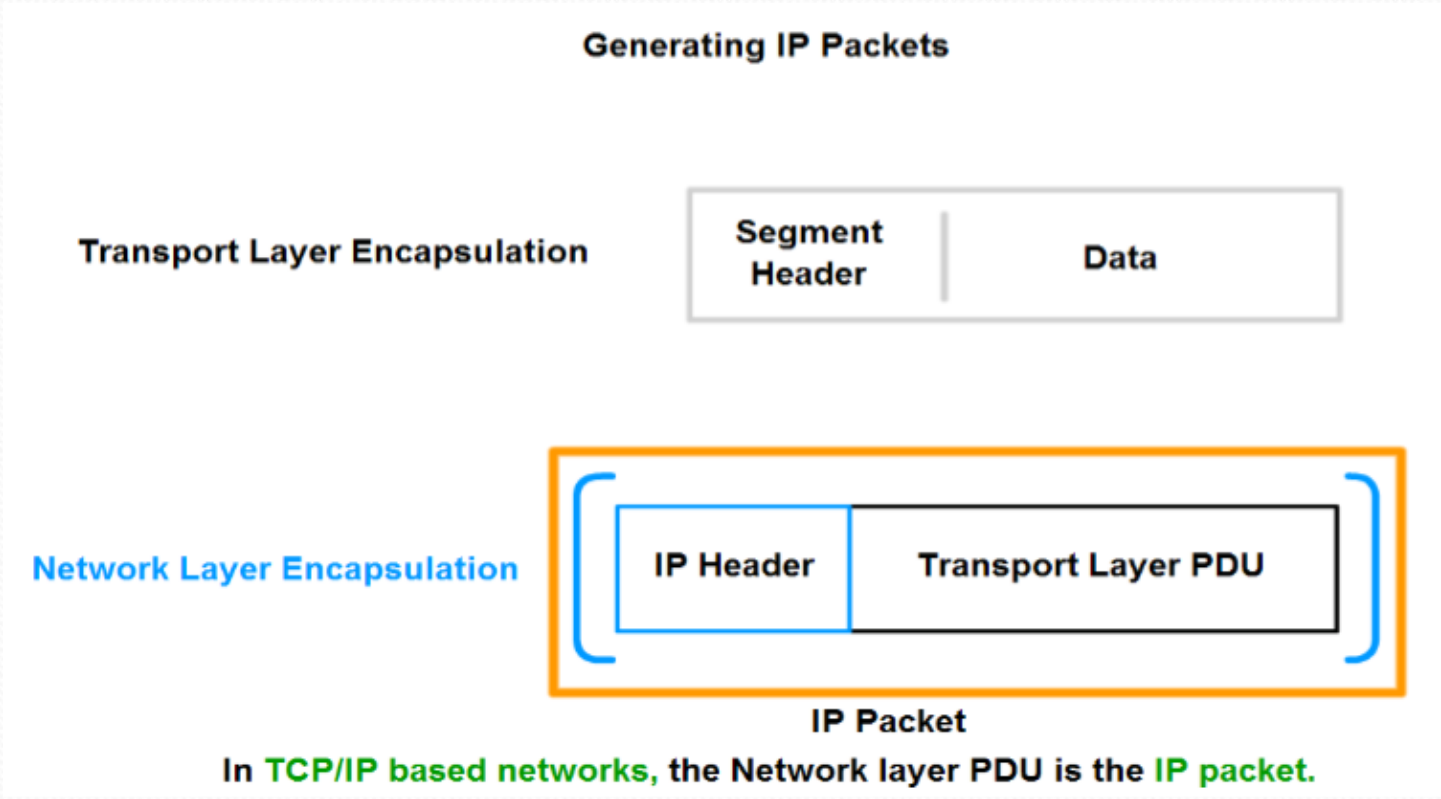
IPv4 – nezavisnost od medijuma



- MTU (Maximum Transmission Unit) nekog medijuma => mrežni sloj vrši fragmentaciju paketa

IPv4 – enkapsulacija segmenta

- PDU transportnog sloja (segment) ostaje nepromijenjen u procesu enkapsulacije i zajedno sa IP zaglavljem čini paket



IPv4 - zaglavlje paketa

Service Type

Data QoS priority: Enables router to give priority to voice and network route information over regular data.

Flag

These 3 bits represent control flags, such as DF and MF.

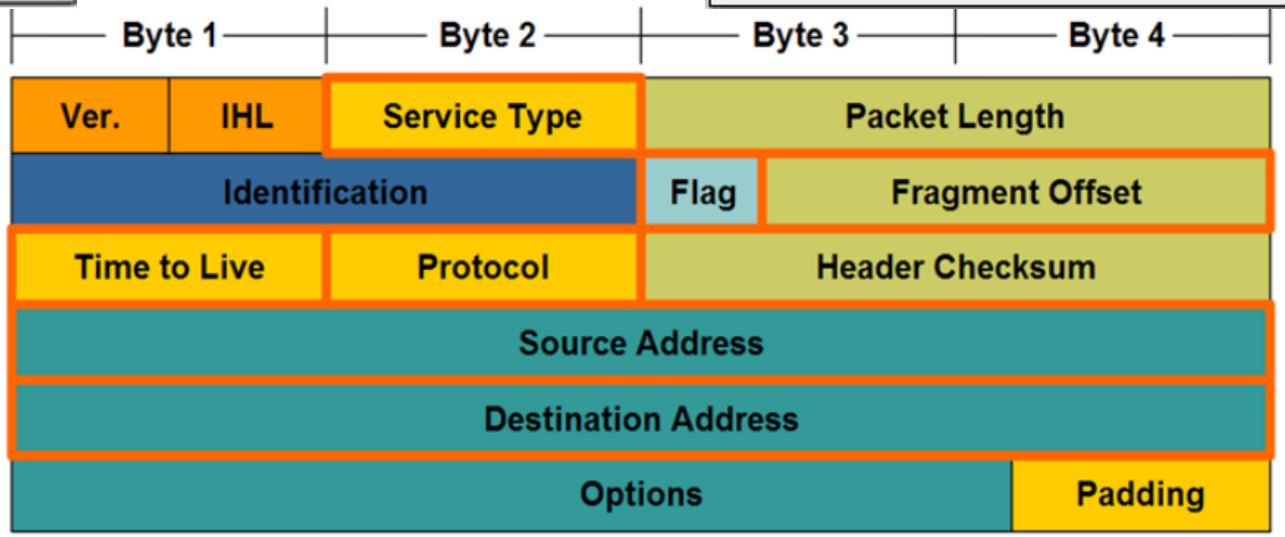
DF = Don't Fragment, MF = More Fragments?

Fragment Offset

These 13 bits allow a receiver to determine the place of a particular fragment in the original IP datagram.

Time to Live

Number of hops before packet is dropped: This value is decremented at each hop to prevent packets being passed around the network in routing loops.



Protocol

The data payload protocol type: Denotes if the data is a UDP datagram or TCP segment because these Transport layer protocols manage the receipt of their PDUs differently.

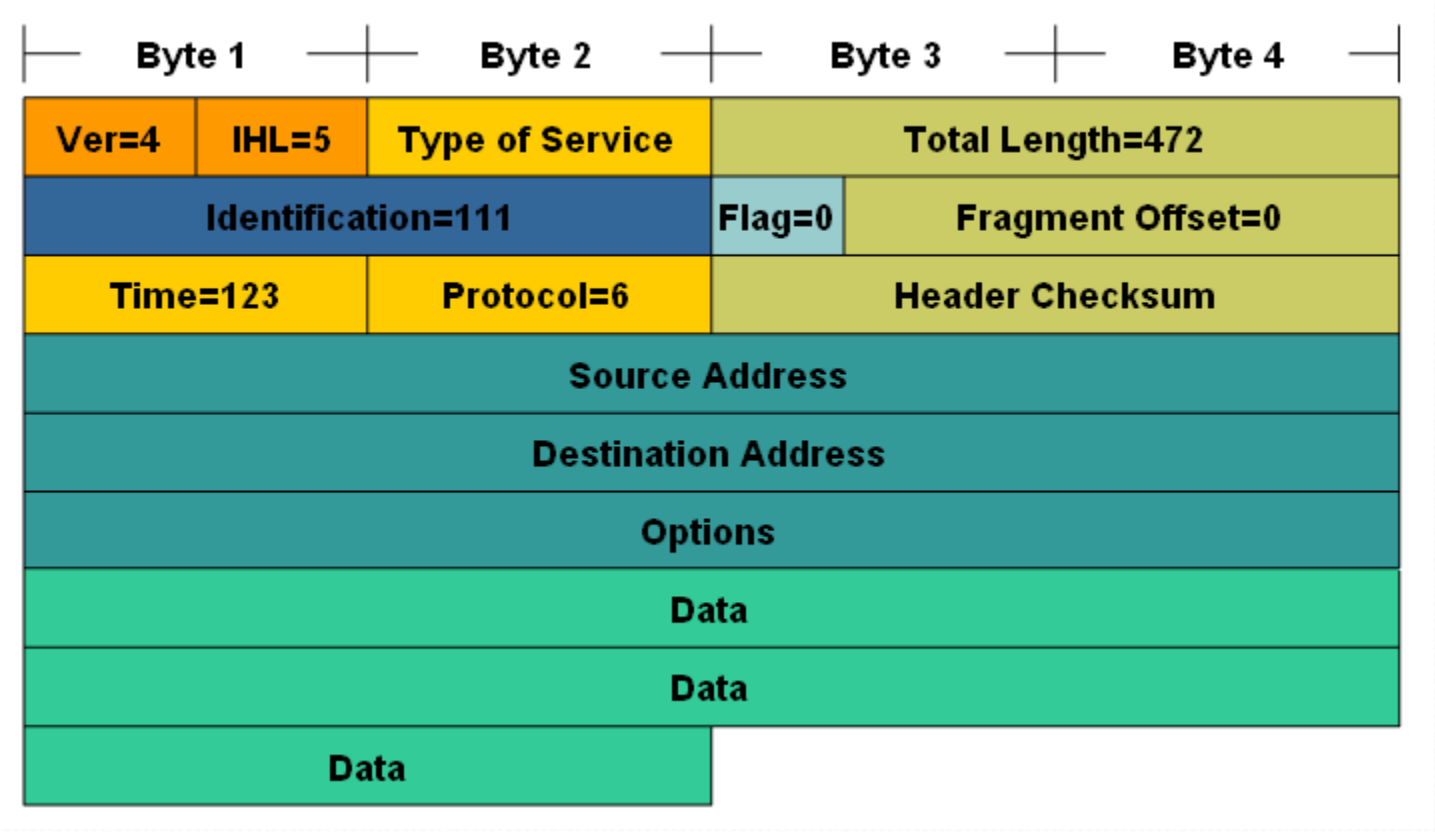
Source Address

IPv4 address of host sending the packet: Remains unchanged throughout the passage of the packet across the internetwork. Enables the destination host to respond to the source if required.

Destination Address

IPv4 address of host to receive the packet: Remains unchanged throughout the passage of the packet across the internetwork. Enables routers at each hop to forward the packet towards the destination.

Primjer IPv4 paketa



Mreže – podjela hostova u grupe

- Globalna mreža postepeno dijeljena u manje cjeline – podmreže (*subnets*) primarno zbog praktičnosti i lakšeg upravljanja

- 3 faktora prema kojima se vrši podjela:

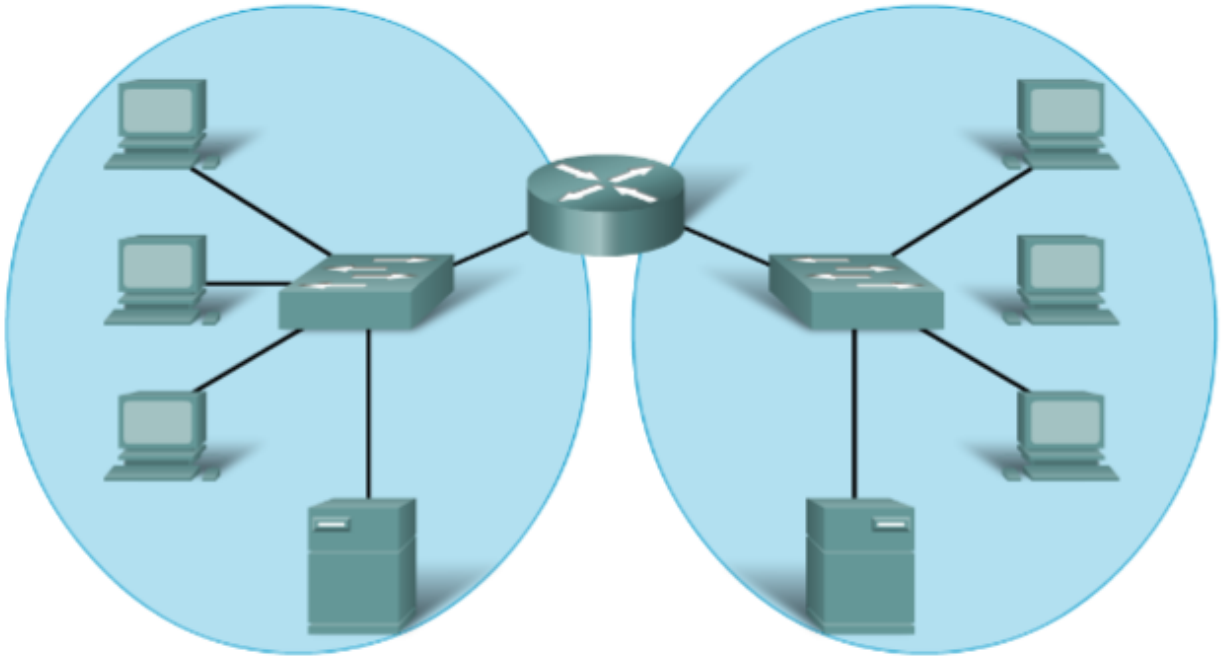
1. Geografski
2. Funkcijski
3. Vlasnički

- Zašto? Nedostaci velikih mreža:

1. Degradacija performansi
2. Sigurnost
3. Upravljanje adresama

Nedostaci velikih mreža - performanse

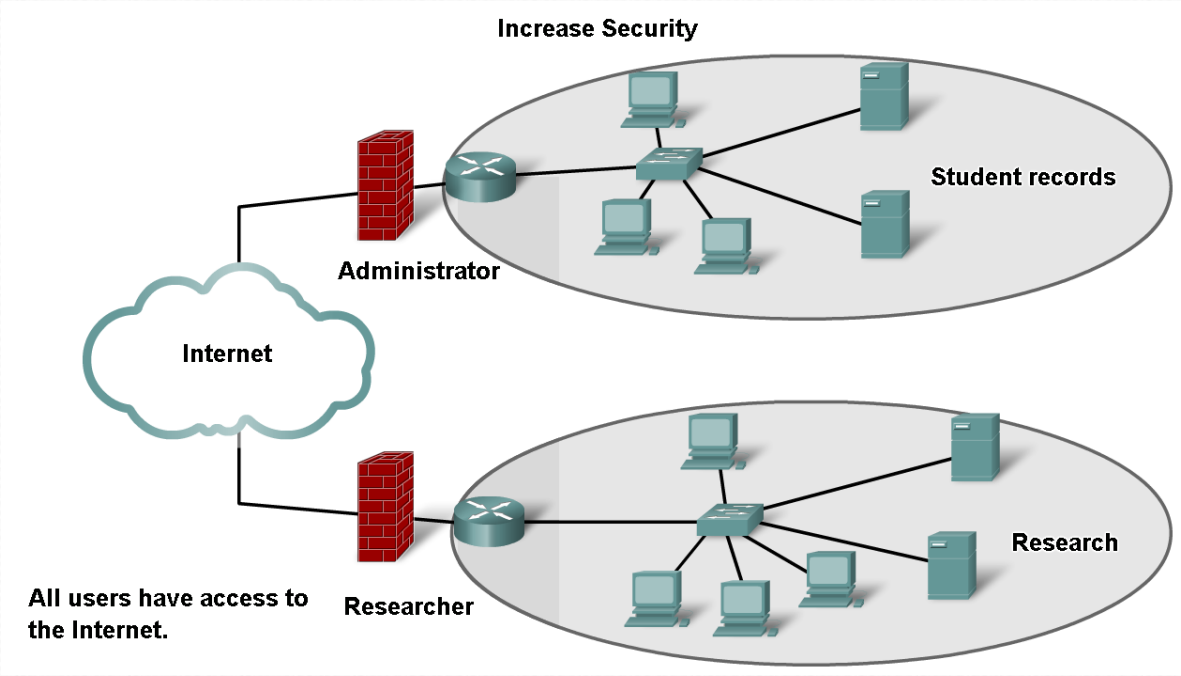
- *Broadcast* poruka – poruka svim uređajima na mreži
- Svaka mreža je jedan *broadcast* domen



Replacing the middle switch with a router creates 2 IP subnets, hence, 2 distinct broadcast domains. All devices are connected but local broadcasts are contained.

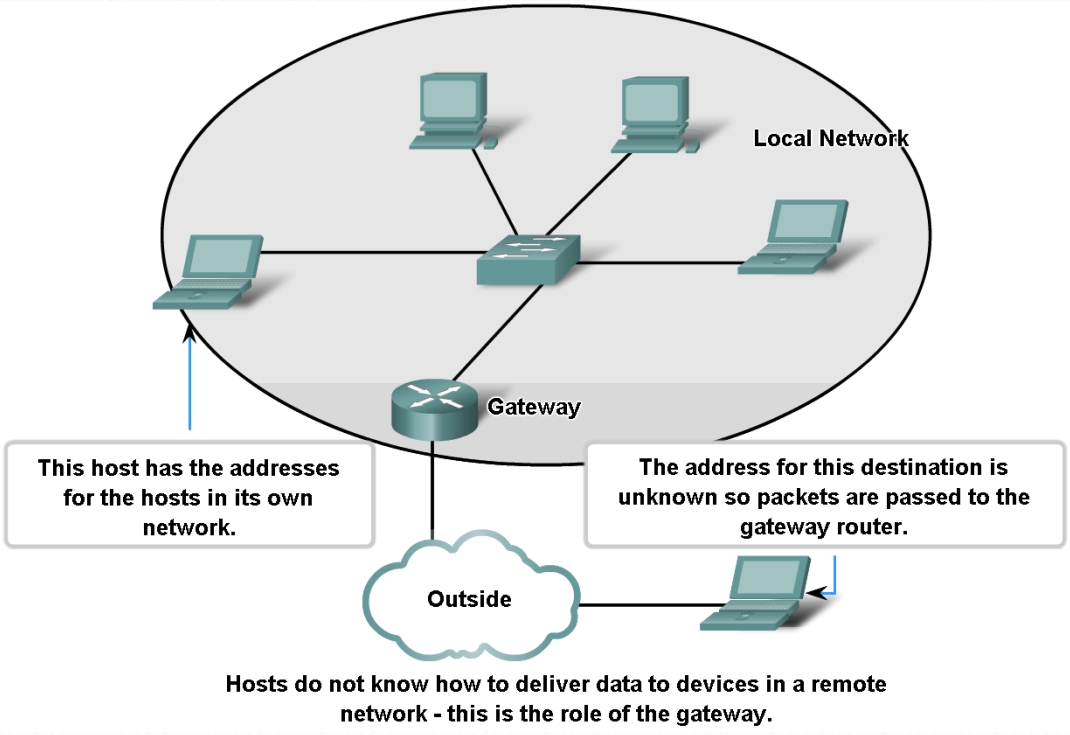
Nedostaci velikih mreža - sigurnost

- Pristup mreži ili iz mreže može se dozvoliti, zabraniti ili nadzirati
- Manje jedinice => lakša implementacija sigurnosti
- Sredstvo – ruteri i *firewall*



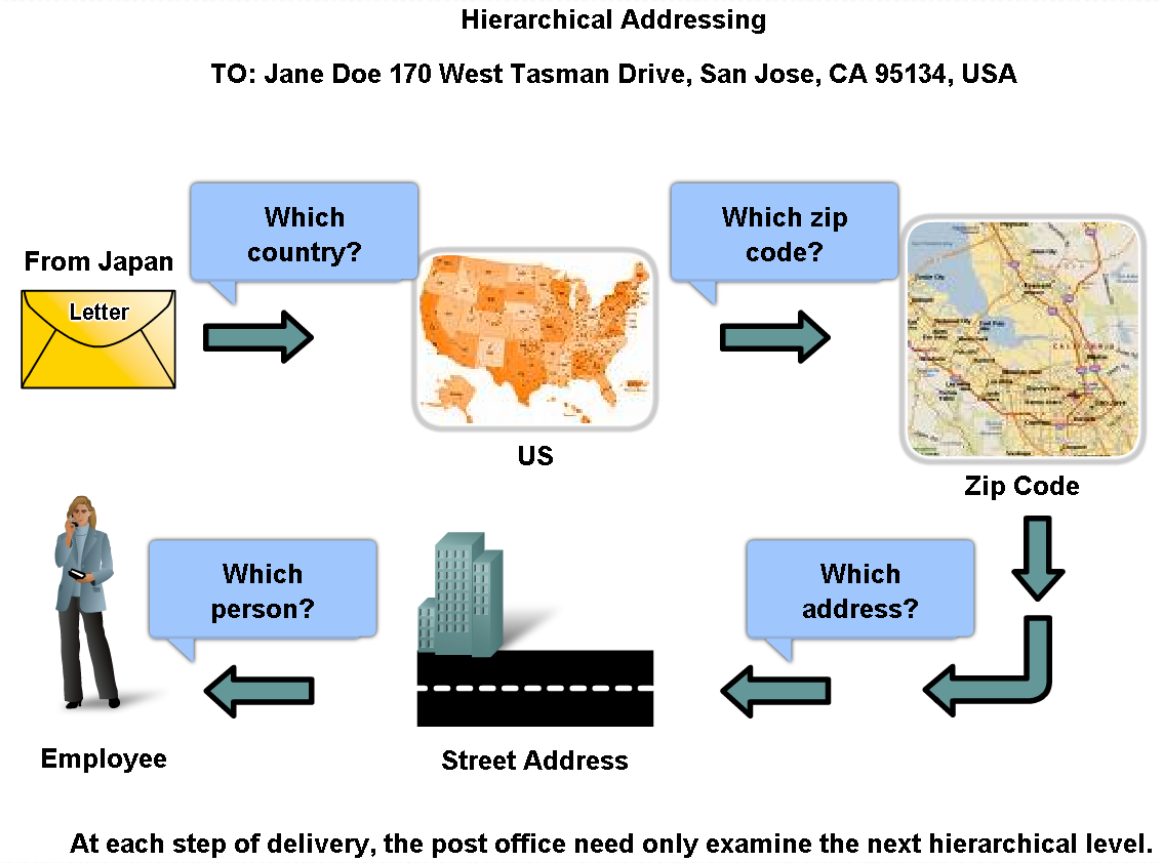
Nedostaci velikih mreža – upravljanje adresama

- Očekivanje da svaki host zna adresu svih drugih hostova je nerealno
- *Gateway* – omogućava hostovima da ne moraju da znaju nijednu adresu van svoje mreže; sve zamijenjene ovom

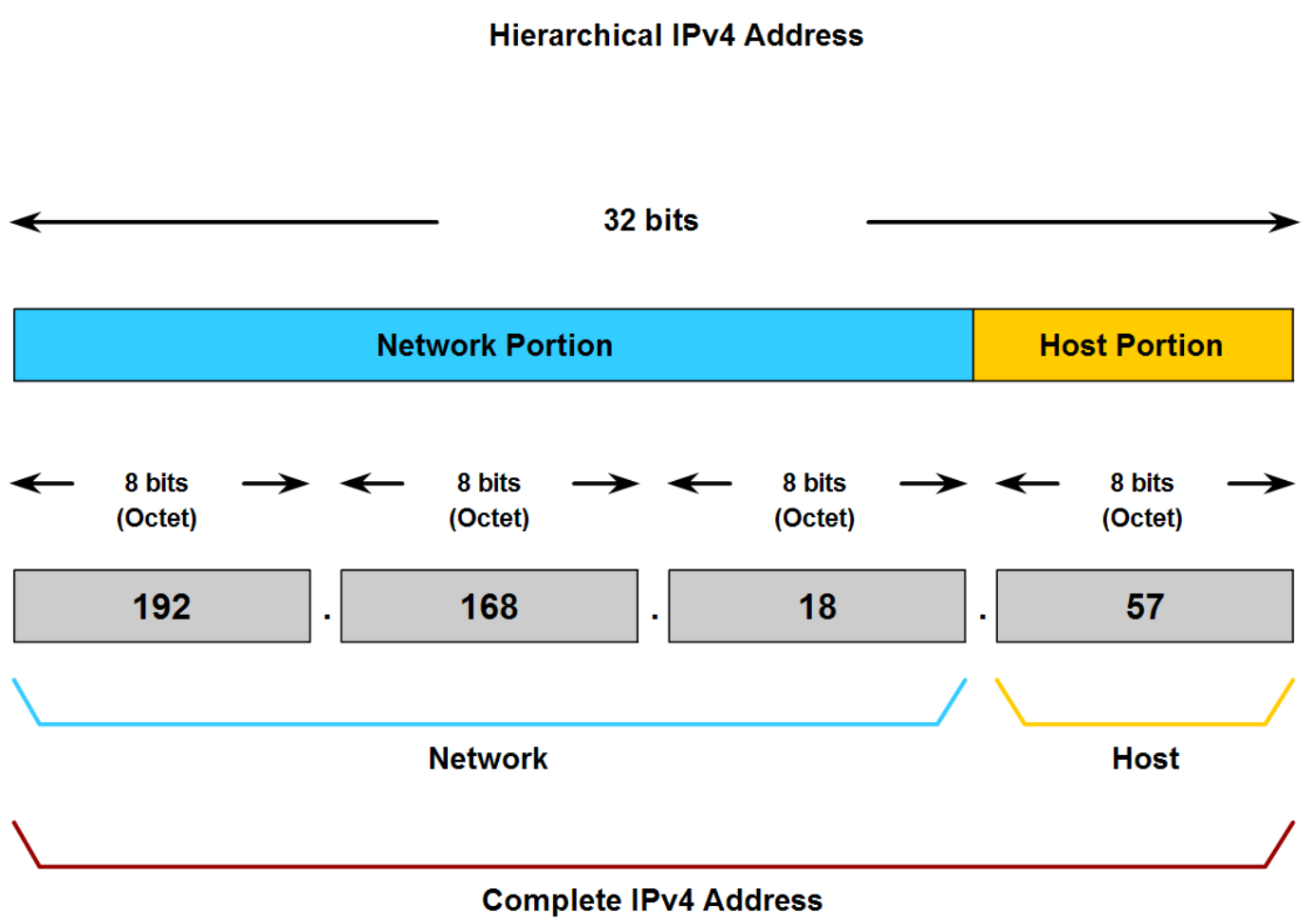


Kako podijeliti hostove po mrežama?

- Rješenje – hijerarhijsko adresiranje

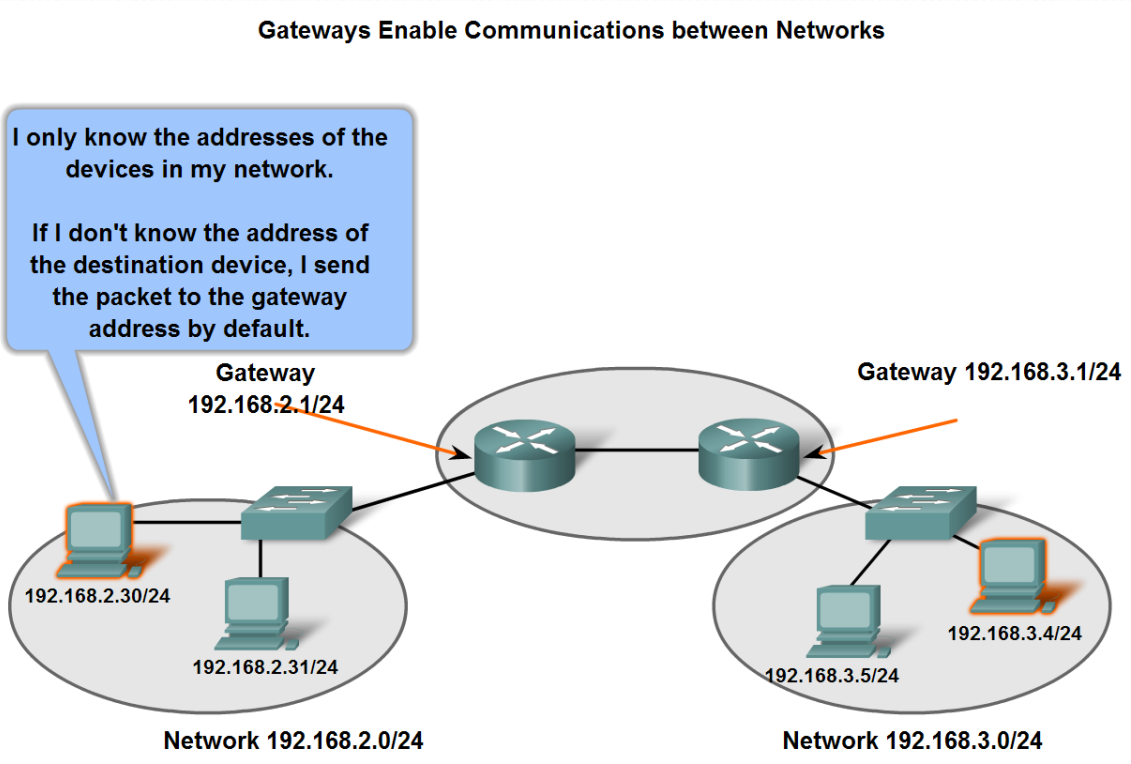


Podjela mreža



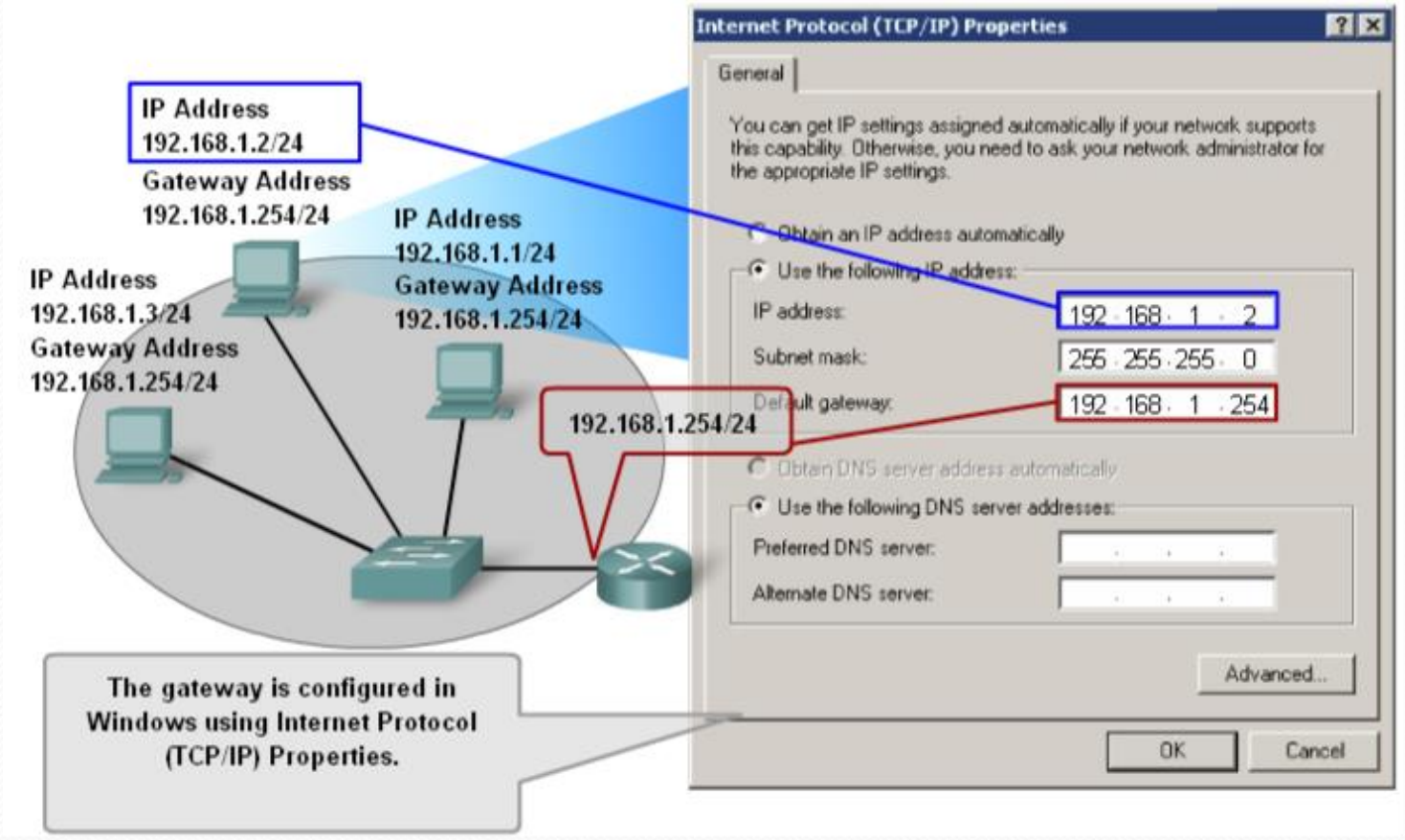
Komuniciranje van mreže

- Osnovni parametri:
- *Default gateway* – omogućava komunikaciju između mreža
- *Next hop address* – ruta gdje se prosljeđuje paket

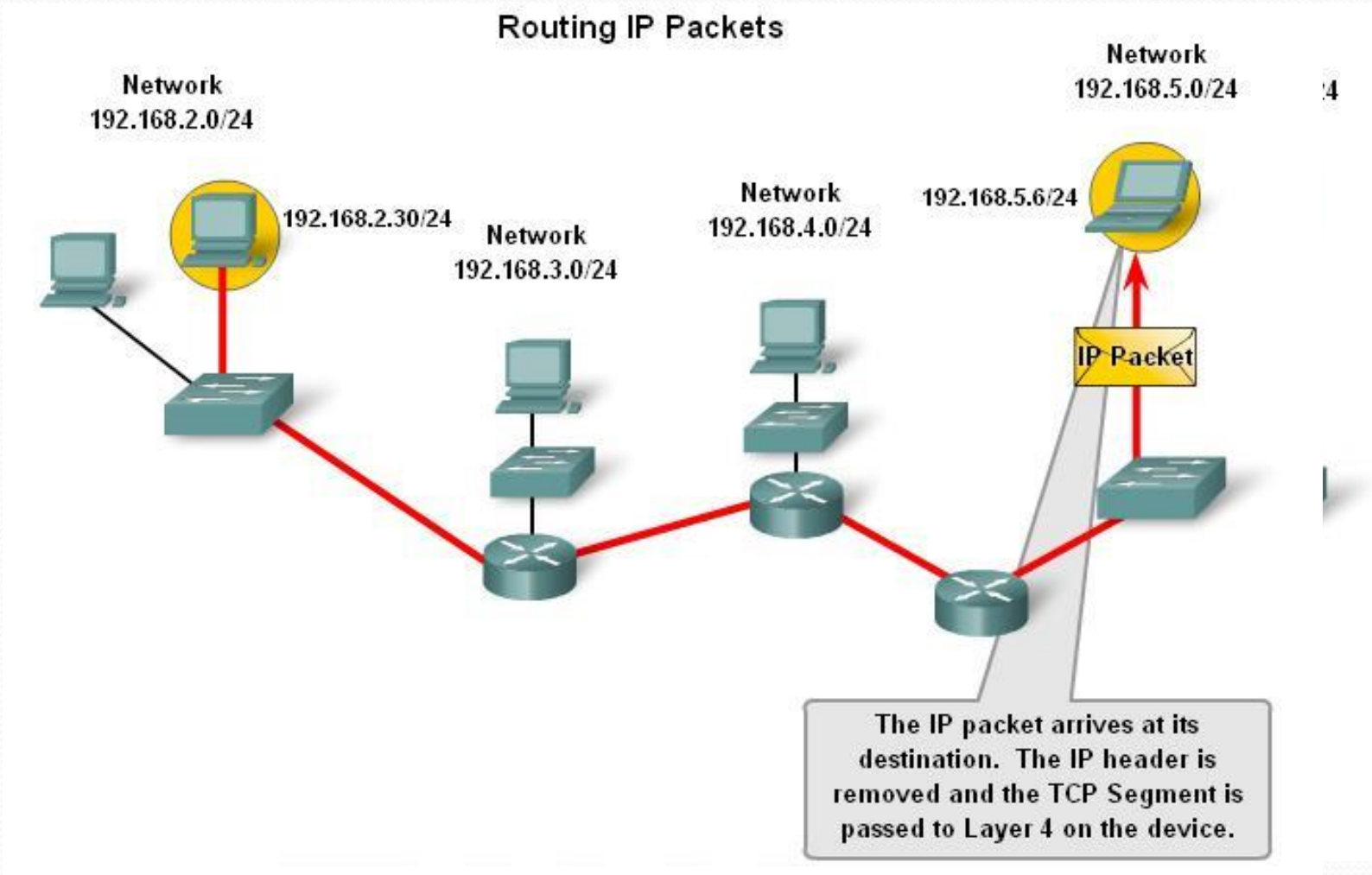


Gateway – put van mreže

- *Windows*, **ipconfig**



IP paketi – slanje end-to-end



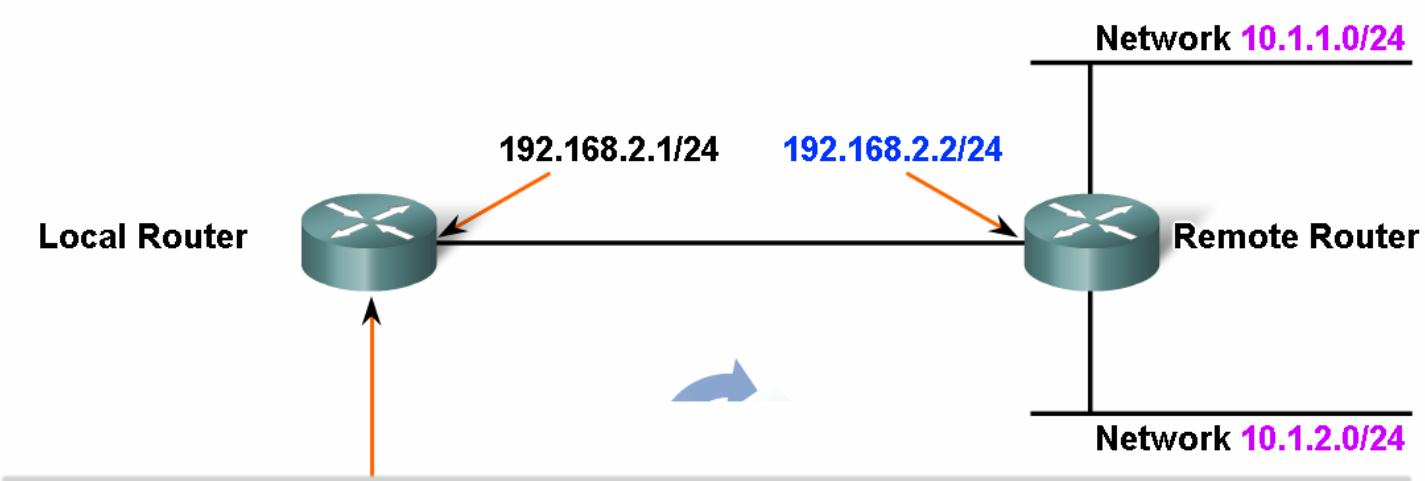
Rutiranje – prosljeđivanje paketa

- Nijedan paket ne može biti prosljeđen bez rute! (host, ruter)
- Hostu je poznata ruta ka hostovima na lokalnoj mreži ili ka *default gateway*-u
- Ruter odlučuje dalju putanju za svaki paket koji primi na *gateway* interfejs – proces rutiranja
- Ruter ne mora tačno da zna gdje je odredišna mreža, mora da zna samo u kom je pravcu (*next hop*)
- Tabele rutiranja (eng. *routing tables*):
  - direktno povezane mreže (mreže koje se nalaze na interfejsima rutera), automatski se unose u tabelu rutiranja
  - ostale mreže koje se mogu ručno unijeti (statičko rutiranje) ili dinamički naučiti (protokoli rutiranja)

Tabele rutiranja (ruter)

- Tri parametra:

1. Odredišna mreža
2. *Next hop*
3. Metrika (više u prezentaciji Uvod u rutiranje!)




```
    10.0.0.0/24 is subnetted, 2 subnets
R       10.1.1.0 [120/1] via 192.168.2.2, 00:00:08, FastEthernet0/0
R       10.1.2.0 [120/1] via 192.168.2.2, 00:00:08, FastEthernet0/0
C   192.168.1.0/24 is directly connected, FastEthernet0/0
```

Odredišna mreža i sljedeći hop

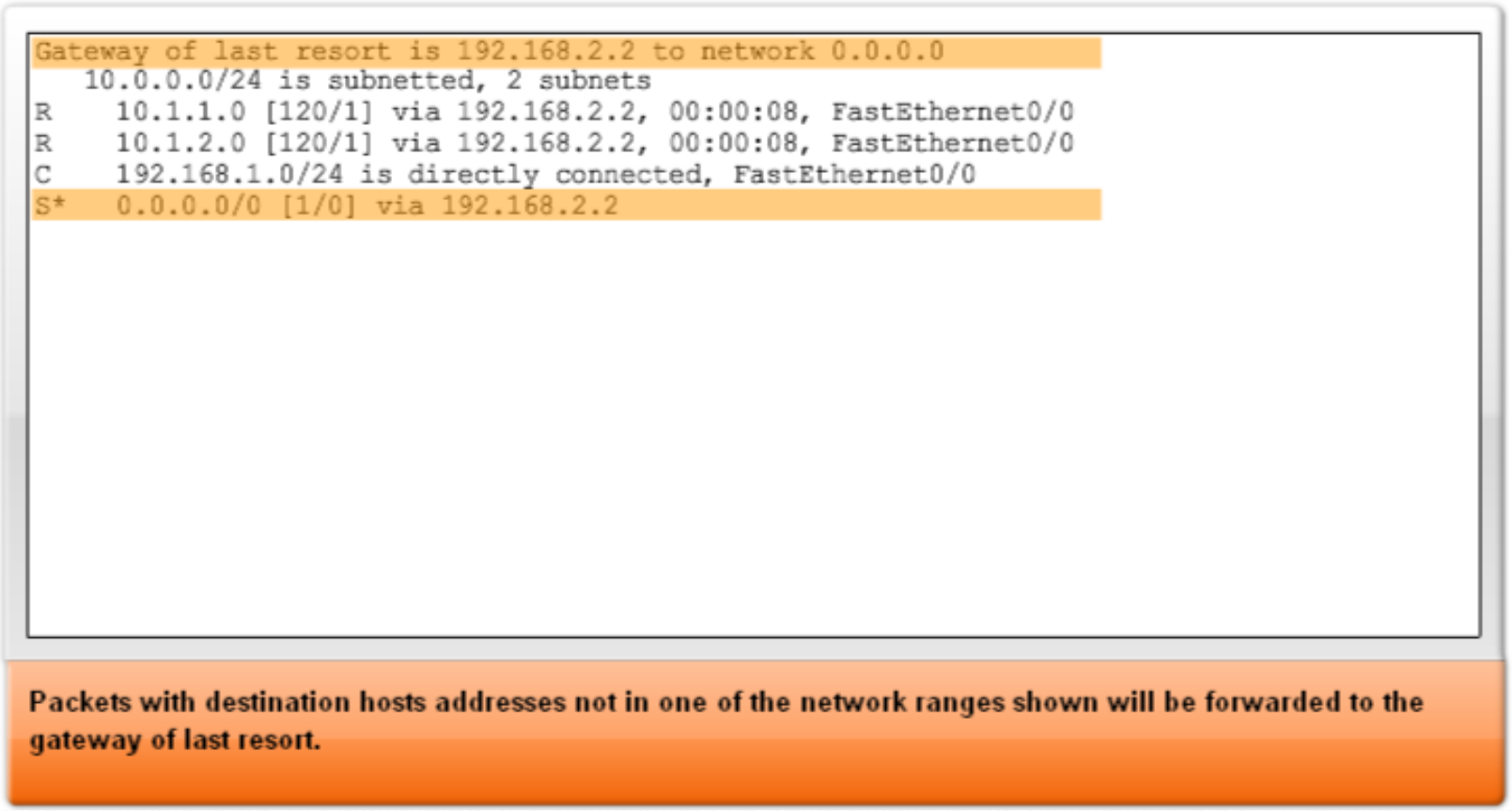
- Odredišna mreža – opseg host adresa koji se nalaze u datom pravcu
- *Next hop* – sljedeća stanica, direktno povezane mreže je nemaju jer nema rutera između

Routing Table Output with Next Hops

```
  10.0.0.0/24 is subnetted, 2 subnets
R     10.1.1.0 [120/1] via 192.168.2.2, 00:00:08, FastEthernet0/0
R     10.1.2.0 [120/1] via 192.168.2.2, 00:00:08, FastEthernet0/0
C 192.168.1.0/24 is directly connected, FastEthernet0/0
```

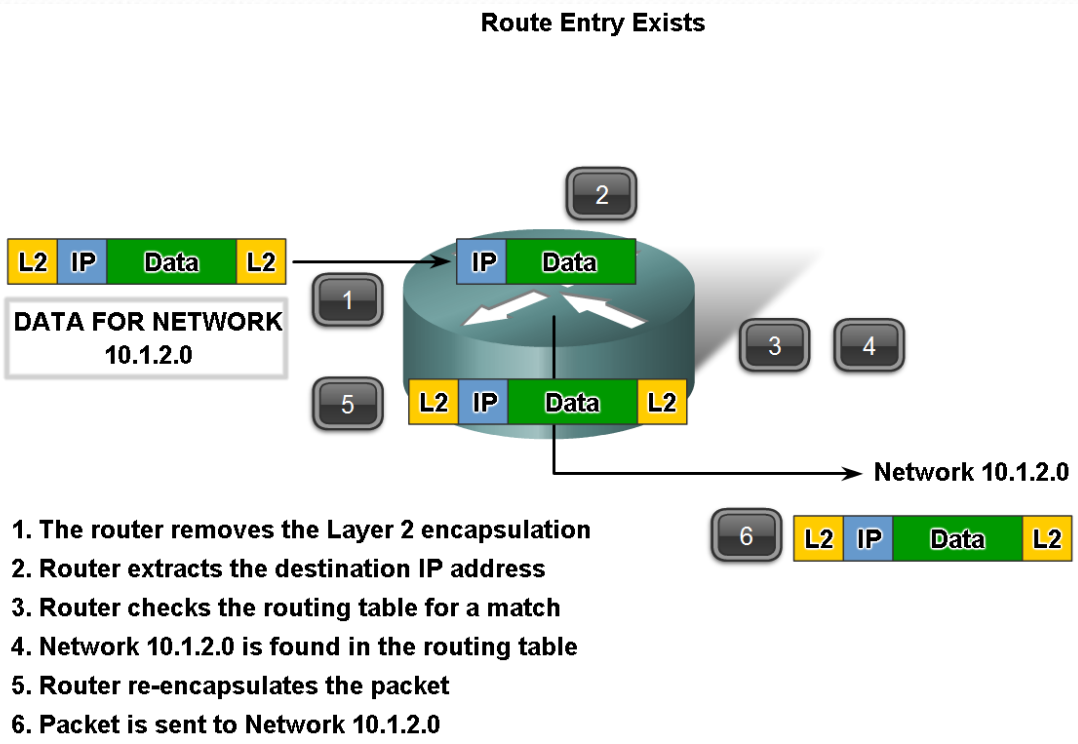
Default route

- Ruta za sve pakete čija odredišna mreža nije u tabeli



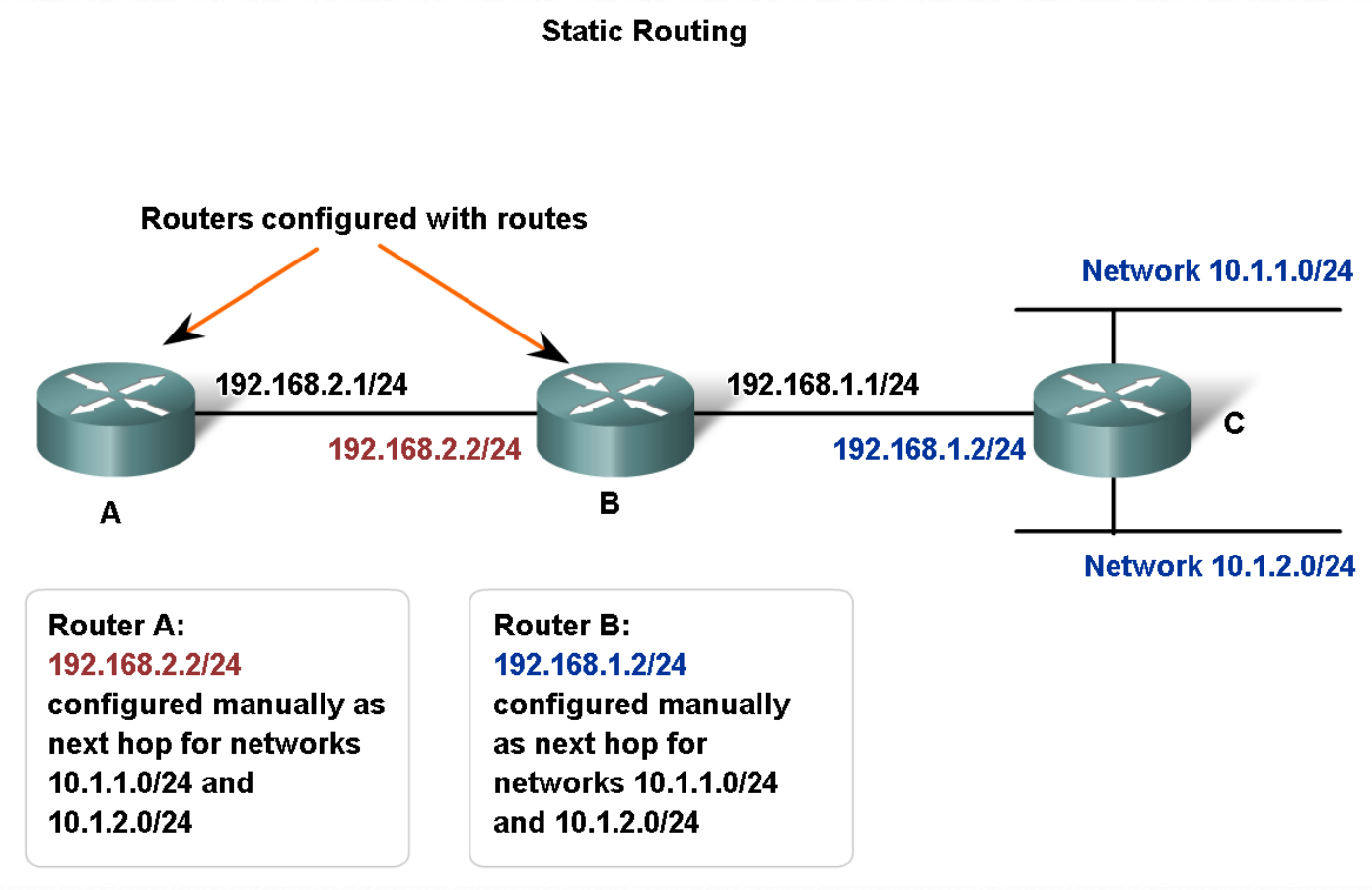
Prosljeđivanje paketa

- *Packet-by-packet* + *hop-by-hop*
- Ruter sa paketom može uraditi 3 stvari:
  - proslijediti ga *next hop*-u
  - proslijediti ga odredišnom hostu
  - odbaciti ga



Statičko rutiranje

- Ručno unošenje ruta (više u prezentaciji Uvod u rutiranje!)



Dinamičko rutiranje

- Protokoli rutiranja – skup pravila pomoću kojih ruteri dinamički razmjenjuju informacije o rutiranju
- RIP, OSPF (više u prezentaciji Uvod u rutiranje!)
- Propusni opseg, procesna moć