

Računarske mreže i komunikacije

(laboratorijske vježbe)

II Laboratorijska vježba

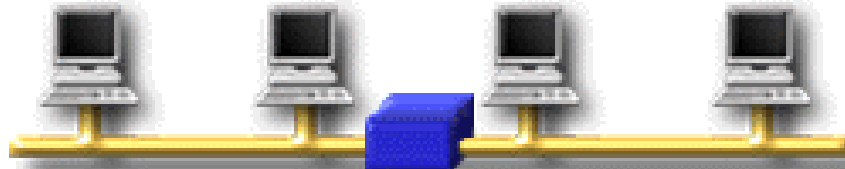
- Povezivanje računara u računarsku mrežu
- UTP kablovi

Types of Networks

Directly Connected



Shared Media (multiple access)

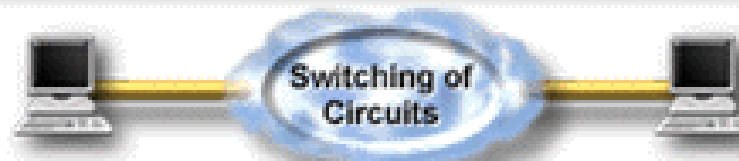


Extended Media
(multiple access with layer 1 networking device)



Point to Point

Indirectly Connected



Circuit-Switched



Packet-Switched

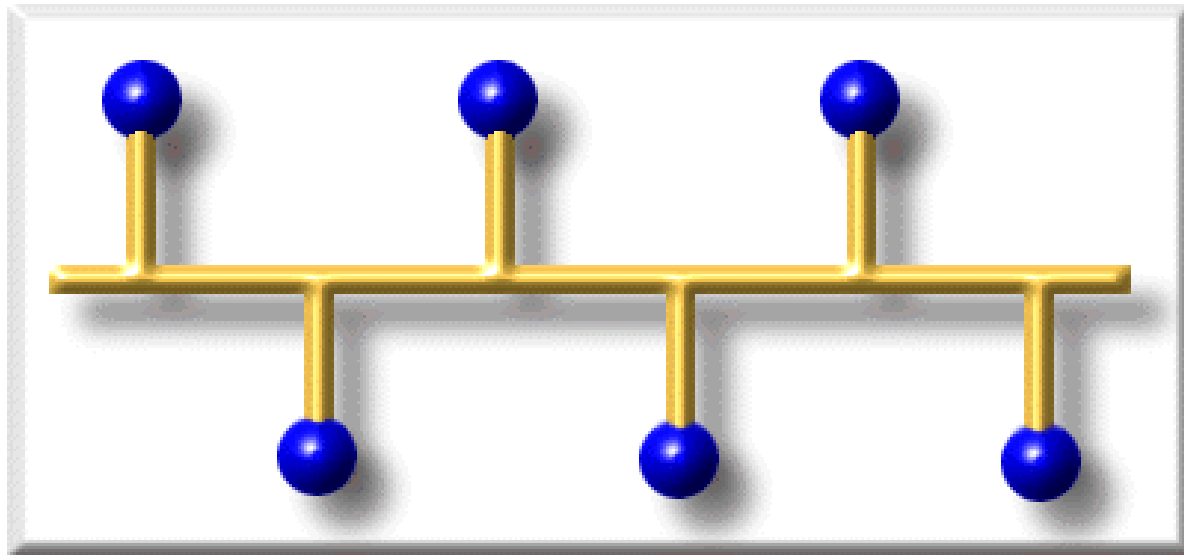
Mrežne topologija

- Fizička topologija
 - stvarni fizički raspored kablova i uređaja
- Logička topologija
 - način na koji je ostvaren pristup medijumu za prenos podataka

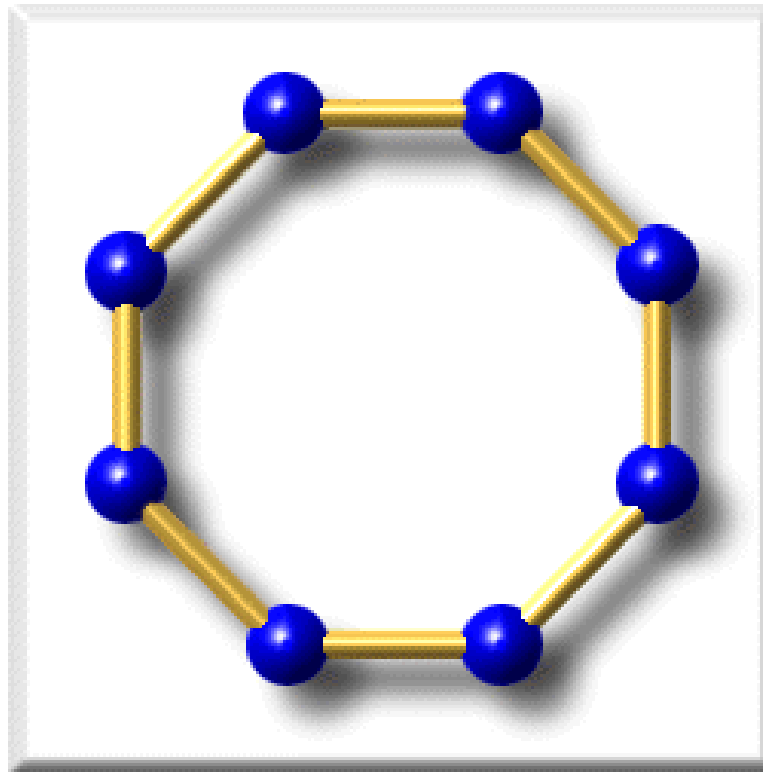
Fizičke topologije

- Bus
- Prsten i dvostruki prsten (Dual Ring)
- Star - topologija zvijezde
- Extended star - proširena zvijezda
- Hijerarhijska topologija
- Mesh
- Neregularna topologija
- Čelijska topologija

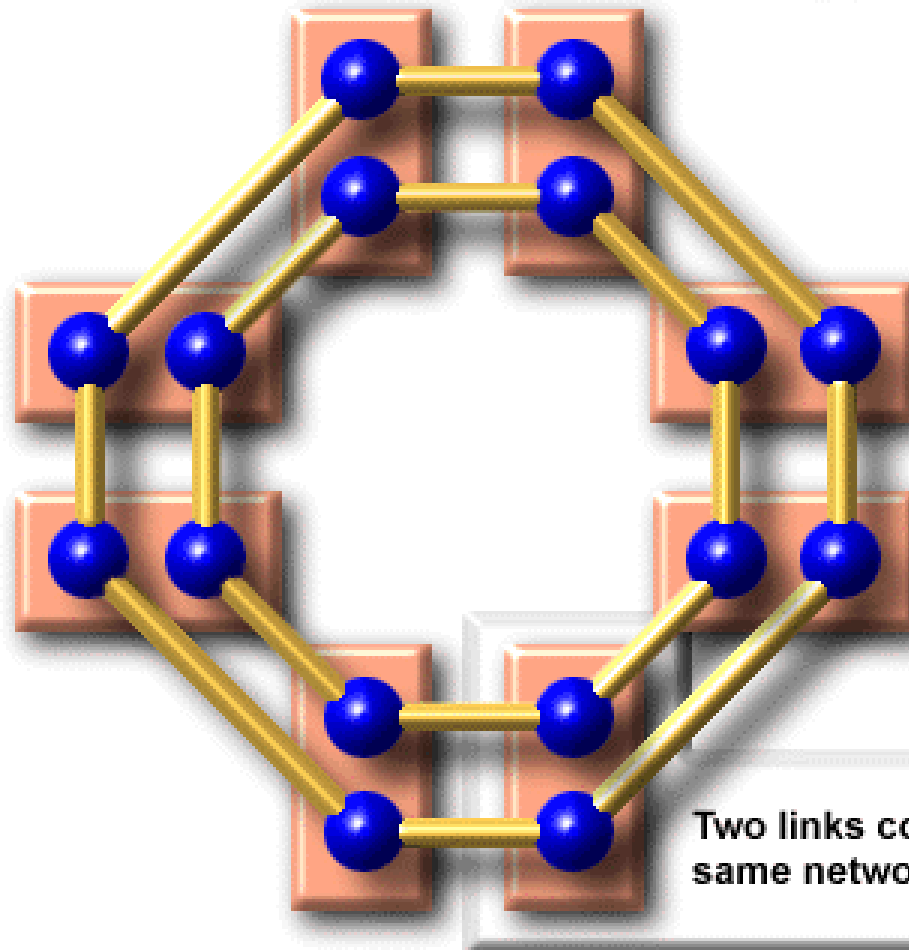
Bus Topology



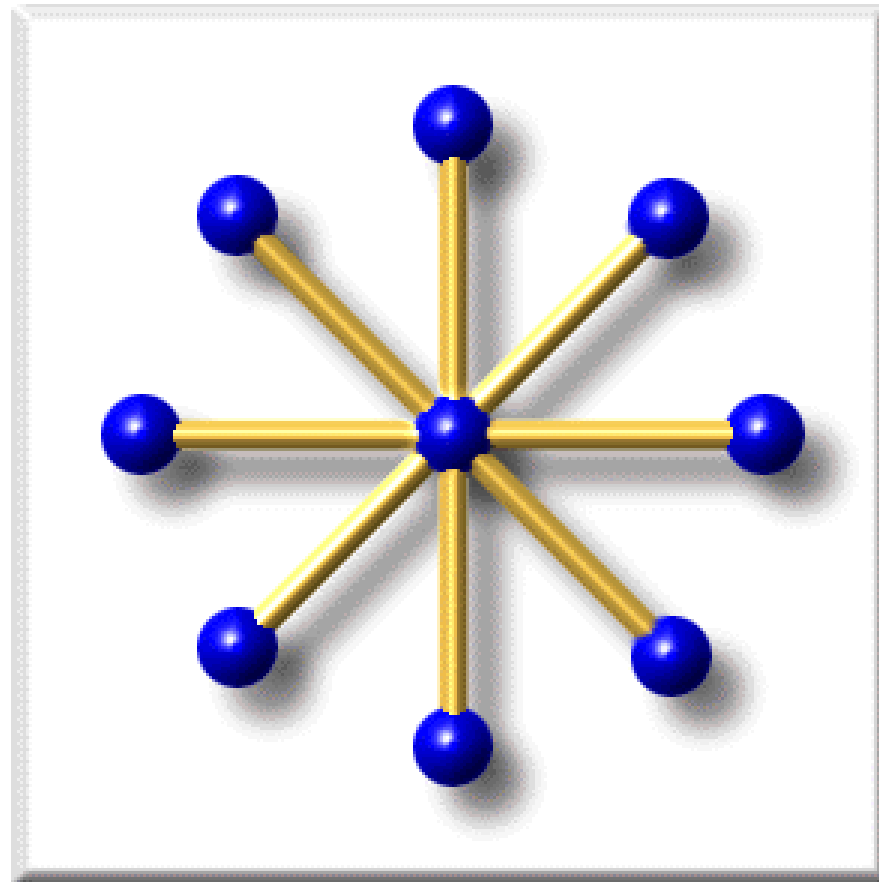
Ring Topology



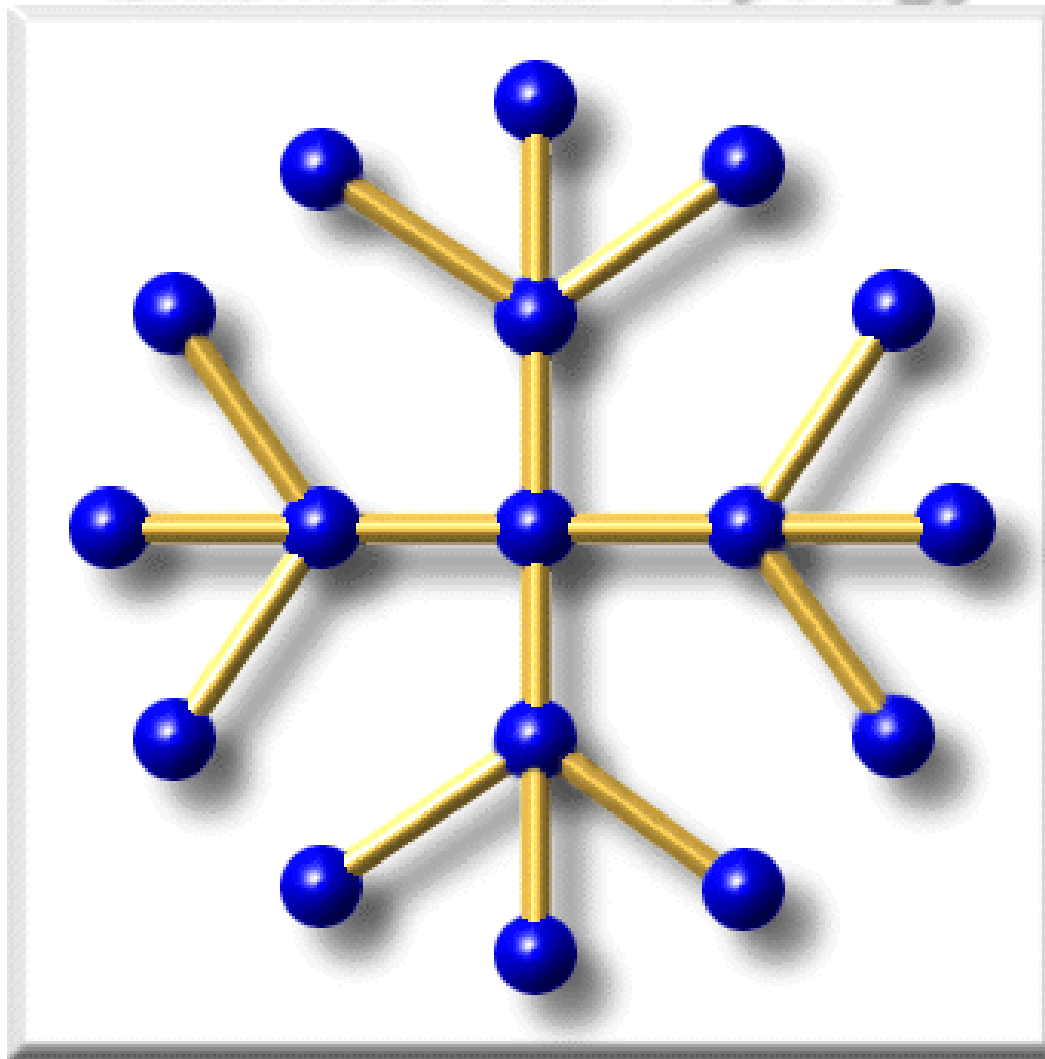
Dual Ring Topology



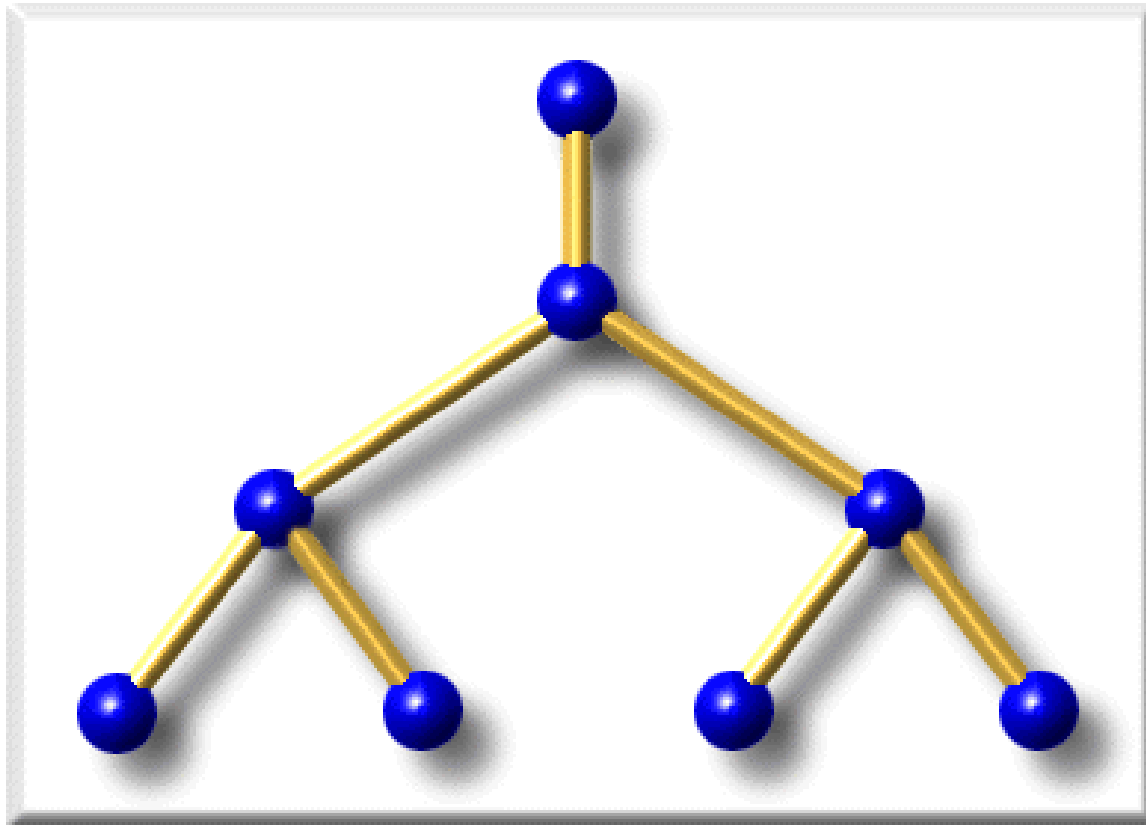
Star Topology



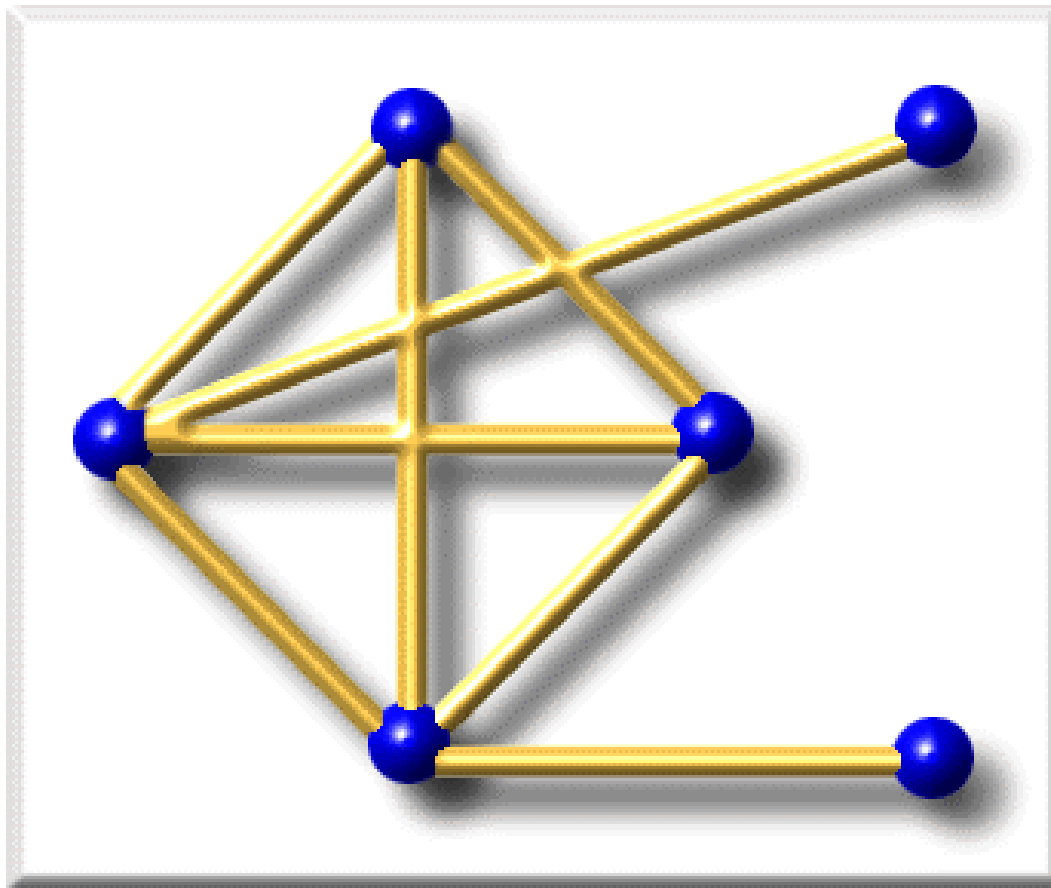
Extended Star Topology



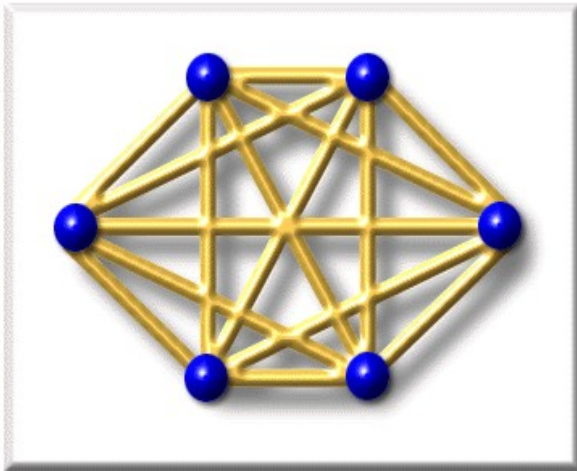
Tree Topology



Irregular Topology

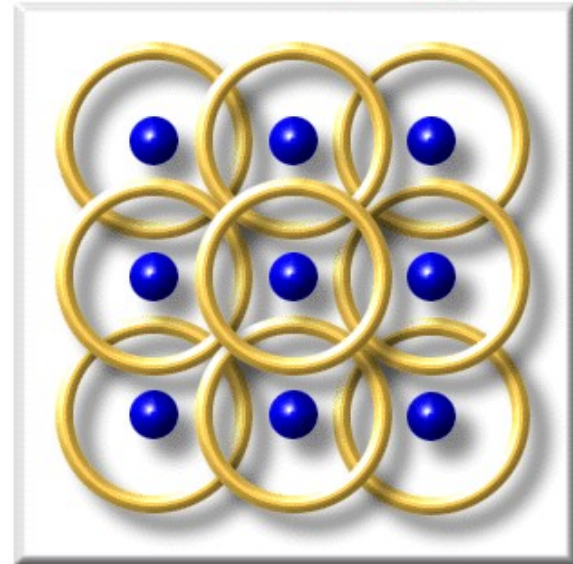


Complete (Mesh) Topology



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Cellular Topology



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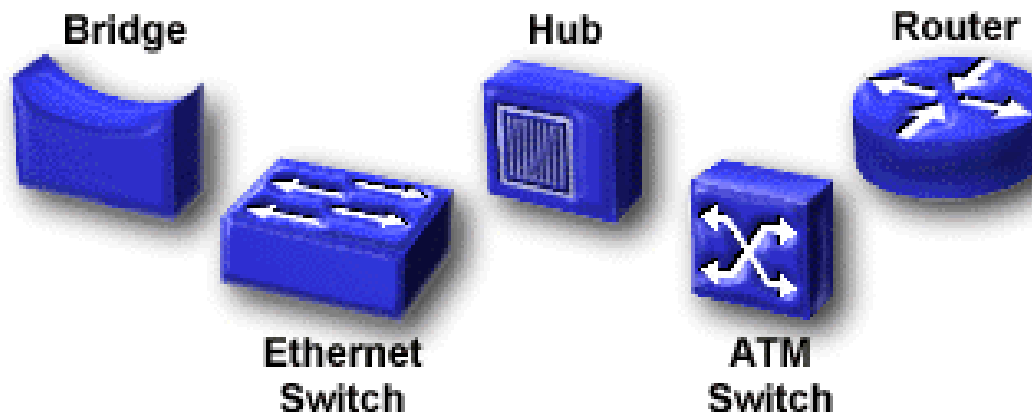
$$n(n-1)/2$$

Logičke topologije

- Broadcast
 - svaki host šalje svoje podatke svim ostalim hostovima na mrežnom medijumu (Ethernet tehnologija)
- Token passing
 - samo računar koji je posjedu token-a, može da šalje podatke (Token Ring, FDDI)

Local Area Networks and Devices

- Operate within a limited geographic area
- Allow multiaccess to high-bandwidth media
- Control the network privately under local administration
- Provide full-time connectivity to local services
- Connect physically adjacent devices



LAN

- Sastoji se od sledećih komponenti:
 - Računari
 - NIC
 - Periferijski uređaji (printeri, sl.)
 - Mrežni medijumi za prenos podataka
 - Mrežni uređaji
- LAN Tehnologije
 - Ethernet
 - Token Ring
 - FDDI

Povezivanje računara

- Pomoću mrežnih kablova

- Koaksijalni kablovi
- UTP
- STP
- Optički kablovi

- Direktno povezivanje

- serijski port
- paralelni port
- USB
- Modem

- Bežična veza

- Wireless (RF)
- Infrared

Various Types of Network Media



Coaxial



Fiber Optic

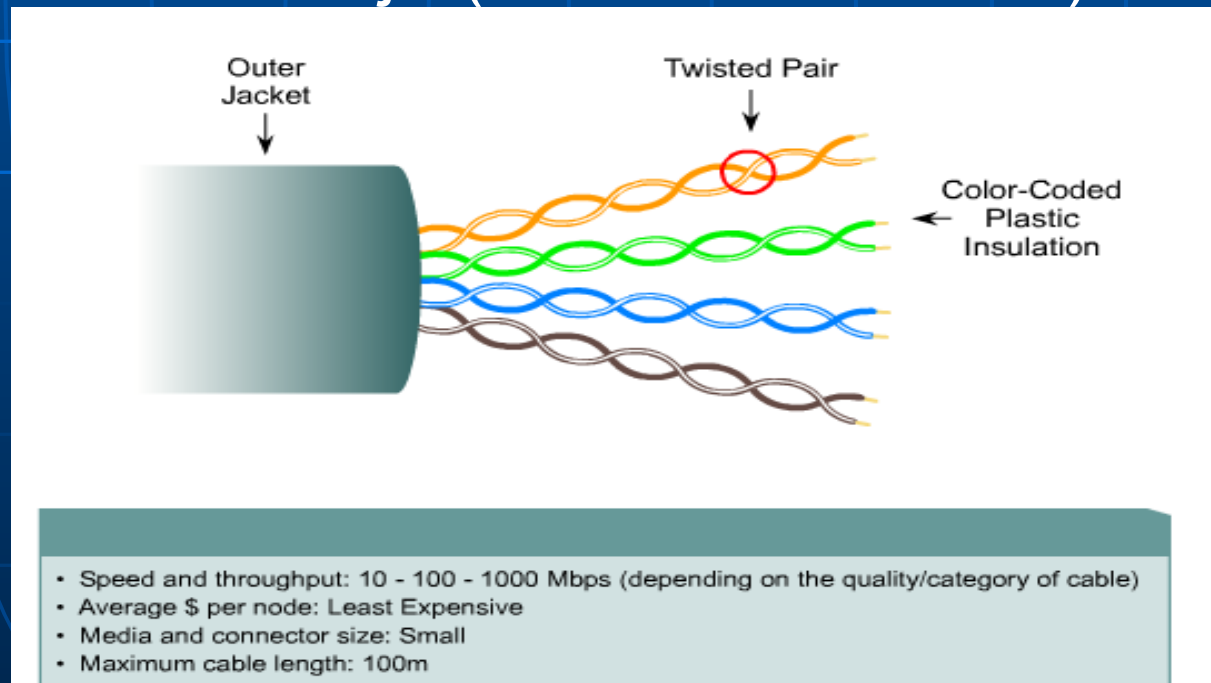


Unshielded Twisted Pair

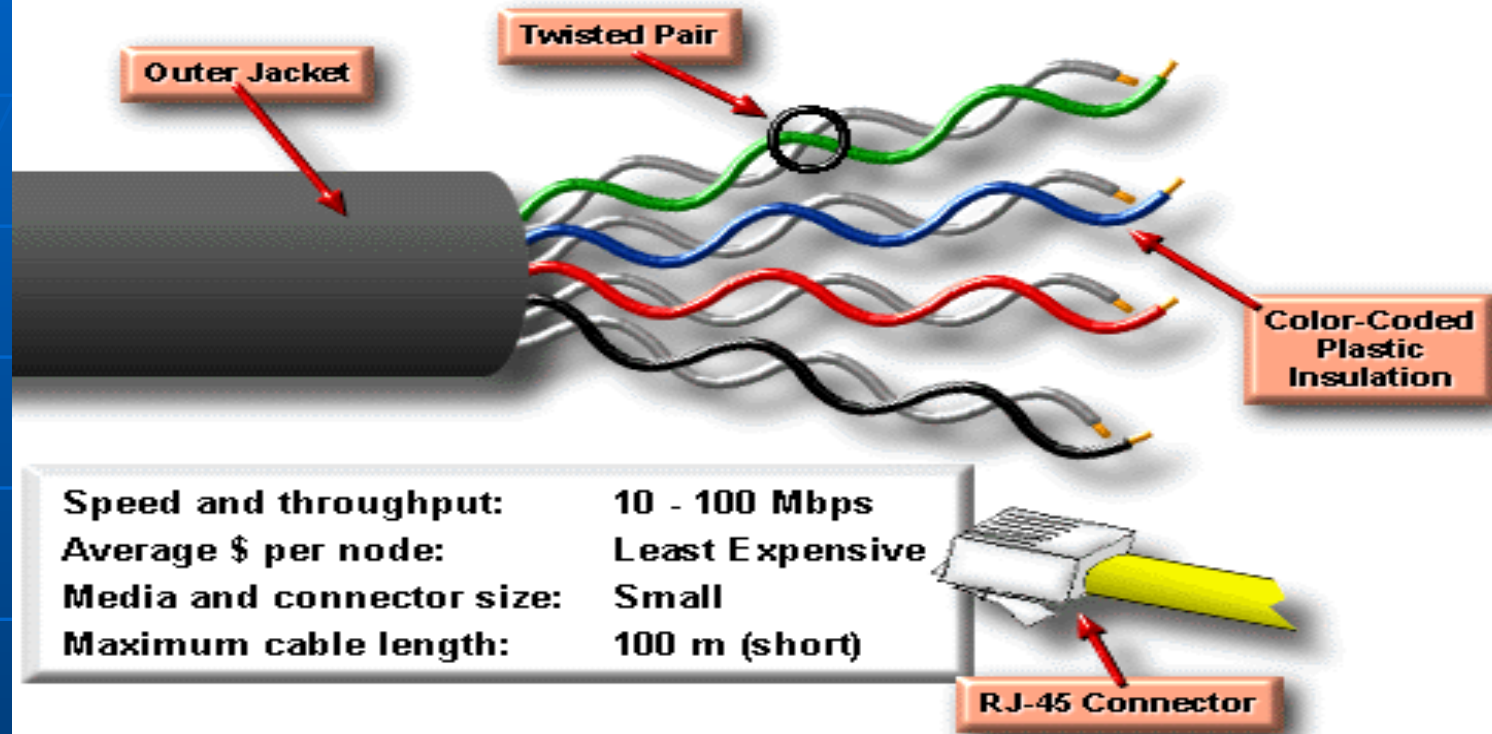
Various types of network media.

UTP kablovi

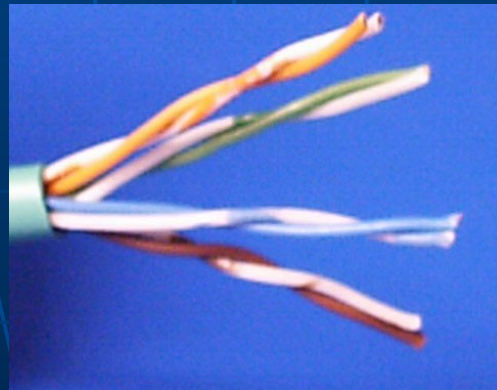
- Unshielded Twisted Pair - UTP
- Svaki par žica prepoznatljiv po boji (zelena, narandžasta, plava, braon)
- Parovi žica su upredeni (twisted) da bi se umanjile međusobne smetnje (cancelation effect)



Unshielded Twisted Pair (UTP)

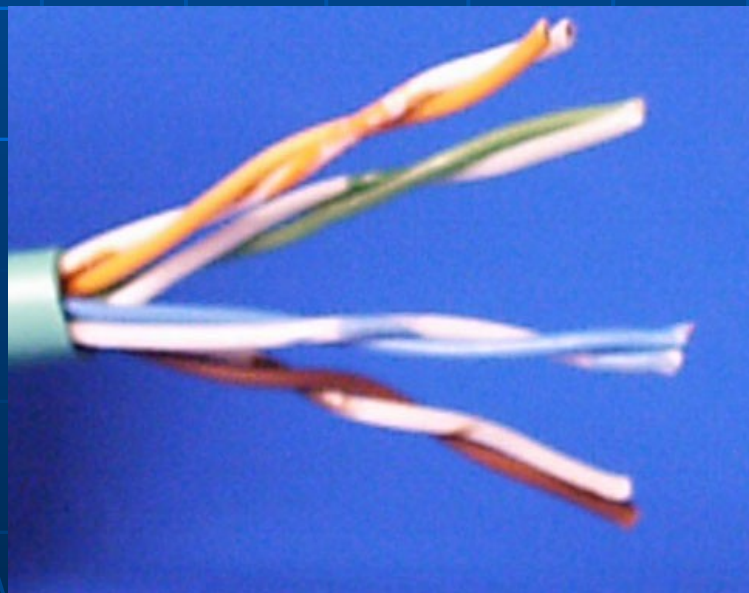


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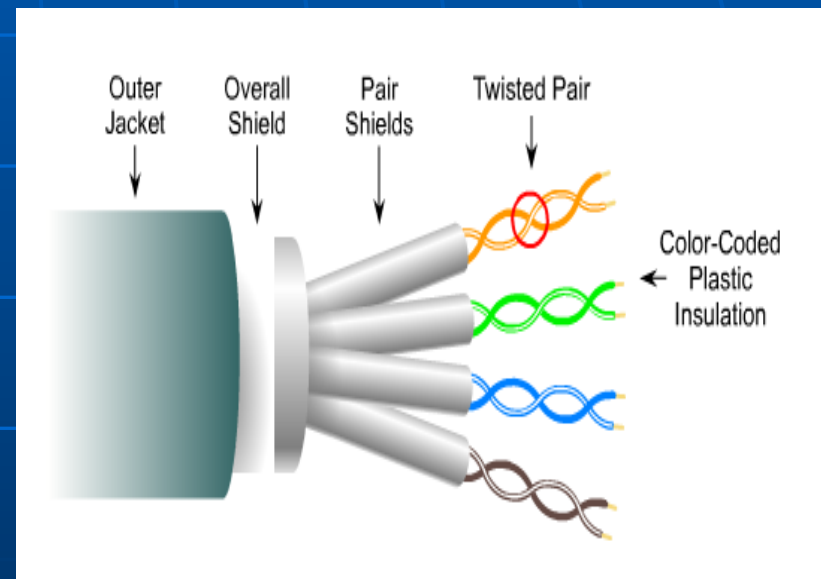
UTP - Prednosti i mane

- Jeftini i jednostavni za ugradnju
- Malih dimenzija - debljina
- Osjetljivi su na uticaj elektronskog šuma (EMI i RFI)

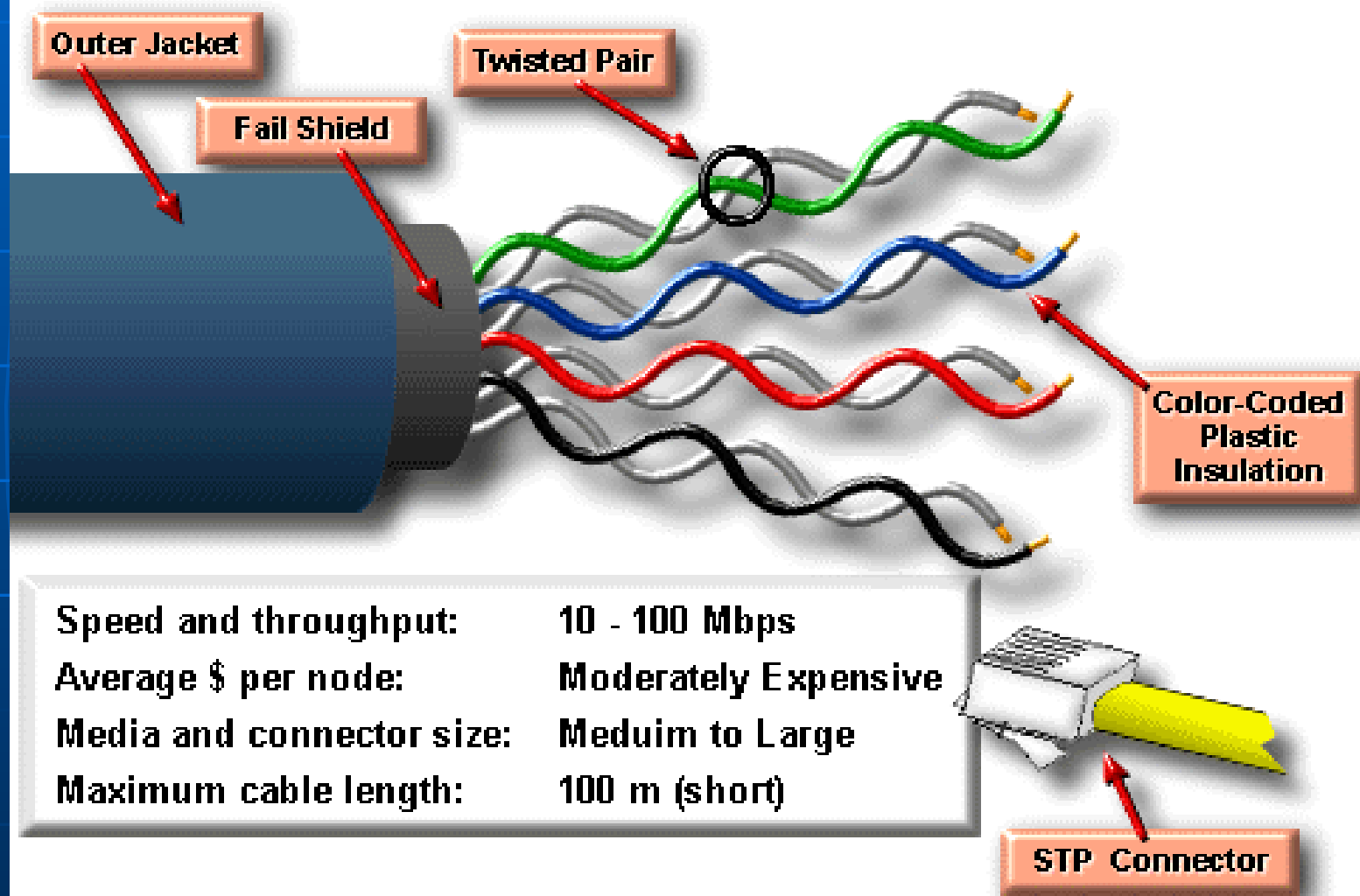


STP - Shielded Twisted Pair

- Svaki par žica je u metalnoj foliji
- Četiri para žica su u metalnoj pletenici ili foliji
- Umanjen uticaj elektronskog šuma (EMI i RFI)
- Skuplji i komplikovaniji za ugradnju od UTP



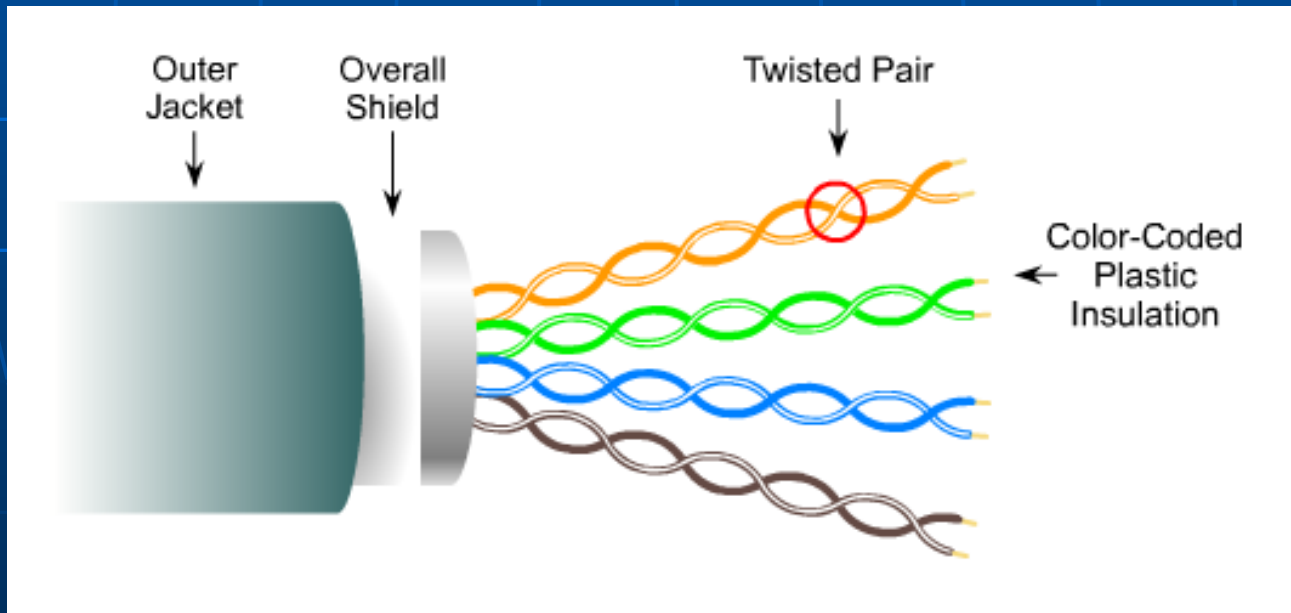
Shielded Twisted Pair (STP)



Speed and throughput:	10 - 100 Mbps
Average \$ per node:	Moderately Expensive
Media and connector size:	Medium to Large
Maximum cable length:	100 m (short)

ScTP ili FTP kablovi

- Foil Twisted Pair
- Isto što i UTP kabal ali sa dodatkom metalne folije (shield or screen)



Metalni šild

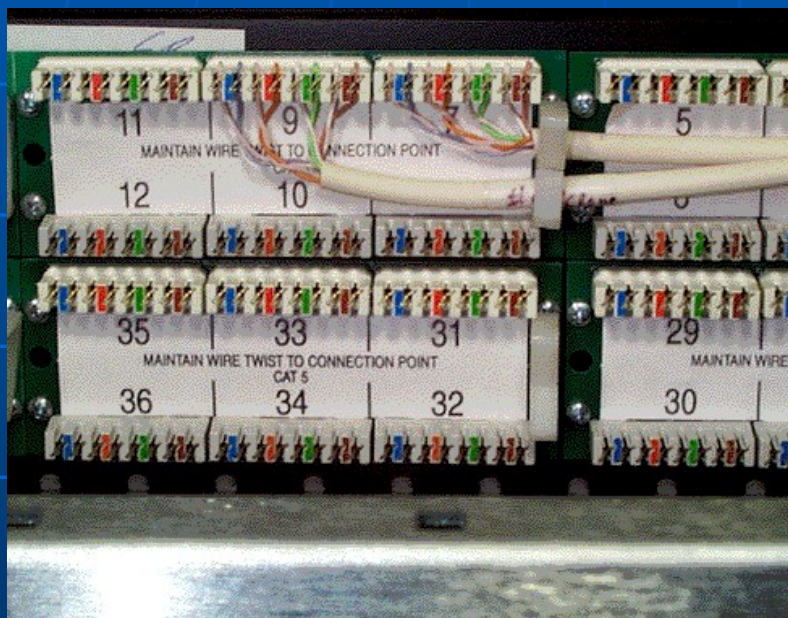
- Kod STP i ScTP (FTP) kablova, zaštitni metalni omot (shield) mora biti uzemljen
- Bez pravilnog uzemljenja shield-a, kabl je podložan uticajima EMI i FRI

RJ - 45 konektor

- UTP i STP (ScTP, FTP) kablovi koriste RJ-45 konektor



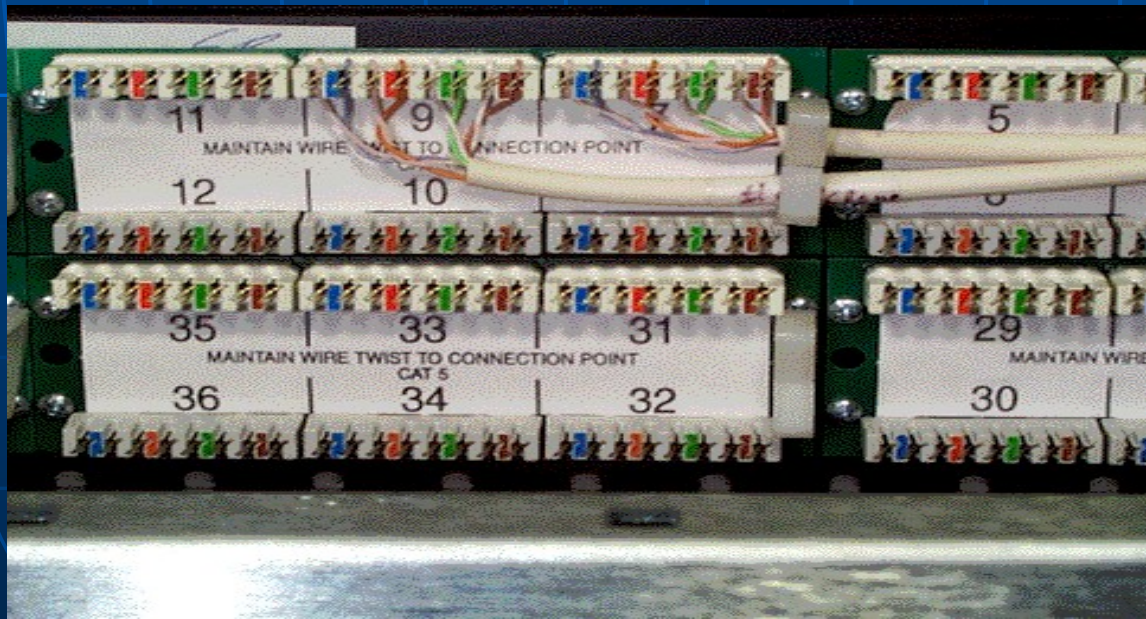
Utičnice (RJ-45 jack) i Patch panel (UTP i STP)



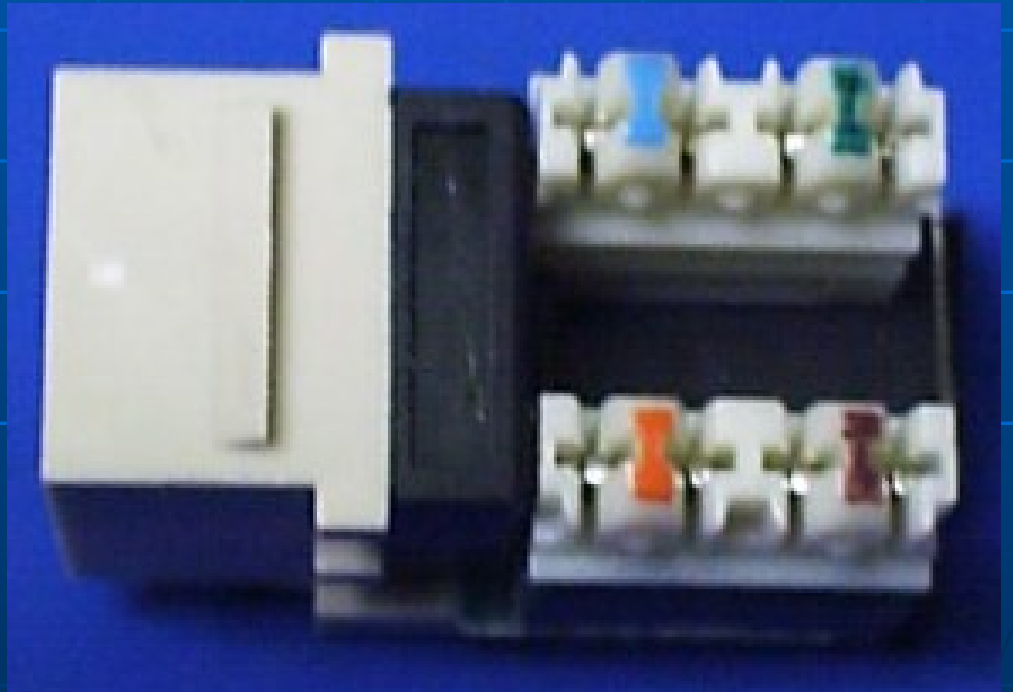
- Wall kabal - utičnice, patch panel
- Fly (patch) kabal - konektor RJ-45

Fly i Wall

- Wall kabal - ugradnja u zid ili plastične kanale
- Fly kabal (patch)
 - Od mrežne utičnice do računara
 - Od Patch panela do mrežnog uređaja

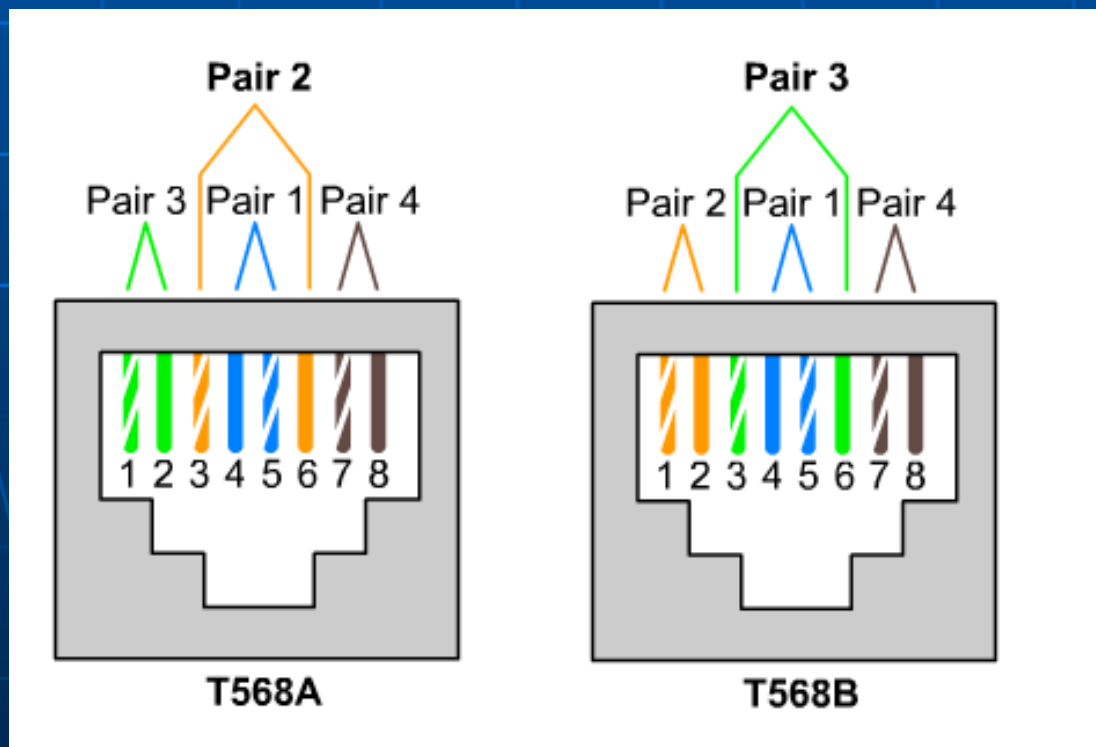


RJ-45 jack



Standardi kabliranja

- TIA/EIA-568-B (T568A, standard A)
- TIA/EIA-568-A (T568B, standard B)

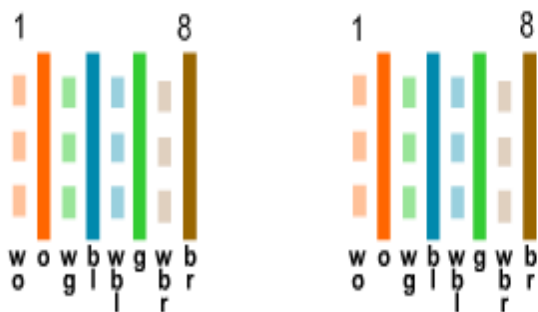


Direktni kabl - straight-through

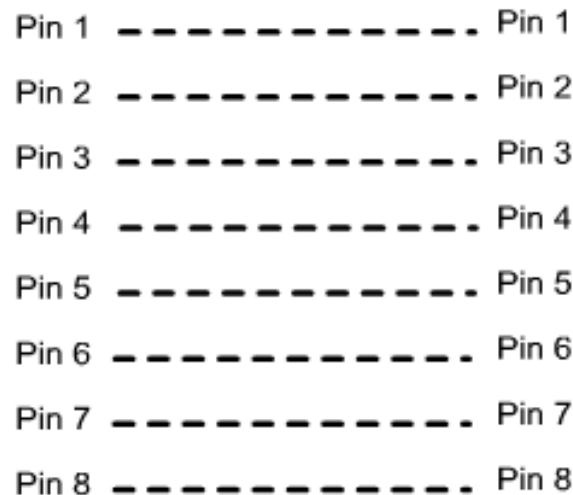
- Na oba konektora je isti raspored žica

Pin Label

1	TD+
2	TD-
3	RD+
4	NC
5	NC
6	RD-
7	NC
8	NC

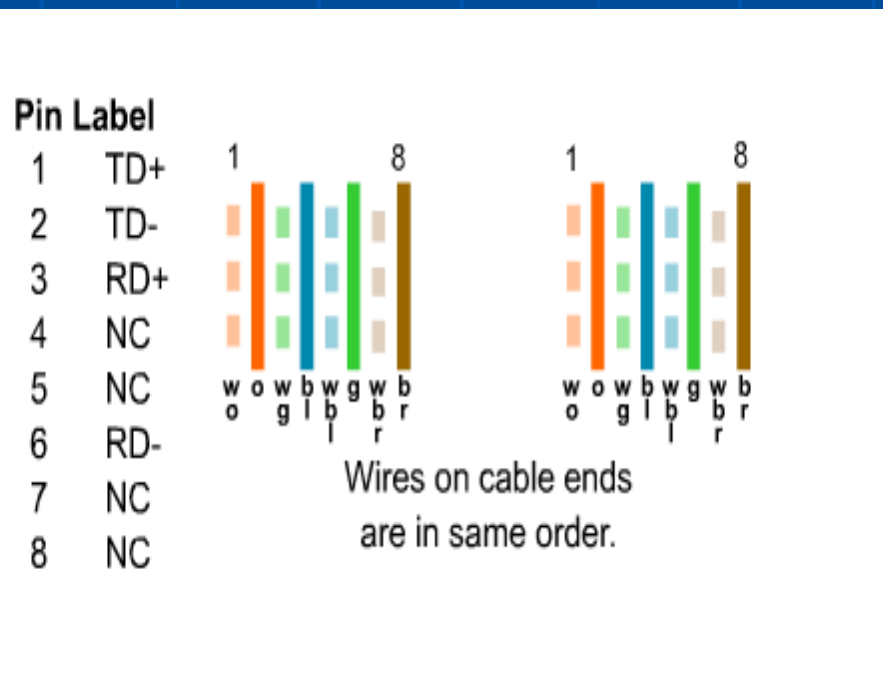


Wires on cable ends
are in same order.



Direktni kabl - straight-through

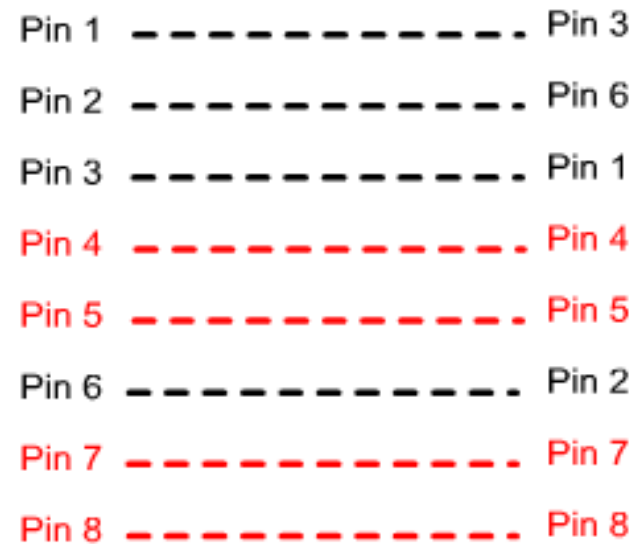
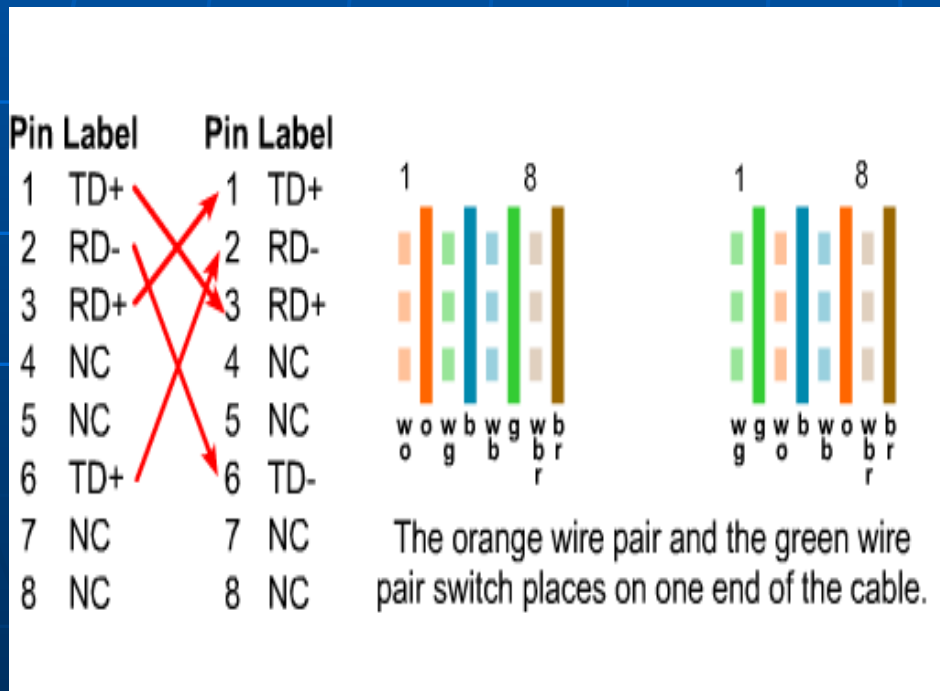
- Na oba konektora je isti raspored žica



- Switch - ruter
- Switch - PC (server)
- Hub - PC (server)

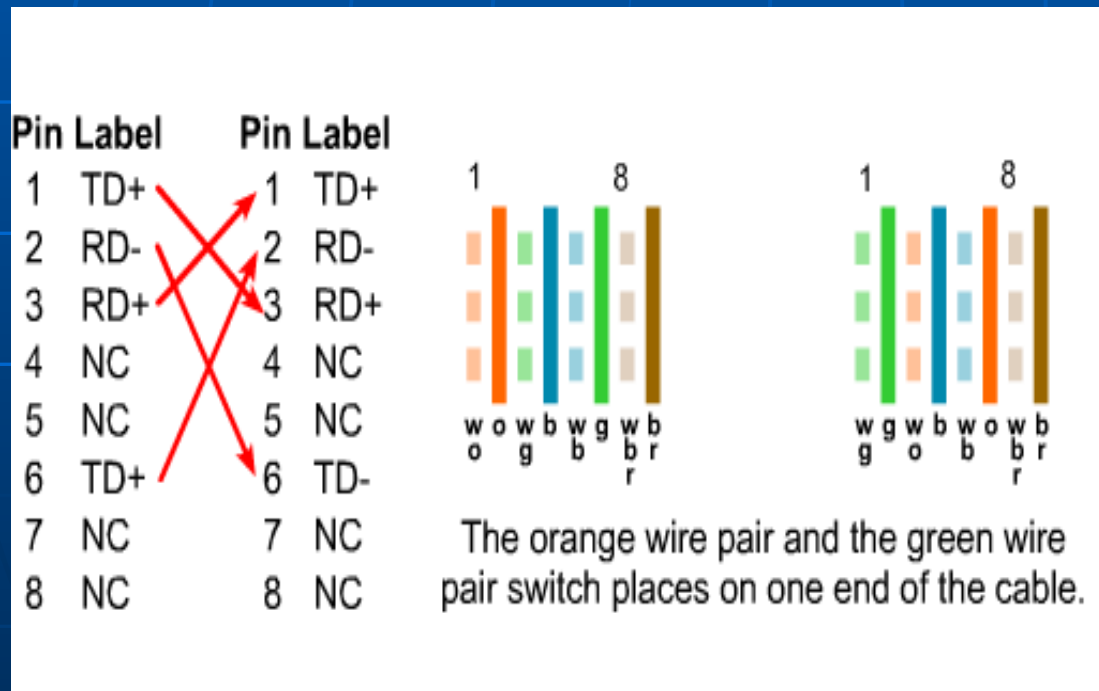
Ukršteni kabl - crossover

- Na konektorima je različit raspored žica (zeleni i narandžasti par žica mijenja svoje pozicije)



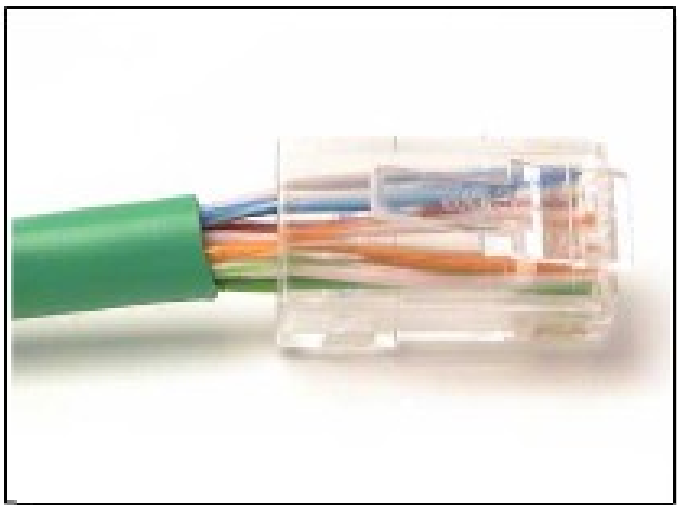
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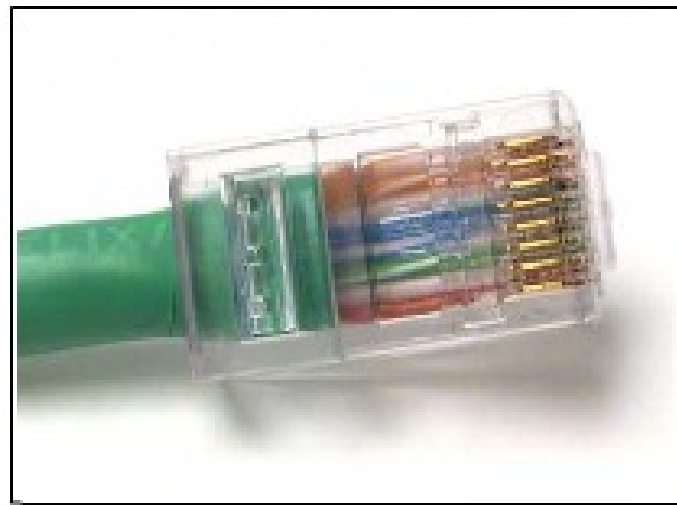


- Switch to switch
- Switch to hub
- Hub to hub
- Router to router
- PC to PC
- Router to PC
- MDI (PC), MDI/X

Nepravilno i pravino povezan konektor

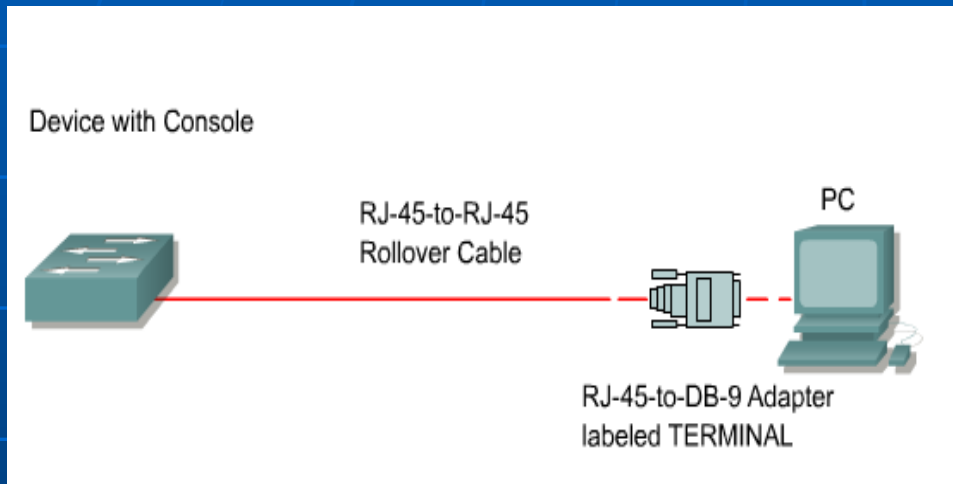


Bad Connector - Wires are untwisted for too great a length.



Good Connector - Wires are untwisted to the extent necessary to attach the connector.

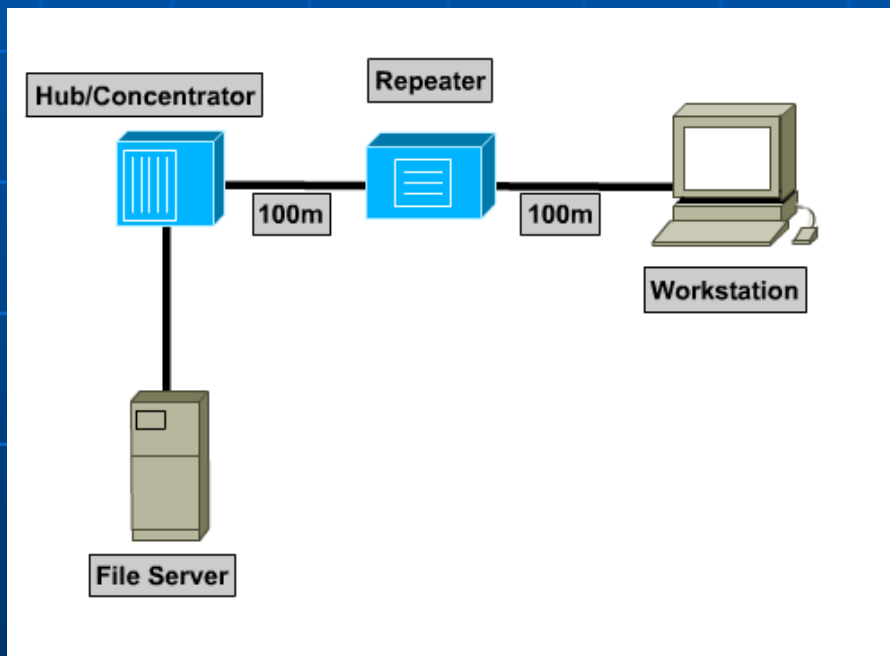
Rollover kabal



Pin 1	-----	Pin 8
Pin 2	-----	Pin 7
Pin 3	-----	Pin 6
Pin 4	-----	Pin 5
Pin 5	-----	Pin 4
Pin 6	-----	Pin 3
Pin 7	-----	Pin 2
Pin 8	-----	Pin 1

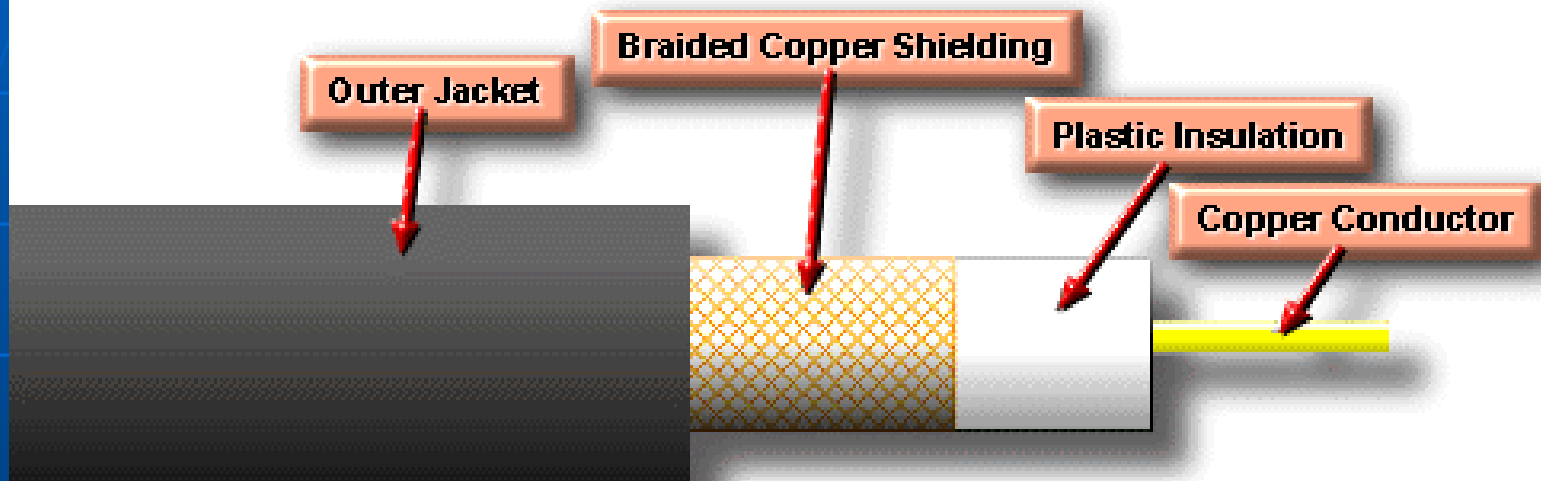
Povezivanje RJ-45/com port (serijski port) adaptera računara na konzolni port rutera ili switch-a

UTP - Povezivanje mrežnih uređaja



- Switch to router
- Switch to PC or server
- Hub to PC or server
- Switch to switch
- Switch to hub
- Hub to hub
- Router to router
- PC to PC
- Router to PC

Coaxial Cable



Speed and throughput:

10 - 100Mbps

Average \$ per node:

Inexpensive

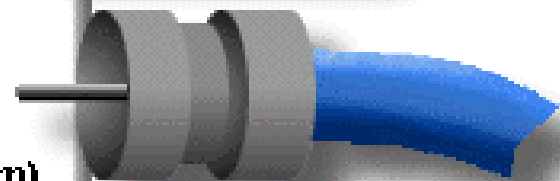
Media and connector size:

Medium

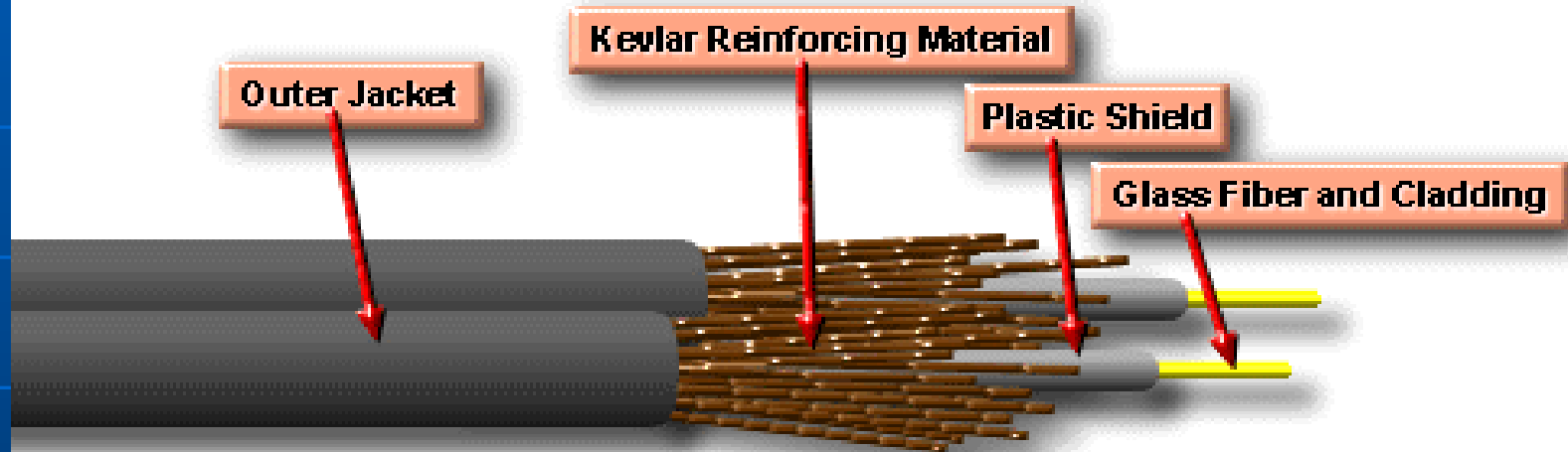
Maximum cable length:

500 m (medium)

BNC Connector



Fiber Optic Cable

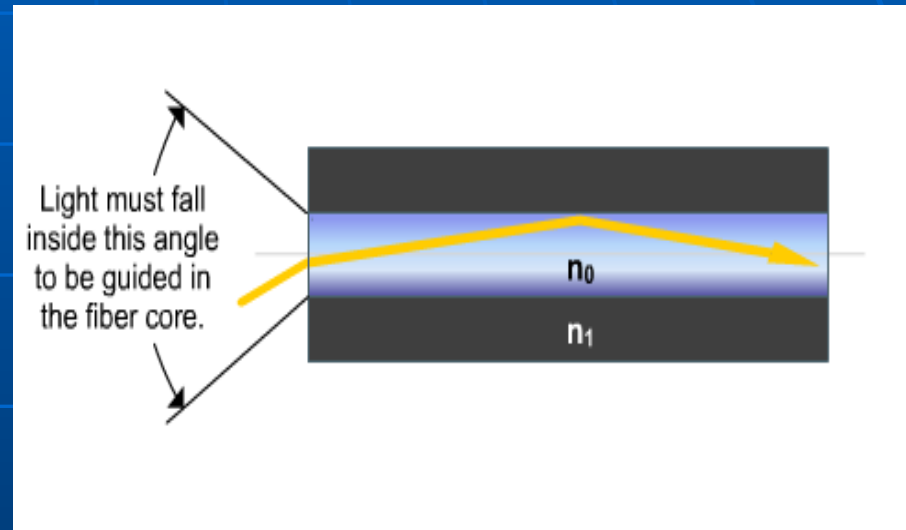
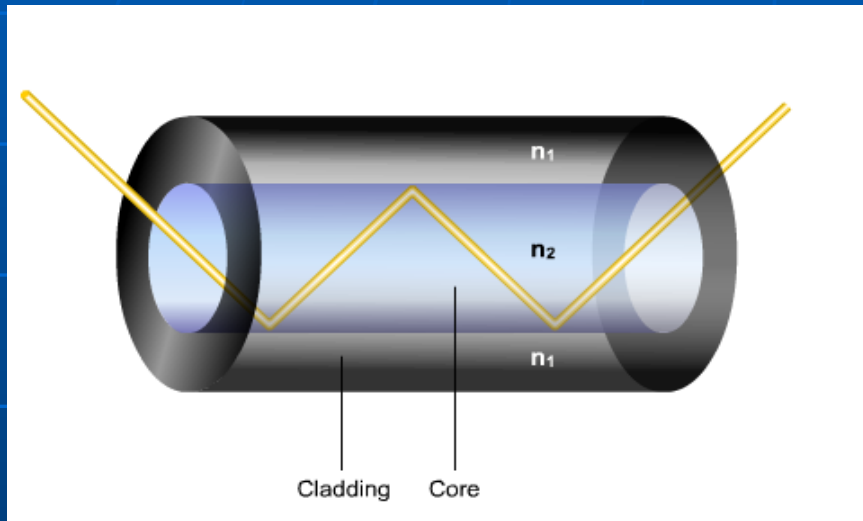


Speed and throughput:	100+ Mbps
Average \$ per node:	Most Expensive
Media and connector size:	Small
Maximum cable length:	up to 2 Km
Single mode:	One stream of laser-generated light
Multimode:	Multiple streams of LED-generated light

Multimode Connector

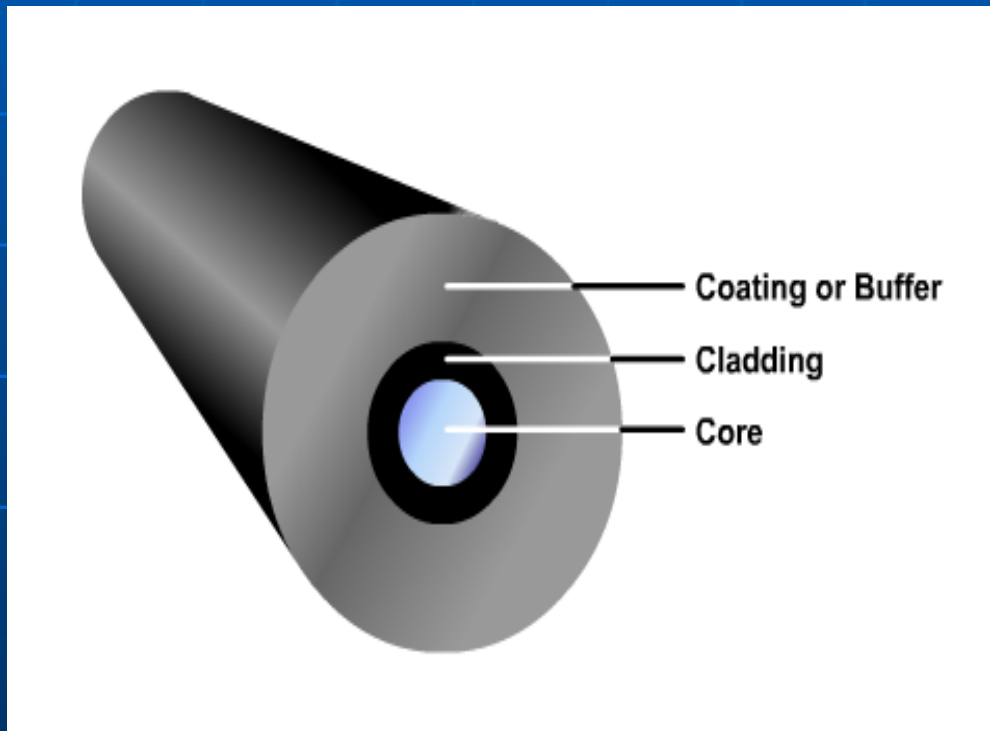


Refleksija optičkog zraka



- Jezgro optičkog vlakna mora imati veći indeks refrakcije (n) od kladinga
- Ugao pod kojim ulazi svjetlosni zrak (ugao incidencije)

Komponente optičkog kabla



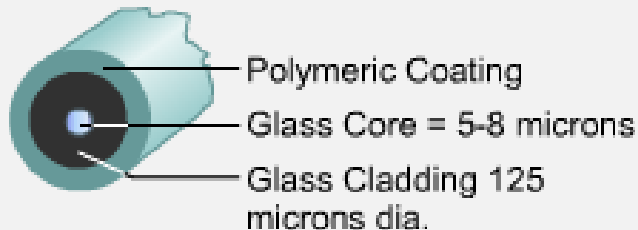
- Omotač (coating)
- Klading
- Jezgro (core)

Single-mode i Multimod

Single-mode

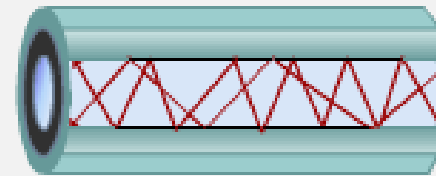


Requires very straight path

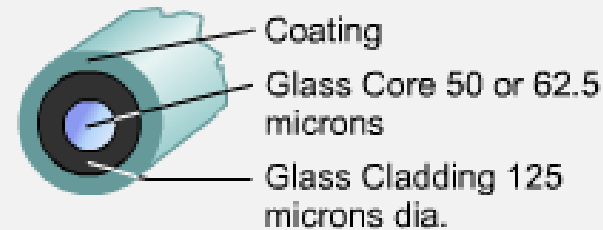


- Small core
- Less dispersion
- Suited for long distance applications (up to ~3km, 9,840 ft)
- Uses lasers as the light source often within campus backbones for distances of several thousand meters

Multimode

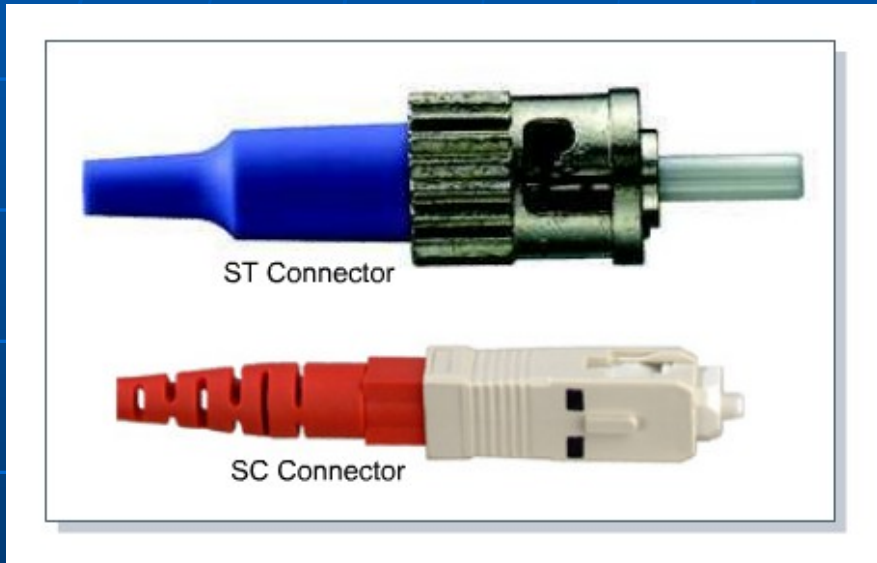


Multiple paths-sloppy



- Larger core than single-mode cable (50 or 62.5 microns or greater)
- Allows greater dispersion and therefore, loss of signal
- Used for long distance application, but shorter than single-mode (up to ~2km, 6,560 ft)
- Uses LEDs as the light source often within LANs or distances of a couple hundred meters within a campus network

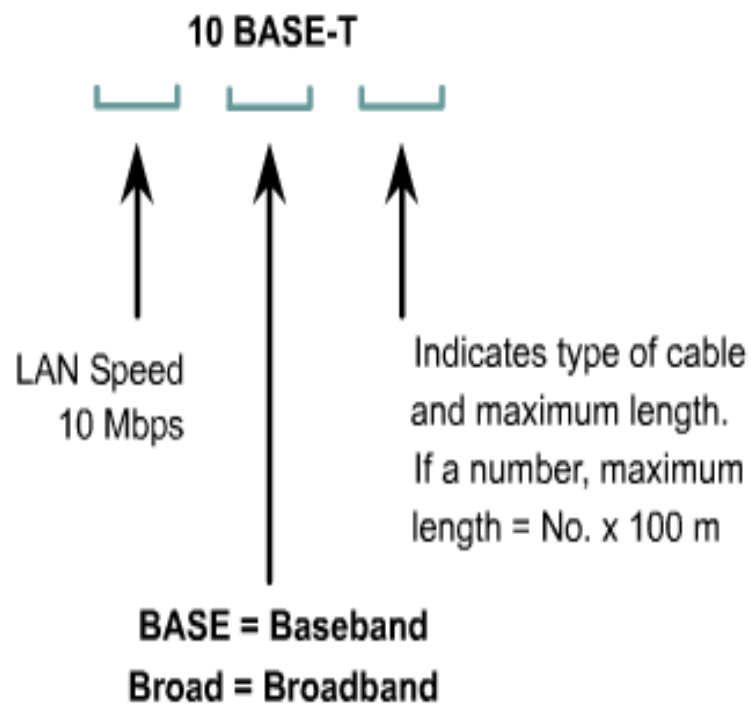
Konektori za optičke kablove



Laserski zrak u single-mod optičkim kablovima može da izazove teška oštećenja oka !!!!

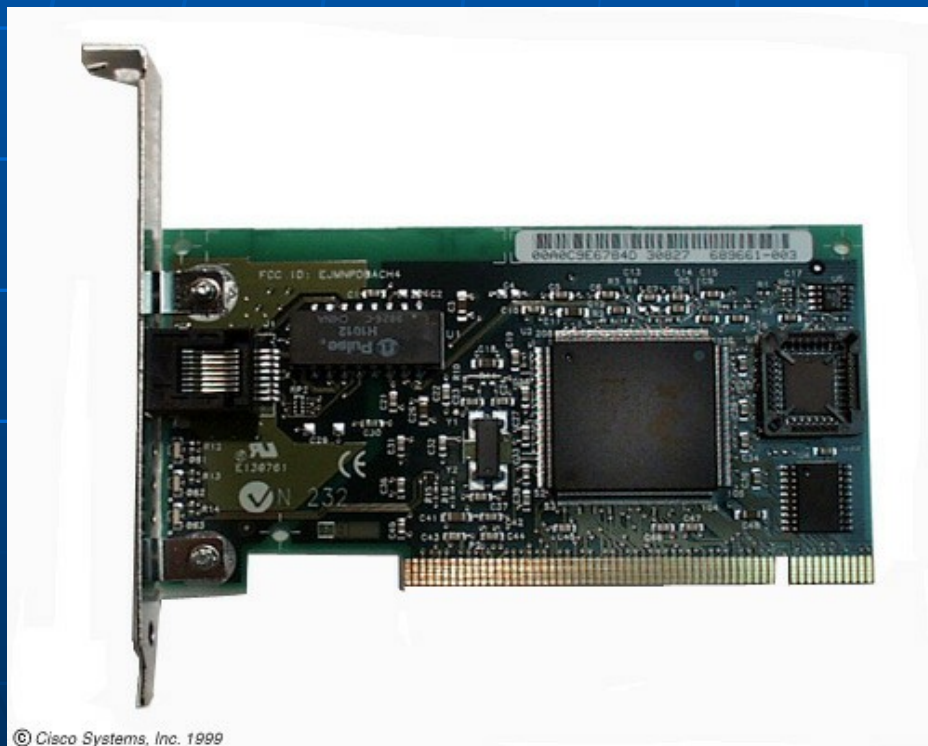
Some Typical Media	Maximum Theoretical Bandwidth	Maximum Physical Distance
50-Ohm Coaxial Cable (Ethernet 10Base2, ThinNet)	10-100 Mbps	200m
75-Ohm Coaxial Cable (Ethernet 10Base5, ThickNet)	10-100 Mbps	500m
Category 5 Unshielded Twisted Pair (UTP) (Ethernet 10BaseT, 100Base-TX)	10 Mbps	100m
Category 5 Unshielded Twisted Pair (UTP) (Ethernet 100Base-TX)(Fast Ethernet)	100 Mbps	100m
Multimode (62.5/125um) Optical Fiber 100Base-FX	100 Mbps	2000m
Singlemode (10um core) Optical Fiber 1000Base-LX	1000Mbps (1.000 Gbps)	3000m
Other technologies being researched	2400 Mbps (2.400 Gbps)	40km = 40,000m
Wireless	2.0 Mbps	100m

Ethernet specifikacije



- 10Base2
- 10Base5
- 10BaseT
- 100Base-TX
- 100Base-FX
- 1000Base-LX

Mrežni adapter - NIC network interface card



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- LAN adapter
- Komunicira sa mrežom preko serijske konekcije a sa računarom preko paralelne konekcije
- Zahtjevaju IRQ i I/O adresu

Hub

- Regeneriše signal
- Koristi se kao mjesto koncentracije
- Ne filtrira saobraćaj
- Ne definiše put podacima
- Naziva se i multiport repeater



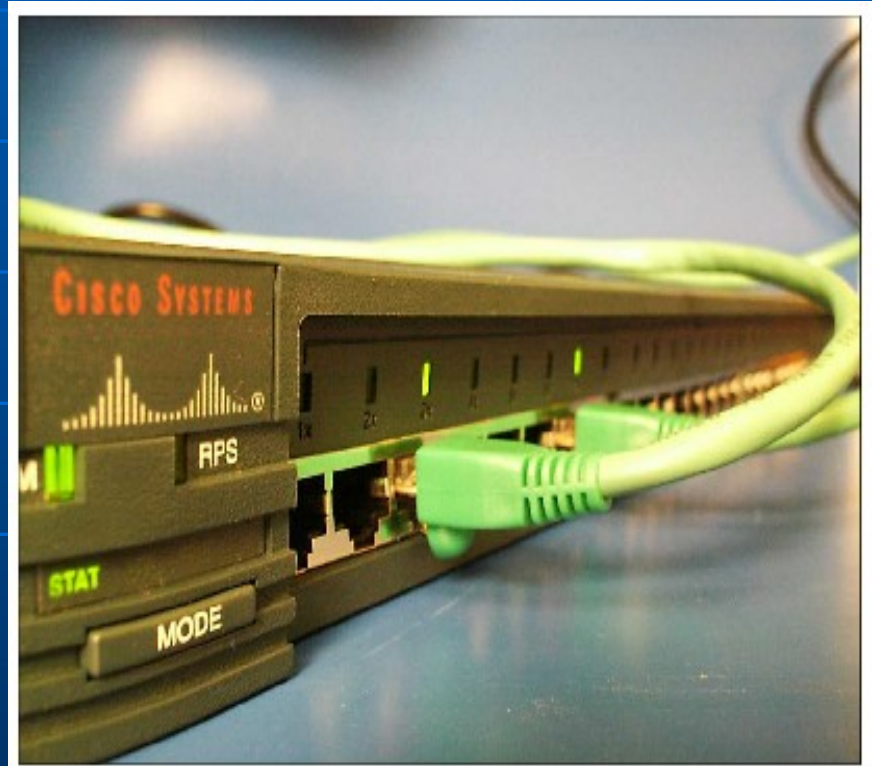
Hub

- Uređaji priključeni na HUB primaju sav saobraćaj koji prolazi kroz HUB
- Više priključenih uređaja - veća vjerovatnoća da će doći do kolizije
- Uređaji priključeni na isti mrežni segment su u jednom kolizionom domenu

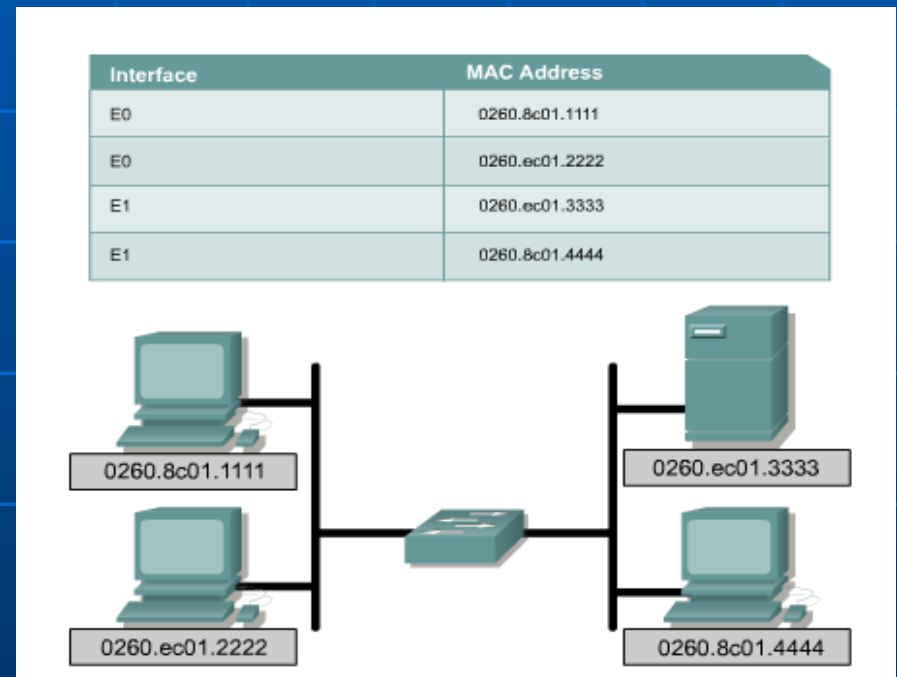
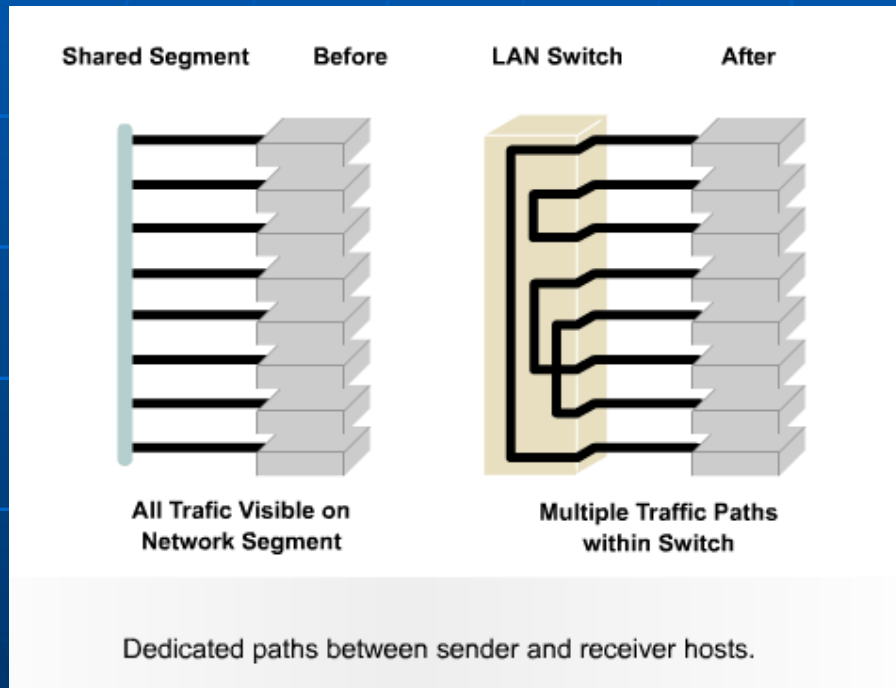


Switch

- Koriste se kao mjesto koncentracije
- Kombinuju konektivnost HUB-a i mogućnost regulacije bridge-a
- Obezbjedjuju odvojene puteve za podatke



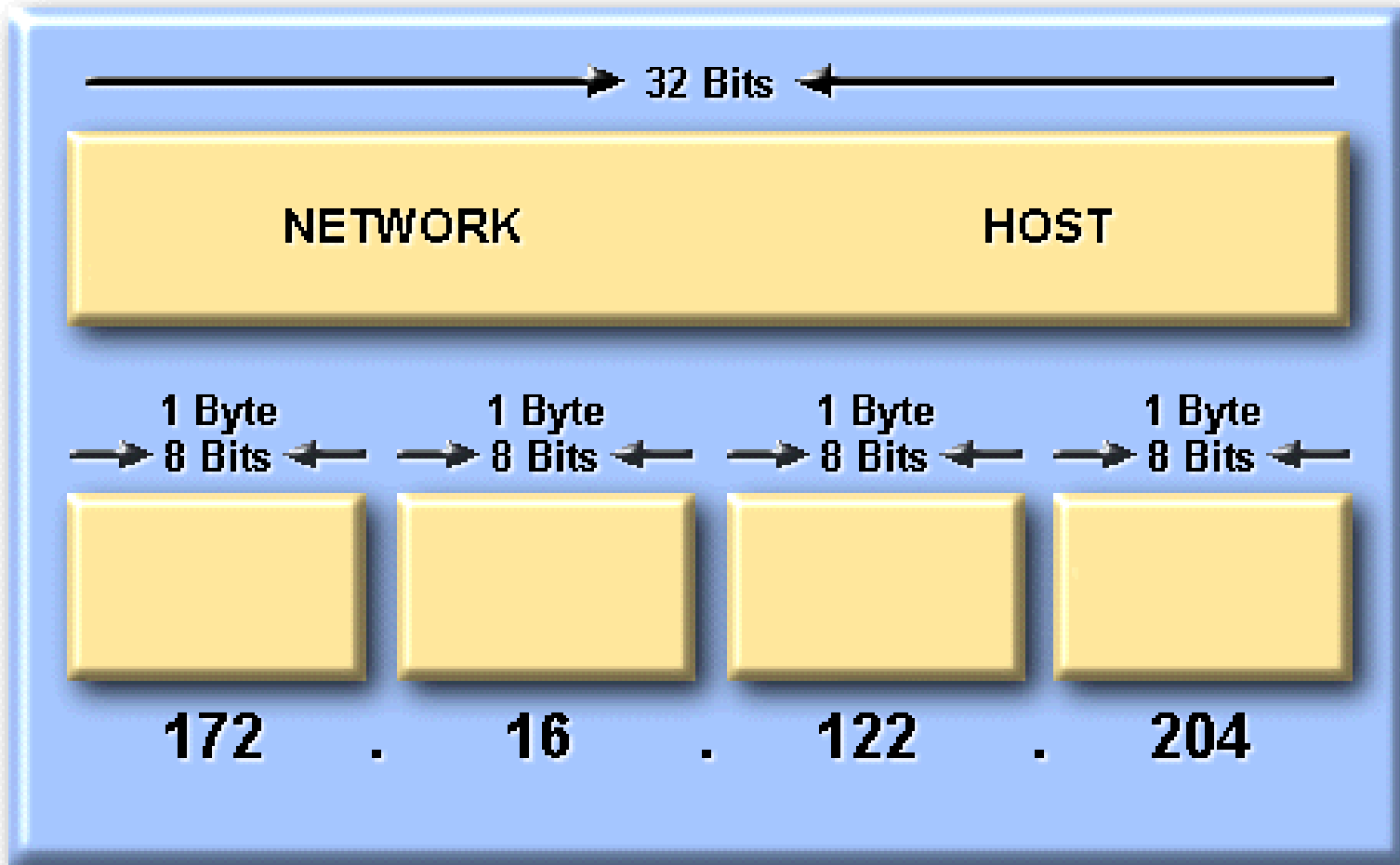
Switch



Uspostavljanje puta namjenjenog komuniciranju dva uređaja

Pravljenje tabela na osnovu portova i MAC adresa

IP Addressing



IP adrese

- IP adresa sastoji se od 32 bita.
- Predstavljena je u četiri okteta.
- Sastoji se iz dva dijela:
 - mrežni ID
 - host ID

233.14.17.0

Subnet Mask - Podmrežna maska

IP adresa

172.16.2.120

Subnet Mask

255.255.255.0

10101100.00010000.00000010.011

AN 11000111.11111111.11111111.0000

D 0000

10101100.00010000.00000010.0000

0000

Mrežna adresa

172.16.2.0

Mrežna adresa pomaže pri odredjivanju puta-rute

Rezervisane adrese

- Broadcast adresa – koristi se za slanje podataka svim uređajima na mreži.
- Broadcast IP adresa se završava sa binarnim jedinicama u host dijelu IP adrese.

(decimalno 255 = binarno 11111111)

Binarni brojni sistem

145

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
1	0	0	1	0	0	0	1

Binarni brojni sistem

35

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
0	0	1	0	0	0	1	1

Binarni brojni sistem

255

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1