Applied!

Computer Networks

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aComputerNetworks.github.io

Spring 2025

Introduction

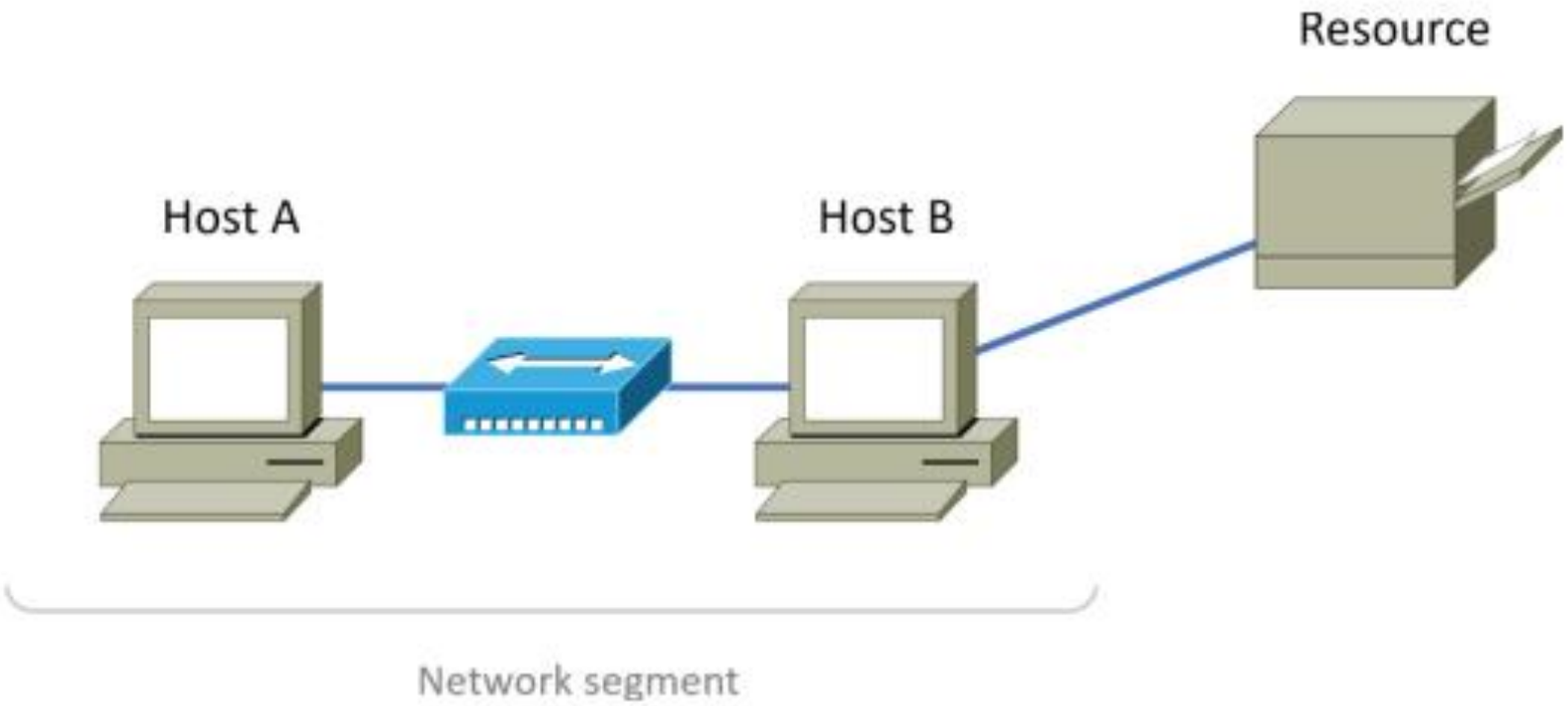
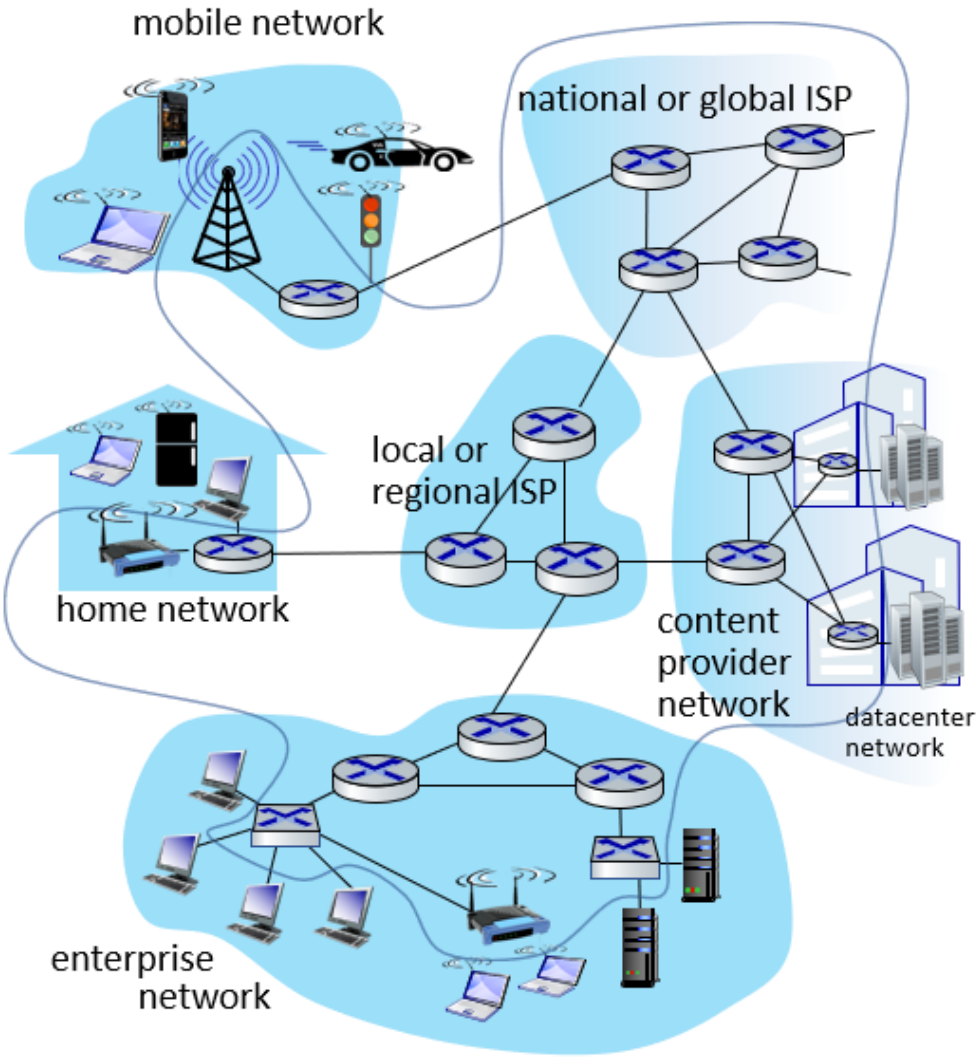
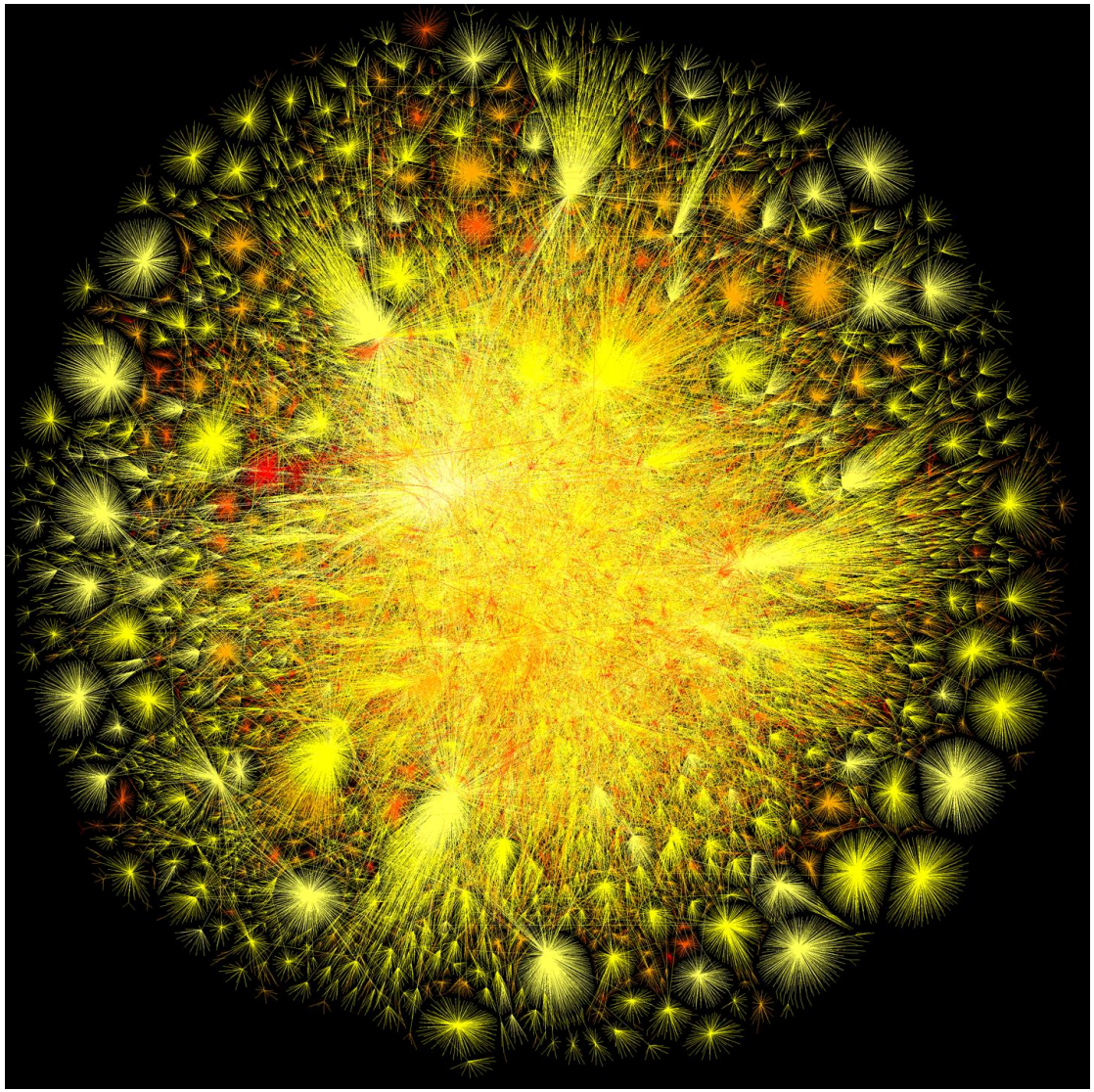


FIGURE 1.1 A basic network

Internet: “network of networks”

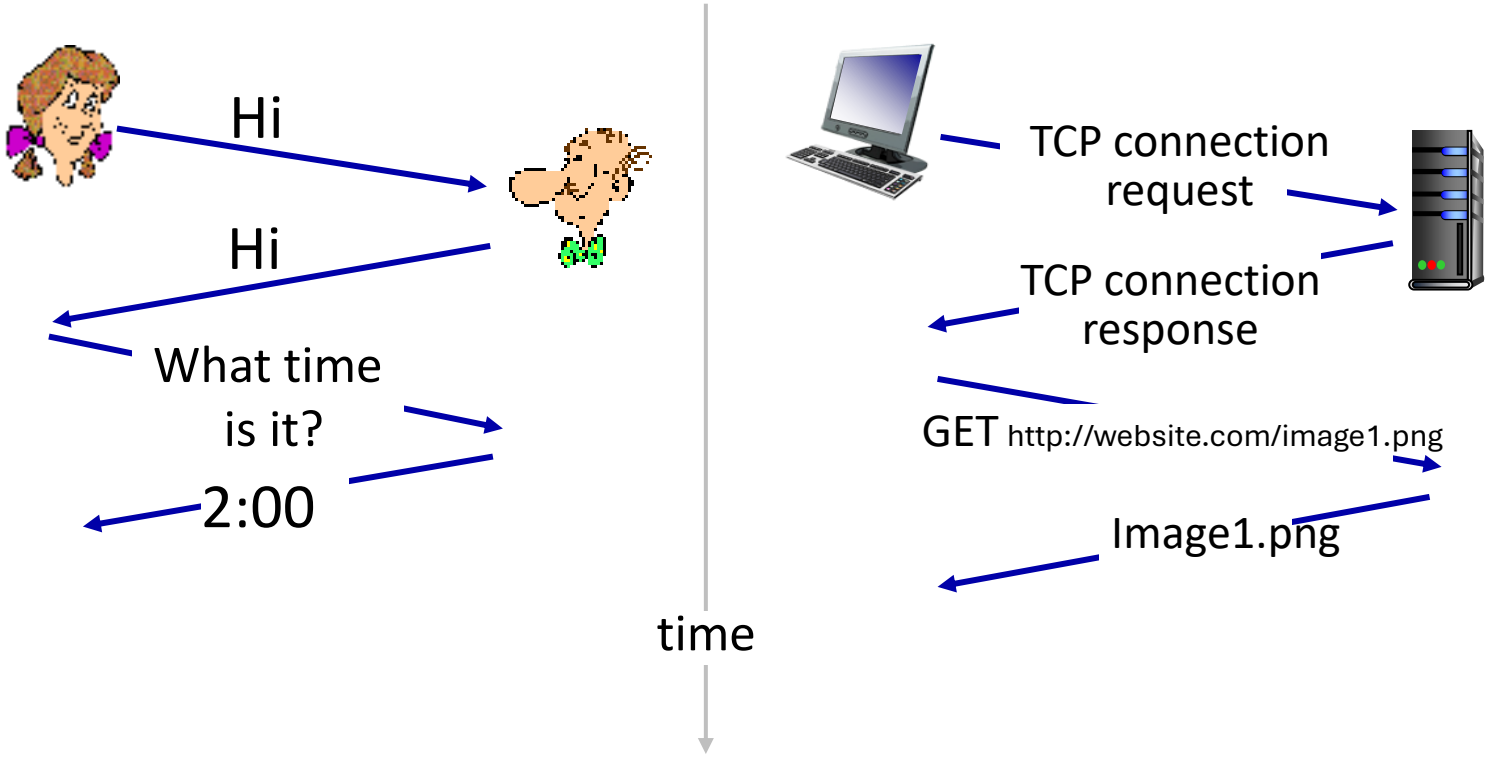


Internet



http://content.opte.org/content/opte/maps/static/opte-2010.png

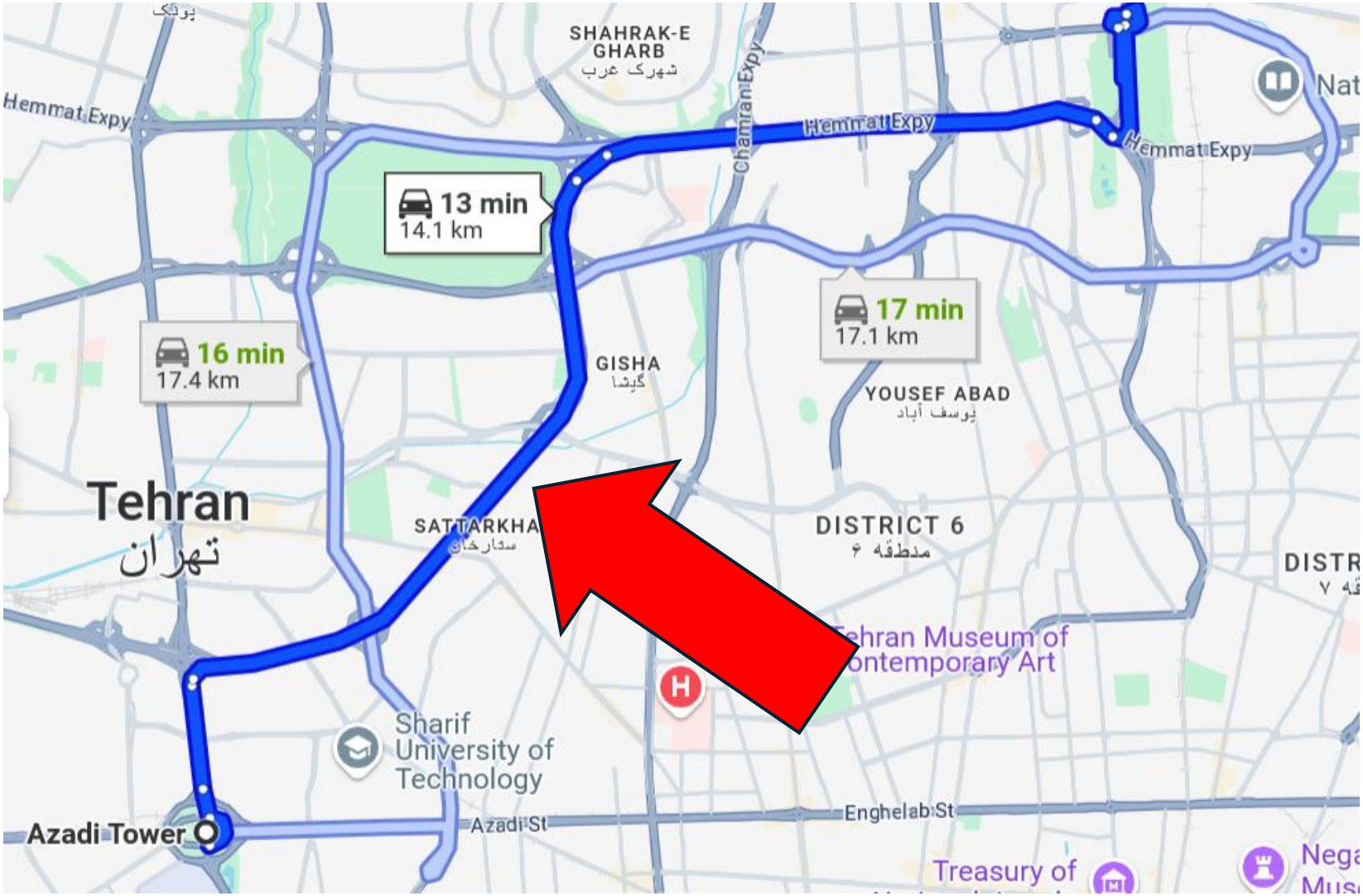
What is a Protocol?



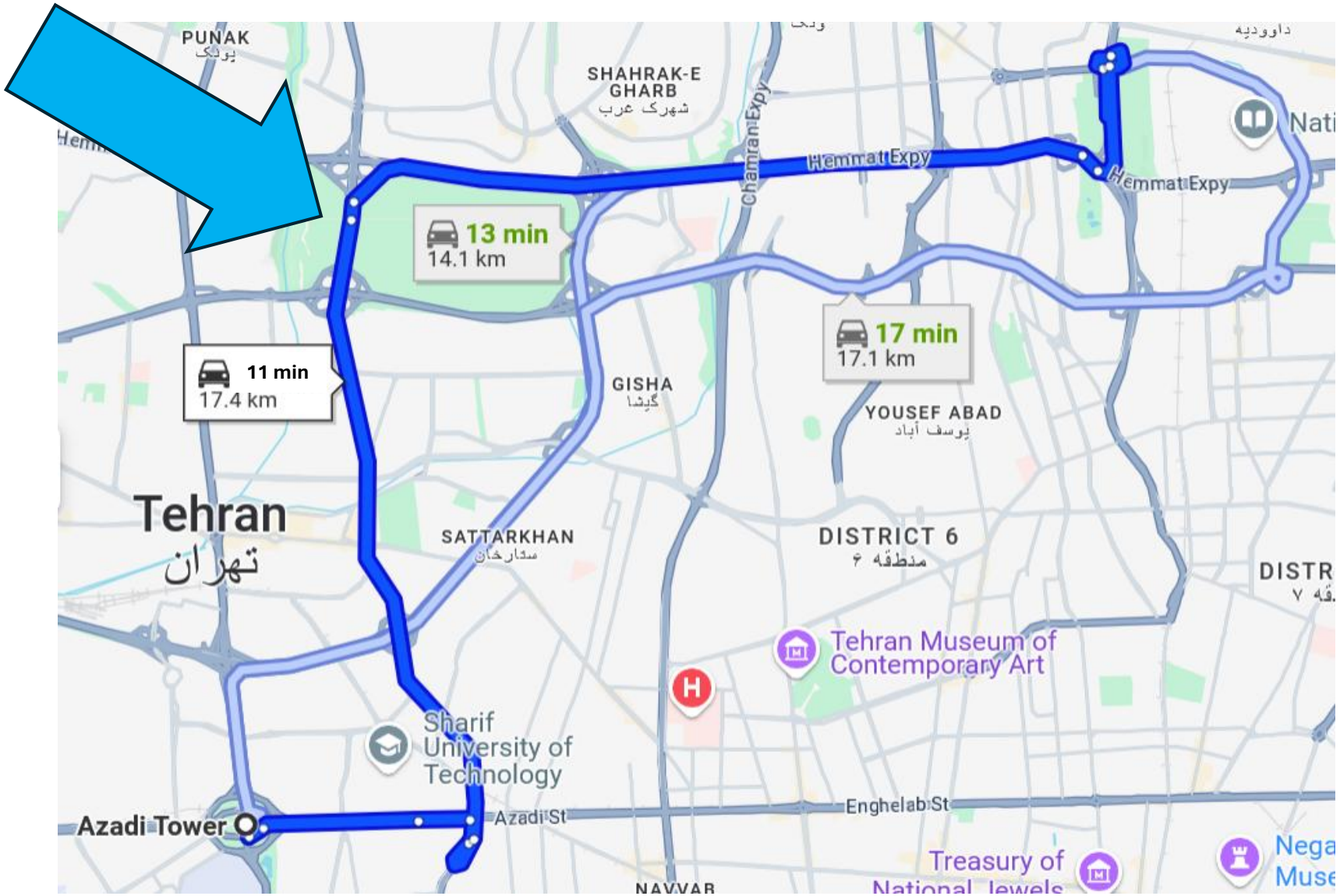
Example

GET PooleTabiat.png

Routing


SHAHRAK-E GHARB
شهرک غرب
Hemmat Expy
Chamran Expy
Hemmat Expy
Hemmat Expy
13 min
14.1 km
17 min
17.1 km
16 min
17.4 km
GISHA
گیشا
YOUSEF ABAD
یوسف آباد
Tehran
تهران
SATTARKHA
ستارخان
DISTRICT 6
منطقه ۶
Tehran Museum of Contemporary Art
Sharif University of Technology
Azadi Tower
Azadi St
Enghelab St
Treasury of

Routing


PUNAK
SHAHRAK-E GHARB
شهرک غرب
Chamran Expy
Hemmat Expy
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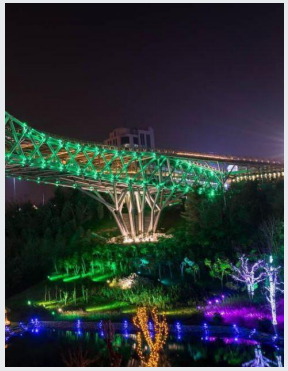
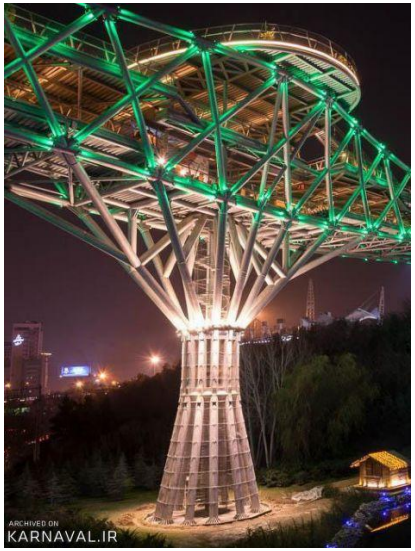
Sharif University of Technology
Azadi Tower
Azadi St
Enghelab St
Treasury of National Jewels
NAVVAB

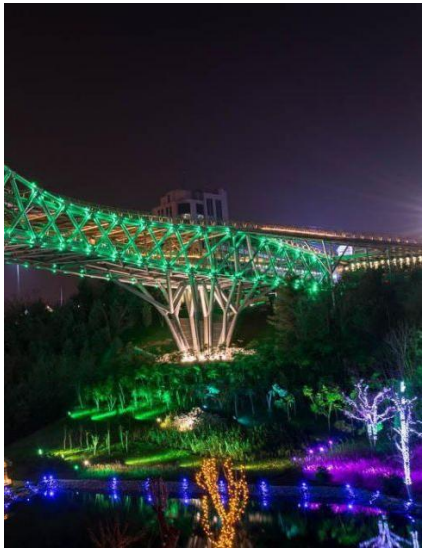
Fragmentation

- Image is too large!

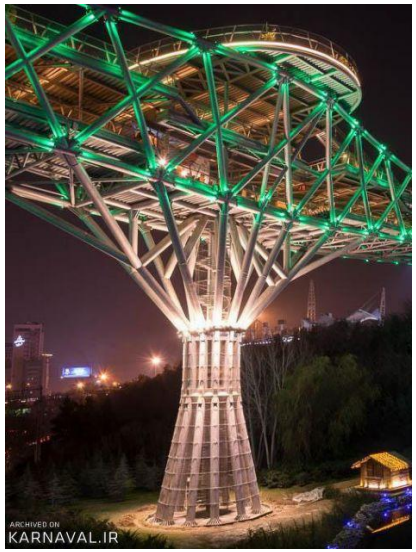
Packet	Data
Packet1	
Packet2	

Assemble



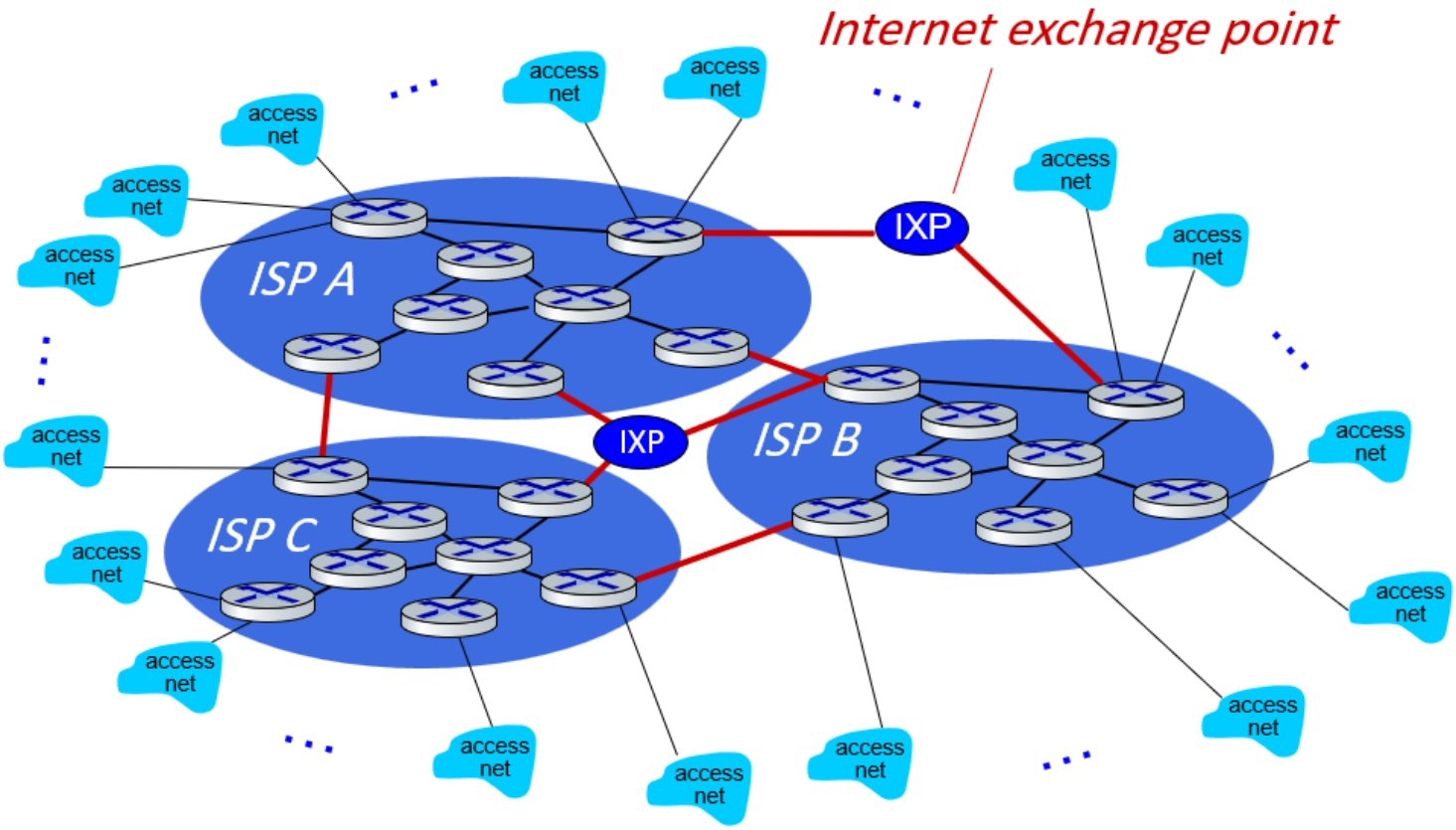


Packet Loss

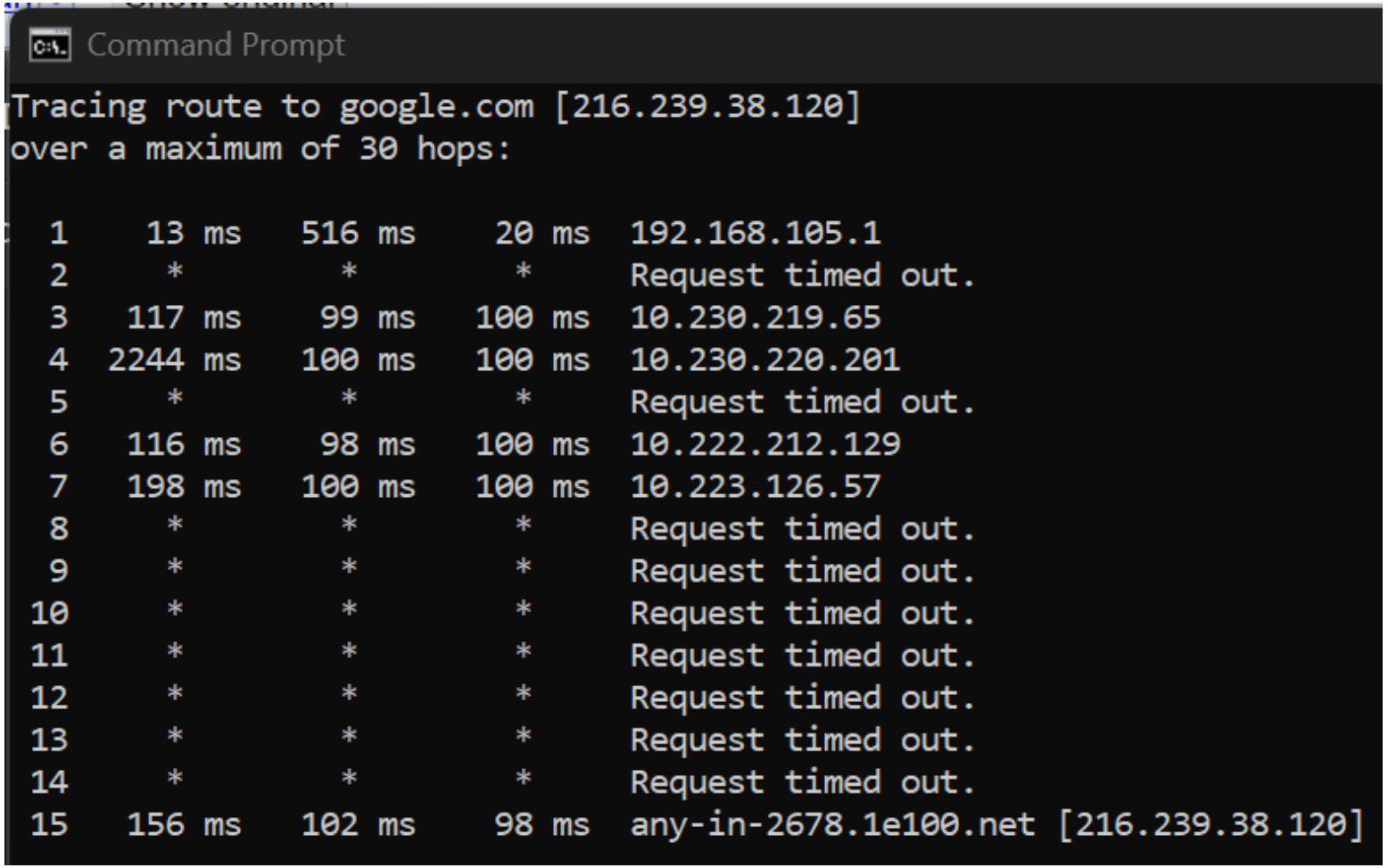


GET Packet2

Internet structure: a “network of networks”

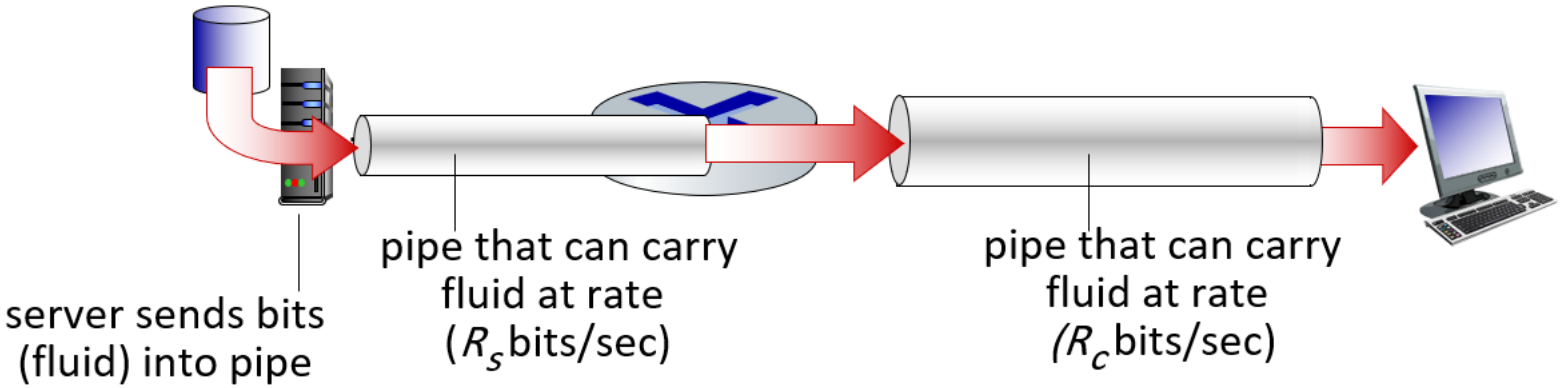


Traceroute


Command Prompt
Tracing route to google.com [216.239.38.120]
over a maximum of 30 hops:
1 13 ms 516 ms 20 ms 192.168.105.1
2 * * * Request timed out.
3 117 ms 99 ms 100 ms 10.230.219.65
4 2244 ms 100 ms 100 ms 10.230.220.201
5 * * * Request timed out.
6 116 ms 98 ms 100 ms 10.222.212.129
7 198 ms 100 ms 100 ms 10.223.126.57
8 * * * Request timed out.
9 * * * Request timed out.
10 * * * Request timed out.
11 * * * Request timed out.
12 * * * Request timed out.
13 * * * Request timed out.
14 * * * Request timed out.
15 156 ms 102 ms 98 ms any-in-2678.1e100.net [216.239.38.120]

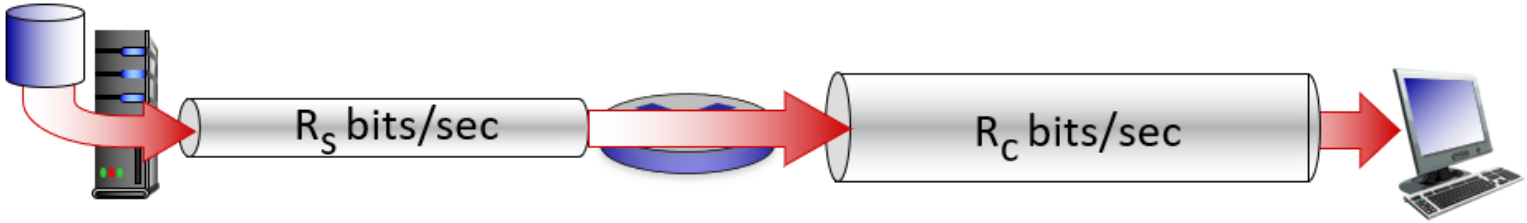
Throughput

- *throughput:* rate (bits/time unit) at which bits are being sent from sender to receiver

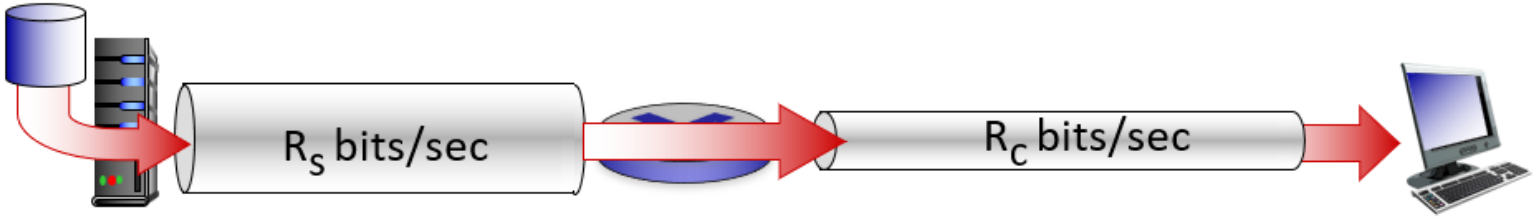


Bottleneck

$R_s < R_c$ What is end-end throughput?



$R_s > R_c$ What is end-end throughput?



Physical Layer

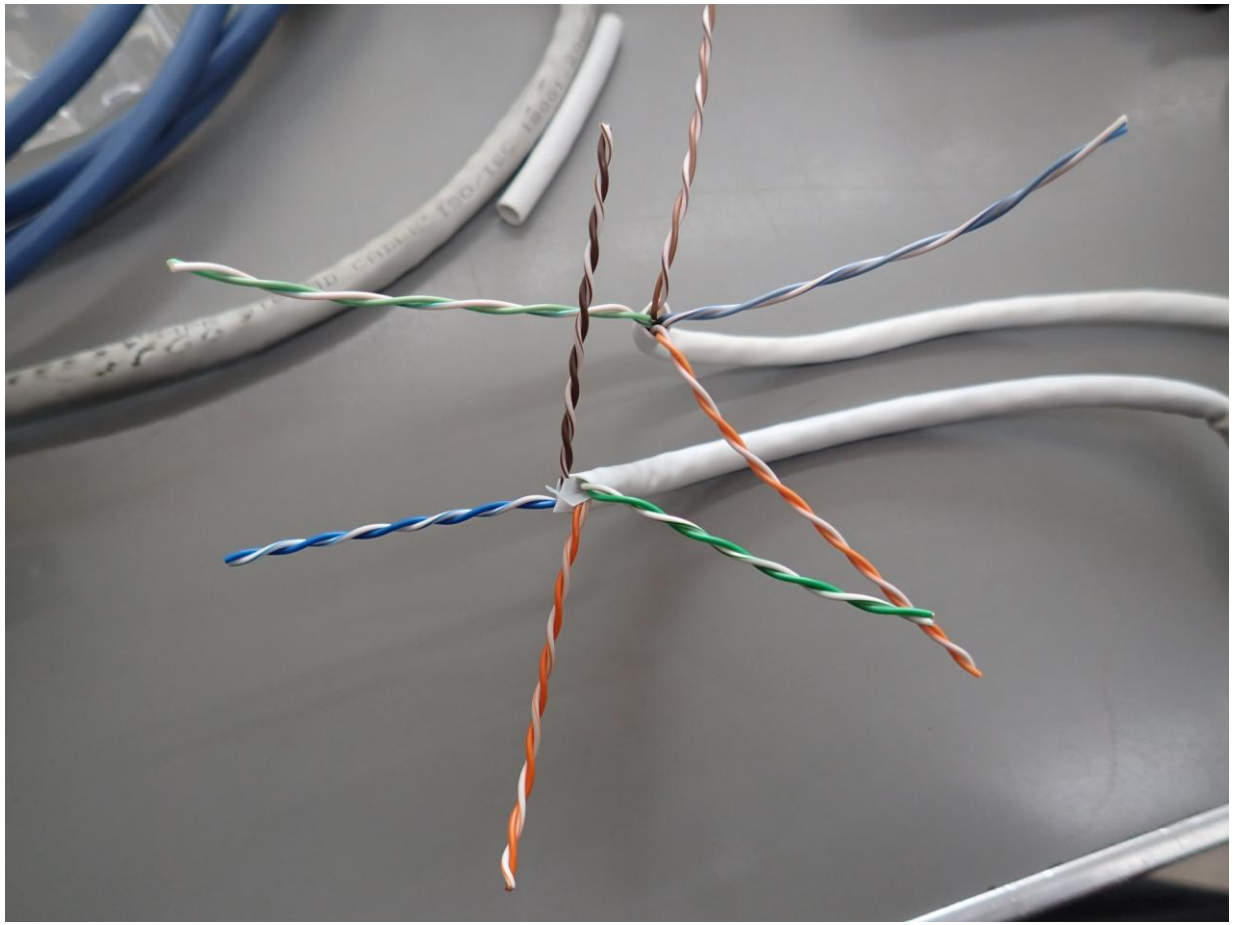
- Wireless
- Cable
  - Cat5/5e/6 …
  - Fiber

Patch Cord

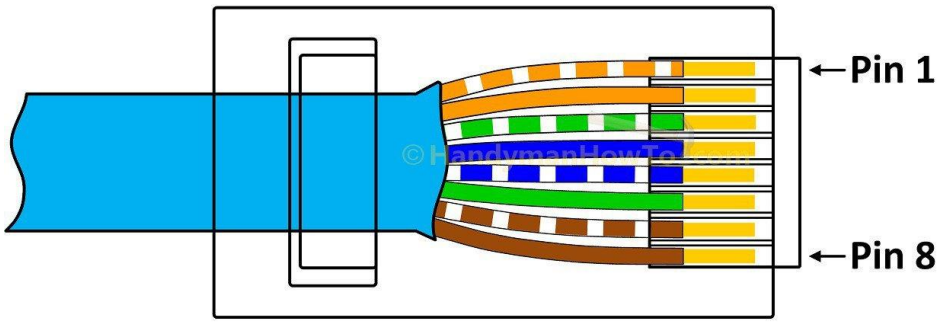
Socket

FIGURE 3.4 RJ-11 and RJ-45 connectors

Network Cable



EIA/TIA T568B Ethernet Plug Wiring

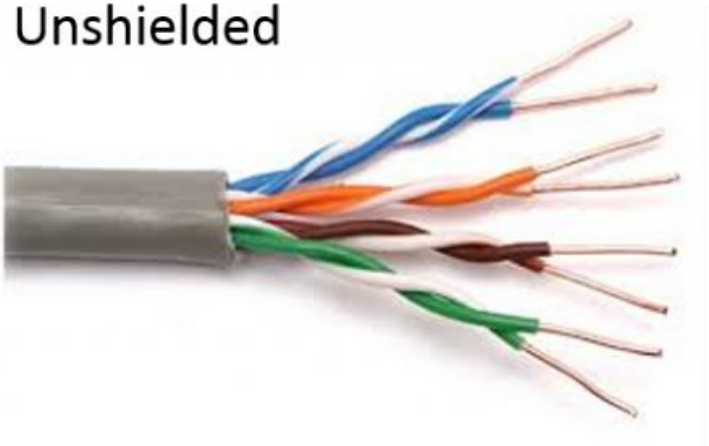


Latching Tab Faces Away
(On Opposite Side)

Usage

UTP vs STP

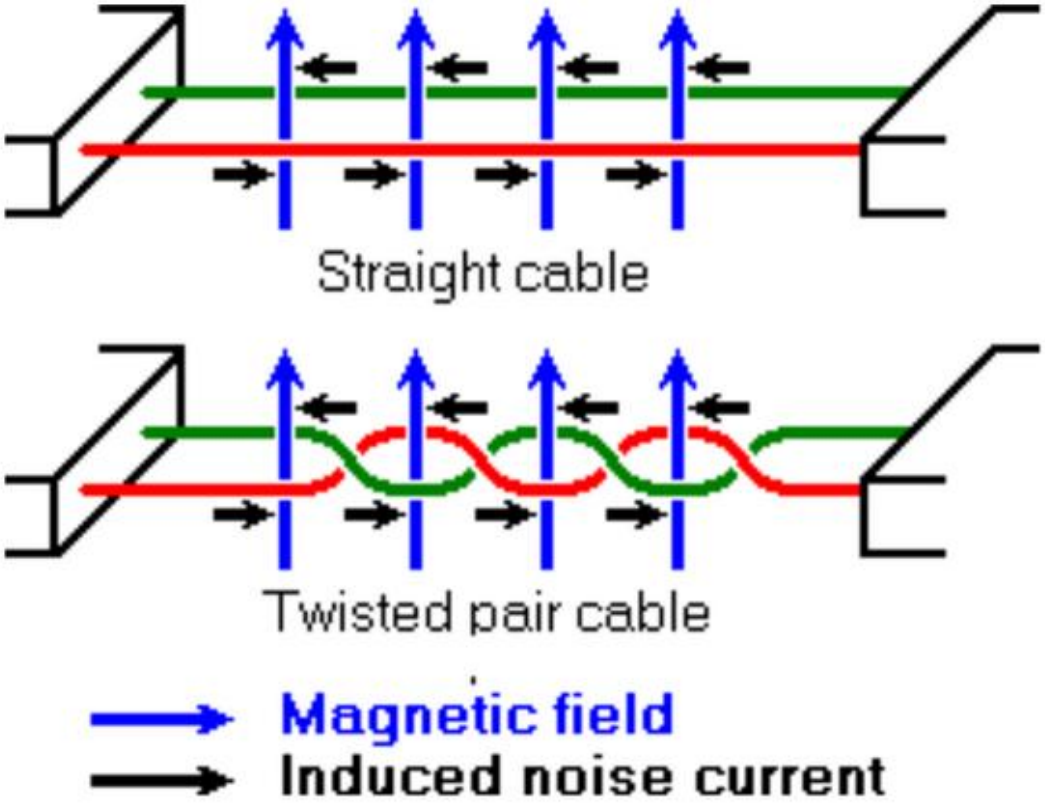
Unshielded



Shielded

Why Twisted Pair?

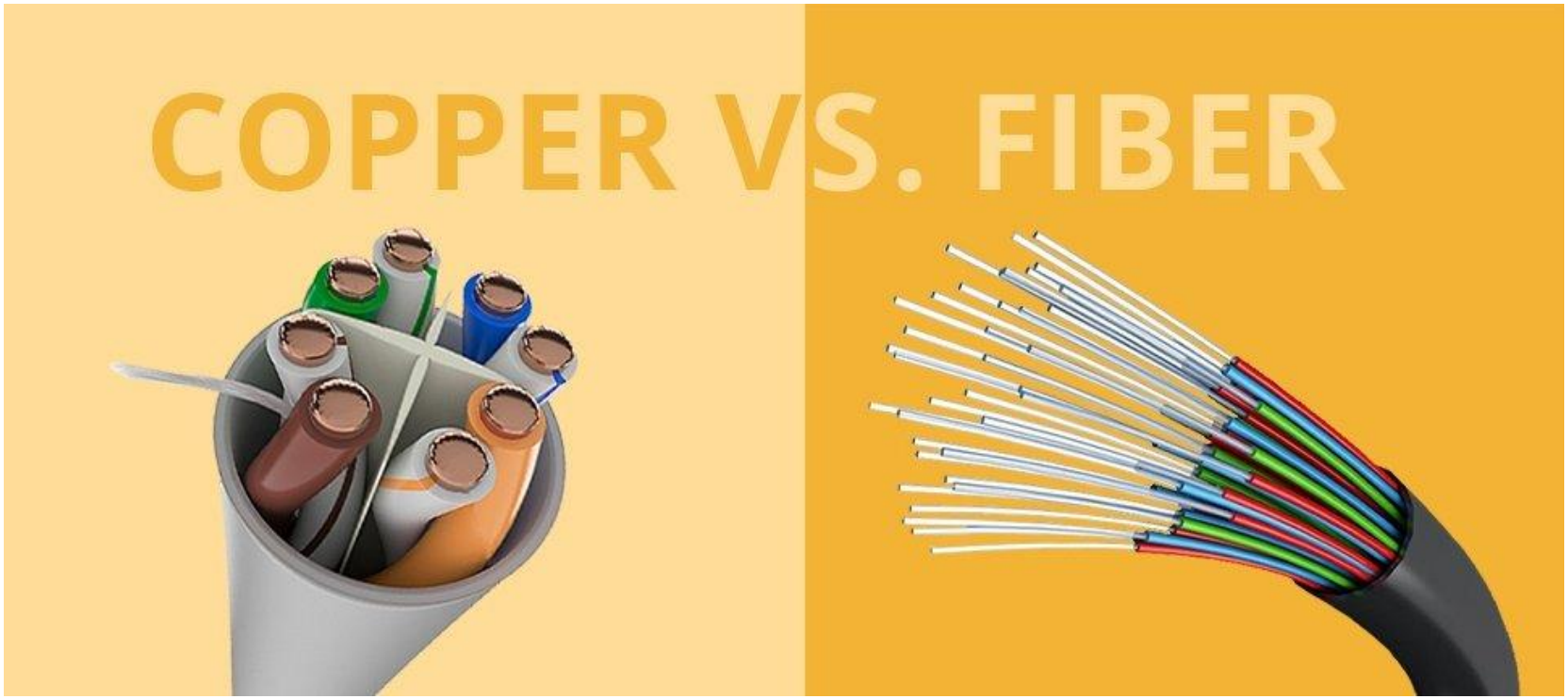
Why Twisted Pair?



Speed Compare

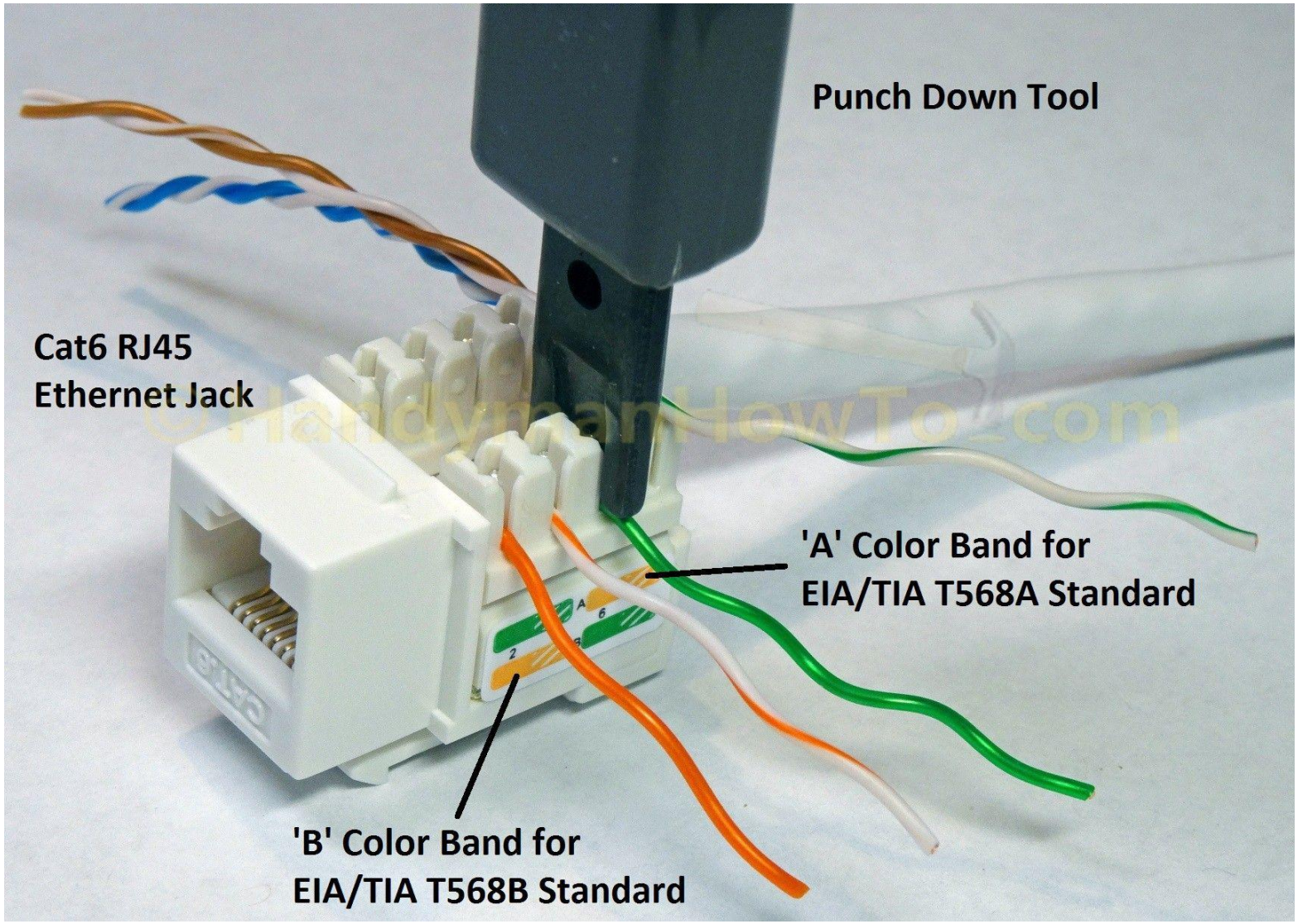
FEATURES / SPECS	CAT 5E	CAT 6	CAT 6E	CAT 6A	CAT 7
Common Usage					
Phone Lines	✓	✓	✓	✗	✗
Home Network	✓	✓	✓	✗	✗
Office Network	✓	✓	✓	✓	✗
Data Center	✗	✗	✓	✓	✓
Potential Bandwidth (per sec)	1000 Megabits	1000 Megabits	1000 Megabits	10,000 Megabits	10,000 Megabits
Time to transfer 1 Terabyte	3 hours	3 hours	3 hours	20 minutes	20 minutes
Data Transmission	1000 BASE-T	1000 BASE-TX	Exceeds 1000BASE-TX	10GBASE-T	Exceeds 10GBASE-T
Connector Type	RJ45 8P8C	RJ45 (for Cat6)	RJ45 (for Cat6)	RJ45 (for Cat6A)	GG45
Frequency Range Minimum	0 - 100 MHz	0 - 250 MHz	0 - 250 MHz	0 - 500 MHz	0 - 600 MHz
Frequency Maximum	350 MHz	500 MHz	550 MHz	600 MHz	750 MHz
Performance Distance	328 Feet	328 Feet	328 Feet	328 Feet	328 Feet
Alt. Distance		10Gb @ 180ft	10Gb @ 180ft		

Optical Fiber


COPPER VS. FIBER


LAN
LAN
CAT5E

Inside


Punch Down Tool
Cat6 RJ45
Ethernet Jack
'A' Color Band for
EIA/TIA T568A Standard
'B' Color Band for
EIA/TIA T568B Standard

Network Duct