Informatica II (Laboratorio)

Corso di laurea magistrale in Scienze pedagogiche

Reti di computer e internet
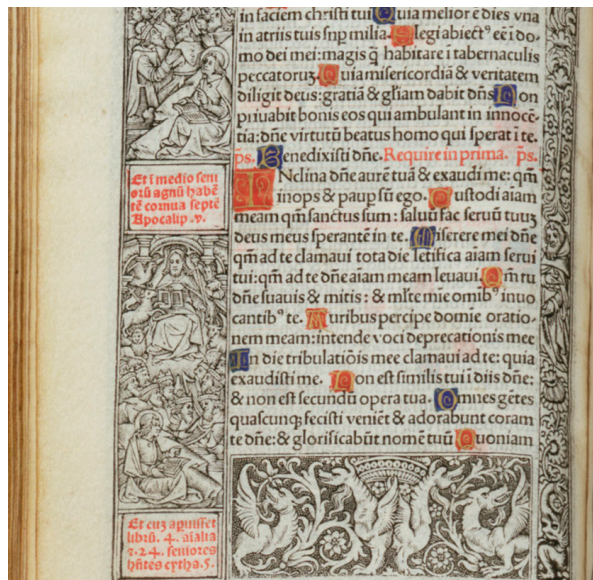
Andrea Bracciali – a.a. 2024/2025

In this lesson

- Computer Networks
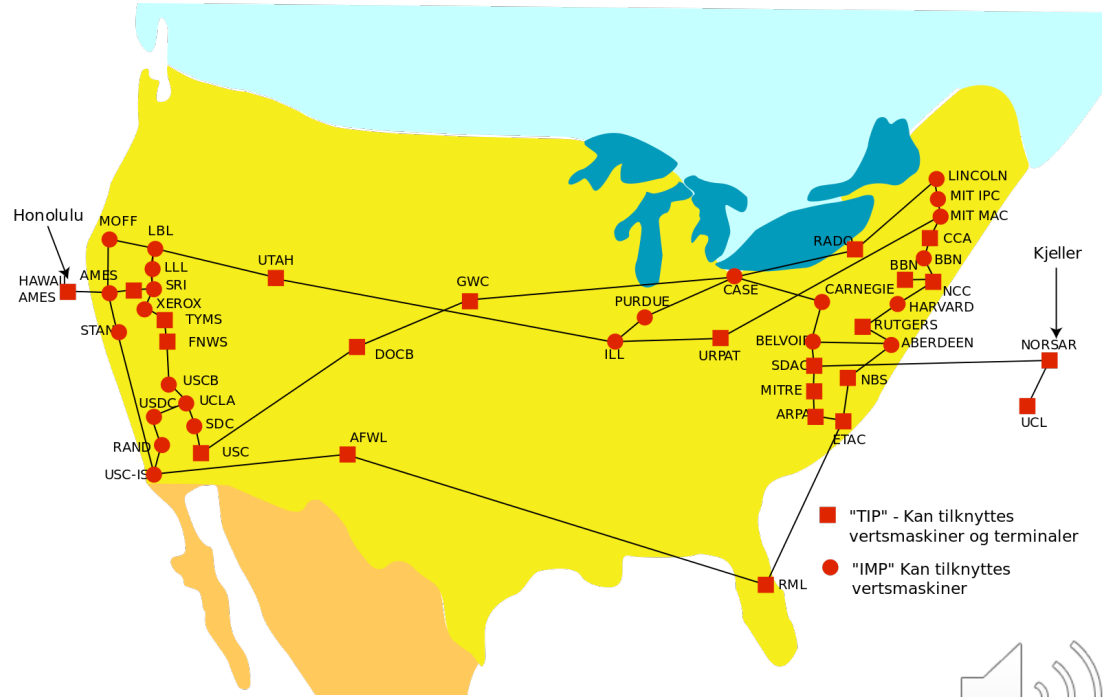
- Internet

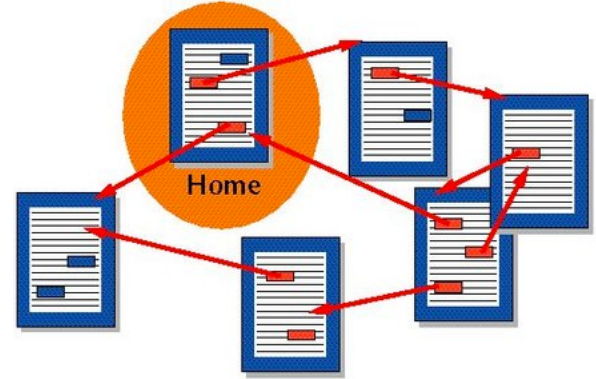- The World Wide Web

Revolutions

Arpanet

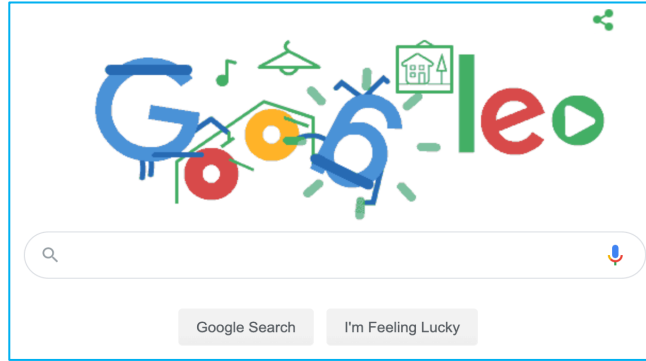Advanced Research Projects Agency Network (ARPANET)

The World Wide Web

- Tim Berners-Lee

- Hypertext

- Link

- Web browser
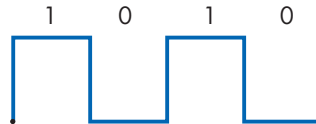
Internet systems

- Web pages

- E-mail
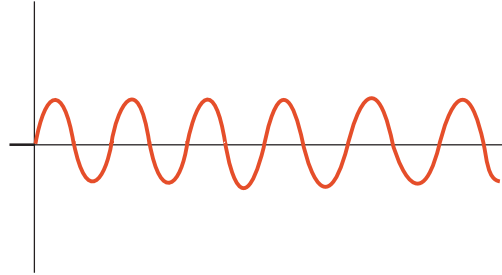
- Usenet

- Social networking

Communication Links

Modulator
demodulator
(Modem)

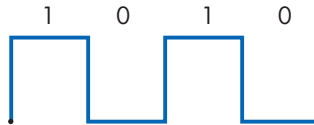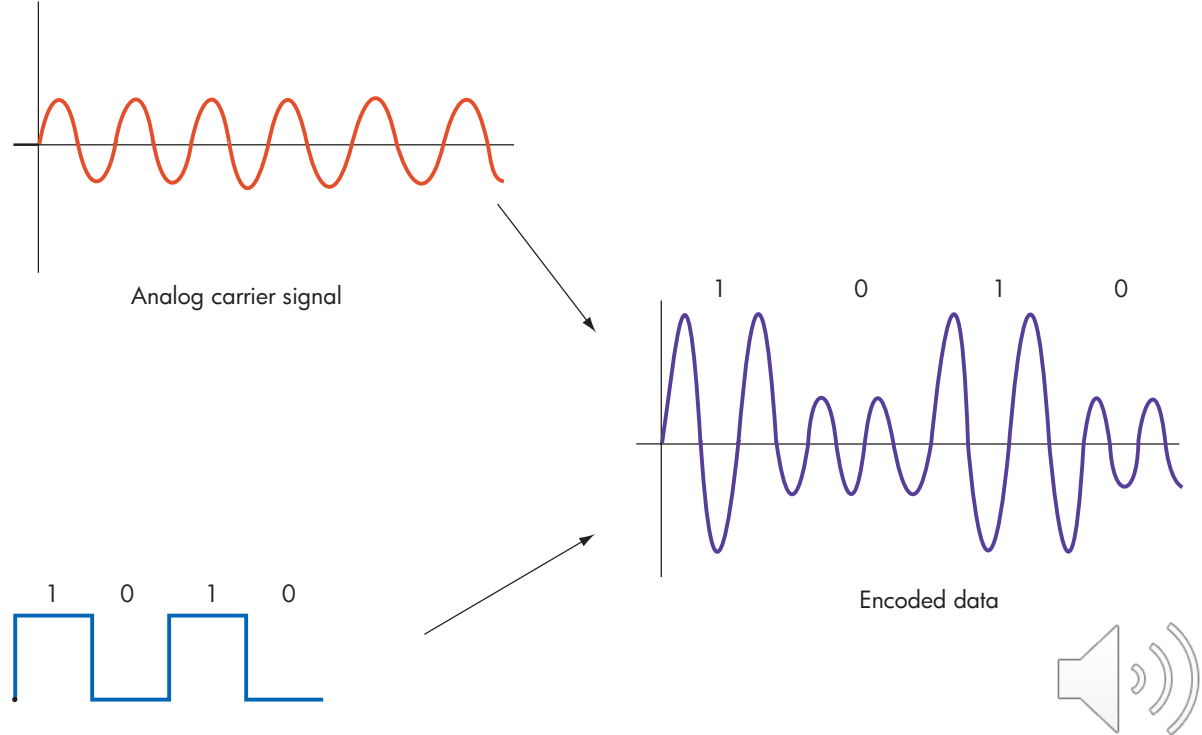1   0   1   0

Communication Links

Modulator demodulator (Modem)

Analog carrier signal

1   0   1   0

Communication Links

Modulator
demodulator
(Modem)

Analog carrier signal

1   0   1   0

1   0   1   0

Encoded data

LAN

- A Local Area Network (LAN) connects hardware devices such as computers, printers, and storage devices that are all in close proximity.

  – Examples of LANs include the interconnection of machines in one room, in the same office building, or on a single campus.

- Ethernet (/ˈiːθərnɛt/) is a family of computer networking technologies commonly used in local area networks (LAN).

100 Mbps	1 Gbps	10 Gbps	10 Gbps
CAT 5/5e	CAT 6	CAT 6a	
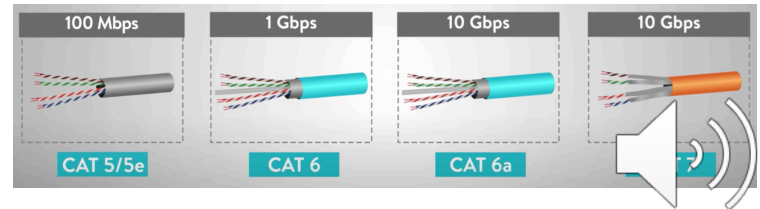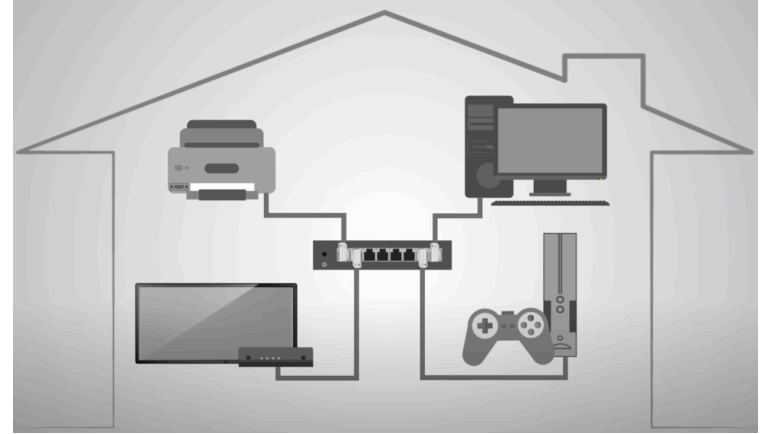
Network topologies

- Topology → Topos (space in greek) + logy (study in greek)
  - Study of the geometrical properties
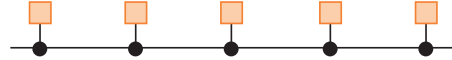
(a) Bus

(b) Ring

(c) Star

Ethernet LAN

(a) Single Cable Configuration

Ethernet cable

Transceiver

A

B

LAN 1

Bridge or repeater
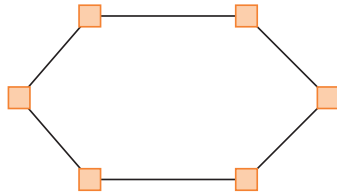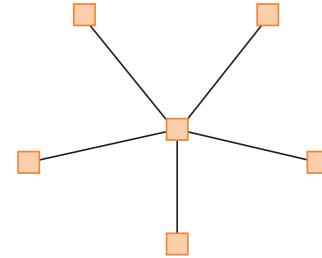
LAN 2

C
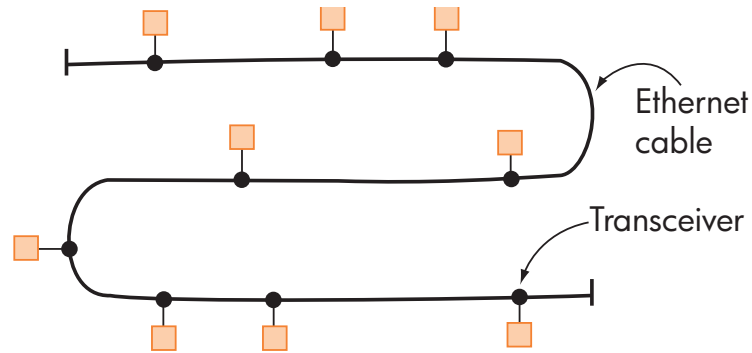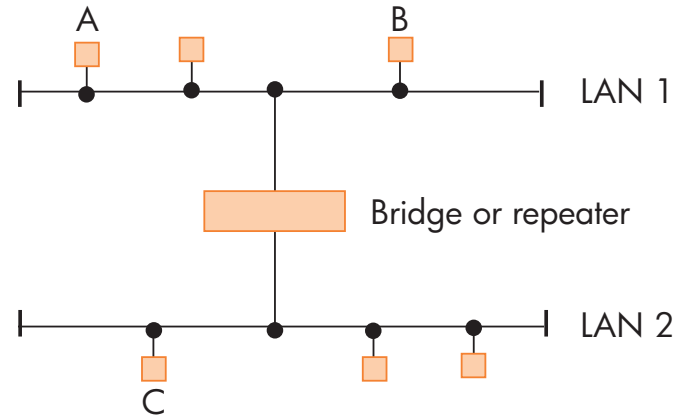
(b) Multiple Cable Configuration

WAN

- A Wide Area Network (WAN) connects devices that are not in close proximity but rather are across town, across the country, or across the ocean

- Unlike a LAN, in which a message is broadcast on a shared channel and is received by all nodes, a WAN message must "hop" from one node to another to make its way from source to destination.

- The unit of transmission in a WAN is a *packet*—an information block with a fixed maximum size that is transmitted through the network as a single unit.
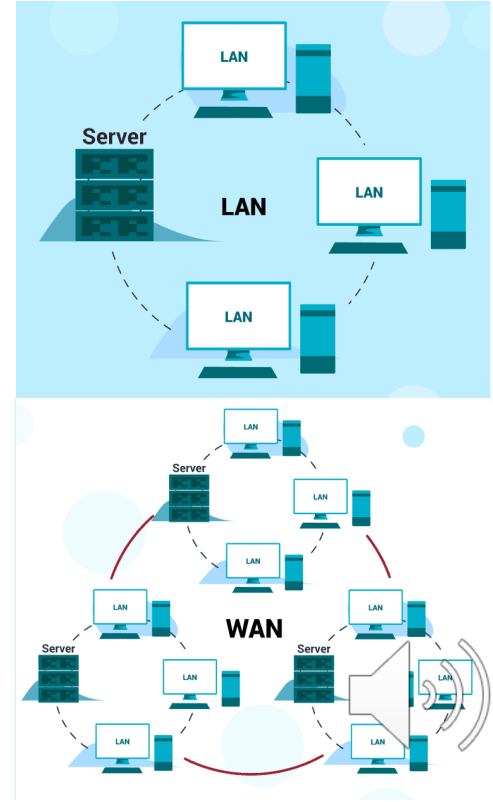
Example of WAN
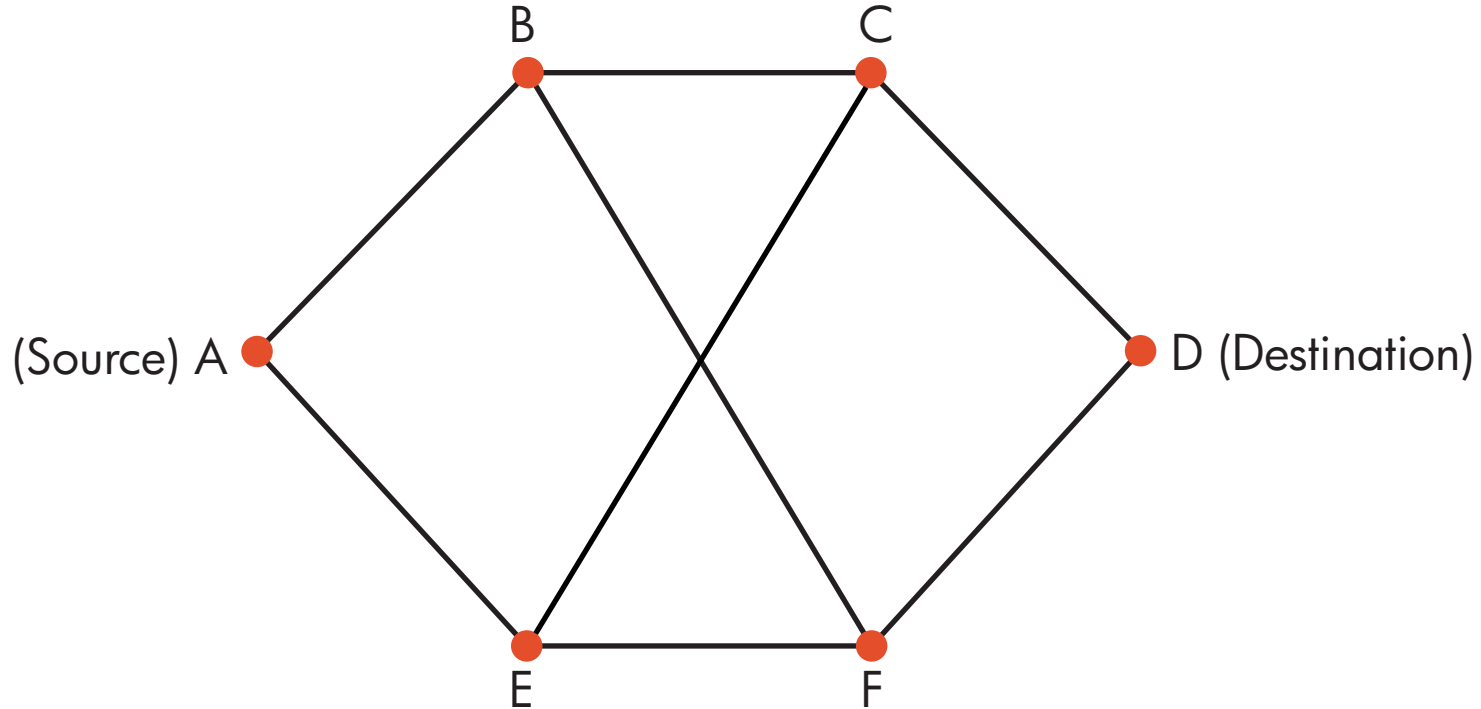
Example of WAN
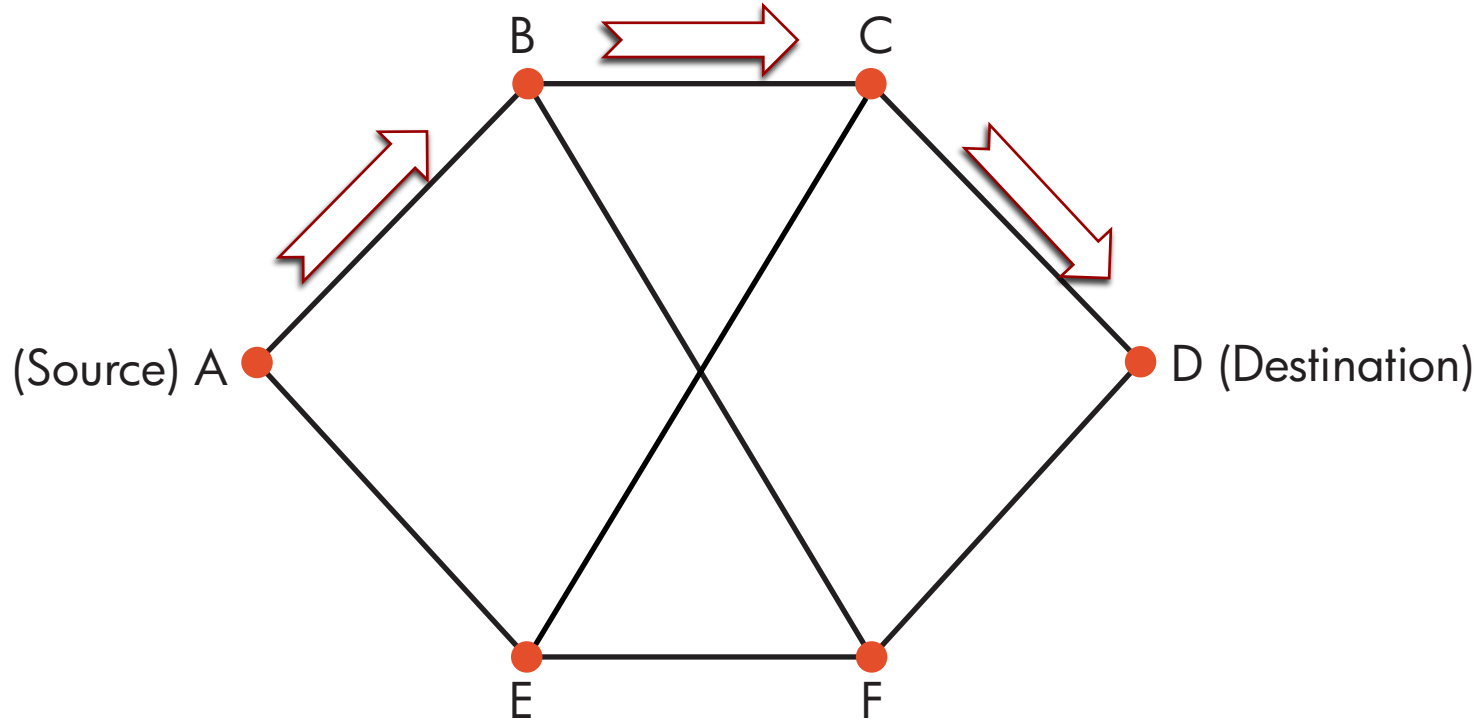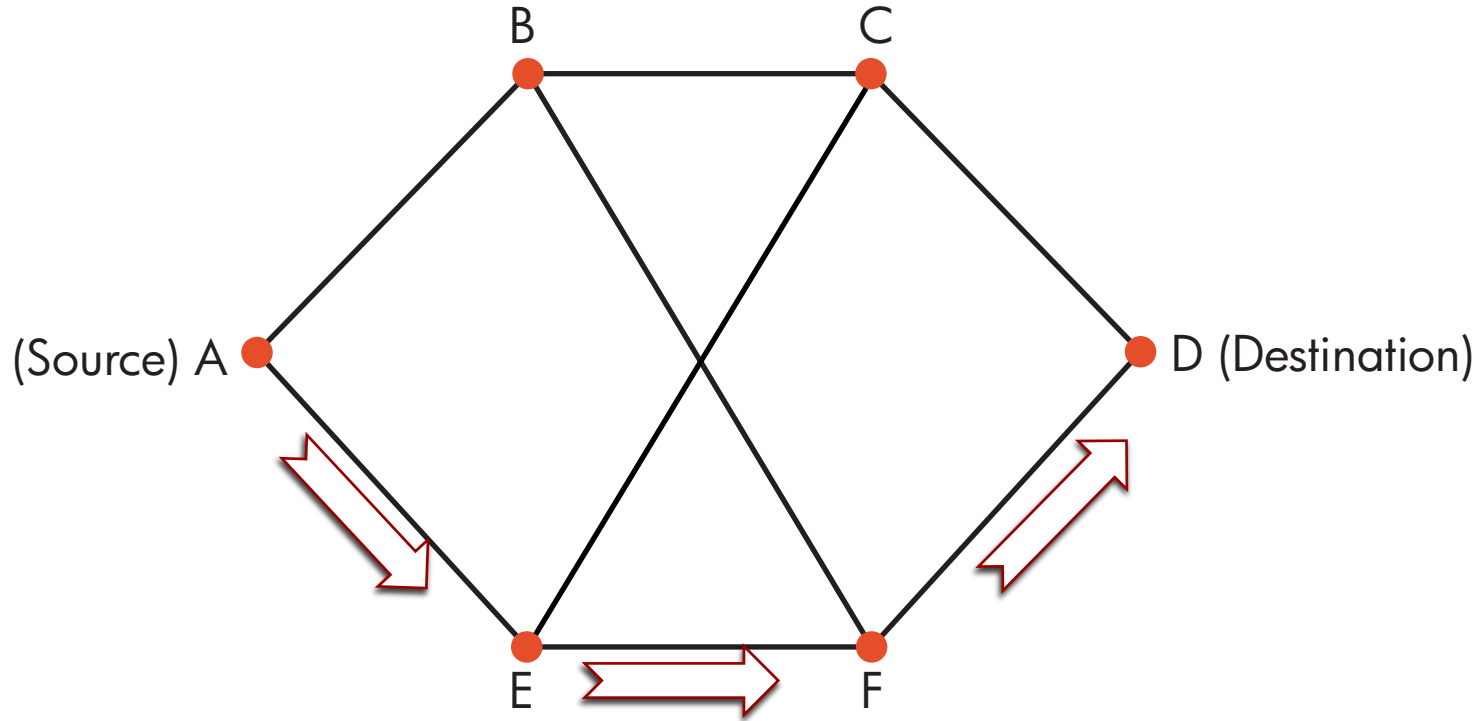
Example of WAN
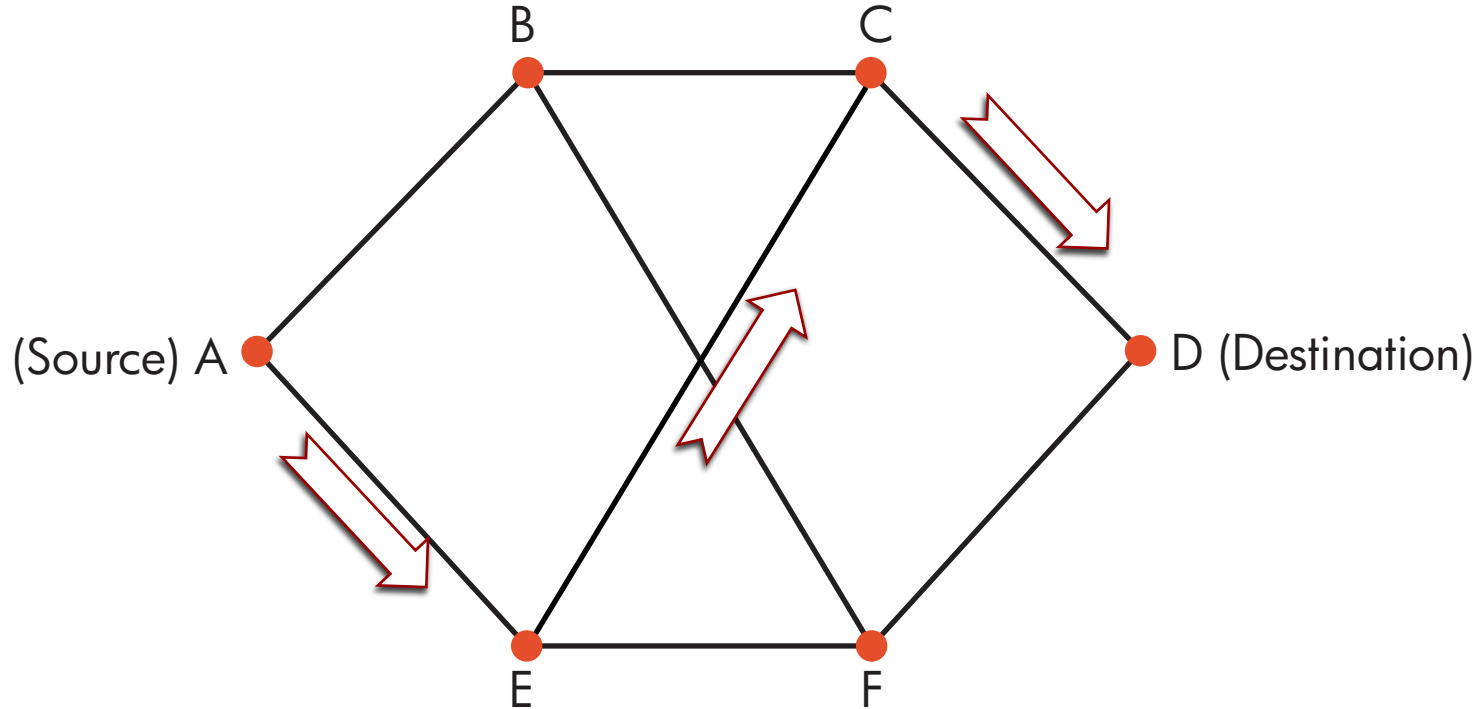
Example of WAN
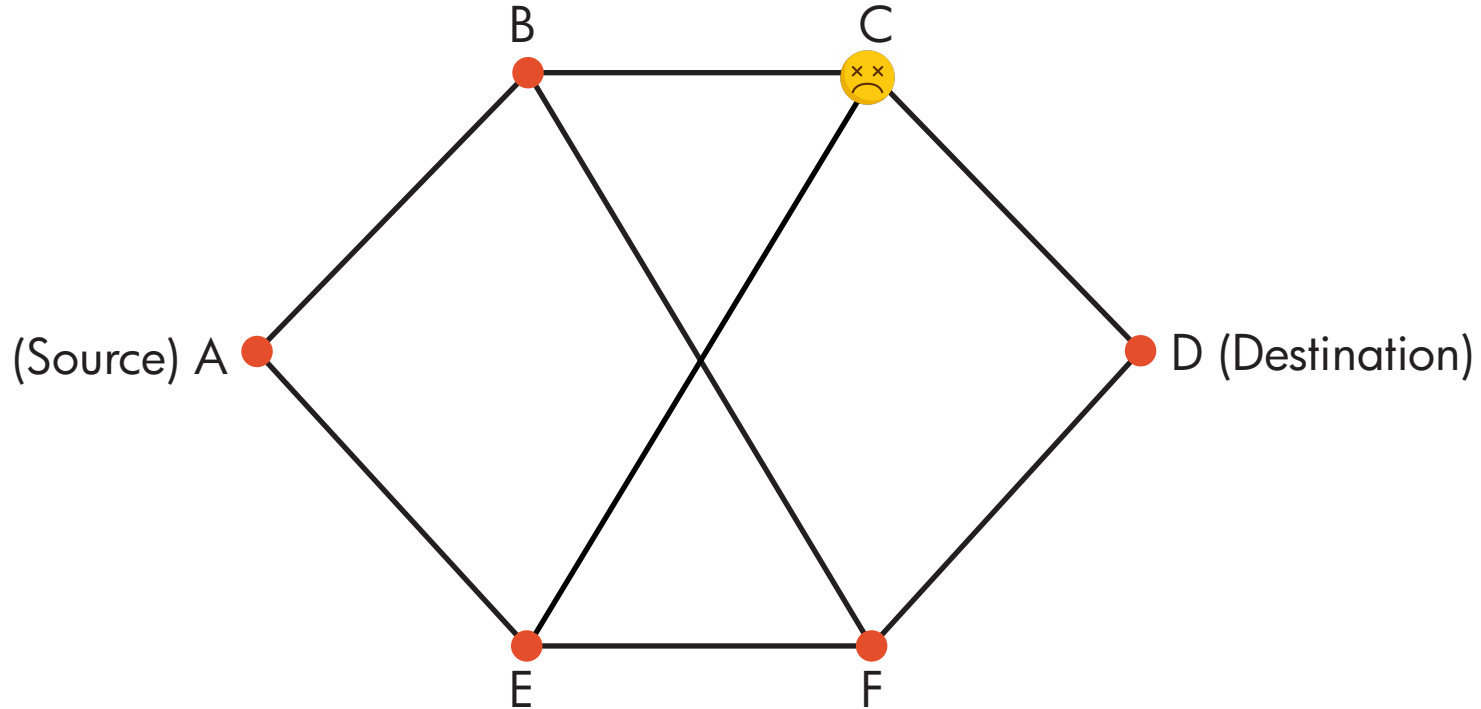
Example of WAN

Example of WAN

Reliability and fault tolerance
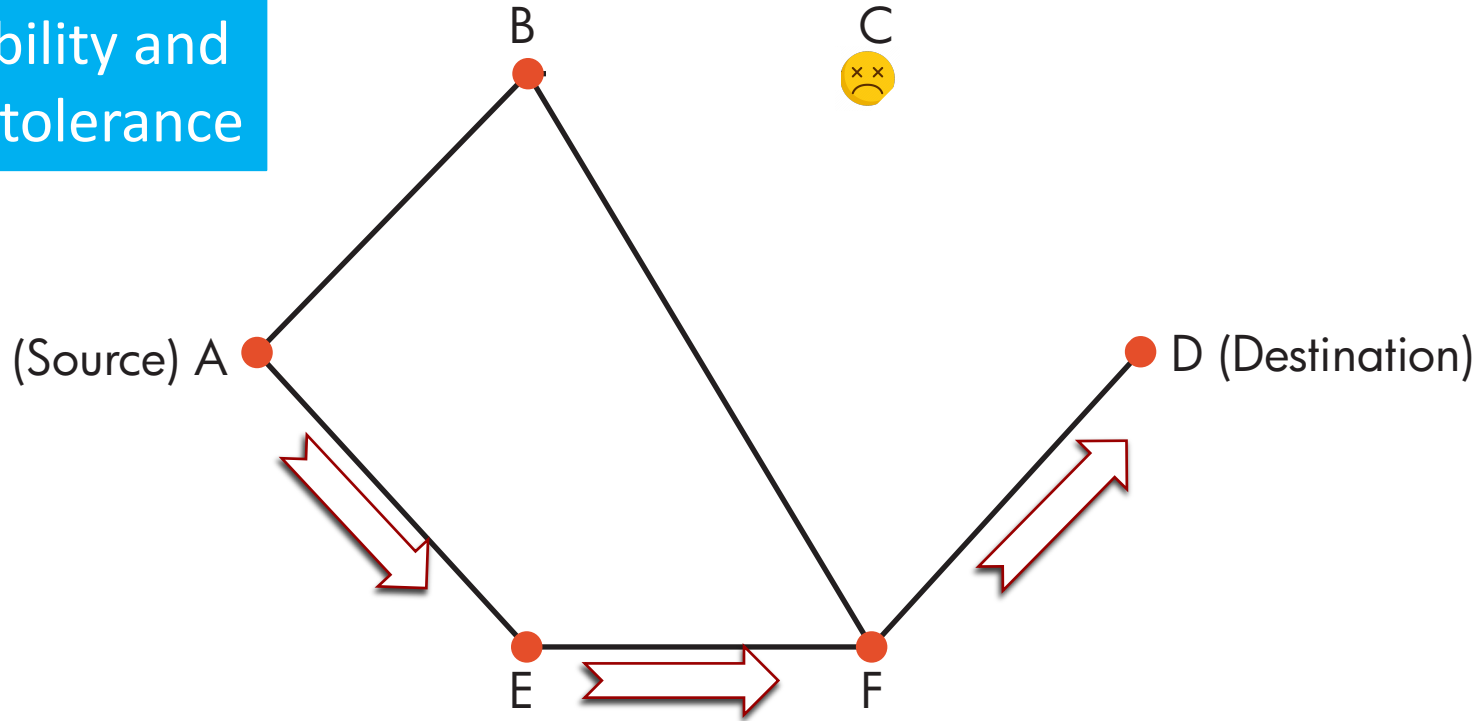
Example of WAN

B   C

(Source) A   D (Destination)

E   F

Internet

- We have defined two classes of networks, LANs and WANs, but all real-world networks, including the Internet, are a *complex mix of both network types*.
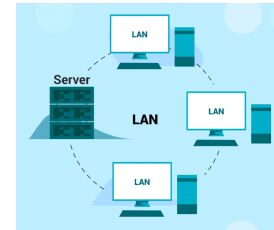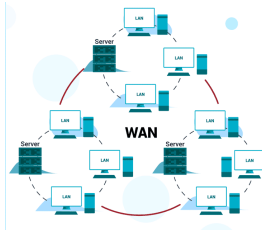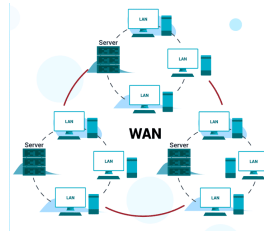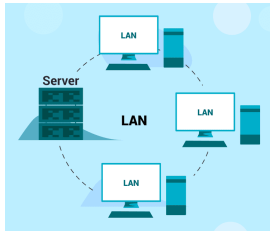
Internet

- We have defined two classes of networks, LANs and WANs, but all real-world networks, including the Internet, are a *complex mix of both network types*.

- Individual networks are interconnected via a device called a *router*.

Internet

- We have defined two classes of networks, LANs and WANs, but all real-world networks, including the Internet, are a *complex mix of both network types*.

- Individual networks are interconnected via a device called a *router*.
  - Like the bridge a router transmits messages between two distinct networks.
  - However, unlike a bridge, which connects two identical types of networks, routers can transmit information between networks that use totally different communication techniques (much as an interpreter functions between two people who speak different languages).

Internet

But how do these people reach users outside their institution?

How do they access remote resources such as Web pages that are not part of their own network?
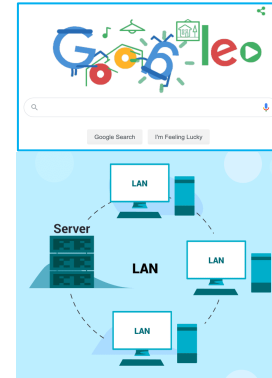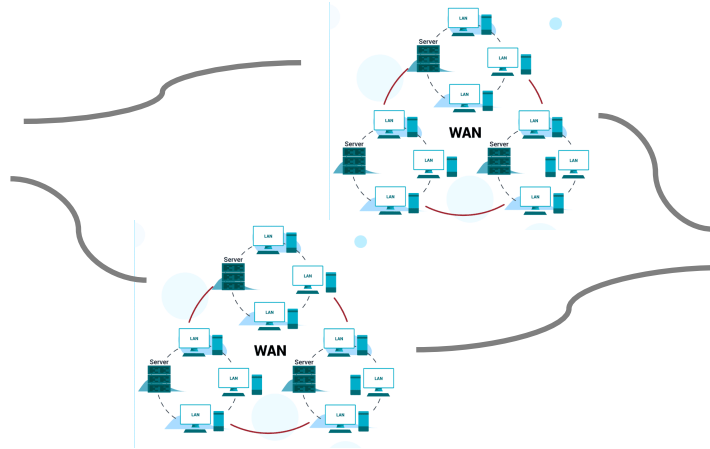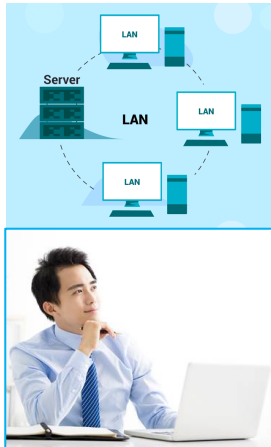
Internet

- A user's individual computer is connected to the world through an Internet Service Provider (ISP).

Internet

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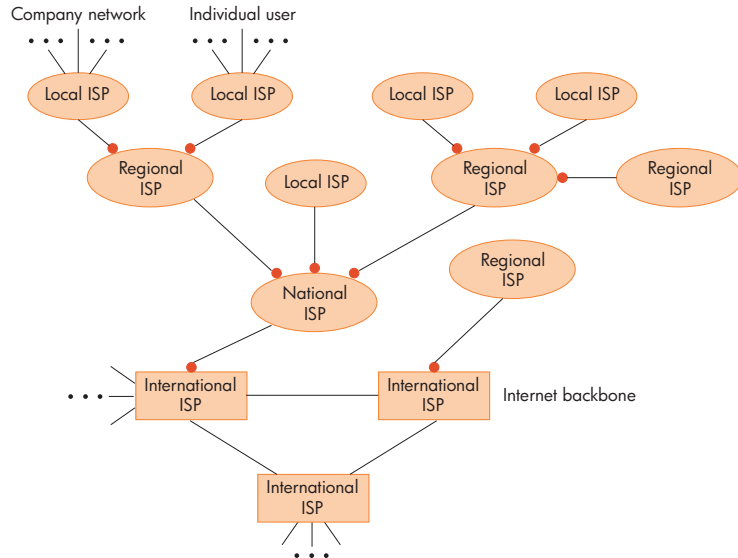
Internet

More than 1 billion machines around the world

How does something as massive as the Internet actually work?

Communication protocols

LANs

Routers

WANs

Internet

ISPs

sky broadband

Virgin media

vodafone

Bridge

Bridges
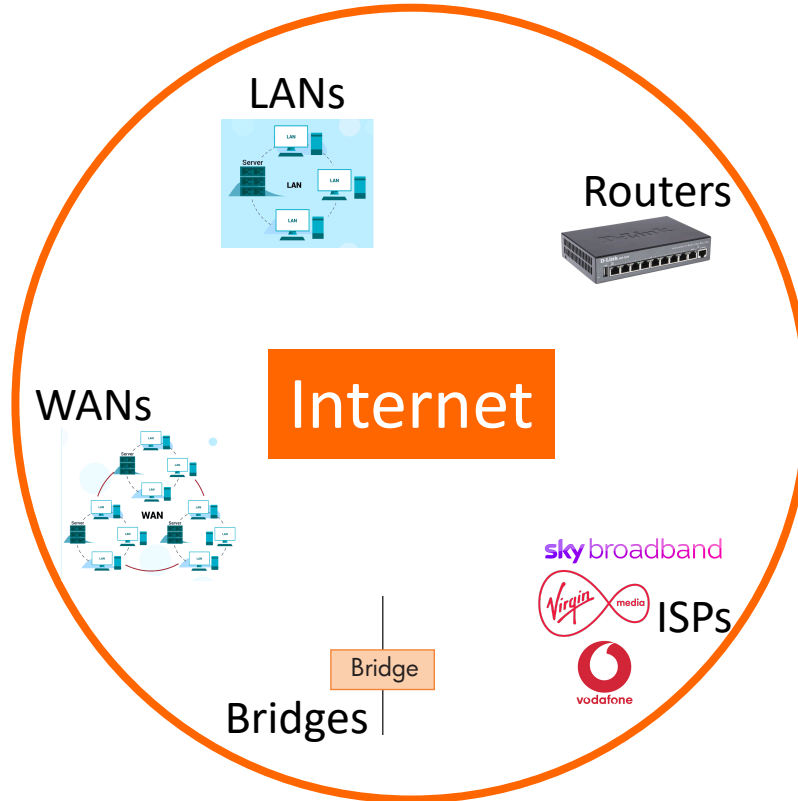
Communication protocol

- What's a protocol?
    - Mutually agreed set of rules (kind of saying "hello" when answering a phone call).

- The Internet is operated by the *Internet Society*.
    - It is a nonprofit, nongovernmental, professional society com- posed hundreds of worldwide organizations in 180 countries.
    - *Goal*: maintaining the viability and health of the Internet.

- This group, along with other organisations, establishes and enforces *network protocol standards*.

TCP/IP

- The Internet protocol has five layers, this hierarchy is referred to as TCP/IP.

Application

Application and process

Transport

Network

Data link

Data transfer

Physical

TCP/IP

10.0.1.1
Port 7268

10.0.1.2
Port 80

HTTP request
Get http://webserver.com

Application
Transport
Network
Data link
Physical

Application
Transport
Network
Data link
Physical

TCP/IP

10.0.1.1
Port 7268

10.0.1.2
Port 80

HTTP response

| Application |
| Transport |
| Network |
| Data link |
| Physical |

| Application |
| Transport |
| Network |
| Data link |
| Physical |

TCP/IP

10.0.1.1
Port 7268

10.0.1.2
Port 80

HTTP request
Get http://webserver.com

Source port: 7268
Destination port: 80

| Application |
| Transport |
| Network |
| Data link |
| Physical |

| Application |
| Transport |
| Network |
| Data link |
| Physical |

TCP/IP

10.0.1.1
Port 7268

10.0.1.2
Port 80

HTTP response
Source port: 7268
Destination port: 80

Application

Transport

Network

Data link

Physical

Application

Transport

Network

Data link

Physical

TCP/IP

10.0.1.1
Port 7268

10.0.1.2
Port 80

| Application |
| Transport |
| Network |
| Data link |
| Physical |

| Source IP: 10.0.1.1 Destination IP: 10.0.1.2 |
| Scr:7268, dst:80 |
| HTTP data |

| Source IP: 10.0.1.1 Destination IP: 10.0.1.2 |
| Scr:7268, dst:80 |
| HTTP data |

| Application |
| Transport |
| Network |
| Data link |
| Physical |

TCP/IP

10.0.1.1
Port 7268

B → C

10.0.1.2
Port 80

TCP/IP

B   C

10.0.1.1
Port 7268

10.0.1.2
Port 80

E   F

TCP/IP

10.0.1.1
Port 7268

B   C

E   F
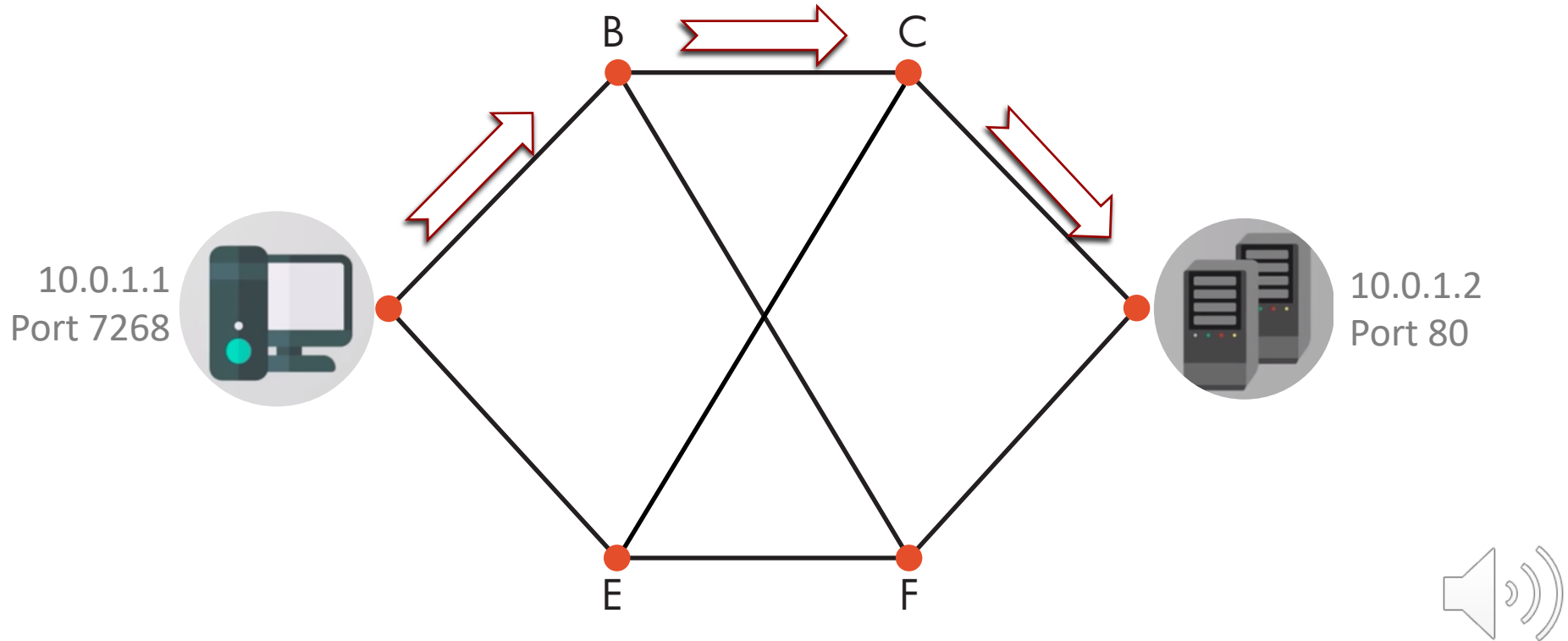
10.0.1.2
Port 80
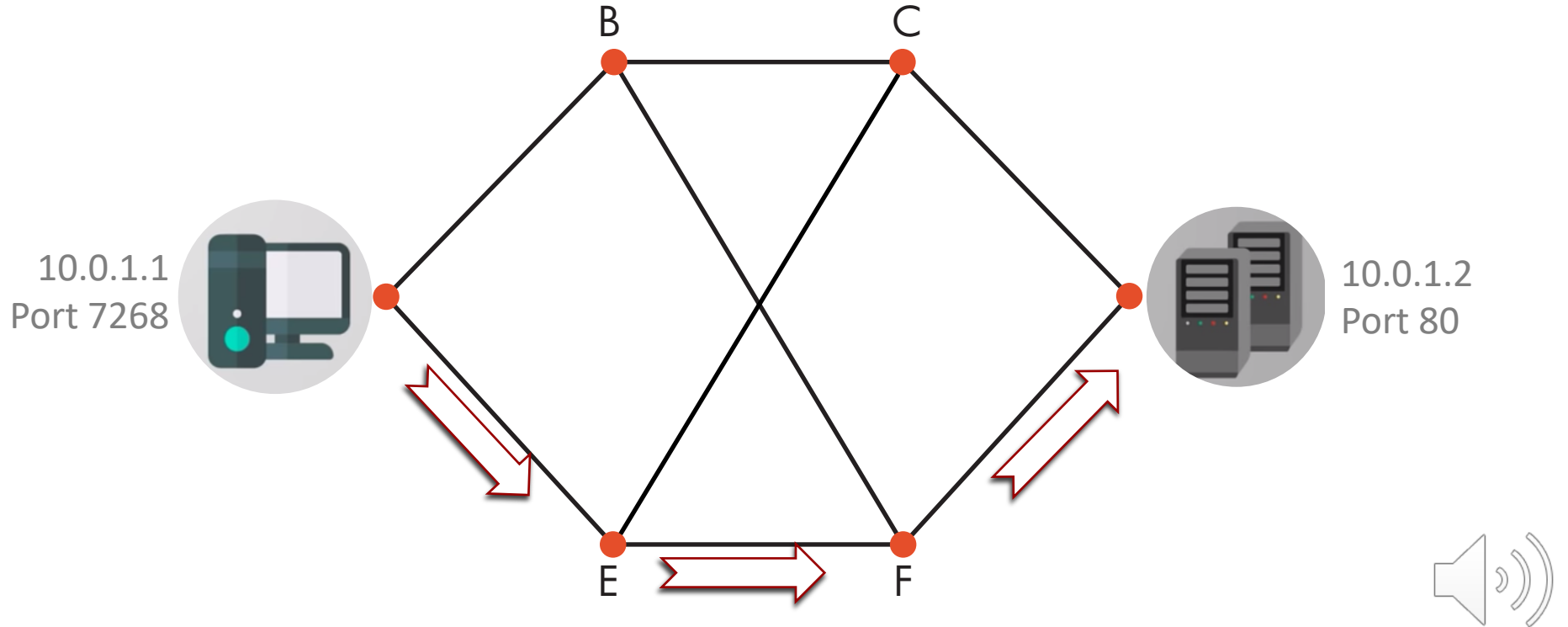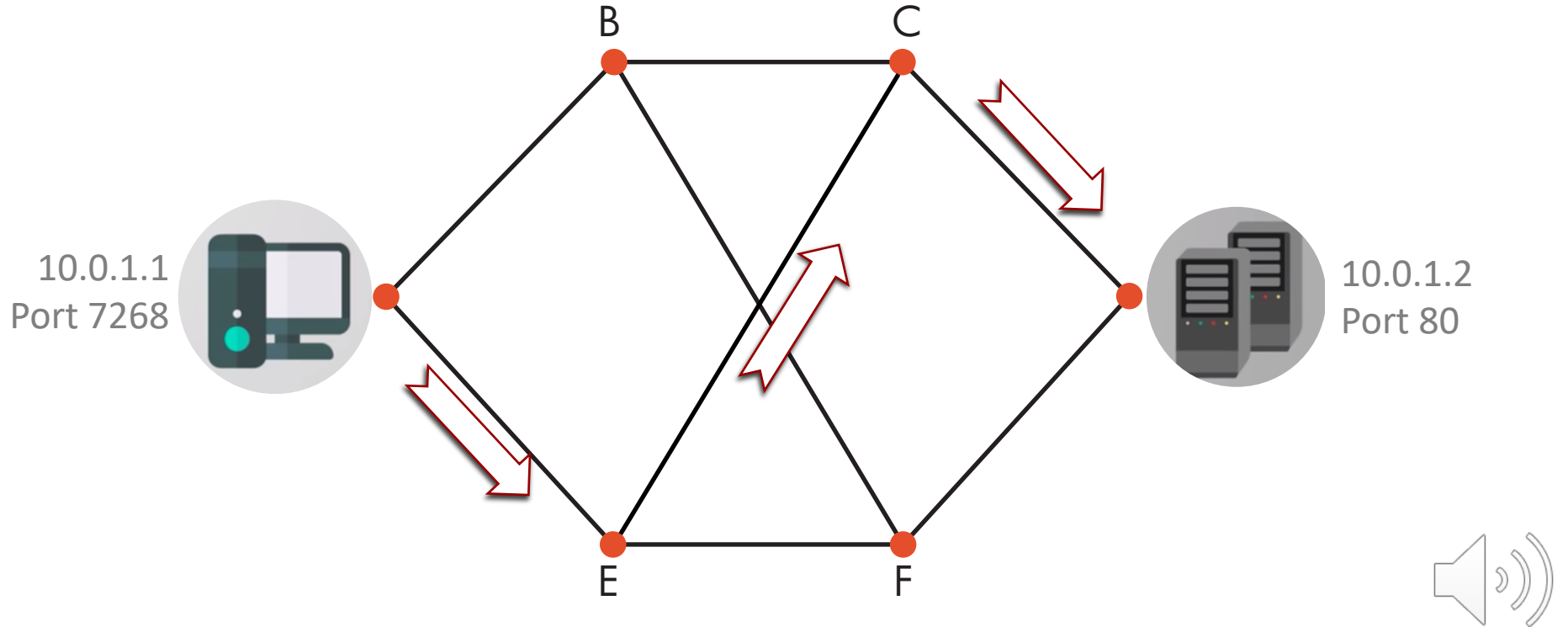
TCP/IP

10.0.1.1
Port 7268

10.0.1.2
Port 80

| Application |
| Transport |
| Network |
| Data link |
| Physical |

Source MAC:
02:1A:23:9A:4B:C^
Destination MAC:
02:54:28:DC:5A:12

Source IP: 10.0.1.1
Destination IP: 10.0.1.2

Scr:7268, dst:80

HTTP data

Ethernet trailer

| Application |
| Transport |
| Network |
| Data link |
| Physical |

TCP/IP

10.0.1.1
Port 7268

10.0.1.2
Port 80

| Application |
| Transport |
| Network |
| Data link |
| Physical |

101011010101

| Application |
| Transport |
| Network |
| Data link |
| Physical |

TCP/IP examples

Informazioni sulla comunicazione (una parte del pacchetto)

TCP segment header

Offsets		0								1								2								3							
Octet	**Bit**	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
0	0	Source port																Destination port															
4	32	Sequence number																															
8	64	Acknowledgment number (if ACK set)																															
12	96	Data offset				Reserved 0 0 0 0				C W R	E C E	U R G	A C K	P S H	R S T	S Y N	F I N	Window Size															
16	128	Checksum																Urgent pointer (if URG set)															
20	160	Options (if *data offset* > 5. Padded at the end with "0" bits if necessary.)																															
⋮	⋮																																
56	448																																

https://en.wikipedia.org/wiki/Transmission_Control_Protocol