ETSF15
What its all about

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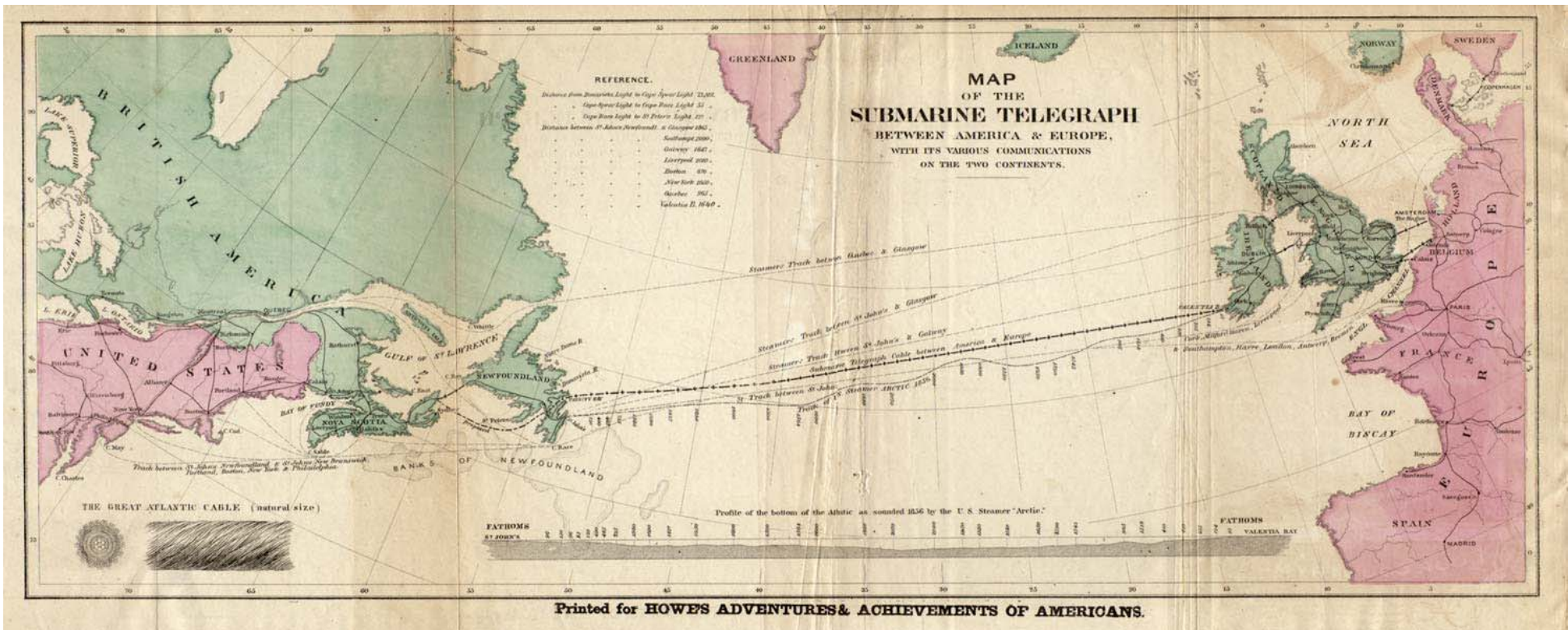
Data communication not new

Optical telegraph system from end of the 18th century.

Electric telegraph

Initial deployment beginning of 19th century.

Networks for telephony

The telephone was patented 1876. Requirements for telephone networks arose quickly.

Radio communication

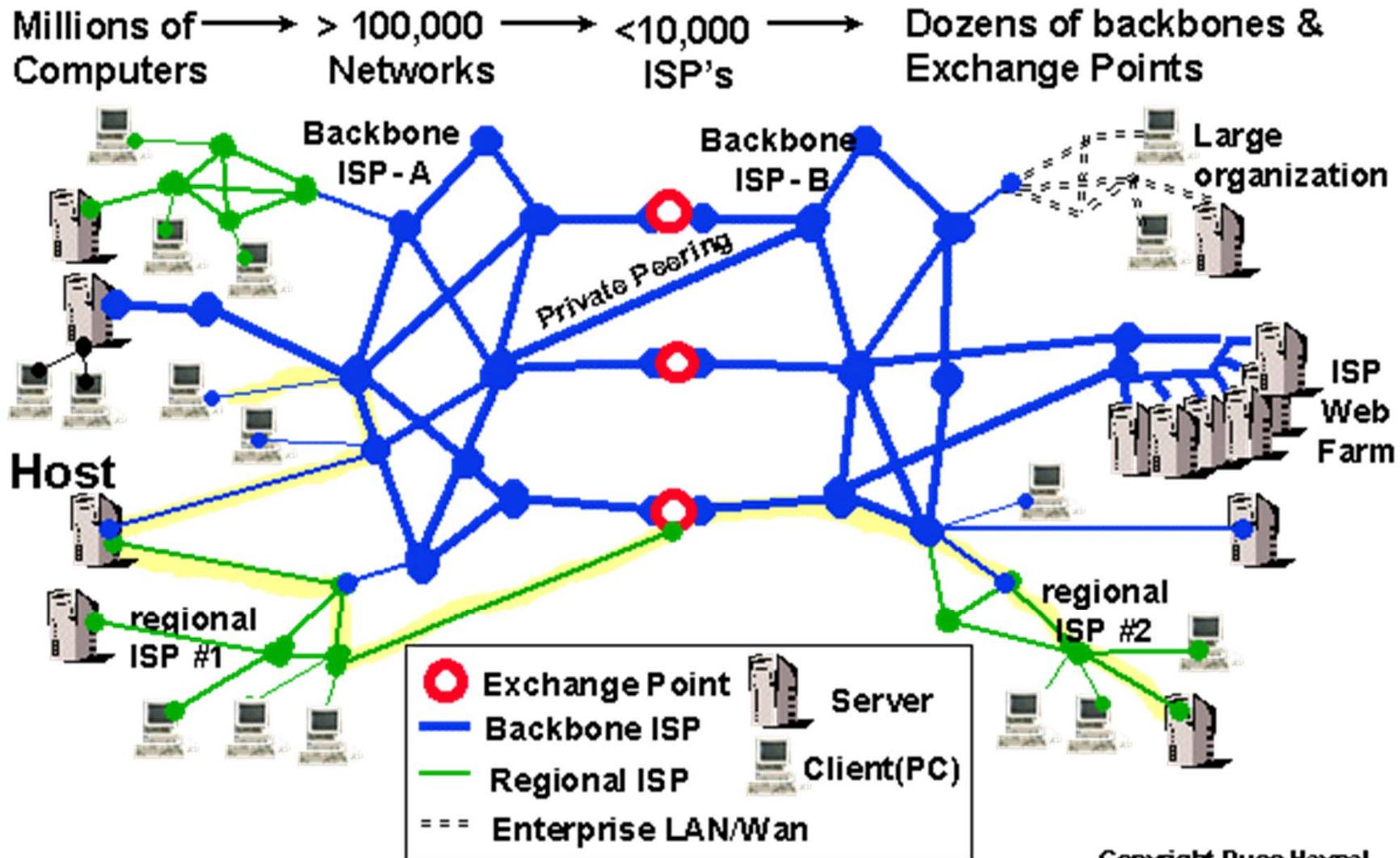Maxwell, Hertz and Marconi founders.

Television

John L Baird demonstrated mechanical television sets 1926

ARPAnet evolution

December 1969

June 1970

March 1972

July 1977

From data access to exchange of information

Internet from a technical perspectiv

Millions of Computers → > 100,000 Networks → <10,000 ISP's → Dozens of backbones & Exchange Points

Backbone ISP - A
Backbone ISP - B
Large organization
Private Peering
Host
ISP Web Farm
regional ISP #1
regional ISP #2

Exchange Point
Backbone ISP
Regional ISP
Enterprise LAN/Wan
Server
Client(PC)

Information Flows over MANY Paths

Internet from a user perspective
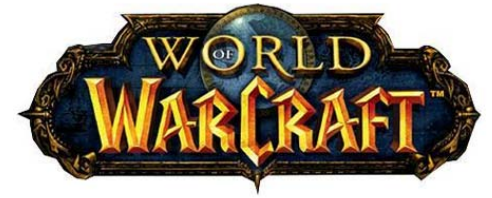
Next step: *Converged network*

One network for everything:

- Data communication

- IPTV, Video on Demand

- Broadcast radio

- Telephony

- ***Mobile backhaul & fronthaul (baseband signals)***

Protocols

- Describes
  - how
  - when
  - were
- to do what, so all can communicate with each other

- Other names are standard or Request for Comment (rfc)

Dialog independent of communication media

Hi!

Hi!
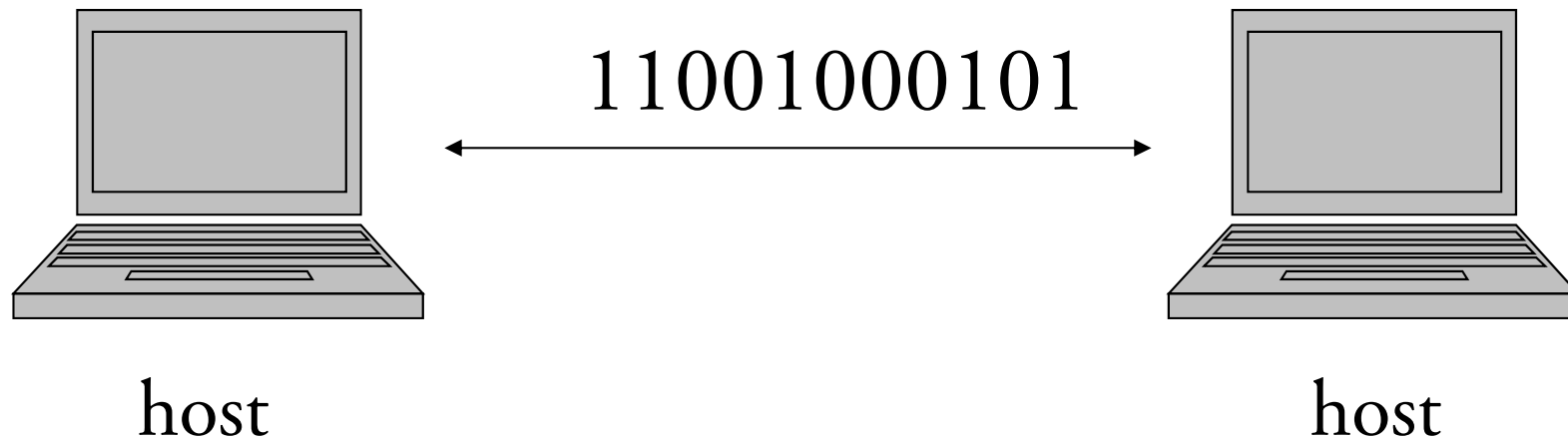
Dialog start

Buy milk, please.

Will do!

Information exchange

Bye!

Bye!

Dialog finish

# This is our main problem!

11001000101

host   host

♦ Two computers to communicate.

♦ Computers can understand only information in digital form, that is combinations of 1 and 0

Layered network models

- To complicated to solve everything in one application
  - ***Divide and conquer***
  - Hierarchical
  - Specialising
  - Simplifying

Problem 1: Digital communication

110101 → | Net adapter | ～～～～ link ～～～～ | Net adapter | → 110101
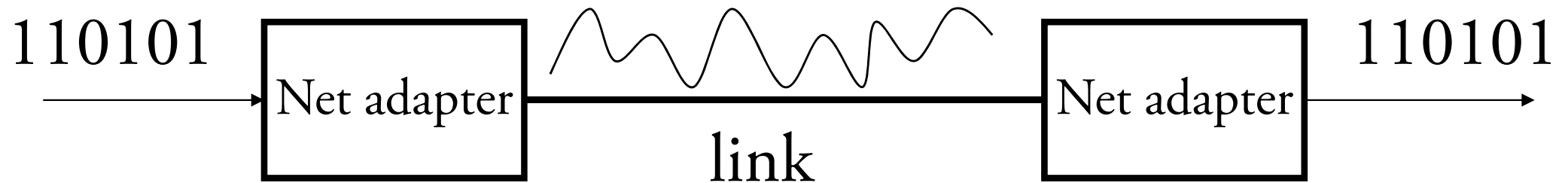
- In the transmitter there is an adapter that converts bits into signals that are then sent on the link.
- An adapter in the receiver translates the signals into bits again.

Problem 2 & 3

- How to get access to a shared link?
  - ♦ Only one can send at each given time
- How to send to the correct recipient on a multi-access link?
  - ♦ Addressing is needed

Problem 4

- How to detect (and correct) transmission errors?
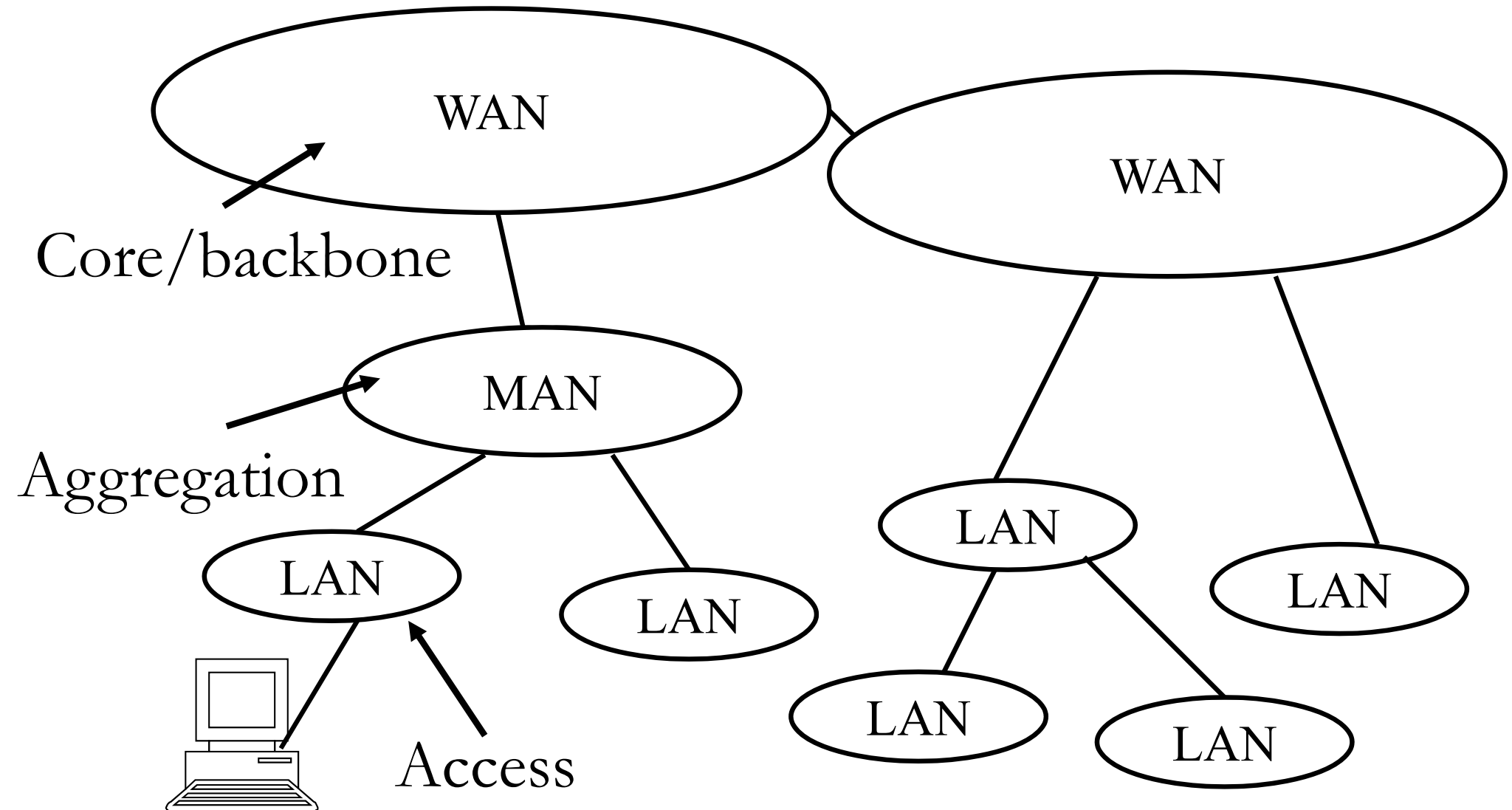 - ◆ Stupid to transfer 1GB only to discover that one bit error occurred

Solution to Problem 4: Frames (*sv. ramar*)

- Divide message in frames
- A frame consists of up to three parts:
  - header, data och tail

header	data (payload)	tail

Header and tail contains control information

Problem 5: Connection of networks

Core/backbone

WAN

WAN

Aggregation

MAN

LAN

LAN

LAN

LAN

Access

LAN

LAN

Problem 5 continued …

- ◆ Different propagation medium

- ◆ Different signaling methods

- ◆ Different address format
  - Addresses not used!?
  - Address is a relative time!?

Solution to Problem 5: Network Protocols

- For a package to arrive at the correct destination, there is in each node a network protocol that takes care of e.g. addressing.

- All networks between sender and receiver must use the same network protocol for global communications to work.

- Thanks to the network protocol, different links / link protocols can be used between nodes!

One network protocol: IP

- IP = Internet Protocol
- IP is the network protocol used on the Internet.
- Addressing is carried out with the help of IP addresses.
- Data is transmitted in the form of datagrams (IP packets).
- Connectionless data transfer.
- No error handling or verification that the recipient can receive the data.
- Such data transfer is called "best-effort".

Problem 6: End 2 end

- Communication between applications!?

  ◆ How address applications?

- Even if the error is detected during transmission of frames, errors may occur when transferring between computers.

  ◆ Datagrams are not guaranteed to be delivered in order

  ◆ Datagrams can be lost

Two transport protocoll:
TCP and UDP

- Both TCP and UDP addresses applications

- TCP also contains

  - Error detection and correction

  - Flow controll

Two layered reference models

OSI model	TCP/IP model
Application	Application
Presentation	
Session	
Transport	Transport
Net	Net
Link	IP carrying nets
Physical	

Actual reference model:
Hour glass model