

TCP/IP Internetworking

ET2438



Welcome

- Lectures – Sven Olof Larsson
- Laborations – Karel de Vogeleer
- Individual work (to be defined)

Course Objektives

After the course you should:

- Understand principles of TCP/IP internetworking
- Have familiarity with TCP/IP protocols
- Have familiarity with IP routing and design of networks within autonomous systems
- Understand mobile IP
- Understand DNS
- Be able to set up, configure and run simple networks within autonomous systems
- Be able to examine, analyze and evaluate diverse Internet protocols with the help of Opnet simulator
- Be able to do future research and development within the Internet domain.

Schedule

All lectures are in Landstingssalen at Wämö Center 09:00 – 12:00*

Week	Mo	Tu	We	Th	Fr
36		1-3, 10			
37		4, 5, 9	6-8		13-14
38			15 + ex.	11, 12	
39		12 + ex.*			16-18
40			19-21	Reserve	22, 23
41	24-27		28, 29		30, 31
42		Rehearsal			

***) Tuesday 22/9, week 39 is 13:00 – 16:00**

Course Book

Comer, D. E.,

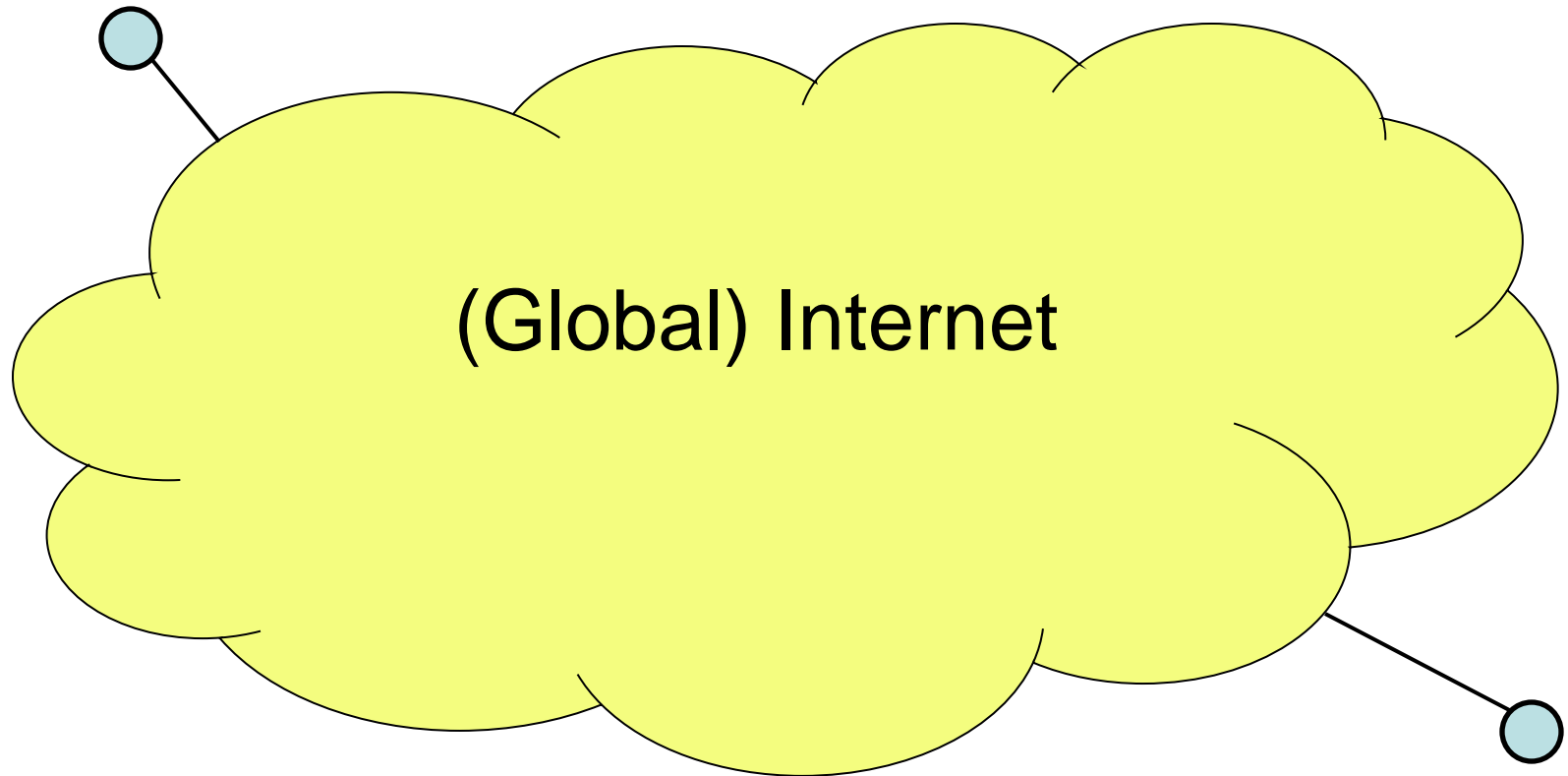
Internetworking with TCP/IP

Principles, Protocols, and Architectures, Volume 1,
Prentice-Hall, Inc., 2006 (5th edition),

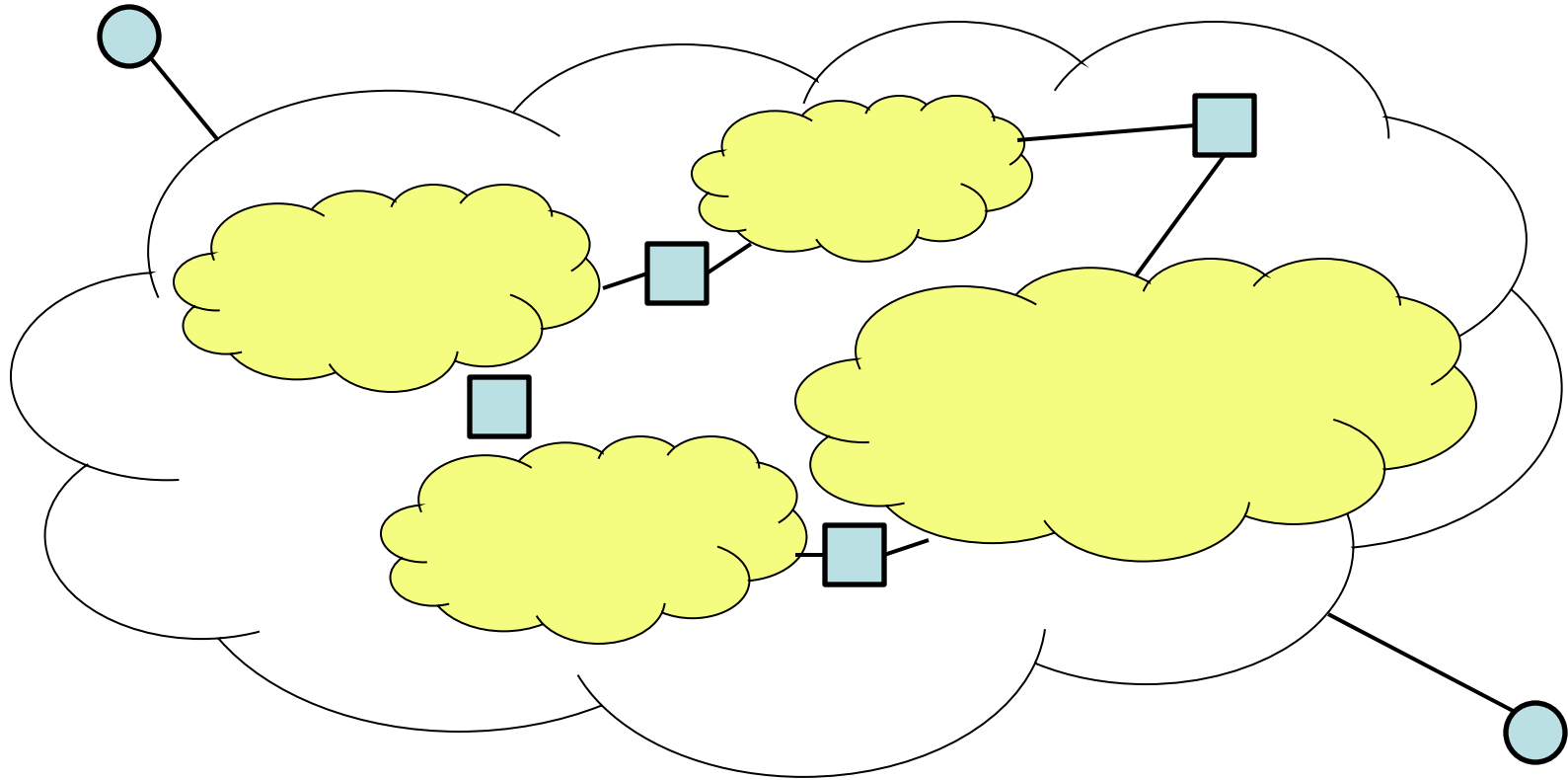
ISBN 0-13-187671-6

We will use a “bottom-up” approach.

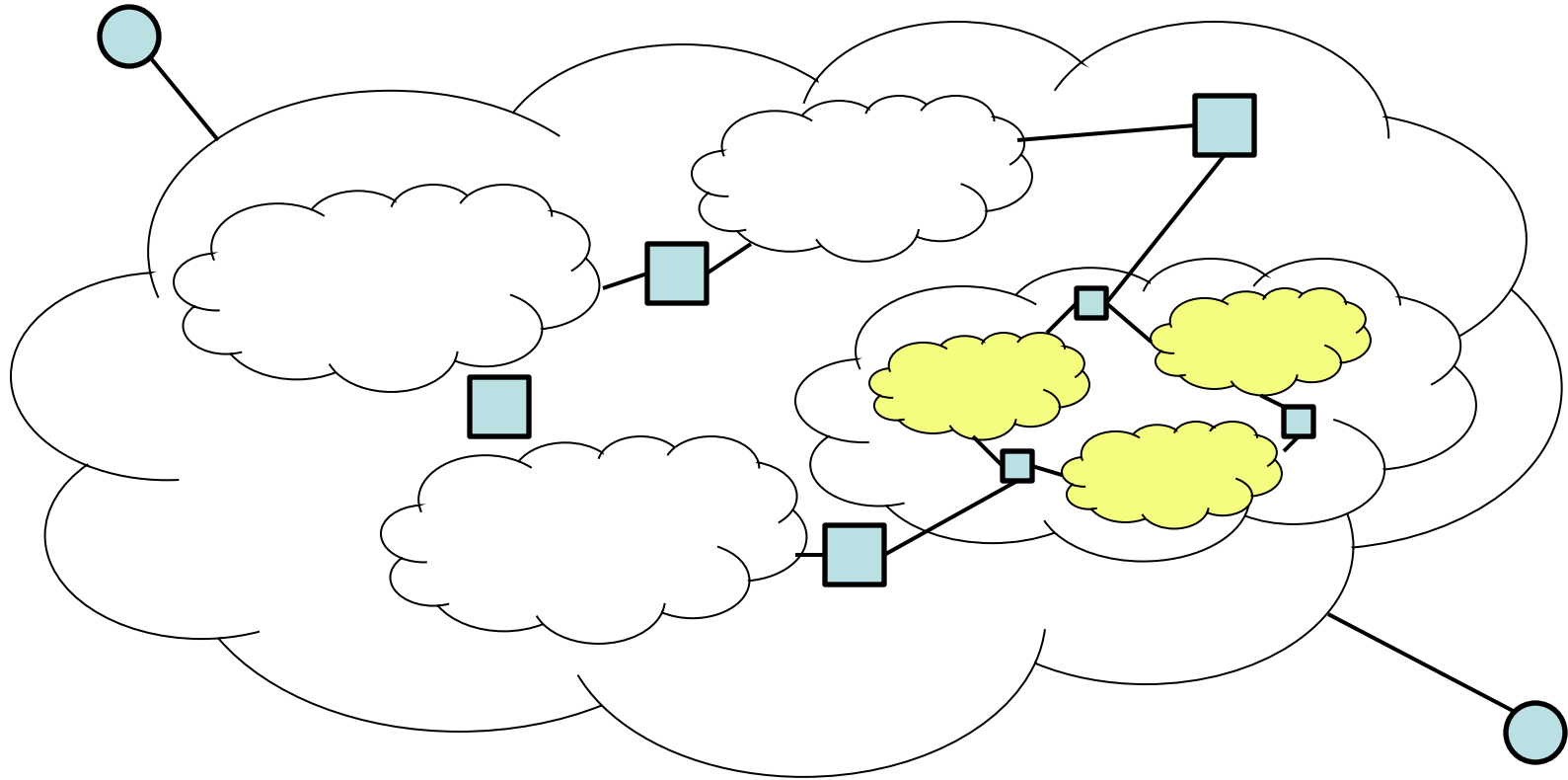
Internet



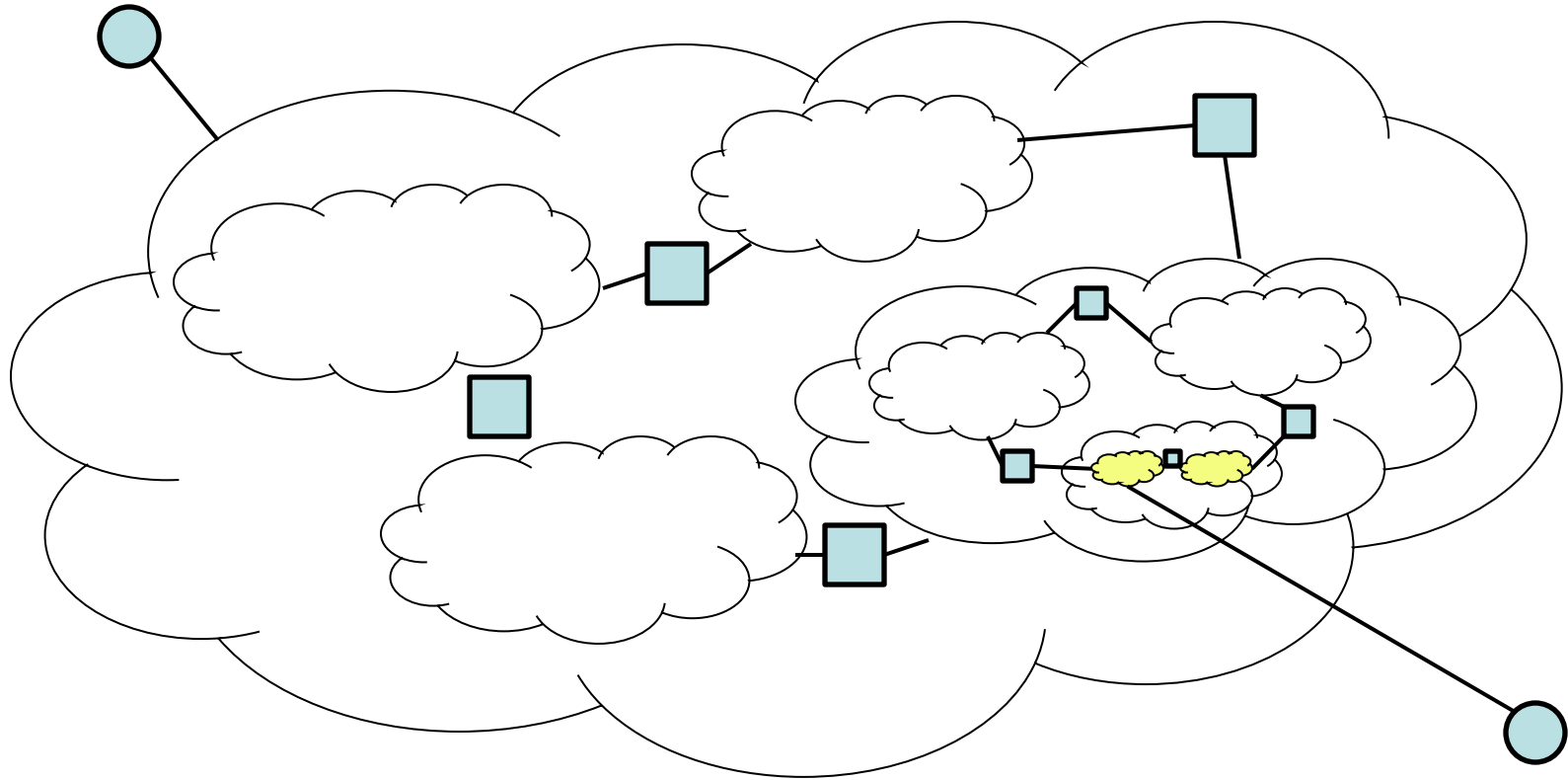
Continental Core Networks



National/Regional Networks - WANs



Local Area Networks - LANs

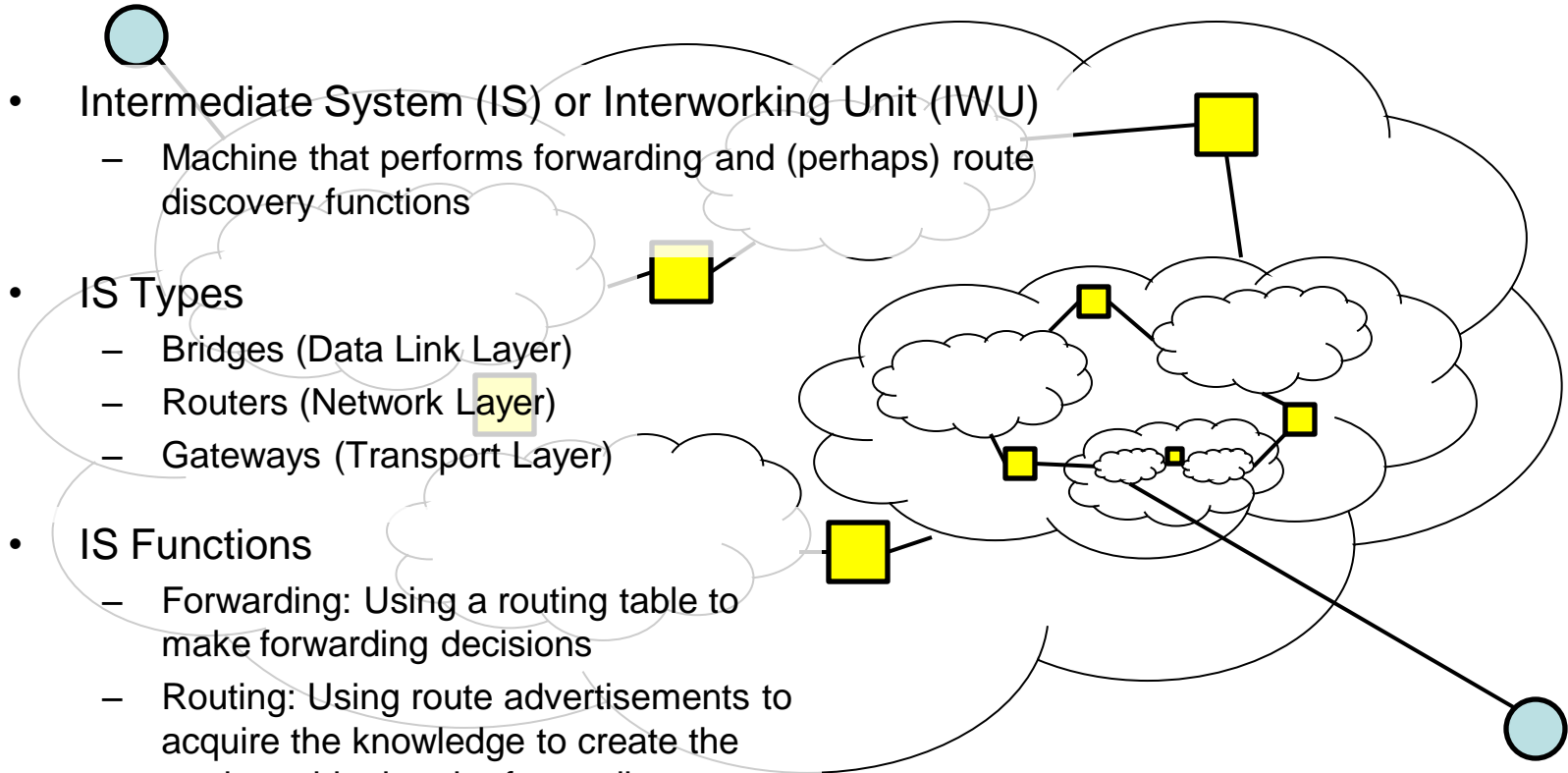


With other words...

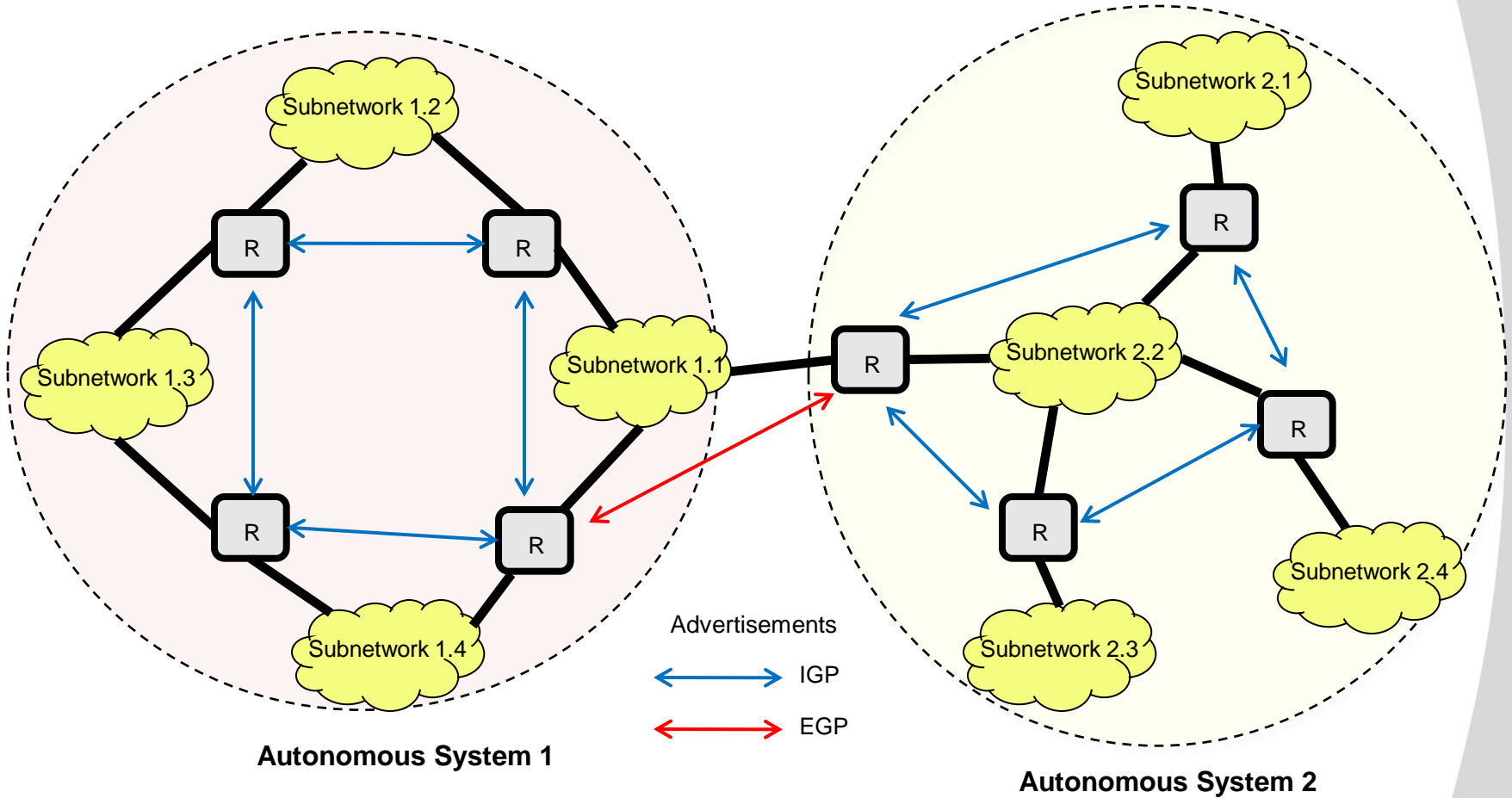


Intermediate System (IS)

- Intermediate System (IS) or Interworking Unit (IWU)
 - Machine that performs forwarding and (perhaps) route discovery functions
- IS Types
 - Bridges (Data Link Layer)
 - Routers (Network Layer)
 - Gateways (Transport Layer)
- IS Functions
 - Forwarding: Using a routing table to make forwarding decisions
 - Routing: Using route advertisements to acquire the knowledge to create the routing table that the forwarding protocol uses. Find paths.



Autonomous Systems – AS (Typically ISPs)



Overview

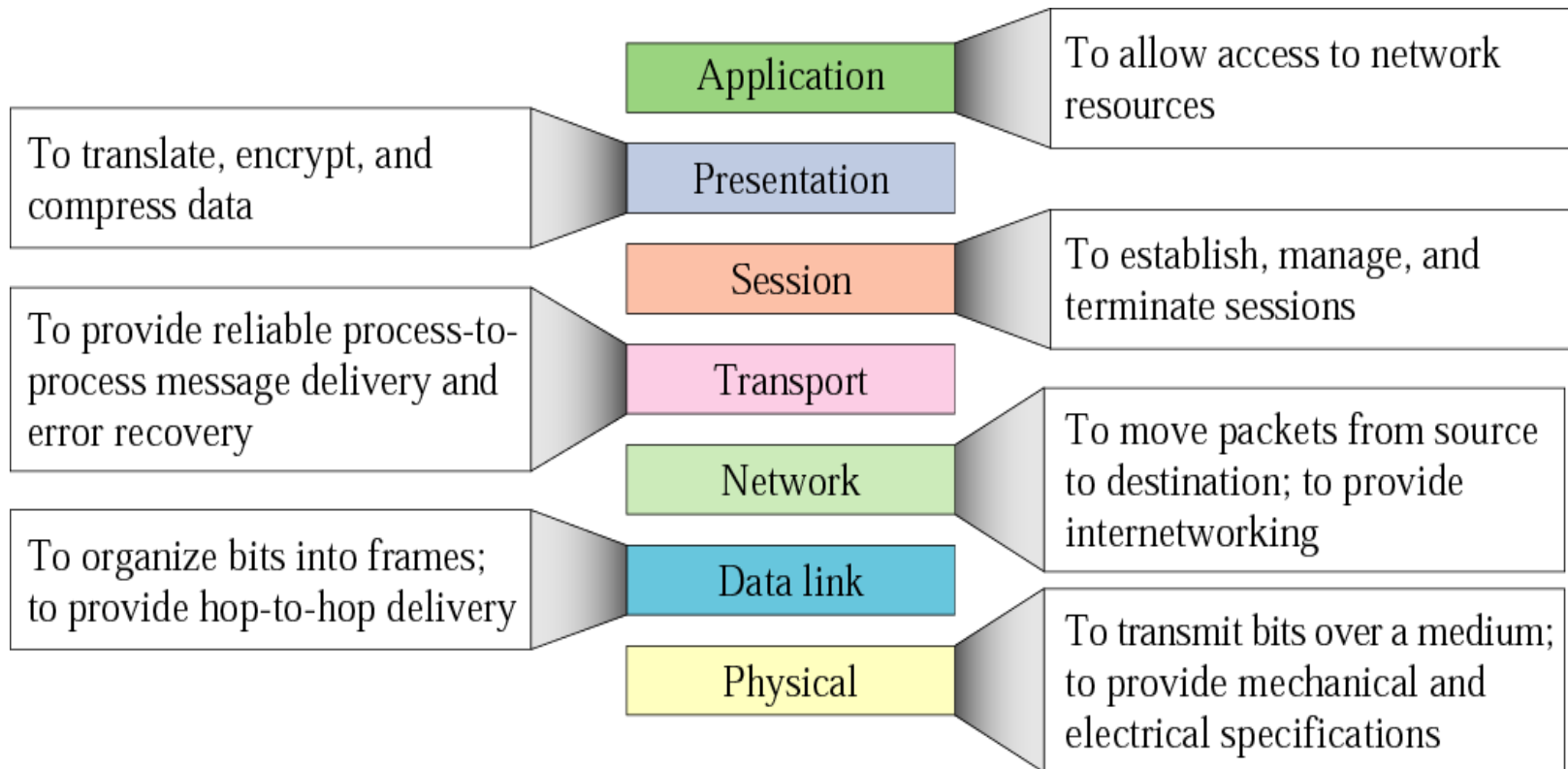
- All networks behave the same, at some **level** of abstraction (IP level)
- All levels are arranged into **layers**
- The abstraction is implemented by the use of **protocols** (conventions, rules on how to behave)
- Protocols are described in **standards** – RFCs
- Standards are coordinated by IETF (Internet Engineering Task Force)

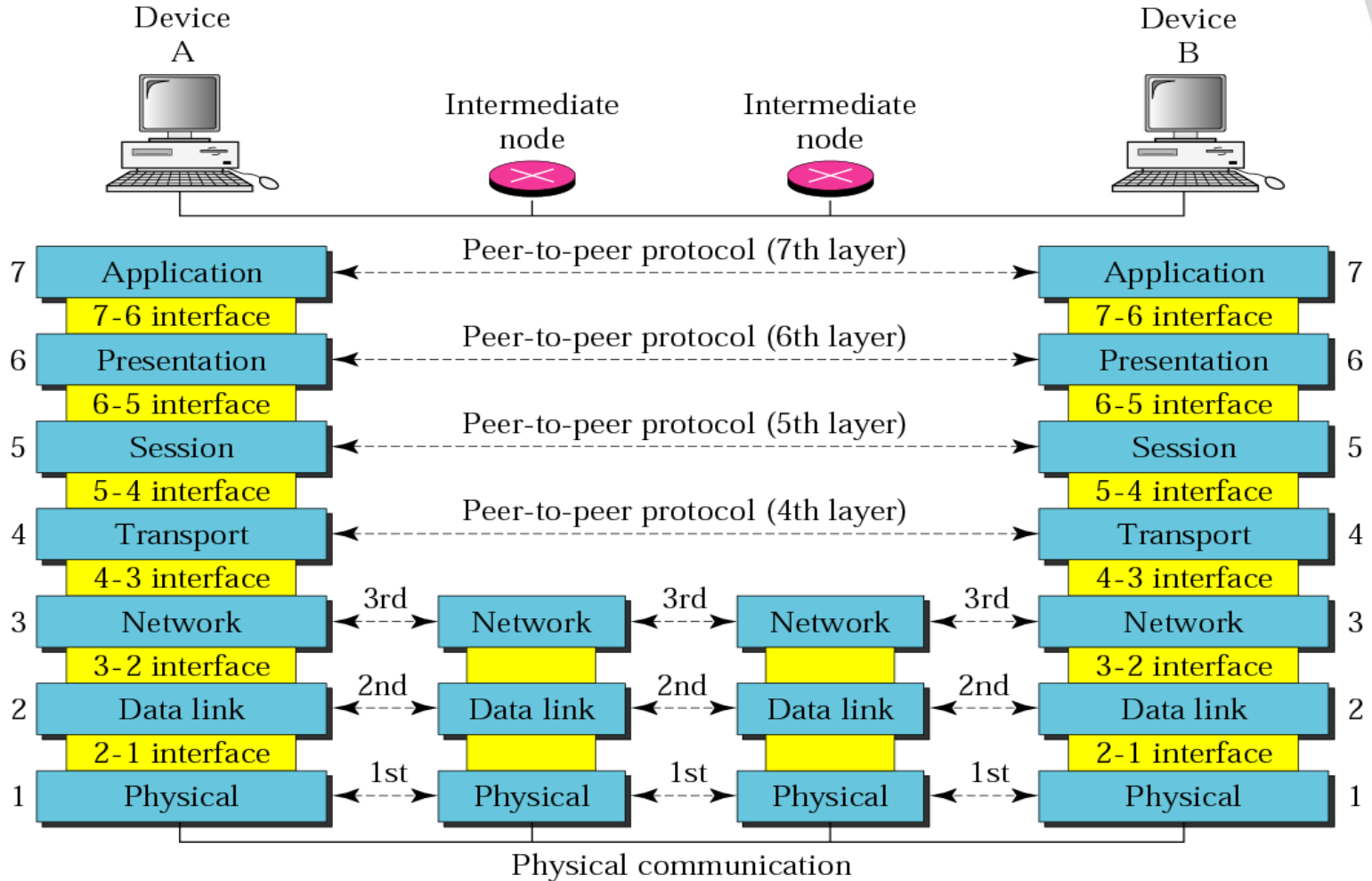
Protocol Layers

Most important protocol layer designs:

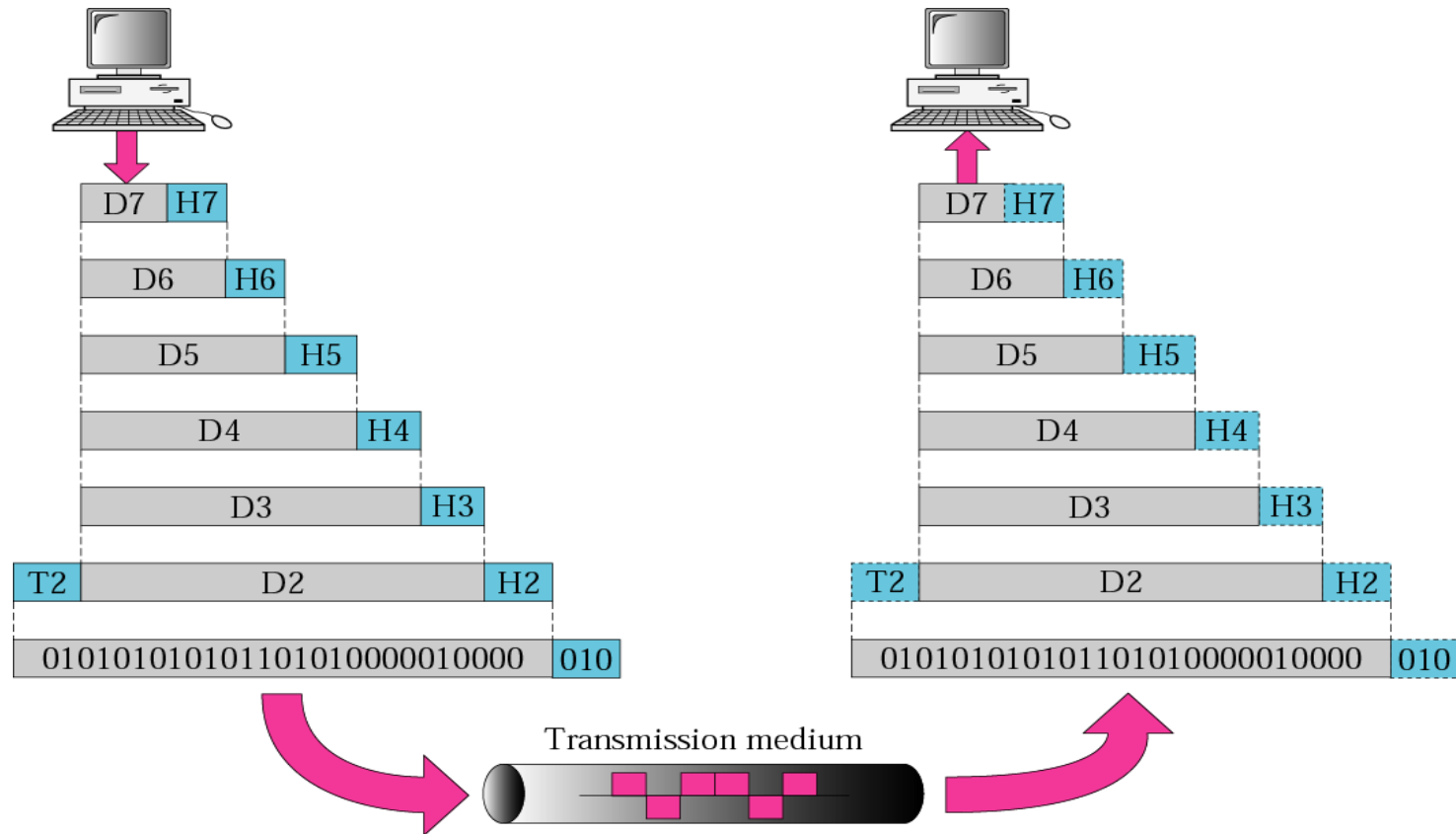
- ISO (Intl. Standards Org.) has made the OSI (Open Systems Interconnection) 7 layer model
- DoD (Department of Defense) model (4 layers)
- TCP/IP model (4 layers): actual Internet model

OSI Reference Model



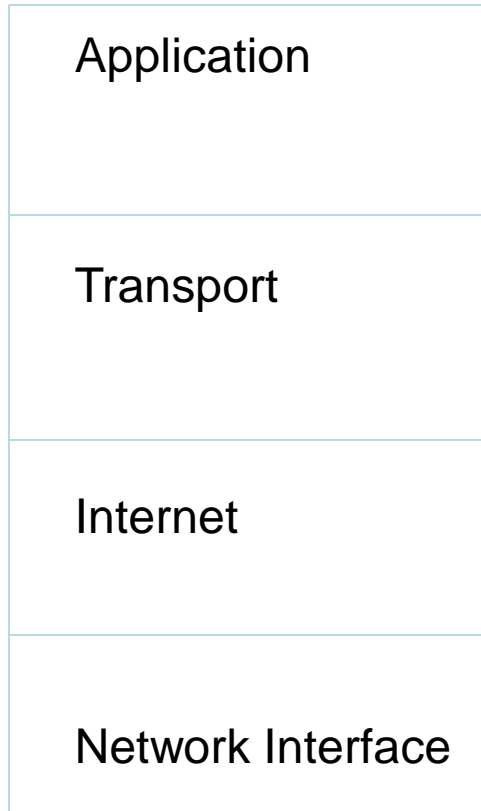


Encapsulation

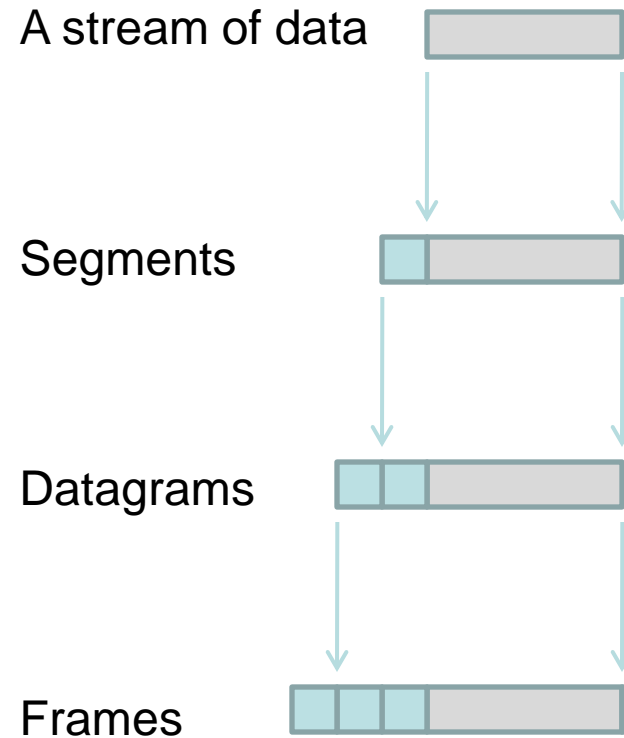


TCP/IP Reference Model

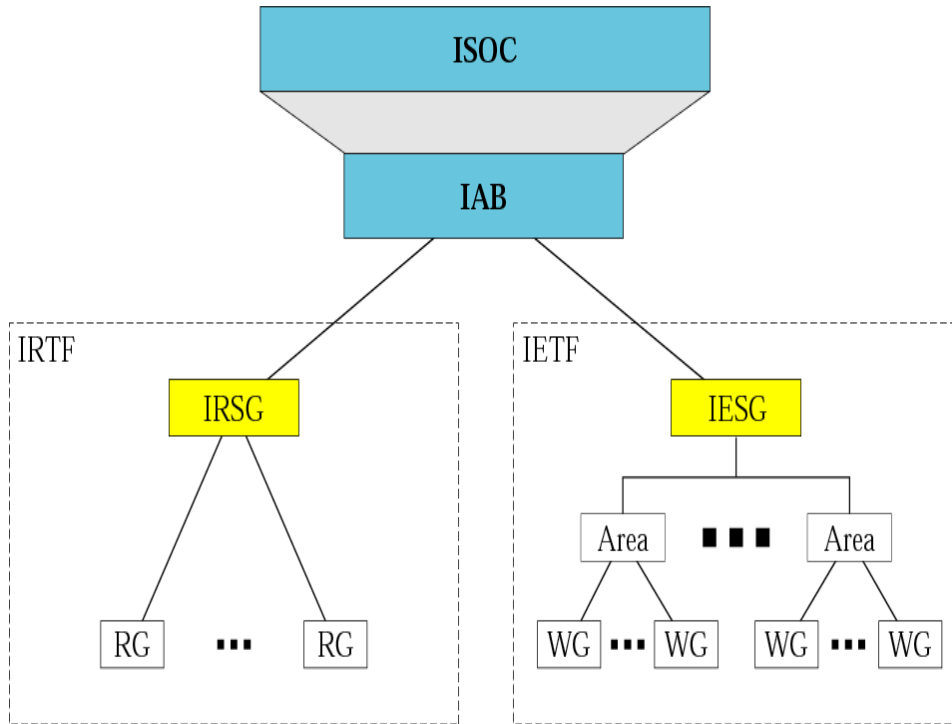
Layer



Objects passed



Internet Standards



Groups that coordinate diverse Internet issues

- Internet Society (ISOC)
- Internet Architecture Board (IAB)
- Internet Research Task Force (IRTF)
- Internet Research Steering Group (IRSG)
- Research Group (RG)
- Internet Engineering Task Force (IETF)
- Internet Engineering Steering Group (IESG)
- Working Groups(WG)
- Internet Assigned Numbers Authority (IANA)
- Internet Cooperation for Assigned Names and Numbers (ICANN)
- Network Information Center (NIC)

Network HW Technologies

- Types of communication networks
 - Telephone Networks (PSTN)
 - Local Area Networks (LAN): IEEE 802.3 (CSMA/CD)
 - Wireless Local Area Networks (WLAN): IEEE 802.11
 - Wide Area Networks (WAN): ADSL; CATV; SONET; FTTH; PPP; X.25; FR; ATM
 - Metropolitan Area Networks (MAN)
 - Radio Networks (RN): single-hop; multi-hop
 - Mobile Communication Networks (MCN): GSM; UMTS
 - Satellite Networks (SN)
 - Cable Television (CT)
 -
- Ethernet implementations
 - 10BASE5; 10BASE2; 10BASE-T; 10BASE-FL;
 - Fast Ethernet: 100BASE-TX; 100BASE-FX; 100BASE-T4;
 - Gigabit Ethernet: 1000BASE-SX/LX; 1000BASE-T;
- Different standards for PHY and DLL (OSI - data link layer)

Maximum Transmission Unit - MTU

- Examples of MTU (in bytes):
 - 1500 (Ethernet IEEE 802.3)
 - 8191 (Token Bus IEEE 802.4)
 - 4464 (Token Ring IEEE 802.5)
 - 4352 (FDDI)
 - 576 (X.25) IP specified minimum size
 - 53 (ATM)
 -
- In order to avoid segmentation, one needs to know the so-called **Path MTU**, (smallest MTU of the end-to-end path)
- Besides MTU, there is also a minimum transmission unit, e.g. 46 bytes (Ethernet)

Switching Technology

Circuit Switched

“Bandwidth allocation”
(Reservation of resources)

Low multiplexing gain

Intelligent network – Simple hosts

Packet Switched

No reservations needed
(Packets can get lost. Store & Forward)

High multiplexing gain

Intelligent hosts – Simple network

Mechanisms at transport level makes
It reliable
(Virtual connections end-to-end,
retransmissions etc.)