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#### Lecture Computer Networks

Basics

## **Basics**

- Characteristics of data communication technologies
- OSI-Model
- Topologies
- Packet switching / Circuit switching
- Medium Access Control (MAC) mechanisms
- Coding
- Quality of Service (QoS)

# **Characteristics I (examples)**

- Access to the communication medium (MAC)
  - stochastic or deterministic

Technology	STOCHASTIC	DETERMINISTIC
Ethernet	YES	
CAN	YES	
Profibus		YES
MOST		YES
LIN		YES
IEEE 1394 (Firewire)	YES (asynch.)	YES (isochron.)
IEEE 802.11 (WLAN)	YES	
Bluetooth		YES

### **Characteristics II (examples)**

- Real-Time capability
  - fully-, conditionally- or not- capable

Technology	FULLY	CONDITIONALLY	ΝΟΤ
Ethernet			YES
CAN		YES	
Profibus	YES	YES	
MOST	YES	YES	
LIN	YES		
IEEE 1394 (Firewire)	YES	YES	
IEEE 802.11 (WLAN)			YES
Bluetooth	YES	YES	

## **Characteristics III (examples)**

• Type of the nodes (Master, Slave, Equal)

Technology	MASTER / SLAVE(S)	MULTI-MASTER / SLAVE(S)	EQUAL NODES
Ethernet			YES
CAN			YES
Profibus		YES	
MOST			YES
LIN	YES		
IEEE 1394 (Firewire)			YES
IEEE 802.11 (WLAN)			YES
Bluetooth	YES		

# **Characteristics IV (examples)**

- Modes of data-communication
  - asynchronous, synchronous or isochronous

Technology	ASYNCHRONOUS	SYNCHRONOUS	ISOCHRONOUS
Ethernet	YES		
CAN	YES		
Profibus	YES		
MOST		YES	
LIN	YES		
IEEE 1394 (Firewire)	YES		YES
IEEE 802.11 (WLAN)	YES		
Bluetooth	YES	YES	

# **Open Systems Interconnect (OSI) Model**

- International Standards Organization (ISO) developed a model in 1983
- This model is to define an architecture that describes the communication between heterogeneous computers
- Communication is respectively the exchange of data between computers
- Various elements are involved:
  - electrical characteristics
    - coding cable types
    - network adapters
    - data segmentation / packetizing
    - error control
    - software compatibility ...
- Strategic solution Handling of the different aspects in seven distinct layers: Seven layer OSI model

### **Seven Layer OSI Model**

The main characteristics of the seven layer OSI model are:

- Each layer performs a defined subset of functions for the overall communication process
- The functions rely on those of the previous lower layer:
  - To perform more primitive functions
  - To hide the details of the lower layer functions
- Each layer provides services to the next higher layer
- Modifications within a layer do not require modifications of the other layers
- Dividing the communication functions into separate layers facilitates the management of the communication process

### Main OSI Layer Terms

The main terms used in OSI Layer can be summarized as follows:

- <u>Service</u>: Each layer serves additional services for the higher layer. Type of service is dependent on the definition of the layer model.
- Interface: Services are usable via an interface through layers. Usage of services is also specified between layers.
- <u>Protocol</u>: It defines the internal operation procedure of a layer. The protocol is private to the layer. It can be changed or replaced without affecting other layers.

### **Peer to Peer Communication**

How do two networked systems communicate?

- Through their network protocol stacks
- Each layer communicates with its peer

e.g. as bit streams are received by a receiving node's physical layer,

they are passed up to the data link layer where they are again formed into frames and then to the network layer where they again become packets as shown below.



## **OSI Reference Model for "Open Systems"**

- 1<sup>st</sup> Layer Data transmitted by bits.
- 2<sup>nd</sup> Layer Data transmitted by frames
  3<sup>rd</sup> Layer Data transmitted by packets
- Network layer creates a Protocol Data Unit (PDU) and those PDUs are passed the 4th Layer
- Each layer receives a PDU from the layer below.
- In this way, each layer in a transmitting node communicates with its peer • layer of the receiving node.



# Layers 1 and 2

### **Physical Layer**

- Mechanical
- Electrical
- Procedural characteristics

#### **Data Link Layer**

- Transport / Error Free
  Transmission
- Facility Sequential Transmissions
- Flow Control
- Access Protocols

Establishment, maintenance and deactivation of the physical link Application Presentation Session Transport Network Data Link Physical

Reliable transfer of data across the physical link



### Layers 3 and 4

#### **Network Layer**

- Unreliable datagram service
- Static & Dynamic Routing Control
- Transport Accounting
- Packet Segmentation
- Heterogeneous Network
   Control

#### **Transport Layer**

- Segment Messages
- Establish & Manage Connections
- End-To-End Control
- Multiple Connection Control

Upper Layers are independent from the data transmission and switching of technologies



Reliable, transparent transfer of data between source and destination



### Layers 5 and 6

#### **Session Layer**

- Session Establishment
- Session Control
- Dialog Control
- Token Management Synchronization
- Checkpoint Insertion

#### **Presentation Layer**

- Encryption & Decryption
- Reformatting
- Syntax & Semantics
- Information
   Representation
- Data Compression & Decompression

Control structure for communication between applications



Standardized application interface Common communications services



# Layer 7

#### **Application Layer**

- Network applications facilitate network connectivityVirtual Terminal
- File Transfer
- E-Mail
- Service announcement
- Service availability
- Mapping of virtual world into real world

Services to the users of the OSI environment

Application
Presentation
Session
Transport
Network
Data Link
Physical

### **Layer Concept**



#### **Access Methods**



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