

Introduction: Local Area Networks (1/2)

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LAN – Local Area Network – connects computers in close spatial proximity ($\sim$ several hundred meters)

- In contrast to point-to-point connections, computers linked to a LAN share the network infrastructure and transmission medium
- Shared use of network resources creates high economic efficiency
- LAN is the most widely used form of computer networks
- LANs are typically private networks that can be installed and operated by people or companies on their property without special regulations

Introduction: Local Area Networks (2/2)

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Shared use of the transmission medium demands a high coordination and administrative effort

Basic idea

- Information is sent in form data packets
- Sent data packets are initially received by all connected computers

“Broadcast Network”

- An address field in the data packet specifies the intended recipient
- After receiving a data packet every computer checks if the packet is intended for it – if
 - no → packet is discarded
 - yes → packet is processed

Local Data Management in the LAN (1/4)

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For a computer in the LAN to be uniquely addressed, it must be assigned an **address**

- Addresses are values in a specified format that uniquely identify computers (more specifically, network interfaces) within the network
- On each layer of the communication protocol stack unique address formats can be defined
- Each data packet contains a header with the addresses of the sender (source) and the receiver (destination) as well as other additional information necessary for correct transport

LAN communication interface of a connected computer filters incoming data packets based on the receiver's address. In case of an address match it hands over the packet to its operating system

- Data to be sent is passed to the LAN communication interface, there, it is packed into a packet, addressed and sent (without making use of the computer's CPU)
- There are different types of addresses:
 - **Individual address** – address for an individual computer
 - **Multicast addresses** – common address for a group of computers
 - **Broadcast address** – for addressing all computers in a LAN

Local Data Management in the LAN (3/4)

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Of special importance are so-called **MAC addresses** – **Media Access Control Addresses** –, the hardware addresses of the LAN communication interfaces

A MAC address only appears once within a LAN, it must be unique

A distinction is made between:

- **Static addresses** – worldwide unique hardware addresses assigned by the manufacturers to the LAN interface cards
- **Configurable addresses** – determined freely by the network operator, uniqueness in the LAN must be ensured
- **Dynamic addresses** – LAN interface card initiates when computer starts the automatic assignment of a hardware address (possibly there are failed attempts)

MAC addresses follow the IEEE 802 addressing scheme: 16 or 48 bits

Local Data Management in the LAN (4/4)

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Every LAN technology defines its own **packet format**

- A packet consists of a packet header and a payload
- Besides the sender and receiver addresses a packet header contains additional administrative information, e.g., type of user data, ...
- Each layer of the protocol stack of a network technology adds its own packet header to a data packet. together they make up the payload of the underlying layer

Special LAN Hardware (1/2)

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LAN interface card (also network adapter, LAN communication interface card, network card, Network Interface Card (NIC), ...):

- Hardware needed to connect a computer to a LAN
- For each LAN technology LAN interface cards are specifically designed
- A LAN interface card
 - functions like an input/output device, taking over details of packet transmission without accessing the computer's CPU
 - is able to correctly interpret the physical signals transmitted in the LAN
 - filters out non-relevant data packets

Special LAN Hardware (2/2)

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Network analyzer (also network sniffer, packet sniffer):

- (Portable) device, or special software used to determine the performance of a LAN as well as for error detection
- “Listens” to all data that is sent over the network - via the “promiscuous mode” every received packet can be forwarded to the analysis software of the network analyzer for further examination
- Network analyzers can also be implemented to monitor specific computers

Important LAN Technologies

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Ethernet

- Most important LAN technology

Token-Ring technology

- For a long time main rival of the Ethernet

FDDI – Fiber Distributed Data Interface

- Similar to Token Ring but with optical fiber and other access mechanism

ATM – Asynchronous Transfer Mode

- Basic technology for B-ISDN

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LAN Expansion

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To extend the limited range of a LAN, and to connect different LANs, there are special hardware components available, such as

LAN-Repeaters – for the extension of communication lines

- Can amplify signals (electrical or optical)

Hubs – for the connection of computers and LAN segments

- Can aggregate different LAN segments into one.
All packets are transmitted to every connected device

Bridges – for the connection of LAN segments

- Can forward packets between two different LAN segments, depending on their destination

Switches – for the connection of computers and LAN segments

- For each packet a destination is determined, and the packet is sent only towards that destination