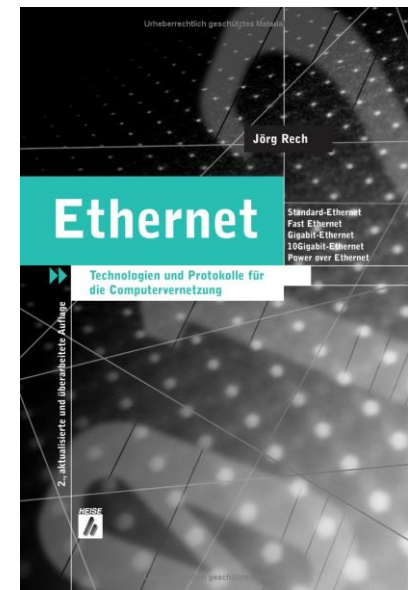


2.9 Ethernet Frame

Prof. Dr. Andreas Steffen
Institute for Internet Technologies and Applications

Lesestoff im Ethernet Buch

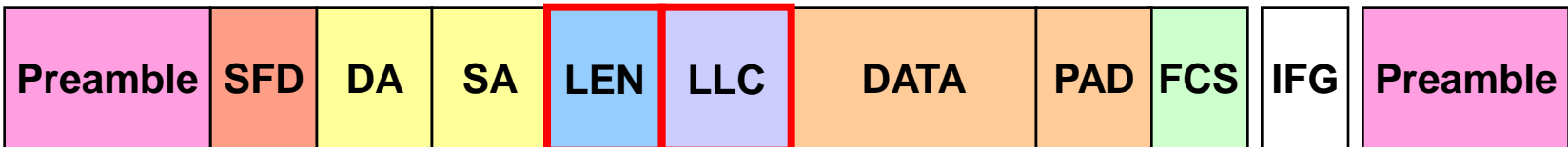
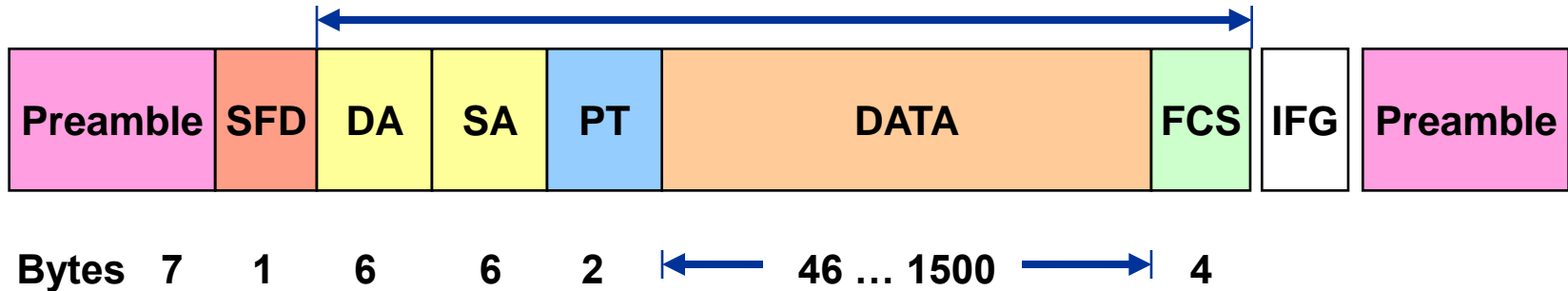
- Kapitel 2 Ethernet, Seiten 71-83
2.10 Frameformate bei Ethernet



Ethernet Rahmenformate

Ethernet II (DIX)

MAC Rahmengrösse 64 ... 1518 Bytes



IEEE 802.3

802.2 LLC
802.2 SNAP

- Unterscheidungsmerkmal zwischen DIX und 802.3
 - Maximale Payload Länge ist 1500 Bytes (**0x05DC**)
 - Ethernet Payload Types (PT) haben Werte grösser als 1500, z.B. IP: **0x0800**, ARP: **0x0806**, AppleTalk: **0x809B**, Novell: **0x8137**, **0x8138**

Felder im Ethernet-Frame

- Preamble 7 Bytes
1-0-1-0 Sequenz zur Bit-Synchronisation
- SFD (Start-of-Frame Delimiter) 1 Byte
10101011 zur Byte-Synchronisation, Beginn des MAC-Frames
- DA (Destination Address) 6 Bytes
Hardware Adresse des gewünschten Empfängers
- SA (Source Address) 6 Bytes
Hardware Adresse des Senders
- LEN (IEEE 802.3 Length) oder PT (DIX Ethertype) 2 Bytes
Länge der LLC PDU oder Ethernet Payload Type
- DATA / PAD (Padding) 46...1500 Bytes
Padding mit 0x00 garantiert minimale Paketdauer für CSMA/CD
- FCS (Frame Check Sequence) 4 Bytes
32 Bit Cyclic-Redundancy-Check (CRC-32)
- IFG (Inter Frame Gap) 12 Bytes
Minimaler Abstand zwischen zwei Ethernet-Frames

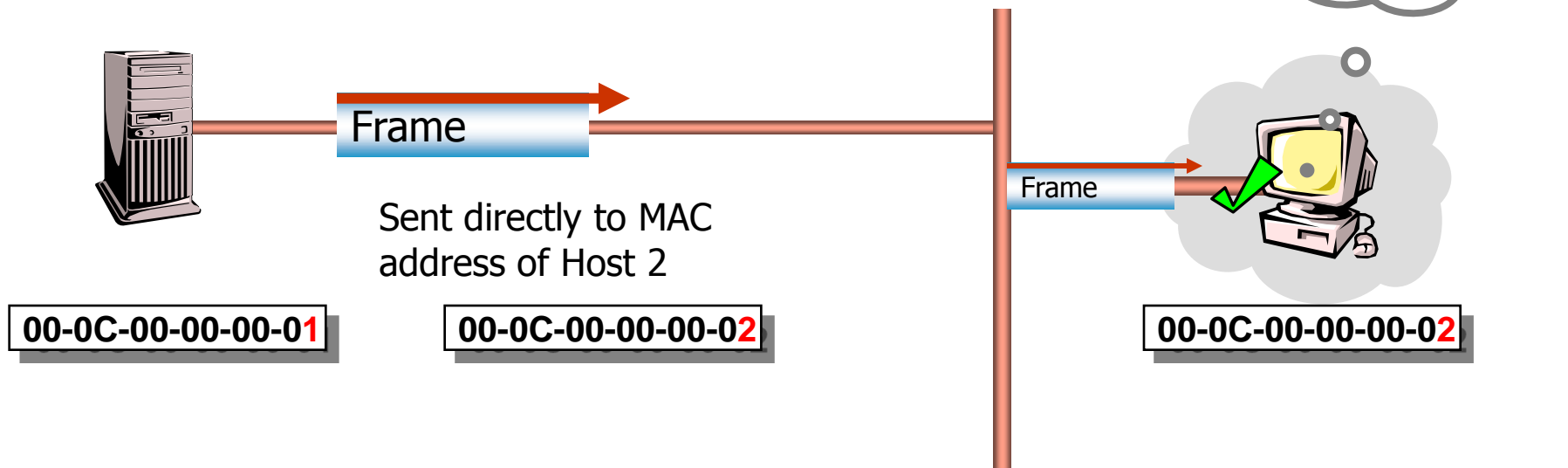
MAC Adressierung - UNICAST

Unique MAC Hardware Address: **00-0C-00-12-34-56**

VENDOR Code (OUI)
24 Bits

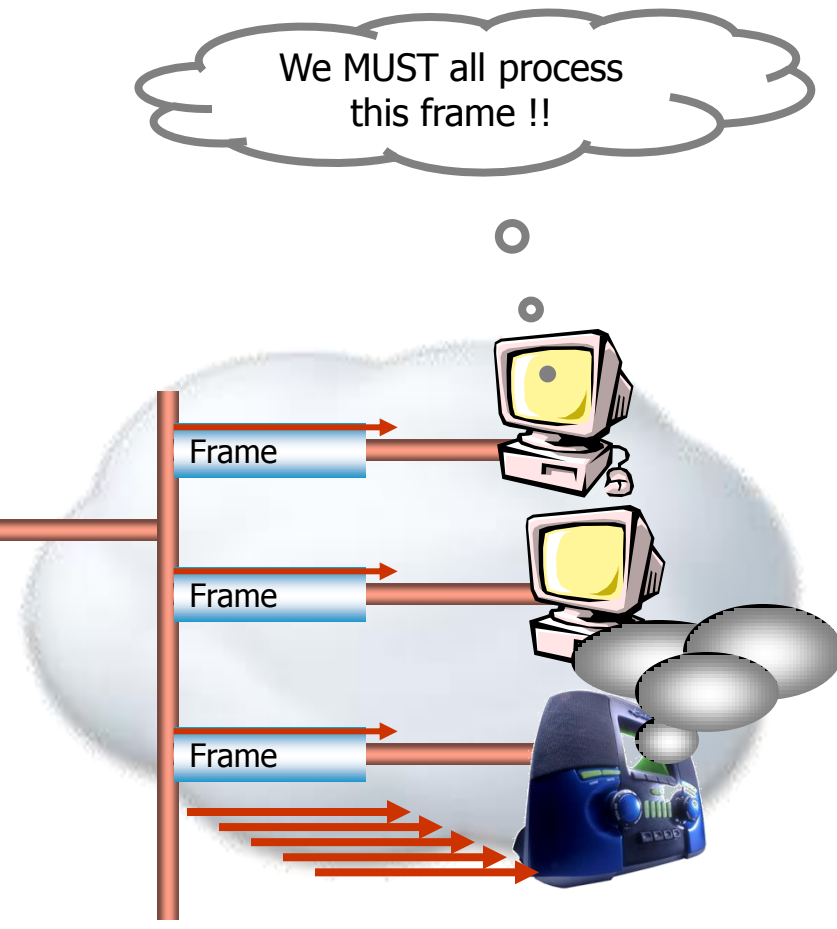
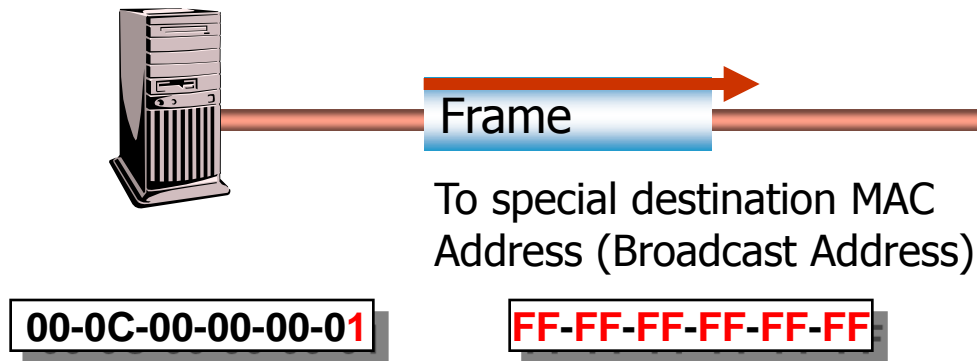
Unique Number
24 Bits

One-to-One: **UNICAST**



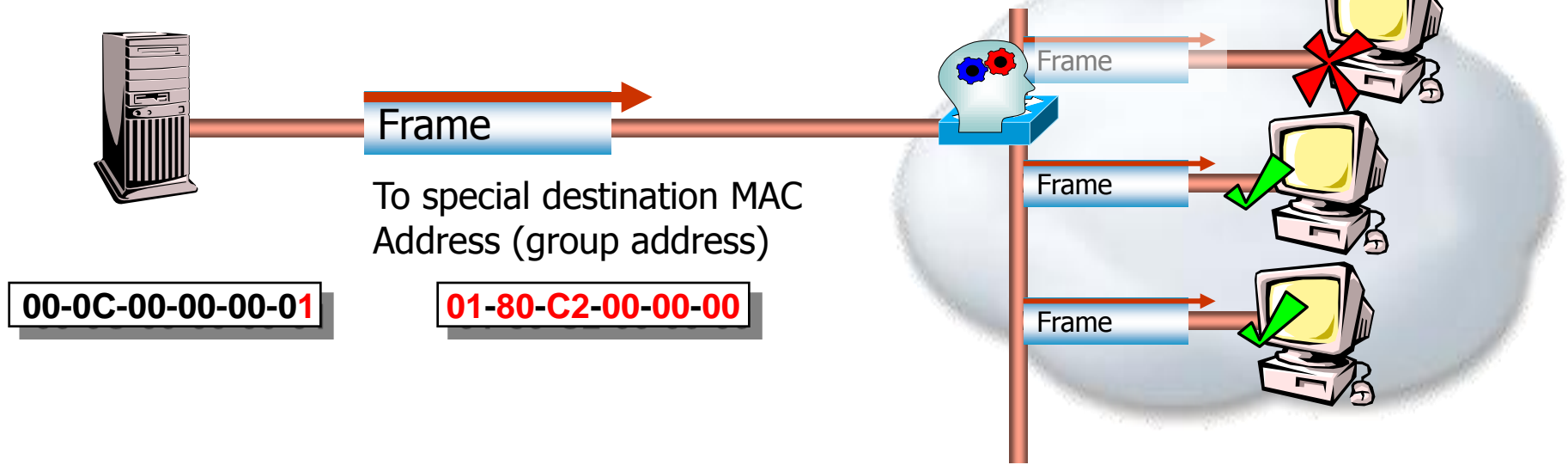
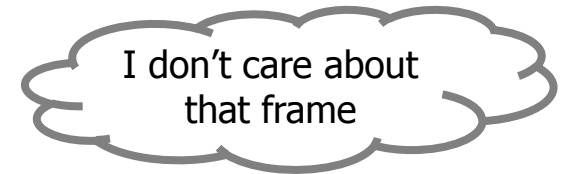
One-to-All: BROADCAST

- Must be received by all stations
- Can be a severe burden especially to slow systems and appliances
- Should be used as little as possible
- Main obstacle in large flat networks

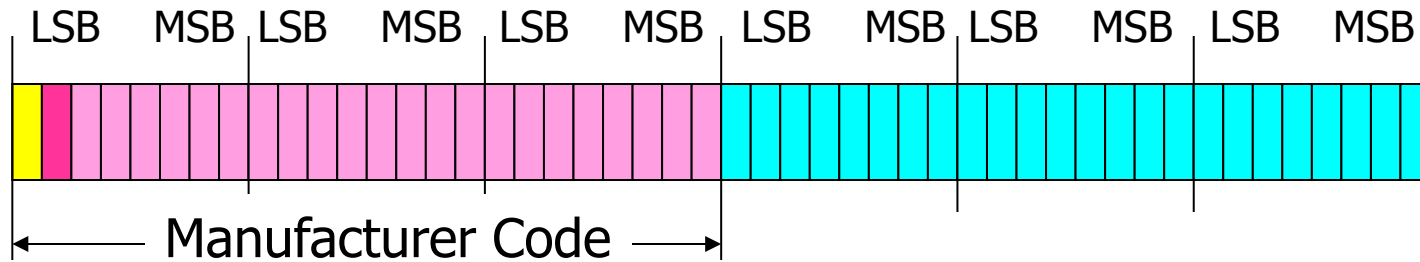


One-to-Many: **MULTICAST**

- IP Multicast Addresses map to Ethernet Multicast Addresses
- Efficient Mechanism for Group Traffic (Video, Spanning Tree, etc.)
- Usually locally controlled by additional Protocols (CGMP, IGMP, RGMP, GMRP)
- Globally controlled by Multicast routing



Medium Access Control (MAC)- Adressen



- Individual/Group Bit (erstes Bit, LSB der DA):
 - I/G=0: Individual Address
 - I/G=1: Group Address (Broadcast / Multicast)
- Universal/Local Bit:
 - U/L=0: Universally (globally) Administered Address
 - U/L=1: Locally Administered Address
- Manufacturer Code

Manufacturer Codes

00-00-0C	Cisco
00-02-55	IBM
00-09-7B	Cisco
00-AA-00	Intel
00-0B-5D	Fujitsu (Broadcom Gigabit Ethernet NIC)
00-20-AF	3COM Corporation
00-0D-88	D-Link
08-00-09	Hewlett-Packard
08-00-20	Sun

What is your PC's OUI (Organizationally Unique Identifier)?

Look it up at: <http://standards.ieee.org/regauth/oui/index.shtml>

Each OUI allows to uniquely address $2^{24} = 16\,777\,216$ NICs

Multicast Adressen

01-80-C2-00-00-00	Spanning tree (for bridges), Ethertype: -802-
01-80-C2-00-00-10	Bridge Management, Ethertype: -802-
01-00-5E-00-00-00	DoD Internet Multicast (RFC 1112), Ethertype: 0800
CF-00-00-00-00-00	Ethernet Configuration Test protocol (Loopback), Ethertype: 9000

Bestimmung der MAC-Adresse

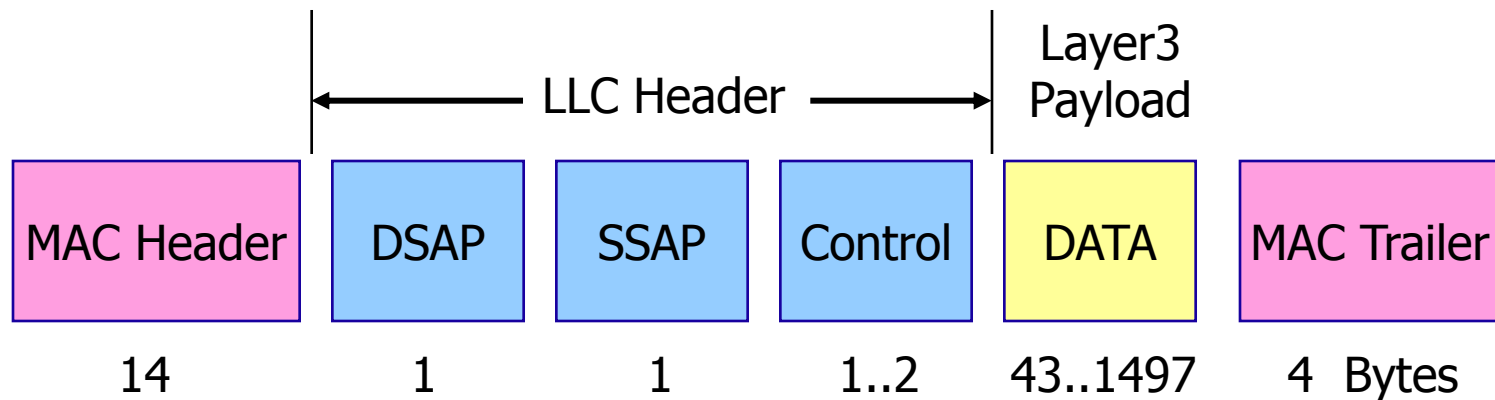
- Windows: **ipconfig**
- Unix/Linux: **ifconfig**
- Beispiel:

```
satay# ifconfig eth0
eth0  Link encap:Ethernet
      HWaddr 00:0D:88:3C:30:F9
      inet addr:80.219.192.127
      Bcast:255.255.255.255
      Mask:255.255.248.0
      inet6 addr: fe80::20d:88ff:fe3c:30f9/64
```

2.10 Logical Link Control Layer (LLC)

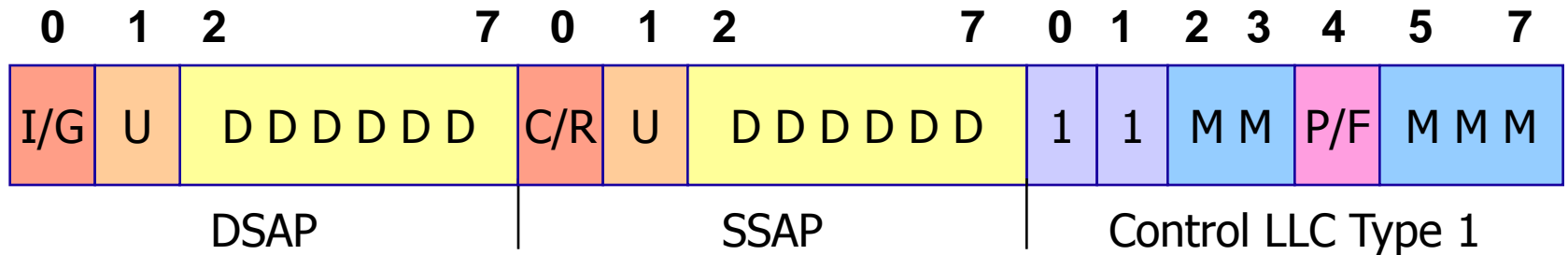
LLC Header Format

- LLC header is prepended to higher layer data
 - DSAP (Destination Service Access Point), 8 bits
 - SSAP (Source Service Access Point), 8 bits
 - Control Field, 8 or 16 bits
- LLC PDU
 - is encapsulated in MAC frame



DSAP and SSAP

- Destination Service Access Point and Source SAP
 - identify the higher level protocol, which is the destination and the source of the given frame
 - are a kind of protocol type or protocol stack identifier



I/G=0: Individual DSAP
I/G=1: Group DSAP

U=0: User defined
U=1: IEEE defined

C/R=0: Command
C/R=1: Response

Values for DSAP / SSAP Field

- 128 values possible for I/G = 0
 - 63 are reserved for IEEE protocols (U = 1)
 - 63 for vendor specific protocols and for free application usage (U = 0)
- SAP Examples:
 - 0x00 Null SAP
 - station with running LLC software always responds to a frame destined to the Null SAP -> LLC Ping can be implemented
 - 0x03 LLC sub-layer management (U=1)
 - 0x06 DoD IP (U=1)
 - 0x42 802.1d Spanning Tree Protocol (U=1)
 - 0xAA SNAP sub-layer (U=1) [0 1 0 1 0 1 0 1]
 - 0xFE ISO Network Layer (U=1)

Values for LLC Control Field

- LLC Control field and protocol procedures are similar to HDLC
 - HDLC procedures allow connection-less and connection-oriented services on a layer 2 link
- Connection-less mode is used by
 - IP, IPX, AppleTalk, etc. over LLC Type 1
- Connection-oriented mode is used by
 - SNA over LLC Type 2
 - NetBIOS over LLC Type 2 (NetBEUI)
e.g. in Microsoft Peer-to-Peer Network

Sub Net Access Protocol (SNAP)

- SNAP header is prepended to higher layer data
 - OUI (Organizational Unit Identifier), 3 bytes
 - Ethernet Type, 2 bytes
- In an IP-based Network
 - OUI: 00-00-00
 - Ethertype: 0x0800 (IP), 0x0806 (ARP)

