# Ethernet

## ITS323: Introduction to Data Communications
## CSS331: Fundamentals of Data Communications

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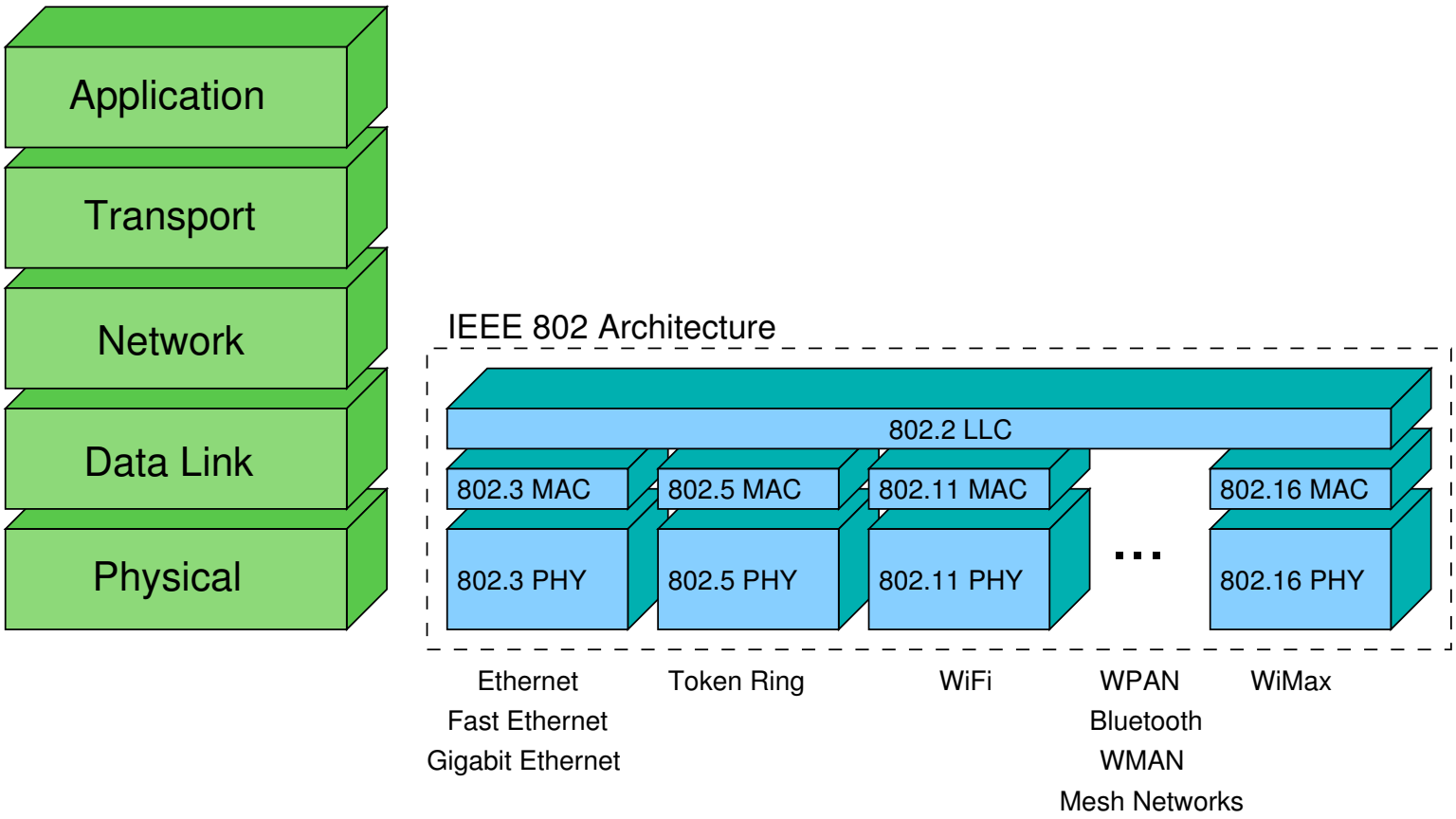
# Contents

# IEEE 802 LAN Architecture

- Institute of Electrical and Electronics Engineers: professional and standards organisation
  - 754 (Floating Point Arithmetic), 828, 829, 830, (Software Development), 1003 (POSIX), 1076 (VHDL), 1363 (Cryptography), 1394 (Firewire), ...
- IEEE 802: LAN/MAN standards committee
  - Developing standards for PANs, LANs, MANs, WANs
  - Divided into numbered working groups
- IEEE 802 standards focus on:
  - Physical (PHY) layer
  - Data link (DL) layer
    - Medium Access Control (MAC): efficient data transfer, sharing the medium
    - Logical Link Control (LLC): addressing, connecting to other networks
- IEEE 802.3 (Ethernet), IEEE 802.5 (Token Ring), IEEE 802.11 (WiFi), IEEE 802.15.1 (Bluetooth), IEEE 802.16 (WiMax), ...

# IEEE 802 LAN Architecture




LLC = Logical Link Control
MAC = Medium Access Control
PHY = Physical

# IEEE 802.3: Ethernet

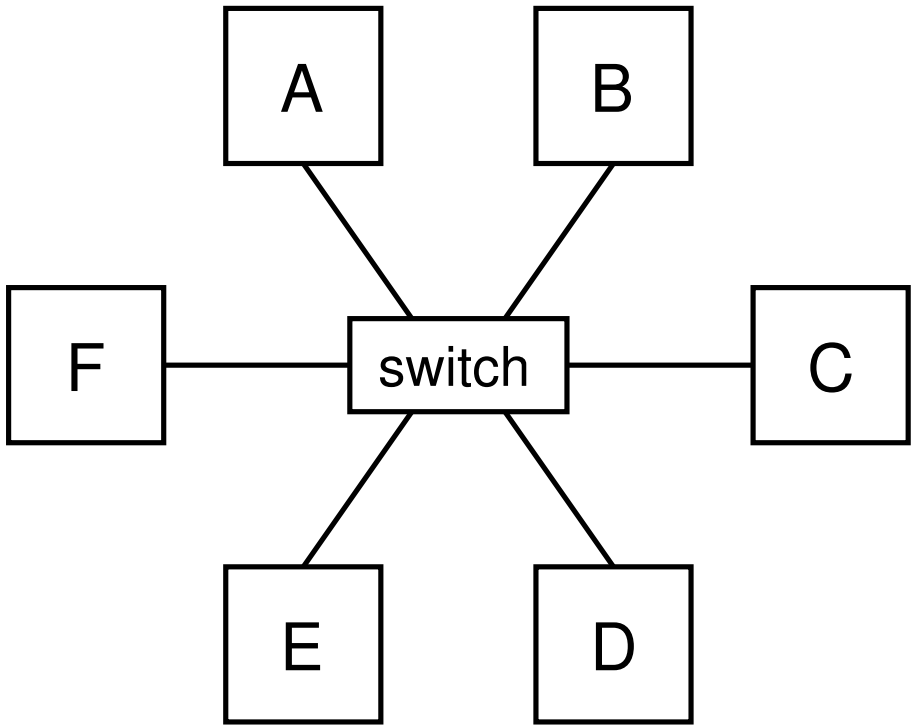
- Ethernet developed for LAN communications in 1970's; standardised as IEEE 802.3 in 1983
- Several competing technologies at the time: Token Ring, Token Bus
- Ethernet became most popular and now most common LAN standard
- Evolution of Ethernet:
  - Ethernet ('73): 3 Mb/s, coaxial cable, bus topology, half-duplex, shared medium
  - Ethernet II ('83): 10 Mb/s
  - Fast Ethernet ('87): 100 Mb/s, twisted pair, star topology with hub
  - Switched Ethernet ('90): 100 Mb/s, full duplex, star topology with switch, point-to-point links
  - Gigabit Ethernet ('99): 1 Gb/s, twisted pair or optical fibre
  - For data centres, MANs and WANs: 10 Gb/s, 40 Gb/s, 100 Gb/s, 400 Gb/s

# Contents

# Switched Ethernet

- Most LANs today use Ethernet in a star topology
- Centre device is called switch (different from a hub)
- Key characterstics of today's LANs:
  - Stations have full-duplex, point-to-point links to switch
  - Twisted pair cable (Category 5 UTP)
  - Data rate: 100 Mb/s or 1 Gb/s (auto-negotiation)
  - PHY standard: 802.3u (100BASE-TX) or 802.3ab (1000BASE-T)
  - Distance: 100 m
  - Random access is *not* used

# Switched Ethernet Topology



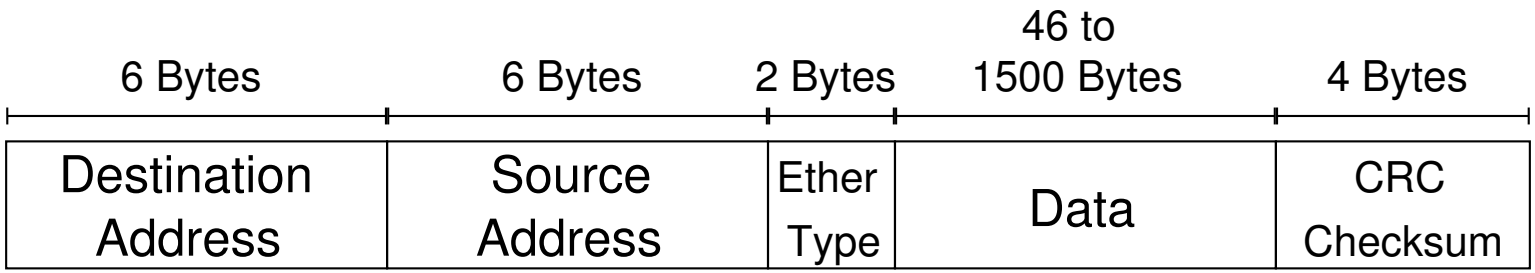

- Stations (hosts, routers) connect via full-duplex twisted pair to switch
- Switch has multiple ports, e.g. 4, 8, 24, 48
- All frames between stations pass via the switch

# Contents

# IEEE 802 Addresses

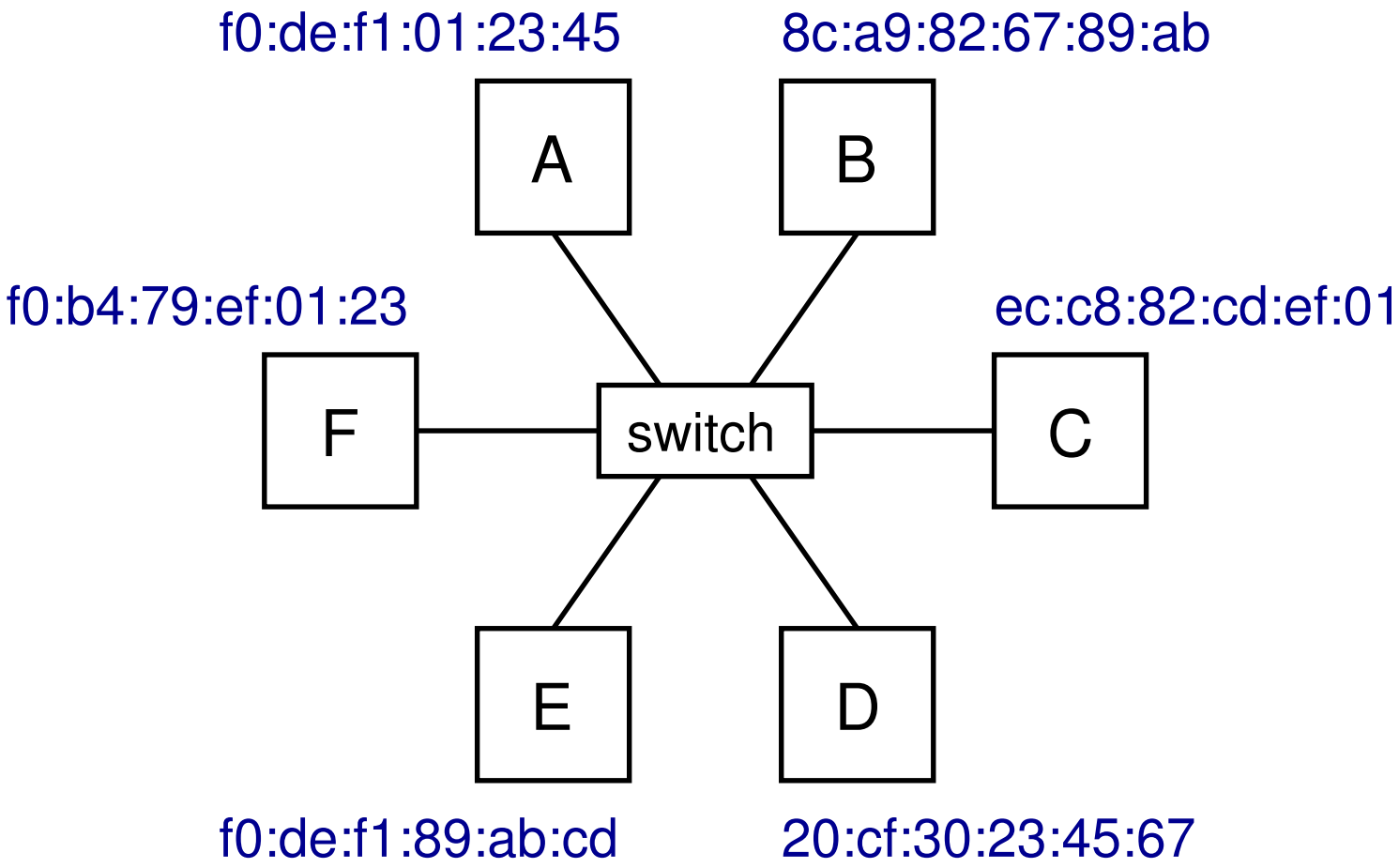
- IEEE 802 standards use common IEEE 48-bit address format
- Commonly called MAC or hardware addresses
- Globally unique (ideally)
  - First 24-bits assigned by IEEE to manufacturer `http://standards.ieee.org/regauth/oui/`
  - Second 24-bits assigned by manufacturer to device
- For simplicity, represented as $6 \times 2$ digit hexadecimal numbers, e.g. `90:2b:34:60:dc:2f`
- Special case broadcast address: `ff:ff:ff:ff:ff:ff`
- Common in other standards: Bluetooth, ATM, FDDI, FibreChannel
- IEEE 64-bit address is alternative format: Firewire, ZigBee, IPv6

# IEEE 802.3 Frames



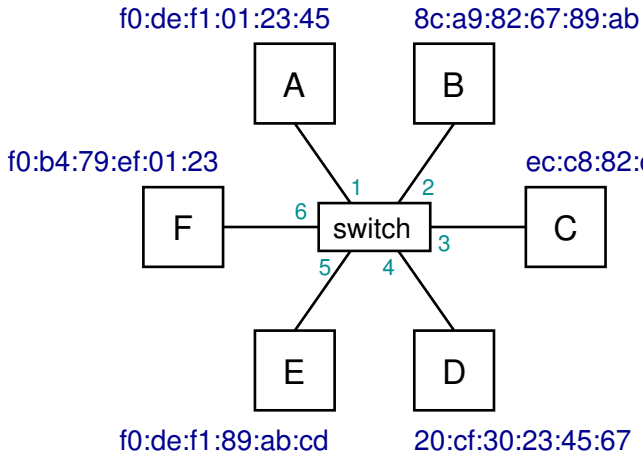

- Typical maximum data size is 1500 Bytes (optional Jumbo frames)
- 1st 8 bytes (preamble, delimiter) sometimes considered part of Physical layer

# Example Hardware Addresses




- Hardware (MAC) addresses are assigned to LAN card by manufacturer
- Each station (hosts and routers) has address for each network interface card

# Example MAC Table used by Switch




**MAC Table of switch**

| *Port* | *HWaddress* |
|---|---|
| 1 | f0:de:f1:01:23:45 |
| 2 | 8c:a9:82:67:89:ab |
| 3 | ec:c8:82:cd:ef:01 |
| 4 | 20:cf:30:23:45:67 |
| 5 | f0:de:f1:89:ab:cd |
| 6 | f0:b4:79:ef:01:23 |

- Switch learns address of station at other end point of link
- Store address and port in memory; used for forwarding frames