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TU Graz

SCIENCE
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TECHNOLOGY

Computer Organization and Networks
Task 3.a

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03.12.2021

Outline

1 Motivation

2 Ethernet Protocol

3 Creating a Network

4 Task 3.a

Previous Tasks

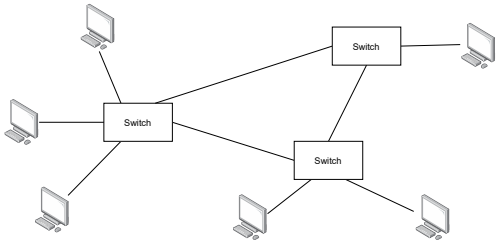
- You built your own hardware and integrated it into a CPU!
- You made your CPU more efficient!
- You wrote a program for your CPU!
- Imagine your CPU inside a computer:
  - How can we connect multiple computers and let them communicate?
  - Let's find out...

How can two (or more) computers communicate?

- Wired connection between devices.
- Define a protocol, valid for every device: Ethernet!
- The Ethernet protocol operates on the link layer (TCP/IP Model)
- Back in the days (1983) Ethernet used a shared medium
- Shared medium is collision-prone

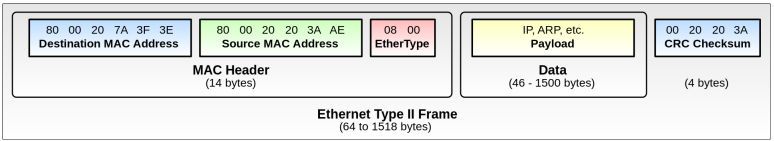
Modern Ethernet

- Network switches are used to connect multiple devices
- Point to point connections between hosts and switches



Frame

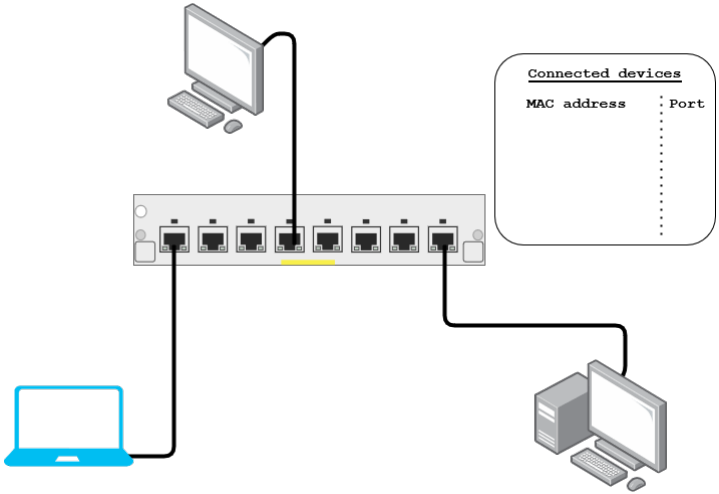
- 6 Byte Destination and Source MAC Address
- 2 Byte Message Type (info about message length or payload type)
- 46 - 1500 Bytes Payload (other protocols encapsulated)
- 4 Byte CRC Checksum



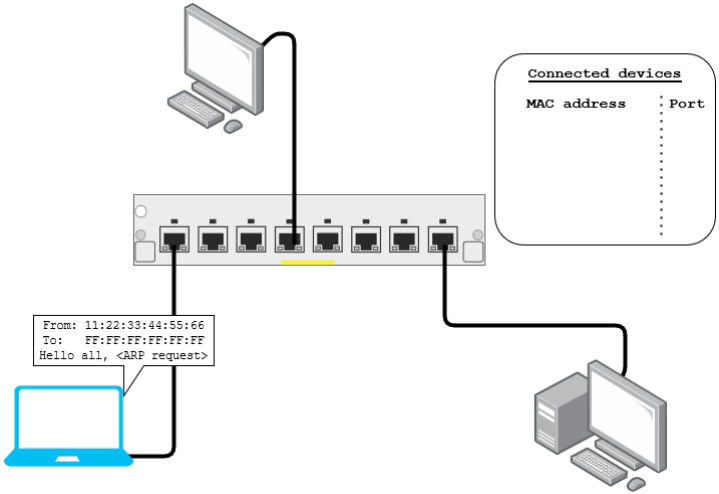
A Switch ...

- ... connects all hosts within a local area network (LAN).
- ... is smart and stores a source address table (SAT), to know which address belongs to which port.
- SAT is filled on the fly:
  - A package with an unknown destination will be broadcasted.
  - The source address and the port of the incoming package will be stored in the SAT.

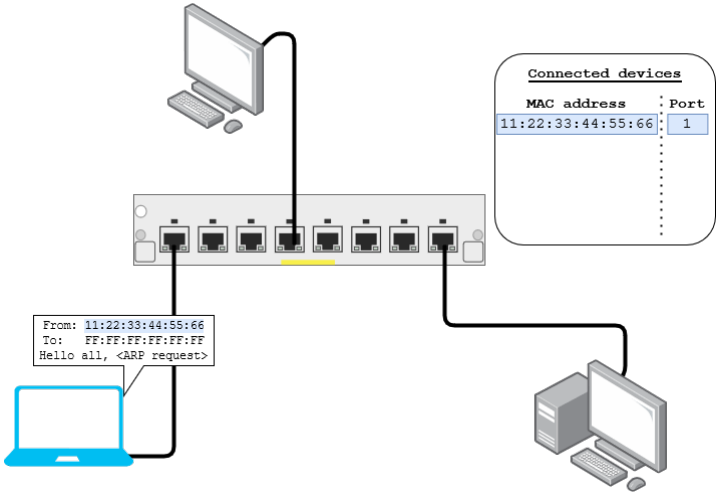
Transfer I



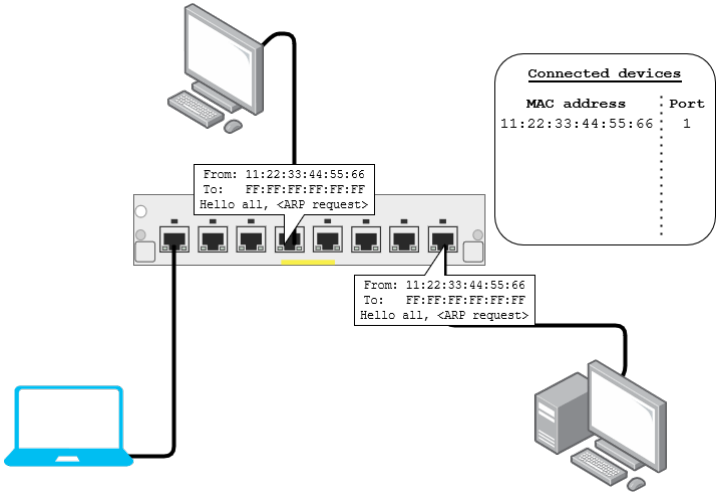
Transfer II


Connected devices
MAC address
Port
From: 11:22:33:44:55:66
To: FF:FF:FF:FF:FF:FF
Hello all, <ARP request>

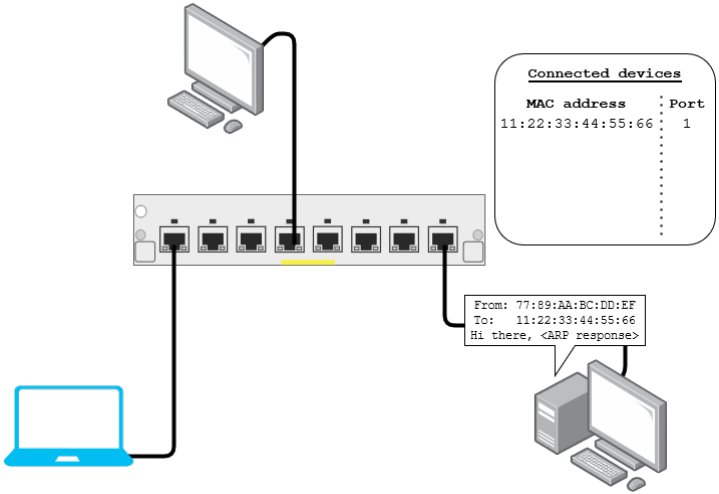
Transfer III



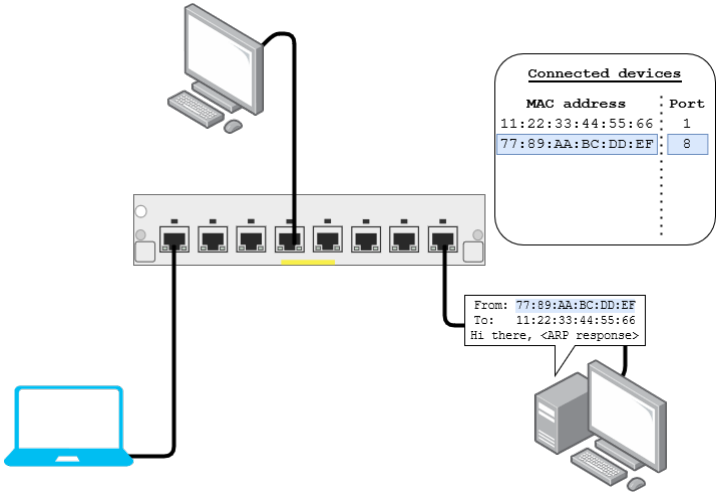
Transfer IV


Connected devices
MAC address
Port
11:22:33:44:55:66
1
From: 11:22:33:44:55:66
To: FF:FF:FF:FF:FF:FF
Hello all, <ARP request>
From: 11:22:33:44:55:66
To: FF:FF:FF:FF:FF:FF
Hello all, <ARP request>

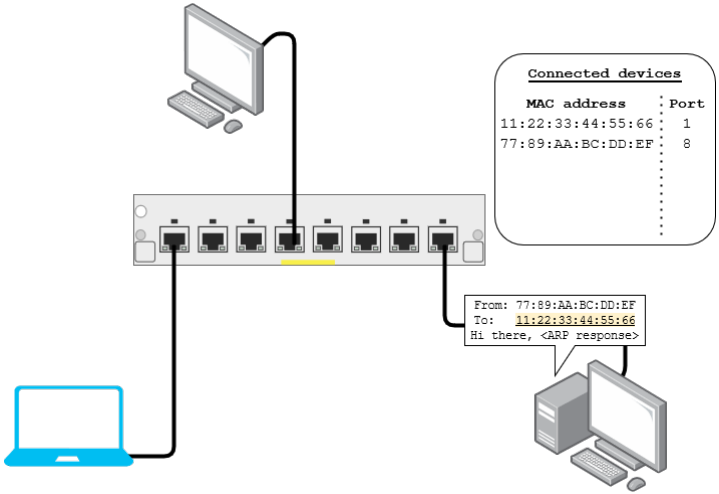
Transfer V


Connected devices
MAC address
Port
11:22:33:44:55:66
1
From: 77:89:AA:BC:DD:EF
To: 11:22:33:44:55:66
Hi there, <ARP response>

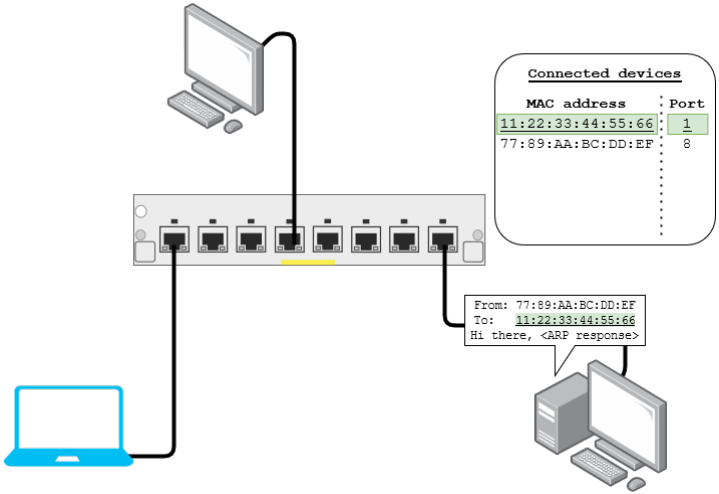
Transfer VI


Connected devices
MAC address
Port
11:22:33:44:55:66
1
77:89:AA:BC:DD:EF
8
From: 77:89:AA:BC:DD:EF
To: 11:22:33:44:55:66
Hi there, <ARP response>

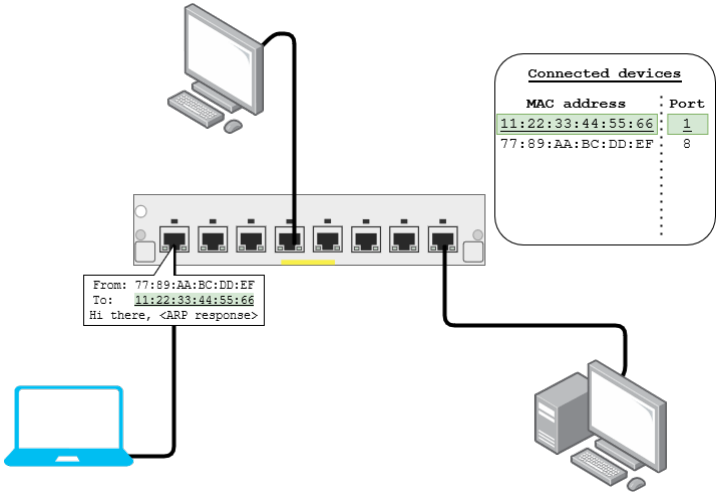
Transfer VII



Transfer VIII



Transfer IX


Connected devices
MAC address
Port
11:22:33:44:55:66
1
77:89:AA:BC:DD:EF
8
From: 77:89:AA:BC:DD:EF
To: 11:22:33:44:55:66
Hi there, <ARP response>

Virtual LAN (VLAN)

- VLANs provide network segmentation within a LAN.
- Each VLAN is an isolated sub-network.
- A host can only be in a single VLAN and cannot unicast or broadcast a package to hosts outside the VLAN.

Framework Hands On

Summary I

- The framework consists of one switch (with your implemented logic) and 8 ports with each port connected to a host.
- Implement `processFrames()` and `set/getPortVLAN()` in `switch.cpp`.
- Add needed variables or datastructures to the `EthernetSwitch` class in `switch.h`.

Summary II

- Process the `receivedFrame` which was received with `getFrame()`.
- Calculate the CRC32 checksum and only forward a package if the checksum is correct.
- Use `queueSend()` to send a frame to a port (only if port is within the senders VLAN).
- Remember source address ports in the SAT.
- Use the framework to manually test your implementation.

Submission

- All relevant files need to be in the `.\task-3a\` directory.
- Add your changes to the file `switch.cpp` and `switch.h`.
- Push your additional `.cpp` and `.h` if needed.
- Add a short description to your `README.md` file.

Good luck and have fun

with the assignment!

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