



**MASARYK  
UNIVERSITY**  
Czech Republic

# **PV198 – One-chip Controllers**

## **Ethernet**

# Content

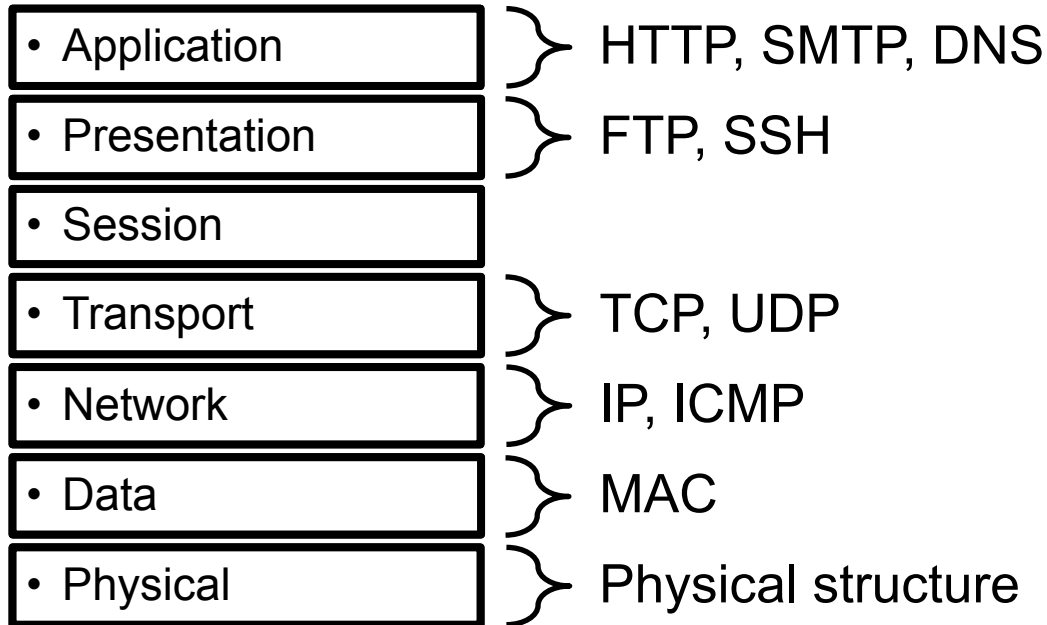
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## What is Ethernet used for

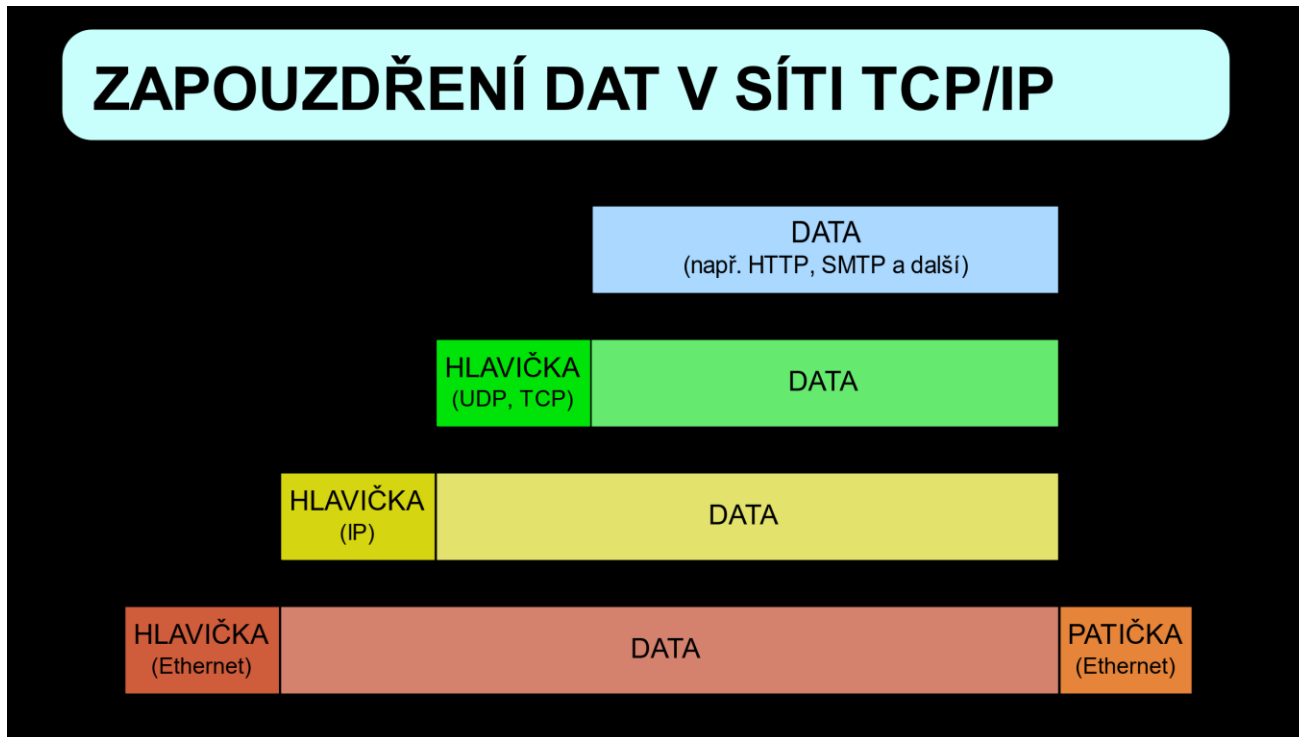
- Connecting embedded devices to a network

## Overview – ISO/OSI Model



# Overview

## ZAPOUZDŘENÍ DAT V SÍTI TCP/IP



By David Mudrák (mudrdmz) - Vlastní produkt, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=5181616>

# Overview – IPv4 header

**Table 50-6. IPv4 header format**

31 30 29 28	27 26 25 24	23 22 21 20	19 18 17 16	15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Version	IHL	TOS		Length			
Fragment ID			Flags	Fragment offset			
TTL		Protocol		Header checksum			
Source address							
Destination address							
Options							

K66 Sub-Family Reference Manual, Figure 50-6.

# Overview – UDP header

**Table 50-11. UDP header format**

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Source port												Destination port																			
Length												Checksum																			

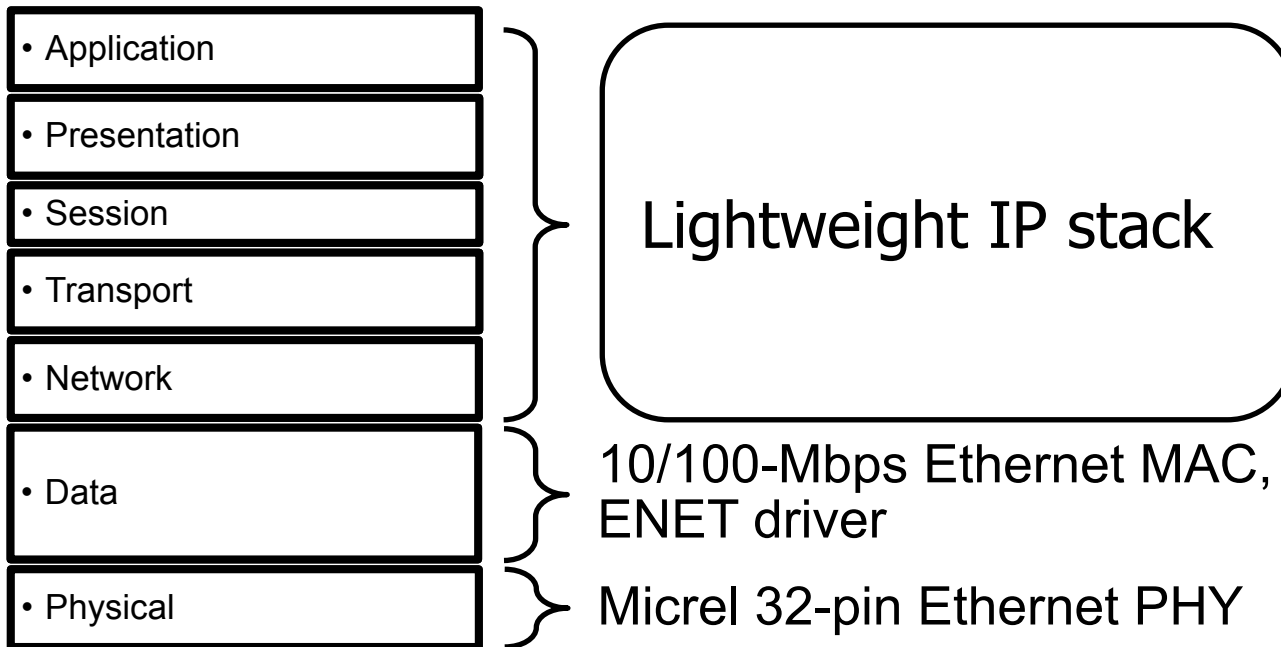
K66 Sub-Family Reference Manual, Figure 50-11.

## FRDM-K66F Ethernet

- 10/100-Mbps Ethernet MAC (ENET)
- Compliant with the IEEE802.3-2002 standard
- Hardware acceleration block to optimize the performance of network controllers providing TCP/IP, UDP, and ICMP protocol services
- CRC-32 checking / CRC-32 generation
- Programmable MAC address



# FRDM-K66F Ethernet



## lwIP

- Lightweight IP stack – [link](#)
- Small independent implementation of the TCP/IP protocol suite – used in embedded
- Features: IP, ICMP, UDP, TCP, DNS, DHCP, and more


## Application – Overview

- The application sends a message to a Database
- Uses UDP packets, InfluxDB and data are shown with Grafana
- When you successfully send a message, it will be visible on a dashboard

## Application – Template

- Contains initialization of pins, clocks, peripherals and lwIP
- Works as UDP echo – when the board receives an UDP packet, it sends the packet back to the sender
- Uses predefined static IP address

## Application – Source Code

- Main:
  - Configure (pins, clocks, peripherals, lwIP)
  - *Send udp packet – your task to implement*
  - Loop:
    -  Receive packets
- UDP Callback:
  - handle received packet – send the packet back to the sender

## Application – Task

- Define your unique IP address (192.168.0.x)
- Implement method in `udpecho_raw.c`:

```
void udp_send_data(const ip4_addr_t dst_addr,
uint16_t dst_port, char *msg);
```

## Homework

Send meaningful data to the database.

E.g.:

- Data from sensor (temperature, pressure, accelerometer, ... )
- Logging information (button pressed, ...)