Introduction to IoT

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Course outline

- Aim and goal
- Lecture organization
- Evaluation
- Managerial stuff
- Content and scope of the course

Aim and goal

- Understand IoT systems architecture
- Overview of commonly used IoT systems‘ HW components
- Basic knowledge of communication busses and protocols commonly used in IoT systems
- Overview of cloud-based IoT support

Prerequisities

- Basic knowledge of
  - computer architecture
  - operating systems
  - OS Linux
- ABC of programming in C/C++
- Minimal knowledge of physics and measurement is an advantage

Course organization

- Focus on lab exercises and hands-on experience
- Lessons to give an overview
- In average 1 lesson covers 2 lab exercises
- Minimizing the obligatory stuff
- Flexibility in lab design
  - KYPO lab MS-Windows stations or BOYD laptops
  - Basic set of modules part of the planned labs, more modules available
  - Extension to bachelor thesis upon request

What Introduction to IoT is About

- Basic properties and interfaces of common sensors
- Basic properties and interfaces of common HMI devices
- Overview of available MCUs from SW point of view (IDE)
- Overview of both internal and external busses
- Interface to cloud applications

What Introduction to IoT is NOT About

- Physics of the sensors
  - Department of physics at Faculty of Sciences
- Electronics design
  - Faculty of Electrical Engineering and Communication Technology
- Sensors with analog output
  - Too close to the physics

Course organization

- Focus on hands-on experience on HW and SW
- 10 + 1 lab exercises
- 5 + 1 lectures
- Free labs or invited lectures in remaining timeslots
- Content not strict, will be influenced by your feedback

Lecture

- 5 topics + introduction
  - IoT peripherals connected via GPIO
  - IoT peripherals connected via a standardized interface (I2C, SPI,…)
  - Interconnection of IoT nodes (RS-485, MODBUS, CANBUS, …)
  - Linux-based IoT nodes
  - Data presentation (MQTT, Grafana, …)

Lab exercises

- 10 labs (2 per topic) + 1 introductory
- No soldering or pin-by-pin cabling needed
- Standalone projects for colloquium
- All necessary SW installed on PCs in KYPO, students' own devices supported as well
- Detailed overview of available HW in lab exercises

Lab exercises

- KYPO lab – room S108
- Access controlled
- KYPO is a lab → **no food and drink allowed inside**
- Physical management of lab equipment still under development → good ideas welcome
- Free openlab days will be managed near end of the semester

Lab exercises

- Room for lab exercises accupied by other event from time to time – reschedule or cancelation needed.
- Schedule irregularities will be announced by e-mail, please chct your e-mail regularly.
- Number of participants on lab exercise limited by room size and number of equipment.
- Moving between lab groups allowed upon mutual agreement of students.

Studying material

Available on the web (is.muni.cz)

- Slides from presentations – commonly after the lesson, slides are still under development
- IDE and supportive SW
- Sample code
- Description and schematics of used HW will be supplemented step by step
- A lot of examples on Internet

Evaluation

- Colloquium
- Standalone project optionaly solved in groups
- Projects will be discussed during the colloquium

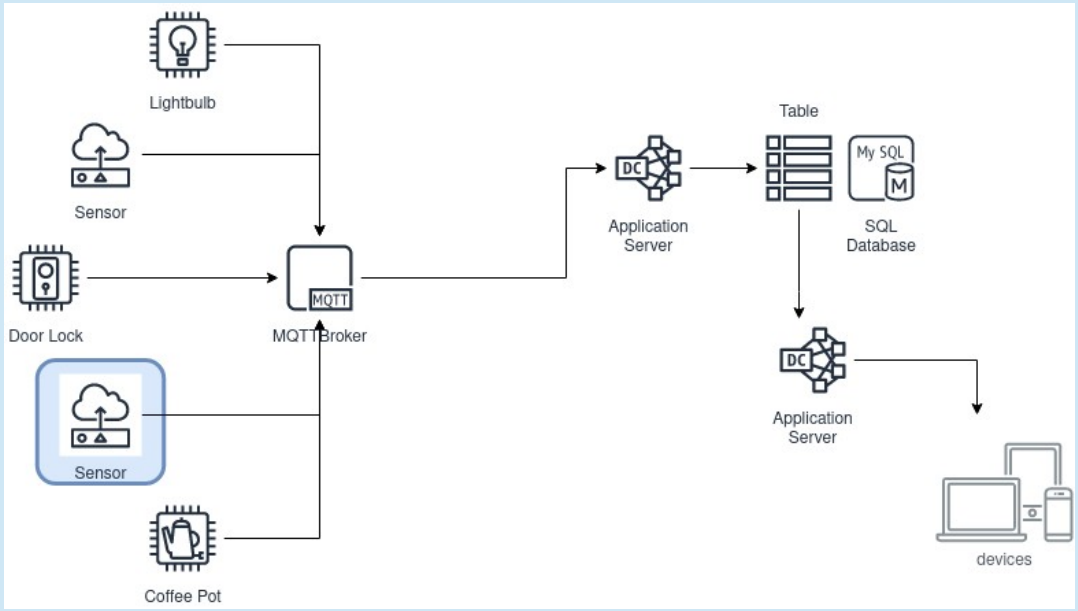
The overall course organization

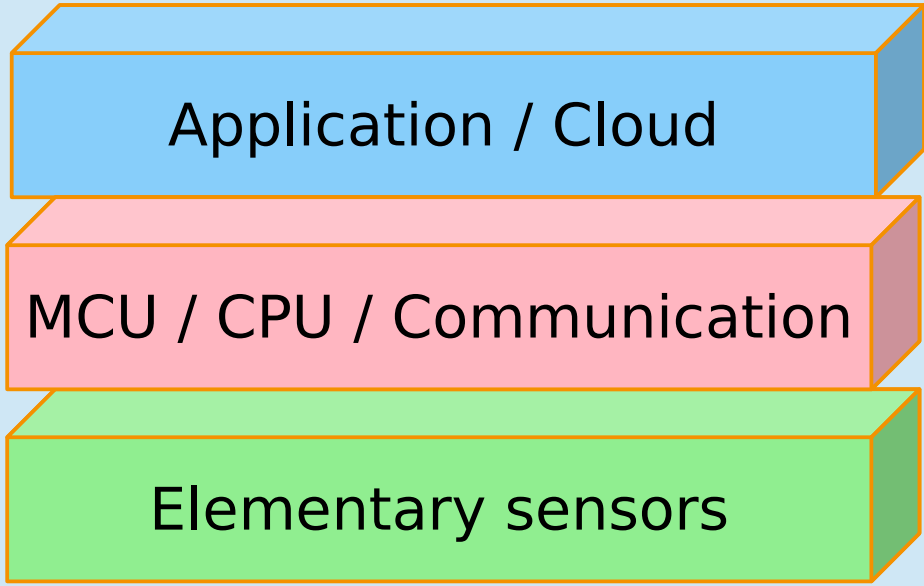
Any questions / comments / requirements ?

Introduction to IoT

What is it the IoT ?

Structure of an IoT System





Structure of an IoT System

Elementary sensors

- Push buttons and switches
- Rotary encoder
- Environment sensing (Temperature, Relative Humidity, Barometric pressure)
- Proximity
- RFID/NFC card readers
- Fingerprint scanners

Output devices

- LED diodes and 7-segment displays
- LCD displays
- OLED
- TFT and capacitive touch screens
- E-paper

Local Data Storage

- uSD
- EEPROM
- FLASH
- eMMC

Internal busses

- I2C
- SPI
- 1-Wire
- UART

MCUs and Singleboard Computers

- Bare metal programmable
  - ARM Cortex M – **STM32**, EFM32, ...
  - AtMega (Arduino)
  - AtTiny
  - MSP430
  - ESP-32
- Singleboard Computers
  - Raspberry Pi
  - **Rock Pi**
  - Orange Pi
  - Anything Pi

External busses

- RS-485 / MODBUS
- CANBUS
- M-Bus
- FlexRay
- UART

Wireless communication

- WiFi
- Bluetooth
- Sub-GHz wireless – 868MHz / LoRa, 433MHz / SigFox, ...
- InfraRed communication

Communication busses

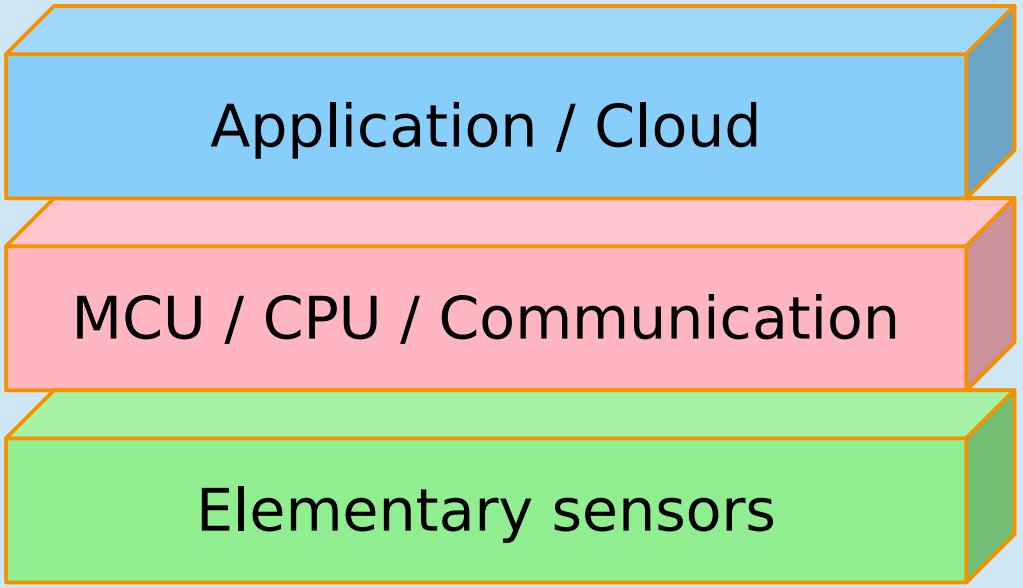
- Similarity with data networks
- Multiple layers: RS-485 / MODBUS
- Similarity with ISO-OSI reference model

Cloud oriented services

- MQTT broker (JSON format)
- Grafana

- Virtual servers at Stratus.fi.muni.cz

Introduction to IoT



Thank you for your attention!

Questions and comments?