

# Home & Building Automation

## Session 2

# Content

- Introduction (IoT & H&B Automation)
- MQTT
- Build your own lock
- NFC

# Internet of Things (IoT)

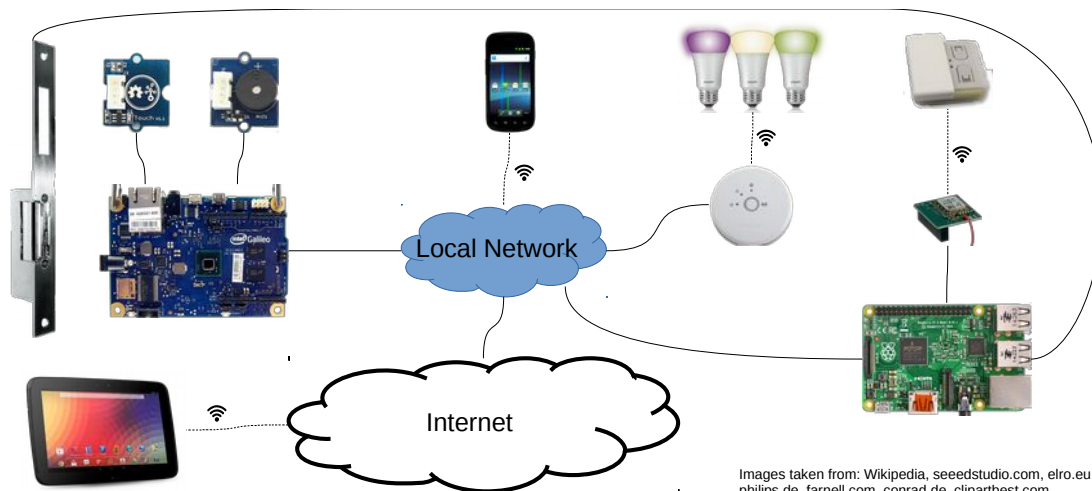
- **Cloud Computing**

- Client/Server
- Distributed computing
- Grid computing
- Software as a network service

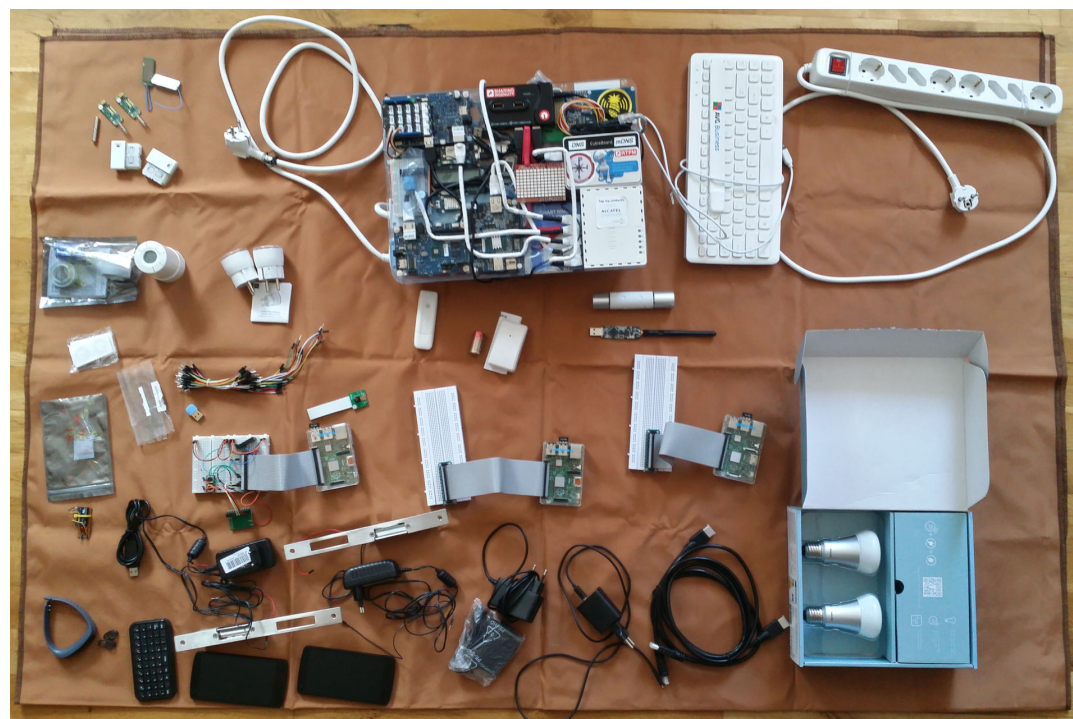
- **IoT**

- Ubiquitous Computing (Pervasive Computing)
- Home automation
- Urban Computing/Smart Cities
- Embedded Computing
- Actor/Sensor Networks
- M2M Communication
- Mobile Computing, Wearable Computing
- (Hacking/Making)
- Big/Actionable Data

→ **Connectivity and data**



Images taken from: Wikipedia, seedstudio.com, elro.eu, philips.de, farnell.com, conrad.de, clipartbest.com



# H&B Automation

- What does the term entail?

# H&B Automation

- What does the term entail?
- Answers: Security, Privacy, Protection, Configurability, Flexibility, Stability, Connectivity/Networking, Automation, Efficiency (Energy, Work, Convenience), Synergy, Integrability, Pervasiveness, Comfort, Transparency
- Services: Lighting, Switches, Heating, Physical Access, Entertainment, HVAC, Traffic Control/Guidance, Information, Backups, Monitoring, Remote Access

# H&B Automation

Residential and commercial buildings should provide an ideal environment for all activities in them ...




**Comfort**



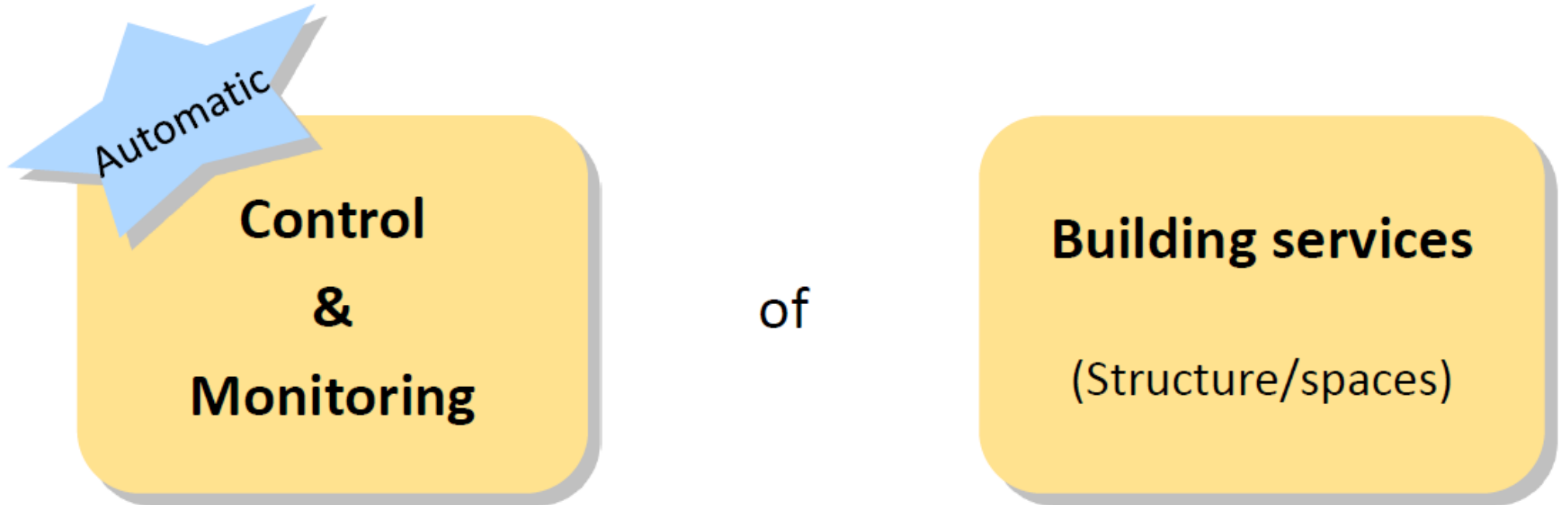
**Protection**

... at minimal expense!



**Efficiency**

# H&B Automation



Direct interaction with the environment

Goal: More and more “intelligent” buildings!

# Homes vs. Buildings

- Fundamental tasks are identical
- Larger uniform units in functional buildings
  - Increased mechanization and automation becomes economical
  - Automation technology applied more comprehensively
- Differences regarding motivation
  - Users “at home” more likely to consider financial impact of their actions
  - Choose individual level of comfort/peace of mind (security/safety)
- Challenges in construction/operation of small residential buildings
  - Organization, skills, cost



# Requirements for Building

- Provide an ideal environment
  - For various activities
  - Varies according to purpose
  - Office, factory, swimming pool, ...
- Appropriate environmental conditions
  - Humans: Comfortable (productive/relaxing)
  - Machines/goods: Temperature, humidity, avoid condensation, solar radiation
- Supporting structure and facilities
  - Stairways, corridors, sanitary facilities, ...
- Protection against hazards and threats

# Building services

List from Unifomat D - Services  
= „Catalogue“ of functional elements in a  
building(e.g., for cost estimations)

- **Conveying**  
Elevators, escalators, moving walks, ...
- **Plumbing**  
Domestic water distribution, sanitary waste, rainwater, natural gas, ...
- **HVAC**  
Heat generation, refrigeration, HVAC distribution,  
instrumentation and controls, ...
- **Fire protection**  
Sprinklers, ...
- **Electrical**  
Service and distribution, interior/exterior lighting,  
communication and security, ...

cf. DIN 276-1  
cf. ÖNORM B1801-1  
(building costs)

# Heating, Ventilation, Air Conditioning (HVAC)

**Supply and remove heat**

**Ventilation**

Free or mechanical

Humidify / dehumidify

Clean / filter

Centralised / decentralised handling

Different requirements: room/stairs, sunny/shady side,  
occupied/not occupied, ... ▶ zones

# Lighting and Shading

Blinds: protect against glare, brightness, heat

Switching/dimming; drive motors

Motion detectors, presence detectors;  
Lux sensors, wind sensors

Daylighting

Switchable (translucent/transparent) and  
electrochromic glazing („smart windows“)



# Security and Safety

## Protect people and property

- Access control, danger alarms, fire-fighting measures
- Local alarms (klaxons, pre-recorded announcements, evacuation routing, ...) and remote alarm



## Protect against malevolence (security)

- Glass breakage detectors, motion sensors
- Turnstiles /revolving doors, authentication
- Surveillance cameras (CCTV)
- Guard tour systems

## Protect against negligence/force of nature (safety)

- Fire protection/alarms (smoke, heat)
- Fire dampers/doors, smoke extraction, sprinklers
- Gas sensors (CO), water detectors (in raised floors)
- Emergency lighting
- Social alarms



# Security and Alarms

- Ability to
  - 1) detect intrusion/threat (sensors)
  - 2) raise alarm (actors)
  - 3) open/lock access (actors+sensors) for doors and windows
  - 4) interact remotely

# Security and Alarms

- Sensors

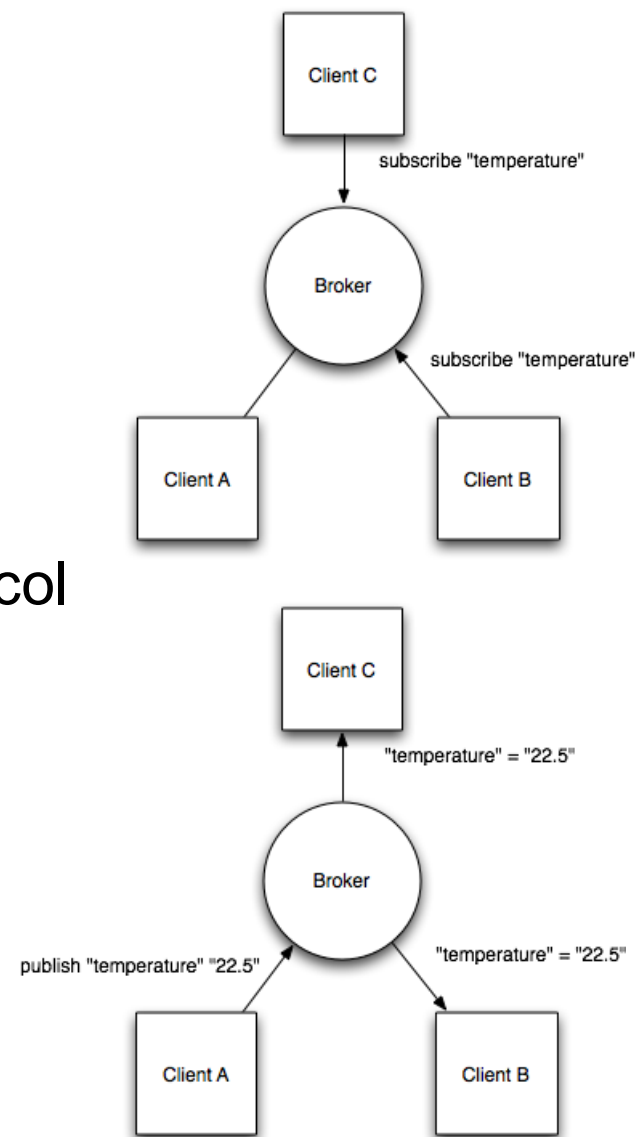
- Motion, Light Gate, Camera, Microphone, Pressure, Temperature, Light Intensity, Humidity, Wifi/Bluetooth Strength Analysis, Smoke, Presence, Acceleration, Gyroscope, (Kinect – 3D Presence)

- Actors

- Lights, Speakers, Motors (Windows, blinds), Locks, AC/Ventilation Units, Sprinklers, SMS Sender, Screens (for messages)

# MQTT – M2M Communication

- MQ Telemetry Transport or Message Queue Telemetry Transport
- MQTT Gateway/Broker, star topology
- Publish Subscribe (Listener, Observer Pattern)
- ISO standard, Invented in 1999
- Runs over TCP/ any other stream-based protocol
- Very lightweight  
→ runs even on slow Pis and routers
- Many implementations
- Built in security
  - Allows layered security/stacked gateways
  - User access management
  - End to end encryption possible





# Connect Lock To Wemos D1 Mini

- Wemos → gpio-port → relais
  - define output
  - challenge: do with servo motor
- 12V power adapter → lock → relais
- Use mqtt to control
  - from command line
  - from mqtt app in phone (mqtt dashboard)
  - from a small python program

# NFC

- Follow public manual on linked Google drive
- Remember to enable SPI on pi (raspi-config)
- Run test
- Extend test to mqtt driver (data readable via mqtt)
- Connect lock and NFC (open, when specific tags are read)