Monitoring Technologies

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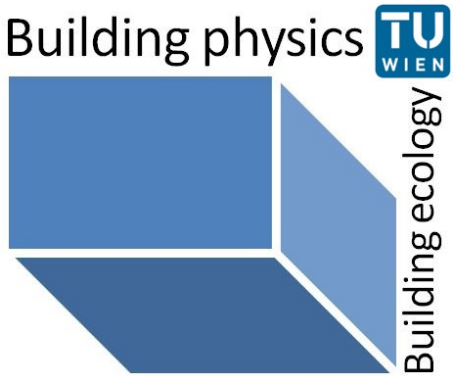
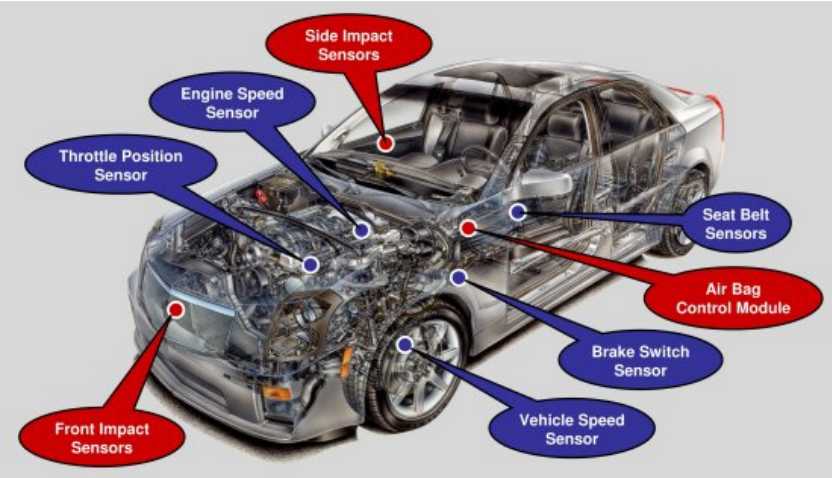


Monitoring - Stand der Dinge?



Use Cases - Monitoring

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Interest groups:

- **Building owner**, **facility manager** (building manager, maintenance person, etc.), **occupant** (daily user, guest, etc.)**, energy provider**, **energy producer**, **goverment** (funding, etc.), ...

Increased **awareness** of **user** regarding their impact on the building performance

- Give **suggestions** (open windows this night, etc.)

Planned/**Preventive maintenance**

Building **system optimization** (energy use, user comfort, etc.)

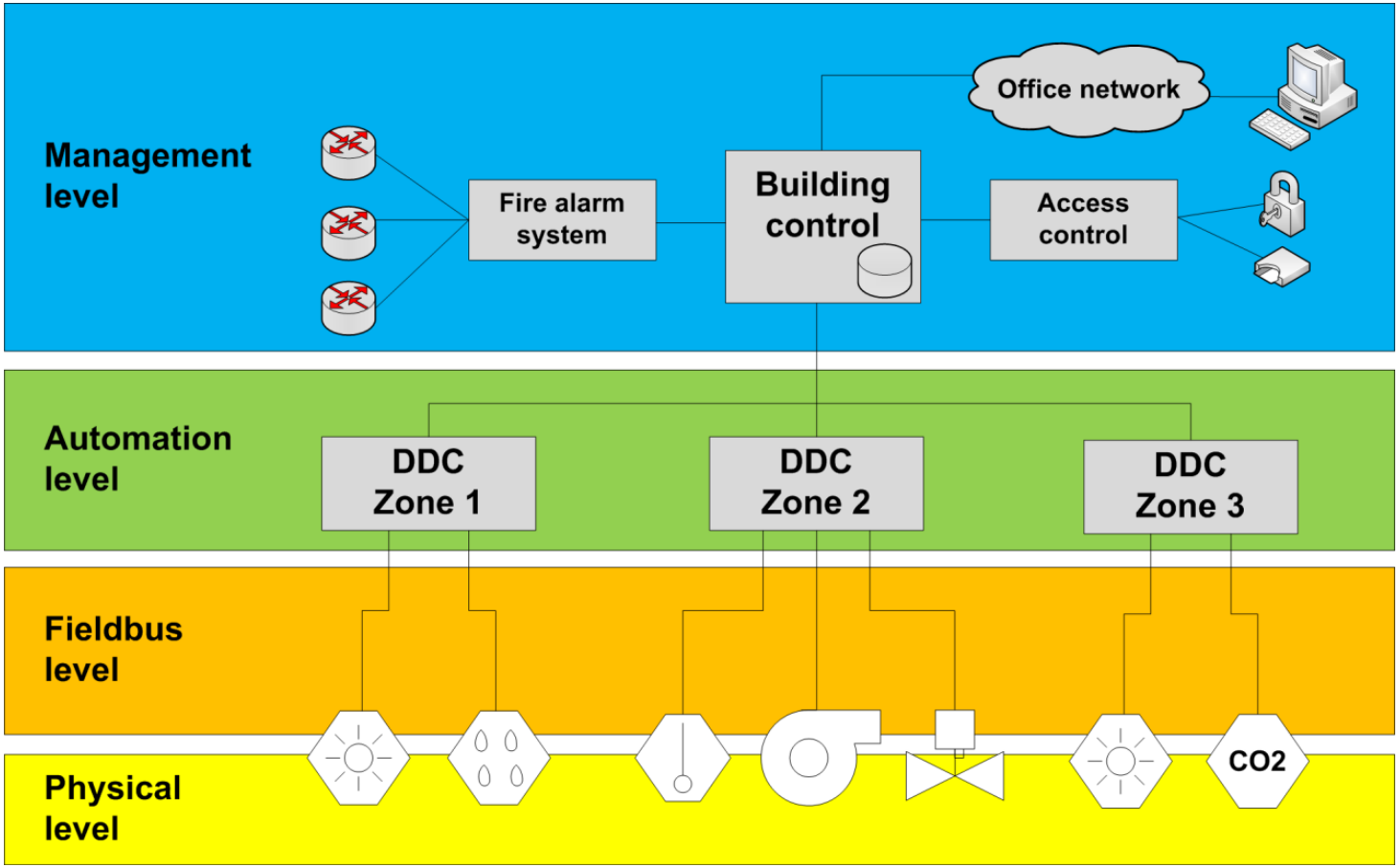
- Legacy control (optimize set values, etc.)
- Advanced building control (simulation based algorithm, etc.)

Early **detection** of deficies and (complex) **malfunctions**

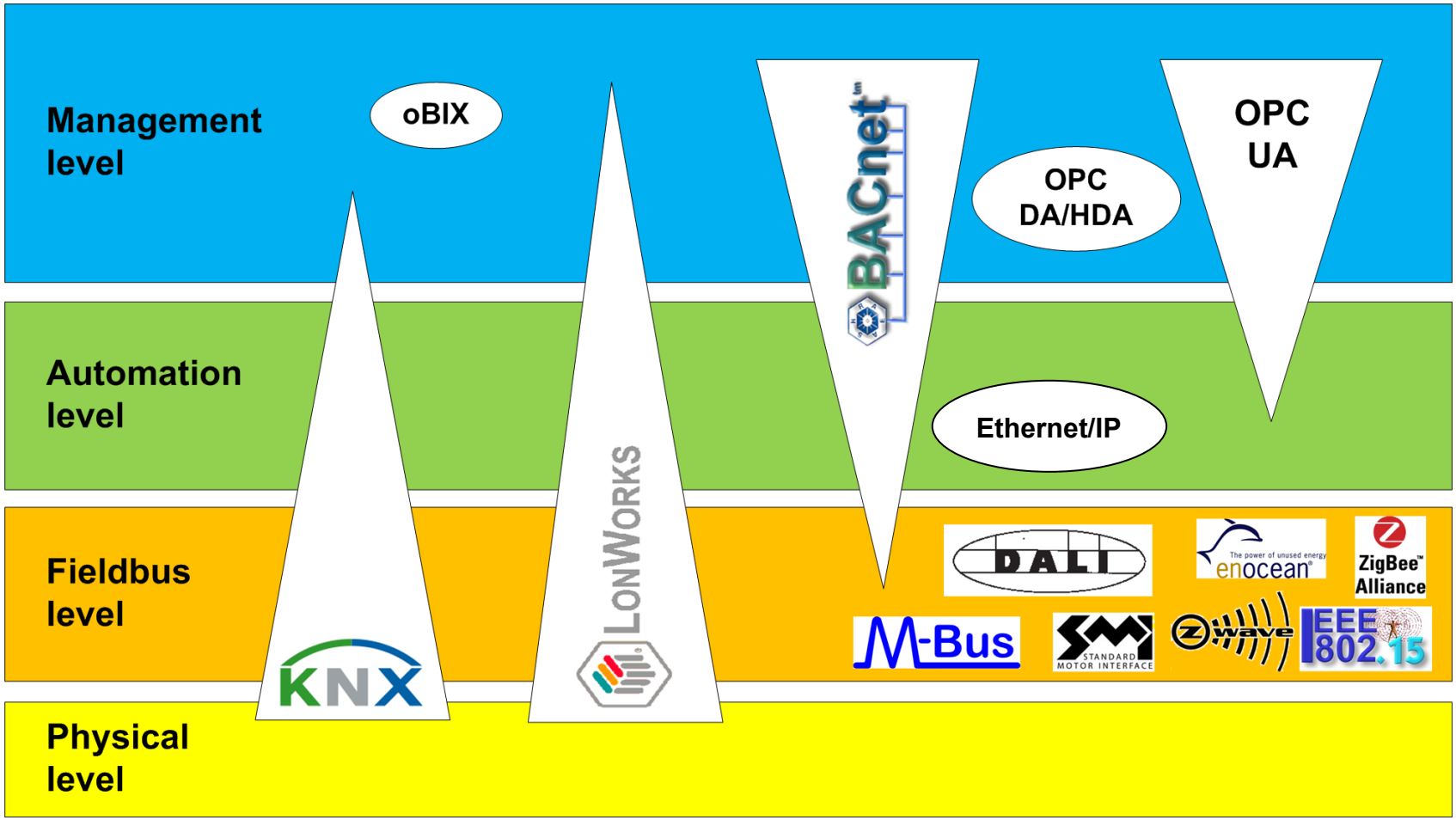
Long-term accumulation on buildings performance

Generic Four Layer Model

- Four layer model of a generic building (control) system

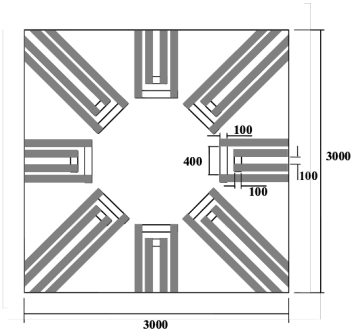


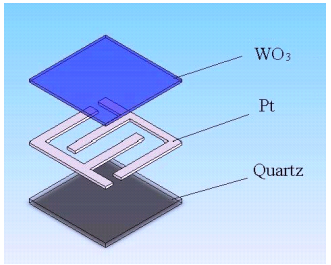
Four Layer Model - Technologies



Physical Level – Sensor Technologies

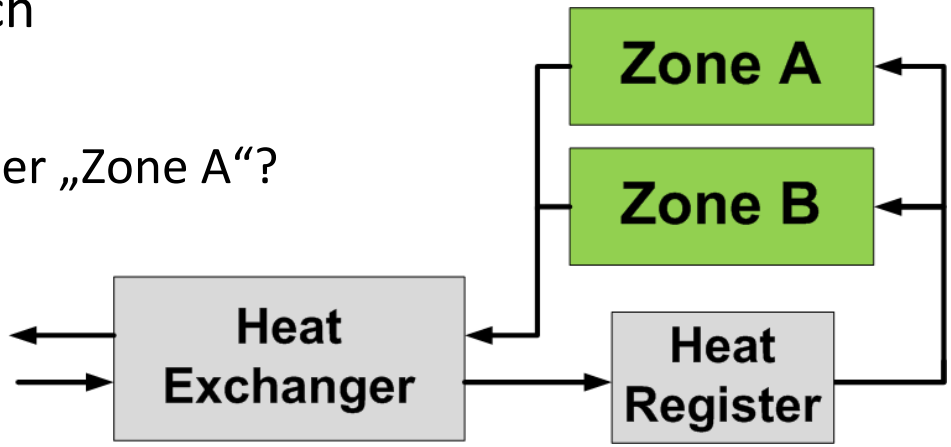
- Sensor technology evolution
  - Integration
  - Power consumption



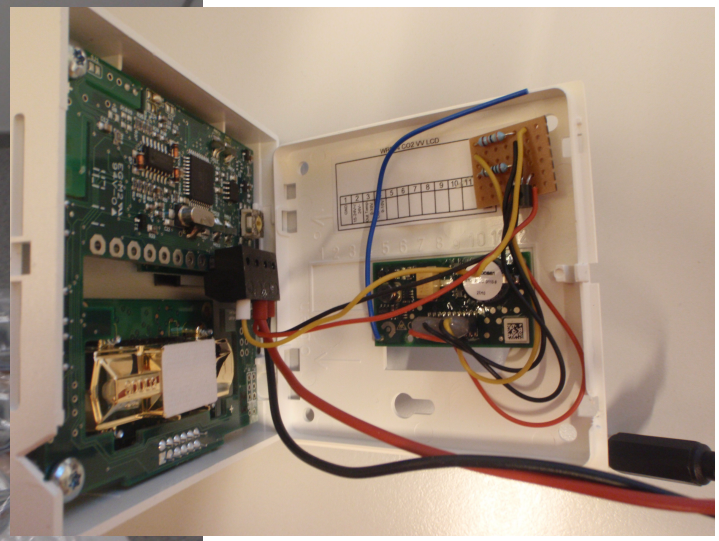


- Energy (Electricity, Heat, etc.)

- Metering approach
  - Example:
    - How to meter „Zone A“?



Physical Level – Sensors



Fieldbus Level

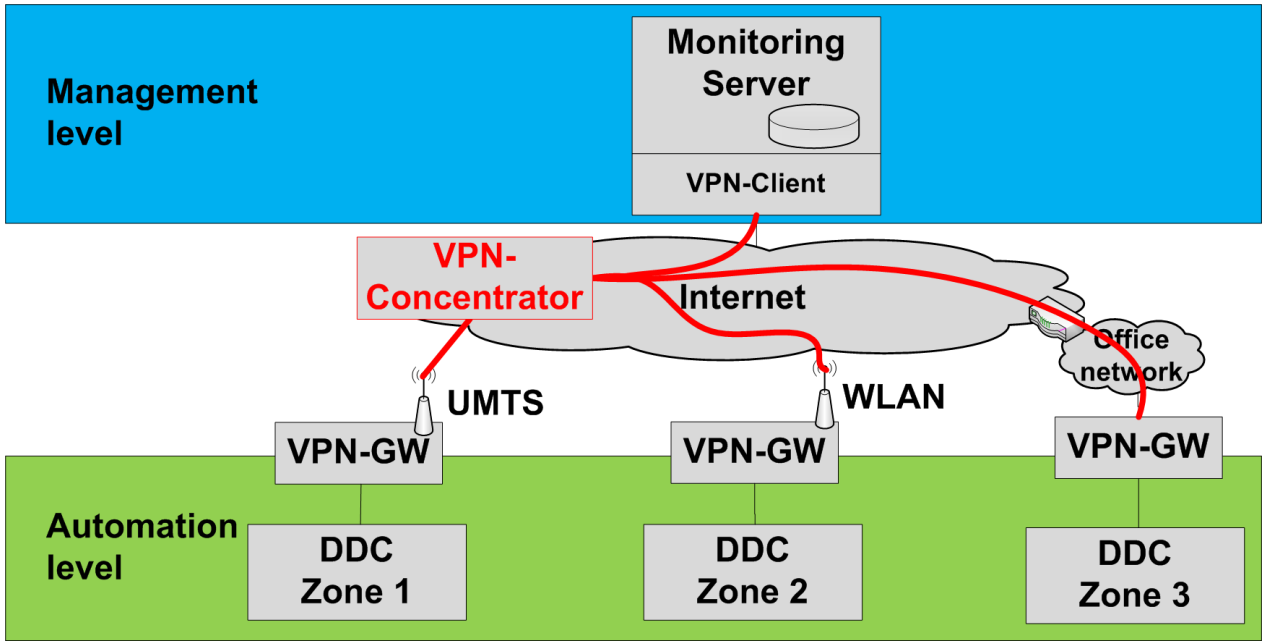
- Measurement collection/transfer
  - **Manual reading**

  - **Data logger**
    - „Post“ fault detection
    - Periodic reading required

  - **Fieldbus**
    - Runtime data collection / processing / fault detection
    - Wired / wireless?
    - Power supply?
    - Event triggered / periodic?
    - Proprietary / open standard?
    - M-Bus, KNX, LonWorks, ZigBee, Enocean, etc.

Automation Level

- BACnet, KNX, LonWorks, OPC UA
- Ethernet/IP
  - Remote → Virtual Private Network (VPN)
- **1 year** (hourly measurement) – without overhead!
  - 4 byte x 24h x 365 days = 35 kByte = **0,035 Mbyte**



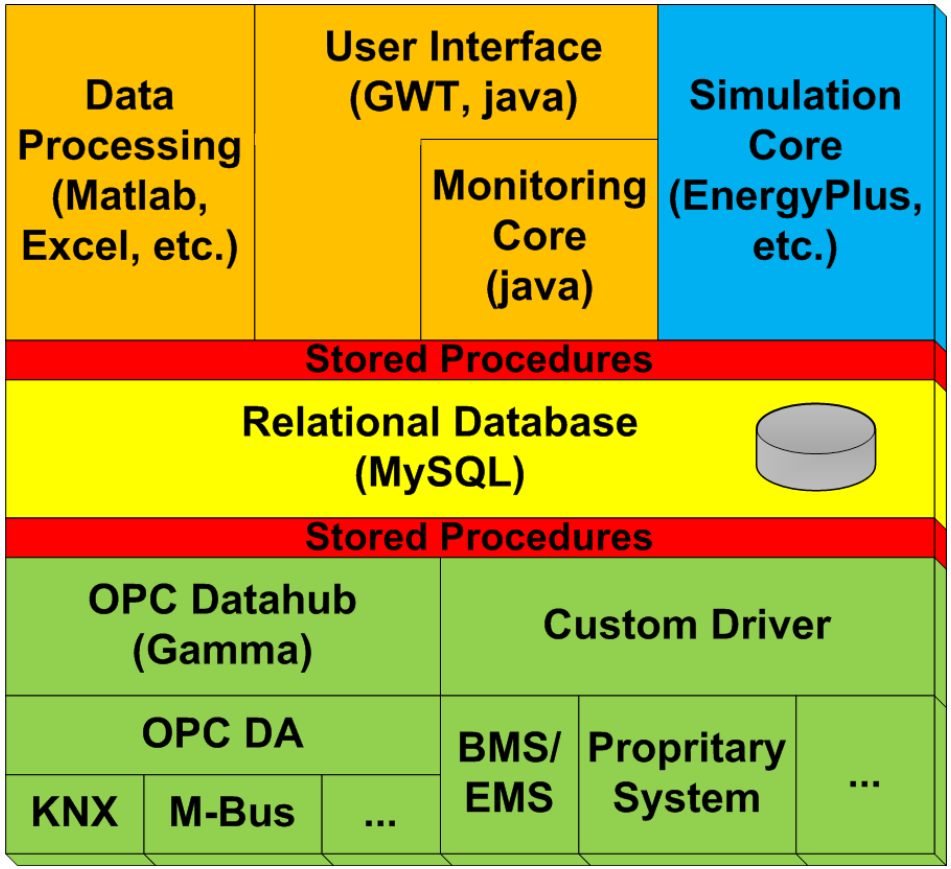
Management Level

- From **excel sheet** to **database**
  - Technology/Vendor independent?
  - **Interfaces?**
  - **History?** - Relational Database, „Data Warehouse“, NoSql, etc.
  - Data preprocessing?

- OPC
  - OPC DA / OPC HDA – Windows only, limited „networking“
  - OPC UA – OS independent, „networking“ supported
- BACnet/WS
- (oBIX)
- Many proprietary solutions!!

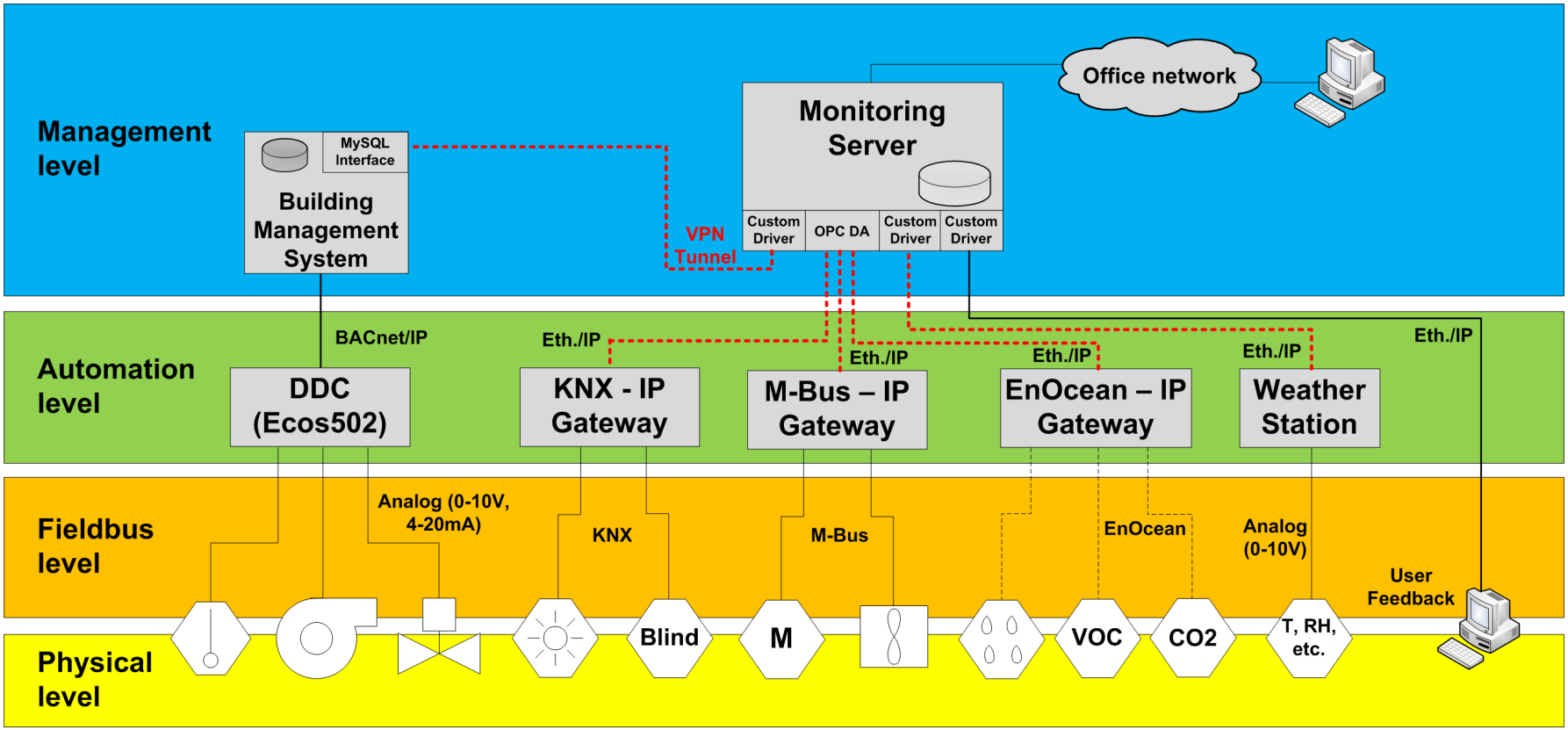
Management Level – Example

- **Data processing**
  - Excel / Matlab / ...
  - Java framework
  - Simulation (ex. EnergyPlus)
- **Data storage**
  - Data preprocessing
  - Performance
- **Connector**
  - OPC DA (M-Bus, KNX, etc.)
  - ODBC (SQL)



Example I

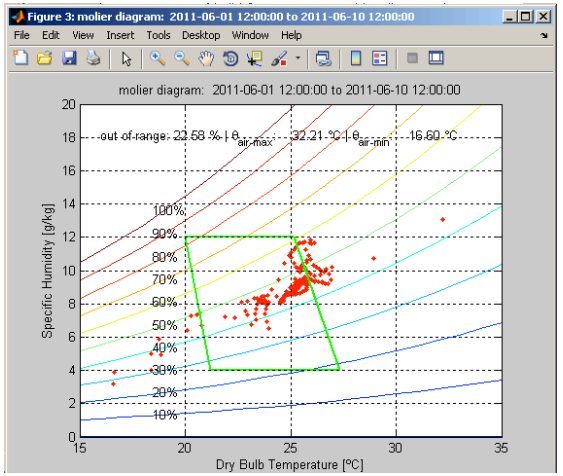
- **Reuse building automation infrastrature!!**



Management Level – Data Processing I

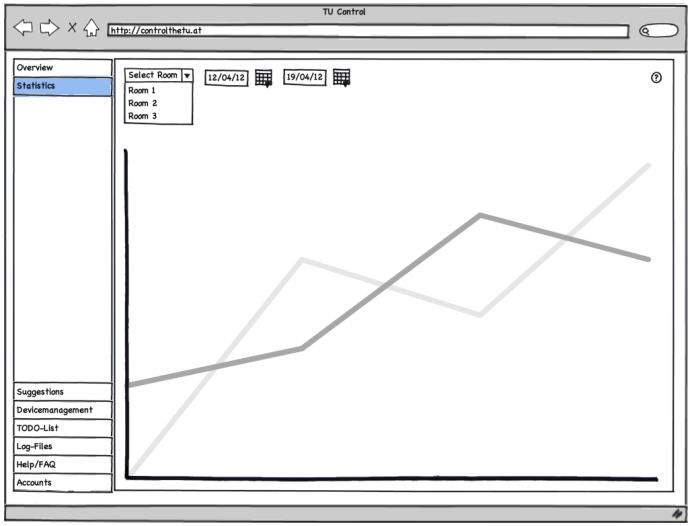
- **Virtual Datapoints**
  - Energy consumption of zone
    - *getPeriodicValues(energy10, starttime, endtime, period)*
  - Values are calculated on request

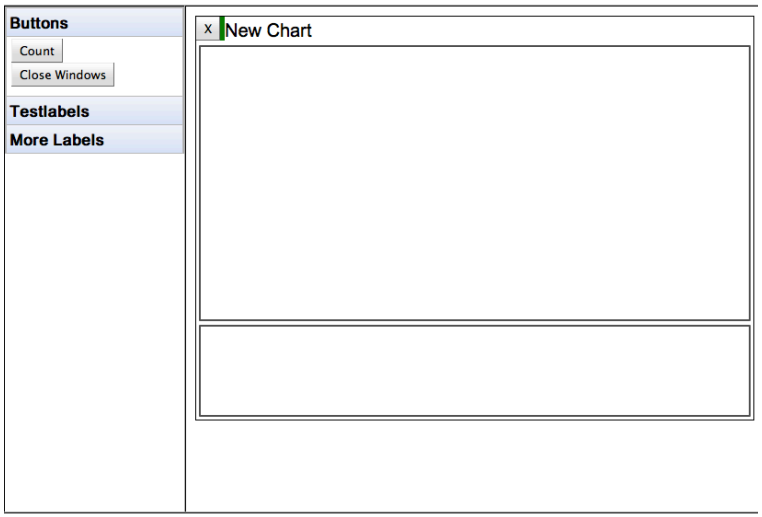
- **Excel** import
- **Matlab framework**
  - Mollier diagram
    - *plotMollier(zone10, starttime, endtime)*
  - Statistic functions
  - Complex requests – ex. energy consumption of zone when occupied



Management Level – Data Processing II

- **Java framework**
- **User Interface**
  - Use case = module
- **Building model calibration**
  - EnergyPlus

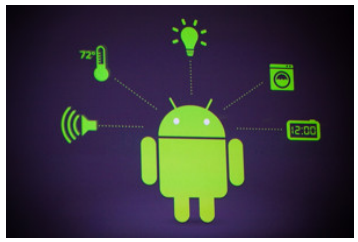




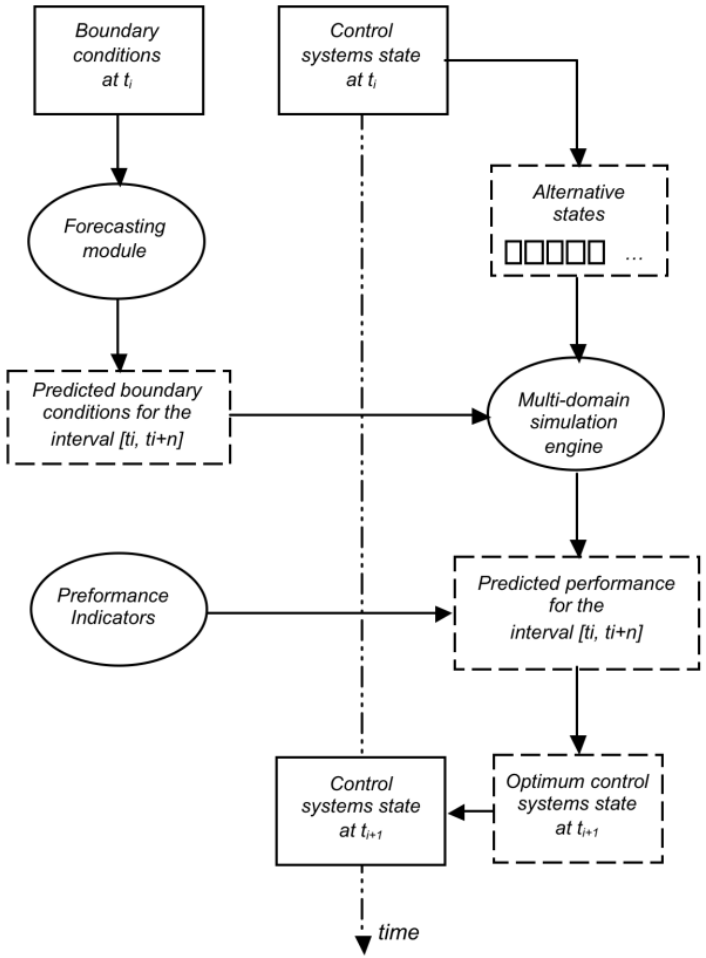
Future - Technologies?

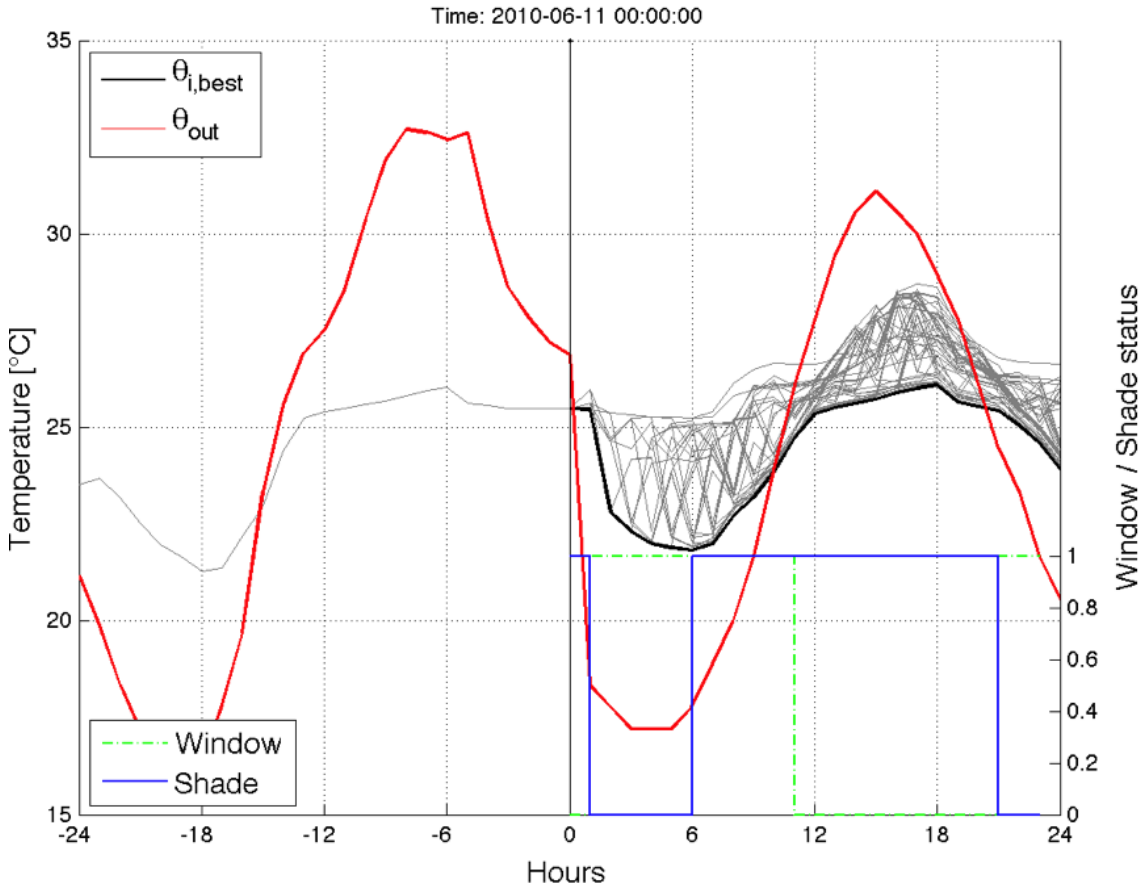
- Physical Level
  - Integration?
- Fielbus Level:
  - 6LoWPAN - IPv6 low power?
- Automation
  - Ethernet/IP, OPC UA?
- Management
  - OPC UA, BACnet/WS?
  - Custom db, data (pre)processing?
  - Use IT (virtual machine, etc.)!
  - Many use cases / big potential!!

- Big player
  - Android@Home?



Future – Use Cases?





Monitoring - Team

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- http://monitoring.bpi.tuwien.ac.at

- Prof. Ardeshir Mahdavi
  - Project leader
- Robert Zach
  - System architecture, fieldbus + automation level, connector
- Rainer Bräuer
  - Data preprocessing, database design, Matlab framework
- Stefan Glawischnig
  - Use cases, data processing, java framework, GWT
- Michael Hönisch
  - Use cases, data processing, java framework, GWT
- Regina Appel
  - Use scenarios, user interface design