Universität Rostock
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Institute of Applied Microelectronics and Computer Engineering

A model based development approach for building automation systems

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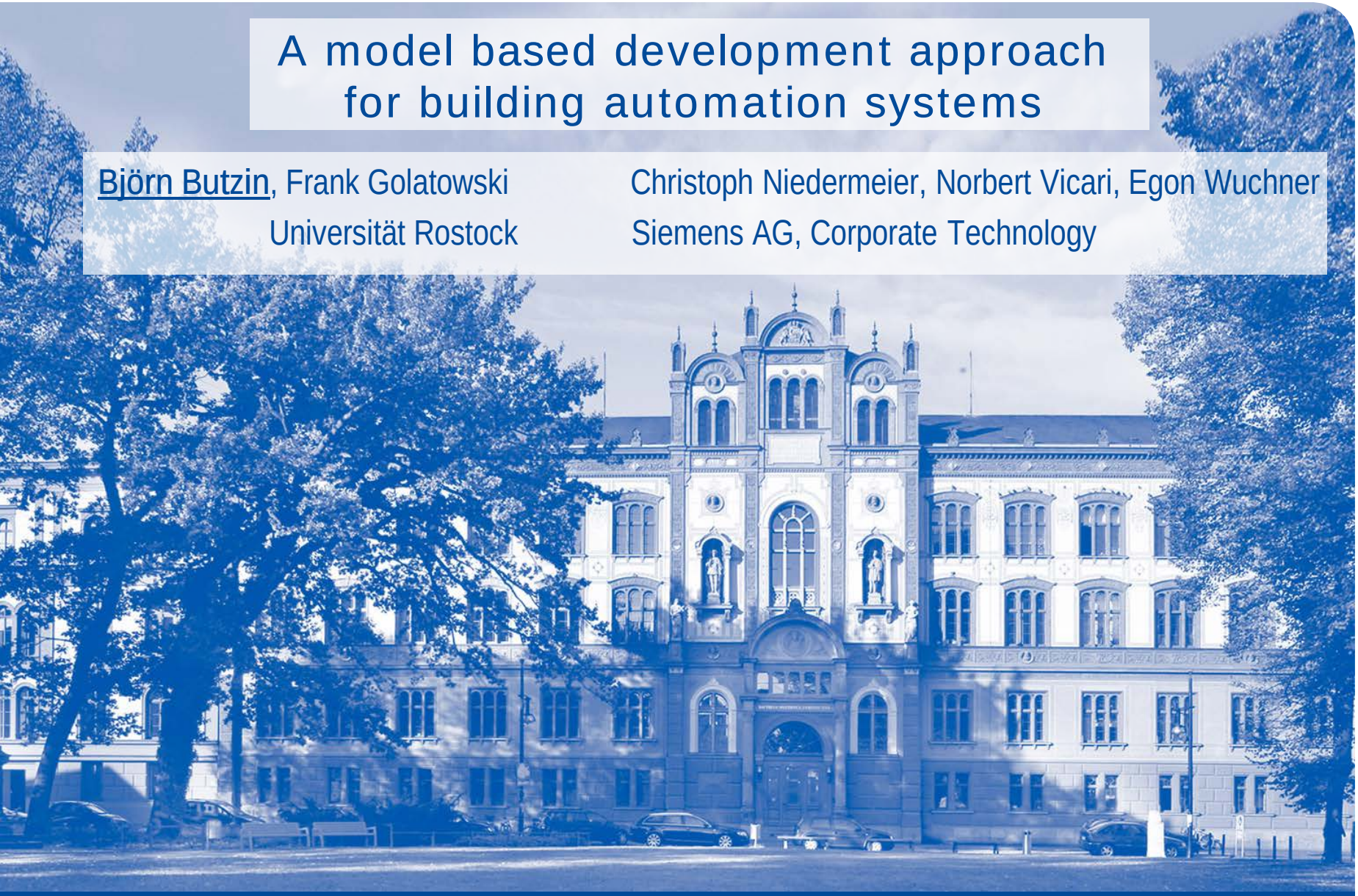

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The Project

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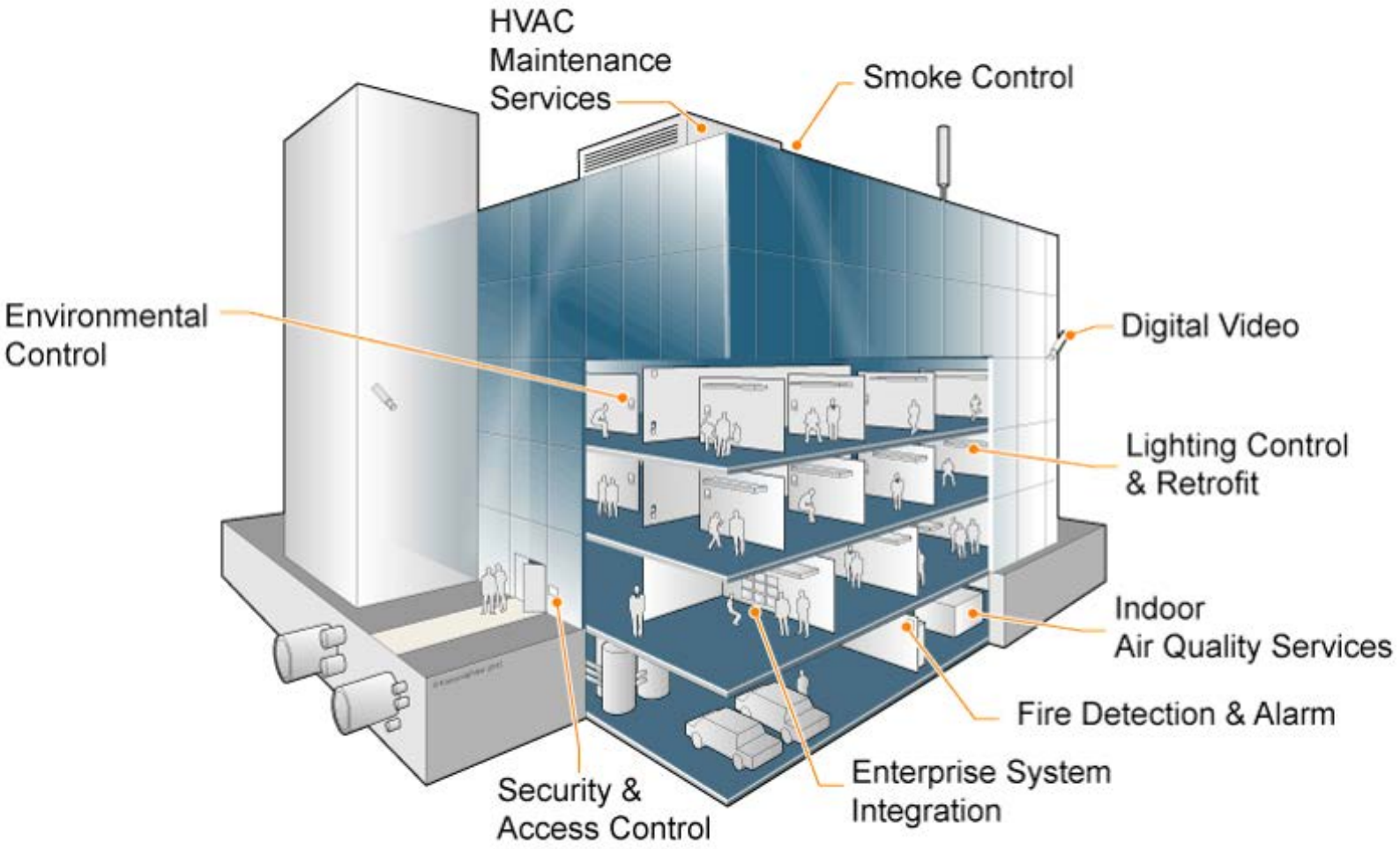
What is building automation?



Source: http://baas-itea2.org/

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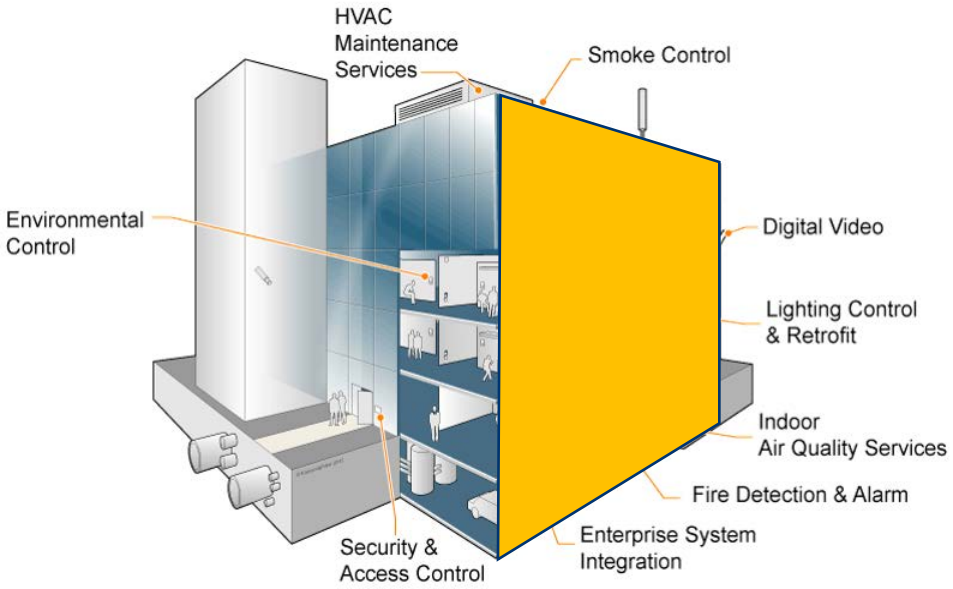
What is building automation?

Building automation

- Distributed control system for networking devices
- Monitoring and control of appliances



Home automation

- Extension for residential building automation
  - Comfort
    - Housework
    - Multimedia
    - Pet feeding
  - Energy efficiency

Source:us.123rf.com

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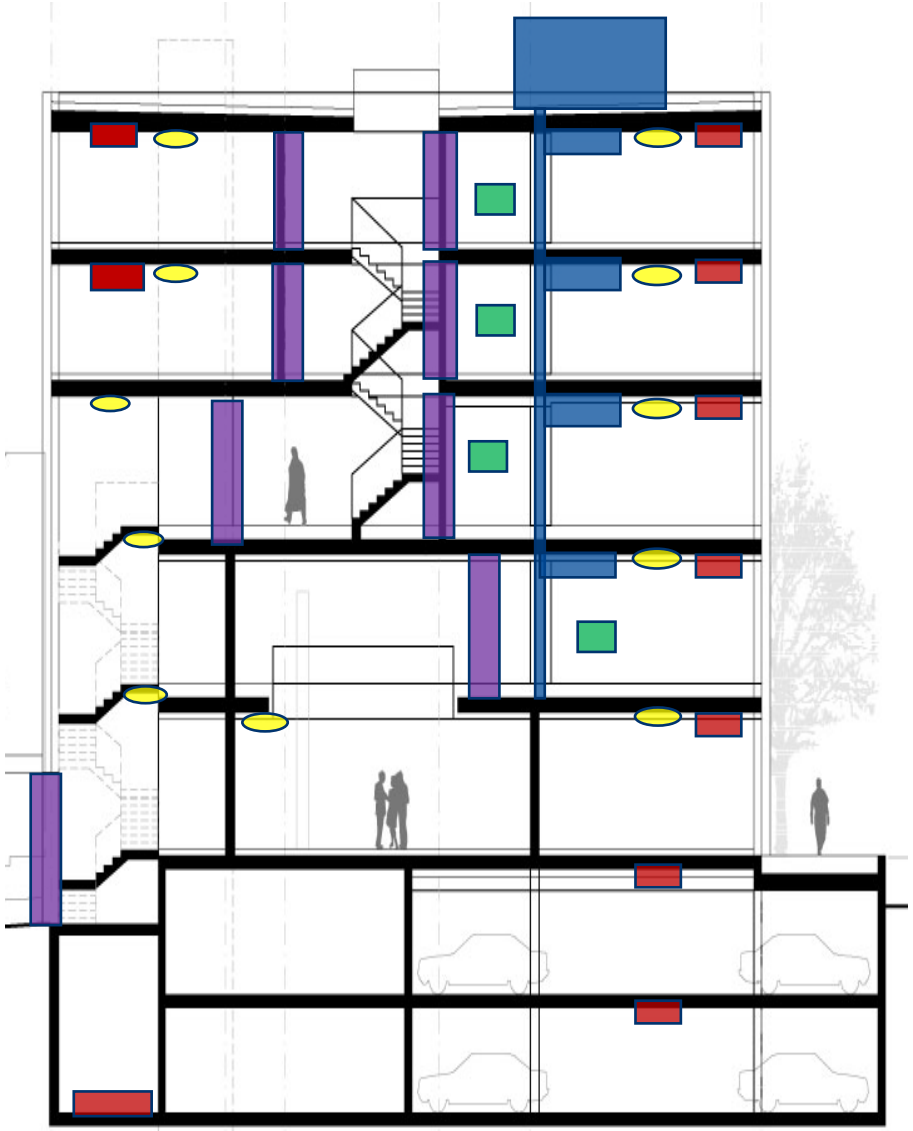
Problem: separated sub domains



Source: http://www.swiss-architects.com/projects/projects_detail/2433

Fire, flood and life safety

Heating, ventilation, airconditioning

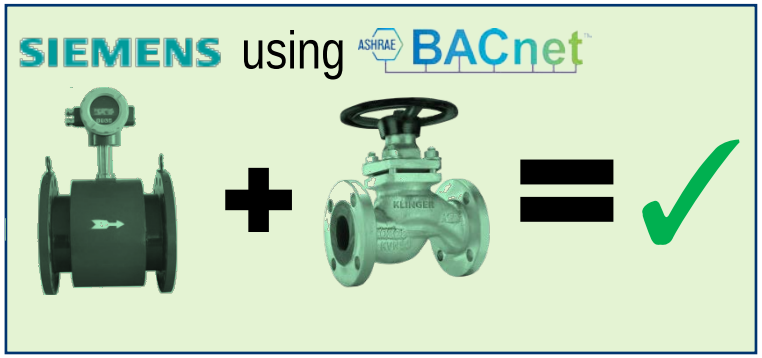
Building management systems

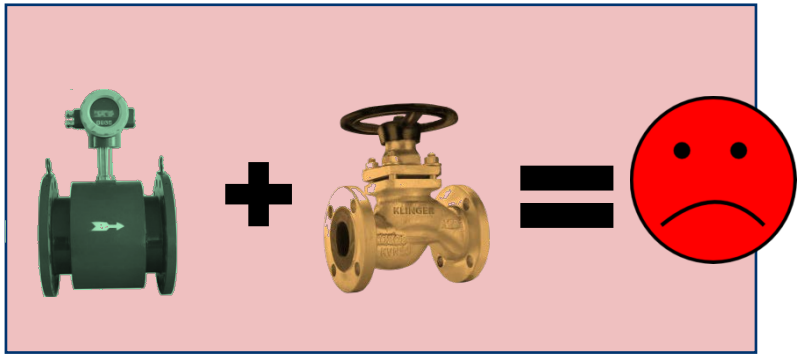
Security and access

Lighting

- Different semantics, protocols, data and security models
- Fields for data usage/analysis are kept small
- High engineering effort to make sub domains interoperable

Problem: proprietary engineering





- Reinvent the wheel
- Bunch of different tools and technologies
- Cause interoperability issues

DALI, BACnet, eQ-3 Electronic Equipment, RWE SMARTHOME, Green. Smart. Wireless. enocean®, LG Smart, LonMark International, Z-Wave Plus, KNX®, OBIX Open Building Information Xchange, OPC Foundation

Source:
Flow-meter: http://ahnam.net
Valve: http://www.uniklinger.com

Problem: no explicit semantic model

- Ambiguities in the meaning e.g.:
  - What is the temperature of a freezer, heater?
  - What to expect when subscribing to an event?
- Prevents dynamic service (re-)configuration
  - Which function should be used? Run() or Start()?
- Some aspects might be omitted that are valuable to other services
- Experts needed for development
- Additional time to examine which data is needed and what the data reflects

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Our goal

Domain specific language (DSL)

- Abstract from communication mechanisms:
  - Technologies
  - Protocols
- Generated code is using standard IT infrastructure
- Faster development

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Semantic and syntactic description of entities

- Comprehensive data models
- Domain knowledge

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Development tool

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A short DSL example

```
device Weatherstation {
    namespace https://example.org/weatherstation

    service temeratureSensor {
        attribute temperature read event;
        attribute unit read;
        attribute alertTemperature read write;
    }

    service humiditySensor {
        attribute humidity read event;
    }
}
```


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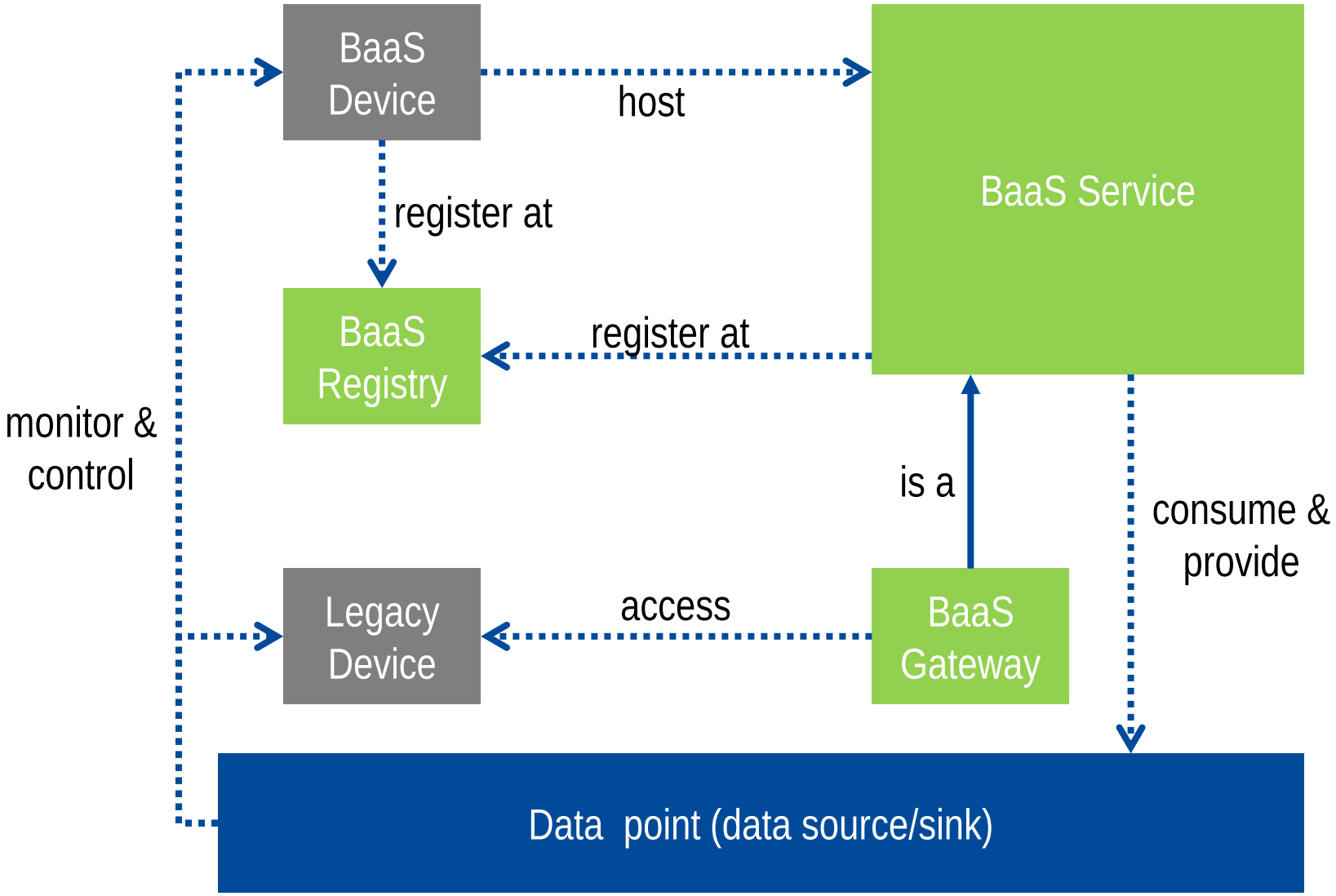
The BaaS domain model



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Data point repository

- Contains data point descriptions
  - Describing all data points within the building automation domain
  - Relates different data points with each other
- Can be queried for specific data points
- Provided by the BaaS project
- Extended by a domain expert

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Software development kit

- Abstract definition:
  - Required data points of a service
  - Provided data points of a service
- Select additional adapters:
  - Communication protocols
  - Security
  - Administration
  - …

Service refinement

- BaaS SDK generates:
  - Service basic code
  - Code for:
    - Communication protocols
    - Interface
    - Security
    - Administration
  - Used libraries
- The software engineer just needs to provide the business logic
  - Use tool of own choice

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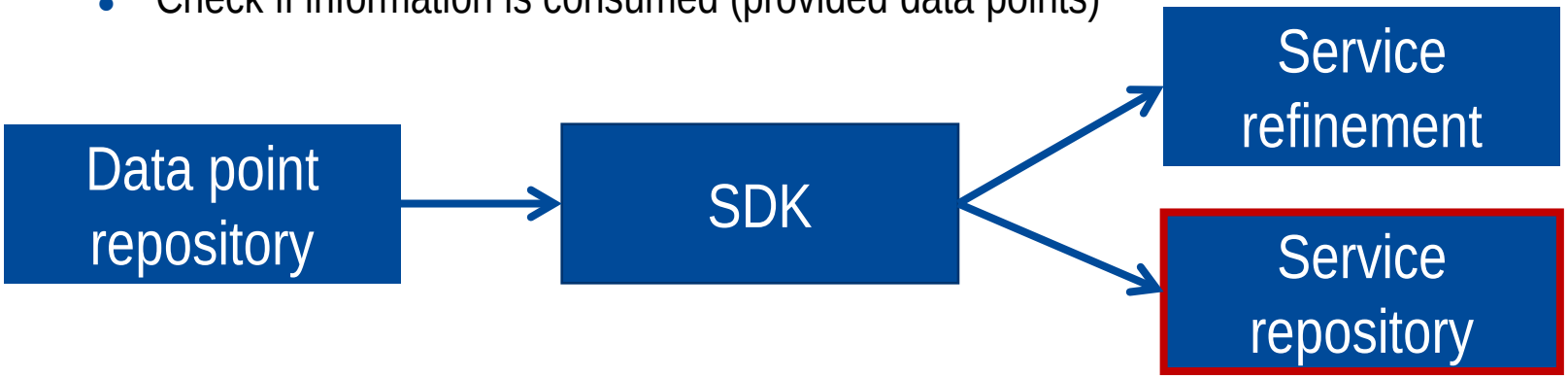
Service repository

- Store information about each engineered service
  - Provided data points
  - Required data points
  - Used adapters

- This information can be used later when planning installations
  - Plan multiple instances
  - Check if conditions for service operation are given
    - Required data points
    - Used adapters
  - Check if information is consumed (provided data points)



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Summary

- Combining a domain specific language and semantic descriptions
  - To create building automation services …
    - … abstracted from communication mechanisms
    - … with comprehensive data models
    - … with less domain knowledge
    - … using standard IT infrastructures
    - … in a shorter time
  - Enable the use of information in further steps

- Future Work
  - Methodology and (graphical) tool for engineering building automation installations based on developed services and existing infrastructure
  - Tool for commissioning services in the field

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Questions?

- Thank You for your attention

- Our project website: http://baas-itea2.eu/

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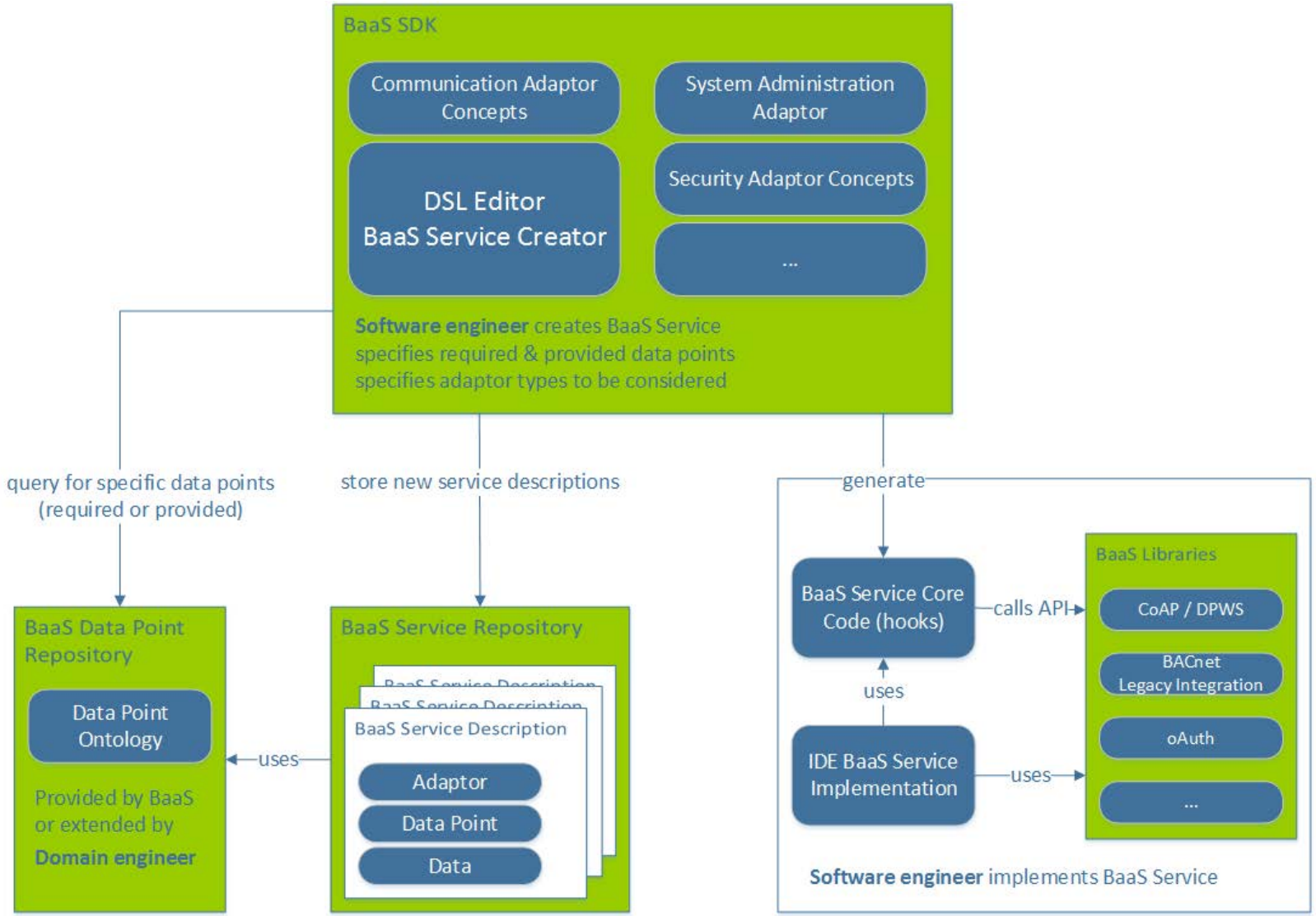
- Institute of Applied Microelectronics and Computer Engineering, University of Rostock, Faculty of Computer Science and Electrical Engineering

Our Concept



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What is a DSL

- A domain specific language is …
  - … a formal language having syntax and semantic
  - … limited to a certain domain
  - … used to easily describe entities, relations, problems and solutions

- A domain specific language can be …
  - … a graphical or textual language
  - … an extension of an existing language or a stand-alone language