Smart Grid Demonstrator of a Future Office Prosumer

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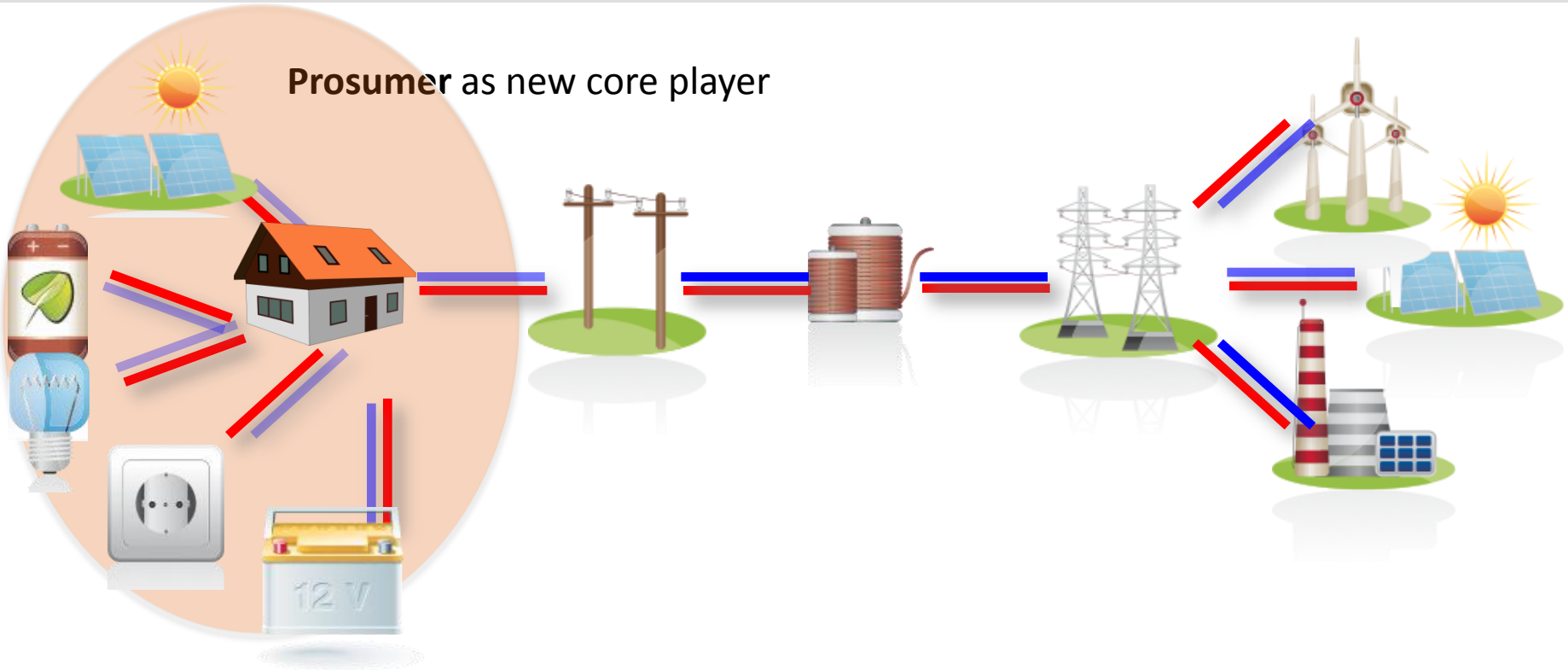
Joint work with Siemens CT & EIT ICT Labs

Motivation

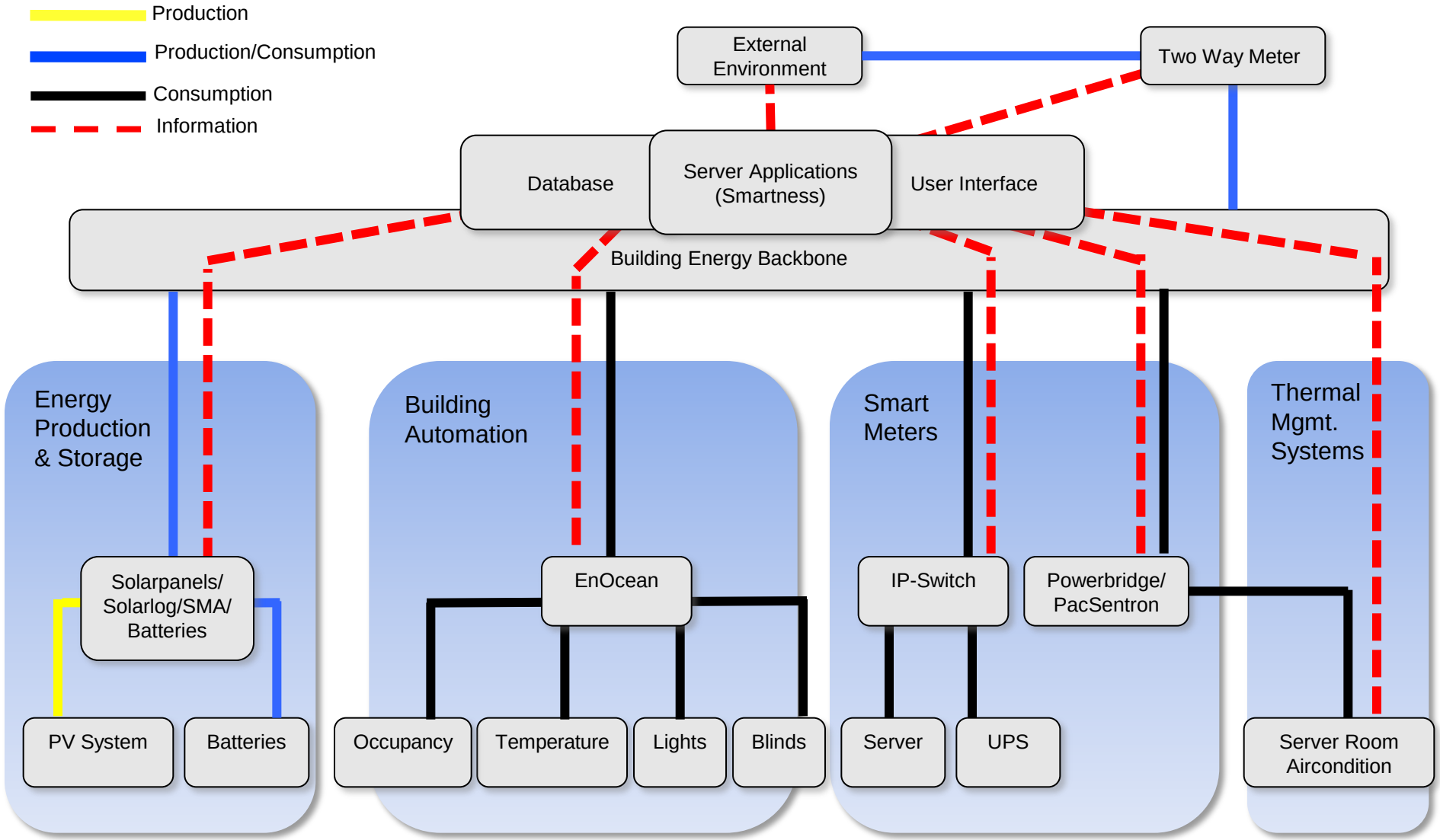


- **Prosumers = Producers + Consumers**
- Decentral but stable network
- New reliable energy mgmt. solutions and IKT infrastructure

Goals

- Build a real prosumer experimental platform
- Real-world experience and co-simulation
- Implementation of extendable reference architecture
- Behaviour of an office building as smart grid prosumer

Overview of Devices in the Demonstrator



Following SOA Principles

Control Service Layer:

- Node Management
- Planning Services
- Execution Services
- Billing Services
- Maintenance Services

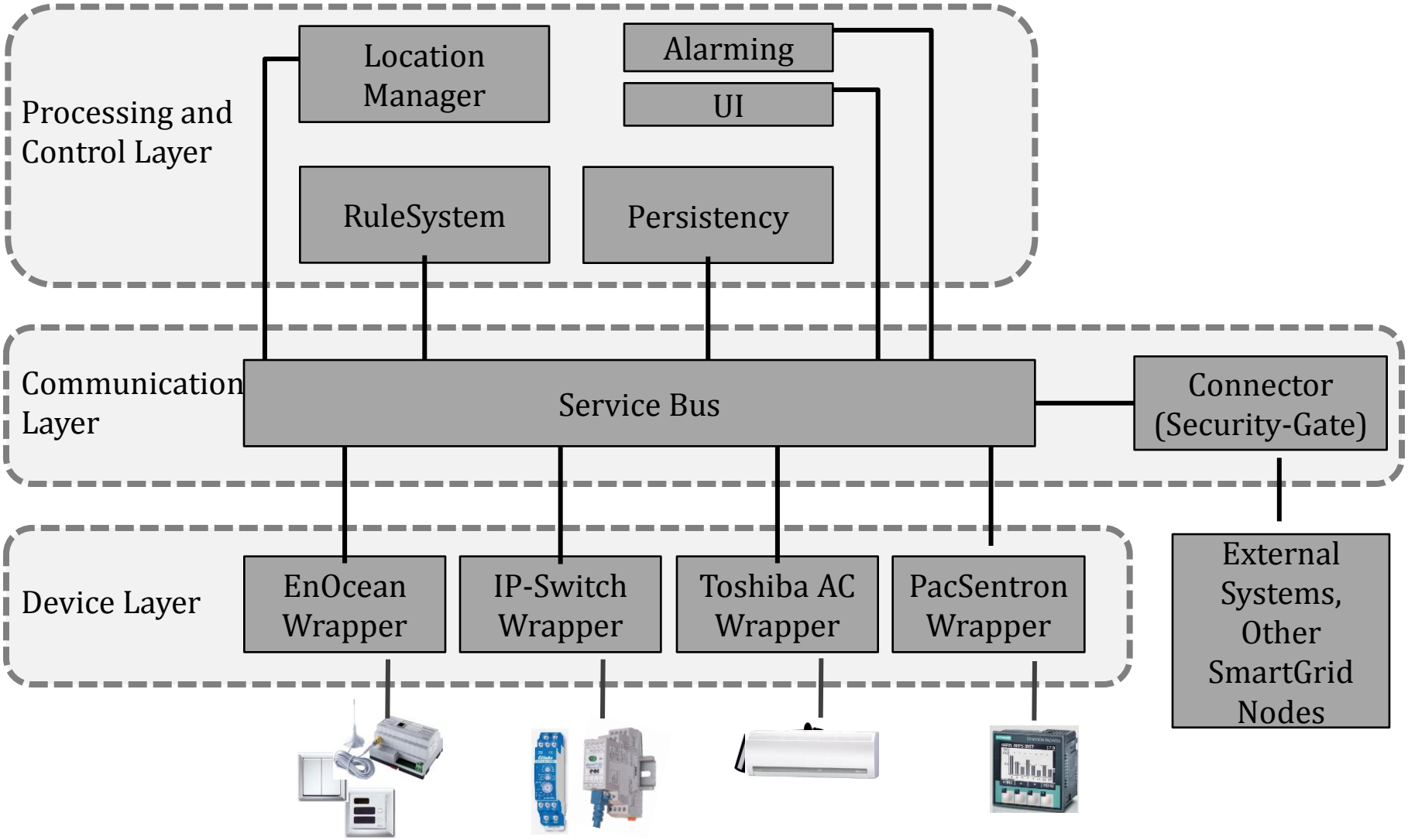
Function Service Layer:

- Service Coordination
- Service Orchestration
- Security Mechanisms
- Automatic Adaption
- Data Management
- Event Management

Device Service Layer:

- Sensors/Actors
- Communication
- Config./Parameterization
- Identification
- Diagnosis

Technical Architecture



iSOA: Integrated Services for Holistic Energy Management

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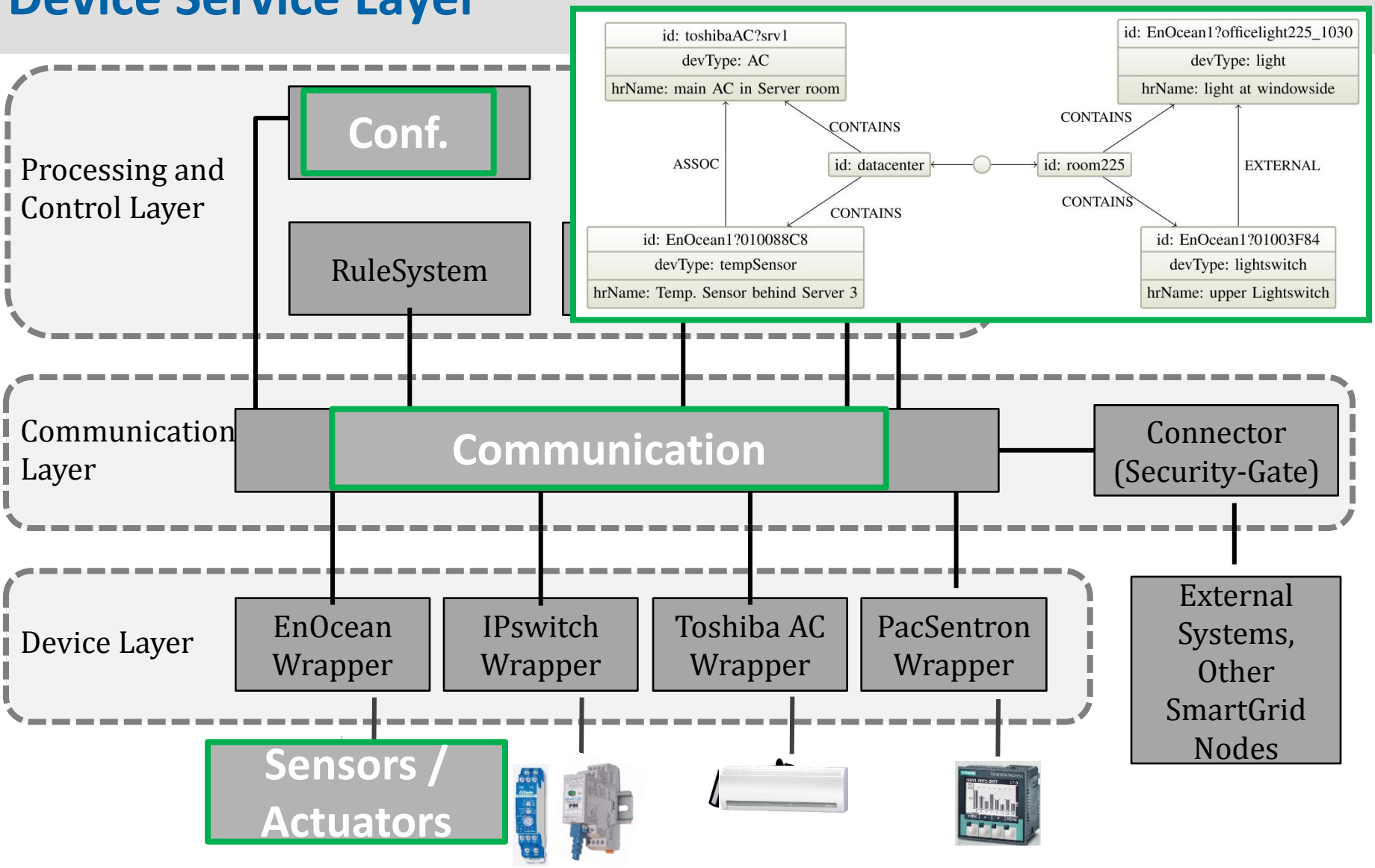

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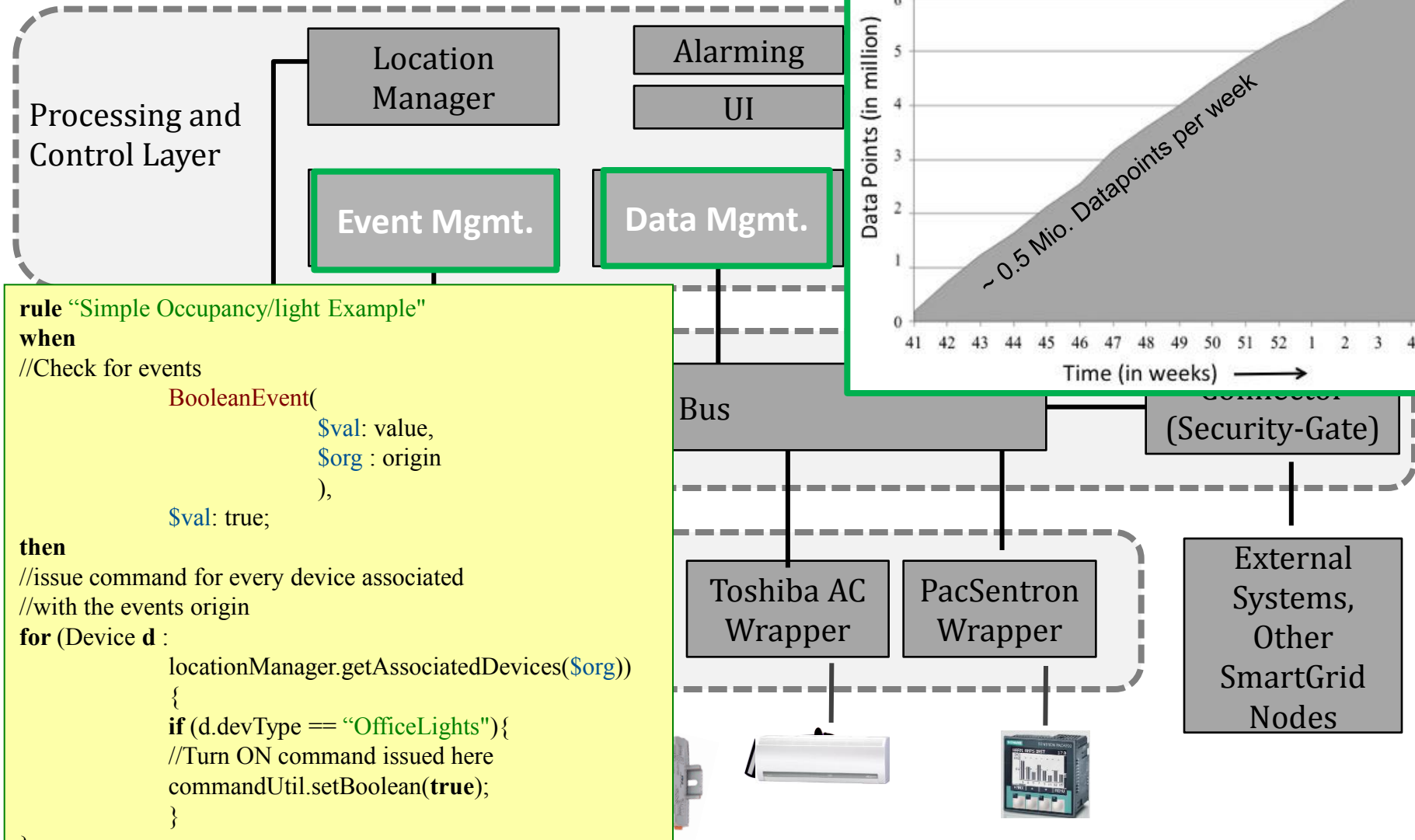
Function Service Layer




```
rule "Simple Occupancy/light Example"
when
//Check for events
        BooleanEvent(
                $val: value,
                $org : origin
                ),
        $val: true;
then
//issue command for every device associated
//with the events origin
for (Device d :
        locationManager.getAssociatedDevices($org))
        {
        if (d.devType == "OfficeLights"){
        //Turn ON command issued here
        commandUtil.setBoolean(true);
        }
}
end
```

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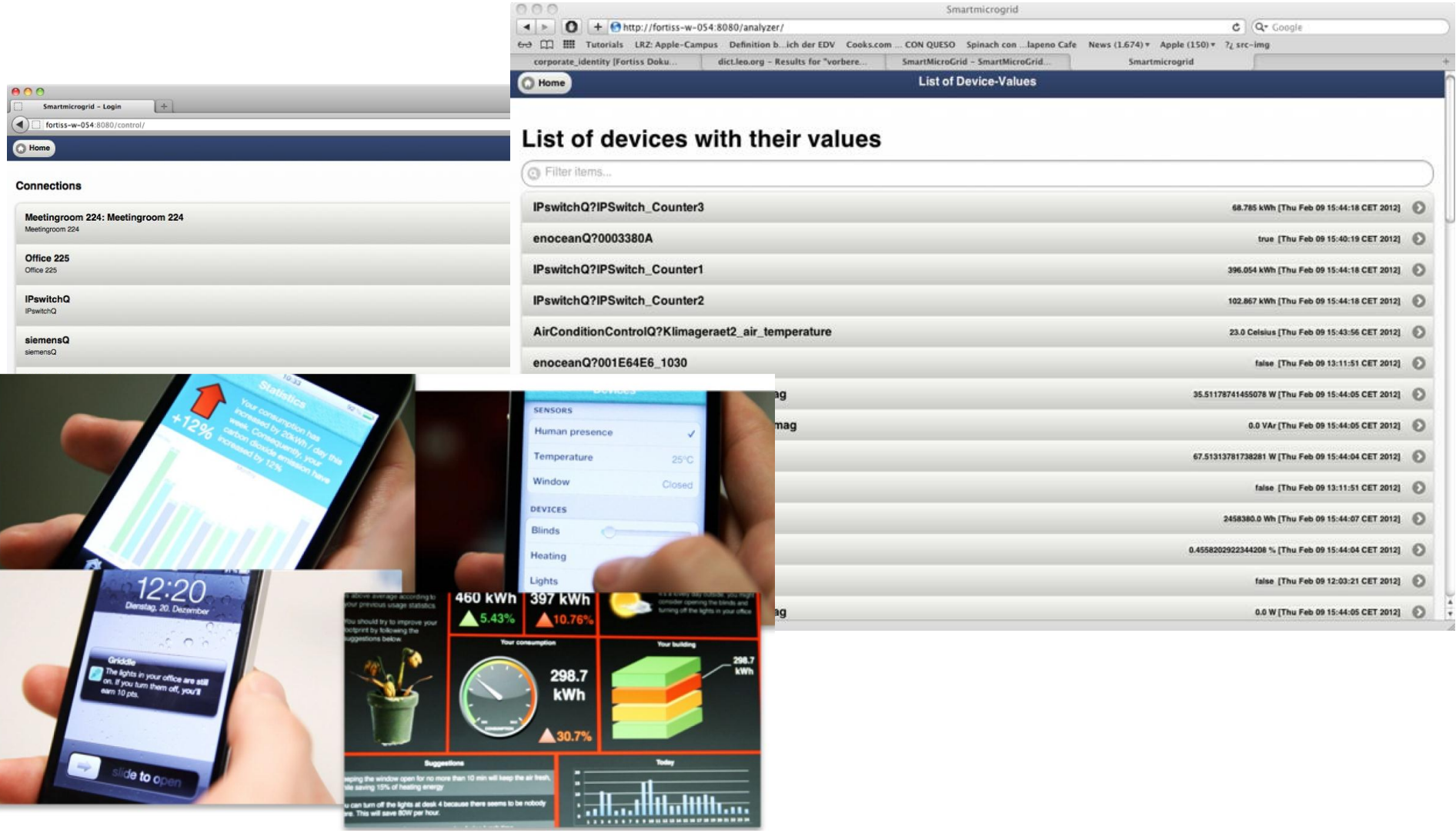
Control Service Layer



Implementation details

- **Technical Infrastructure**
  - Service Bus - ActiveMQ, JMS, SOAP
  - Component Platform – OSGi
- **Generalized data & events**
  - double event
  - boolean event
  - toggle event
  - string event
- **Interfaces**
  - External communication with IEC 61850 / 61400 standards
  - Wrapper end-point address?device ID (e.g. enoceanQ?010088C8)

Adding Functionalities

- **New services** extending the system (e.g. decision system)
- **External data**: market prices, weather forecast
- **Prediction** of power usage
- **User interface & data visualization** (smart phones, tablets, web)
- **Security**, fault management mechanism
- **Machine learning** (configuration automation)
- **Connection** to the grid and other demonstrators
- **Co-Simulation** framework

Conclusion

- **Demonstrator Environment**
  - System is running several months
  - Flexible architecture
  - Plug & play
  - Heterogeneous device handling
  - Interconnection with EU Demonstrators (KIT, DAI, Imperial, Delft, …)
  - External communication based on standards - IEC 61850 / 61400
- **Challenges faced**
  - Hardware pitfalls
  - Amount of data
  - Efficiency of communication protocols
  - Basic data-type Interface

Contacts

http://www.fortiss.org/research/projects/smart-micro-grid.html

More Infos…

Smart Grid Research Initiative: http://smartgrid.in.tum.de

Collaboration with Software and System Engineering Group (Prof. Broy)