MASARYKOVA UNIVERZITA

Intelligent Facility Management for Sustainability

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Facility Management

- *„Profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology."*

IT in Facility Management

- CAFM – Computer aided facility management
  - Space management
  - Preventive & On—Demand maintenance
  - Helpdesk
  - Energy management

- Intelligent buildings
  - Cooperating and remotely controlled building technologies – Building management systems (BMS)
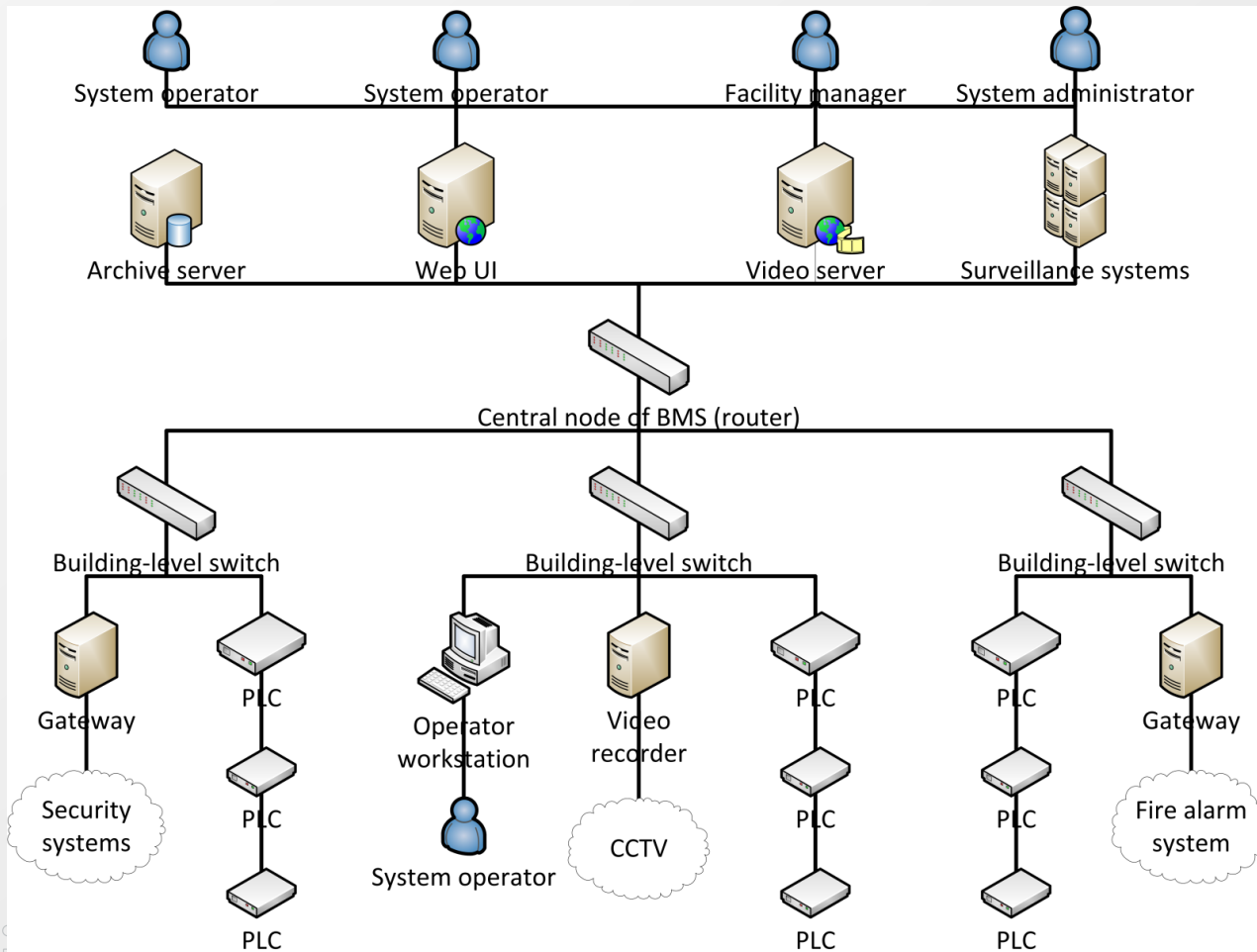
Building Management Systems

- Integrate various building technologies:
    - HVAC (Heating, Ventilation, Air Conditioning)
    - Lighting control
    - Elevator control
    - Energy monitoring
    - Fire alarm
    - …
- Provide unified user interface for monitoring and control
- BMS at MU: over 30 buildings, 5 sites / faculties, 800 devices, 1 network

BMS Schema

Requirements for effective FM

- Effective FM is:
    - Cost saving
    - Sustainable, Environment-friendly
    - Fault resistant
    - Prepared for crises
- How to reach effective FM:
    - Monitoring
    - Integration (Timetables, Weather information)
    - Operation analysis (Business intelligence)
    - Continuous optimization

Monitoring of BMS

- Monitoring ensures **high availability and reliability** of BMS and ensures **data validity** for post-mortem analysis
- Specialized tools monitor different aspects of BMS

Tool \ Device	Application server	Gateway	PLC	Switch/router
BMS Sentinel	Functionality	Functionality, Accesibility	Functionality, Accesibility	
Network traffic probe	Communication characteristics	Communication characteristics	Communication characteristics	
Nagios	Accesibility	Accessibility		Functionality, Accessibility

Legend of used protocols:

BACnet	SNMP	ICMP	Ethernet

Integration

- Building automation usually relies on:
    - Static regulation algorithms
    - Human commands & schedules
    - Preset values (requested temperatures)
    - Sensor data from building systems
- Operation can be optimized by integration with other data sources:
    - Other information systems (timetables for lecture rooms)
    - Room occupancy (based on number of enrolled students)
    - Weather data & forecast

Operation Analysis

- Analysis of past performance is required in order to optimize system operation
- **Business intelligence** tools presents data to responsible personnel in easy understandable and adjustable format)

Business Intelligence: Adding semantics

- BMS data are missing semantic information
  - Data points are identified only by its network address
  - Data point names are unsuitable for machine processing
- Data point data can be enriched by:
  - Location (integration with GIS)
  - Source device
  - Measured/Controlled quantity (temperature, humidity,...)
- Additional semantic information can be used for querying in Business intelligence applications

Business Intelligence Tools

- Technology **data mart**
  - Stores semantics-equipped building operation data in structure that is suitable for OLAP tasks and applications
- **Complex event processing**
  - Processes on-line data streams
  - Simplifies and reduces amount of data and make them easily understandable
  - Grouping, Joining, Aggregations, Patterns
- **Machine Learning** & Data Mining
  - Outlier detection, Clustering
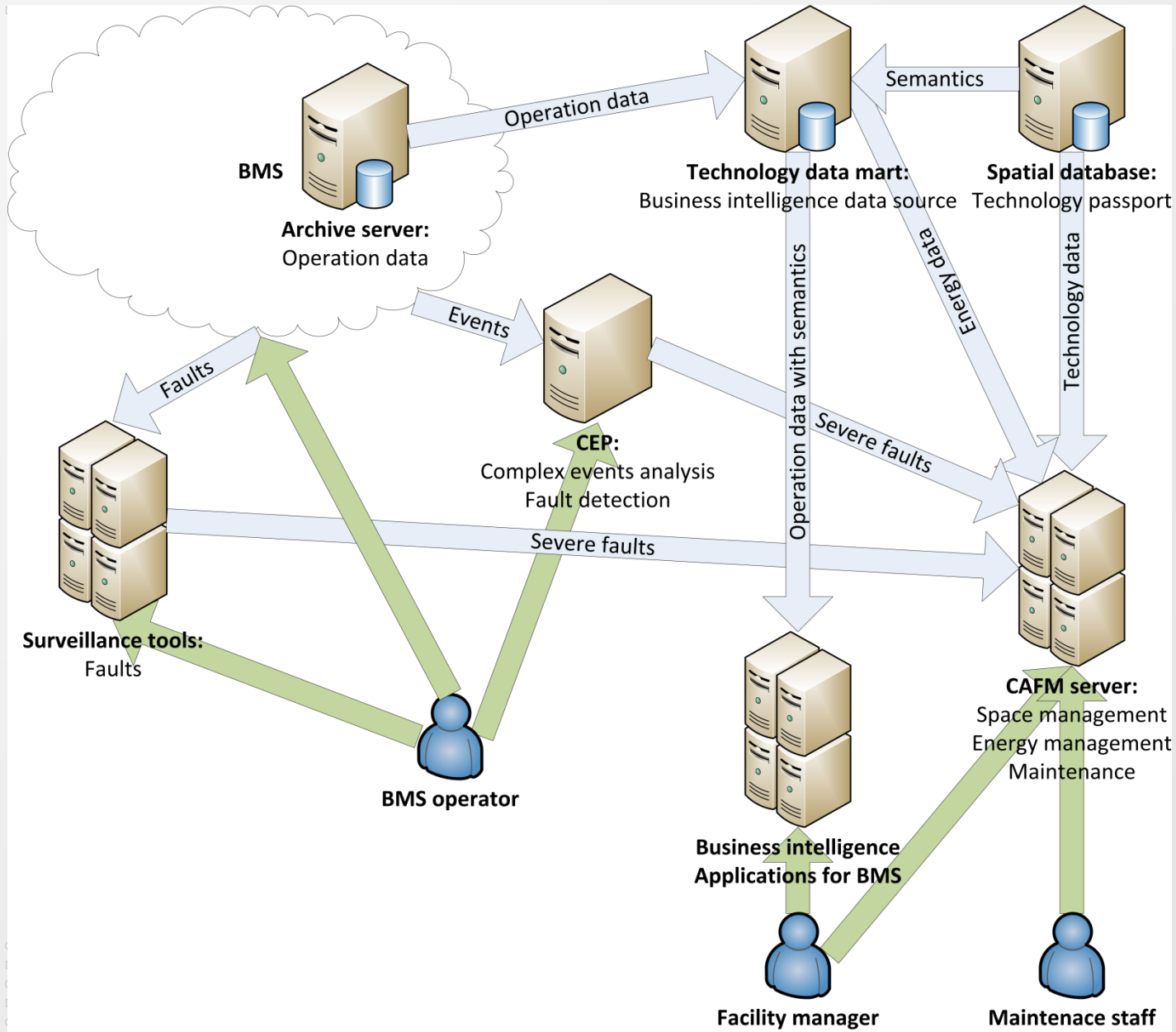
Business Intelligence Use Cases

- Historical **trends & comparisons** (OLAP)
    - **Energy** consumption
    - Room **temperature dependency** on seasons
- Outlier detection (ML & DM)
    - **Overcooled/Undercooled** rooms
    - **Significant** energy consumers
- Causality discovery (ML & DM)
    - **Dependency** of room temperature on room occupancy and/or weather
- Real-time analytical views (CEP)
    - **Detection** of rapid increases of energy consumption/temperatures
    - **Advanced** fault detection

Risk & Crisis Management

- BMS provides **automated reactions** to unexpected faults (power loss, fire)
- CAFM&BMS provides data and applications for **decision support:**
    - Building *plans*
    - Real-time data from *sensors*
    - Additional *semantic* information
    - Easy to use *user interface*

Conclusion

- Intelligent FM can help to maintain sustainable operation by
  - Advanced **monitoring**
  - **Integration** with other systems
  - **Business intelligence** tools (data semantics, data mart, CEP, ML & DM)
- Intelligent FM can help in the field of risk management by
  - **Automated reactions**
  - Providing understandable, up to date, credible, relevant data

Questions? Either directly or later at any time to:

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