

Data Mining and Geographic Information Systems for Facility Management



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Outline



- Introduction – UKB and BMS
- SUKB Requirements - Motivation
- GIS, FM, Data Mining
- The State of Art
- Future Work

University Campus Bohunice

- 30+ buildings
- 100.000 + m²
- 5 phases
 1. MEDIPO – 2003
 - Reconstruction of 2 buildings
 - LON, Wonderware Intouch,
 - BACnet integration in progress (past, present, future)
 1. ILBIT – 2005
 - 4 new buildings
 - LON, Honeywell
 - BACnet integration in (near) future
 1. AVVA Blue – 2007
 - 10 new buildings
 - BACnet, Delta Controls,...
 1. AVVA Green – 2010
 - 11 new buildings
 - BACnet, Delta Controls,...
 1. AVVA Yellow – 2008 – (2012 ?)
 - 2 new buildings 2009,
 - Saia, BACnet,
 - 8 new buildings 2012 ?



EXIT C

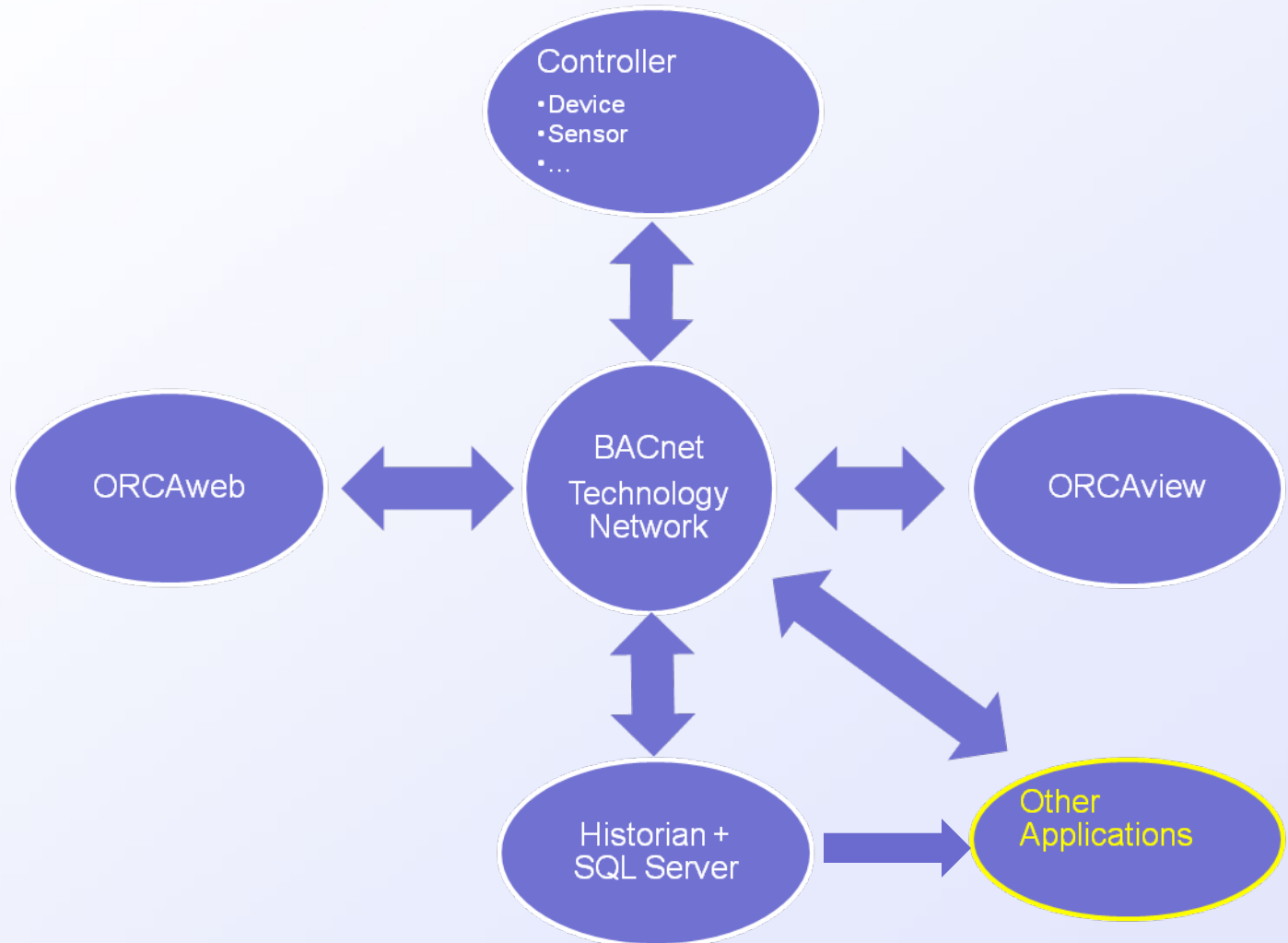
Knihovna univerzitetnega kampusa MU



0 50 100 200 300 400 500 Meters



Building Management System



MU Building Management System

- Building technology monitoring and operation
- ONLY ONE application for all buildings of Campus
- Data Network and Technological (BACnet) Network
- Desktop version - ORCAView
 - From 0 to 5 concurrent users
- Web version - ORCAweb
 - 2 servers - Load Balancing
 - Anywhere on Data Network
 - Approx. from 2 to 10 concurrent users
- Historical Data in SQL Server - Historian
 - 2 servers - Hot Backup
 - Disk Array



BMS MU BACnet objects



- 740+ Controllers and Gateways
- 850+ Graphics
- 5 300+ PGs
- 2 700+ EVs
- 1 500+ SCHs
- 1 300+ AIs
- 3 200+ BIs
- 800+ AOs
- 2 400+ BOs
- 13 800+ AVs
- 16 100+ BVs
- 3 600+ MVs
- 2 400+ TLs
 - 1 700+ TLs save data to Historian

BMS MU Historian DB

- 22 GB
- 250 000 000+ records for trendlogs
- 2 000 000+ records for alarms and events
- 100 000+ new records daily
- 10MB+ data increment daily
- 100+ alarms daily



SUKB Requirements

- Optimisation of building operation
- Historical data visualisation
- Detection of anomalies



GIS

Data Visualisation

- GIS = G + IS
- G = Spatial Context
- Shape
 - Point, Line, polygon, Surface, Dimension, Complex Shape,...
- Position
 - WGS, Linear Referencing System, Container
- 2D and 3 D
- Time



Facility Management



- Facility management is a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology (IFMA, International Facility Management Association).
- Support for core business

Data Mining

Anomaly Detection

- Rare Events
- Similarity of Data
- Data classification
- Weka
- Clustering
- Association Rules
- Decision trees
- Anomaly visualisation

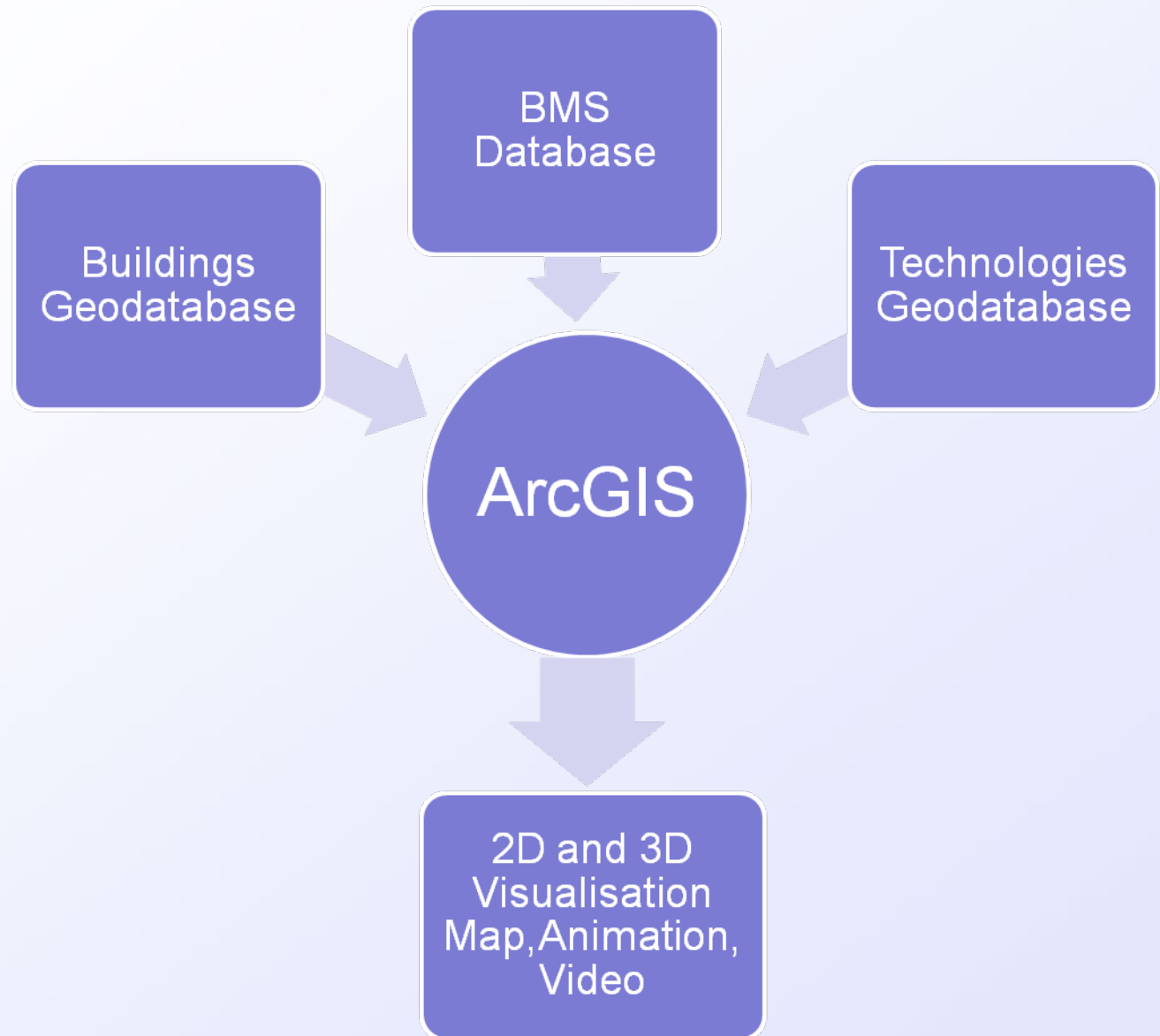


Visualization of Historical Data

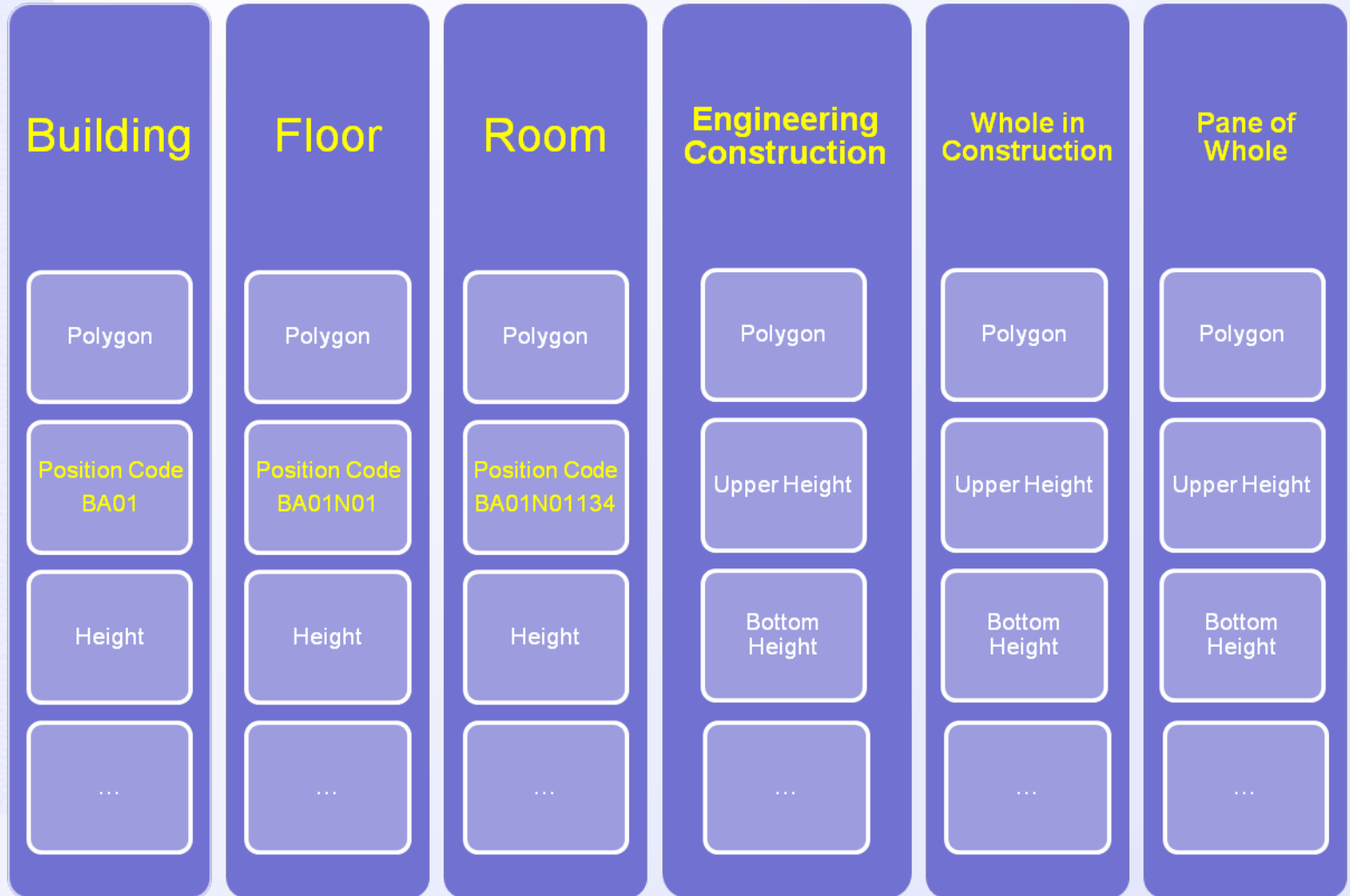


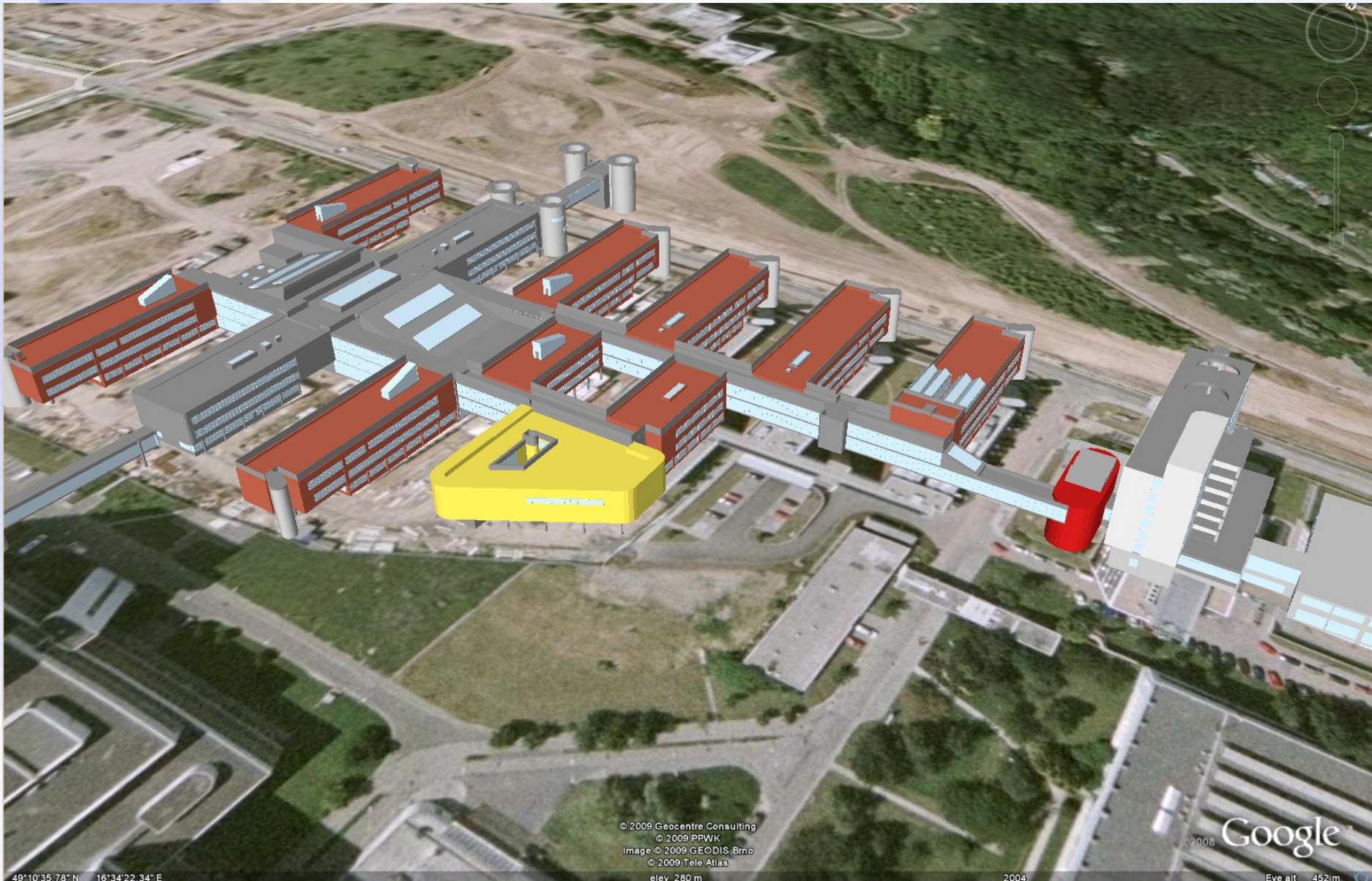
- ESRI ArcGIS
- ArcMap
- ArcScene
- 2D and 3D Thematic Map
 - Values for given instant of time
 - Average, minimum, maximum values ... for time period
- 2D and 3 D Animation
 - Values for given time period
 - Video
- Examples
 - Room temperatures
 - Electric energy consumption

GIS Integration



Buildings





© 2009 Geocentre Consulting
© 2009 PPWK
Image © 2009 GEODIS, Brno
© 2009 Tele Atlas

elev. 280 m

2004

©2008 Google™

Eye alt. 452 m

49°10'35.78" N 16°34'22.34" E

Technologies

HVAC, Fire alarm system, Access control, Intrusion system,...



System

Position
Code

Technology
Code

...

Device

Polygon, Line, Point

Position Code

Technology Code

Upper Height

Bottom Height

...

Technologický pasport MU

Vyhledat Tisk

1. nadzemní podlaží

Strom budov a místnosti

Třídít podle organizačních složek

Budovy a místnosti MU

- ARCH
- AV
- CDVU
- CeŠu
- ESF
- FF
- FI
- FSpS
- FSS
- IBA
- LF
- MM
- PedF
- PrávF
- PFF
- RMU
- SKM
- UCT

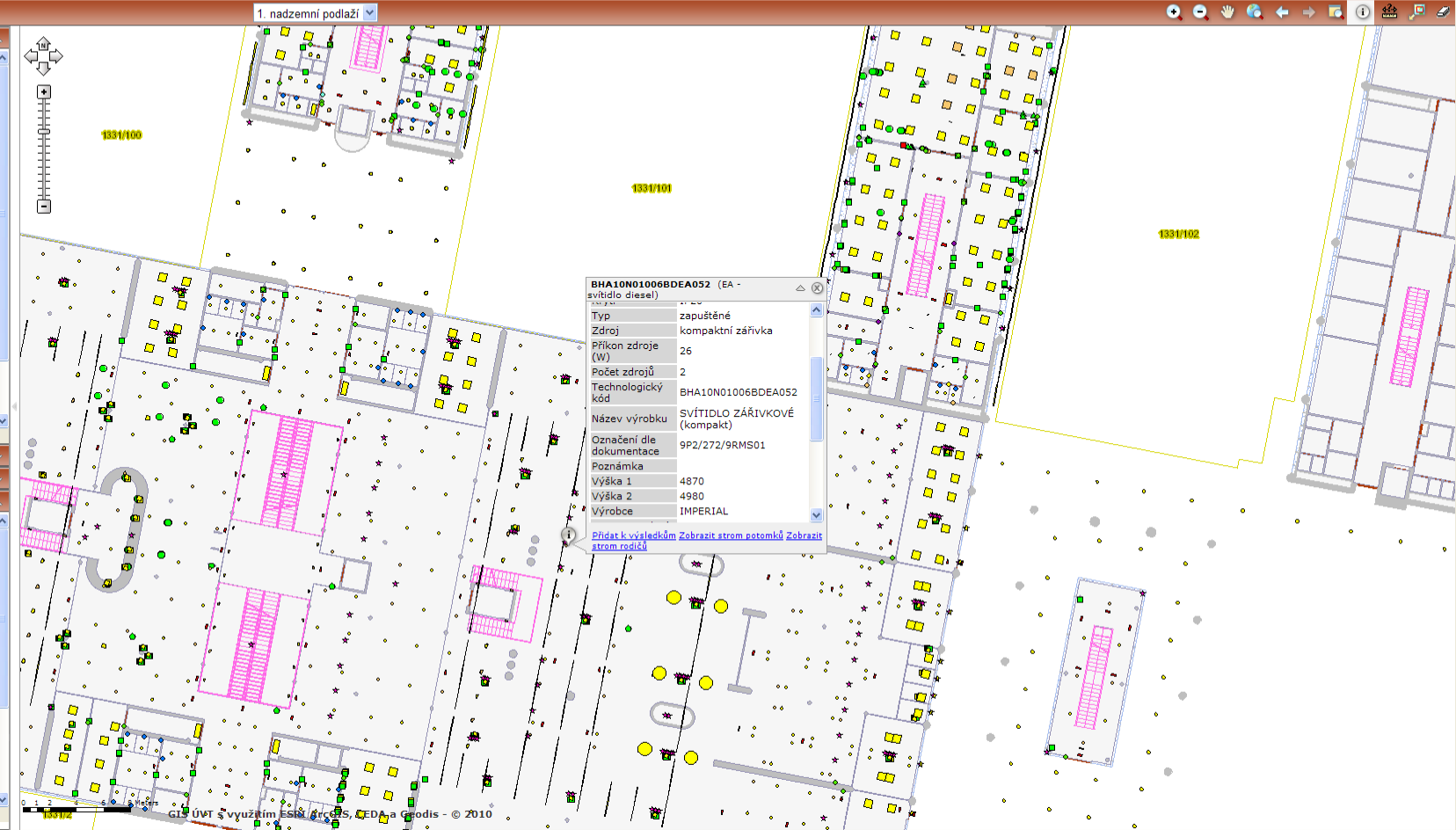
Výsledky hledání

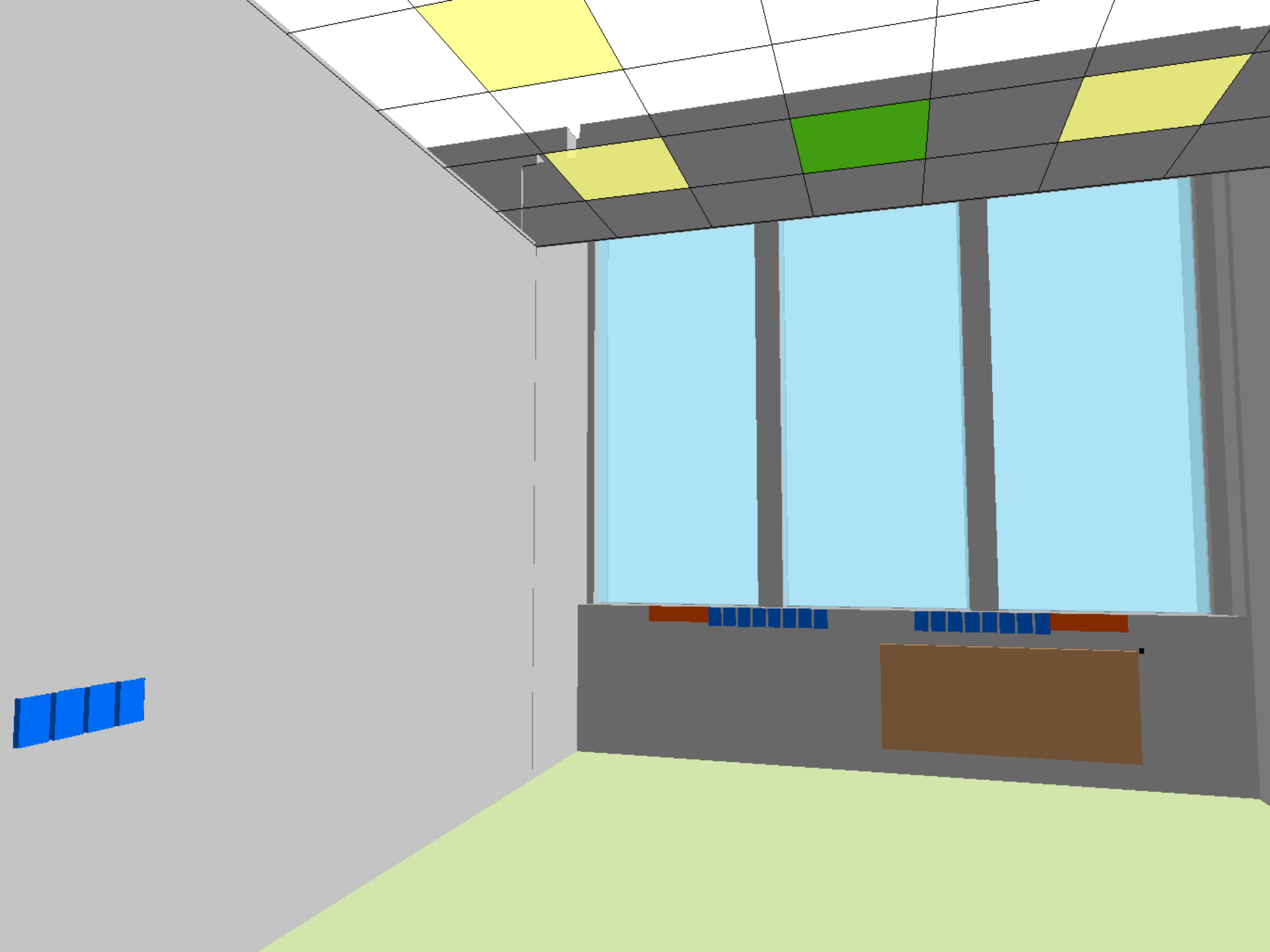
Strom technologií

Obsah mapy a legenda

Technologický pasport

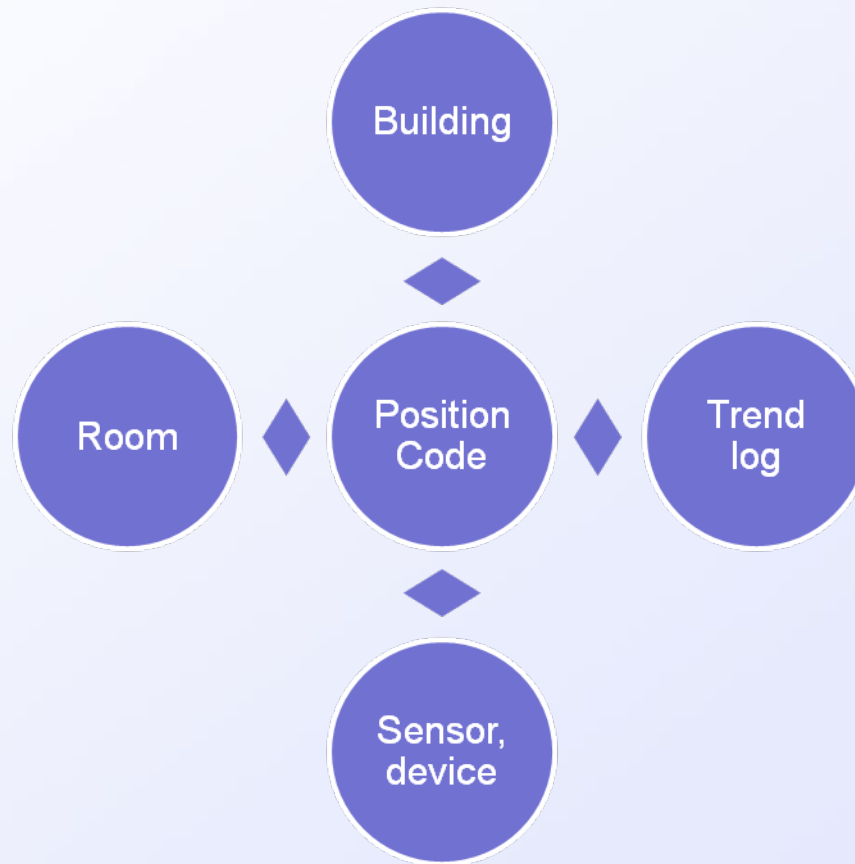
- A - Napájení budovy, areál
- B - Rozvody silnoproudé
- C - Slaboproudé systémy
- Stavební pasport
 - Orientační schodiště
 - Popis místnosti
 - Půdorys místnosti
 - Otevírání dveří
 - Dveře
 - Stavební konstrukce
 - Okna
 - Půdorys podlaží
 - Půdorys budovy
- Parcely





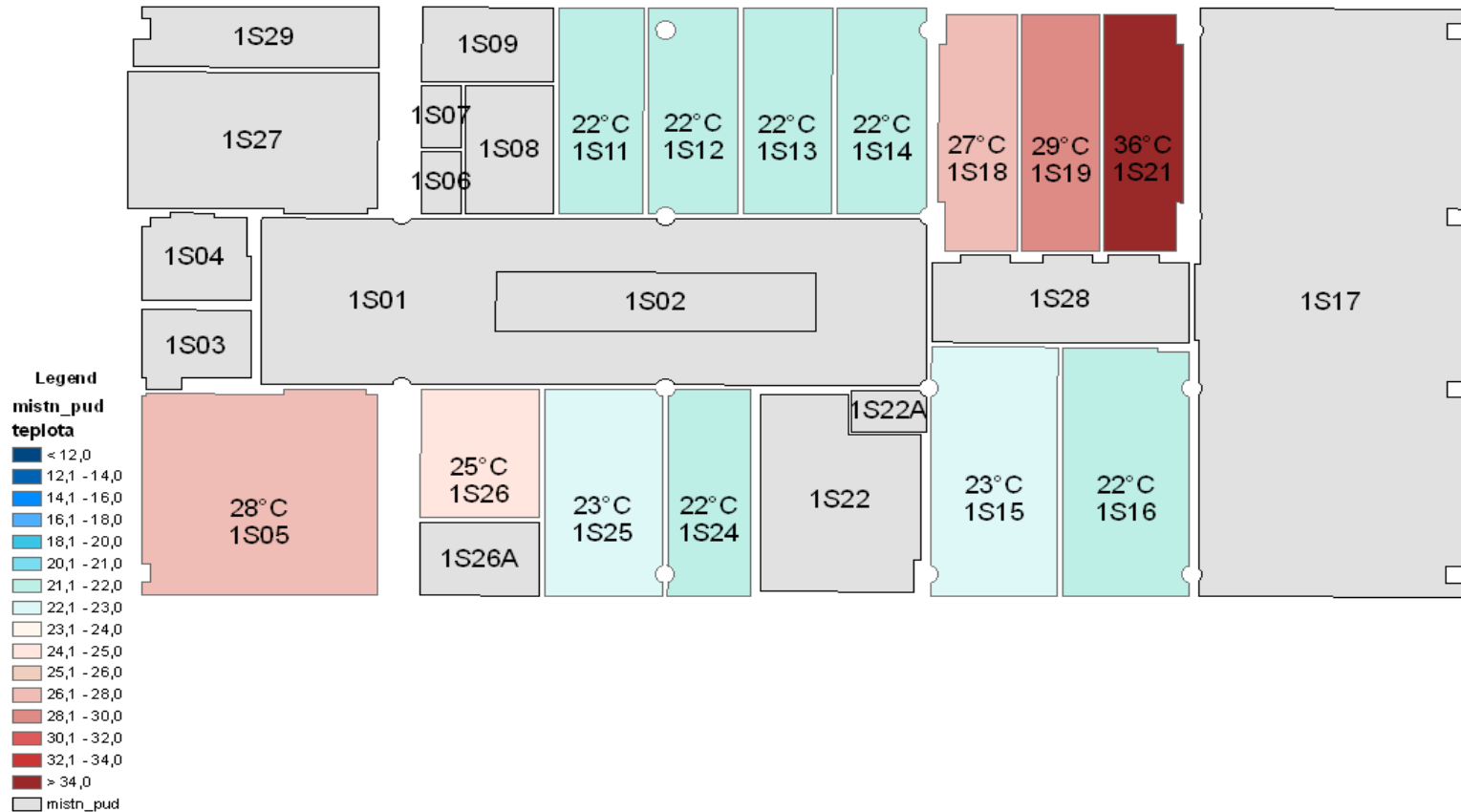
Visualization

- Position Code – key item for data integration



2D Thematic Maps

Room Temperatures



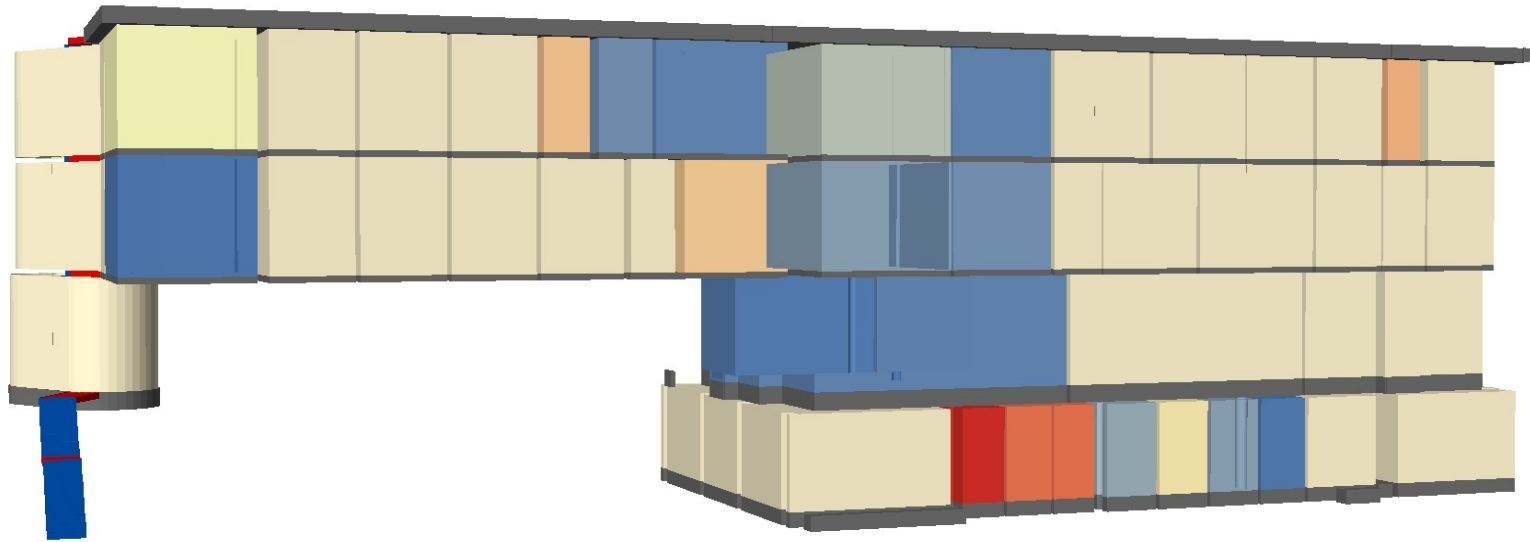
2D Thematic Maps

Electric Energy Year Consumption



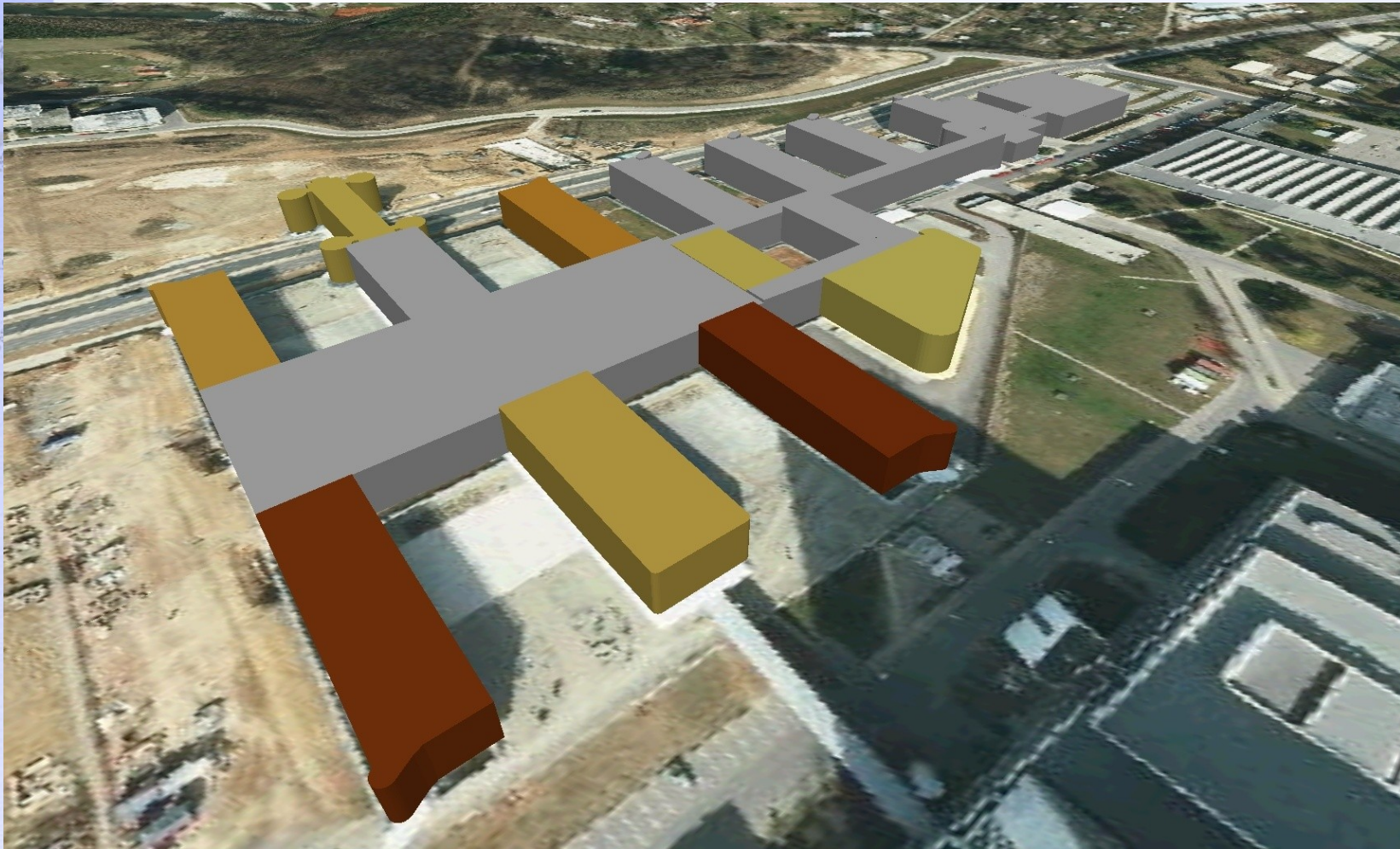
3D Thematic Maps

Room Temperatures



3D Thematic Maps

Electric Energy Consumption

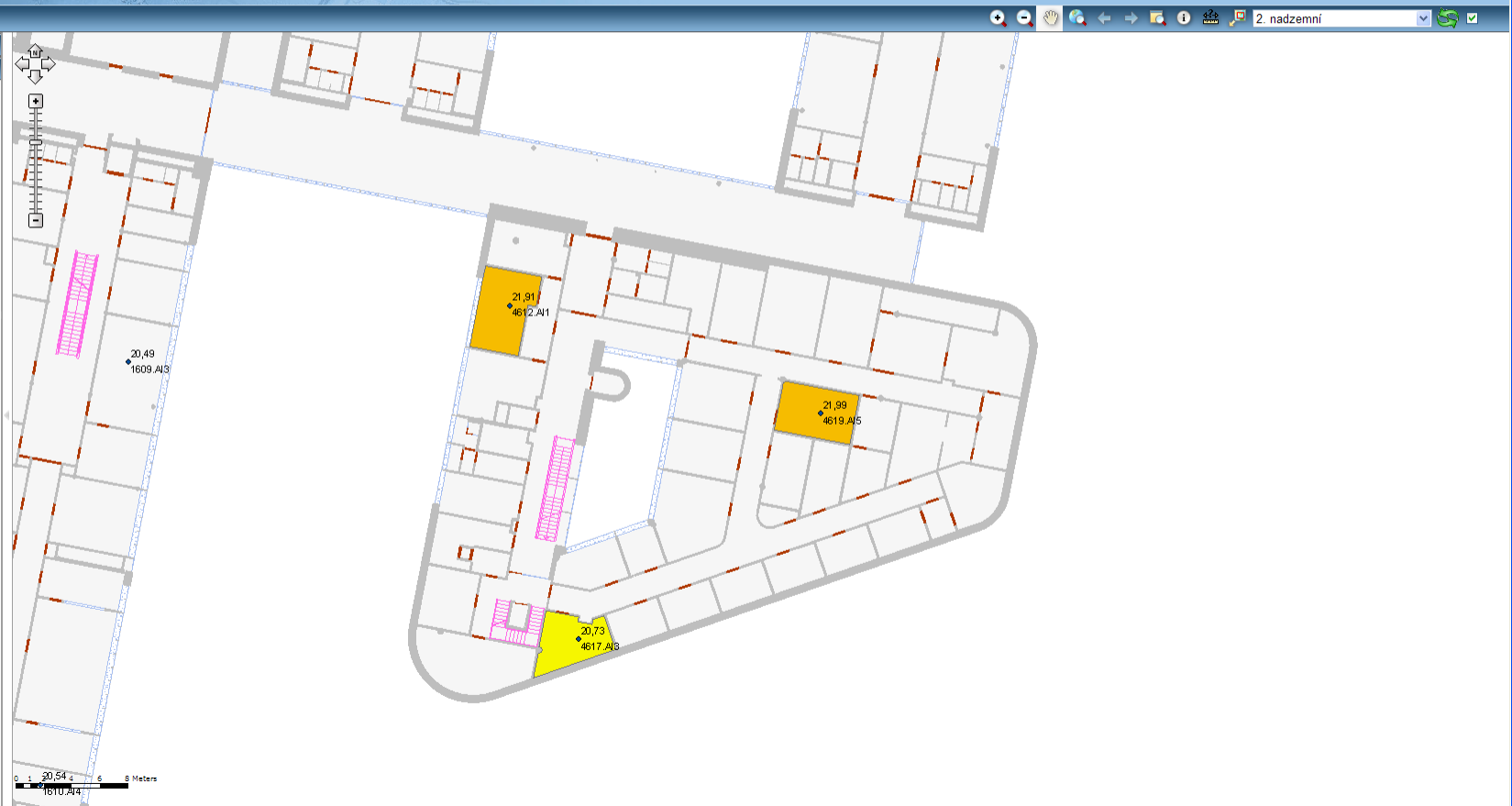


Visualization of Live Data



- SCADA Engine
- ESRI ArcMap - Desktop
- ESRI ArcGIS Server – Web Application
- 2D and 3D Thematic Map
 - Values for given instant of time
- Examples
 - Room temperatures

- Výsledky hledání
- Obsah mapy a legenda
- Rozšířená služba
 - BACnet objekty
 - Stavební pasport
 - Orientační schodiště
 - Popis místnosti
 - Půdorys místnosti
 - Otevírání dveří
 - Dveře
 - Stavební konstrukce
 - Okna
 - Půdorys podlaží
 - Půdorys budovy
 - Brno
 - Adresní body
 - Názvy ulic
 - Katastrální území
 - Budovy MU
 - Ortofoto
 - Orientační plán



Future Work

- Testing and modification DM methods for anomaly detection
- Weka and ArcGIS integration





Thank you for your time and attention.

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