

A Real-time Platform for Asset Operation & Maintenance

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Agenda

Why do utilities need a new platform and how does it look like?

Some examples how the platform is already used

- **Load Forecasting**
- **Transformer Analytics**
- **Asset Health Management**

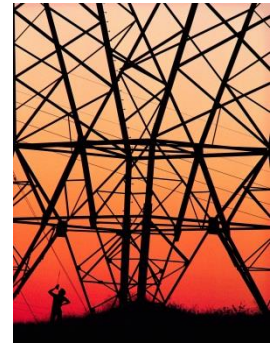


Why do utilities need a new platform and how does it look like?

Hypothesis: Utilities need a new platform to integrate IT and OT and to enable the Smart Grid

Data from IT and OT data sources has to be gathered, combined, and leveraged to support smart grid processes, advanced maintenance strategies and renewable power generation

- **Asset health management**
- **Predictive maintenance**
- **Management of severe events / outages**
- **Demand response management**
- **Virtual power plants**
- **Grid infrastructure analytics**
- **Consumption and load analytics**
- **Leakage and fraud management**



The platform needs to fulfill many requirements to enable IT/OT integration

Combine data from various sources

Handle Big Data

Support spatial data

Support (near) real-time processes

Simplify the overall system landscape

Enable new business scenarios



SAP HANA is an in-memory database

Supported IT/OT Requirements

Combine data from various sources

Handle Big Data

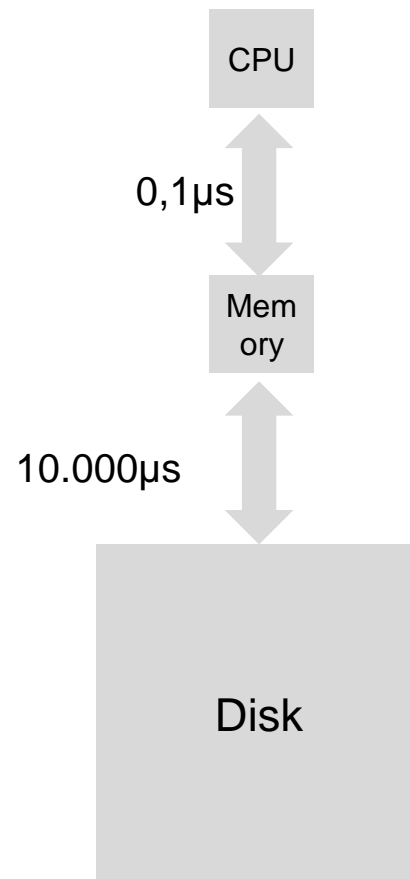
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Support (near) real-time processes

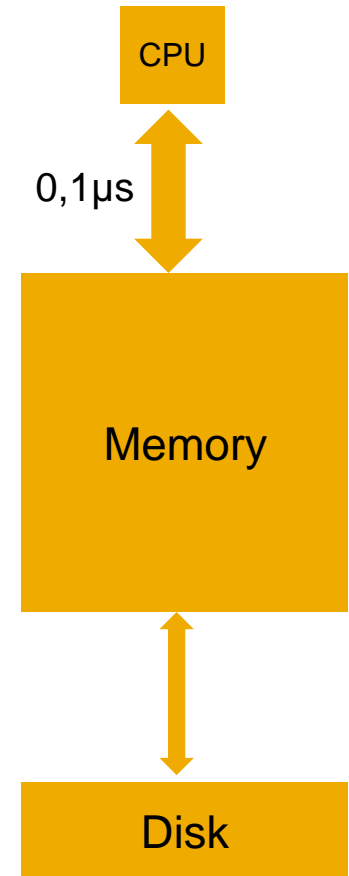
Simplify the overall system landscape

Enable new business scenarios

Traditional Architecture



In-memory Architecture



SAP HANA simplifies the analytical IT landscape

Supported IT/OT Requirements

Combine data from various sources

Handle Big Data

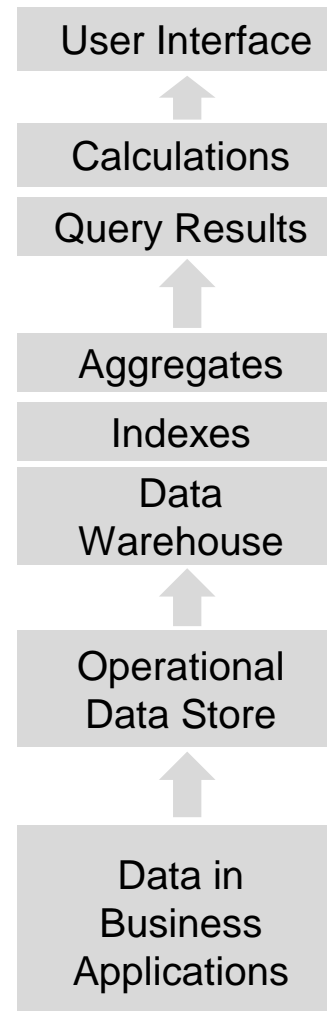
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Support (near) real-time processes

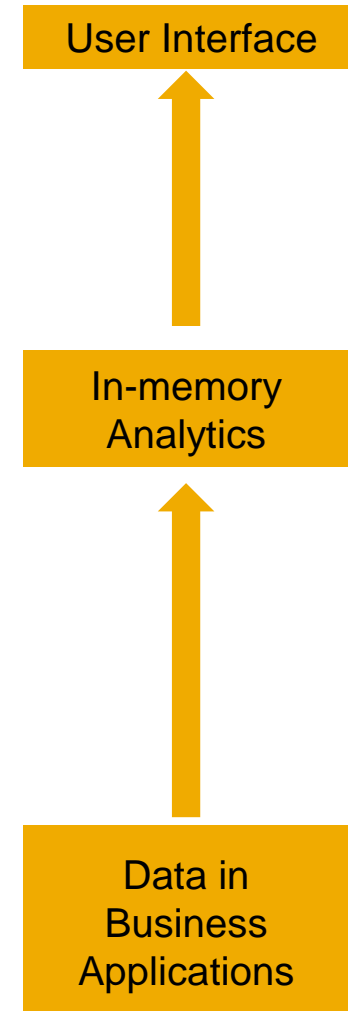
Simplify the overall system landscape

Enable new business scenarios

Traditional Architecture



In-memory Architecture



Example: Simplified IT landscape at SCE

Reducing TCO with Near Line Storage



SCE decided to move to BW on HANA

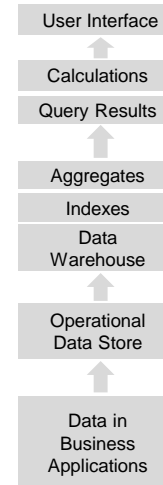
- Reduce batch loading time
- Improve reporting performance

One challenge the massive amount of data in BW: 22TB (uncompressed)

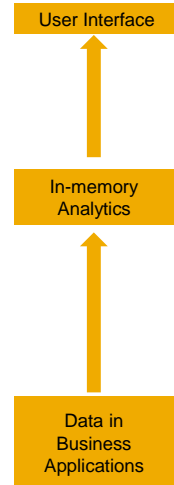
BW on HANA provided already significant reduction: 693 GB

- Removal of PSA, Change Logs, DB overhead, misc. files (3.7TB remaining)
- HANA compression (4.8 : 1 to 770GB)
- Removal of some cubes and master data

Traditional Architecture



In-memory Architecture



SAP HANA has in-built Predictive Analysis capabilities

Supported IT/OT Requirements

Combine data from various sources

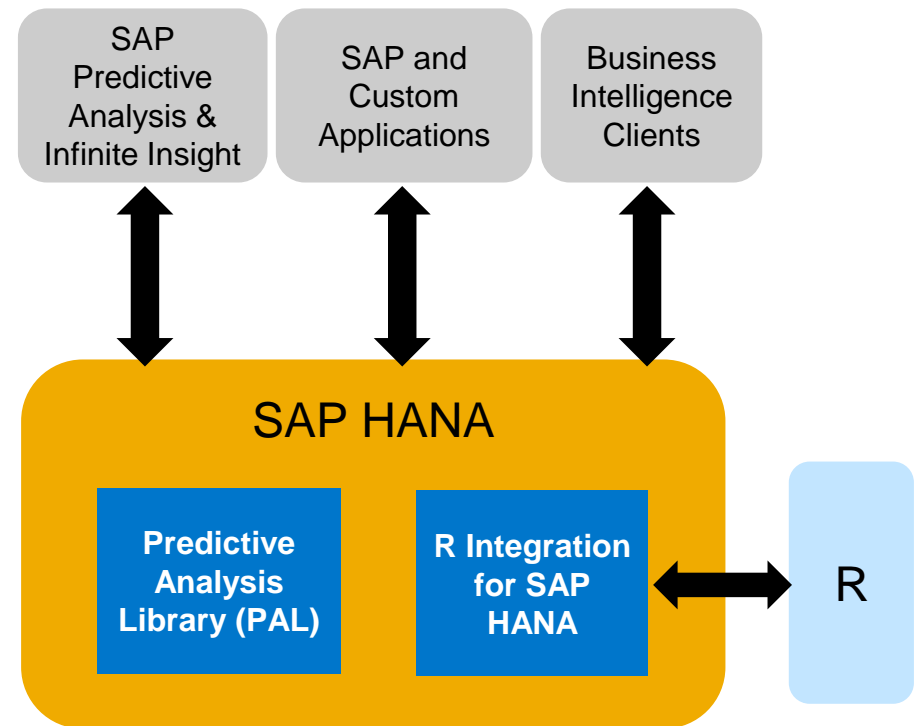
Handle Big Data

Support spatial data

Support (near) real-time processes

Simplify the overall system landscape

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SAP HANA especially supports spatial data

Supported IT/OT Requirements

Combine data from various sources

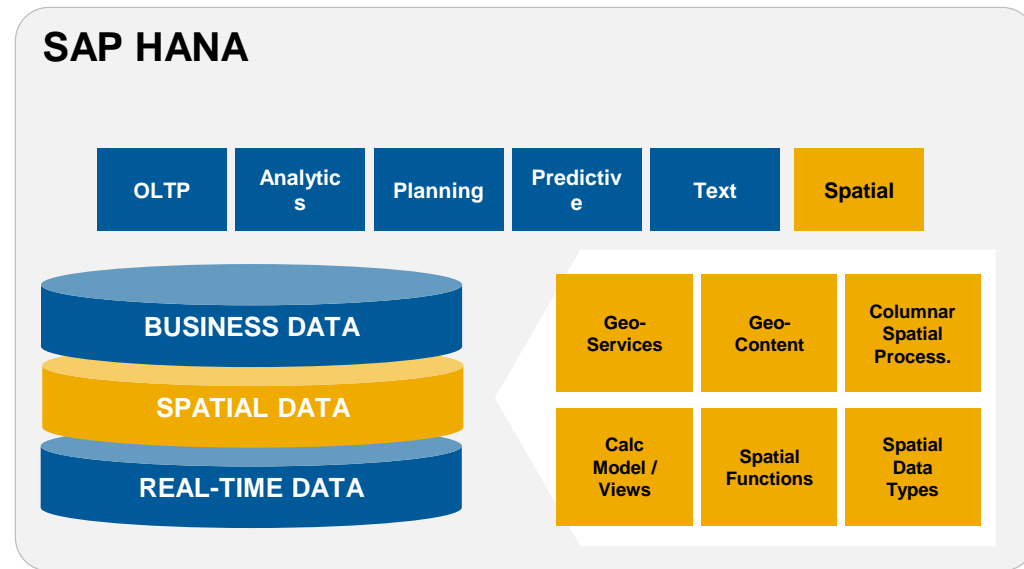
Handle Big Data

Support spatial data

Support (near) real-time processes

Simplify the overall system landscape

Enable new business scenarios



Example: Case Study for Geospatial Analysis at Alliander

- Pipeline integrity management analysis to identify high-risk transportation & distribution pipes that are close to structures.
- Requires pre-processing and analyzing huge amounts of spatial data.
- It took more than 3.5hours for this analysis on legacy architecture.
- SAP HANA PoC brought the compute time to less than 2.5 seconds allowing the company to perform adhoc asset management and reduce potential outages, & avoid catastrophic failures.
- Additionally, geospatial visualization was used to estimate maintenance cost per year for electricity stations.



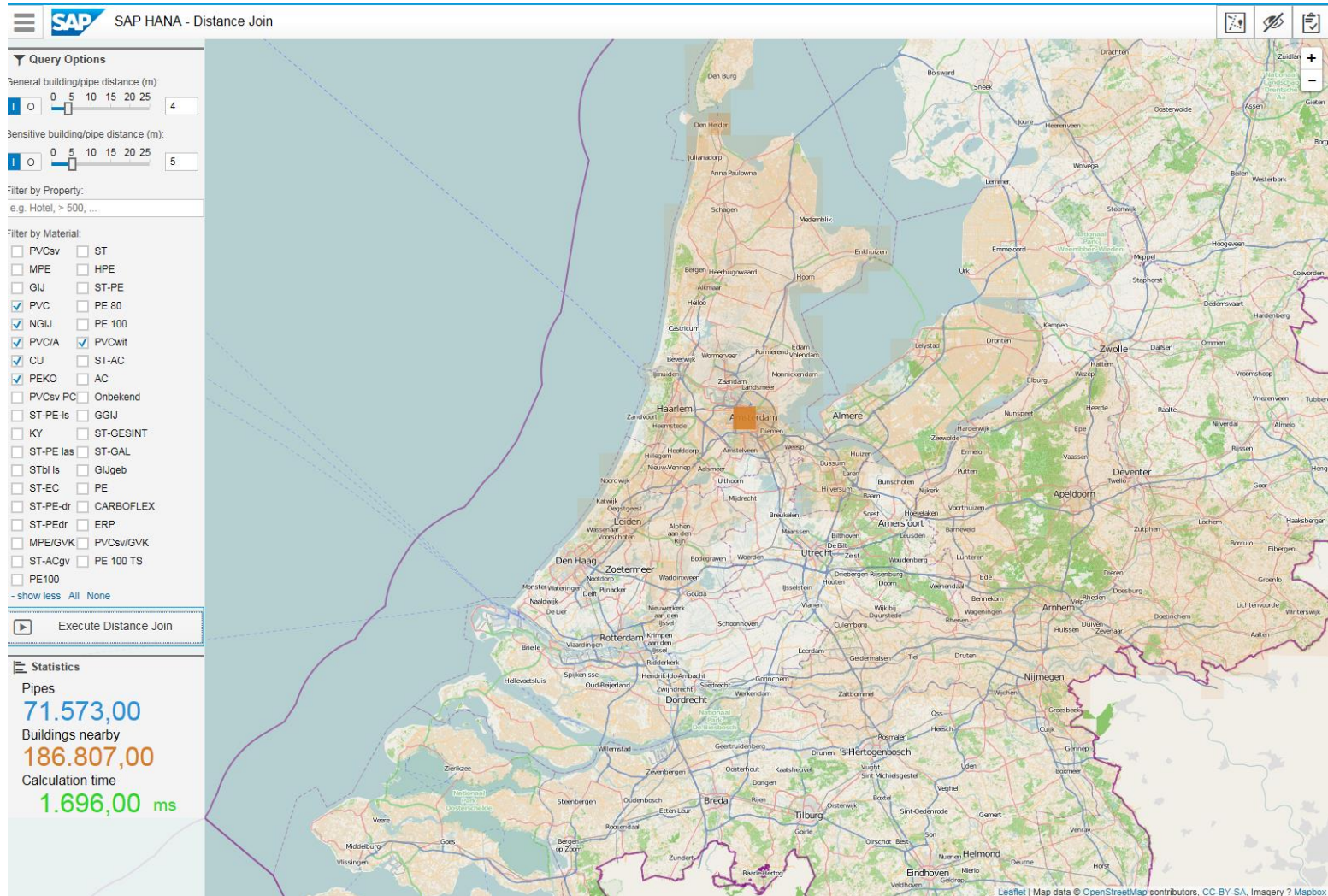
5400x

3.5hours to less than
2.5seconds in PoC

New capabilities

by combining geospatial
with transactional data

Screen Shot from the Alliander Case Study



SAP HANA is a complete application platform

Supported IT/OT Requirements

Combine data from various sources

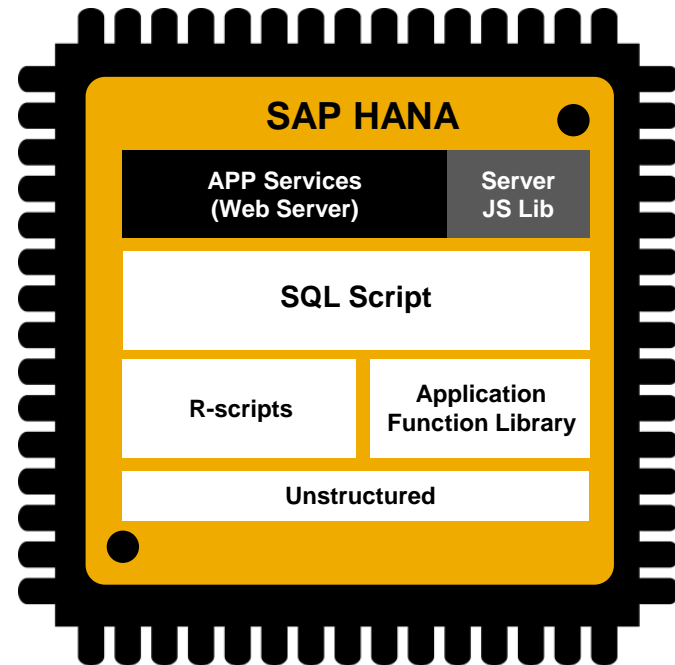
Handle Big Data

Support spatial data

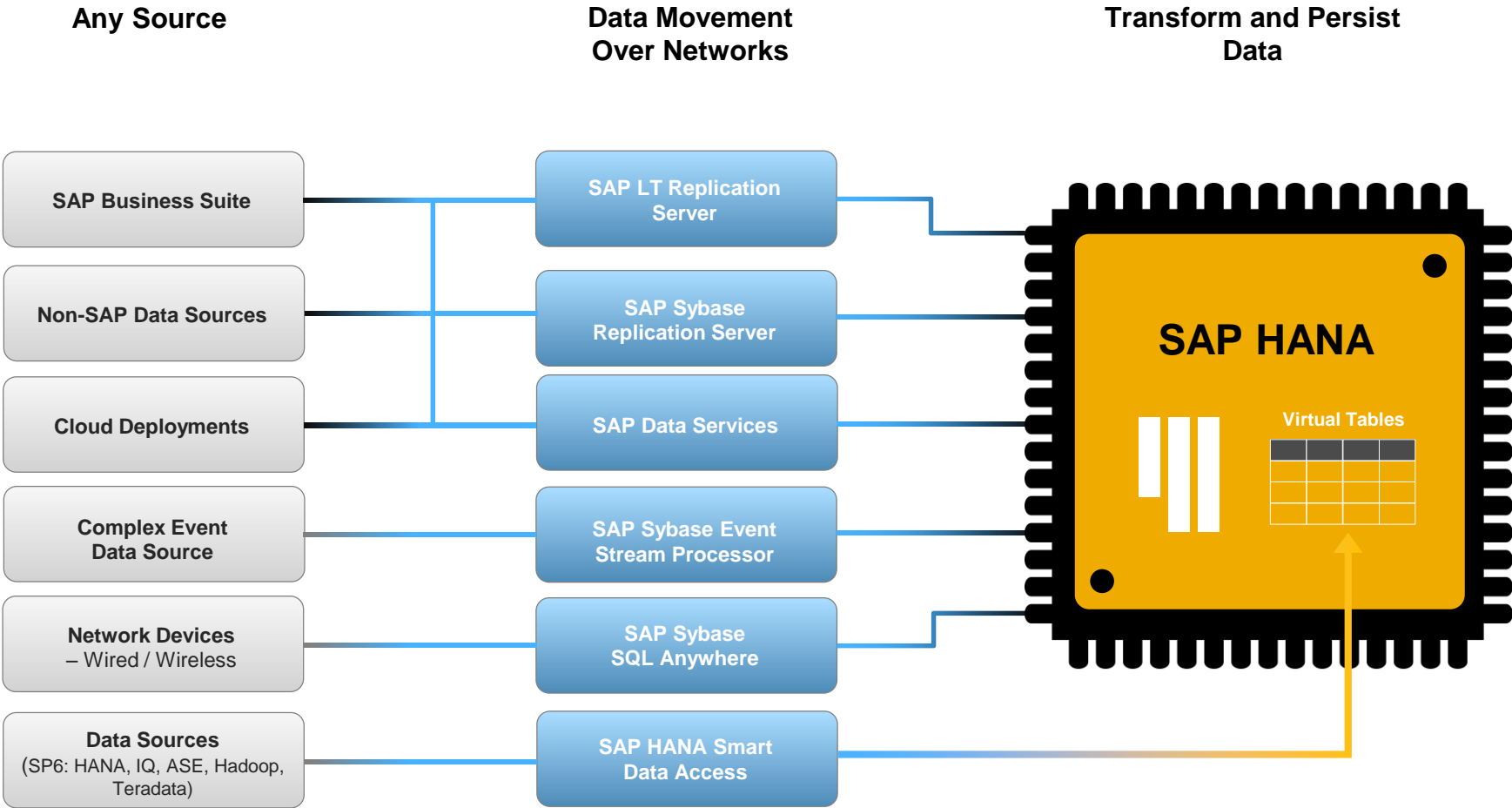
Support (near) real-time processes

Simplify the overall system landscape

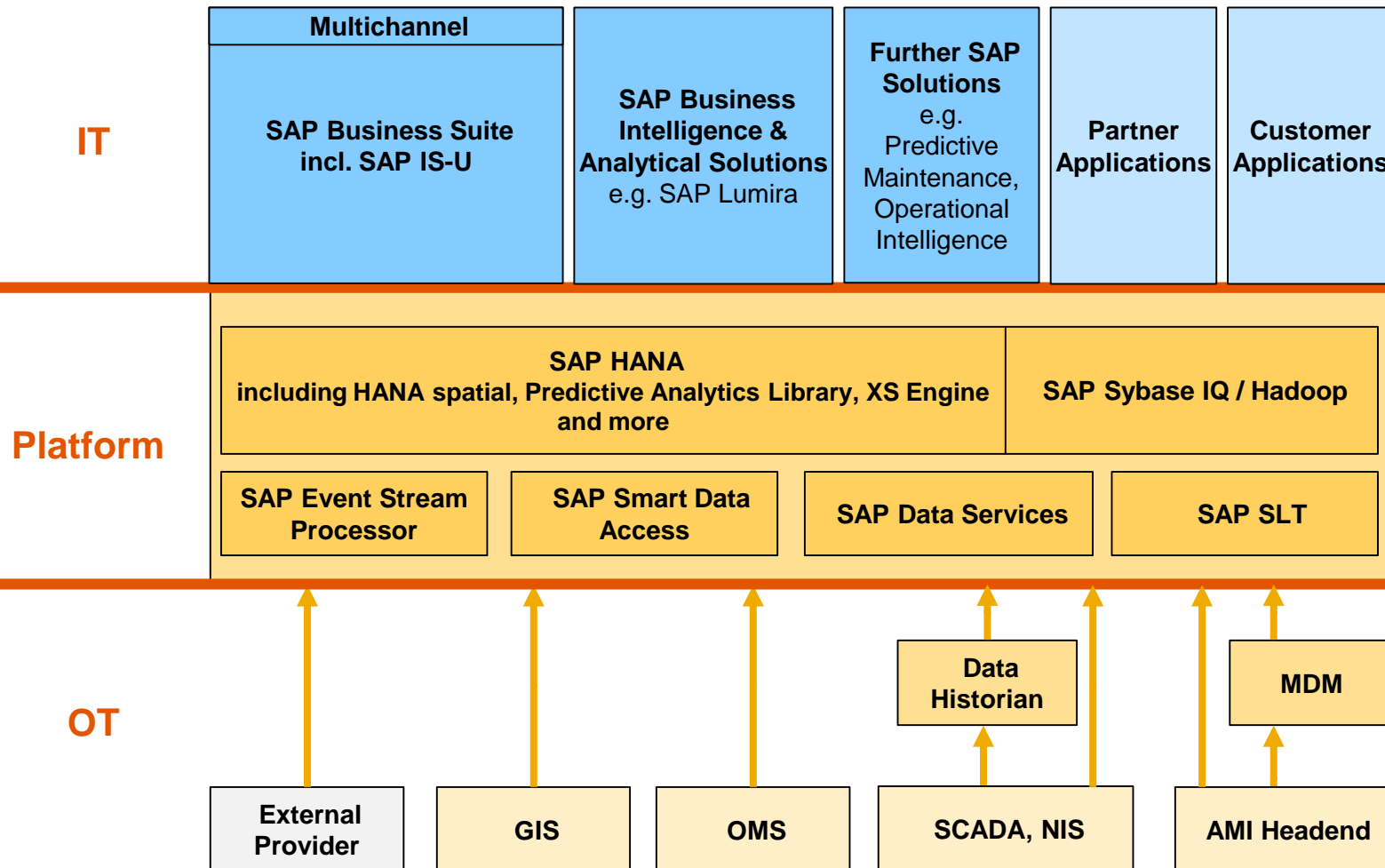
Enable new business scenarios



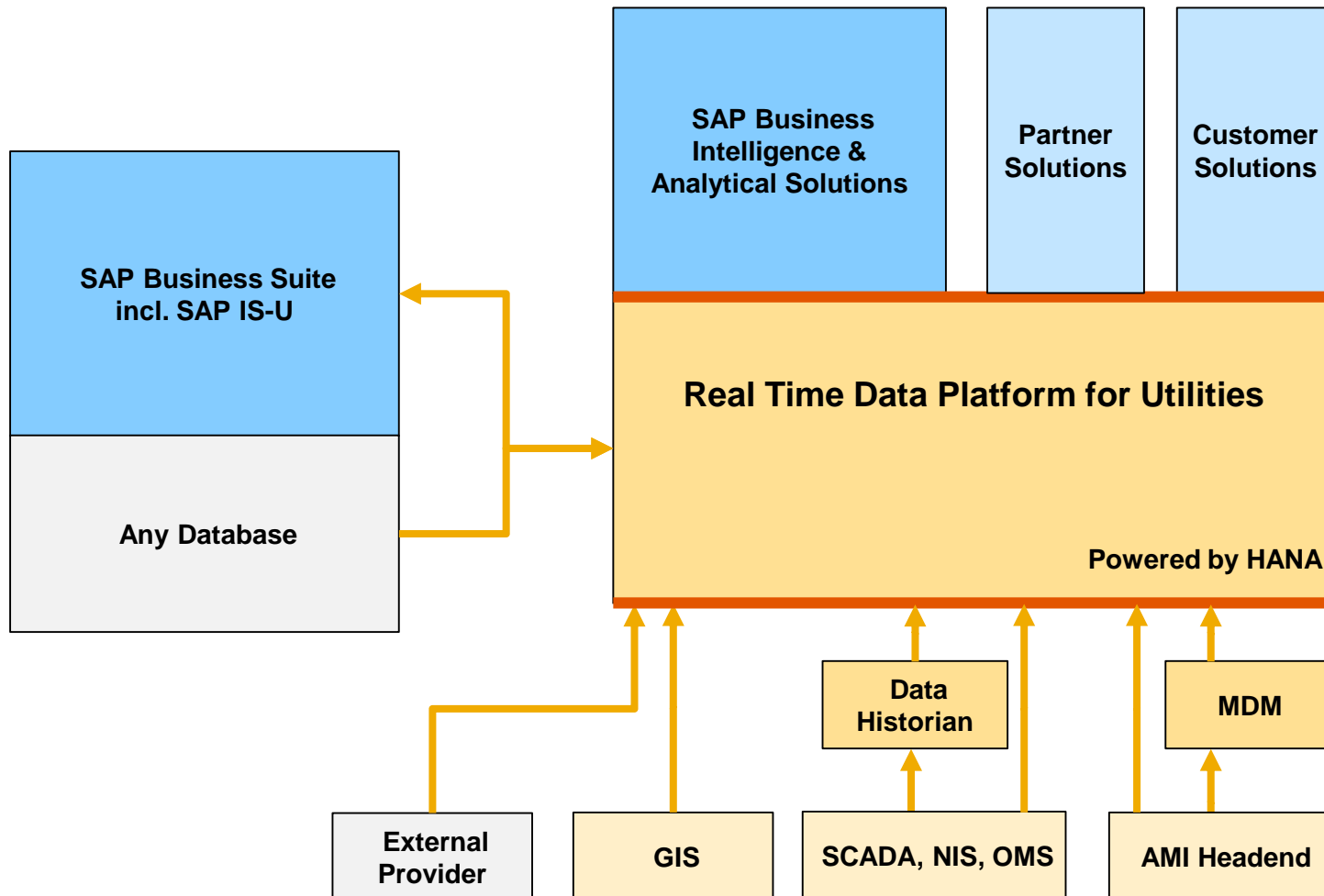
Comprehensive Data Provisioning for SAP HANA

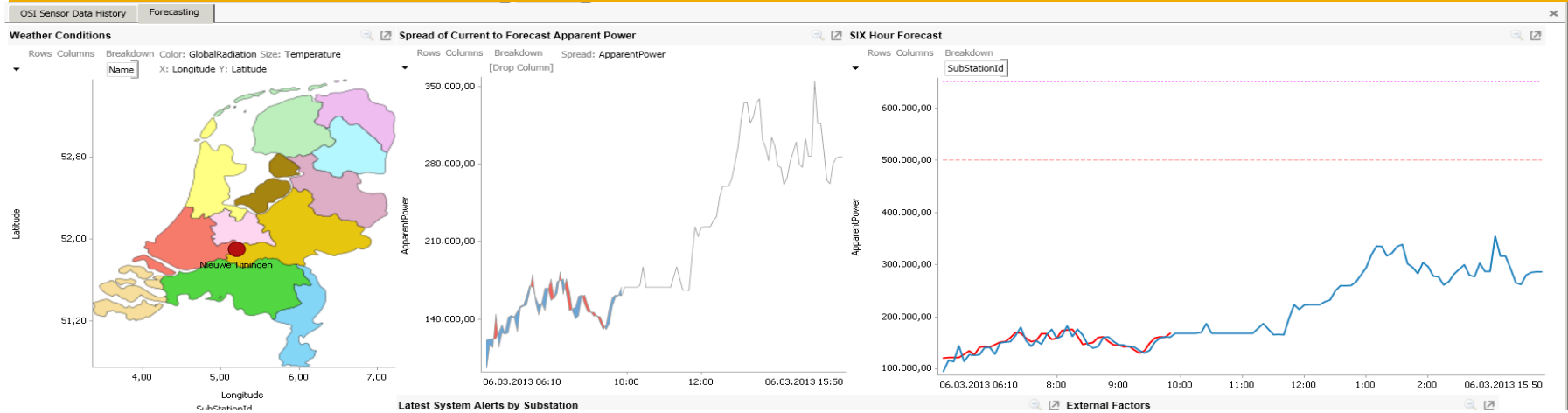


SAP HANA and the data provisioning tools result in the Real Time Platform for Utilities



The Platform can also run as a Sidecar





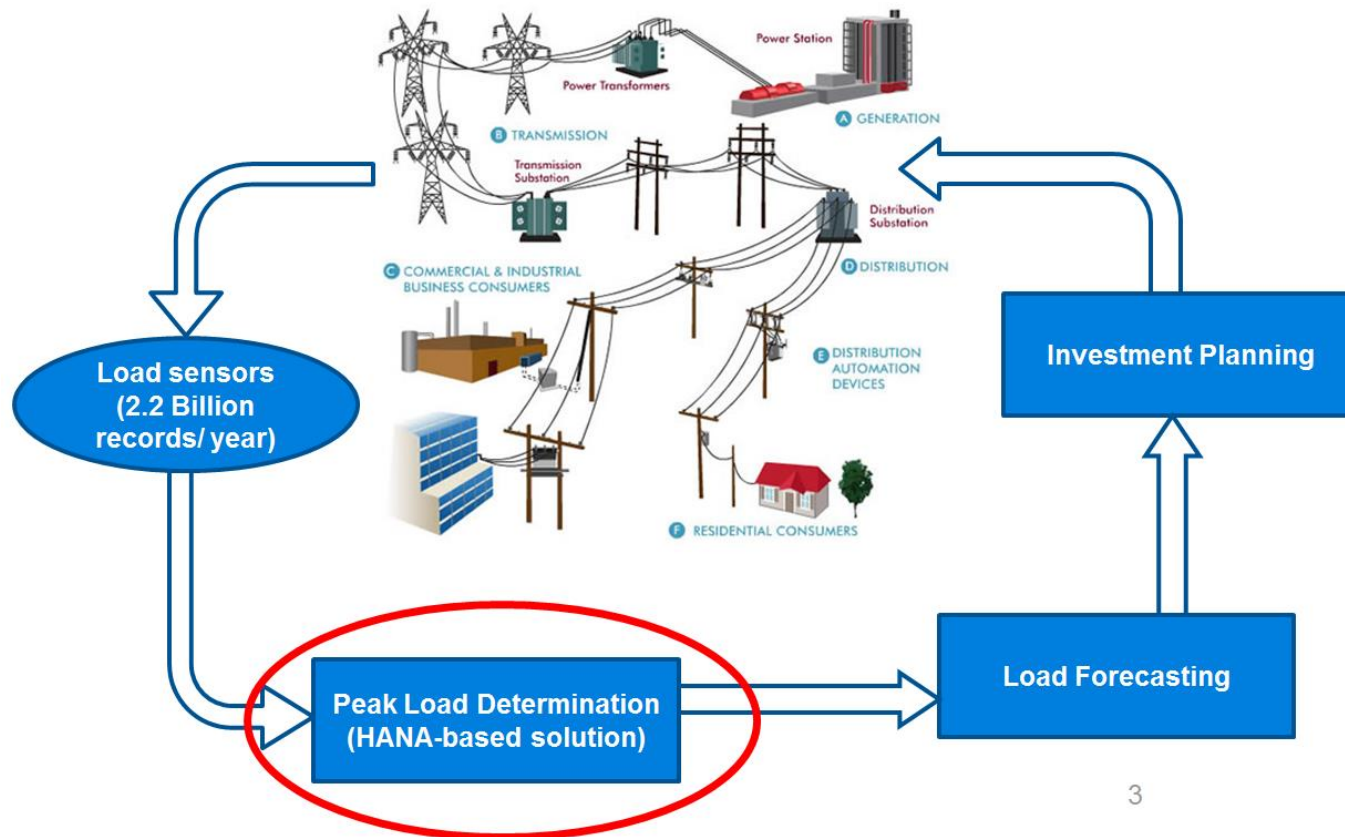
Some examples how the platform is already used

Load Forecasting

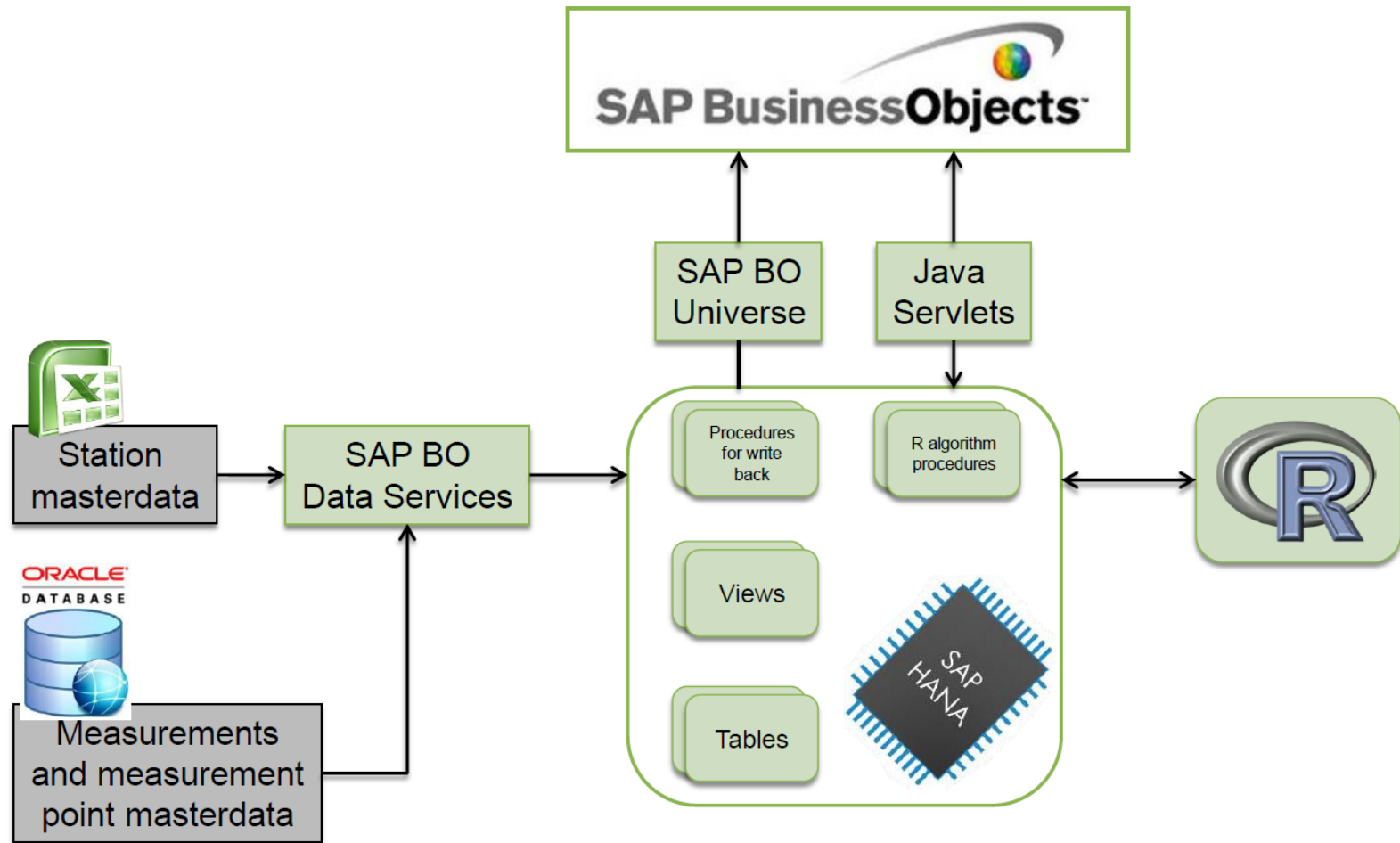
Use case: Load forecasting at Alliander

Implemented by SAP Data Science

Solution Context

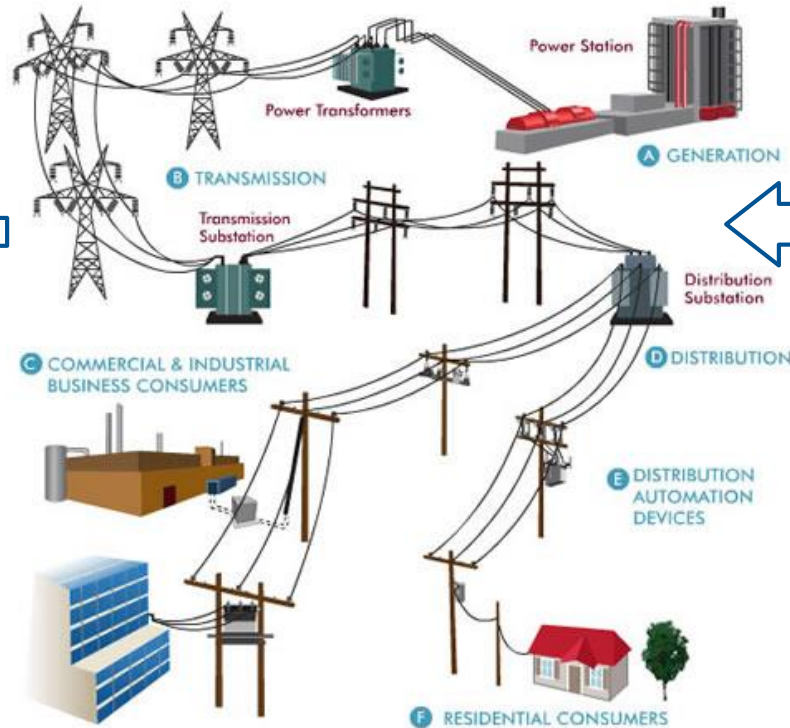


Load forecasting example by Alliander – Architecture

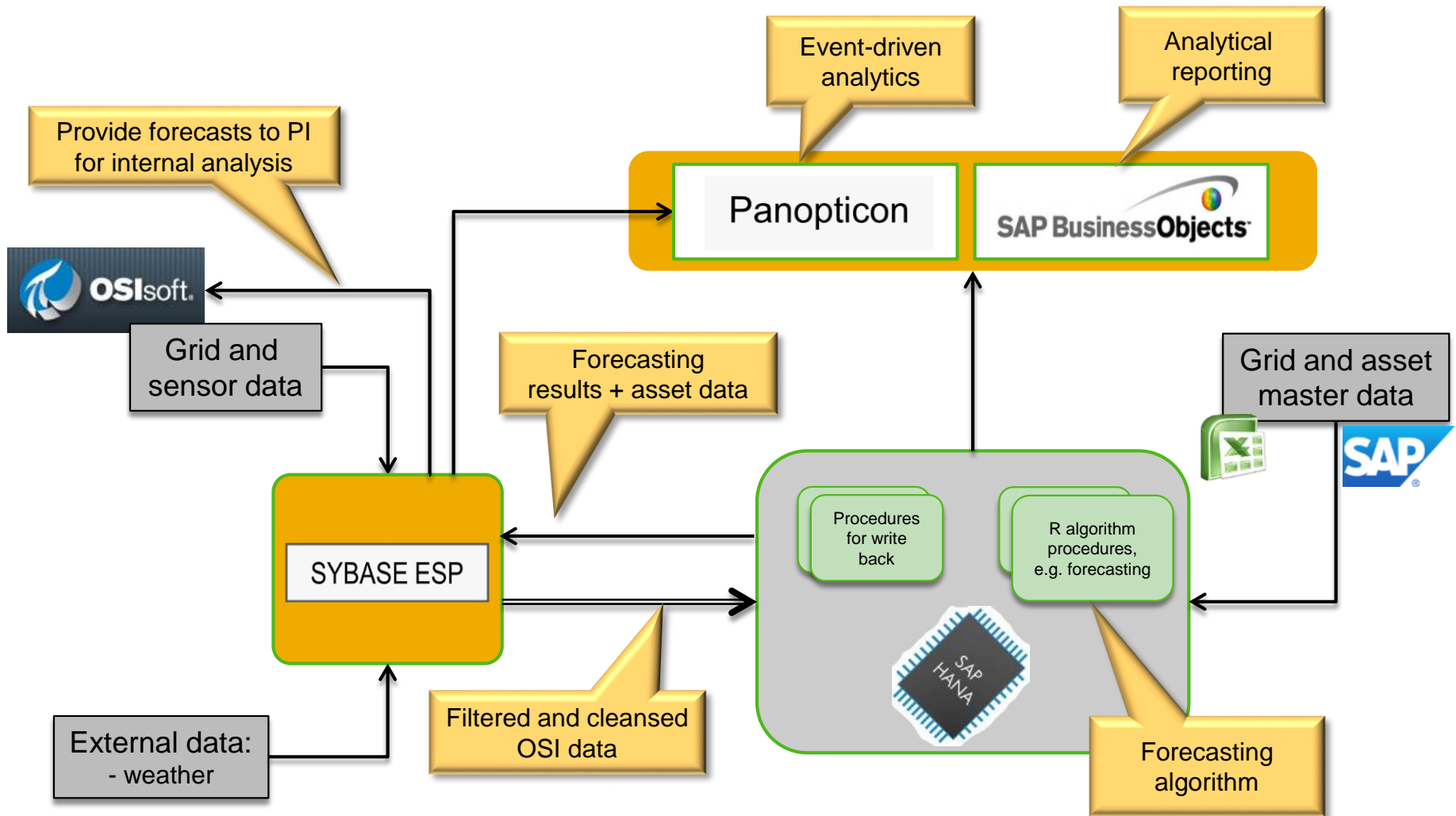


Use case: Real-time load forecasting at Alliander

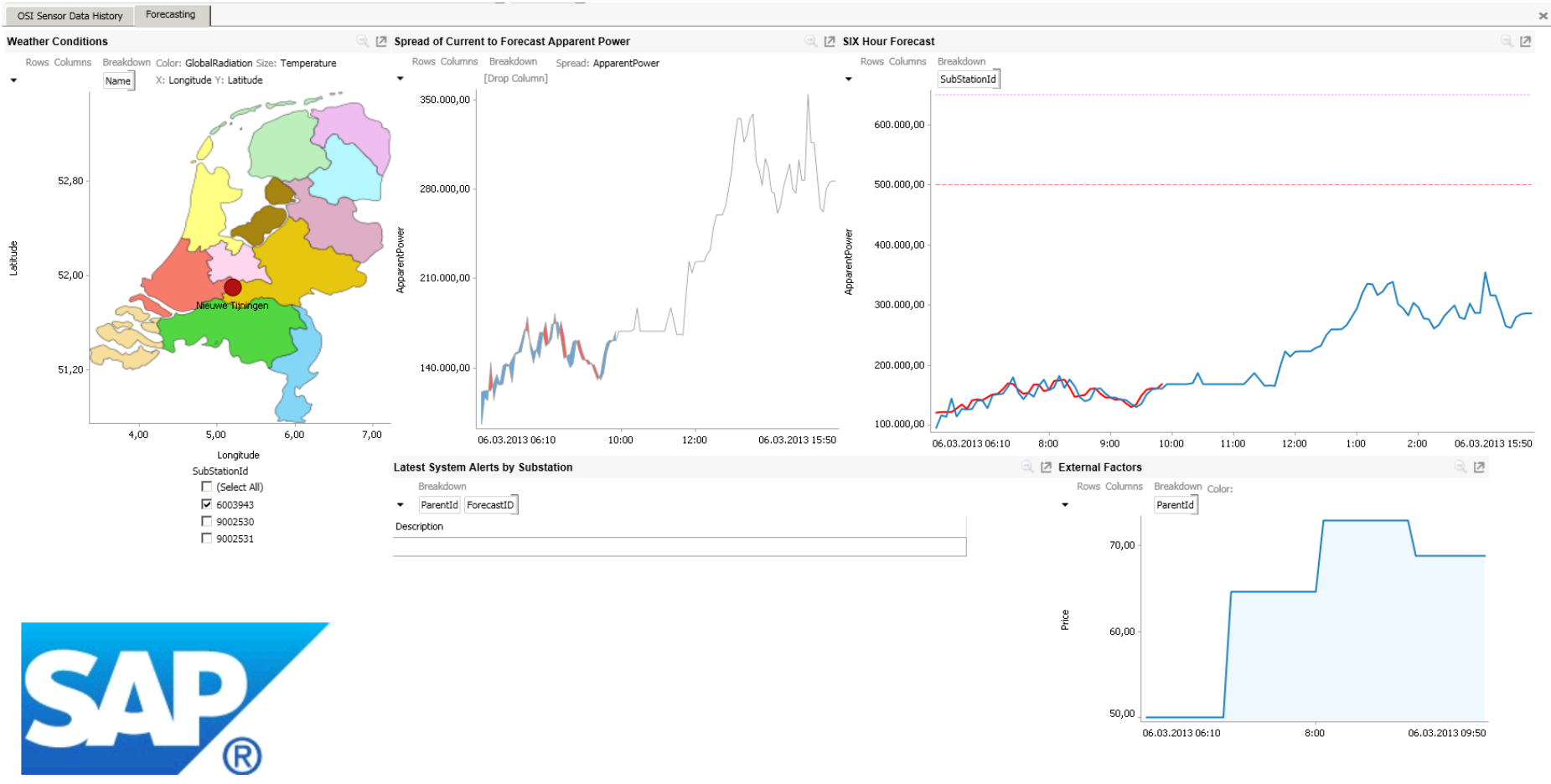
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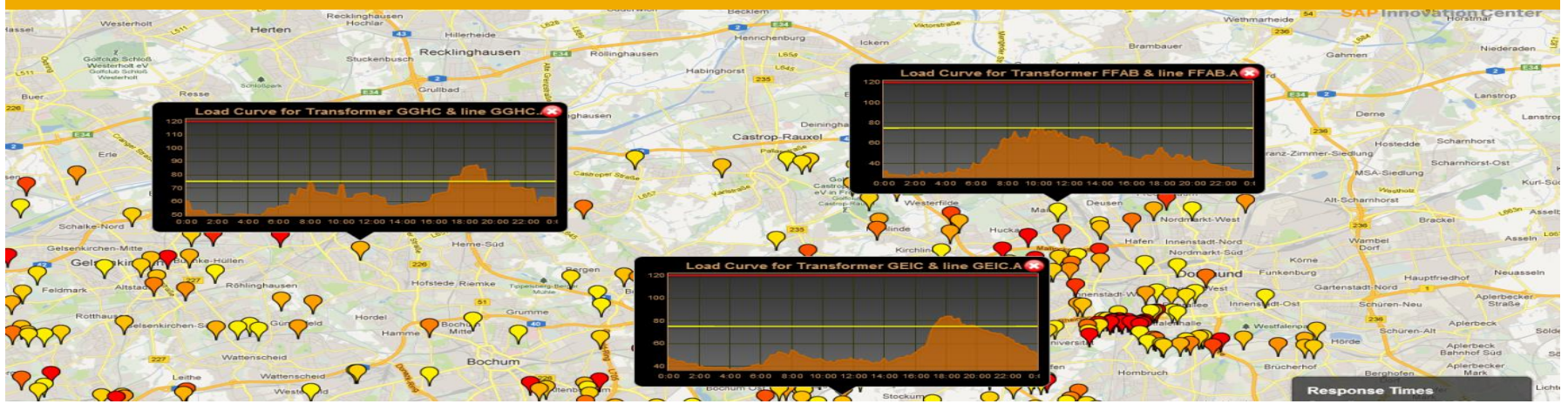


Reference architecture: Real-time load forecasting



Dashboard of the Alliander real-time load forecasting PoC





Some examples how the platform is already used

Transformer Analytics

Use case: Transformer overload analytics

Implemented by the SAP Innovation Center

Business Scenario

- Renewables and distributed generation lower predictability of load in the grid; overload may cause significant wear-out. Insight allows for taking action, e.g.
 - Exchange transformer or reconfigure network
 - Demand-response program with customers repeatedly contributing to overloads

Prototype

- Native SAP HANA implementation
- Comprises 87 weeks of load measurements for ~12,000 transformers
 - ~1 billion records (10-minute measurement interval)
 - ~20 GB compressed in main memory
 - No materialized aggregates

Use Cases

- Transformer overload overview in geospatial context
- Transformer load comparison and investigation of load peaks
- Examining weekly patterns and next-day forecasting
- Weather correlation of load
- Loss of life calculation and visualization

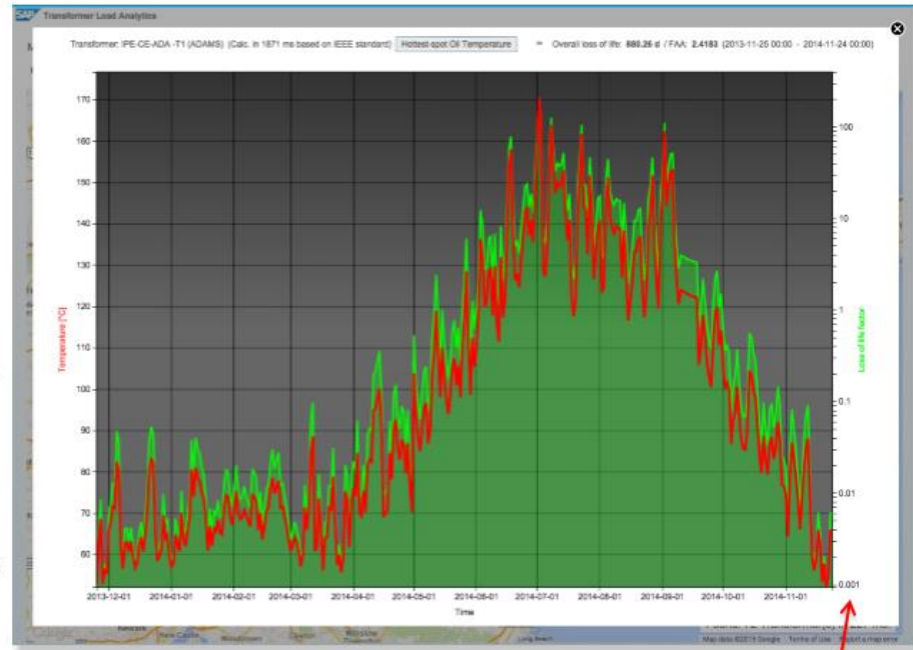


PSE&G has presented this solution at Distributech 2015



Transformer Loss-of-Life Calculation

- ▶ Calculate transformer loss-of-life using IEEE C57.91-2011 (for 1 year with 1-minute measurements 1.8 seconds)
- ▶ Use load or (here) transformer oil temp measurements (top-oil and winding)
- ▶ See development of resulting hottest-spot oil temperature (red) and loss-of-life factor (green) over the year



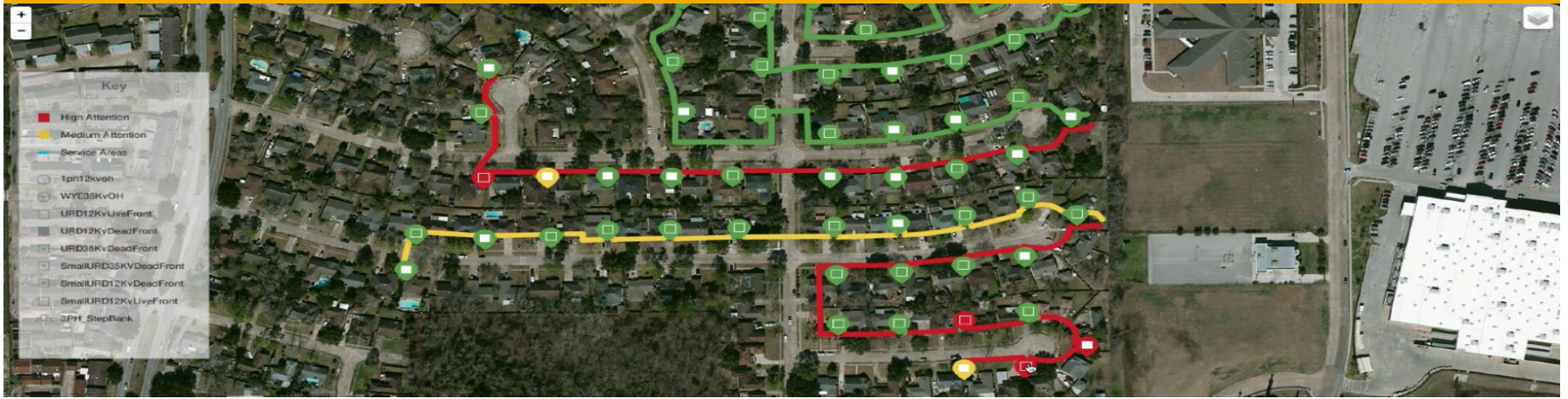
exponential scale!

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Asset Strategy



1/28/2015

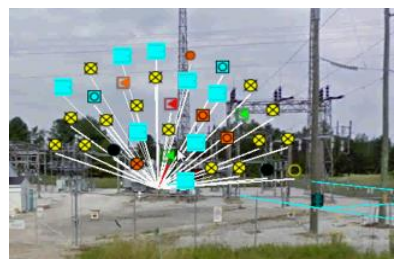


Some examples how the platform is already used

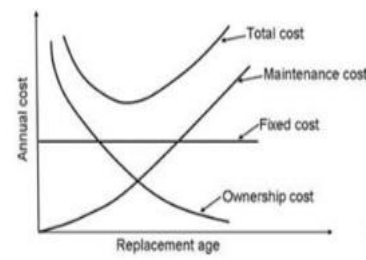
Asset Health Management

Asset Health: The launch application on the IT-OT Integration Solution

1 Asset Information



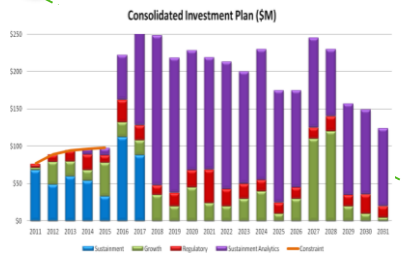
2 System integrity



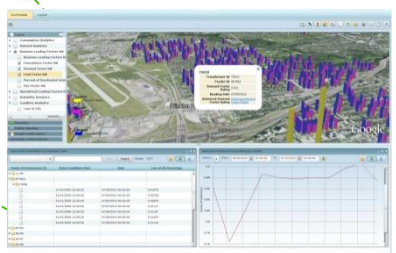
3 Predictive analytics

Severity of Failure	Weighting	PF1	PF2	PF3	PF4	PF5	PF6	Weighting Probability of Failure
SF: Catastrophic	3,000	3,000	3,000	30,000	75,000	225,000	750,000	
SF: Severe	600	600	1,800	6,000	15,000	45,000	150,000	
SF: Significant	125	125	375	1,200	3,125	8,075	21,280	
SF: Moderate	25	25	75	250	625	1,675	4,250	
SF: Minor	5	5	15	45	125	375	1,250	
SF: None	1	1	3	15	75	250	250	

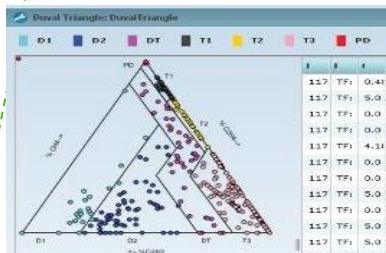
4 Asset risk and algorithms



5 Future simulation for investment



6 Load profiles



7 Duval triangles



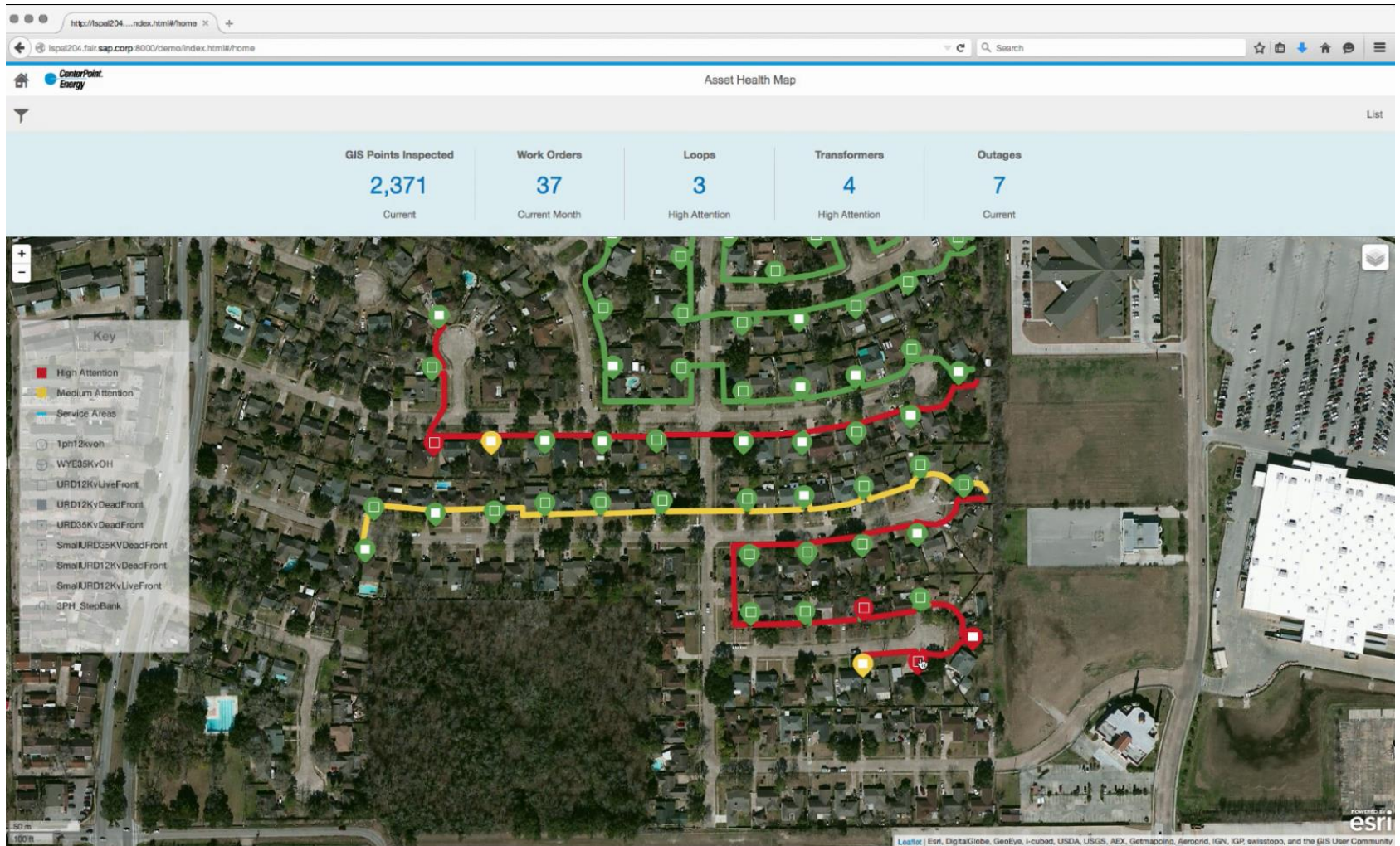
8 Geo-spatial display of analytics

- Asset Classes**
- Substation Transformers
 - Substation Breakers
 - URD
 - Others (TBD)

IT-OT Integration Solution

- Outcomes**
- Reduced Asset Risk
 - Increased Capital Effectiveness
 - Improved System Reliability
 - Improved Maintenance Strategies
 - Increased Regulatory Transparency
 - Increased Cust. & Worker Safety
 - IT Benefits

Asset Health Management Demo



Some IT/OT Partners we are working with

Accenture

BTC

Choice Technologies

Critigen

ESRI

Fichtner IT Consulting

OSIsoft

PowerGrid

Rolta

Space Time Insight

Utopia

Summary

Complemented by several additional SAP solutions, SAP HANA serves as platform for IT/OT integration.

The SAP Data Science team, SAP Custom Development and SAP Consulting support customer projects.

In addition SAP collaborates with various partners to provide a complete IT/OT integration offering.