

# Service, Digital Portfolio, AssetGuard Management

Minerals Week 2020

# Key questions of Strategic Electrical Asset Management

What is the condition of my assets right now?

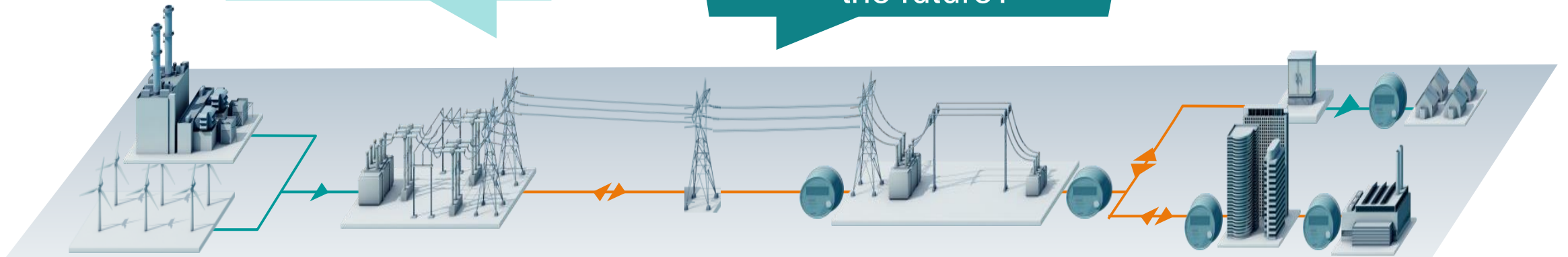
How to extend the lifetime of my assets?

Which long term resources do I need to manage replacement waves?

Am I doing the right maintenance at the right time?

How will the condition of my assets develop in the future?

When should I replace my assets?



Start  
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# Challenges in Medium Voltage Switchgear

## Resiliency

Prioritization in relation to health status and relevance of the feeder becoming key factor to reduce unplanned outage



Due to life time extension policies and changes in maintenance criteria defined by users, care should be taken to keep higher reliability level



This is a challenge when the equipments and components, like the drives, are exposed to stressing operation conditions



Especially non-operation long time may have effect on a reliable switchgear behavior

# Siemens SI DS (Example of SaaS) IoT Services Models

## Option I: Cloud Computing

Lower CAPEX, higher OPEX



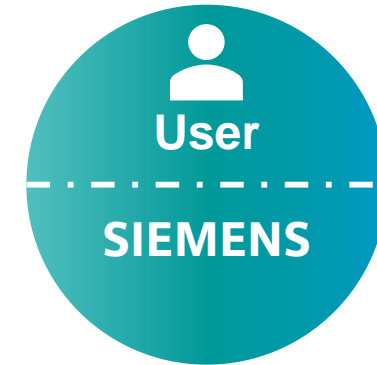
## Option II: Edge Computing

Higher CAPEX, lower OPEX



## Application & HMI

Enable access to data and analytics to experts anywhere



## Siemens Experts

Customer support on evaluating data and defining actions

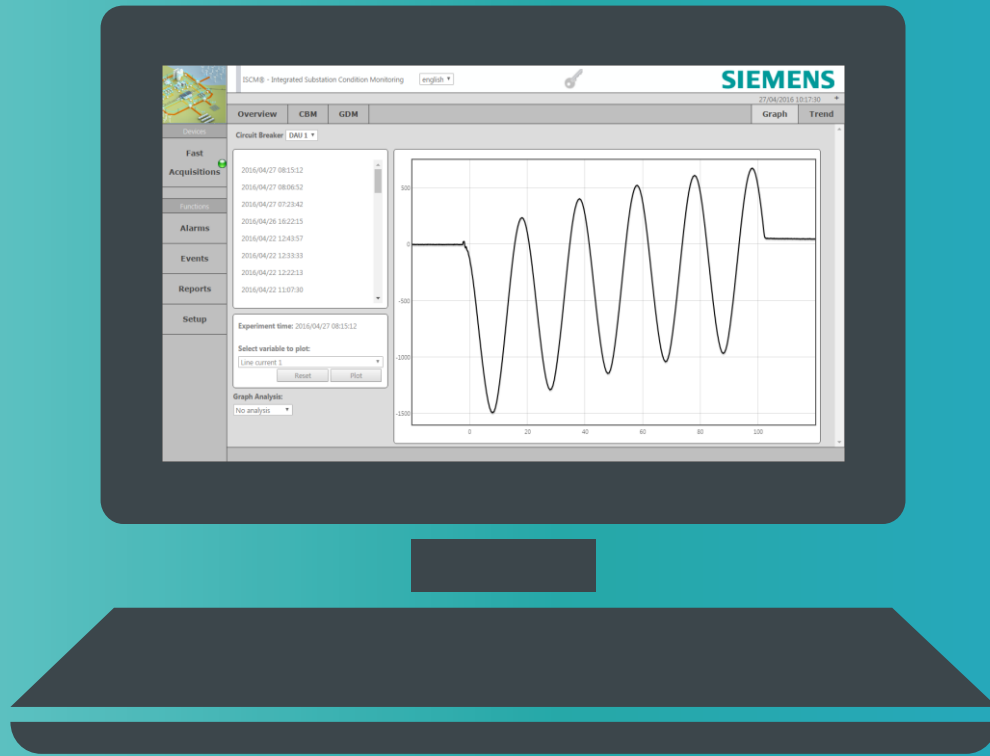
# Benefits of a Digital Asset Management ecosystem for infrastructure networks

<p><b>3 × 3</b></p> <p><b>Key</b></p> <p><b>Benefits</b></p>	<p><b>Lower Costs</b></p>	<ul style="list-style-type: none"> <li>• <b>Improved decision making</b> based on reliable data, e.g. better prioritization</li> <li>• <b>Reduced outage cost</b>, revenue loss, penalties</li> <li>• <b>Reduced maintenance and repair expenses</b> by adoption to Condition Based strategy</li> </ul>
	<p><b>Higher Performance</b></p>	<ul style="list-style-type: none"> <li>• Improved <b>asset utilization and reliability</b></li> <li>• Find pending failures and <b>reduce unplanned outages</b></li> <li>• <b>Prevented catastrophic failures</b> and fewer accidents of planned vs. unplanned outages</li> </ul>
	<p><b>Efficient Processes</b></p>	<ul style="list-style-type: none"> <li>• <b>Optimization</b> and justification of <b>work programs and investment schedules</b></li> <li>• <b>Workforce efficiency</b> by having the right data at hand; compensate retiring experts</li> <li>• Improved <b>regulatory compliance</b></li> </ul>

What keeps you awake at night?	Siemens Asset Management eco-system	Asset Management Consulting	Siemens Asset Management Solution	Remote Diagnostic and Analytics Services	Integrated Substation Condition Monitoring	Condition Monitoring Products	Cyber Security	On-site Condition Assessment	Autonomous on site inspection - SIEAERO	Think big – start small	Benefits of a Digital Asset Management eco-system
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# Why digitalization can increase resiliency



- Early detection of incipient faults situations
- Triggering offline diagnostics measures
- Triggering life extension measures
- Full transparency on Install Base status
- Supporting of maintenance strategies
- Checking of maintenance results
- Prioritization on Health Index and relevance

# Siemens eco-system to support Digitalization

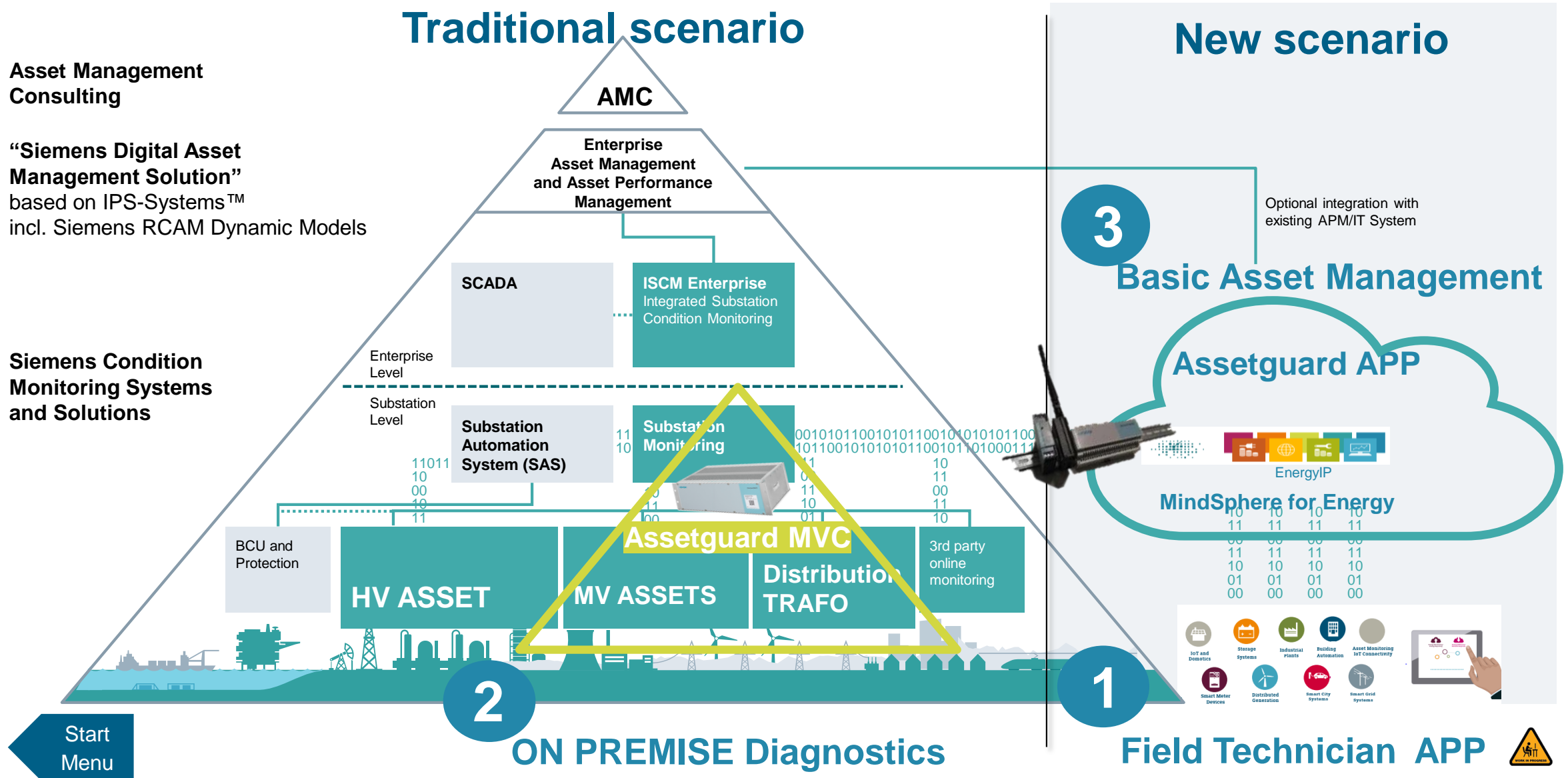
Condition Monitoring and Asset Management

## Traditional scenario

Asset Management Consulting

“Siemens Digital Asset Management Solution”  
based on IPS-Systems™  
incl. Siemens RCAM Dynamic Models

Siemens Condition Monitoring Systems and Solutions





# Condition Monitoring Products Catalog

## Assetguard product family for monitoring and diagnosing

### Electrical Substation

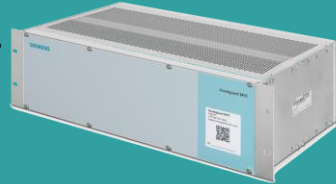


### High Voltage

### Power Transformers

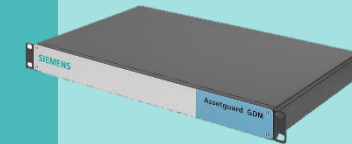
### Low & Medium Voltage

**Assetguard MVC –**  
Circuit Breaker  
Monitoring System



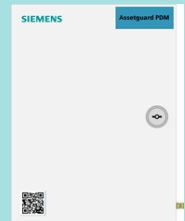
**SITRAM TDCM –**  
Comprehensive fault  
diagnostic Transformer  
Monitoring System

**Assetguard HVC -**  
HV AIS/GIS Circuit  
Breaker Monitoring  
System



**Assetguard GDM**  
– HV SF6 gas  
insulated switchgear  
monitoring system

**Assetguard PDM -**  
HV GIS Partial  
Discharge Monitoring  
System



**Assetguard IoT**  
IoT device to acquire and  
connect HV / MV / LV



### Field Sensors

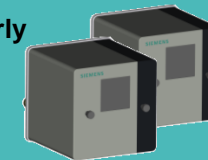
Sensor KIT for  
CB Measures



**Bushing Monitoring –** early  
fault detection in bushings



**SITRAM H2Guard –**  
early fault detection in oil

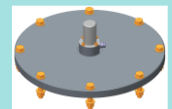


**Multisense 5 and  
9 –** Comprehensive  
fault detection in oil

**SF6  
Sensor**



**PD  
Antennas**



Sensor KIT for  
CB Measures



+3<sup>rd</sup> Party Products e.g. PD sensors for Cables etc.

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# Focus Assetguard MVC

## On Premise Solution

# Assetguard MVC

## Content

Challenges in Medium Voltage  
Switchgear Monitoring

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Siemens Assetguard MVC:  
Basic vs Extended version

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Hardware setup

---

Knowledge Module analysis &  
event

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Optional Functionalities

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More information



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Use Contact: Region: Agostino Trotta, HQ @ Nicolo Bianchi

DEMO LINK

<http://assetguardmvc.azurewebsites.net/>

# Overview: Basic vs Extended version

## Simple solution and easy installation



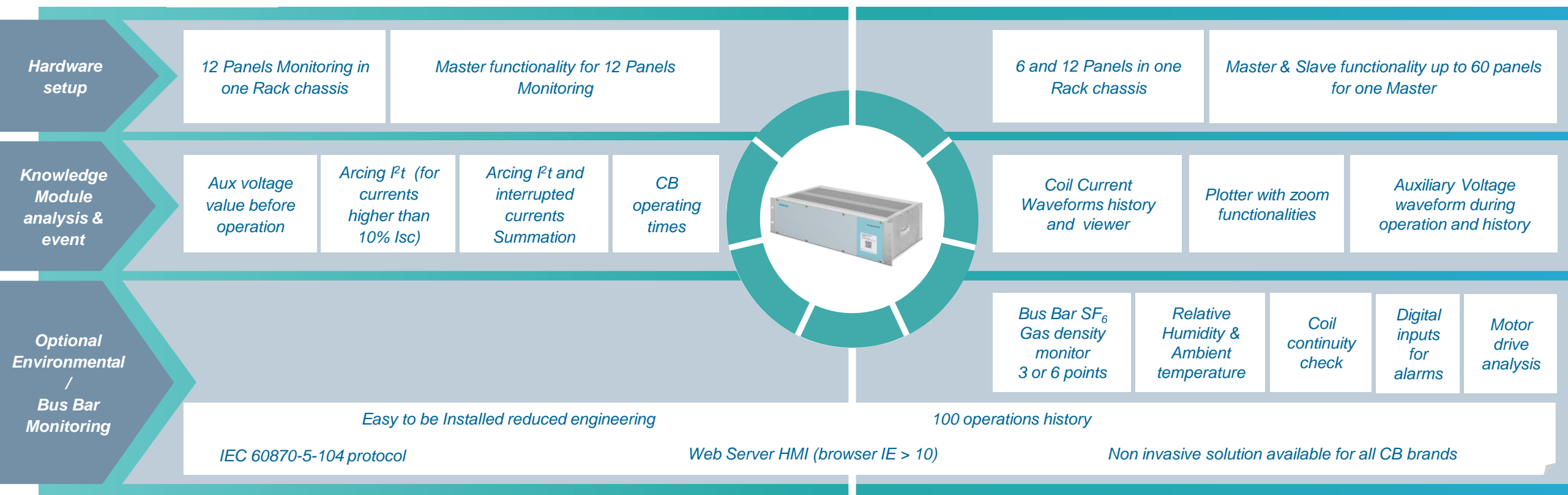
### Basic configuration

One box for monitoring large installed based  
Indicated for AIS Switchgears



### Extended configuration

One box for monitoring critical/strategic equipment  
Indicated for AIS & GIS Switchgears



# Optional Environmental/Bus Bar Monitoring

## *Focus on extended version*

This Option are available only for Extended configuration version in order to extend the monitoring to Bus Bar and Asset Environment status.

*2 Ambient temperatures for 2 Bus Bar points*

*2 Ambient Humidity for 2 Bus Bar points*

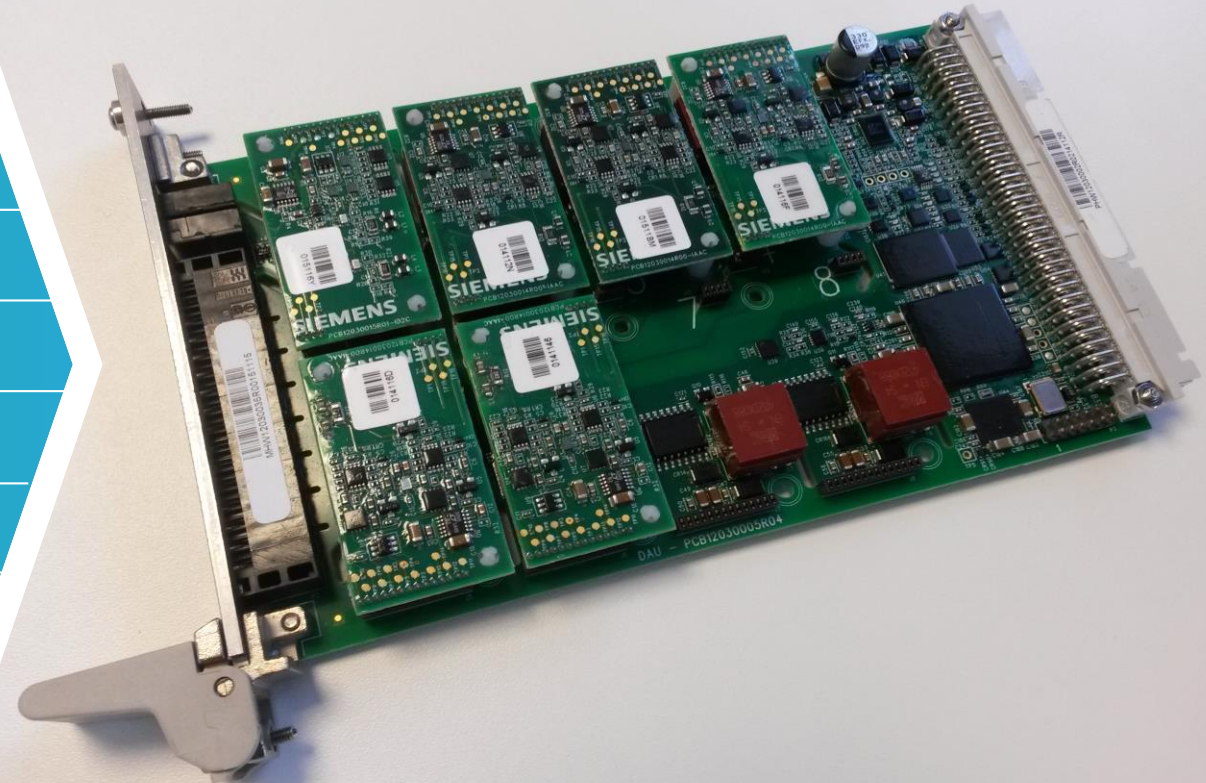
*3 or 6 SF<sub>6</sub> density inputs for bus bar compartments*

*Coils continuity check*

*8 Digital inputs for alarms*

*Multilanguage Features (on request)*

*Additional Reports (pdf format)*





# Hardware setup (basic and extended version)

## All in one Box – Reduced adaptation engineering

Integration  
Level C

SCADA

OTHER eg. PC, tablet

Central Unit  
Assetguard MVC



Switchgear



Electrical safety according to EN 60529, EN 61010-1 and EN 60255-5

Electromagnetic compatibility (EMC) according to EN61000 and EN 55011

Level 3 electrostatic and electromagnetic immunity

4 kV surge immunity

Environmental strength according to EN 60068

Operating temperature -25°C to 70°C

Humidity 10 - 95%

Protection class IP 20

Power supply port and each channel has a dielectric withstand capability of 3 kV<sub>RMS</sub> and 5 kV 1.2/50 µs impulse

Measurement resolution

12 bit at 10 kS/s sampling rate

Accuracy 0.5 % of range

Available communication protocols

IEC 60870-5-104, others on request

Data storage

2 Gigabit for each CB = 100 Operations for CB

Cyclical structure (oldest data is dropped first)

Visualization

Web HMI as stand alone

Dimensions w x h x d

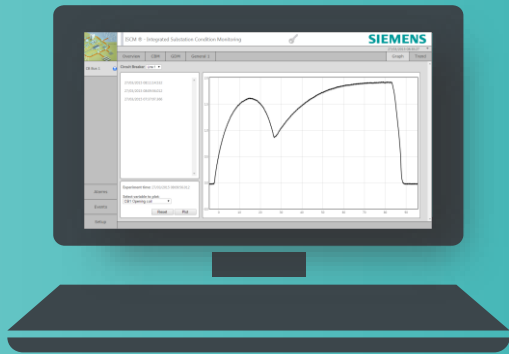
Rack Version (477 x 125 x 210 mm)

up to 12 CBs

Start  
Menu

# Knowledge Module analysis & event

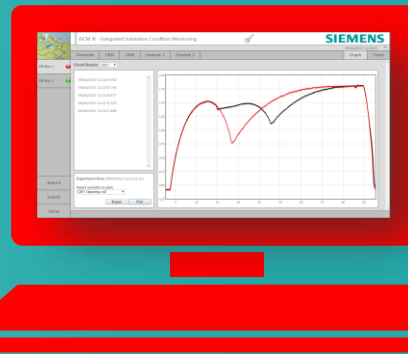
## Normal behavior: No Alarm



All operations are useful to collect data

- Environments info ( temp, humidity)
- CB Timing & Status
- Counter for I<sup>2</sup>t
- Aux voltage measurements
- Coil current data
- Others

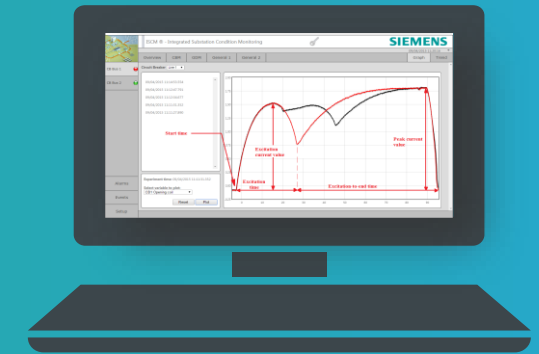
## Fault identification



Synthetic data are essential in order to focus on the asset

- Alarms for defined limit violation
- Warnings on counter overcoming
- Warnings on data analysis (KM)
- Information on Monitoring status on the asset

## Plan & Define restoring measures



Detailed data are useful to define the maintenance activity

- Actual trace comparison with oldest one
- Evaluation of limit violated & other measures
- Remote operation to verify last data
- Log evaluation
- Definition if a local intervention is needed and skills of maintenance people

\* Current waveforms and plotter functionalities just available for the extended version

# Synthetic Analytic Dashboard

Assetguard x +

Non sicuro | assetguardmvc.azurewebsites.net/home.html#/mv/1/dashboard/

App EnergyIP Asset Guard Assetguard MVC Sy... Assetguard Siebase... MindLaunchPAD EM Savona Campus Mi...

**SIEMENS** MVC Extended version 31/07/2017 10:38:04 admin Alarms

Milan

- MV Busbar 1
- MV Busbar 2
- Environment Measures
- Channels
- MB Registers
- TVC Channels

Line 1  
Serie : CB1  
Number of operations:  
Total interrupted current:

Line 2  
Serie : CB2  
Number of operations:  
Total interrupted current:

Line 3  
Serie : CB3  
Number of operations:  
Total interrupted current:

Line 5  
Serie : CB5

Line 6  
Serie : CB6

Overview

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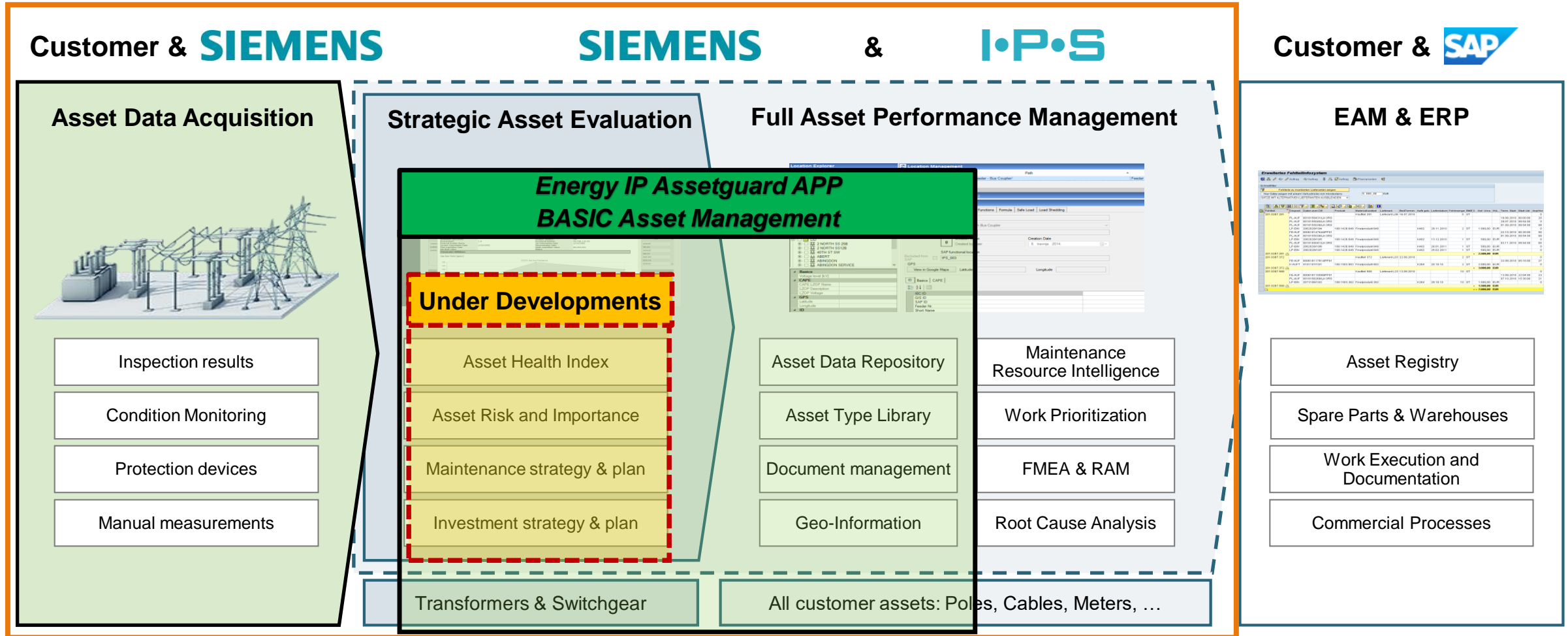
# Focus Assetguard APP

A scalable IoT solution for all  
your Install Base



# Siemens' Asset Management Software Ecosystem

## Scalable solution in relation to our customers needs



# Flexibility in Visualization



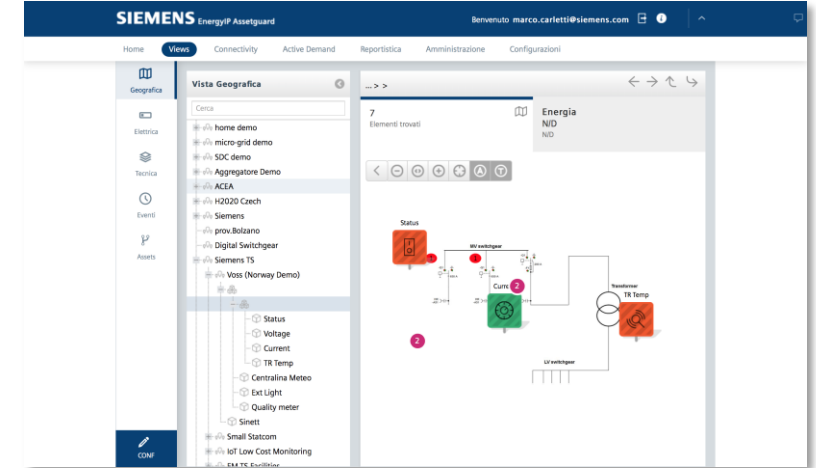
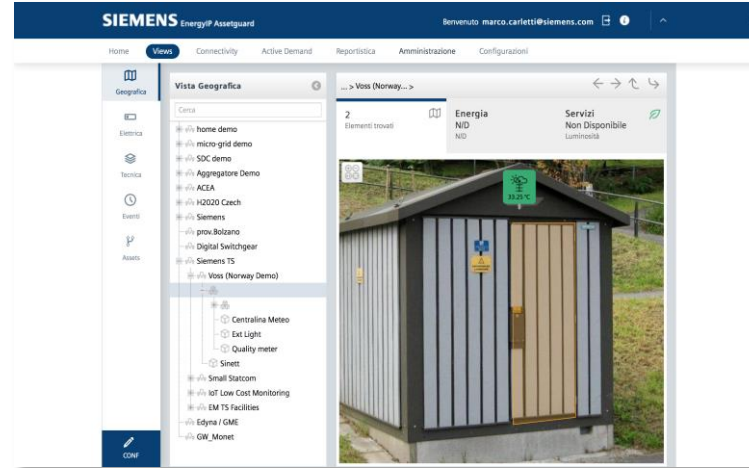
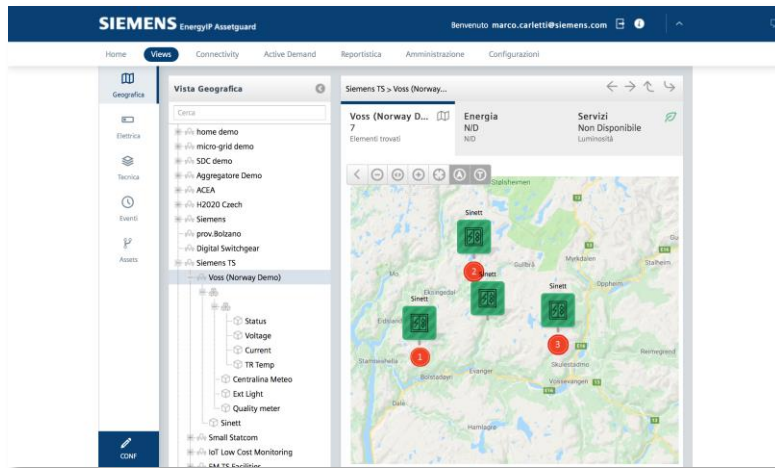
## Views can be customized, enabling :

- Geolocalization of entire site
  - Geolocalization in a plant map of each asset
  - Integration of Real Photo layer view for all assets
  - Integration of electrical scheme layer view
  - Other as requested by customer
- 
- Dashboard can be personalized by each user according to their needs and scope
  - Report can be pre-defined to create new widget to be integrated in Dashboard view
  - Drag & Drop: modifications can be done by every user allowed without any expertise in SW / Programming



# Performance monitoring and Asset Management – Assetguard APP - Sub Station Asset Monitoring

## Detail List of Things and Assets



Mapping and identify assets and Things with S/N Type Vendor Model ...



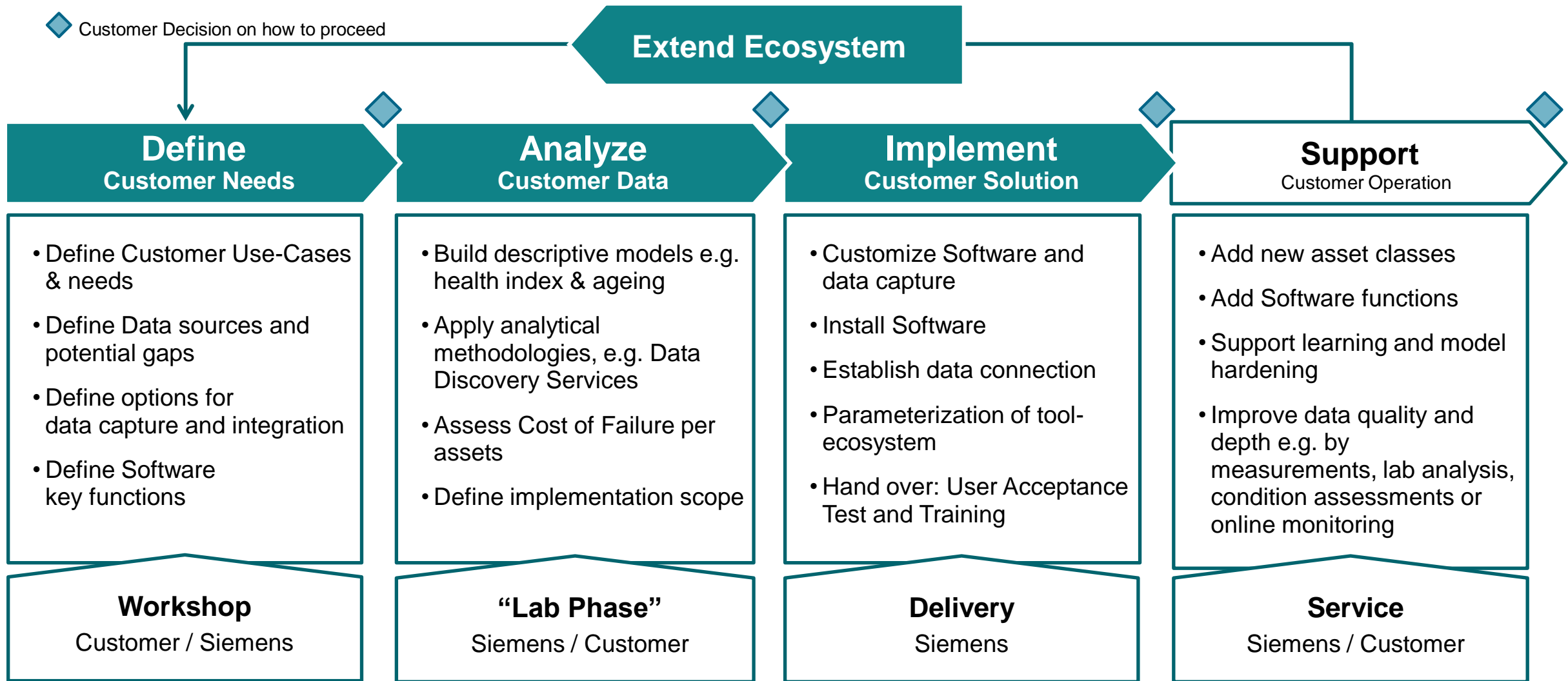
EIP Assetguard APP Mindsphere Access Click [here](#) ; Direct Access Click [here](#)

Please use chrome Browser .

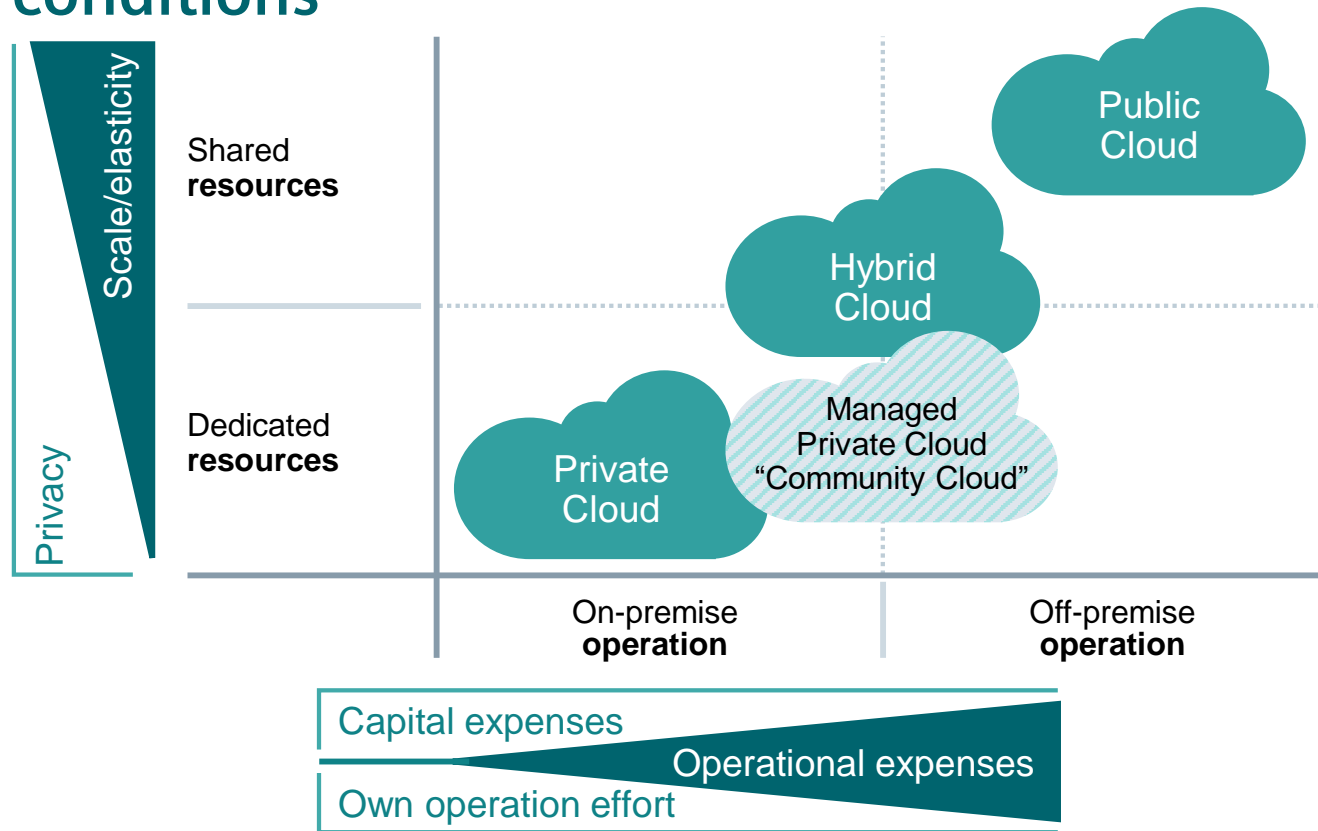
Please note that **any changes you make in the app cannot to be saved**, since this is the public Market Place account. In case you need an account contact [bianchi@siemens.com](mailto:bianchi@siemens.com)

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# Think big – start small ...



# Deployment models yield trade-off between operating or renting infrastructure – Privacy requirements are boundary conditions



## Privacy vs. Elasticity

- Private clouds provide a higher degree of resource isolation and privacy
- Public clouds provide nearly unlimited resources with rapid elasticity

## CAPEX vs. OPEX

- Private clouds require upfront investment in infrastructure and operation effort
- Services in Public clouds are paid when used

## General

- **Privacy requirements may restrict freedom of choice**
- **Economic trade-off determined by**
  - Resource requirements
  - Data center locations
  - Application elasticity
  - Public cloud pricing

Source: Adapted from Siemens Cloud Computing Guide, CT RDA ITP, and SaaS Guide 2016, PLM & Innovation Excellence – Siemens Operating Model



# Digital end-to-end approach from sensor to integrated platform for supporting customer's asset management

## Summary

### Tasks





- 1 Smart devices**  
Installation of sensors and access to monitoring solutions 
- 2 Connectivity & Cloud**  
Secure communication and data storage in data integration platform 
- 3 Modeling & data analytics**  
Accessibility of data from experts and service 
- 4 Service offerings**  
Realization of use cases as applications 

### Applications:



- **Visualization**  
Dashboard view, transparent health check of assets
- **Messages and alerts**  
evaluation of performance and automatic reporting
- **Enhanced performance**  
Identifying additional performance capabilities
- **Optimized maintenance**  
depending on health check and historic utilization of components

### Customer Benefits:

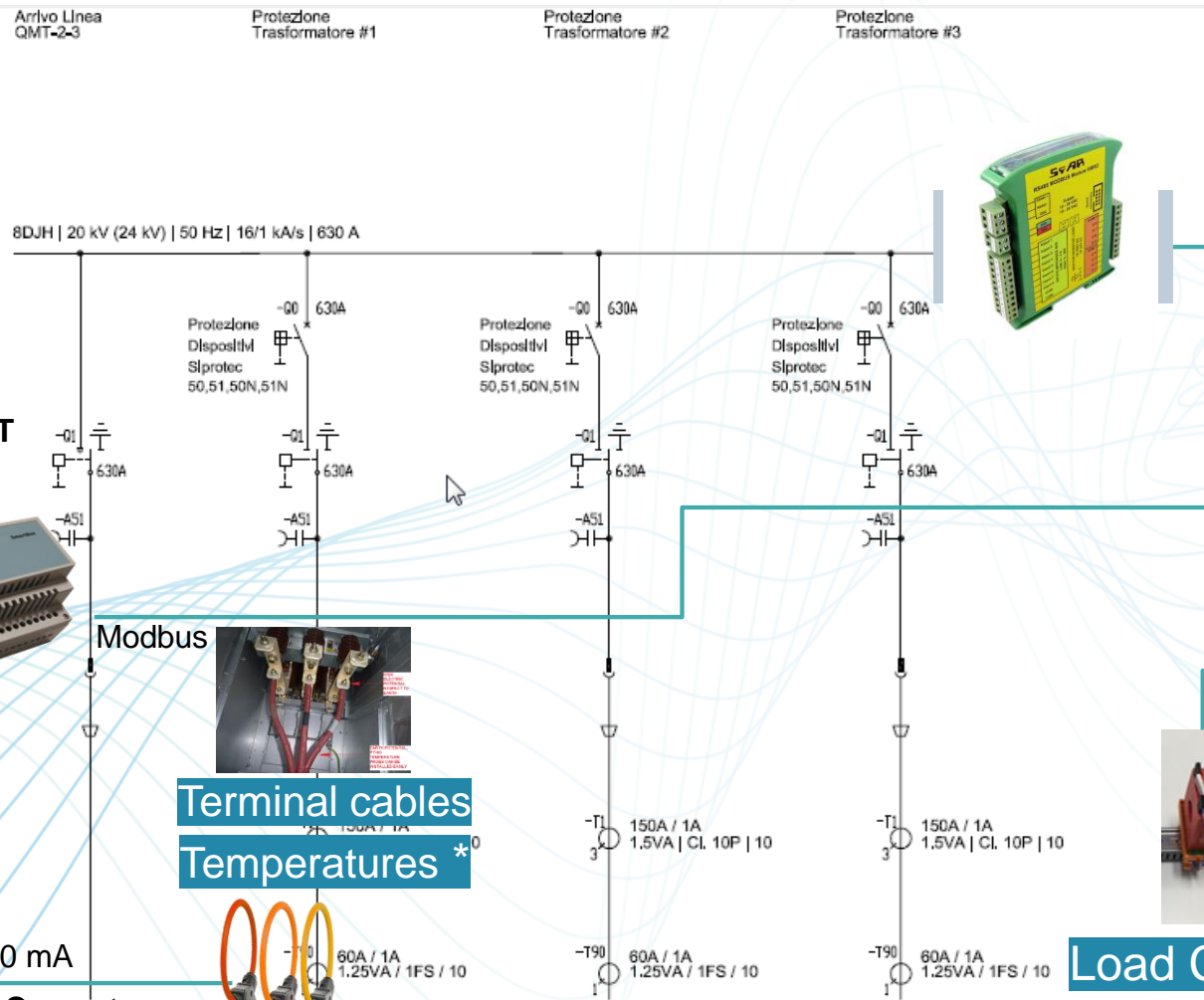
- **Improved reliability**  
by reducing unscheduled outages and prediction of component failures 
- **Low opex**  
Optimized maintenance by reliable prediction of components health status 
- **Enhanced performance**  
Provide performance exceeding standard design ratings, e.g. by dynamic overload management 
- **Increased Profit**  
Enhanced operation and service lead to lower costs and fast return of investment 





# Use Cases - Examples

# Use Case: Panel Monitoring



Arrivo Linea da QMT-2-3	Protezione Trasformatore #1	Protezione Trasformatore #2	Protezione Trasformatore #3
8DJH-R	8DJH-L2	8DJH-L2	8DJH-L2



Modbus

Assetguard IoT Conf. Master



Assetguard IoT Conf. slave



Modbus



Terminal cables Temperatures \*

+20 mA

Load Current Rogowski sensor



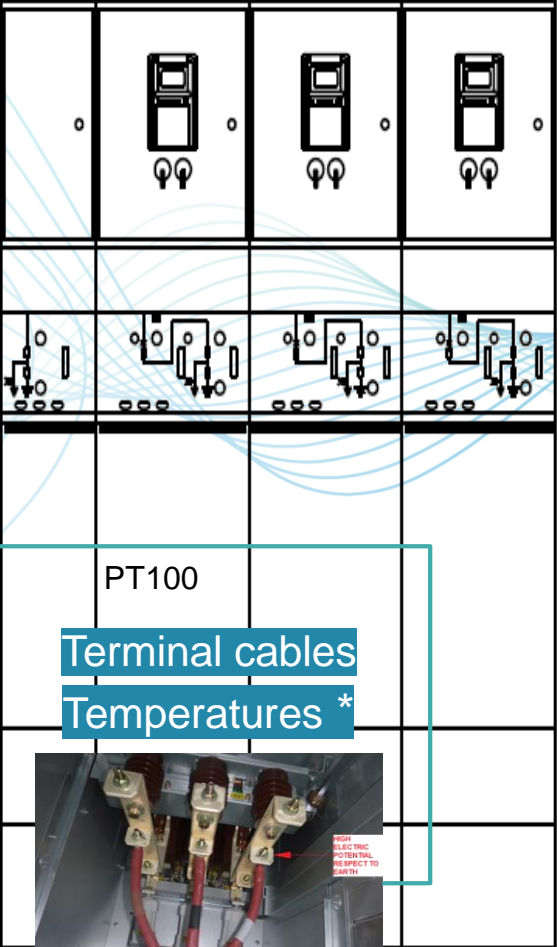
+20 mA



Secondary CT

Load Current

2300



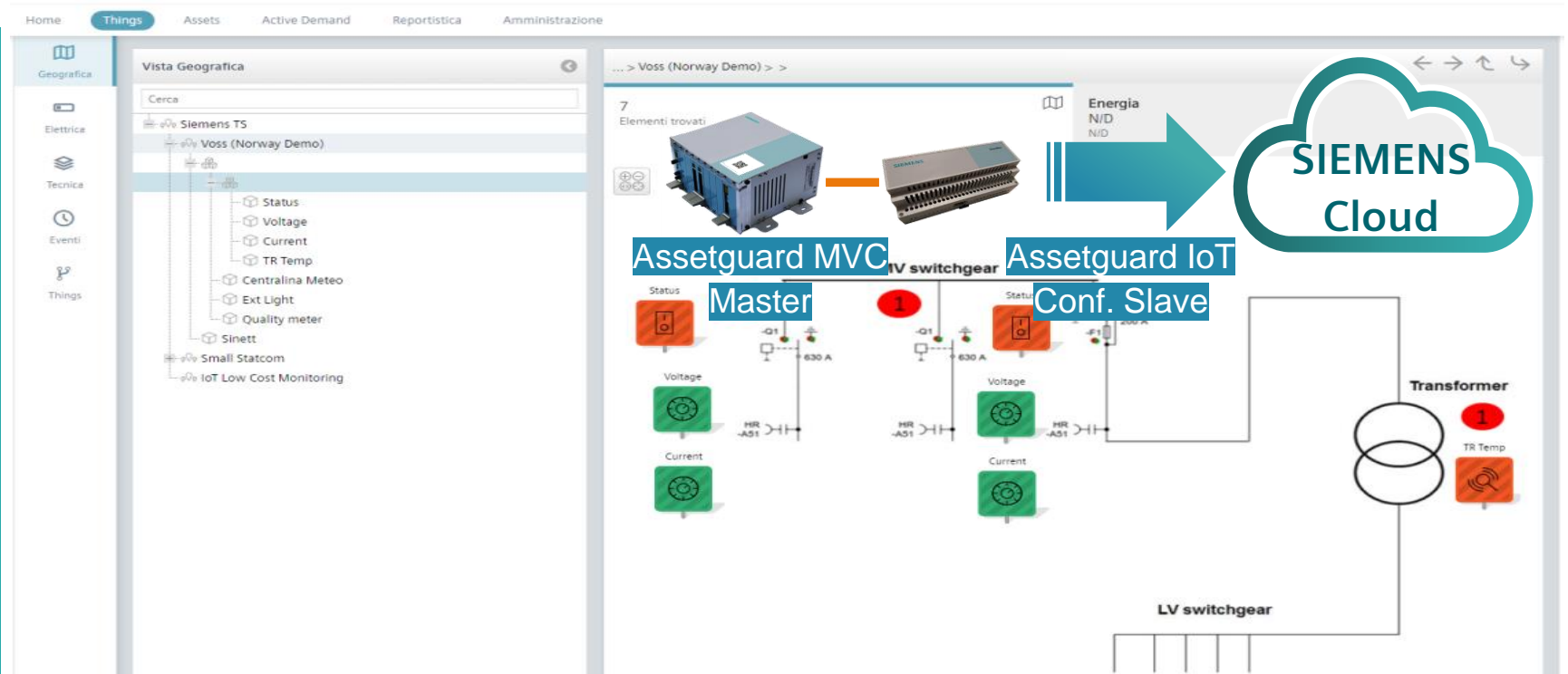
\* Pictures are only indicative



# Use Case: Substation Monitoring

## Assetguard solution will take care of:

- Circuit breaker monitoring system with Assetguard MVC
- Communication with the Cloud Mindsphere Assetguard App through Assetguard IoT
- Easy configuration through web server
- External or integrated modem via MiniPCI express 3G / 4G / NB-IoT... (depending on region & modems)



## Features:

On Premise Analytics + Remote Global Mapping Management

- Up to 12 Feeders
- Up to 2 Trafos

## Added Value:

- All-in-one solution (Power Supply, electrical input/output, etc)
- Compact size allows installation in smaller spaces or external application
- Simple electrical input & Modbus configuration
- Cost Effective

# Use Case: Mobile substation application

Monitoring architecture available to fulfill some requirements



Monitoring architecture to be extended for cloud (**Highlighted**)

Acceleration, speed & pitch recorders + GPS features provided by the devices itself



Hardwire cabling

- Battery damaged by extended discharge status (BMS/Inverter data available?)
- Transformer oil humidity & pollution
- Mechanical stress on substation components + accident
- Environment (metal surface oxidation, vandalism/theft, fire)

- Battery damaged by extended discharge status (BMS/Inverter data available?)
- Transformer oil humidity & pollution
- Mechanical stress on substation components + accident
- **Tire pressure drop**
- **Trailer hydraulic liquid low pressure**
- **Tire worn**
- Environment (metal surface oxydation, vandalism/theft, fire)

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*Supported Monitoring & Diagnostic functionalities*

# Use Case: Environmental and distribute SS monitoring



ASSETGUARD  
IoT  
4G

DUST  
SENSOR X2

TEMP/HUMIDITY  
SENSOR X2

FLOOD  
SENSOR X2

Substation

- Measurement of room temperature
- Measurement of room humidity
- Measurement of room air pollution
- Measurement of water flooding

SIEMENS  
Cloud

Distribution  
Transformer

- Sensor for top / bottom oil temperature
- Sensor for vibration
- 3 phases LV current sensor
- Sensor for Dissolved Gas Analysis (for measuring H<sub>2</sub> & humidity content)

1. TEMPERATURE SENSOR

2. VIBRATION SENSOR

4. H2 GUARD (DGA SENSOR)

3. LV 3 PHASES CURRENT

ASSETGUARD  
IoT  
4G

MODBUS CAT6

MODBUS CAT6

AI

SIEMENS  
Cloud



Start  
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# Develop strategic partnerships with customers: Co-creation Benchmarking services, e.g. applications, OEM's, substations, ...

## Where?

- TCOs, globally
- Industry customers, globally
- Powerplant owners, operators

## Why?

- Less CAPEX investment for the customer
- Lower barrier to the Online Monitoring technology for the customer
- Better access for SIEMENS to customer operational data

## What?

- Transformer Online Monitoring as a cloud-based service

## How?

- Connect transformer sensors directly to the cloud via Digi-Box or SIMATIC IoT
- Process monitoring algorithms in the cloud
- Provide alarms and diagnostics to the customer as defined in a remote service contract



**MindsApp:** Online Monitoring, Cooling control

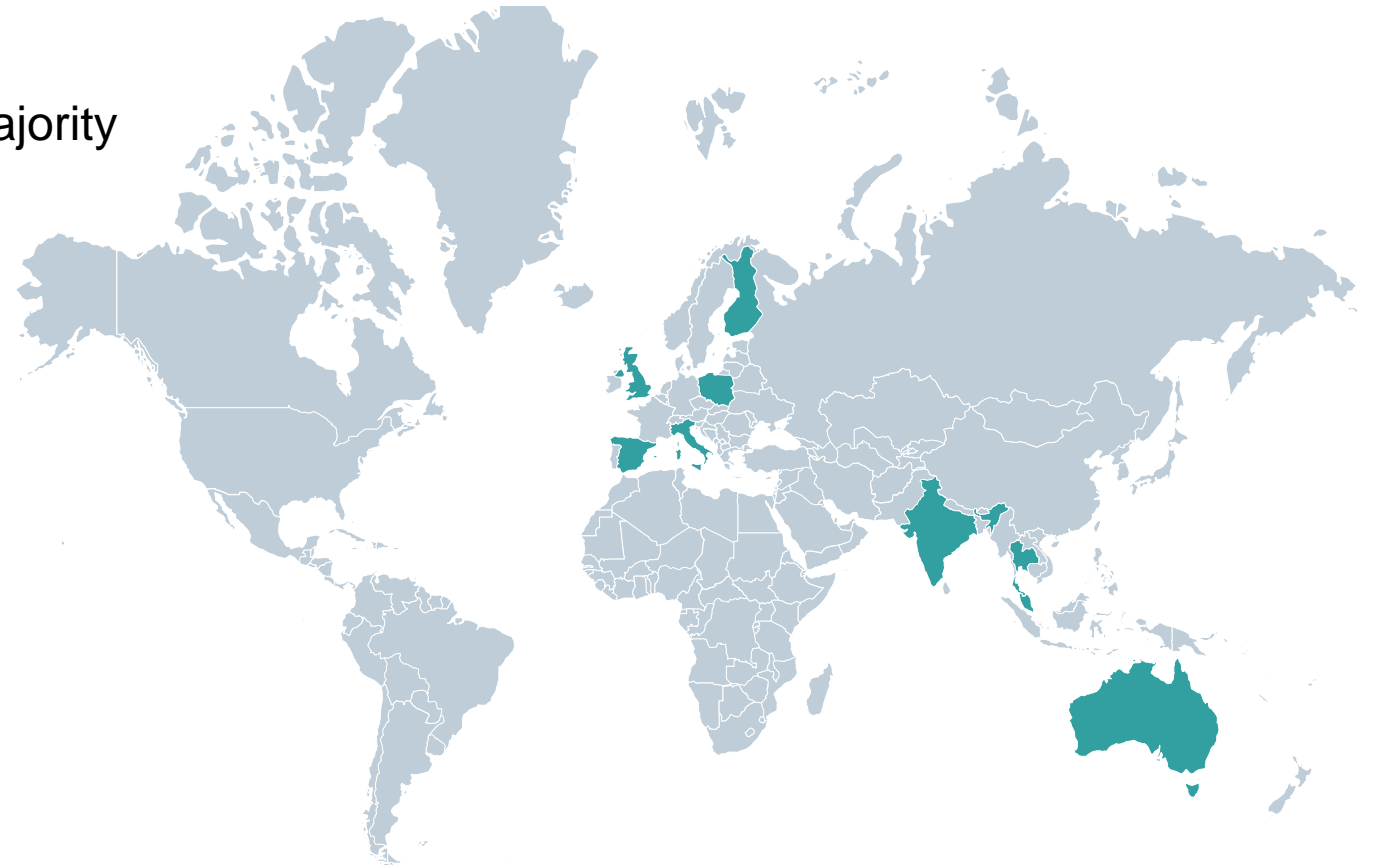


# References & Customer feedback



# Assetguard MVC Product References

- 113 total Assetguard MVC units installed between **December 2012 and August 2019**
- 551 Assets currently being monitored, the majority are in **Italy and UK**



# Reference / DSO in Italy



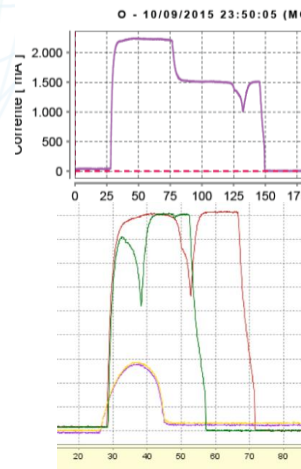
## Scope of Supply 3<sup>rd</sup> party OEM:

- 4 HV GIS BAY: 170 kV
- 43 MV Circuit Breakers;
- 4 Power Transformers: 2 x 40 MVA; 2 x 6 MVA

## Assetguard MVC



- Successfully avoided blackout of 50 MV feeder in the city center
- Condition-base maintenance triggered via warning notification
- **Estimated customer cost of potential damage ~300k€**
- “More than the full SS cost for the monitoring system itself”

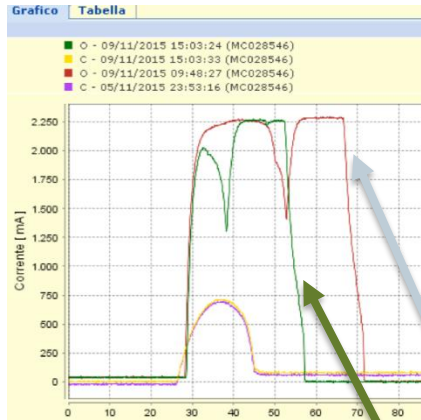


**Red and Purple:** anomalous opening before maintenance

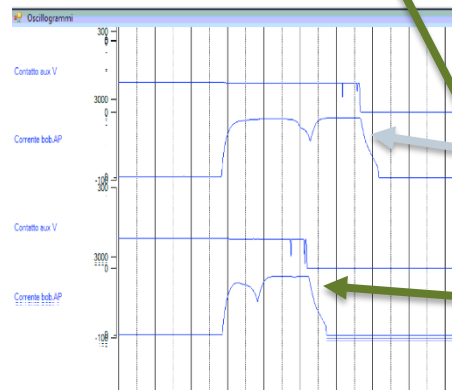
**Green:** successful opening after maintenance

# CASE STUDY (feedback from the Distribution utility): ON CONDITIO MAINTENANCE after anomaly detection

Remote recordings through STman



Local recordings



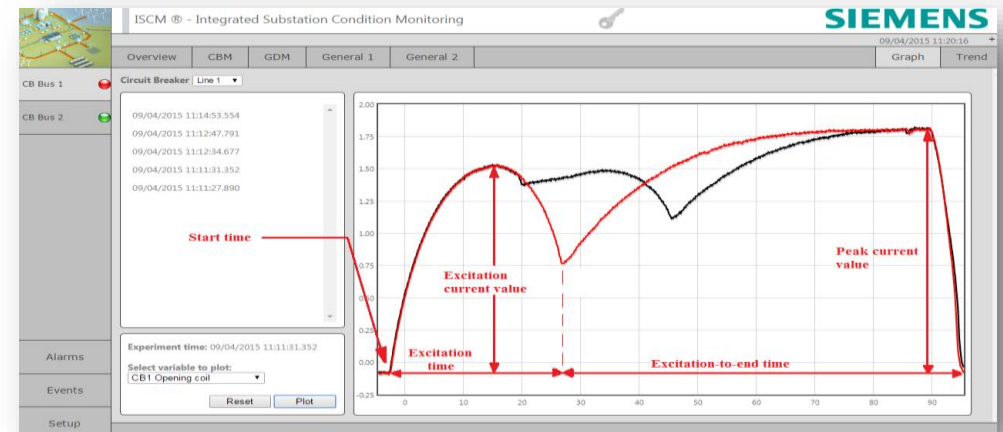
**Trace of Anomalous Opening on 9/11/2015  
9:48 before Maintenance**

**Trace of a successful Opening on 9/11/2015  
15:03 after Maintenance**

This situation has led the customer to the decision for an intervention of maintenance on condition in order to avoid the repetition of the anomalous event and avoid the risk of a failure (missing of opening operation on command).

After the maintenance on the circuit breaker the operation new recording has given positive results indicating a good operation of the circuit breaker and closing the alarm on the monitoring system.

## Trace Key point identification



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# Contact



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*Ingenuity for life*



**Thank you**