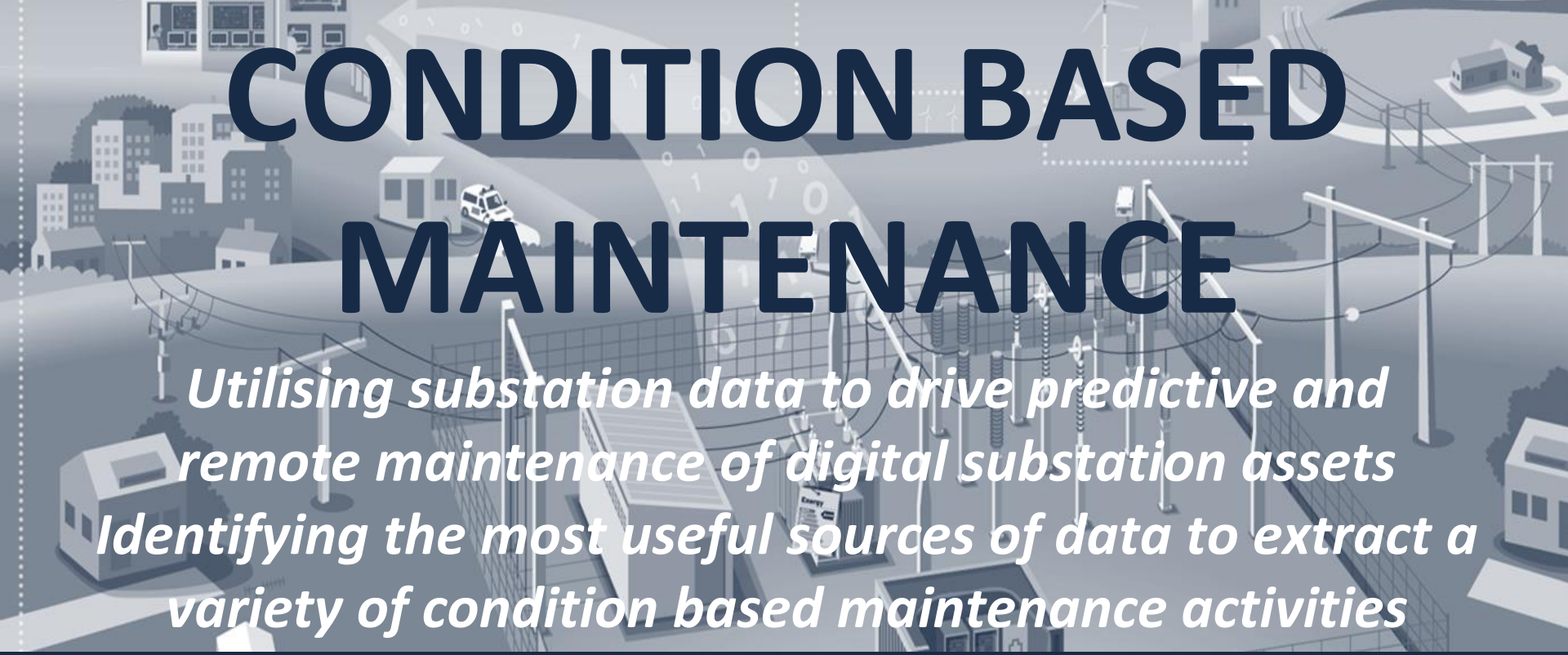


CONDITION BASED MAINTENANCE

Utilising substation data to drive predictive and remote maintenance of digital substation assets Identifying the most useful sources of data to extract a variety of condition based maintenance activities

Anders Johnsson, Vattenfall Eldistribution AB, Sweden

IntelliSub2018, Düsseldorf, April 11

DRAFT

VATTENFALL

INNEHÅLL

- Bakgrund / Resultat från förstudie
- Scope för piloten (BUC Asset Health Analytics)
- SGAM
- Översikt teknisk lösning (Separat underhålls-GW)
- Engineering
- Informationsmodeller (Kopplingen mellan 61850 och CIM, CIMs stöd för att hålla isär Asset, Equipment + Measurements)
- Slutsatser (Möjlig utökning till fler BUC, möjligheter med Open source)

BACKGROUND - DRIVERS FOR CONDITION MONITORING

- **Maintenance and Asset management** - More accurate maintenance through analysis of online information at central level

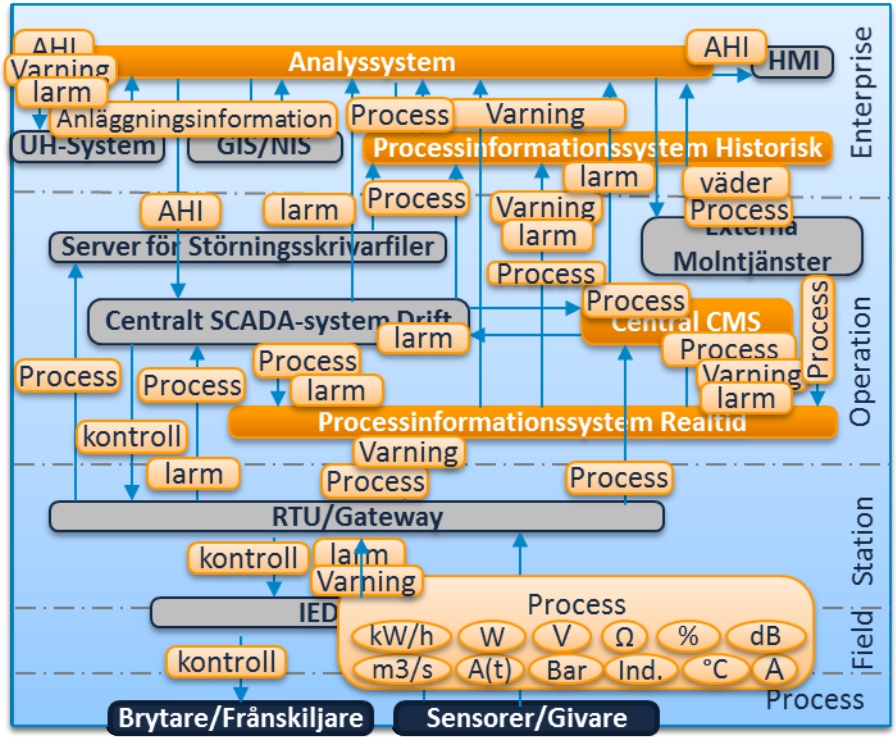
- **Operation** – Decision support through asset health information

- **IT** - Standardized information exchange from station to central level to avoid increasing costs linked to complex integrations

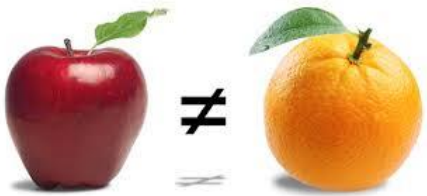
BACKGROUND - PRESTUDY

- … to **present a suitable scope of a pilot installation based on the IEC TC57 reference architecture concept**.
- The pre-study aimed to propose a **realistic scope**, i.e. the scope should be as **limited as possible** while at the same time enabling the **main parts of the concept to be tested**.
- Next step is to use the results **to perform a pilot installation**.

BACKGROUND-INFORMATION



- Integrations at all system levels
- Heterogeneous system environment
  - Communication level
  - Data Level
- Fair analysis needs a common understanding



- Standardization -> corner stone for enabling trust in advanced analytics

PILOT SCOPE

Pilot use case criteria:

- Station object where online condition monitoring has a strong business case
- Addresses a broad spectra as possible of the proposed reference architecture
- Aline with the in-house knowledge regarding methods for asset health index calculations
- Realistic to implement within six months

Selected Business Use Case:

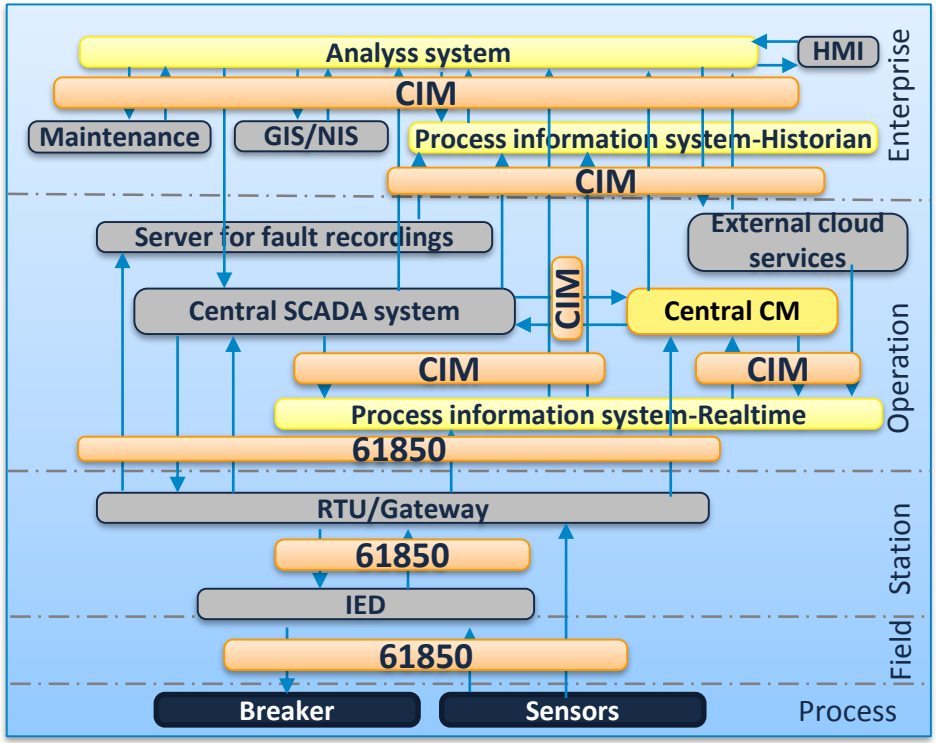
- **Mandatory** – Collect and store process information at central level and make available for Asset Health Index calculation on breakers
  - Information exchange shall be based on IEC 61850 and CIM
- **Optional** - Make also Maintenance and GIS/NIS information available for Asset Health Index calculation
  - Information exchange shall be based on CIM

Selected System Use Case:

Mandatory

- Associate measurements to breaker asset
- Publish Equipment State
- Publish Measurement Values
- Publish Disturbance Information

REFERENCE ARCHITECTURE TO SUPPORT INFORMATION EXCHANGE FROM PROCESS TO CENTRAL CONDITION MONITORING SYSTEM

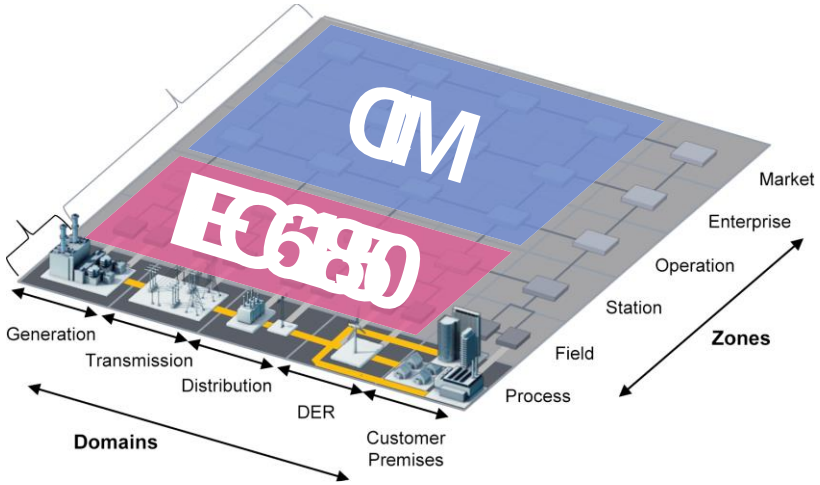


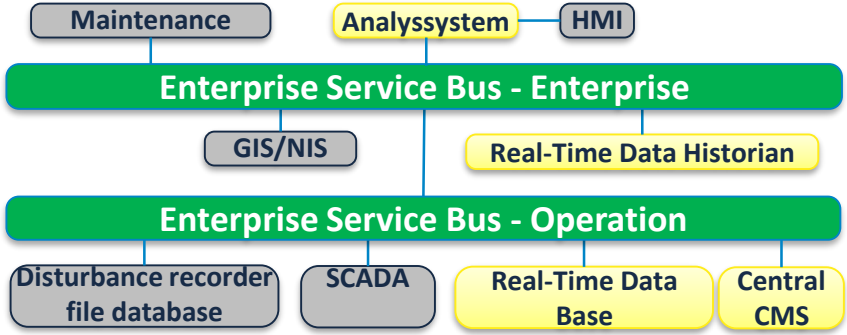
Example - Information exchange for calculation of Asset Health Index – **Breaker**

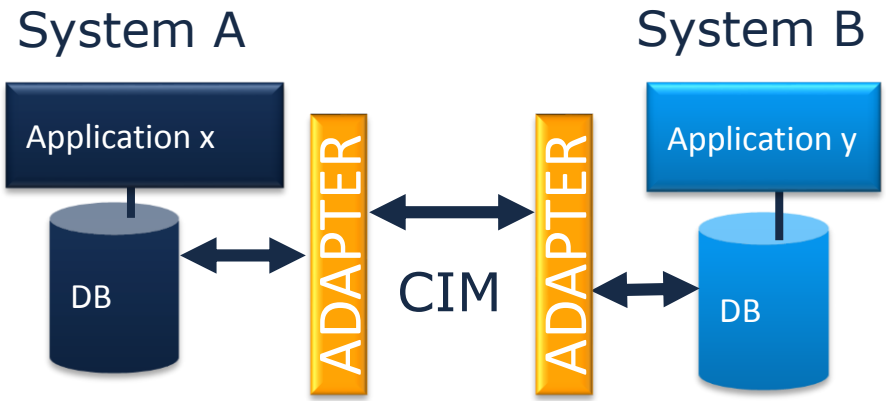
- Creation of realtime Process information
- Reporting of disturbance recordning files
- Creation of historic process information
- Make process information and disturbance records available for analysis system
- Make asset information available for analysis system
- Provide calculated AHI för maintenance.

BACKGROUND - REFERENCE ARCHITECTURE

- IEC 61850
- CIM
- ESB
- Adapters







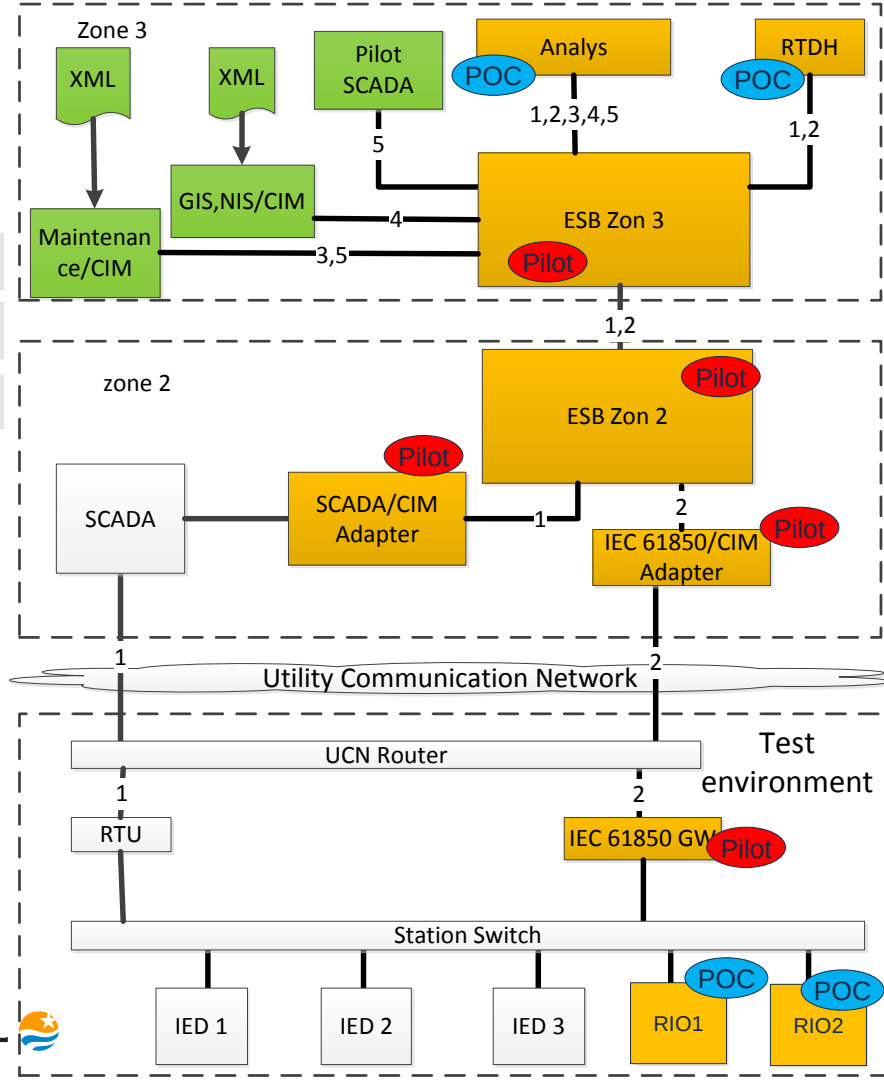
SCOPE – ARCHITECTURAL

- **Pilot Infrastructure (Scalable):**
  - IEC 61850 -> CIM Adapter
  - SCADA -> CIM Adapter
  - ESB zone 2, ESB zone 3
  - ESB Zone 3 to ESB Zone 4 (VIP)
- **POC (no requirements regarding scaling):**
  - Real-time Data Historian
  - Application for Asset Health Analytics
  - RIO for continuous measurement values
- **Optional/Next step**
  - GIS/NIS -> CIM Adapter
  - Maintenance system -> CIM Adapter
  - Calculated AHI to SCADA and Maintenance system
- **Limitations**
  - No integration with real Maintenance system
  - No integration with real GIS/NIS
  - Development of Asset Health algorithm is outside Scope

As is

Mandatory

Optional



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SOURCES OF DATA

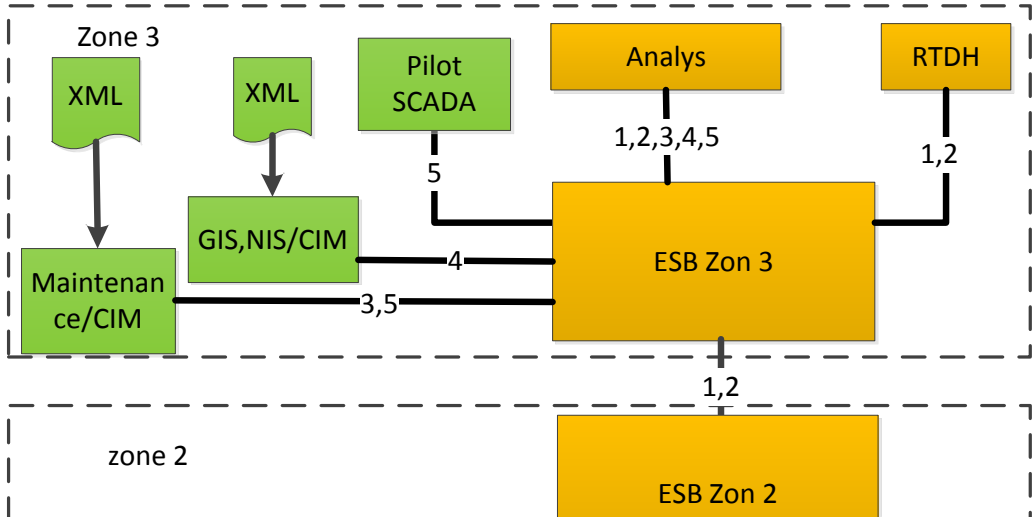
(1) As-is process information

(2) Process information for AH

(3) Static maintenance information

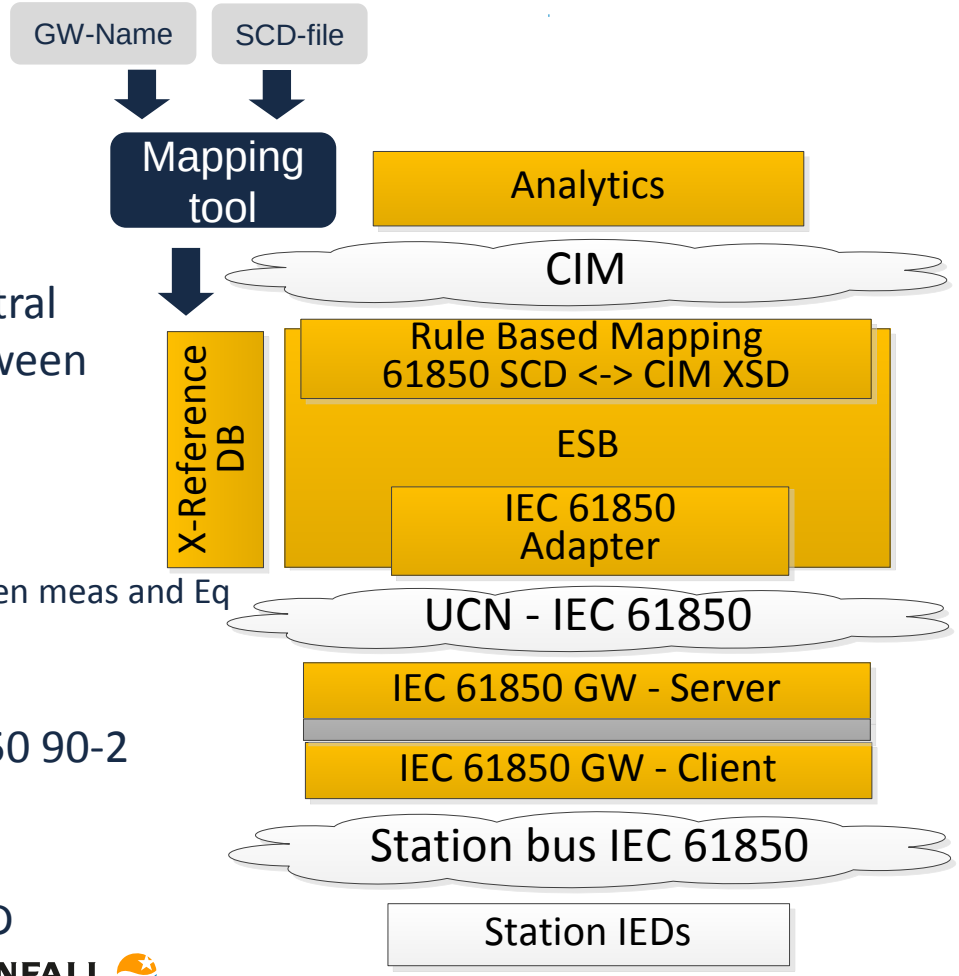
(4) Geographical information

(5) Calculated Asset Health Index

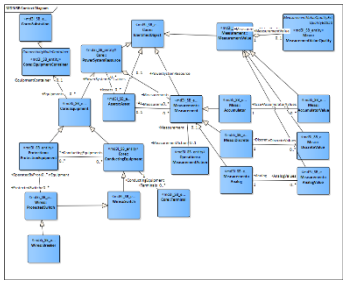


ENGINEERING

- Rule based mapping using IEC 61850 SCL and CIM XSD
- Using SCD as configuration source at central level will enable automatic mapping between measurements and equipment.
- Central Configuration using CC-SCL file
  - Station name -> Find right station SCD file.
  - GW name -> Create the correct mapping between meas and Eq
  - IP address for GW -> connect to right GW
  - RCB -> subscribe to needed signals
- SCD-file and recommendation in IEC 61850 90-2 to configure GW - server side
- SCD-file to configure GW - client Side
- Use-case specific datasets and RCBs in CID



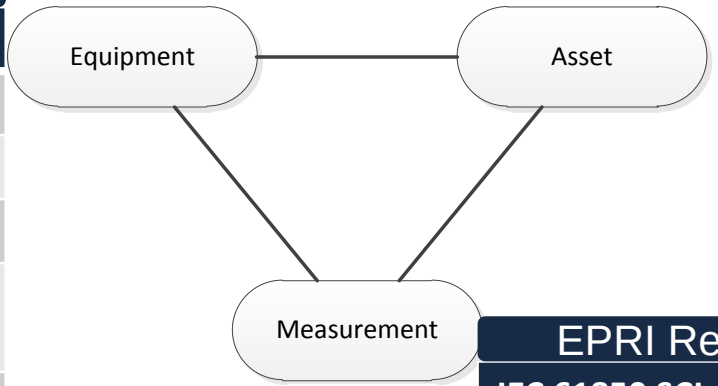
RULE BASED MAPPING BETWEEN INFORMATION MODELS



Important of clean separation between viewpoints in Asset Health Analytics!

Next Step!	CIM XSD
Next Step!	Asset

EPRI Recommendations	
IEC 61850 SCL	**CIM XSD**
VolgateLevel	VoltageLevel
Substation	Substation
tBay	Bay
ConductingEquipent-CBR	Breaker
ConductingEquipent-DIS	Disconnector
PowerTransformer-PTR	PowerTransformer



EPRI Recommendations	
IEC 61850 SCL	**CIM XSD**
FC = MX	AnalogValue
FC = ST	DescreateValue

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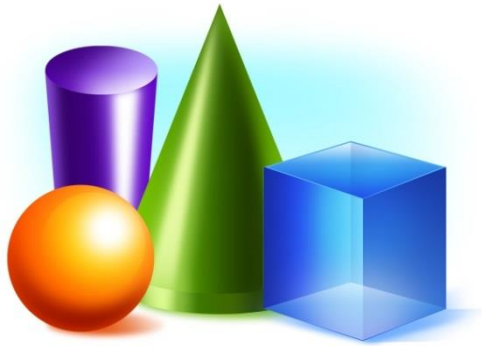
CONCLUSIONS



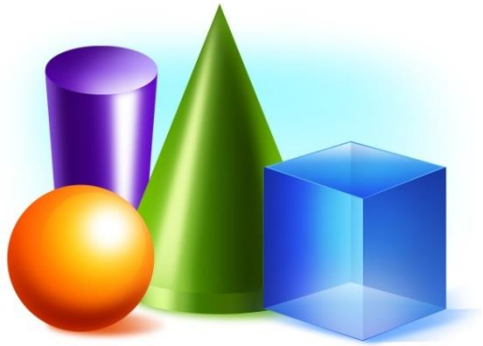
Access to data

- Analytic application for Asset Health Index provided with access to up-to-date as well as historical process information.
- According to IEC TC57 reference architecture.
- Method and solutions can be reused for other applications.

Information exchange

- CIM with Enterprise Service Bus (ESB) to avoid exponentially increased cost related to system integration
- Architecture supports step-by-step implementation by use of CIM-adapters.

CONCLUSIONS (2)



Configuration

- Enabling configuration and use of IEC 61850/CIM gateway to transfer data from substation automation systems to central systems
- IEC 61850 and CIM fulfils the need and are used by others.

Association and mapping of data

- Utilising SCL to associate substation data with CIM asset, equipment and measurements
- Tools for system maintenance is already in place.

SUCCESS CRITERIA

- Analyssystemet har tillgång till aktuell samt historik processinformation.
- Analytic application shall have access to up-to-date as well as historic process information.
- All processinformation samt anläggningshälsoindex är kopplat/associerat till rätt brytarindivid i anläggningen.
- All process information including Asset Health Index shall be associated/connected to the right station object individual.
- Det går att skapa trender för AHI samt för enskild tillståndsinformation relaterad till brytaren
- It shall be possible to create trends for Asset Health Index including condition monitoring information.
- Det historiska processinformationssystemet innehåller aktuell information genom händelsebaserat informationsutbyte från processen
- Up-to-date process information will be stored in the Historic Real Time Database by event based (report/publish) message exchange principle

- Architecture complies with TC57 principles
- Data exchange between systems at central level are based on CIM.
- Already existing IEDs and new IEDs (RIO) can be configured using IEC 61850 substation configuration tools.
- Update and configuration of IEC 61850/CIM adapter using SCL files.
- Comply Vattenfall directive for IT Security Architecture for Plant and Distribution Operation (ISMS109)

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