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USE CASE 8 – MAINTENANCE ENGINEER MONITORS HEALTH OF PRIMARY EQUIPMENT

Use Case Title

Maintenance Engineer monitors health of primary equipment

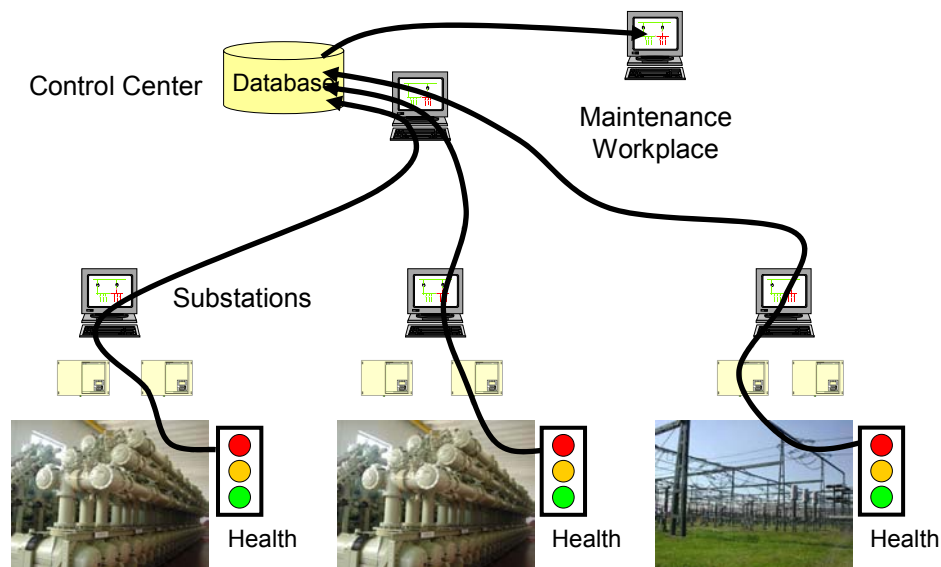
Use Case Summary

Monitor an existing field implementation...substation and feeders...to keep an up to date view of the health of the system. Providing hourly status on sick equipment to maintenance personnel will enable them to keep the implemented system in a near turnkey status at all times. May also involve distributed generation or customer demand response.

- System is monitored for connectivity and IED placement on the utility grid using CIM and for Health using IEC61850.
- The application continuously monitors the health of devices on the electric utility grid.
- When a device is reported in an abnormal condition, the maintenance personnel are notified of the device in trouble, and the device type and location.
- The maintenance personnel are then able to prioritize maintenance to ensure MTTR is minimized for all classes of equipment to meet corporate goals and objectives.

Use Case Detailed Narrative

The health of the primary equipment is supervised by the substation automation system and reported to the control center. The maintenance engineer has to monitor the equipment of the existing field implementations to keep an up to date view of the health of the system. He gets an hourly status on sick equipment.



The use case includes the following steps:

1. The health of the equipment is monitored by the substation automation system.
2. The health is reported to a central database in the control center
3. Critical health status results in an immediate alarm to the operator
4. The maintenance engineer gets an hourly report on the status of all equipment
5. The maintenance engineer can browse the device for additional status information

1. Monitoring the health by the substation automation system

The primary equipment is equipped with multiple supervision circuits. Examples are:

- insulation medias (levels of liquids, density of gas)
- trip circuits
- operating mechanism of a circuit breaker

Based on the status of the different supervision circuits, the substation automation system determines for each individual primary equipment information concerning the health. That information is a "green – yellow – red" indication with the following levels:

- green - ok: the primary equipment is healthy
- yellow - warning: the condition of the primary equipment is such, that some maintenance is required, but the operation is still safe

- red - critical: there is a serious problem with the primary equipment; operation is not safe anymore

2. Reporting the health of the primary equipment to a central database

Any change of the health information determined by the substation automation system is reported to the control center and stored in a CIM based database.

3. Creation of an alarm for the operator

If the health of individual primary equipment is reported as critical ("red"), an alarm is created for the operator.

4. Creation of an hourly report for the maintenance engineer

An application in the control center is creating an hourly report for the maintenance engineer from the information in the database. That report lists equipment

- that can not be operated anymore due to the health being critical (red)
- that needs maintenance (health being yellow)

The report includes the name of the equipment and the physical location.

5. Browsing the device for additional status information

The maintenance engineer can browse the object related to the faulty equipment in order to retrieve additional information concerning the fault. This can be done by a direct access to the component in the substation automation system related to the faulty equipment using an IEC 61850 browser.

In order to establish the association to the component of the substation automation system, the maintenance system needs to retrieve the relevant communication information for that component based on the name of the component. That communication information is both the logical information (e.g. substation / IED / logical device / logical node) as well as the required physical information (e.g. IP address).

Once the association is established, the maintenance system can browse the component for additional information using the self descriptive capability of IEC 61850.

Harmonization tasks

The following harmonization tasks have been identified:

1. The health information for external equipment, as defined in IEC 61850, needs to be available in CIM

2. The values of health as defined in IEC 61850 (green, yellow, red) as available in 61850 need to map on the values in CIM. If CIM provides more details, extension of 61850 may be required.
3. The 61850 communication information of an object in CIM needs to be available from CIM

Extension of the use case

The use case can be further extended to monitor not only primary equipment, but as well the substation automation system itself. The procedure can basically be the same as above, using health information of IEDs, of logical devices and of logical nodes.

This creates an additional requirement for the harmonization:

- the CIM model needs to be able to include information about IEDs, logical devices and logical nodes

Business Rules and Assumptions

ACTORS

<i>Actor Name</i>	<i>Actor Type (person, device, system etc.)</i>	<i>Actor Description</i>
Primary Equipment	Device	Electrical network equipment. (Transformers, circuit breakers, etc.)
Field Device	Device	IED that monitors Primary Equipment
Field Device Communication Interface	System	Generic architectural component that communicates with substation and field devices using IEC 61850. This system can translate IEC 61850 services to GID services.
Maintenance Application	System	Application which interprets CIM and 61850 data for display to the Maintenance Engineer
Maintenance Engineer	Person	Monitors Primary Equipment status and makes decisions on how to allocate service and repair resources.

STEP BY STEP ANALYSIS OF EACH SCENARIO

Scenario Description

Triggering Event	Primary Actor	Pre-Condition	Post-Condition
<i>(Identify the name of the event that start the scenario)</i>	<i>(Identify the actor whose point-of-view is primarily used to describe the steps)</i>	<i>(Identify any pre-conditions or actor states necessary for the scenario to start)</i>	<i>(Identify the post-conditions or significant results required to consider the scenario complete)</i>
	Maintenance Engineer		Maintenance Engineer receives needed data on Primary Equipment

Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
#	<i>What actor, either primary or secondary is responsible for the activity in this step?</i>	<i>Describe the actions that take place in this step including the information to be exchanged. The step should be described in active, present tense.</i>	<i>Elaborate on any additional description or value of the step to help support the descriptions. Short notes on architecture challenges, etc. may also be noted in this column.</i>
1	Field Device	Field Device measures Primary Equipment attributes and settings.	
2	Field Device	Field Device reports Primary Equipment attributes and settings to Maintenance Application	Publish / subscribe
3	Maintenance Application	Maintenance Application alerts Maintenance Engineer of any critical alarms.	
4	Maintenance Application	Maintenance Application creates periodic report of equipment that has failed or requires maintenance.	Narrative assumes periodic interval of 1 hour
5	Maintenance Engineer	Maintenance Engineer views alerts and reports	
6	Maintenance Engineer	Maintenance Engineer requests more information on Primary Equipment	
7	Maintenance Application	Maintenance Application retrieves Field Device communication details from CIM Model Server	
8	Maintenance Application	Maintenance Application sends data request command to Field Device	

<i>Step #</i>	<i>Actor</i>	<i>Description of the Step</i>	<i>Additional Notes</i>
9	Field Device	Field Device transmits requested data to Maintenance Application	
10	Maintenance Application	Maintenance Application displays requested data to Maintenance Engineer	

REQUIREMENTS

Functional Requirements

<i>Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>
CIM database needs to support IEC 61850 Health information		3
The values of health in CIM and according to IEC 61850 shall be harmonized		3
Maintenance information needs (from CIM database) information related to IED / Logical Device / Logical node that interfaces to a equipment		7
CIM database needs to be able to store detailed information of the equipment. Structure and semantic of that detailed information is not necessarily known before it is retrieved from the equipment		9

Non-functional Requirements

<i>Non-Functional Requirements</i>	<i>Associated Scenario # (if applicable)</i>	<i>Associated Step # (if applicable)</i>