Condition monitoring of wind turbines using inter-cloud communication

System-of-Systems Description

Abstract

ARTEMIS Innovation Pilot Project: Arrowhead
THEME [SP1-JTI-ARTEMIS-2012-AIPP4 SP1-JTI-ARTEMIS-2012-AIPP6]
[Production and Energy System Automation Intelligent-Built environment and urban infrastructure for sustainable and friendly cities]

Contents

About 12% of the electricity in Sweden is made from wind turbines. As such it is vital that these turbines does not halt its production of electricity. In order for a turbine to halt as few times as possible all components need to be continuously monitored to ensure proper operation as any sudden failure would inevitably lead to a halt in the production of electricity. Therefore condition monitoring boxes are typically installed in the wind turbines which in turn monitor and track the deterioration of the mechanical components and displays this information to a wind farm operator.

1 Overview

In this document, it is outlined how the Condition monitoring of a wind farm can be achieved using several Arrowhead local clouds, one for each turbine, together with a local cloud for the farm operator. The reader is excpected to have read and having access to the SysD documents for both the Wind Farm HMI system as well as the Wind Turbine Condition Monitoring box system. The reader is also expected to have knowledge about the manditory core systems Service Registry, Orchestration, Authorization and the systems which is required for inter-cloud communications which are the Gateway and Gatekeeper. Since the datamanager is central in this SoS it is also vital to have an understanding about the datamanager and access to the datamanagers SysD, Service IDDs and Service SDs.

The rest of this document is organized as follows: In Section 2 a generic system-of-systems topology is outlined, which can be extended to facilitate many neighboring clouds. In Sections 3 a use cases is presented which describes the simplest setup with a single wind turbine.

1.1 Status of this Document

At the time of writing, a simple use case is implemented using both the Wind Farm HMI (HMI) system and a single Wind Turbine Condition Monitoring Box (CMBox) system. This implementation makes use of a modified datamanager which has not been officialy released. These changes has changed how the CMBox access the datamanager however the implementation should be reveriable once the datamanager functions properly.

2 Archetypical System Topology

In order for this system of systems to be functional it must be possible:

1. for the Wind Farm local cloud and the HMI system to access the information of the CMBox systems in the neighboring Wind turbine local clouds.
2. for the HMI system to be able to access the information of the CMBox even should the sensors be asleep should they be low power sensors.
3. for the CMBox system to be able to be lowpower and not be available at all times.

The first requirement is satisfied using the Arrowhead Gatekeeper and Gateway systems in conjuncture with the Authorization system. The Gatekeepers allows for negotiating connections between local clouds and is what makes use of the authorization rules for the receiving local cloud. The Gateway in turn relays the requests between the local clouds.

The second and third requirement can be fullfilled by making the CMBox and HMI systems to not communicate with eachother directly but instead use the datamanager as an intermediary. This in turn allows the HMI system to always fetch the latest information from the datamanager and for the CMBox system to update the information on the datamanager whenever necessary.

3 Use Case A: Selling Service Access

This usecase describes the simplest application of this System of System. In this System of System there is a need for:

1. One local cloud in a central position designated for the use of the HMI system with a Gatekeeper configured to access the Wind Turbine cloud.
2. One local cloud in a wind turbine designated for the use of the CMBox system and a datamanager and an authorization rule for which the wind farm cloud can access the datamanager.
3. One activemq relay which the gatekeeper and gateway makes use of to relay requests between the local clouds.
4. One instance of the HMI system running on the Wind Farm local cloud.
5. One instance of the CMBox system running on the Wind turbine local cloud.

When using this configuration the dataflow would be as shown in figure 1 for the Wind Farm cloud and figure 2 for the Wind turbine cloud.

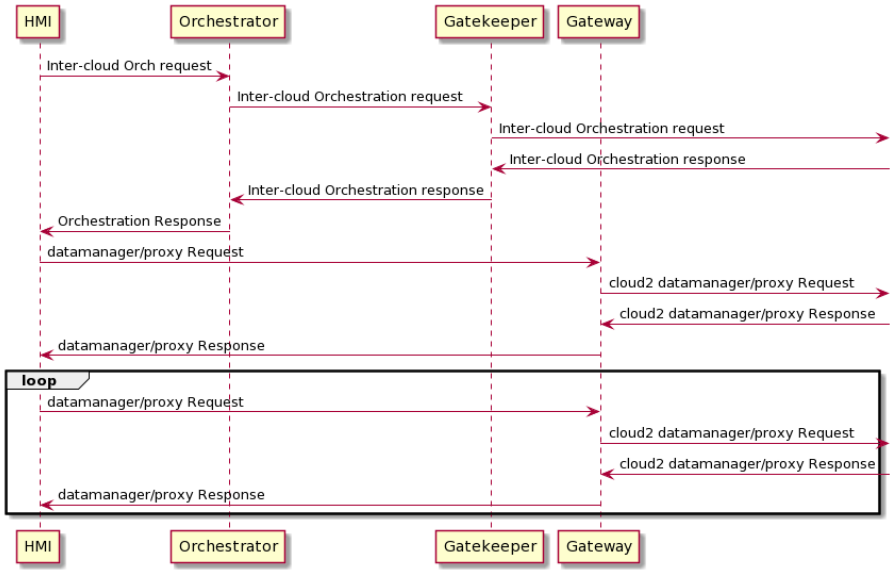

Figure 1: Dataflow of the Wind Farm cloud.

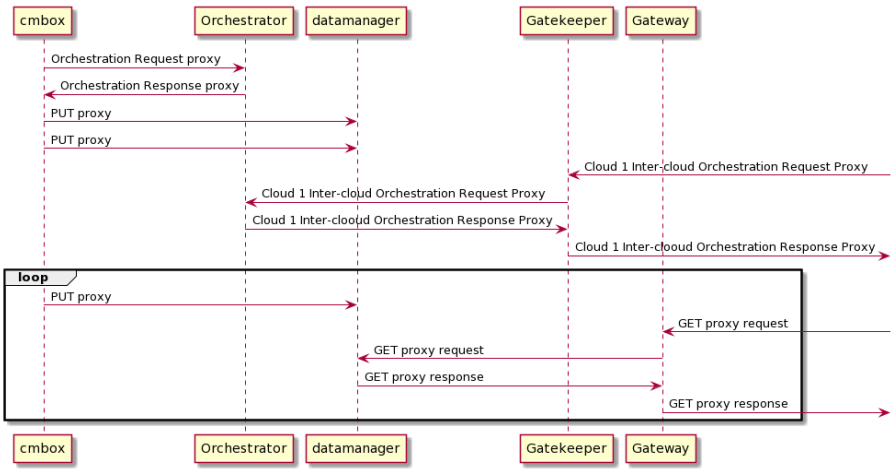

Figure 2: Dataflow of the Wind turbine cloud.

4 Revision History

4.1 Amendments

No.	Date	Version	Subject of Amendments	Author
1				

4.2 Quality Assurance

No.	Date	Version	Approved by
1			