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Common Data Model in AmI Environments

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Abstract. Ambient Intelligence environments involve a wide range of different devices typically associated to protocols not compatible with each other. This is probably one of the possible problems to reach the full explosion of the internet of things because of the lack of standards for sensor data exchanging. This paper proposes a solution for the exchange and storage of information developing a generic model to be used with different sources of data. The model is light enough to be used in low-cost and low performance hardware. The paper also describes how the model is used in a scenario supporting different contexts, as industrial devices or environmental data.

Keywords: Internet Of Things, IoT, BACnet, O&M, Data Model.

1 Introduction

In today's world, most of sensors have proprietary software interfaces defined by their manufacturers and used selectively. Each manufacturer brings to market their own solutions. It is true that there are some initiatives [1] to try to unify the way to handle the various devices and services designed but none stands above the rest.

This situation requires significant investment on the part of developers with each new sensor or project involving multiple systems and on the part of the providers of sensors, gateways and portals or services where observations are used. Standardized interfaces for sensors in the Internet of Things (IoT) [2] will permit the proliferation of new high value services with lower overhead of development and wider reach.

In our experience [3] there are some different data type sources: home automation data, environmental data, building management system (BMS) data, health data,... and in each case the data exchange models are quite different: ZWave, BACnet, O&M, …

Our objective is to develop a common data model for our framework DADIS to the transmission and storage of data in order to generalize all models in a single common data model. To do that a data model is described in the following section and is tested in one scenario with the result that will be discussed in the conclusions.

2 DADIS Common Data Model (DADIS-CDM)

The proposed common data model it has been developed based on OGC Observations and Measurements[1] proposals and is represented in Fig.1. The main components of our data model are explained next.

[1] http://www.opengeospatial.org/standards/om

R. Hervás et al. (Eds.): UCAmI 2014, LNCS 8867, pp. 212–215, 2014.

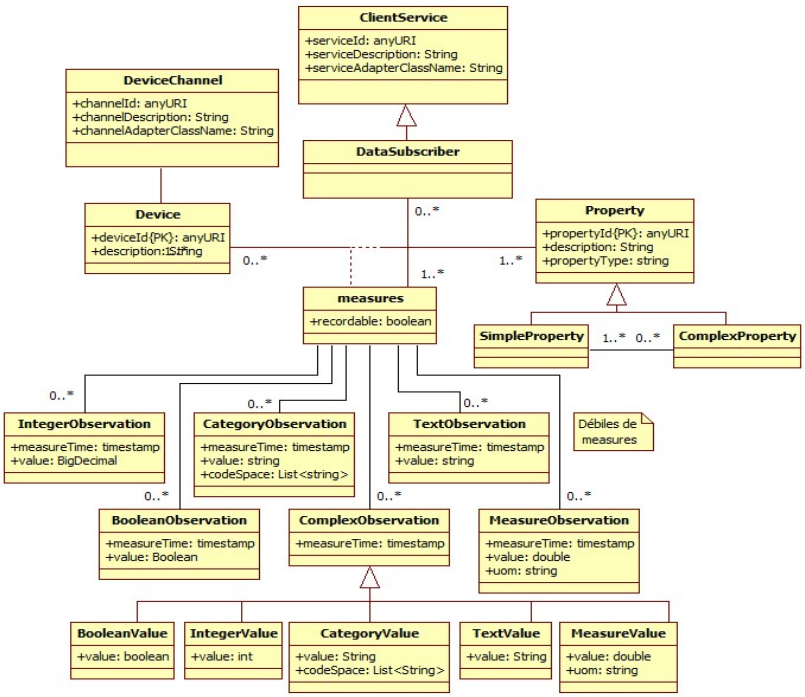


Fig. 1. Proposed common data model

- ClientService. Represents the communication channel towards the applications, fed by the system, both in synchronous or asynchronous manner. This provides, through a set of wrappers, the flexibility to cover a large set of technologies such as HTTP, TCP, XML and JSON.
- DeviceChannel. Represents the communication channel to communicate devices with the system. Takes account of the data communication protocols used by the sensors that send data to the system such as TCP, UDP, HTTP, MQTT and others.
- Device. A device element of the model represents a mechanism that can perform measurements on physical magnitudes, i.e. a sensor.
- Property. A property represents a measure attribute that can be measured by a device and referenced by a name. We consider two types of properties: *SimpleProperty* and *ComplexProperty* (aggregation of simple properties).
- Measure. Association between device and property to take into account a device can measure various properties and a property can be measured by various devices.
- Observation. Represents the value of a property obtained through a measurement process. An observation has a reference to the device that has performed the measurement process, a reference to the measured property, the time instant of the measurement process and the value of the measurement result. Depends on the type of result there are several observation types: *BooleanObservation* (true/false), *CategoryObservation* (option in a group), *IntegerObservation* (dimensionless

integer), *MeasureObservation* (real number with unit of measure), *TextObservation* (free text) and *ComplexObservation* (aggregation of any of the above).

3 Test Scenario

To test our proposed model we've developed a platform in Java programming language running on a Raspberry Pi[2] (low-cost hardware) and using a relational database engine (H2 Database[3]). The objective is testing the monitoring process in a set of university buildings equipped with devices for different contexts:

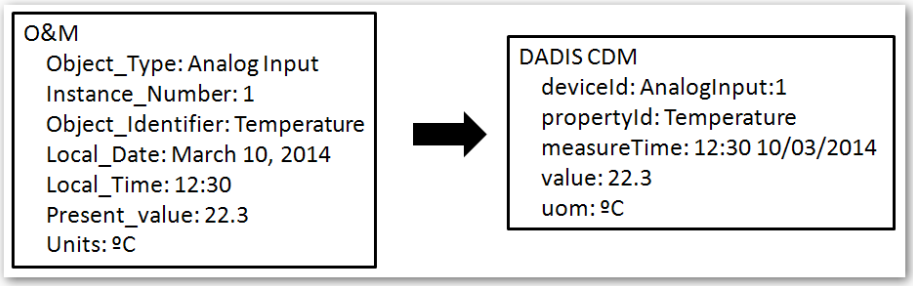
- A set of 15 buildings equipped with **BACnet** technology that allows us to collect measures of energy consumption, environment, … and perform actions on them.
- A set of **O&M** meteorological stations to collect data from outdoor environment.
- A set of **Zwave** and **XBee** devices to monitor indoor locations in specific points where BACnet is not available. Both, Zwa**ve an**d XBee protocols and devices allow us an indoor mobile monitoring, tuning the sensor network to the different implemented applications.

BACnet [4] is a data communication protocol designed to link together the electronic devices present in buildings, used in an industrial context. BACnet data model is based on the definition of a set of services, objects and properties. We use the readProperty service which allows us to read the properties of BACnet objects and do the following mapping process.

O&M is an international standard for modeling observation events and describing their relations to the target spatial objects under observation, the measured properties & measurement procedure, and the captured data resulting from those events. O&M standard is the basis for our model so it fits naturally.

Z-Wave is a wireless protocol designed for home automation, specifically to remotely control applications in residential and light commercial environments.

Xbee is an open protocol for wireless communications. Since, in this case, we control both sides of the communication we use our common model in JSON format.



[2] http://www.raspberrypi.org/
[3] http://www.h2database.com/html/main.html

An example of the mapping process to convert data from sensors using BACnet technology is shown in the figure below. The process for O&M, ZWave and XBee is quite similar.

4 Conclusions and Future Work

In this paper we describe a common data model in order to unify the information storage from information related to different contexts: Building Management System, Environmental platforms, health devices... The objective is the sensor data feed in ambient intelligence applications.

We have conducted a series of tests on data linked to various protocols: BACnet, O&M, Z-Wave and XBee and the results have been satisfactory. The common data model is flexible enough to accommodate every of these models without losing information in the process. Running in low-cost hardware with simple databases the platform is capable of manage data from 1000 sources every 30 seconds.

The model can be used in other scenarios where we control both communication sides: wired sensors, wifi, Bluetooth.

The next step would be test the proposed common data model to provide the ability to send commands to devices so that they carry out concrete actions: lighting control, HVAC control, access control, etc.

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