Internet of Things and M2M for the industry

White Paper

The Day Zero Supervision Approach

Context

Recent advances in wireless networks and cellular technology and the availability of cloud based data repositories are clearing the path towards the integration into the internet of virtually any kind of device. When we say integration we are actually talking about data transfers between the central location and distributed nodes.

The kind of data transfers can be divided in these simple categories:

- Internal data, such as the state of a toaster
- External data, such as temperature sensors on a motor.
- Receiving data and acting upon it such as a vending machine receiving a sale authorization.

The central servers store the values in real-time and historic databases and provide methods to use the data in domain specific applications.

These trends are being known as “Internet of Things” (IOT) and “Machine to Machine” (M2M).

All these buzzwords and technologies are being pushed by the media for the consumer market. On the other hand, the industry already has very mature technologies that have implemented remote acquisition and control since the early 90’s using technologies such as radio based RTUs and intranet based historians.

Industrial M2M is a set of technologies aimed to adapt the new hardware and software solutions to the well-known industrial remote acquisition and control domain.

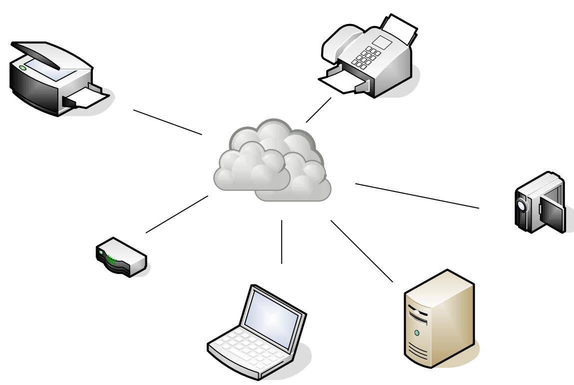

Figure 1 - Machine To Machine idealization

Requirements for industrial M2M

There are several requirements that an acquisition system has to implement in the industrial world.

External analog and digital inputs

The goal of such a system is to sense external variables and those coming from existing instruments appear in different electrical interfaces such as 0-10V voltages, 4-20mA current loops and they need to be electrically isolated in order to prevent hazard conditions.

Data volumes and rates

The industrial applications require samples at a faster pace than regular M2M applications, as an example a weather station may send 10 variables at one minute intervals while a small production line supervision may require 100 variables at one second intervals which require approximately 100 times more data.

	Variables	Scan Time	Samples/ Second
Standard M2M	~10	~60 sec	<1
Industrial M2M	~100	~1 sec	100

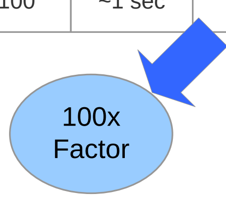

Figure 2 - Data Volume comparison

Low latency

Defined as the time it takes for a sample to arrive in the cloud servers and displayed in an application. This time is expected to be low in industrial applications.

Robustness

Wireless networks are prone to have frequent interruptions and variations on the bandwidth and latency parameters. An industrial acquisition system must provide mechanisms to isolate these factors.

A good strategy is to have an intermediate local buffer and store the data points temporarily until the communication channel is available.

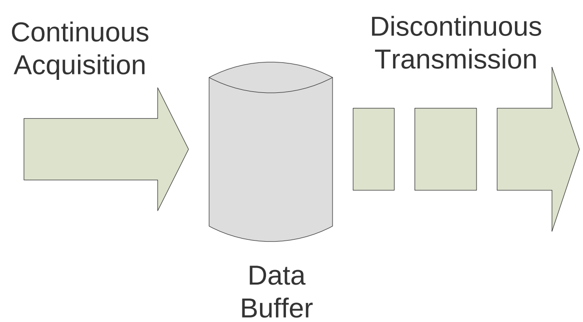

Figure 3 - Store and Forward

Day Zero Supervision Architecture

Day Zero supervision is a unified architecture that can be divided in three layers.

Acquisition Layer

The acquisition layer is composed of measurement devices, wireless sensors and computer applications that obtain, process, compresses and send data to storage layer.

There are three typical acquisition scenarios that can coexist in one Day Zero Supervision setup:

1 - An already existing OPC server is linked to the system through the installation and configuration of the *OPCAgent* application/service.

2 - Already existing instruments are connected to one or more *Dots* wireless devices which are linked to a *Dash* GPRS or WiFi router.

3 - Direct physical variables such as temperature and vibration are measured by *DotSensors* which are wirelessly linked to a Dash GPRS or Dash WiFi routers.

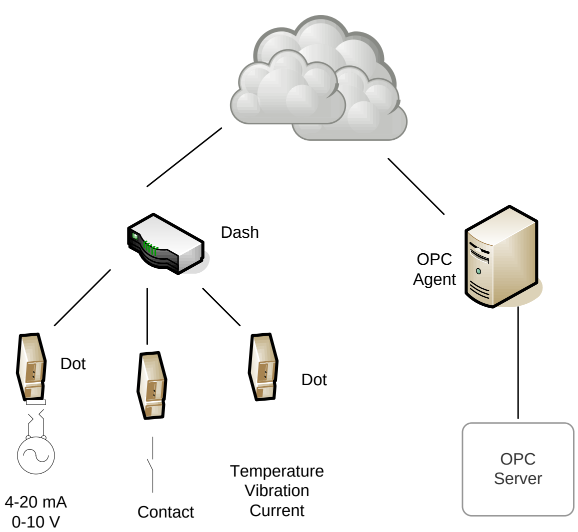

Figure 4 - Common scenarios

The acquisition layer is also responsible for time-tagging the samples, perform the scanning and compression policies and implement store and forward buffers to overcome the instability of the internet connection.

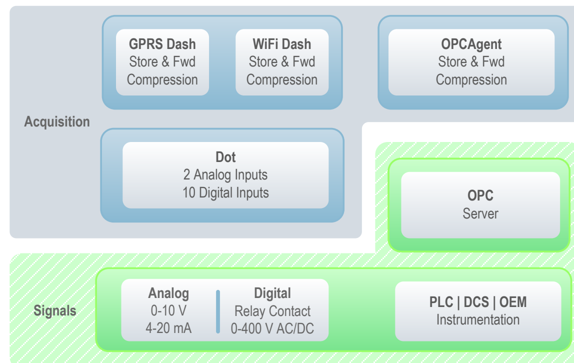

Figure 5 - Acquisition Layer

Storage Layer

The storage layer is a cloud based real-time and historic database that receives and normalizes data from the acquisition layer, store it for long periods of time and serves the data to the Application Layer.

This layer was designed to be very efficient in the following two items:

Sample Footprint: the amount of bytes per sample, this required a careful choice of compression algorithms and data types.

Input Bandwidth: The amount of data arriving in the servers can be huge, so the communication protocols was designed to avoid unnecessary redundancy and overhead.

Application Layer

This layer uses the data from the storage and performs calculations to summarize the information in usable ways. It is implemented as a web application that runs from a SSL secured web site https://dzsupervision.com.

This layer is inherently domain-specific. Depending on the type of industrial plant different graphs and reports may be required. However Day Zero Supervision provides modules that can be used in almost all cases:

- Trending Module
- Delays Module
- KPI and OEE Module
- Motor Maintenance Module

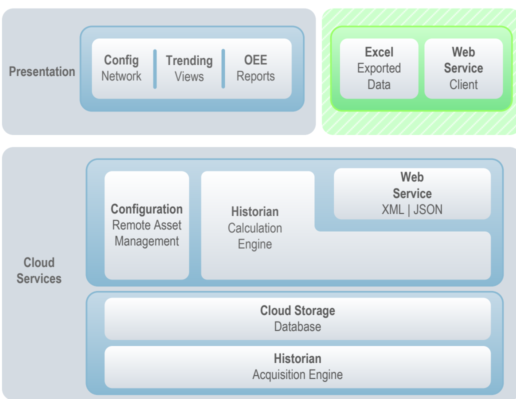

Figure 6 - Storage and Application Layers

The Trending module has many advanced features such as multi-scale, multi-curve, digital variables, gesture enabled pan and zoom, and auto-refresh for real-time visualization.

The Delays module allows selecting one variable (direct or calculated) to determine if the production line is running or not. Based on that information and a couple of configuration screens, the operator can justify the delays and the managers obtain summarized availability indicators.

The KPI and OEE module allows calculations on direct variables to be summarized by hour/shift/day/month and viewed in standardized tables and charts.

The motor maintenance module allows the user to select one signal assign it to one motor and the system will accumulate run-time in hours and start/stop counts, presenting the information in a global motor list.