



Altior for water sub-metering services

A technical application paper

InkwellData
Connected Innovation

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Introduction

The purpose of this technical paper is to provide an introduction to one of the most promising industrial IoT service applications, water sub-metering, and to highlight how Inkwell Data's digital twin IoT platform, Altior, can be of significant assistance to all key stakeholders. The intended audience of this paper are Systems Integrators, IoT service providers, as well as property managers, landlords, utilities, and local authorities.

About sub-metering

Water metering can be broadly divided into three main categories:

- **Direct metering:** every flat and property are equipped with an individual meter. The utility provider owns the meter and is responsible for providing the service (water) as well as the billed measure;
- **Master metering:** a block of flats has a single meter, owned by the utility. The utility invoices the building owner or the landlord/property manager for the overall water consumption. Residential units are not metered separately and invoices are provided by the landlord on a pre-agreed basis (e.g. equal division). This typically results in unfair allocation of costs to tenants and resulting disputes. It also weakens the incentive for sustainable and responsible consumption;
- **Sub-metering:** these devices measure water usage at a more granular level than required by utilities for their billing. This involves recording usage data for individual buildings within a multi-building complex, individual tenants within an apartment building, individual systems within one building, or even individual devices within one facility. Sub-metering allows measurement of individual unit consumption, and for tenants to be billed for their actual consumption.

The EU is increasingly pushing for regulations to ensure tenants are billed for their actual consumption (Directive 2012/27/EU on Energy Efficiency), and landlords will be asked to enable this.

Sub-metering offers a number of benefits:

- For the tenants: not only can sub-meters create a fairer billing system and help reduce property costs, they can also change the way consumers use (or waste) resources. Each tenant is able to control their utility bill by controlling the quantity of water they use each month, through a regular and accurate reading, as well as identify early a potential leak.
- For the property managers: sub-meters allow them to double check invoices submitted by the utility, as well as identify speedily potential leakage damage caused by the property's own water network, for which they are responsible.

To deliver the benefits of sub-metering, the property manager has to connect and manage the devices in a way that reduces both utility costs and administrative overheads, to limit new tenant charges.

Inkwell Data’s Altior digital twin platform for industrial IoT is a powerful enabling technology that can be applied for the development of such sub-metering applications.

A digital twin is a digital copy of all the objects and business processes involved in the sub-metering value chain. The digital twin extends the capabilities of physical objects and allows the creation of custom workflows using an intuitive graphical representation, making it possible to develop and operate a sub-metering application without any specific industrial IoT training.

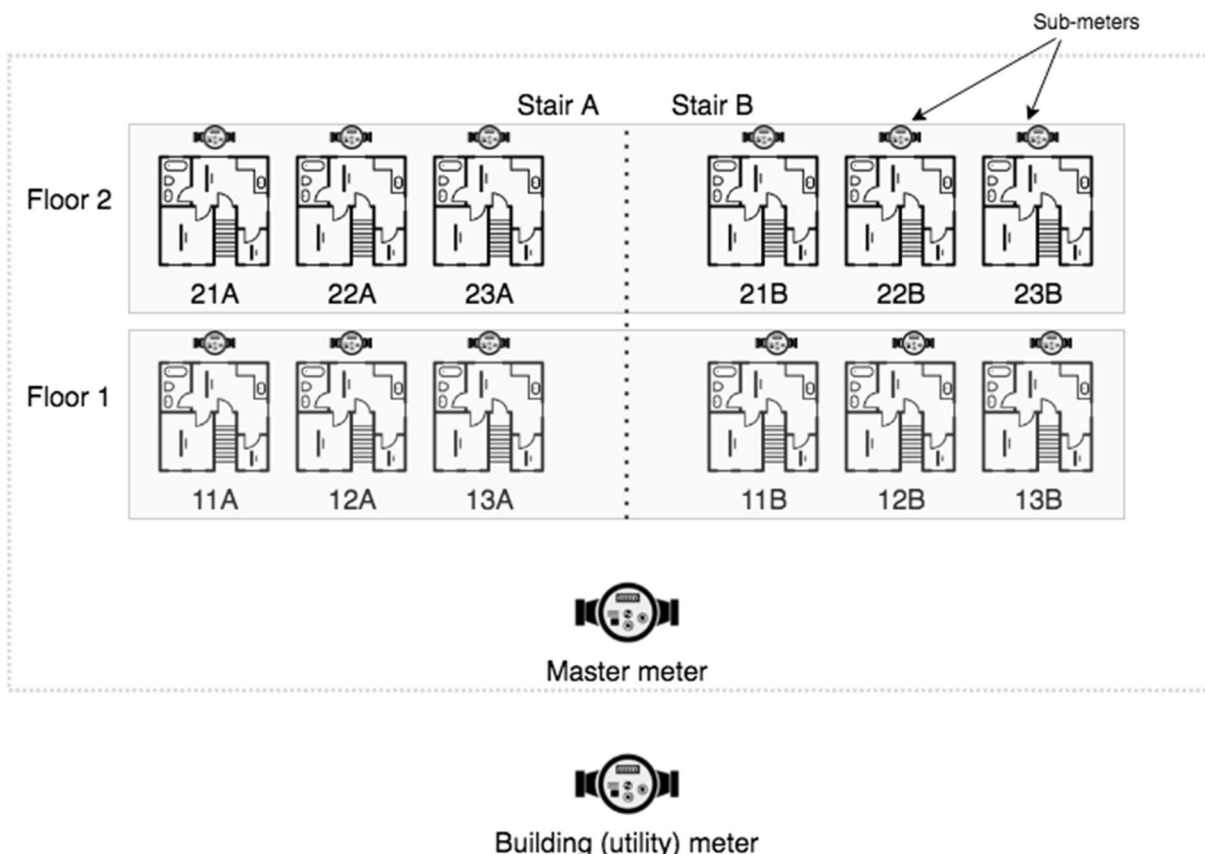
A sub-metering application example

As an example of a sub-metering application, consider a block of flats that has a cold-water meter provided by the water company.

For the purpose of our example, the building is divided in two different staircases, and each staircase has two floors with three flats on each.

To implement correct water billing, a smart (communicating) master sub-meter is installed after the utility meter, and a smart sub-meter is installed in each flat. The purpose of sub-metering is to collect all of the water consumption readings from the flats and bill the tenants accordingly.

The master meter is used as a reference to check the sum of all the flats consumption and to compare the aggregate consumption with the one provided by the water utility company.



Source: Inkwell Data

Altior is able to define a digital twin for the utility meter, as well as for the master meter, and any of the flats’ meters.

Using a local wireless network infrastructure shared by all the sub-meters, all the consumption readings from single meters are managed by Altior, and then by using the SWaRM application on Altior, the billing data can be automatically generated for every billing period.

Altior offers a number of added-value services to sub-metering that can be of interest to the landlord or the property manager. By comparing the utility meter reading to the master meter reading and the sum of individual consumption, Altior can help identify in-building water leaks. By collecting daily or hourly meter readings, it is possible to identify abnormal usage patterns or potential frauds.

Although traditional metering systems may perform the same tasks using meter data management databases and specific procedures, the standard approach becomes challenging as the number of managed meters increases. Scalability can be a problem for a large property manager or for a sub-metering service provider.

Another potential source of problems is when different buildings are using different meters and sub-meters, with various communication protocols. This usually means separate managements per vendor, with ad-hoc software solutions required to try and reconcile the differences.

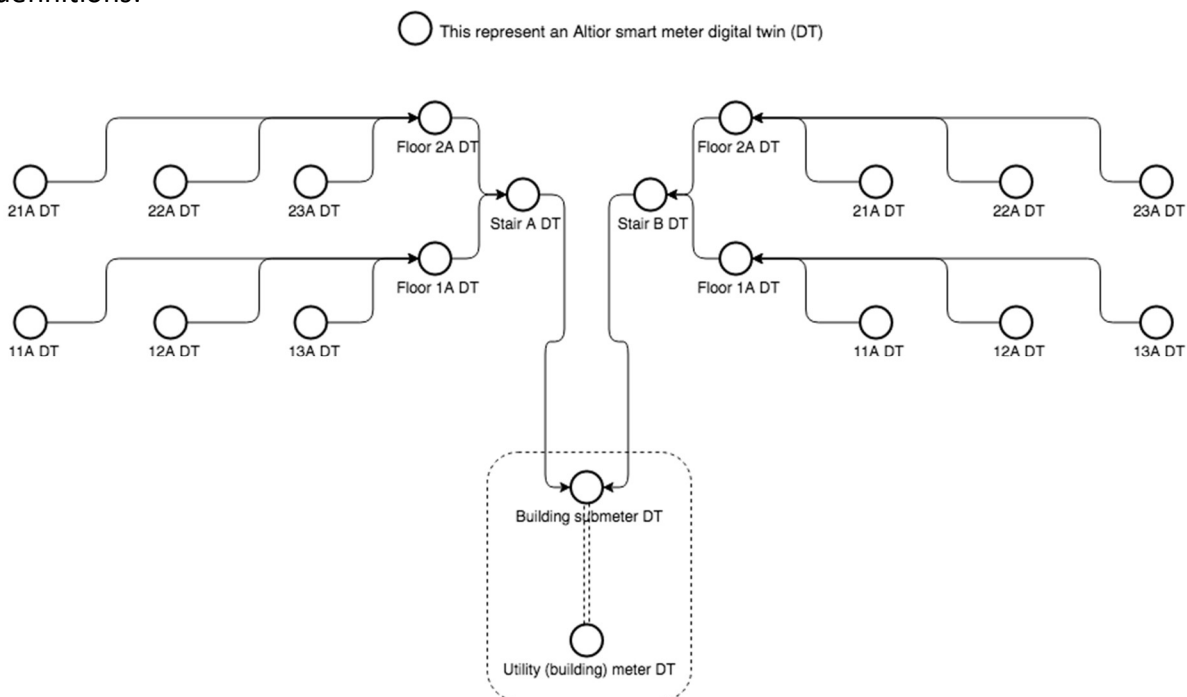
Inkwell Data solves all these issues with its digital twin platform, Altior.

Altior digital twins for sub-metering

The Altior web-based front-end makes it easy to define digital twins for all the components of the sub-metering value chain.

For a variety of physical objects, their digital twin definition is a matter of selection from existing implementations; Altior has a growing device twins library including popular water smart meters.

The following diagram is a representation of the example building in terms of Altior digital twin definitions:



Source: Inkwell Data

Altior’s description of a building for a sub-metering application is actually the definition of a graph of interconnected simpler digital twins.

On the IoT side, the Altior service developer can define or reuse existing digital device twins for all deployed meters.

Cold and hot water meters, electricity and gas meters, heat meters, temperature sensors, HVAC, all of these physical devices from different manufacturers can have a digital device twin on Altior which is used to collect readings, events and alarms and their general status.

For devices that support commands (i.e. a return channel), Altior’s digital twin platform is able to send action requests to the devices (such as “synchronise clock” or “shut off valve”) in a manufacturer-independent manner.

Altior extends the digital twin model to complex “objects” such as flats, floors, stairs, and even buildings and compounds.

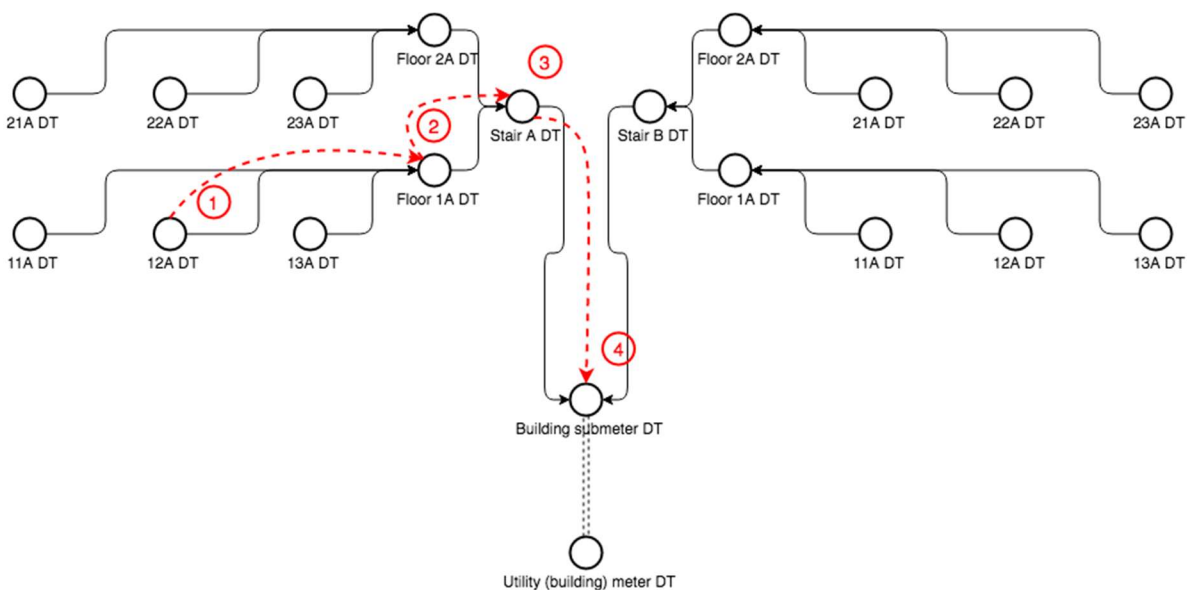
On Altior, one can design a “flat” digital twin which is defined as a collection of meters and sensors device twins installed in the flat with some additional properties such as the tenant’s references, contracts, etc.

The flats’ digital twin instances are grouped in a “floor” digital twin, that can also include some additional properties such as the door number, position, and maybe some other digital twin features such as fire and smoke sensors installed on the floor.

A collection of floors digital twins is used to define a “staircase” digital twin, that will also include additional properties to identify the staircase, such as the name or the position in the building, and maybe other digital twins like the lighting system, lifts, intercom systems and master meters.

A collection of staircases’ digital twins will define a “block” or building digital twin, that will include properties such as the address, the master meters and other common devices like external lighting, pools, etc.

Inside Altior, digital twins are independent data objects that communicate through messages passing in real time. This means that once the digital twins’ relationships are defined, every change in the state of a single component is relayed to the relevant portion of the structure, in real time.



Using the diagram above as a reference, when a new reading is collected by the flat 12A water meter (1), the value is relayed to the “floor” 1A digital twin (2), that keeps a running sum of all of the water consumptions for that floor.

The 1A floor digital twin relays (3) the original meter reading to the “staircase” A digital twin. The staircase digital twin keeps the sum of all the consumptions in the floors and in the flats.

The staircase A digital twin relays (4) the flat reading to the building’s sub-meter digital twin, that keeps the grand total of all the readings.

This process happens instantaneously for every meter reading, and with this approach it is easy to establish consumption check points at every level in the building structure.

With Altior, leak detection can happen at every level, from the staircases down to each single flat. The real time meter reading features allows detection of unusual consumption patterns, such as a forgotten running tap. The master meter digital twin also allows for consumption comparisons with the utility provided meter, and helps to locate leaks in common parts of the building, like an outdoor tap.

Another feature of sub-metering with Altior is that since the digital twins are lightweight data structures, scalability is not an issue. As the Altior platform is designed for scale and to manage millions of IoT objects, so the grouping of meters in complex structures such as floors, staircases and buildings has little or no impact on the system’s performances.

Using Altior digital twins for sub-metering is not just a way to create timely and accurate bills for the building residents, but also make it easy to provide every resident with a smartphone application to track bills and monitor the water consumption of their own flat in real time.

On Altior, adding other sub-metering services, such as electricity, gas or heat metering, is simply a matter of adding more digital twins into the application and some business logic to handle the new cases and their data flows.

Conclusions

This technical paper is only an introduction to the features and capabilities included with Altior, such as the native data security framework (Aegis) that provides out-of-the box data encryption services that are in compliance with the GDPR requirements, or the graphical data exploration tool (Dex), that allows non-technical users to visually navigate all the data managed by their Altior-based IoT services to create monitoring dashboards or to export selected data to third party applications for further processing.

But arguably the most important aspect of Altior is Inkwell Data’s technology agnostic approach to industrial IoT. Technical issues such as cloud or on premises installation, multiple IoT networking technologies, the different application protocols by meter vendors, or the scalability and availability of the services are handled through Altior’s digital twin platform.

Because the only important thing to the Altior user is to get the job done regardless of the underlying complexity.

Altior users and clients need only to focus on what they want to do, not how do it.

This is what makes Altior different from any other IoT platform.