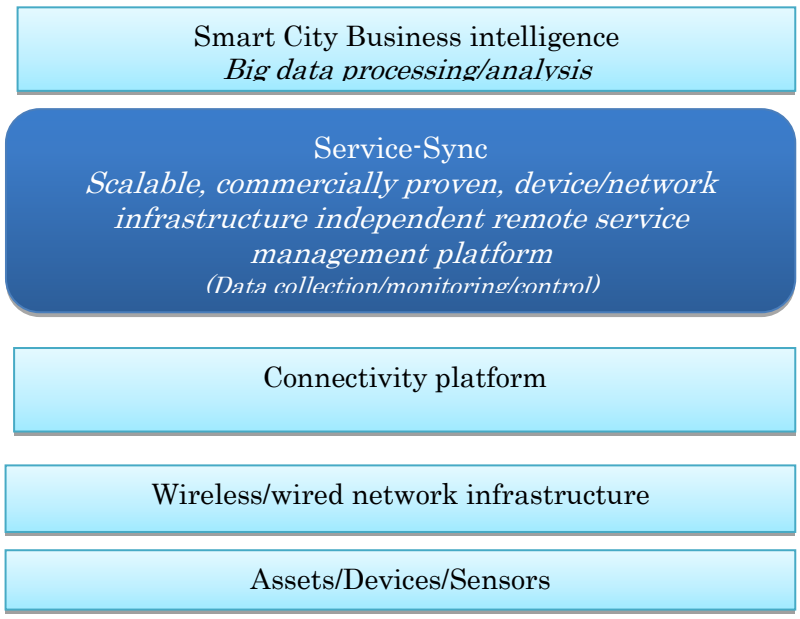
Inventit *Service-Sync* Internet-Of-Things Platform

"White Paper for Smart City"

Overview

Major IT companies around the world are addressing the potential of smart cities, focusing on the space where cleantech meets information technology. The smart management of power and resources requires real-time data and the ability to analyze and respond, opening up a significant opportunity for large scale networking and services giants with the scale, the budget and the track record to deal with municipalities. Creating smart infrastructure for cities around the world has become the new frontier of urban planning; a global business that IDC has estimated could be worth as much as $122 billion over the next two years alone.

The cost of building, improving or maintaining infrastructure to keep up with growing demand is the most significant challenge that cities face today. The smart city initiative includes multiple project domains: energy management, water management, transportation, environmental monitoring, mobility management, and improve efficient energy consumption. To challenge these, the companies seeking this huge opportunities have been acquiring and collaborating with the companies of the smart device/sensor and business intelligence in each knowledge domain, which moves the concept of smart city from "may-be someday" to "today."



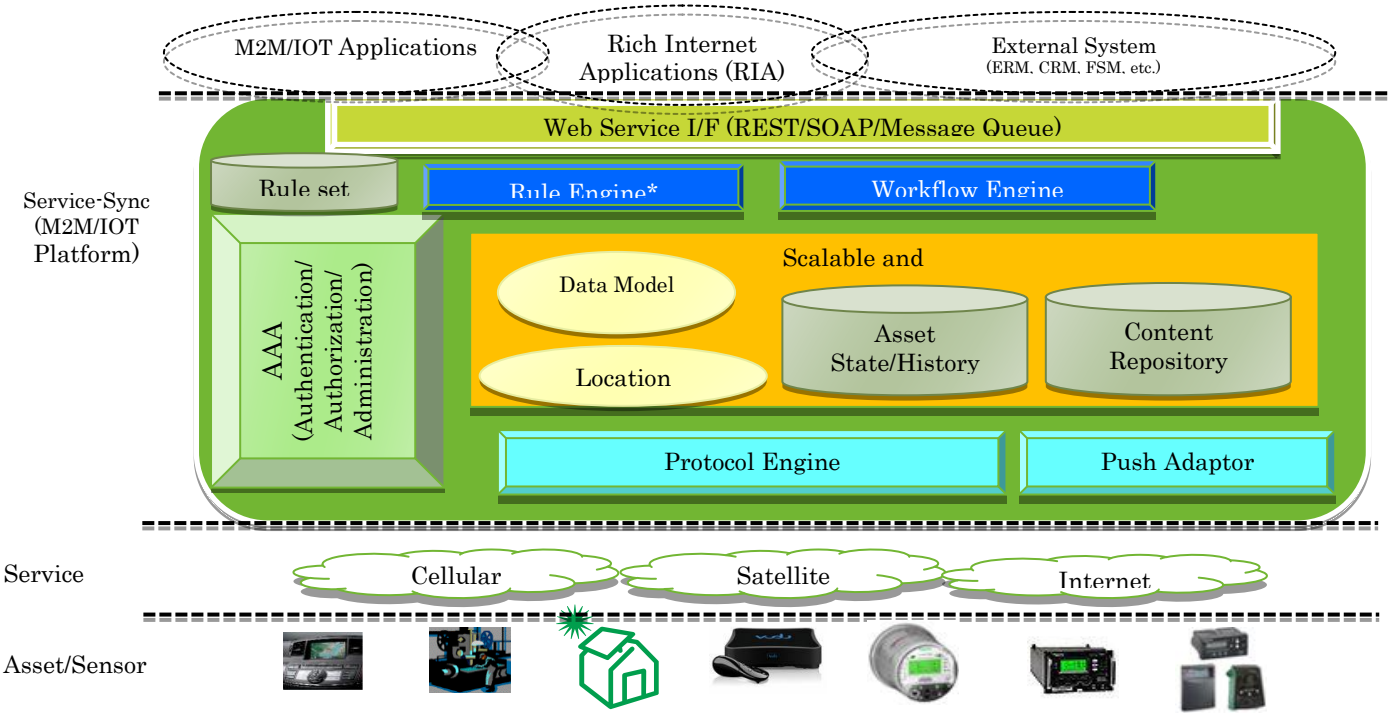
An important technology, however, which has been overlooked, is common platform of connectivity, between the smart devices and real-time business intelligence, and service delivery platform independent of diversity of both network infrastructure and device/sensor. Since the network focuses on niche solutions, aka vertical-silos, the total cost building smart city becomes traditionally huge. Besides, to harness full power of new intelligent and functional smart devices, industry needs a proven, scalable, and secure remote management platform. Building remote management solutions require the list of technical expertise, e.g. embedded software, communication, device protocols, wireless provisioning, Web services, security, data management, and scalable modern cloud infrastructure. In today's lean business environment, very few organizations have talents with all these skills.

Building remote management solutions from scratch involves significant implementation effort before you can begin adding value. Inventit's ***Service-Sync*** provides many parts of the solution, so that the smart city service providers can focus on the parts of the solution that add value for their customers. ***Service-Sync***, allows organizations to build and deploy scalable and compelling connected-device applications, e.g. asset tracking, machine monitoring, remote control, etc., faster, more predictably and with lower development costs. The modern intelligent devices in smart city use a variety of communication channels and variety of data

encoding methods. Service-Sync hides these details from your applications, which in turn can focus on the data from the devices. Since the data of devices is stored in Service-Sync in a normalized format, several remote service applications in smart city can access device data in unified manner. Service-Sync standardizes the ways to access the functionality in remote devices so that remote applications can control the devices through unified APIs exposed by Service-Sync, which reduces your development and interoperability test cost drastically.

Technology and Components

Service-Sync Server: is the platform (M2M Application Enablement Platform), where M2M applications can be built and executed in cloud environment. The data gathered is converted and stored into database in a normalized format so that the remote applications can handle device data in a unified manner. The server platform includes development environment and runtime for customized workflow when you need to extend its built-in function and Rule Engine for running simple business rules, e.g. threshold rules. The remote monitoring policies, e.g. set threshold, created by the remote applications and downloaded to the target devices enable devices to run the management application locally and to off-load the remote applications. Rich sets of Web service APIs are exposed so that remote applications can be developed in several ways.



Service-Sync Client: is embedded into the managed devices and exposes platform APIs through which device manufactures can integrate their device dependent applications in order for them to send alert/log data to and receive control requests from the server. The client platform APIs allow the manufactures application to send data and receive command to/from the remote application in a uniformed format without knowing the protocol detail for server communication.

Service-Sync Gateway: is a proxy function through which the devices in a local network, e.g. Wi-Fi, Zigbee, etc. are connected to the central server beyond internet. The gateway multiplexes and normalizes the device data from devices before sending it to the server and converts the management requests from the server into what can be recognized by the devices.

Service providers can add and install new gateway service functions complied with JSR232 on the fly.

The following summarizes the technology uniqueness of Service-Sync:

- **Multi-purpose Architecture**: Service-Sync unique data model and flexible/customizable archicture allows remote service providers to add remote applications in a modular manner. Devices that behave the same function can be grouped into models so that rules and operations can be applied to every device of the same type in a uniform manner. The platform abstracts devices based on their functionality and capability and presented into XML format.
- **Offload applications:** The platform can timestamp and store every data point of operation. The applications can query the platform for the last known state and the platform can notify to the applications whenever the last state is changed, which means the applications can function independently of the behavior and communication channel to the device.
- **Scaling and Growth:** As requirements grow, e.g. number of connected devices, logic executed, rate of Web requests, etc., Service-Sync mitigates the scalability concerns by allocating the resources on demand.
- **Ensuring Security:** User privileges are defined in two ways: operation-based permission and device-based access control. The device-based access control can be defined per property and attribute associated a device. The standard mutual authentication, integrity check and encryption of communication channels between applications and devices are maintained by the platform. FIPS certified and regulatory compliant security agents are provided upon request.
- **Open Platform for integrating with Enterprise Applications:** Enterprise applications, e.g. business intelligence, can be easily integrated with the platform in three ways of handling and the applications can be deployed on Inventit cloud environment or your data center:
    - **Rich sets of Web services interface for both to create or synchronize information**
    - **Customized workflow which can call the Web services of another application, e.g. another cloud application**
    - **Message Queue for integrating with external application behind a firewall**
- **Customizable Workflow and Building Rule:** The users can create the customized workflow using the GUI tool, which the platform automatically converts into the internal logic to integrate with the built-in logics. The idea behind Rule is that they provide a simple means (IF-THEN-ELSE) of expressing business logic for remote service management.
- **Real-time and large data processing:** Service-Sync provides users with sophisticated data processing engines for analyzing complex events without, for real-time, and with, for offline processing with big data, storing data into the database.
- **Using Location-Based Services:** Inventit has a comprehensive set of capabilities for building location-based services into your solution.
- **Testing Environment:** The Service-Sync server and client simulators are useful tools for testing the devices and server before launching the commercial service in terms of both stress and function tests.

Value Proposition

The following summarizes Service-Sync value proposition to remote service providers:

- **Build and Deploy Remote Applications Faster at Lower Costs:** Service-Sync allows organizations to rapidly build and deploy next-generation remote applications that leverage the expanding world of connected devices. The platform lets you significantly lower the costs and reduce the risks involved in developing and deploying the remote management solutions. The platform enables you create custom remote applications and services quickly using proven building blocks.
- **Scale with Your Business**: As Platform-as-a-Service (PaaS) offering, Service-Sync platform scales with your business. Regardless of the size and scope of your deployment, no matter which networks or what types of devices are involved, Service-Sync is scalable and flexible enough to meet your needs.
- **Carrier grade with the flexibility of Enterprise SOA**: Service-Sync server and client have been commercially deployed in Tier-1 mobile operators to gather data from and to control several ten millions mobile devices, and they have been building several remote service applications using platform APIs and integrating with their enterprise systems.
- **Support both demand (event)-driven and control-driven processing**: Most of smart city applications are demand-response type. Tremendous amount of demand from devices need to be handled in real-time and efficient manner. Devices include Service-Sync's intelligent agent software can remotely trigger the real-time demand-response programs which are assigned beforehand by business rules determined by remote service applications.
- **Unified access to diverse devices' data from diverse sets of management applications:** Service-Sync can provide unified view of diverse sets of data with devices in smart city, e.g. smart meter, mobile, transportation, grid, etc. to diverse sets of remote services. Since variety of remote operations to devices are undertaken through single platform API provided by Service-Sync platform, the programing interface of remote service to the devices are standardized, which in turn reduces the development cost drastically.
- **Administrative tools:** In addition to the remote service, Service-Sync enables device manufactures to manage their devices remotely, e.g. over-the-air firmware update, device provisioning, diagnostics, etc. to make remote service healthy.

Competitive Advantages

Service-Sync does not compete with smart grid or city software products, like Telvent, Hara, Agilewaves, Silver Spring Networks, which comprise a robust standard baseline and flexible metering services layer to adapt to the requirements of each customer. In fact, Service-Sync can co-exist with smart metering and grid software. It can be used underneath of smart city technology. The key advantage of Service-Sync platform is for easily customizing workflows and creating demand driven actions to accommodate those several demands.

The combination of smart city software and flexible Service-Sync platform complements the existing infrastructure products, transforms them into the smart devices and gives the industry equipment suppliers a reach into the new world.

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