IBM Haifa labs - Position paper for SECOND USAGE AREA WORKSHOP

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Areas: eHealth (Smarter Remote Healthcare), Smart cities (e.g. Water, Smart Electricity Grids), Location-based Services

(1) What use case and scenario in your area would you consider the most appropriate and representative one for large-scale experimentation with the Future Internet platform to be built starting from 2013 (please refer to the documents referred to on the above websites for inspiration)?

IBM Haifa labs has a very deep expertise, experience and knowledge in the areas of: Sensors and Actuators, Event Processing, Data Stream Processing and Management, high volume of messaging, reliable Multicast Messaging, Optimization and the usages of these expertise to several important domains such as: Healthcare, Energy & Utilities, Smart cities and location-based services.

Following are several more detailed examples of use cases and scenarios:

eHealth **(Smarter Remote Healthcare)**:

Promote patient empowerment for chronic disease management by providing interactive telemedicine services via the web as well as a comprehensive support system. The objective is to provide the patient with continuous feedback and support as well as to provide feedback to the healthcare professionals who are responsible for his treatment and to trigger additional services when needed. For example, diabetic patients and their doctor/nurse are to interact remotely for ongoing monitoring, feedback and alerts including the automatic initiation of services needed based on medical protocols and guidelines.

A possible scenario:

John is enrolled in an interactive disease management program through his doctor utilizing the future internet platform, which enables remote monitoring through an ongoing interface with devices in the patient's home that measure glucose levels (glucometer), weight, blood pressure, pulse, and level of acetone in the urine (which the patient or his caregiver must enter based on the results of a simple stick test). There is an interface with John's doctor's electronic medical record so that information such as results of recent lab tests is automatically entered into the patient's baseline information. Alerts are automatically transmitted by SMS to the patient his caregivers, as well as to the doctor's electronic medical record and to the nurse who is John's diabetes case manager.

On Monday morning, a glucose level of 40 (normal is about 100) was entered into the system triggering an alert. The patient (and caregivers) receives an SMS instructing the patient to swallow a teaspoon of sugar and turn on his internet disease management program for further instructions. He opens the program, which then asks him a number of questions such as: Is he sweating? Does he have chest pain? When was the last time he took his medication? What dosage did he take? When did he take his last dose of insulin and what was the dose? When did he eat last and what did he eat? Depending on John's answers to these questions, he will be instructed to measure his glucose level again in 15 minutes, or the program will automatically dial his doctor's clinic and initiate a video conference between the John and the case management nurse and/or the doctor, or it will automatically order an ambulance. Simultaneously, an SMS will be sent to the caregiver's cellular phone informing him of the action the program has initiated. Likewise, this information will be forwarded as an active alert to the doctor and nurse and will create an automatic entry of the event in the doctor's electronic medical record.

Smart cities - Water

Another important area we believe can utilize the new platform is the Intelligent Water Operations & Management.

Today, the Water supply infrastructure is composed of large complex networks, composed of many components that must be constantly and optimally operated and maintained in order to provide a constant supply of water at the required quality in an efficient manner. Carrying out such operation and maintenance requires careful and constant planning and response, due to the variety of resources involved (people, equipment, etc.), disruptions such as the need to close roads, and the potential disruption to water supply. In addition, such planning and response requires constantly acquiring and assimilating data from a variety of sources, such as usage readings, pressure sensors, sources such as water/sewage pumps and purification plants, and customer complaints, notifications and feedback.

We therefore propose to significantly improve the operation and management of the water supply infrastructure by utilizing the Future Internet Platform to gather and assimilate the data from the required sources. Concrete operational and management improvements will then be obtained by applying advanced analytical techniques and optimization algorithms. Example scenarios include:

1. Intelligent Energy usage management – optimizing the energy requirements of providing the water technology, advanced energy optimization driven by Events and optimization technology. Optimizing power usage based on pricing models, environmental context (such as weather).
   Data sources that can be used in this scenario are: weather forecast, history of usage in similar environmental conditions, history of usage this time of year, information regarding energy prices, real time data on the status of facilities and the efficiency of each facility, real time consumption data.

Benefits: a water corporation that uses this platform will be able to significantly reduce its energy costs and minimize its carbon footprint by using energy only when he needs to, using energy at lower prices, and utilize the facilities that are more efficient.

2. <u>Intelligent Pressure reduction</u> – Advanced Pressure optimization driven by Events and optimization technology. Optimizing pressure levels based on predictive models, environmental context (such as weather)… Lowering the pressure helps prevent water leakage.

   Data sources that can be used in this scenario are: weather forecast, history of usage in similar environmental conditions, history of usage this time of year, real time consumption data, network GIS data, real time maintenance data (e.g., broken pipes).

   Benefits: Water corporations that uses this platform will be able to significantly reduce the pressure in its water network, thus reduce both leakage and energy usage both result in cost and carbon footprint reduction.

3. <u>Intelligent Leakage detection</u> – Using real time data from underground sensors we can detect leakages, predict its location and help prevent water loss by using actuators that reduce the pressure in the problematic pipe.

4. <u>Intelligent Maintenance live Scheduling</u> – Water corporation has maintenance schedule that was optimally planned but needs to be changed as a result of real time events such as pipe burst. After the decision to move a maintenance team and equipment to another location is made, we can use the team's mobile devices to inform them of the change and send them specific details of the new task. We want the change in plan to be as smart as possible: low cost, minimum disruption to consumers, minimum image damage, and minimal water loss. After the change was made we want to change the maintenance schedule so that the tasks that weren't done due to the change will be rescheduled.

   Data sources that can be used in this scenario are: sensors in pipes, call center reports, traffic sensors, weather forecast, history of usage in similar environmental conditions, history of usage this time of year, network GIS data, real time maintenance data (e.g., broken pipes), street cameras, data regarding skills and equipment that it needs to perform this task, data regarding the current location of the maintenance teams that is provided using their mobile devices.

   Benefits: Water corporations that use this platform will be able to better react to unplanned maintenance requests such as pipe burst – assigning the team and equipment that can get there according to task's priorities with minimal impact on other systems and other maintenance operations. The WC can also prioritize different events according to different parameters such as cost or disruption to residence life.

A possible scenario: we assume the Example for such real time events that change the schedule:
Call center receives a report that a pipe burst in a certain street. It uses the street cameras inputs to see the severity of the water loss. It sees that the water loss rate is very high and it receives reports from the traffic sensors that traffic jams are created in the area of the street. Context data is received – is this a main road or a side road. It turns out it's a main road so the pipe should be fixed immediately. The system needs to estimate which equipment is needed to perform the fix and which personnel with which skills it needs to perform this job. It can also check the maintenance history of this pipe, are there known issues or problems. The mobile devices that each maintenance team has indicate its location and work progress. The system calculates which teams and equipment are allocated to handle this pipe water burst and notifies their portable devices. The notification to the team includes the optimal route to go to the problematic street (taking traffic data into account). The teams relocate to the problematic street.

All above described use cases are fed from multiple sources of events and publish events to other recipients.

The incoming inputs include:

- Events produced by the call center that includes consumers complaints and reports.
- Events produced by other utility corporations such as electricity corporation. Such event can be notifications on different maintenance jobs performed and the different costs of the different inputs it uses (such as the price of energy).
- Event produced by the emergency agencies. For example: Fire, attacks…
- Events produced by sensors in pipes. These sensors can indicate the pressure in the pipe, water quality…
- Weather predictions.
- Traffic sensors.

The Intelligent water operations management aggregates the data coming from different sources to understand the current state of the system and proactively react to it. Example of such reactions can be increase pressure in pipes, test for leakage in specific pipes, reschedule maintenance teams to maintenance tasks, reacting differently to events according to the weather forecast.

The water corporation that will use this system will be able to view all the aggregated events displayed on several dashboards, including a GIS display.

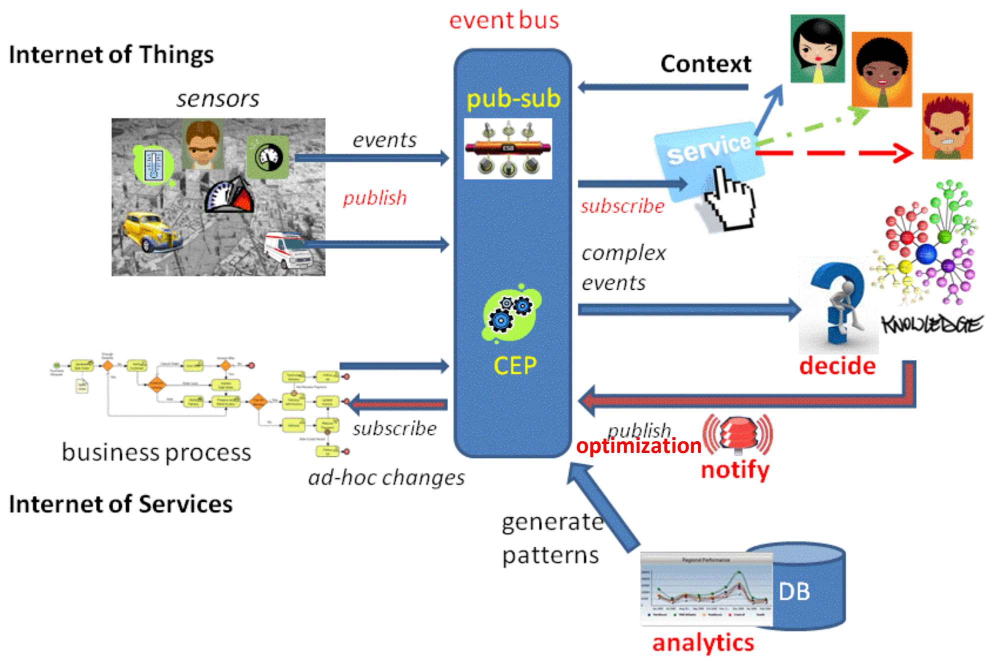
Having the future internet platform supporting such scenarios will also help citizens and consumers play a significant role in the operations and management. Besides viewing usage, supply problems and water quality online and at first hand, they can become yet another sensor in the system providing feedbacks, alerts and visual confirmation of the status of the water operations and management

Smart cities - Smart Electricity Grids

Smart Electricity Grids - dozens of millions of smart meters deployed at homes, businesses and distributed energy producers (such as solar panels, wind turbines, etc). The consumer meters are attached to every significant home device - cloth dryer, electric car charger socket, washing machine, etc. The meters are connected, within a private or public network, to the utility monitoring and control points - both central (utility headquarters, data centers) and distributed across the grid infrastructure (neighborhood substations, backhaul systems).

The information, produced by the meters, serves to closely monitor the state of the energy consumers and producers. One goal is pro-active detection of imminent power failures and immediate system re-configuration required to prevent the black-out. Another goal is demand-response - careful planning of electricity consumption during the day cycle, reducing the peak demands by sending differentiated pricing to the smart meters so the consumer has an incentive to move the less urgent jobs (such as running cloth dryer) to off-peak hours. Electric car charging, that will soon emerge as a source of major electricity consumption, also requires fine-tuned management. For the utilities, an even electricity consumption throughout the day, means a significant cost saving, since they are required to support the peak demands, so can build less power plants if the peaks are reduced.

(2) What innovative Internet functionality and technologies would you consider important for your suggested use case and scenario (e.g. context awareness, sensor networks, advanced real time processing capabilities handling huge volume of data, ad hoc service composition and mash-up, managed broadband connectivity and services, embedded media support for interfaces easing the interpretation of processed contextual data, etc.)?



All the areas described in this position paper (**eHealth, Smart cities (e.g. Water, Smart Electricity Grids), Location-based Services)** requires several technologies:

- Advanced sensor networks
- Event and Data processing and management
- Real time processing handling huge volumes of data – scale, elasticity
- Context awareness
- Ad-hoc service composition
- Embedded media support (e.g. communication with patient over video)

In particular, the SmartGrid scenario will need an Internet platform with embedded advanced real time processing capabilities handling huge volume of data. It is impossible, and often not required, to deliver every meter reading (taken frequently) from dozens millions of smart meters, to the control center of electric utility. Therefore, most of the data needs to be processed in the network in a distributed fashion, by active analytics/application elements that understand the message content and can perform data aggregation, produce information digest, extract the most import message parts, etc.

Context awareness and sensor network support features of Future Internet can be useful in this scenario as well.

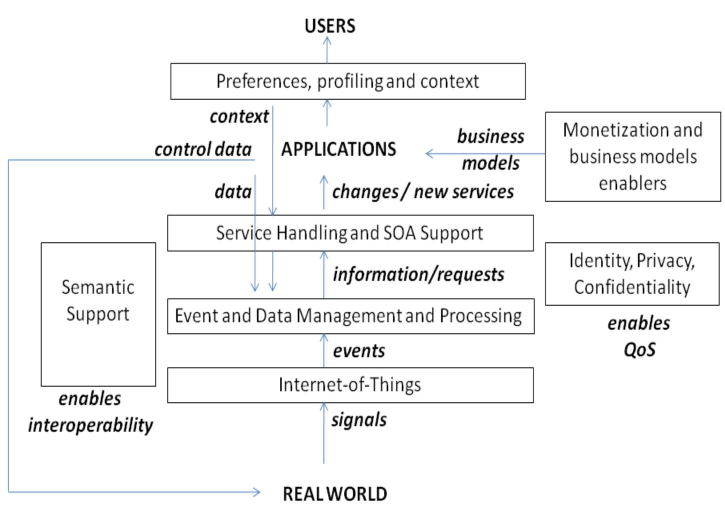
(3) Which of the identified functionalities would you expect the Future Internet core technology platform to deliver to support your and other usage area scenarios?

- CEP (Complex Event Processing) technology
- Date Stream Processing
- BI , Dashboarding technology
- Sensors and Actuators technology, Sensor networks/Internet of things
- Context awareness
- Standardization of messages

Following General Enablers should be taken into account:

- Service Handling and SOA Support
- Event and Data Management and Processing
- Semantic Support
- Preferences, profiling and context
- Identity, Privacy, Confidentiality
- Internet-of-Things
- Monetization and business models enablers

Illustrates their possible composition:



The composition of General Enablers in an FI Platform Instance for realizing Responsive Smart Emergency Management

(4) What kind of experimentation environment would you consider necessary for broad large scale testing of the platform to be developed in your use area? What would be needed to experiment new services and applications cutting across use areas (services and application mash-up) and building a new services and application ecosystem around the prototype implementations of the platform?

For eHealth: Hospital, clinic institute

For smart cities: In order to set up an experimentation environment for smart cities a municipality must be selected. The municipality will need to be set up with the required sensors. The different utilities that operate in the municipality will connect to the proposed platform. The water utility of the municipality will use the platform as a basis for their day to day operations.

The following sources should be provided:

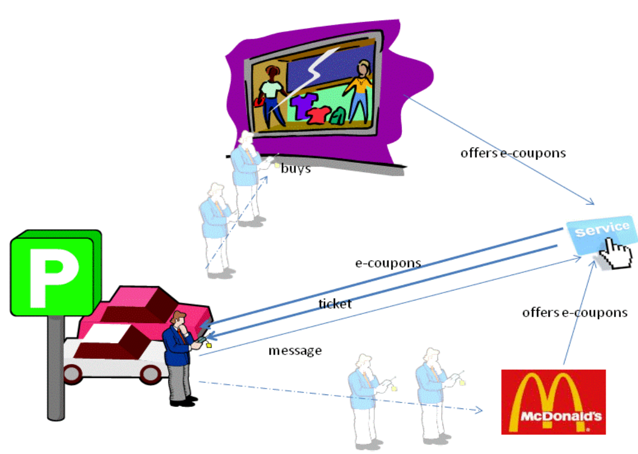
Real world:

- Sensor Networks in the city (e.g. air pollution, congestions)
- Sensors in the car (e.g. GPS location, control information)
- People (presence, itinerary)

Digital world:

- Public transportation information services (e.g. schedules, delays, …)
- Weather information services
- Parking information services
- Service providers (e.g. car maintenance, taxi, rent-a-car, …)

Such a platform would enable creation of new services especially those related to the route rescheduling and location-based advertisement.



Location-based advertisement (e-coupon)

For **Smart cities - Smart Electricity Grids**

Ideally, a geographic region with deployed AMI (advanced metering infrastructure) makes a best environment for experimenting with the Future Internet technologies for Smart Grids. Today, a large number of electricity companies worldwide actively work on installation of smart meters and other parts of AMI, with a goal to complete laying out this infrastructure in a year or two. So it might be feasible to identify an European electricity company with a deployed AMI and discuss with it ways to participate in Future Internet experimentation with Smart Grid scenarios.

Another option is to build a synthetic Smart Grid scenario, with many regular computers simulating smart electricity meters.

(5) How do you see the potential role of your organization in the FI-PPP, in the context of Usage areas taking a prominent role in the Initiative, to ensure an appropriate application driven approach?

IBM – scenario provider, technology provider.

FZI – technology provider

Locate the municipality building on the Smart Cities center in Dublin. Provide the main technology for this use case as part of the core platform – event processing within Internet-of-things and data management. Apply expertise and experience of SME in water operations and management that exists in IBM and build on ongoing engagements IBM has in this problem space.

IBM Haifa labs works on a technology for data traffic management in Smart Electricity Grids and integration of content aware analytics with data communication fabric. This team also participates in a joint Smart Grid project with a number of European electric companies and IT vendors.