

# Position paper on Use Case Responsive Smart City<sup>1</sup>

FZI Karlsruhe, [www.fzi.de](http://www.fzi.de)

Contact person: dr. Nenad Stojanovic

(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](#))?

## Responsive Smart City

One of the main challenges in the urban environment is the unpredictability of emergency<sup>2</sup> situations that might arise all the time and very fast and which require a prompt and correct reaction. Indeed, due to many data sources, heterogeneous services and actors with different goals, such an eco-system is always in a state of an unstable equilibrium. Currently there are weak opportunities to react promptly, in real-time, on (unexpected) emergency situations since the vertical application silos cannot be easily and ad-hoc composed in a horizontal application scenario. Especially important is the connection between the objects from the real-world (e.g. sensors) and the business processes and services, that must be changed accordingly in order to enable a prompt reaction on the current/emerging situation. Additional problem is the high dynamics of the changes that might happen in these situations. It will require that data must be combined from different sources on demand and that services will be changed in an ad-hoc manner. Finally, the quality of a provided solution (e.g. adapted services), incl. privacy of data must be ensured.

An example for the Smart City is the dynamic re-composition of a transportation route in an urban environment due to emerged “critical” events, like traffic accidents, increased air pollution. See slides for more details. Such a scenario requires an active, real-time integration of information from different sources and the ad-hoc changes in the collaborative business processes. In the best case the support should be proactive: the actors should be informed before a situation escalates

On the other side, there is a huge opportunity of the FI Platform to realize this goal: a reactive, self-evolving infrastructure for the emergency management in sm. See Figure 2

(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.)?

- context awareness
- sensor networks
- advanced real time processing capabilities handling huge volume of data (events)
- ad hoc service composition
- event-driven architecture

See Figure 1.

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<sup>1</sup> This work has been done in the cooperation with IBM Haifa Research Lab, contact person: David Botzer

<sup>2</sup> We consider as an emergency any situation that emerges suddenly and can have a (negative) impact on the environment (business, nature), like traffic jams, accidents, increased air pollution...

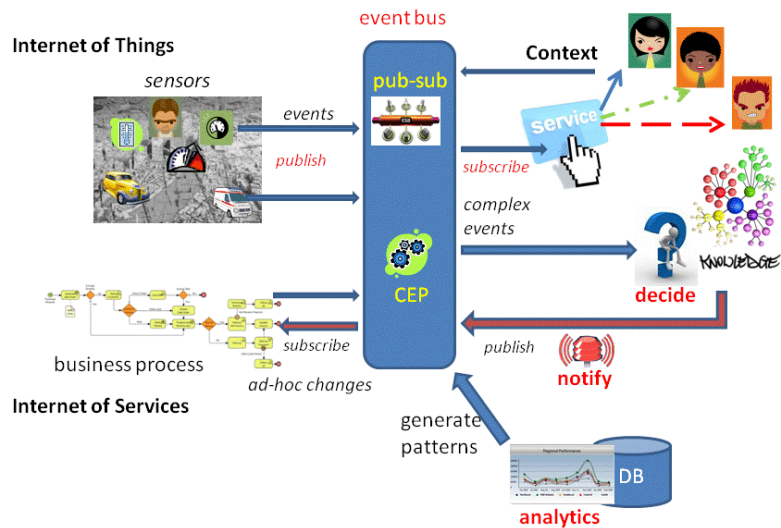


Figure 1: Top-level architecture for the proposed Responsive infrastructure

(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?

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

Figure 2 illustrates their composition.

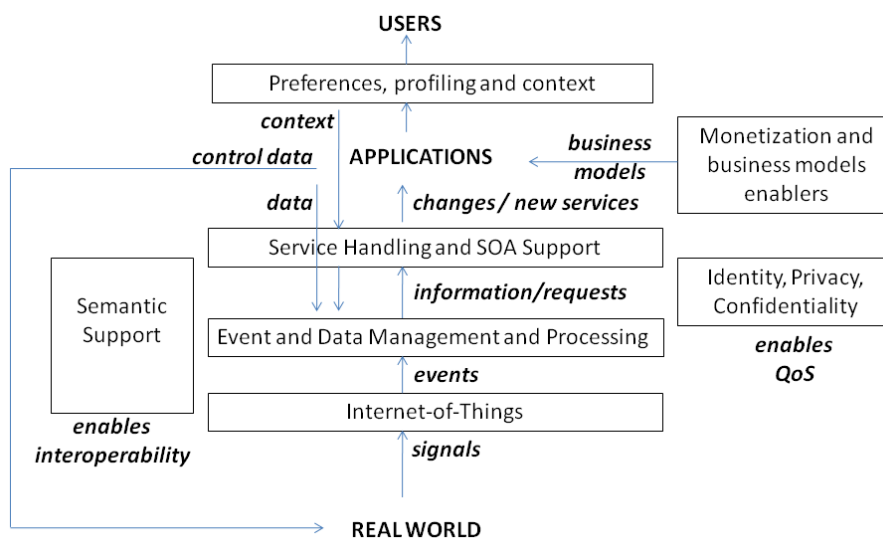


Figure 2: The composition of General Enablers in an FI Platform Instance for realizing Responsive Smart City

(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?

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. See Figure 3

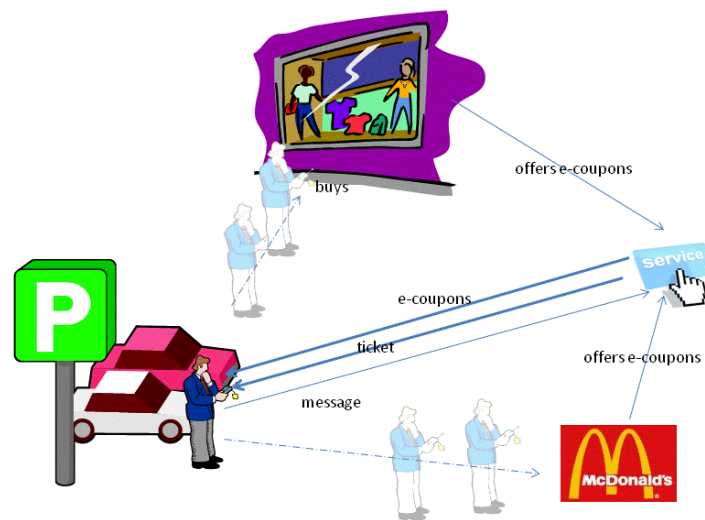


Figure 3: Location-based advertisement (e-coupon)

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

As already mentioned, this work has been done in the cooperation with IBM Haifa Research Lab, which is responsible for the selection of end users. FZI would be a technology provider for the advanced methods for event-driven processing, depicted in Figure 1.

FZI can provide a framework (called iCEP, intelligent Complex Event Processing) that represents an end-to-end solution for event processing, starting from the definition of complex event patterns, through intelligent detection, till advanced 3-D visualization of complex events. It satisfies above

mentioned requirements. The framework is realized as a set of advanced services (CEP as a Service) for processing heterogeneous, distributed and complex stream data:

- **Detection** of complex events, states, situations of interest, and further controlling reactive behavior (actions/reactions) triggered by detected events;
- **Reasoning** about events (over time, space, context, their relations and constraints): Contradicting complex events/situations; Probabilistic events and event retraction (revision); Out-of-order events; Detection of not yet fulfilled complex patterns (e.g. 80% fulfilled situation).
- **Management** of complex situations to be detected, including their discovery and evolution
- Active **visualization** of complex events

The framework is based on the EDA (Event-driven Architecture). The services can be easily integrated in the existing SOA infrastructure (several adopters are already implemented).

The framework has been developed in three EU FP6/FP7 ICT projects (SAKE, VIDDI, SYNERGY) and Germany-government funded THESEUS programme and applied in several real-world use cases

## ABOUT FZI

FZI is a non-profit research and technology transfer center comprising 14 R&D teams – each of them directed by a Professor also holding a chair for Computer Science, Electrical or Mechanical Engineering, or Business Administration at the University of Karlsruhe – Germany's oldest and one of its most successful Technical Universities (now Karlsruhe Institute of Technology - KIT). FZI helps its partners and customers in applying novel information technologies for realizing new and better products, services, and business processes. FZI is a member of the World Wide Web Consortium (W3C), member of the Object Management Group (OMG), member of NESSI, it participates in the IBM Center for Advanced Studies (CAS) programme, it established together with Microsoft a .NET-based center for Innovative Software Concepts, and it won several contracts from the European HPMT Programme to act as a Marie-Curie Training Center.

FZI was founded in 1985, currently employs ca. 120 researchers plus additional student assistants. It has outstanding experience in scientific research and industrial development projects in regional, national and international cooperations, as well as in providing technology consulting services, for instance feasibility studies, technology scouting, market studies, prototype development, etc. Through its multidisciplinary, close-to-the-University approach and its close collaboration in manifold networks (with its University sister institutes, several spin-off companies, partners in European Networks of Excellence, etc) it can ensure on one hand that newest methods are applied and further developed and the highest level of ICT research excellence can be reached, and on the other hand that research results can widely be spread into the scientific community.