

— Introduction —

Smart Applications and Services in the Future Internet

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Introduction

This is the fifth book capturing the results of the Future Internet Assemblies – the first was published in 2009. In that time we can see that the prominence of applications has increased of that time – there were no application chapters in the first book. This increase is due to two main factors. Firstly, the technologies are maturing over time and are now at a stage where serious industrial deployment is feasible. Secondly, within the early Future Internet Assemblies (FIAs) there was a realization that a wide range of stakeholders needed to be engaged to ensure that we continue to move in a direction which meets Europe’s economic and societal needs. Moreover, it is essential that our stakeholder group includes representatives from the important vertical niches such as transport, energy and the public sector. The fact that we now combine Smart Applications and Services into one section highlights the strong connection between these two strands.

The Future Internet can be thought of in many ways. A simple service-centric view is the Internet has three main components: (i) a network to provide connectivity (wired or wireless), (ii) a service layer to expose resources and (iii) an application layer which provides added value for end-users. Within the service layer two main classes of services can be found. Infrastructure services expose core capabilities required for the service layer to function. Typically, these may be related to networking, to managing resource repositories and core SOA function such as service invocation. Higher level services support the creation of business services supplying value to customers typically for a fee. Thus, the service layer acts as a bridge between the low-level network infrastructure and companies enacting a variety of business models to serve the related communities.

Smart applications was a concept which was adopted early on in the FIA series. The notion captured here was that Future Internet technologies enable a new type of application to be constructed. Ubiquitous and high bandwidth connectivity means that in principle applications have access to all required data and resources in real-time as required with geographic distance no longer a barrier. Applications based upon ecosystems of online data and computational

resources, developers and users are now emerging where boundaries between both real-world and computational entities and roles are blurred.

The complexity in the Future Internet will increase, as billions of devices, users and service will coexist and interact. In such a sophisticated infrastructure which can be seen as a very complex system of systems, the applications will be the entry point for many users to interact and enjoy its offerings. Future Internet application developers will have to tame the heterogeneity of sources and target end-user devices, in addition to dealing with the utilization of the Future Internet infrastructure offerings such as Cloud Computing, and the Internet of Things. Collaborative approaches may give rise to a new generation of applications and sophisticated services that are user-centric and provide added-value at a fraction of time and cost. However for the latter to happen, several grand challenges still need to be tackled.

Challenges

A world where on the one hand users demand 24/7 access to cheap (or free), easy-to-use, secure, mobile, personalized and context aware applications and on the other where services and applications are provisioned within dynamic, fluid frameworks with no central control, provides many challenges for the Future Internet community. Within this scenario, the components of applications and services are spread over highly inter-connected infrastructures which may be hosted on heterogeneous hardware and software platforms within distinct organisations. In order to fulfil user demands service and application Future Internet technologies need to support a range of non-trivial requirements including:

- On-the-fly discovery – instantaneously finding resources which match new or changing user requirements, within a setting where no uniform description language or vocabulary exists.
- On-the-fly aggregation – automatically or semi-automatically composing components to create a running application requires a number of research problems to be solved.
- Transitivity – passing information related to payments and faults, for example, between just-aggregated systems across institutions and platforms is a significant challenge.
- Interoperability – systems run on a mixture of software and hardware platforms where data and services will differ in syntax, semantics and interaction characteristics. Mediating between these heterogeneities requires more research.
- Seamless substitution – if a service or resource becomes unavailable finding and accommodating a new one, which meets the needs in a seamless fashion, is an important pre-requisite to fulfilling end-user expectations today.

Meeting the above challenges has been a goal for the research carried out in the FIA projects since the begin of FIA.

Contributions

Chapters contained in this book that address some of the aforementioned challenges include:

- The chapter *"Towards an architecture for Future Internet applications"* deals with the needs of applications in the Future Internet Era where multiple devices should be addressed and context information provided by ubiquitous sensors need to be integrated. Here challenges addressed include integration and device-agnostic application development.
- The chapter *"User Involvement in Future Internet Projects"* addresses in a survey the aspect of user-centred development. User involvement is highly valued and expected to maximise the societal benefits of Future Internet applications.
- In chapter *"An Internet-based Architecture Supporting Ubiquitous Application User Interfaces"*, a multi-device application platform founded on the Future Internet infrastructure is presented; the focus is on the model-based user interface framework as a mean to support context-aware adaptiveness for applications that are executed in ubiquitous computing environments such as those envisioned in Future Internet.
- The chapter *"ComVantage: Mobile Enterprise Collaboration Reference Framework and Enablers for Future Internet Information Interoperability"* presents a reference architecture for mobile enterprise collaboration based on linked-data interoperability. Additionally, security, semantic data lifting, business process modelling interoperability and mobile app orchestration enablers are presented with the goal of facilitating trustful and effective inter-organisational collaboration.
- The chapter *"SmartSantander: Internet of Things Research and Innovation through Citizen Participation"* depicts the development of smart city services and applications in the Future Internet era that benefit all stakeholders.

Conclusions

Smart applications and services lie at the heart of the Future Internet. Value added services and innovative applications that will empower their users is one of the key goals for the new global communications platform. The challenges that lie ahead in order to support multi-domain scenarios over an increasingly complex infrastructure should not be underestimated and need to be addressed in a cross-disciplinary manner.