INFORMATION SOCIETY TECHNOLOGIES ADVISORY GROUP

Working Group on Web-based Service Industry

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1 Introduction

Over the last decade the Services sector has become the biggest and fastest-growing business sector in the world. It now employs by far more people than any other sector and forms 64% of the world-wide GDP[1], twice that of the Industry sector. For this growth to continue, this sector is faced with unprecedented pressure to make services more widely and easily available and to yield higher productivity. In order to do so the Service sector should benefit more from innovation like the Agriculture and Industry sectors have done. This follows the restructuring of national economies through deregulation and globalization, forcing companies to focus on core competencies and innovation with lowering cost levels through partnering, delivery through low-cost countries or outsourcing.

In particular the introduction of ICT can bring more innovation to the Service sector like it has done to the other sectors. We already see this trend in the USA. However Europe is lagging behind by a factor 2. Although we have to be careful to deduct that a higher ICT spending automatically results higher innovation, it is interesting to note that for instance in Europe the healthcare ICT spending as percentage of revenue (typically between 2-5%) is much lower than in the US (6-8%)[2] or in industry (typically between 5-9%).

The rapid development of the Internet, both in speed and in capabilities, will enable this re-engineering of the service industry. Relying on very sophisticated architectures and supporting tools (Internet of Services), and intelligent devices (Internet of Things) that create a whole new and innovative market for new services for sensing and reacting to the physical world (medical, agricultural, environmental, energy-related, etc.) the Web-based service industry will leverage the Future Internet in providing a new service experience to the users.

Enabled by this Future Internet the Web-based service industry will be able to address the requirements of our society like health, aging, environment and mobility and our core industries like manufacturing, finance and telecommunications much better.

This reflects a strong alignment with the 7 ICT challenges of the 7th Framework Programme.

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[1] CIA data from 2004 https://www.cia.gov/library/publications/the-world-factbook/geos/xx.html

[2] http://www.govhealthit.com/online/news/350171-1.html

2 Interdependencies

A critical interdependence for the success of the Web-based service industry will be the extension of the Future Internet by offering very rich “horizontal services”. These services will foster an interoperability and trust framework for service integration, authentication, privacy and security. This framework will enable the Web-based service industry to procure, extend and repurpose services to new markets.

Besides the technology infrastructure and interoperability aspects, the success of web-based services also depends on the maturity of the definition of the business processes, business objectives and associated key performance indicators. Examples of such business processes are the pay process, supply chain process and trading processes.

The emergent Web-based service industry depends on symbiotic relationships with established Internet and telecommunications ecosystems to leverage their existing business lines and long-established trust. At the same time, a rich array of web-based content and social services will be used to enhance more traditional services into new channels such as the growing world of handheld devices. This integration with new generation Internet services will present complex integration challenges for established vertical services, which are typical in government, healthcare, banking, and telecommunications.

Unlike present web service provisioning such as software-as-a-service, sophisticated service enablement and business process management technology needs to exploit the new capabilities in the Future Internet to allow services to be rapidly composed, configured and orchestrated in new business contexts. Supportive “horizontal services” can be discovered, ordered, negotiated for pricing, composed, settled/fulfilled, rated and consumed by “vertical services”. In addition, “vertical services” need to be carefully mediated across potentially long-running interactions with their backend applications using a variety of adapters available through “horizontal services”.

The intelligence of web-based services is captured in the business processes and how these processes are composed of service capabilities over the value chain whereby each service capability is priced in terms of value. Also we see a shift from professional users to casual users in the consumption of these services, requiring significant adaptations in the user interaction and of the legal and regulatory requirements such as safety and privacy.

3 Market analysis

With the maturity of Web Services and Enterprise SOA new delivery models are now demonstrating how services can be traded outside traditional ownership and provisioning boundaries.

Current Web-based service industries have proven that they can be very disruptive due to the low barriers of entry. The successful ones have focused their Application Research on highly integrated service applications across information (content), technology and with

innovative Internet business models. Consumers are rewarded for increased use by cheaper prices and attractive offers, while the web-based service providers will be ranked for quality of delivery. The Internet of Services is in constant interaction with the Services industry to offer the best experience to users based on defined levels of Quality of Experience (QoE). To improve societal acceptance of Web-based Services this QoE should also define fallback services such as a well-trained human operator.

Content and service providers should be able to register their services within different domains of the Future Internet, and once registered, services should be discovered and accessed from different parts of the network and by different and unforeseen applications. Similarly, devices and other service delivery artefacts should also be registered so that they too can be harnessed as part of service applications.

Extending beyond this, the Future Internet should not constrict the various service enterprises into a single universal model. It should reflect different configurations of partnering structures, policies and interactions of different types of service provisioning enterprises. Hence different service provisioning enterprises and a rich variety of business models will spread throughout the Future Internet based on different service types such as business services, societal services etc.

Following the successes of Amazon and eBay, software-as-a-service marketplaces have emerged. Salesforce.com, Employease and Reardon Commerce and others are leveraging the existing service creation capabilities and already available Web Services to expand offerings of hosted business applications. In turn, mainstream industries are capitalizing on service-enablement investments by turning to the private sector for value-added service partnerships[3]. Meanwhile, in telecommunications, services are being pushed to "experience" as content and, increasingly, enterprise services become crucial differentiators for slim-margin mobile services.

As open service partnerships and service ecosystems have quickly grown, their limitations are also becoming clear. Current service marketplaces are one-off and cannot be reused without large overheads. They remain fixed in oligarchies, limiting further service growth beyond proprietary platforms and business models and within stringent governance boundaries. A good example of such a Web-service industry ecosystem is the vertically integrated service delivery by which Apple has integrated the iPhone and iPod with iTunes and via the iTunes Store with the content providers (both commercial and unpaid). In this case the vertical integration of service delivery across the Internet of Services and the Internet of Things is tightly and proprietary controlled.

Through the Future Internet, it is envisaged that these proprietary barriers will be removed giving way to a "level playing field" for service development, deployment and access. Beyond ordering books, renting downloaded movies, booking flights and the like, commoditized business transactions from mainstream industries are set to take off as the next wave of consumable services. Examples such as property conveyance, business

[3] Singapore Government's TradeExchange: regulatory trade services are being aggregated with services such as logistics and the goods tracking, through third parties.

formation and life events (e.g. births and marriage) entail complex integration challenges. These services require long-running transactions and are implemented through legacy applications hosted by multiple providers. Access to these services requires interactions with backend applications and several agencies may be involved. Navigation of such services therefore needs to be as seamless for consumers as linking to pages, facilitated by *semantic* descriptions of services and their interactions.

The vertical integration of Web-based services with the Internet of Things will allow content (music, movie, maps and traffic information) commercialization for small single/multi purpose appliances such as phones, mp3 players, personal navigation assistants and mobile email devices or will enable new services in the sustainability domain

A new service domain that is getting a lot of attention lately is consumer targeted health service (in particular in the US[4,5]) to address the lack of consolidated health information given by the different actors in the health(care) industry.

In the Internet of Things we expect "machines", and not just individuals to be interactors with web-based services. When harnessed through business processes, services such as environment sensors and decision-support (data mash-ups) streamline otherwise "out-of-band" operations like exception handling. They draw business processes out of internal stovepipes and rigid B2B interactions, into "real-world" awareness and agility. In research Event-Driven Architecture (EDA) is addressing this asynchronous behaviour, complementing SOA[6].

High-resolution management is the next evolutionary step after lean manufacturing and the Web-based service industry will facilitate this step. High-resolution management is based on vastly lowering the scale at which you analyze space, time, products and business models. As a result a few different sectors have already started fragmenting their products and services all with the aim of improving quality and reducing cost. In the long-term, a packetized distribution network, where each product contains all of the necessary information to essentially become its own store, could replace the current supply chain model[7]

4 Business Models

The Internet has catalysed the experimentation with many new business models mostly targeted at consumers. Services paid for by targeted advertising, free teaser products to

[4] Google Health: http://blogoscoped.com/archive/2007-08-14-n43.html
[5] Microsoft HealthVault: http://www.healthvault.com/
[6] EDA: http://jack.vanhoof.soa.eda.googlepages.com/How_EDA_extends_SOA_and_why_it_is_important_-_Jack_van_Hoof_-_v6.0_-_2006.pdf
[7] Fleisch, E., Sarma, S. & Subirana, B. (2006). High-Resolution Management. IESE Alumni Magazine, Juli/September, 8-13.

pull through the purchase of more featured products are just a few examples. Already large infrastructures are in place for these consumer services like Microsoft hotmail en Google mail.

The Internet has not only lowered the barrier of entry for new services but has also enabled fast acceptance without limited or no advertising or promotion at all. Examples are very popular sites like Flickr, FaceBook and YouTube to name just a few.

Other, more collaborative, business models exist as well. A good example is the "Mechanical Turk" or mturk business model used by Amazon.com[8]. In this service "warm bodies" are paid for small tasks they can do better than computers. In healthcare successful community websites[9] are helping patients to select the best quality or best priced healthcare are.

Today we also see business model innovation targeted at the B2B channel and based on Business Process Management and Lifecycle Management of Business Processes. Examples are "cloud computing" (charging for actual CPU capacity used or actual disk storage used either on- or off-site), "software-as-a-service" (outsourced enterprise office automation, CRM or ERP systems), business service marketplaces, partner ecosystems and dynamic trading or collaborative networks to name just a few. The decomposition of a commercial service into a collection of smaller services along the value chain will lead to requirements to value and price these "sub-services" in the business model.

We can expect a new range of service offerings based on the Internet of Things that will require their unique business models.

Besides the Community and Industry focused Business models we have to recognise the importance of the public sector (45% of European GDP) and the innovation they will drive. Examples of successful government websites are in France and the UK.

5 Technology

Web-based service industry will depend on a new class of technologies and infrastructure services. In particular service registration and discovery have to be supported by a service repository infrastructure such as the Web Services Universal Description, Discovery and Integration (UDDI). This will be a difficult topic to harmonize and both the ontology and semantic descriptions are required.

Enterprise service-oriented architecture (Enterprise SOA) holds the key for businesses in industry verticals to consolidate and repurpose business applications to dynamic market needs. Through a sophisticated software stack, Enterprise SOA allows large business applications to be accessed through self-contained, reusable and adaptable enterprise services. However we have to recognize the unique requirements that each individual industry will have.[10]Once in place, enterprise services provide the basis for flexible

[8] mturk: http://www.mturk.com/mturk/welcome
[9] http://www.vimo.com/ , other examples can be found in http://www.health2blog.com/
[10] For example SAP maintains a set of 11 billing engines tailored per industry

interoperability and can be composed into long-running business processes, spanning intra- and inter-organizational boundaries.

The emphasis will shift from user to system navigation of required services, enriched and linked through semantic service descriptions. Thus, the challenge will be to develop services such that they can be easily identified and can be composed seamlessly into more comprehensive and situational relevant services.

A service-enabled application architecture based on API's, widgets and "mash-ups" will require the Internet to be knowledgeable about the semantics of the services offered, the context of using the service, as well as the intended usage of the service. Having these API's will allow decoupling the User Interaction from the application and facilitating the Machine Interaction with the applications. In particular the RESTful[11] semantic web with its mark-up languages such as Resource Description Framework (RDF) and Web Ontology Language (OWL) will play an important role to realize this.[12] Also specific standardized vocabularies such as the Systematic Nomenclature of Medicine (SnoMed) will assist in cross application communication.

Inherent to the integration with the Internet of Things will be the asynchronous nature of many stimuli. This will require besides SOA the use of an Event Driven Architecture (EDA).

Critical will be all aspects of privacy, safety and security. For example in combining various services major privacy or security breaches or safety exposures can be envisaged. This means that the individual services must have the ability to define and protect information at a granular level and limit their service to the trust level of the requestor. DRM technology is able to perform this kind of protection.

6 Strategic Value to Europe

A strong Future Internet with very rich horizontal services can catalyse the development of an industry around "vertical services", strengthening the economic prosperity and the fabric of the European society.

A Web-based service industry has very different characteristics when compared with the traditional service industry. This means that society has to be prepared for this evolution and besides the technological enablement also the right political and regulatory frameworks have to be in place.

Due to the ubiquitous nature of the Internet the barrier to entry for the Web-based service industry is very low and the potential reach is very large. Because it is possible to target the audience for these services in a very precise way the monetary aspects are often based on targeted advertising or low cost transaction pricing.

[11] REST: Representational State Transfer (http://www.ics.uci.edu/~fielding/pubs/dissertation/top.htm)
[12] http://www.regdeveloper.co.uk/2008/02/25/ws_versus_rest/

While the tools to develop these services have become very sophisticated[13], the innovation and creativity for the development of the services themselves do not require today's large research and development facilities and can easily be developed in an SME environment to fit local requirements. Eventually a successful service can easily be expanded globally through the Internet. However a clear and transparent regulatory framework will be required to ensure that the privacy, safety and security related aspects of the citizens using these services is taken care of.

This new service industry is unique because both established players and start-ups are able to compete on an equal footing – all storefronts on the Internet are on the same "high-street". Speed, business savvy-ness, smart technology choices and agility are the key words associated with successful web-based services. Hence the classic economic laws about productivity and cost are less relevant than in the industrial world or the labour intensive service industry world.

Major gains in productivity can be achieved by the introduction of eAdministration services for its citizens. Public sector services could be transformed from pure regulatory services to those fostering economic growth, such as small business formation, and incentive building to attract the labour force into newly developing business regions.

For instance, improvements in the efficiency and effectiveness and reducing cost in health(care) can be facilitated by the development of the appropriate eHealth services for health, aging and chronic diseases.

Local mobility is a major problem in Europe both from a commuting and from a transportation perspective. Sophisticated road-pricing concepts will be introduced in several member states. In particular the forthcoming availability of Galileo's very precise location based capabilities together with improvements in the mobile communication infrastructure can form the trigger for a strong pan-European Web-based service industry in this domain.

And, given the recent consideration on energy consumption and global warming new services and methods have to be developed for preserving the environment. The Future Internet, as such, should be used to affect preserving the environment and reducing carbon foot print.

Today most ICT solutions to support industry are not well integrated, hindering mainstream industries to turn to the private sector for value-added service partnerships. To this end, partner diversification should be supported to open up the innovation and efficiency in which services are brought into new markets. To allow partners to enter service supply networks and drive businesses into wider collaborations, their business operations should be supported. For example, service aggregators need customer-relationship management to hold records of their consumers, consumption patterns and rewards. Payment engines are required for invoicing and payment of service fees. Master-

[13] Ruby On Rails, PHP, .NET, J2EE, Jazz.net

data management addresses data consistency and synchronization for multi-sourced services. Helpdesks are needed to manage service exceptions. Service contracts provide assurance for consumers and delivery partners. Warehouse management and logistics might be used to settle services[14]. These are just some the many functions that come into view when considering the commercial realities of service supply and access. In the international trade and logistics area it needs to be investigated how the Internet of Services and Internet of Things could be harnessed against for instance economic bottlenecks created by business processes.

The Future Internet, enhanced with many new or expanded mission critical vertical applications, will require more focus on privacy and security. New developments in the domain of Digital Rights Management might be able to address these requirements.

The 7 challenges of the ICT component of the 7th Framework Programme are supporting the evolution of the Internet and the utilization of this Future Internet for the core societal and industrial needs as described in this paper.

7 Research Challenges

1. Already at enterprise level, the roll-out of Web-based services creates significant challenges at the governance and deployment levels (status and maturity of specific services, version control and support). Scaling Web-based services beyond the enterprise level will require capabilities of service discovery, governance and quality of service to be registered in a **global (public) repository**.
2. In taking the step from intra- and inter-enterprise applications to the wider setting of Internet of Services, extended capabilities are required from Enterprise SOA. **Enterprise SOA 2.0**, as such, should go beyond carefully controlled installation base and collaboration, to "lighting" up the network with open global service supply and demand of enterprise services. Open service partnerships and ecosystems are crucial for this - for value-added service aggregation, delivery intermediaries and driving new market channels. For this, the impediments to scaling Enterprise SOA from intra- and inter-enterprise applications, to the wider setting of Internet of Services need to be carefully addressed through insights from other technology domains, e.g. service delivery platforms operating the telecommunications sector. New areas at the technical and business need to be identified for standardization, over and above the "WS stack" and established RESTful Semantic Web standards. For added-value mash-up services or for sensing and reacting to (possibly unexpected) situations typical of compliance, logistics or finance services, SOA need to be complemented by EDA (Event Driven Architecture),
3. A **service creation and provisioning environment** will be required that allows a whole set of new applications being developed, leveraging existing services from SME and large corporations as well as from other sources like

[14] e.g. for passing physical goods as is the case with TradeXchange type of marketplaces

community-based information sources, to provide new business services tailored to particular needs.

4. Current mechanisms for service discovery are merely based on keywords. This is suitable in tightly coupled domains where service consumers can readily understand the services offered by the search results. However, within the wider setting of Internet of Services involving a multiplicity of service domains, contexts and heterogeneity, this approach is unviable. The wider the domain, the more general keyword searches are. This places greater onus on consumers to know what they want before they search, limiting the exploitation of the Internet of Services. With services proliferating from widespread domains, **a major challenge will be to transform the *search* paradigm of service discovery to an automatic, knowledge-centric *find* paradigm** by exploiting meta-data and ontology-based search over machine-readable service descriptions. Discovery will also have to be harmonized over services spanning domains as diverse as finance, healthcare to digital media, through industry or community-based ontologies, and having different contexts. The accelerate ramp-up of new markets in particular, natural language search be used in tandem with structured discovery techniques. In addition, the goal of discovery should be not only to find services that exist, but also determine which services should exist, that do not exist (i.e. opportunity sensing).
5. The important societal change in the Service Industry replacing tasks performed by humans by complex computer networks will require special attention for the consumer. Already today it stretches telecom operators to the limit to keep their customers happy in the networked home. In the future web services world with many intertwined actors this will become even more intense both social and technical. **It requires a more profound understanding of the customer expectations, support for self-help and community support**.
6. **Consumers need to be assured of the trust of the web-based service provider and the quality of their experience.** Expectations are typically managed through conditions and obligations set forth in service level agreements (SLAs), with web-based service providers. In the wide setting of Internet of Services, guaranteeing the “quality of experience” carries enormous risks. Whereas the current application of SLAs assumes client/server interactions between consumer and provider, several levels of indirection may be involved. As different services are aggregated and different layers of service intermediation are introduced, the dependencies on service quality are clearly diffuse. Thus we require ways of determining whether conditions and obligations of collective service quality and delivery hold.
7. The **User Interaction** in a web-service of composed services and the **Machine Interaction** in the context of the Internet of Things will require research in the domain of UI/MI interaction in such a way that both the user and the machine can interact with a **consistent and harmonious interface**.

8. **Internet of Things specific application systems** utilize the capabilities of the underlying infrastructure while adding application logic that supports a wide variety of application domains incl. the monitoring, execution and control of enterprise business processes, ensuring environmental health, workplace safety, or the reporting of carbon dioxide emissions, just to mention a few. These application systems will depend heavily on machine to machine interactions. Also the Internet of Things will contain sensors that can trigger context sensitive applications such as SMS distributed astma warnings when pollution level reaches a threshold

8 Recommendations

Towards the cultivation of the Future Internet, underpinned by supportive "horizontal" services and enabling a rich variety of consumable "vertical" services in diverse service provisioning enterprises, the following is recommended:

- That a holistic approach be taken for the Future Internet considering (the interaction of) Technology, Business (Models) and Service Content/Information (Applications Research).
- That existing technology baselines for business enterprises not be displaced but be harnessed and extended to consolidate the underpinning of the Future Internet. In particular Enterprise SOA should be enriched and extended by semantic service descriptions, next generation service delivery capability, and community-driven service innovation and engineering,
- That both medium and long term trajectory be taken for the Future Internet, securing successful "quick win" ventures on the one hand, but increasing in service provisioning sophistication, notably for B2B and the coupling of Internet of Services and Internet of Things, on the other
- That national strategic cross vertical applications be identified and ways of bringing together key industries to the table be fostered

The Service sector is confronted with extreme challenges due to the growth of this sector and the limited productivity gains achieved until now. In order to cope with these challenges and as proven by the other sectors, additional research in ICT innovation can make substantial contributions to a Web-based service industry that can flourish on top of the horizontal services offered by the Future Internet.