SAP White Paper

TOWARD A EUROPEAN STRATEGY FOR THE FUTURE INTERNET

A CALL FOR ACTION

CONTENT

EXECUTIVE SUMMARY

SOFTWARE: DRIVER OF THE NEXT GENERATION OF THE INTERNET

There is an increasing awareness among European policy makers about the crucial role of information and communications technologies (ICT) for European competitiveness. However, the instrumental role of software in this context is often overlooked. With market revenues of €200 billion in Europe and growth rates of between 6% and 8%, software is the largest and the fastest-growing segment of the ICT market. More important, software is embedded within the majority of products we use today and a key enabler for innovation, growth, and employment in almost all sectors of the economy. Software has become the nerve center of all modern economies.

Software will also be the driver of the next generation of the Internet, which undoubtedly will have a dramatic impact on our society and the economy. The political debate on the Future Internet is currently focused on its social dimension with regard to innovative tools such as blogs or mash-ups, which are revolutionizing our daily life and social interaction. However, the effects of the Future Internet on the economy are equally profound. SAP is the world market leader in enterprise software. We serve more than 25 industries and accordingly, have a thorough understanding of the overall technology and business trends. SAP strongly believes that the Future Internet enabled by software will introduce dramatic changes in the economy over the next decade. And it will unquestionably define Europe's future competitiveness.

Key in this respect is the "Internet of Things" and the "Internet of Services." The Internet of Things combines the power of ubiquitous networking connectivity with modern sensor technologies such as radio frequency identification (RFID). It merges the digital world with the physical world in the sense that information concerning the identity, location, and condition of physical objects can be made available through the Internet anytime and anywhere. Moreover, these objects possess the capability to communicate with each other and therefore can become active participants in global business processes. The Internet of Things will lead to tremendous efficiency gains in many industries, particularly when they are combined with the Internet of Services.

The Internet of Services is largely based on a service-oriented architecture (SOA), which is a flexible, standardized architecture that facilitates the combination of various applications into interoperable services. The Internet of Services also uses semantic tools technologies that understand the meaning of information and facilitate the accessibility of content (video, audio, print). Thus, data from various sources and different formats can easily be combined and processed toward a wealth of innovative Web-based services.

The impact of the Internet of Things and Services on the European economy will be significant. First, the technologies will invigorate innovation, resulting in tremendous productivity gains. The benefits of these gains will be reflected most especially within the retail, manufacturing, logistics services, and energy sectors. According to industry experts, RFID technologies could lead to efficiency enhancements of 40% in the luxury goods industry or even 100% in the food sector. Indeed, rapid adoption of the Internet of Things and Services throughout the European economy could be instrumental in closing the alarming productivity gap with the United States and secure European competitiveness in the years to come.

Second, the Internet of Things and Services will shape the future of the services sector. The Future Internet will undoubtedly become one of the major growth engines in all knowledge-based societies. It will be a business opportunity especially for start-ups and small and midsize enterprises (SMEs), and could lead to the creation of high-level jobs. As services comprise two-thirds of the European GDP, it is clear that Europe can only sustain economic growth and prosperity by developing strong Web-based services industries. Moreover, Web-based services that will be developed in Europe could easily be exported through the Web in global markets.

Third, the disruptive technologies of the Internet of Things and Services will create tremendous business opportunities for the ICT sector itself. The world market for technologies, products, and applications alone that are related to the Internet of Things will increase significantly from €1.35 billion to more than €7.76 billion in 2012, with average annual growths rates of almost 50%. Gartner predicts that the worldwide market for software as a service (SaaS) – which is only one concept of the Internet of

Services for the software industry – will grow from €4.25 billion in 2006 to €13.02 billion in 2011. Finally, the underlying ICT infrastructures and data centers provide huge opportunities. Europe's ICT industry should strive to take a leading role in all segments of the Future Internet.

As a result, the Internet of Things and Services will be the essential part of Europe's future ICT infrastructure. It will be instrumental to fostering the internal market as well as to achieving the goals of the Lisbon agenda and ensuring growth, productivity, and employment in Europe.

Europe should build on its strengths to fully exploit the potential of the Future Internet. Comparatively, Europe has one of the world's most highly educated work forces, which can rapidly adopt and use next-generation technologies. We enjoy a competitive advantage in core industries such as automotive, pharmaceuticals, and manufacturing that will be highly affected by the Future Internet. Furthermore, we take a leading role in some important segments of the ICT market such as enterprise and embedded software. And the European Union can build upon one of the largest internal markets in the world with more than 490 million inhabitants.

Regrettably, there are strong indications that the new Web-based industries and their underlying ICT infrastructures are developed in the United States and Asia rather than in Europe. All major service platforms for the Future Internet such as Amazon or Google are headquartered in the United States. The uptake of innovative ICT solutions, in particular by SMEs, is lagging behind the United States. The gravity of the economic impact on Europe has yet to be fully realized by industry leaders and policy makers. It would not be an exaggeration to state that a lack of adoption or efforts to innovate could seriously hamper European competitiveness in the future. The present climate prompts the need for firm action to be taken to avoid falling further behind other knowledge-based economies.

SAP calls upon European industry and policy makers to collaborate and develop a European strategy for the Future Internet. It is imperative that industry invests in R & D to create attractive and cost-effective Web-based services for business and private users. Industry needs to work with academia, venture capitalists, and governments to establish large-scale research and innovation clusters for the Future Internet in Europe. By ensuring that these new applications meet high European security and privacy standards, we can gainfully win the trust of business and private users. In addition, industry needs to forge agreements on global standards to ensure interoperability and economies of scale for new Web-based services.

The European Commission should establish a policy framework for a truly harmonized internal market of the Future Internet, which would be a strong basis for the development of globally competitive Web-based industries in Europe. This policy framework should provide legal certainty, build trust, and foster investment in innovative Web-based services in Europe. To achieve this, the Commission should expand its RFID policy and develop a Recommendation on "the internal market for the Future Internet." The Future Internet should also be set as a priority as part of the European Competitiveness Strategy. To this end, the Commission is strongly encouraged to organize an informal meeting of the Competitiveness Council on this topic. Any Commission initiative should support the creation of large-scale research and innovation clusters on the Future Internet by streamlining and aligning European R & D instruments (FP7 and joint technology initiatives) and by supporting the creation of a knowledge and information center under the European Institute of Innovation and Technology (EIT).

EU Member States should encourage public administrations to become early adopters of the new technologies. They should open up existing ICT infrastructures such as electronic toll systems for the provision of new Web-based services and facilitate access to public data banks for the creation of new applications in the Internet of Services. Finally, they should reinforce specific education and training programs to improve e-skills.

SAP is fully committed to taking a leading role in a collaborative effort to ensure that Europe reaps the full benefits of the Future Internet.

INTRODUCTION

European policy makers now fully acknowledge the vital contribution that ICT has to make to achieve European competitiveness. However, the crucial role of software in this context is not fully understood. Market revenues are estimated at €200 billion and growth rates between 6 % and 8 %. Software is the largest and the fastest-growing segment of the ICT market. Embedded into the vast majority of products in use, software is a major stimulator of innovation, growth, and employment in an expansive range of sectors in the economy.

Software will also be a driving force fuelling the next generation of the Internet, which will bring about a spectacular impact on society and the economy. SAP is the world market leader in enterprise software. We serve more than 25 industries and, accordingly, have a thorough understanding of the overall technology and business trends. We strongly believe that the Future Internet will completely transform traditional industries and generate new markets, particularly in the services sector. Undoubtedly, the Future Internet in many respects will define Europe's competitiveness in the coming years.

Regrettably, there are strong indications that the new Web-based industries and their underlying ICT infrastructures are being developed in the United States and Asia rather than in Europe. The gravity of the economic impact on Europe has yet to be fully realized by industry leaders and policy makers. If Europe does not take firm actions now to fully exploit the potential of the Future Internet, then it will fall further behind other knowledge-based economies.

Against this background, SAP welcomes the initiative of EU Commissioner Viviane Reding, who has recently called for a "European software strategy." We believe that any European software strategy should focus on the Future Internet and should be closely linked to the broader competitiveness agenda of the European Union.

SAP calls for the joint action of European industry, European institutions, and EU Member States to develop a European strategy for the Future Internet. This paper provides input by SAP to elaborate such a strategy. It starts with a brief analysis of the building blocks of the Future Internet, with a particular focus on the emerging Internet of Things and the Internet of Services. It then explores how these new applications will affect the European economy and specific industries. The paper concludes with a set of Recommendations for actions to European industry, the European Commission, and EU Member States to ensure that Europe reaps the full benefits of the Future Internet.

THE FUTURE INTERNET AND THE EUROPEAN ECONOMY

A WEALTH OF NEW SERVICES AND A MAJOR SOCIETAL IMPACT

Over the last 30 years the Internet has developed into the most important global communication and information infrastructure. Currently, the Internet is overwhelmingly used for uploading and downloading static content. In addition, simple communication services such as e-mail, instant messaging, and blogs have gained widespread acceptance. Navigation in the digital universe is handled by key-word search engines.

We are now witnessing the emergence of the next generation of the Internet, which will lead to a wealth of new services and will have an even greater impact on society and the economy than the Internet today. In fact, the Future Internet will be the essential part of Europe's future ICT infrastructure, which will be instrumental to fostering the internal market as well as to achieving the goals of the Lisbon agenda and ensuring growth, productivity, and employment in Europe. The main building blocks of the Future Internet are the Internet of Things, the Internet of Services, and the underlying networked infrastructures.

Internet of Things

The Internet of Things combines the power of universal network connectivity with embedded systems, sensors, and actuators in the physical world. Starting with RFID tags, the technology has developed to integrate a wide range of software platforms spanning from embedded software and middleware to enterprise resource planning.

The Internet of Things makes it possible to extend the reach of ICT beyond the confined use in public or private organizations into everyday service interactions at all levels of society and economy. Sensors and embedded systems collect and carry information about objects in the real world and their respective context. Devices mounted in different environments, embedded in systems, and worn by users – combined with ubiquitous wireless communications infrastructures – can transfer information to all kinds of applications whether local, remote, or distributed.

The increasing computing capabilities of such devices will also allow the implementation of new software for completely novel processes. Enabled by software, the Internet of Things provides for virtually infinite integration of sensors, actuators, microsystems, mechatronic systems, and robots. This allows the Internet not only to exchange and process information but also to control actions in the real world.

The Internet of Things adds an enormous range of new industrial opportunities to the software and hardware markets. It offers new avenues for strategic alliances between ICT and non-ICT industries in Europe. And it holds high potential to reach key markets spanning medical systems to monitor our well-being and support safe and independent living, intelligent traffic management, improved environmental monitoring, and adaptive energy management.

The Internet of Things will lead to tremendous efficiency gains in many industries, particularly in combination with the Internet of Services.

Internet of Services

The Internet of Services makes use of service-oriented architecture (SOA), which is a flexible, standardized architecture that supports the connection of various applications and the sharing of data. SOA is a software architecture where functionality is grouped and packaged as interoperable services. The wide deployment of SOA underpins the broad adoption of service orientation in information technology. SOA software and Web service composition today already realize traditional IT functions and business processes with an unprecedented flexibility. With SOA and semantic technologies, the Internet of Services paradigm enables European businesses to provide higher-level service provisions, including software for mediation, aggregation, and brokering, to enable the creation of new business and growth potential. With the Internet of Services, European organizations can respond to changing conditions by quickly adapting their business processes. The Internet of Services will lead to a wealth of innovative services that will undoubtedly revolutionize the services sector.

The emerging business model of the Internet of Services has also reached the software market. Increasingly, software applications are being delivered over the Internet, also known as "software as a service" (SaaS). Based on SaaS, a new ecosystem will develop in which small and midsize software vendors will benefit from the core capability to integrate new, innovative niche products and services into mainstream software solutions.

Networked Infrastructure

Demands of core network infrastructures are unprecedented. While the networking hardware will continue to be commoditized and generate increased bandwidths, other serious challenges need to be addressed in the software stack for managing these resources. We need to perform adequate coupling between the value-creating services at the top end of the software stack right down to the transport layer, typically through contracts such as service-level agreements (SLAs).

In addition to the traditional network, computational ICT infrastructure itself is beginning to emerge as a service, namely service-oriented infrastructures (SOIs), also known as business grids or cloud computing. SOIs allow for the provision of rapid storage and computational capabilities to handle the needs of the aforementioned applications. As a result of this development, we expect traditional telecommunications providers to increasingly extend their traditional roles into this realm, exploring opportunities beyond their traditional business models and services. The technological convergence brought about by the Internet protocol suite is one of the main drivers.

There is a trend for further raising the level of infrastructure services that encompass complete platforms rather than just basic resources. Such "Internet-scale" platforms provide a complete service programming and delivery environment with inherent scalability features, both for very small scenarios and extremely large ones. Internet-scale platforms have the potential to completely change the business models in the Web by turning platform providers into the "visible" successors of traditional ISPs or even cloud providers. While there are huge potential benefits of Internet-scale platforms, there are also significant risks of solutions of just a few very dominant players and heavy lock-in effects.

The Impact on the European Economy

The impact the Internet of Things and Services on the European economy is significant. First, it will drive innovation and tremendous productivity gains especially in the retail, manufacturing, logistics services, and energy sectors. According to industry experts, RFID technologies could lead to efficiency enhancements of 40% in the luxury goods industry or even 100% in the food sector. In Germany alone, efficiency gains could in the long run amount to €20 billion annually.[1] Indeed, rapid adoption of the Internet of Things and Services throughout the European economy could be instrumental in closing the alarming productivity gap with the United States and secure European competitiveness in the years to come.

1. McKinsey Research, 2007.

Second, the Internet of Things and Services will shape the future of the services sector. Already today a vast number of services are traded over the Internet, supported by software or entirely software-based. This trend is likely to accelerate. We believe that the Internet of Services paradigm based on electronically tradable digital services, or hybrid offerings that combine traditional and digital services, will revolutionize the services sector. The Future Internet will undoubtedly become one of the major growth engines in all knowledge-based societies. It will be a business opportunity especially for start-ups and SMEs and could lead to the creation of high-level jobs. As services comprise two-thirds of the European GDP, it is clear that Europe can sustain economic growth and prosperity only by developing strong Web-based services industries. Moreover, Web-based services that will be developed in Europe could easily be exported through the Web in global markets.

Third, the disruptive technologies of the Internet of Things and Services will create tremendous business opportunities for the ICT sector, especially for software vendors. The world market for technologies, products, and applications alone that are related to the Internet of Things will increase significantly from €1.35 billion to more than €7.76 billion in 2012, with average annual growths rates of almost 50%.[2] More aggressive forecasts predict a market volume of more than €18.22 billion in 2011.[3]

Currently, software accounts for roughly 20% of the market. However, software will soon become the major segment of the market for the Internet of Things once the initial investments in hardware (tags and readers) have been made. Gartner predicts that the worldwide market for SaaS – which is just one concept of the Internet of Services for the software industry – will grow from €4.25 billion in 2006 to €13.02 billion in 2011.[4] Finally, the underlying ICT infrastructures and data centers provide huge opportunities. These platforms are currently being developed mainly in the United States. Examples are Google or Amazon. Europe's ICT and software industry should strive to establish a leading role in all market segments of the emerging Internet of Things and Services.

Finally, major efforts to establish clouds are currently undertaken mainly in the United States. To safeguard Europe's competitiveness, starting from the infrastructure level, the European Commission, the Member States, and European telecom operators should join forces to set up a European initiative to establish an EU cloud.

Web-Based Service Industries

We believe that the following industry sectors will undergo the most drastic transformations in the coming years due to shifting business and technological trends in the Future Internet.

E-Energy

The energy sector is undergoing dramatic changes as the costs of fossil fuels soar and the current level of environmental impact is universally no longer acceptable. A more sustainable approach to energy provision becomes urgent. An energy infrastructure based on renewable and distributed energy resources, able to maintain high cost-efficiency and incorporating low CO_2 emissions, will be a key differentiator between the world's competing economies. Both energy systems such as electricity grids and energy markets will require adaptation to support this infrastructure. Europe is especially vulnerable and could benefit the most from intelligent energy provision, saving systems, and methods.

In our vision, new, highly distributed business processes will need to be established to accommodate these innovations. The traditional static customer process will be increasingly superseded by a very dynamic, decentralized, and market-oriented process where a growing number of providers and consumers interact. These processes are expected to be pervasive, ubiquitous, and service-oriented, and will usher in a new generation of affordable ICT infrastructure. This infrastructure will be developed to support and enable the efficient functioning of the deregulated energy market. The architecture of such distributed system landscapes has to be designed based on standards that are widely supported, comprehensive, and integrated into reliable software applications.

2. Forester Research, Global Extended Internet Forecast, 2006–2012, September 2006.
3. ABI Research, RFID Market Update, 2006.
4. Gartner, May 2006.

ICT and software in particular will make it possible for future distributed energy systems to be self-managing, self-sustaining, and robust and will enable dynamic reorganization and coordination of services markets. Therefore the Internet-based infrastructure will be tightly coupled to the energy domain and used to support the development of new mechanisms for trade based on supply and demand in the electricity market. Different models and scenarios for a highly distributed information-based energy infrastructure will emerge. Platforms for the Internet of Things and Services will provide services such as electronic marketplaces, facilitating the commercial activity associated with the buying and selling of electricity and its derivatives, not only for utility companies but also for decentralized consumers and producers.

The Internet of Things and Services will combine ICT innovations such as intelligent sensors, agile middleware, and business back-end systems to make it possible to provide new forms of more intelligently managed energy production, distribution, and consumption on a point-to-point basis. As a result of experimenting with and exploring different business models enabled by the Internet of Services, a wide spectrum of market-based and regulatory options are created that quickly react to the changing supply and demand side of ecosystems.

Europe industry has taken a leading role in renewable-energy technologies such as wind generation and photovoltaic. It should also develop innovative Web-based e-energy business models and applications that can be exported around the globe.

Retail

Of the top 25 global retailers, 15 (Carrefour, Tesco, Metro Group, Ahold, and so forth) are European. Intelligent management of the entire retail chain based on ICT can help address this sector's impact on the environment and reduce unnecessary production or waste and loss during distribution. This will help the retail industry respond to the valid concerns of consumers regarding transparency, health, and safety.

To accommodate the increasingly demanding consumer, retailers are looking into improving existing sales channels and expanding into new ones. As a result, consumers are offered greater choices with buying in a store and online shopping from the same retailer. Integrated services are emerging that incorporate, for instance, consumer information and payment solutions that are delivered over the Internet to the customer's mobile phones. The Internet of Things and Services will enable retailers to attract and retain consumers, while at the same time allowing increased operational efficiencies in terms of product range, inventory levels, and stock replenishment.

These improved efficiencies will be most visible on the shelves, manifesting in increased availability of fresh products, more information on goods and their origins, guaranteed authenticity, targeted and tailored service – thus leading to an improved shopping experience for the consumer. The SAP future retail store (FRC) in Regensdorf, Switzerland, makes first examples of the Internet of Things and Services accessible to a wide audience.

RFID technologies and related Web-based services will also enable retailers and consumers to tackle plagiarism and thus facilitate the fight against piracy. In particular, luxury goods, media content, drugs, and automotive parts are affected by pirate copies. The economic costs of product piracy in the European Union are huge. In 2006 a total of 130 million counterfeit pieces were confiscated at European borders.[5] More important, in the health sector, RFID can avoid false medical treatment and prevent health damage caused by counterfeit drugs.

Travel and Logistics Services

The travel and logistics services industries are economically vital, especially for the European retail and manufacturing industry. Current supply chain scenarios are unthinkable without transport by land, sea, and air and the supporting logistics services. Moving goods inherently involves many issues such as CO_2 emissions and safety.

5. www.planetretail.net.

The industry's energy consumption makes it particularly vulnerable to oil prices, which currently continue to increase with a trend that is not reversible in the long term. Intelligent logistics management that integrates with traffic control and management systems is a prerequisite for a considerable reduction in natural resource consumption. Further efficiency gains, particularly with the logistics of cargo (mail and luggage), can be improved dramatically.

At the same time, the safety and quality as well as the traceability of imported goods (perishable and nonperishable) coming into the European Union will remain an important issue to ensure consumer protection and health. Sensor data on production and shipment conditions can dramatically improve the efficiency of the business processes and the quality of goods at the point of sale. It is vital to create and implement traceability systems based on open standards and adopt modern engineering methods to enable cost-effective adaptability and ensure scalability.

With the Internet of Things, many services can be offered to increase transport, storage, and handling efficiency and traceability. The baggage pileup at Heathrow airport in March 2008 highlighted the problem of mishandled airborne luggage. The overall costs for the airline industry related to this kind of incident were €3.8 billion in 2007. RFID applications are now being introduced at airports to significantly improve baggage handling.[6]

With the increasing capabilities provided by RFID technology and embedded systems, more information can be stored and processed on physical objects. Thus, new application domains, in addition to the currently considered logistics scenarios, are getting closer to commercialization. The most promising ones are in the area of production, for more robust or decentralized production, for example, as well as maintenance and repair.

Manufacturing

The 2007 European Competitiveness Report emphasizes that the manufacturing industry and related service sectors will remain a key pillar of the EU economy in the 21st century. To withstand growing competitive pressures, particularly from Asia, manufacturers need to quickly adapt to changes in their market and economic environment and reduce the time taken for new, innovative products to reach the market. ICT plays a key role not only in providing a tool for reducing costs but, more important, as a means of providing dramatically increased competitive advantage.

With tight integration between the boardroom and shop floor based on ICT, manufacturers can obtain accurate, timely, and relevant information that allows them to react promptly to changes in the (industrial) environment. These changes might involve anything from unforeseen lack of resources to customer demand fluctuations. The recent trend toward distributed manufacturing also requires better plant-to-plant and supplier integration on a global scale, allowing for planning and operation in one plant to be directly coupled with the production processes in another plant. This also leads to new challenges in the area of just-in-time and flexible logistics, thus increasing the need for efficient logistics as mentioned earlier.

The Future Internet will furthermore provide for the required integration of techniques and mechanisms to exchange information with suppliers and subcontractors in a collaborative manufacturing environment. In addition, plant workers would benefit from the provision of appropriate user interfaces for improved visibility of a current production status and production logistics and equipment integration. The ability to deliver on "green manufacturing" will provide for a strong competitive advantage in the European Union. A strong focus on environmental factors will require more intensively driven production processes and the consideration and tracking of CO_2 footprints.

The Internet of Things and Services for manufacturing has the potential to provide the right means for better traceability and real-time decision making. It can also improve collaboration along the manufacturing process, and in this way open up new opportunities for flexible business processes and introduce a swifter implementation of disruptive business models and products. SAP research and external partners have started the future Factory Initiative (FFI) to showcase innovative Web-based applications for real-world integrated business processes in the manufacturing domain. FFI closely cooperates with other European initiatives in this field such as Smart Factory and My Open Factory.

6. Murray, Sarah; Airport technology: Tags that keeps bags on track; FT.Com, June 17, 2008.

Europe is leading in manufacturing of high-value products and machinery. This position can only be sustained by early and effective adoption of the Internet of Things and Services.

Financial Services

Many products of the financial services sector, due to their intangible nature, have already been traded electronically via the Internet for quite some time. And a new generation of customers who have grown up with e-mail and cell phones are selecting their bank and insurance carrier based on the proficiency of their Internet Services instead of their local presence. The Internet has helped tremendously in both areas to increase the transparency of investment performance or loan conditions, as well as of insurance policies, which undoubtedly will have a profound impact on existing business models and service offerings. As a consequence, the Internet of Things and Services can be of particular importance here to create new and attractive services.

Instances of the early trend toward an Internet of Services can be seen through the emergence of many Internet banks and loan providers, as well as of new institutions and platforms for loan and insurance brokering. Compared to existing Internet-savvy companies from other sectors, the financial services sector needs to rapidly innovate to keep up with customers' growing expectations, based on experiences with other state-of-the-art Internet services offered in other industries. In addition, the sector will face increased competition from new market entrants due to the fact that the seamless integration of digital and conventional services through the Internet of Services will rapidly eliminate the boundaries between financial and nonfinancial services.

Looking at the banking sector in particular, growth predictions for the future interbank market show that real-time settlement of all transactions via the Internet will lead to significantly more transactions and immediate settlement. The impact on available liquidity will lead to new and sophisticated models for the capital market. Furthermore, with the Internet of Services, corporations can merge logistical and financial supply chains. The creation of new management services for financial assets and liabilities will also be possible. Ultimately, the successful integration of these supply chain services will enable financial services providers to offer comprehensive management of working capital, including inventory management.

The banking crisis in the recent past has shown that ICT should also be better utilized in financial services with respect to risk assessment, risk mitigation, and compliance. The Future Internet can help here to pull together and access all information that is instrumental in this regard.

There are many specific technical and legal requirements for the financial services sector; however, the European financial sector has a good track record in creating innovative services. The sector can build on these achievements and take the next step in implementing the Internet of Services to ensure its global competitiveness.

For the insurance sector the Internet of Things and Services will provide a huge opportunity for companies to differentiate their products. As an example, insurers can monitor the status of a client's car by connecting to car devices, which will allow policy premiums based on the actual car usage (pay-as-you-drive). Additionally, it will help provide instant information to a car owner's insurance company in case of an accident to assist the policy holder with emergency services, towing, or vehicle repair services. Another example is the monitoring of process equipment, such as the pipes of a refinery, to assess risks associated with the chemicals being processed. This way, chemical companies can assure that their risks remain fully covered and at the same time optimize their production.

Public Sector

Public services are the backbone of any modern society. Without a functioning framework providing core services such as public administration, public security, healthcare, education, and defense, there can be no social stability or economic growth. The role of efficient public services is even more important in Europe since the public sector accounts for more than 40% of GDP. Following developments in the private sector, the vision for modern public services in Europe is one of a constituent-centric services platform, focusing on enabling citizens and businesses to get personalized services and designed to provide the right information, anywhere, anytime, at low cost.

It is well understood that ICT can significantly reduce costs and enhance the quality of public Services. It is increasingly being regarded a strategic tool for the much-needed modernization of public Services in Europe, which in turn reduces administrative burden and enhances European competitiveness.[7] And much as in the private sector, the Internet of Things and Services can lead to tremendous efficiency gains and innovative service offerings in the public sector.

The implementation of the EU Services Directive can serve as an example. The Directive strives to establish a truly internal market for services by removing legal and administrative barriers. ICT plays a major role for the implementation of the Directive. For the first time, EU Member States have made binding commitments to deploy e-government applications. By the end of 2009 all Member States must ensure that service providers can access all relevant information for opening up a new business via electronic means. Governments must also be able to process all applications and handle formalities electronically. For a service provider, the choice of location is critical when founding a new business, especially for SMEs. Criteria include the degree of competition, the number of potential customers, and local labor market and infrastructure conditions, among others. The related information is currently difficult to access for entrepreneurs since it is distributed among several data sources, each of them using different formats and structures. Semantic technologies would allow for aligning the information and for providing value-added Services for entrepreneurs. In fact, Web-based service platforms will be essential for a proper implementation of the EU Services Directive.[8]

Public security is another important area where these new technologies can help improve transnational incident and crisis management, which is driven by the need to instantaneously coordinate relief operations between different public authorities. In addition, the borders of internal and external as well as private and governmental security merge. As a result, a coherent and holistic cooperation of different public and private stakeholders is essential to manage large events or complex transnational crises. A unified and pan-European Web-based service platform would foster a faster integration of and collaboration between public security agencies and should be a major objective of EU security policy.

7. See Commission of the European Communities; Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – i2010 eGovernment Action Plan: Accelerating eGovernment in Europe for the benefit of all, 2006.
8. For more details see EICTA position paper on the IT implementation of the EU Services Directive, 27 June 2008.

RECOMMENDATIONS FOR ACTION

TAKING CHARGE FOR EUROPEAN COMPETITIVENESS

The previous section has demonstrated the tremendous opportunities offered by the Future Internet for specific industries and the European economy in general. Unfortunately, there are strong indications that the new Web-based industries and their underlying ICT infrastructures will be developed in the United States and Asia rather than in Europe. For example, all major services platforms for the Future Internet – such as Amazon or Google, which in 2006 and 2007 invested over €1 billion each year in ICT infrastructure – are headquartered in the United States. Microsoft alone invested €2 billion in data centers in the same period. The uptake of innovative Web-based services in Europe is lagging behind the United States. In particular, SMEs – the backbone of the European economy – have not fully utilized the potential of ICT innovations. Furthermore, there is little awareness among the industry leaders, policy makers, and general public in Europe concerning the dramatic economic impact of the Future Internet. These are clearly worrying developments that could seriously hamper European competitiveness in the future. If Europe does not take firm action now it will fall further behind other knowledge-based economies.

SAP calls upon other European industry players and European policy makers to join forces and develop a European action plan to ensure that Europe fully exploits the potential of the Future Internet. This section contains Recommendations for actions for European industry, the European Commission, and EU Member States.

The Role of European Industry

Extended ICT research that is conducted in Europe is often commercialized first in North America and Asia. It is time that Europe puts in place technology transfer centers to commercialize technology from our esteemed research institutes into large-scale industries. To this end, Europe needs to establish large-scale ICT clusters that deliver what is most urgently needed in Europe: turning knowledge into marketable products. Europe today is host to a number of ICT clusters, including the Oulu Technology Cluster and Sophia Antipolis "Secure Communication Solutions," as well as clusters that are under development such as the European Business Application Belt and the Commercial Vehicle Cluster (CVC) South West in Germany. Yet even the larger ICT clusters such as the Rhein/Main/Neckar region with 100,000 people,[9] or the one in Oulu with 60,000 people, are small when compared to the 300,000 in Silicon Valley. Equally alarming is the size and the growth of ICT clusters in Gumi City, Korea; Silicon Sea Belt, Japan; or Bangalore, India. There are various reasons for these shortcomings, such as the lack of entrepreneurship and management skills,[10] the missing link between industry and academia, the fragmented ICT market in Europe, the high degree of red tape, a less advanced venture capital industry in Europe, and the lack of a balanced and effective EU-wide intellectual property rights (IPR) framework.

As a result, venture capital looks to other regions like India or China for the emergence of an entrepreneurial environment and large community of highly skilled scientific technicians. India is also named as the country of choice, behind the United States, for sourcing software development. Only the United Kingdom, Germany, and France are ranked among the top nine.[11]

Create Large-Scale European Research and Innovation Clusters

If Europe wants to position itself as a global player developing new Web-based industries, then a large-scale research and innovation cluster for the Internet of Things and Services is needed. This cluster would address horizontal issues such as security, the infrastructure layer, and vertical components in the most important application areas (e-energy, retail, manufacturing, logistics, financial services, and public sector). The firm commitment of major European ICT companies, as well as the active participation from private and public user organizations, will be essential in establishing this cluster and ensuring a fast commercial uptake of the Internet of Things and Services in Europe.

SAP is currently involved in several projects and initiatives that could contribute to a European cluster for the Future Internet. One example is the THESEUS initiative in Germany. The consortium comprises 30 academic and industrial partners alongside public administration and is funded by the German government. For six use cases, partners will develop and test innovative

9. European Cluster Observatory, 2007.
10. Communication from the Commission on a proposal for a "Small Business Act for Europe" – Impact Assessment, SEC (2008) 2101.
11. Global Trends in Venture Capital, 2007 Survey, Deloitte & Touche, and The SME Financing Gap Volume I Theory and Evidence, OECD, 2006.

Web-based applications for business and consumer markets up to 2011.[12] In addition, SAP operates capital venture funds that increasingly look into opportunities to invest in start-ups engaged in the Internet of Things and Services. Finally, for various industries SAP has created so-called industry value networks, in which SAP experts together with customers and partners create innovations and address long-term technology and market trends. Here, once again, the Future Internet is of major interest.

Other public and private stakeholders in Europe are also pursuing similar projects. However, none of these individual initiatives alone will be able to compete with sizable ICT clusters in other regions of the world. What we need is a large-scale European innovation and research cluster for the Future Internet that integrates existing and emerging activities in Europe and thus focuses on a few lighthouse projects. The European institutions can and should play a crucial role in coordinating and promoting those efforts (see below).

Raise Visibility and Build Trust in the Future Internet

The economic and social benefits of the Future Internet and its impact on productivity, growth, and employment are currently not fully understood in Europe. In particular, there is a lack of trust among consumers and in public opinion related to new ICT applications. The debate on data privacy issues related to RFID is an example. These concerns are perfectly understandable. Privacy and security issues must be addressed proactively through an open dialogue among all relevant stakeholders. The Future Internet will only rapidly reach a critical mass in Europe if the benefits are widely understood among business and private users and if there is real trust in the new technologies. In essence, it must be clear that existing European standards for security and data privacy will apply in the Future Internet.

It will be the role of EU policy makers to adapt existing privacy and security rules to the Future Internet, wherever necessary and appropriate, and ensure their enforcement. Industry, on the other hand, must invest in secure technologies and applications for "information rights management" in the Future Internet. As virtual markets, ICT-supported services, ICT-controlled supply chains, and ICT-assisted collaboration increase in the Future Internet, security measures at infrastructure level become even more important. In particular, identity management will be essential for trust establishment and management and for safeguarding privacy, as well as for designing and implementing business security models and policies. Full IT support for compliance during the whole software development and service life cycle is mandatory to ensure the quality and effectiveness of security measures. Finally, methodologies for secure implementation and operation of software systems have to be advanced to systematically achieve security and dependability of applications.

Even more important, industry must actively educate business and private users about the benefits of the new technologies and how to use them in a secure manner.

Agree on Standards to Ensure Interoperability and Economies of Scale

Standards need to be created in many areas to ensure interoperability in the Future Internet and to realize economies of scale that are essential for reaching a critical mass for new applications. In particular, there is a need for standards to ensure the unique identification of objects in the Internet of Things. Numerous unique identification schemes and issuing authorities have arisen over the years in specific industries. This includes, but is certainly not limited to, vehicle information numbers (VINs), International Standard Book Numbers (ISBNs), Global Trade Identification Numbers (GTINs), and the like. These schemes were developed independently for different purposes, which could potentially mean that different objects use the same identification number. This could obviously jeopardize the unique identification of objects, once different industries are virtually merged with the Internet of Things. Therefore, we need to create a global platform and global standards to ensure that different issuing authorities can coexist while creating truly unique IDs, which are required for the Internet of Things.

12. For more information see http://theseus-programm.de.

The Internet of Services will mainly be based on Web services standards, starting from SOAP and Web Services Definition Language (WSDL) up to standards like WS-Federation and WS-Coordination. In the area of semantic technologies, the most relevant standards are the W3C recommendations Resource Description Framework and Schema (RDF/S) and Web Ontology Language (OWL). A crucial but still missing piece for the Internet of Services where Europe could take the lead is the definition and standardization of a Service Description Framework (SDF). From the logical perspective, the SDF is built on top of the technically oriented WS standards and will take care of the transformation of a technical service into a tradable good. In the end, this SDF will form the heart of the Internet of Services. A second crucial enabler for the Internet of Services is the standardization of the core business-critical knowledge in the form of ontologies to enable the automation of business processes for providing, trading, and consuming services.

SAP believes that standardization in the Future Internet should be industry led. In fact, consortia standardization bodies such as W3C or OASIS will drive the development of standards for the Internet of Things and Services. Obviously, any industry consortia must meet certain criteria; among other things, they must ensure open procedures, nondiscriminatory access, and a transparent, legally certain, and well-balanced IPR policy.

The Role of the European Commission

The European Commission can play a major role in supporting the development of the emerging markets for the Future Internet in Europe. The building blocks for a European policy for the Future Internet should include three core measures, namely to establish a single market for the Future Internet, to make the Internet a priority for the EU Competitiveness Strategy, and to align EU R & D instruments toward the Future Internet.

Establish a Truly Internal Market for the Future Internet

One of the major stumbling blocks for the development of a strong European software industry is the fragmented market structure in Europe. National markets differ significantly in terms of regulations, labor law, culture, and so forth. There is no true functional internal market for software in the European Union. This puts European software vendors at a disadvantage when compared to their U.S. competitors, which benefit from a large homogeneous home market.[13]

Therefore, from the outset, Europe should strive to establish a single market for the emerging Internet of Things and Services. The single-market approach is a prerequisite for creating large-scale Web-based industries in Europe that can compete in global markets. The related EU policy framework should pursue three objectives. First, it should ensure legal certainty and build trust for all stakeholders involved. Second, regulatory intervention should be kept to the minimum to foster investment and innovation in this emerging market. Third, the framework should be coordinated with Europe's major trading partners since the Future Internet will be global in nature.

The nucleus for an EU policy framework for the Internet of Things and Services already exists: in 2006 the European Commission launched a comprehensive program to establish a policy for RFID. A Recommendation on privacy issues related to RFID is expected to be adopted in 2008; a Communication on the Internet of Things will follow by the end of 2008. SAP appreciates that the Commission has chosen a balanced, inclusive, and global approach to develop a policy framework for RFID.

We encourage the Commission to continue its efforts and broaden the scope so that the policy framework would also encompass the Internet of Things and Services. The focus should be on creating a single market for the Future Internet. Measures could include:

- Prepare a Recommendation "Toward an Internal Market for the Internet of Things and Services." This Recommendation should identify the main obstacles for an internal market for the Internet of Things and Services and propose measures to address them. In particular, this Recommendation should ensure that suitable radio-frequency bands are allocated to the

13. See Adam Hale/Léo Apotheker, The Demise of the European Software Industry, ACH/cs/262237; European Software Association, European Software Industry: Looking for a Competitive Advantage, June 2008.

Internet of Things and Services. Furthermore, there is a need for an EU-wide harmonized regulatory framework for the implementation of RFID. Several EU Member States are considering making RFID (or similar technologies) mandatory in specific industries, such as the pharmaceuticals sector, to pursue policy objectives. Obviously, divergent national regulations and standards would lead to fragmented markets in Europe. A homogeneous EU-wide approach, on the other hand, would foster the creation of a large-scale single market and boost the demand for RFID in Europe.

- Establish a fast-track process for the formal recognition of industry-led consortia standards at the EU level, which would certainly be instrumental in accelerating the creation of a truly single market. SAP welcomes a recent proposal by the European Commission to set up a stakeholder platform that would establish a minimal set of criteria for the recognition of consortia standards.
- Ensure a balanced, effective EU-wide European IPR framework for the Future Internet. The role of IPR to foster investment in innovative Web-based applications will certainly increase in the Future Internet. SAP welcomes ongoing efforts for an institutional reform of the European patent system.

Make the Future Internet a Priority for European Competitiveness Strategy

Any European policy on the Future Internet should be closely linked to the European Competitiveness Strategy. In fact, the Future Internet should become a priority of the new Lisbon agenda. To achieve this, the Commission should:

- Launch a socioeconomic study on the Future Internet. There are scarcely any studies available that deal with the socioeconomic impact of the Future Internet. A profound understanding of the socioeconomic dynamism, however, is needed to create the necessary political awareness and develop a sound European policy for the Future Internet. The study would analyze the potential benefits of the Future Internet to business and citizens, quantify the market potential, and analyze the impact on specific industries. It would estimate the macroeconomic impact in terms of growth, employment, and productivity; identify bottlenecks for the development of the Future Internet in Europe; and propose measures to address them. Finally, it would conduct a benchmark analysis of the development of Web-based industries in other regions of the world. The study should be finalized in spring 2009.
- Based on the socioeconomic study, organize a series of high-level seminars on the impact of the Future Internet on specific industries such as retail, logistics services, financial services, manufacturing, energy, and the public sector. The seminars would bring together representatives from the ICT industry, the respective user industries, academics, and policy makers to discuss the specific challenges and opportunities of the Future Internet. These seminars could take place in Q2 2009.
- Encourage the Competitiveness Council to organize an informal meeting on the Future Internet with involvement of CEOs from European ICT companies and industries that will be highly affected by the Future Internet. Obviously, the results of the socioeconomic study and the outcome of the high-level seminars should feed into the informal meeting of the Competitiveness Council.

Align European R & D Instruments Toward the Future Internet

The European Commission should support industry efforts for the creation of large-scale research and innovation clusters on the Future Internet by streamlining and aligning European R & D instruments. In particular, the Commission should:

- Launch a feasibility study on a European research and innovation cluster for the Internet of Things and Services.
- Continue to put a strong emphasis on the Future Internet in its FP7 research programs, recognizing that collaborative basic research under the FP7 can provide for a large part of the necessary scientific activities within the envisaged cluster.

- Establish a Future Internet joint technology initiative (JTI), which can provide guidance for application-related research. Research fields should comprise Future Internet scenarios in sectors such as energy, manufacturing, retail, and the public sector; the new JTI should be linked to other existing JTIs (ARTEMIS, ENIAC) to complement the vision of the Future Internet.
- Support the creation of an IT knowledge and innovation center (KIC) under the European Institute for Innovation and Technology (EIT). Such a KIC should focus on the Future Internet and serve as a coordination platform to link the activities in education, R & D, and innovation. The EIT could also develop curricula for the Internet of Things and Services.
- Promote the use of the Competitiveness and Innovation Program (CIP) for projects related to the Internet of Things and Services. SAP welcomes a recent proposal of the European Commission to establish a thematic network to define lighthouse projects on RFID.
- Include the Internet of Things and Services in its lead market Initiative; for example, identify potential lead markets that are related to innovative Web-based applications.
- Focus public venture capital on companies that develop technologies for the Future Internet through the European Investment Funds in collaboration with national or regional venture capital programs like the Portuguese Venture Capital Initiative (PVCi), the NEOTEC (ES), Venture German Capital Promotion Programs, or the Regional Venture Capital Funds in the United Kingdom.

The Role of EU Member States

As mentioned, innovative Web-based services could significantly enhance cost efficiency and the quality of public services. At the same time, investments by public administrations could be instrumental for achieving critical mass for a breakthrough of the Internet of Things and Services in Europe, since the public sector accounts for more than 40% of GDP. Indeed, EU Member States could take a number of measures to promote the development of the Internet of Things and Services, including:

- Apply Web-based services to modernize its public services and public healthcare systems – in particular, using these new technologies for the implementation of the EU Services Directive.
- Promote the use of precommercial procurement in the area of the Internet of Things and Services.
- Open up existing ICT infrastructures such as electronic toll systems for the provision of new Web-based services.
- Facilitate access to public data banks for the creation of new applications in the Internet of Services.
- Reinforce specific education and training programs to improve e-skills
- Align national R & D programs toward the Future Internet.

The European Commission could support these efforts at a national level by launching a study on how public services could benefit from the emerging Internet of Things and Services – both for national services as well as cross-border services. The Commission should also promote the development of EU-wide standards for Web-based public services and e-skills training activities. Furthermore, the Commission should make Web-based public services a priority of its eGovernment policy and propose to put the topic on the agenda of the next Ministerial eGovernment Conference in 2009. Finally, the Commission should continue to focus on "Web-based public services" under the CIP.

CONCLUSIONS
FIRM ACTION REQUIRED

The next generation of the Internet enabled by software will lead to the most significant changes in the economy in the next decade. It will drive productivity gains in many industries and shape the future of the services sector in all knowledge-based economies. Europe can only sustain its competitiveness if there is effective and rapid uptake of these technologies throughout the economy and if competitive Web-based industry can develop in Europe. Unfortunately, there are strong indications that Europe will miss out on this opportunity – with severe implications for employment, growth, and productivity. Firm action by European industry and European policy makers at all levels is needed to ensure that Europe reaps the full benefits of the Future Internet. SAP is fully committed to taking a leading role in this endeavor.

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