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Cloud Based Infrastructure, the New Business Possibilities and Barriers

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Abstract Realization of the cloud computing infrastructure requires access to data anywhere, anytime at any device at a sufficient perceived quality of service. Many Western European countries, such as Denmark, have a high percentage of individuals (inhabitants and companies) that has access to broadband internet via cable, satellite and mobile. This gives a unique position in roll-out and deploying intelligent cloud based services that can be applied for a number of purposes, but where lack of sufficient capacity/quality and IT readiness will be barriers in realization of the "Global Information Multimedia Communication Village (GIMCV)". Broadband is here defined as more than 2 Mbps. In this paper, the combination of e-commerce, cloud computing and broadband infrastructure has our focus, and its unique possibilities for the overall IT society. However, it is also about a significant number of Small and Medium sized Enterprises (SMEs) that today applies manual billing systems or Excel like systems in combination with severe lacks of sufficient IT skills. This means that the most commonly used systems are the ones requiring the most of our time. Therefore, the move for the SME towards e-commerce and electronic processes has a significant economical potential for the SMEs. E-commerce and other internet based services will simplify their business, and hence allow the SMEs to focus on their core business which was their raison d'être. In addition to this can be added other fundamental IT systems that will help their business, but that is outside the scope of this paper. Furthermore, this paper focuses on infrastructural barriers and cloud computing; not only focusing on bandwidth, but also the entire issue of service offering. Services offered via cloud computing solutions will minimize the SMEs investment in own hardware (HW), software (SW) and maintenance. The focus

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is also the upgrade to a superior infrastructure that provides the platform for efficient cloud computing, for e-commerce, and beyond.

Keywords Cloud computing · Ubiquitous broadband infrastructure · SME · Internet of things · IoT · PEPPOL · E-commerce · Deployment of the cloud · Global ICT infrastructure · "Always on"

1 Introduction

An infrastructure that takes its offspring from services, services of high quality, requires that the service is always accessible anytime, at any device (mobile and fixed), at any connection (between personal computers (PCs), peer-2-peer, via fixed and wireless connections, Human-to-Thing and Thing to Thing) and from any place (on the move, outdoor or indoor), as illustrated in Fig. 1. This means that all entities must be interconnected in order to fulfill this demand; and hence the realization of the Internet-of-Things (IoT). It is not all connected items in the IoT that are equally applicable for the Small and Medium sized Enterprises (SMEs)—but they will be for other purposes.

Furthermore, the service focus requires an infrastructure that supports seamlessness and user friendliness for the end-user—and also simplicity for new users, the ones with low degree of IT-competences. The new users should be able to get access to whatever services that support their needs and their business, the latter especially interesting for the SMEs. So, the IoT must support any services at any available bandwidth to provide the required perceived quality of service. However, the available bandwidth might be too low to support the service offerings, a bandwidth demand that increases with a factor 10 every 4 years [1].

This leads to the focus of this paper:

- E-commerce—the barriers and the advantages for the SMEs
- Cloud computing—what is it? What are the demands? And is it secure enough?
- The infrastructure challenge—how to allow anyone to get access to the internet (wired or wireless) satisfying the demands to network performance/quality?

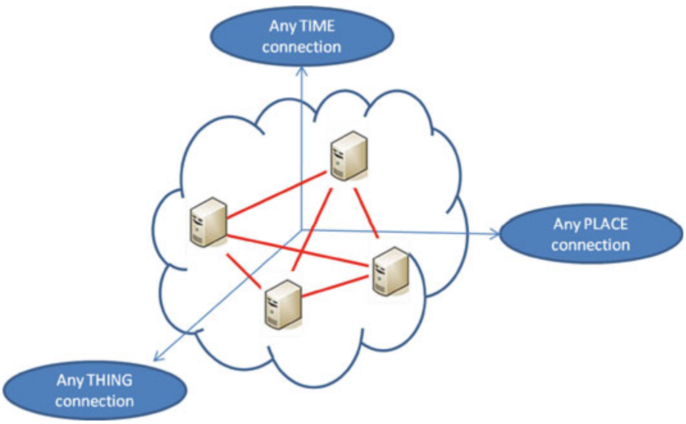

Fig. 1 The ubiquitous infrastructure providing services anytime, anywhere and anything; an infrastructure based on the cloud

In order to meet the demand of the future for the Global Information Multimedia Communication Village (GIMCV) [2], or simply building a society that benefit from the possibilities with Information and Communication Technologies (ICT) for the wider population, it is a necessity that the applied processes are efficient, like for e-commerce. This means that the processes are based on an easily maintainable, flexible and scalable worldwide platform. A mean to offer this is by cloud computing and the necessary infrastructure.

The infrastructure is the carrier of the successful implementation of remote service from an end-user perspective. By remote services, this paper considers cloud based services; services being applicable in different manners either as software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS) as well as remote storage of data (DaaS).

It is a pre-requisite that the services must be available anywhere, anytime and at any device. This requires that:

- There must be no spam (on e-mails, VoIP, chat, etc.)
- It must be easy for the end-user to do self-management
- Authentication must be easy
- Security must be strong and be built in from the beginning (to accomplish data security and privacy)
- Lawful interception must be present up front to avoid conflicts between management and security
- Whatever we build must be user transparent
- Device interoperability must be easy
- Protocol must not be heavy—but extensible (e.g. by active networking support) to cope with the diversities in the underlying infrastructure
- The services must be available at flat rate or close to free

With the realization of this service platform, e-commerce can now be applied as explained in the following sections.

This leads to the structure of the paper. The first section covers e-commerce as of today, and the challenges related hereto. Hereafter, the paper covers cloud computing and the possibilities with cloud computing—and the concerns that are pre-dominant at the moment. The final section is about the underlying infrastructure putting it all into perspective.

2 The Internet from a Business Perspective

E-business is every action on the internet related to the business. This includes e-marketing, e-delivery, e-service, e-procurement and e-commerce. One of the fundamental factors for spreading out e-business is how well the actions *ordering* and *payment,* in short*e-commerce,* can be handled via the available channels.

From an ordering perspective, the ordering can be handled via mobile phones as well as a typical PC platform. Hereby said, the underlying motivation for further realizing electronic procurement services is available, especially when providing easy accessible interfaces that support complete ordering systems; systems that can handle e.g. thousands of product numbers, and payment via a diverse set of devices including the mobile terminal.

Electronic data interchange (EDI), defined by NIST (National Institute of Standards and Technology), is the standard for computer-to-computer interchange of non-monetary documents and can be transmitted from originator to recipient via telecommunications or physically transported on electronic storage media. The EDIs are exchanged via the value added

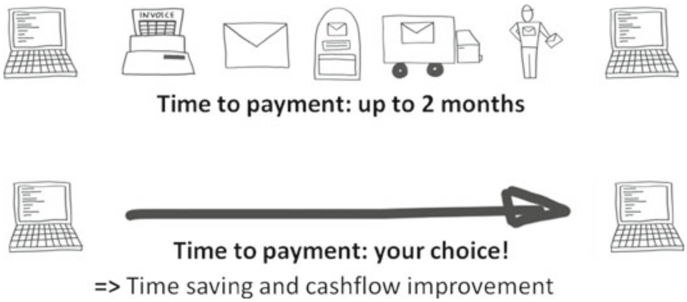

Fig. 2 Difference between the lower 40% and the upper 60% of the companies with respect to applying electronic invoices based on a common standard like UBL or other electronic business standards (the figure is from Tradeshift, see www.tradeshift.com)

network (VAN) operator like the Danish company DanNet A/S. Unfortunately, only the major companies use EDI, roughly the upper 20% of the SMEs in Denmark, leaving roughly 80% doing differently as illustrated below, a situation that is almost equivalent in most of the western European countries.

The larger VAN service providers in Denmark, EVENEX, KMD and IBM have realized that NemHandel (EasyTrade), based on OIOUBL (a subset of Universal Business Language [10]), is applied by other 40% of the SMEs. The SMEs urge the bigger players in the market to support this relative new business infrastructure as NemHandel transactions can be transferred to customers applying EDI via a gateway at the VAN service providers. This is the reason the operators, one by one, establish gateways to Nemhandel in the old EDI set-up.

Also from an European perspective there is an increased interest in NemHandel, as the Danish experiences are taken into account in the establishment on PEPPOL (Pan-European Public Procurement Online). The focus in PEPPOL is to establish a common standard for business processes like quotations, product catalogues, invoices and orders for all countries in EU. These standards describe how to exchange electronic documents across borders, also in cases where the national legislation varies from country to country.

2.1 E-commerce—One of the Enablers of a Modern Society

In principle, e-commerce is transferring money between two electronic entities, but e-commerce does not define how this transaction shall take place. Figure 2 illustrates the different ways of doing e-commerce. The first one implies scanning, printing, sending invoices to the customer—a very inefficient manual way that means that it may take up to 2 months from the job has been executed until the payment has been received.

Opposite to this is e-procurement, where the invoice can be sent directly from one to another and hence save time and improve the cash flow. Examples of efficient e-procurement methods are Nemhandel [3] and PEPPOL (Pan-European Public Procurement OnLine) [4]. Both initiatives want to increase the companies' attention and usage of ICT, and hereby reduce the administrative burden. Ideally, all exchange of written information between the citizens, the companies and the public administration around 2012 should be digital, and also become simple, flexible and secure.

Common for Nemhandel and PEPPOL is that they provide a standard for transmitting business information across the internet between the public and private entities. In practice, they do not require Cloud Computing based solution as such, but introducing the services

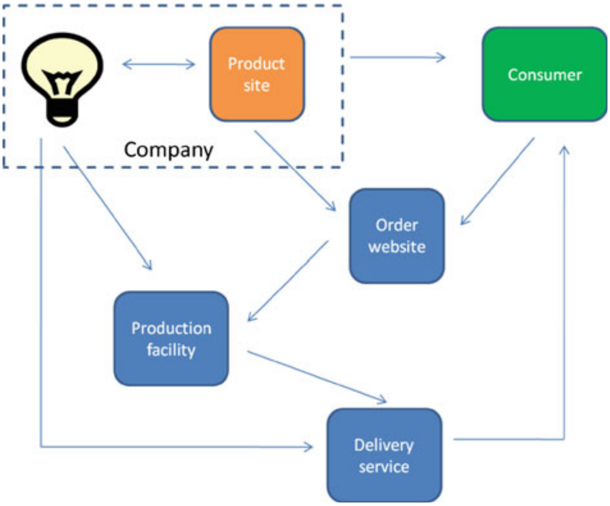

Fig. 3 The future winners

on a cloud platform has a number of advantages with respect to simplicity, scalability and accessibility, and hence it becomes natural to provide a business platform based on cloud computing.

Cloud computing provides also a platform that enables the inventor/entrepreneur to loosen control of some of their business processes as they become physically—and logically—distributed, see Fig. 3. The inventor/entrepreneur protects the idea and product by Intellectual Property Rights (IPR) and maintains the focus on marketing and further development. For the other parts of the supply chain, the inventor/entrepreneur has out-sourced those and therefore needs to trust all suppliers in the supply chain including the production facility and the delivery services.

The content of the product website is provided by the company, but the site is stored in the cloud. The production is outsourced to a production facility—and delivery is handled by 3rd party delivery companies like DHL/UPS.

In the global market, it is important that whenever customers, from any country around the world, orders a product, the product information must be easy accessible in the customers own language (e.g. being translated using Google Checkout), and the product delivery very feasible. Therefore, the product site must link to well-established ordering website, like Vortex links to the cloud based site Amazon.com, that forwards the ordering information to the production facility whenever the order has been received. The world-wide delivery service delivers the product to the consumer. Another example is Sony Ericsson that produces the hardware platform for their mobile, but allows installation of Android. Android market and Apples Appstore are examples of well established platforms for offering 3rd party products—the applications.

In general, cloud computing services provide an open business platform for everyone, everywhere, for every country, for every company, for every organization and for every kind of business.

For the inventor/entrepreneur, using the cloud is a must in order to be able to focus on what they are best at; but it is also a way to simplify the business for other SMEs, for instances the carpenter. Figure 4 illustrates the set-up for the SME using Nemhandel.

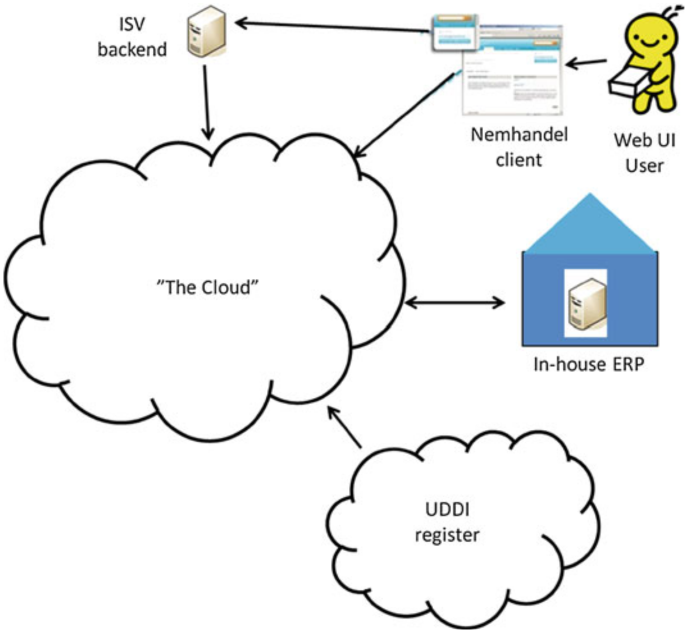

Fig. 4 A Nemhandel interface to a cloud based infrastructure

The SME has a web interface towards the cloud in order to connect to the Universal Description Discovery Integration (UDDI) register or its equivalent. The UDDI register can be accessed via PC, laptop or mobile through a NemHandel client, or any e-procurement client. The UDDI register is an on-line register that be used by companies to find and access services at other companies. The UDDI register is also used to confirm the identity of the involved business parties using look-up tables. This means that all economical transactions go directly between the individuals—and not via the UDDI register. The UDDI register is shown here as being separated from the cloud, but this is by no means necessary.

For the SME, the cloud is used for back-up of data, file server, CRM and CMS; only non critical business data. All sensitive and confidential data, like product drawings, customer information and contracts, must be stored locally, and replicated to only trusted parties at physically distributed places for secure back-up.

The Internet Service Vendor (the ISV) is the one handling the access for the SME to the internet and other equivalent tasks.

In principle, there are two ways of introducing Nemhandel:

– The typical way, where the SME acquires a computer with the necessary SW and access to the internet. Furthermore, the local computer may host the internet site and thereby the public profile of the company. Natural, there will be a back-up functionality of all economy data due to requirements from the company's accountant.
– The cloud way, where the company only requires a thin client at the premises. Instead, all non-confidential data are stored in the cloud, including relevant business information. Confidential data might be stored at home, while infrastructure and applications more easily can be accessed in the cloud.

This leads to the follower for this section, the discussion on the cloud based services.

3 Cloud Based Services

Cloud Computing, is a commonly used term, but when asking people about the meaning they often propose many different definitions. Therefore, it is worth referring to the official definitions by international standardization bodies like ETSI (European Telecommunication Standardization Institute) and NIST (National Institute of Standards and Technology):

- ETSI: "Cloud Computing is a rapidly provisioning infrastructure (e.g. compute, storage, network resources) that supports dynamic scaling with uniform interfaces to these resources." [5]
- NIST: "Cloud Computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. network, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

From a service perspective, this means that the consumer can get global access to any capacity demand and cloud service without any human interaction with the cloud provider and through any client.

3.1 Accessing the Cloud

The traditional ownership of the computer infrastructure changes with cloud computing. This means that the end-user, or the SME, does not need to maintain and upgrade servers, the different applications (the software) and the security. Instead, the SME can rely on the cloud service provider that can easily scale up and down through assigning and re-assigning physical and virtual resources in order to meet the actual need. It also means that the consumer has no control over or knowledge of the exact location of the provided resources. This implies that the resources might be shared in an intelligent way by distributing the computer processing power in computer centers, and that the data is not only stored at one place, but replicated at multiple data centers in order to provide the required response time for the end-user. The same account for applications, etc.

On top of this, it is important that the services are measurable, and hence provides the platform for billing, access control, resource optimization, capacity planning, etc.

Naturally, some parts must still remain in control by the end-user/SME, but with the cloud it becomes possible to outsource services on different levels, beyond Data as a Service:

- The SaaS (Software as a Service) allows the end-user use the application, but the end-user has no control of the underlying infrastructure.
- The PaaS (Platform as a Service) enables the consumer to control the application but not the underlying infrastructure.
- IaaS (Infrastructure as a Service) is the full fledge solution where the consumer uses and controls the applications and the infrastructure.

Cloud computing is much more. It is also new web-services that becomes available due to accessibility of data, data that may come from different data providers. The variety of services is enormous and lays the platform for a plethora of possibilities which are beyond our recent needs for services and applications. Therefore, it is only a matter of rethinking the possible services. These services are not only developed by the "service" providers, but they can just as easily be developed by *you* and *me*. The data are accessible; the platforms like the iPhone and Android based phones are available; and the toolkit for application development

Fig. 5 "Are you safe"—an application for iPhone with many possibilities (source:www.areyousafe.com)

are free or relatively cheap. Therefore, the cloud provides a mean for the crowd to generate and apply data in different smart ways to develop new innovative solutions.

An example showed in Fig. 5 is an application that was developed after the municipality of Washington DC decided to release data, of e.g. the crime rate in different parts of the city. The data was used for:

– Development of an application for the iPhone showing how safe you are in different parts of the city.
– Used by the bar-owners to show where people were crowded at night—and thereby indicate which bars were the most popular.
– Applied by the police officers to select where to be present at night in order to be able to assist when needed.

But if these services require full data accessibility, they become sensitive to break-down and bankruptcy; or simply if fake sites are being applied. Thereby, the fundament of the service vanishes. This may be one of the reasons why most services in the cloud are for pleasure instead of business. Furthermore, it is important that these new services do not introduce additional ways of spam just as spam must be avoided on mails, VoIP, chat, etc.

Generally speaking, cloud computing is seen as a platform that supports the needs of the widest possible range of consumers as well as practical possible without using closed, proprietary technologies [6]. The cloud will be used in different ways including pure interconnection of all necessary entities, as a viable cloud based e-business platform as well as on-line services and internal processes (For these and more use-cases see [6]):

– Use of cloud based services like gmail, Linkedin, Facebook, OnLive where the system resources are hidden in the cloud (or on the internet), but the services are accessible with a thin client, accessing the internet via a relative low capacity internet connection. Common for the services, is that all data are stored centrally, and the different service providers have to guarantee the reliability of their individual services.

– Use the cloud for internal processes like back-up, e-mail and calendars. Furthermore, the available computer processing power in the cloud can be applied sequentially, meaning that not all companies need the same high performance at all time.

Bandwidth requirements to the individuals becomes a minor issue to the access site; however having said so, there is still a minimum bandwidth requirement that must be fulfilled for the overall infrastructure, being composed of the needs of the different applications as described in [7].

Capacity scaling is done in the cloud, and not at the customer premises. Typically most companies design the infrastructure to support the company when the load is highest, but in principle it is only needed 5% of the time—and hence the data capacity can be used for other purposes—an issue that is solved by moving the data and computer power to the cloud.

3.2 Deployment of Cloud Computing—Models and Drivers

The drivers for Cloud computing are many: the performance is higher, the infrastructure is scalable, the services are cheaper and the user can pay with the growth—all different from if the company should establish its own computing infrastructure. So the cloud has its potential. Amazon.com provides a cloud based infrastructure; Microsoft goes to the cloud; Sun Microsystems provides container based data storage and processing power—just to be installed in the cloud. In total, private and public data are available in the cloud as it is cheaper, it is faster, it can grow with the demand and it is always accessible. However, care have to be taken in order to ensure that the cloud based services are offered in a degree that matches needs and expected price models.

The question is only how to deploy cloud computing to the masses, the SMEs. There are different deployment models as described in [6], varying from purely private clouds, owned fully by the company, to public ones which are accessible to all interested parties via the internet. This reflects that there are trajectories in the deployment of the cloud that spans over:

– National cloud deployed where the user must determine how to use public cloud to meet their goals—a realistic case for the SMEs.
– Many organizational private clouds are deployed. Organizations must then determine how to federate or hybridize.

In between these two extreme trajectories, there are also community cloud (a cloud that is controlled and used by a group of organizations that have shared interests, such as specific security requirements or a common mission) and hybrid cloud (a combination of a public and a private cloud that interoperates—e.g. for outsourced non-business critical information and processes, while business critical services and data remains under control). It is expected that mainly larger companies will apply hybrid clouds.

The cloud provides an infrastructure, access technologies, services, etc. feasible to all end-users. Therefore, everything must be simple from an end-user perspective independent on the real complexity of what is underneath. However, when it comes to transparency for the location of own data, it becomes a major problem, as the end-user typically is unaware of where the data is stored. This means that the SMEs expect the data to be stored at a certain service provider, but the service provider might have outsourced the data to be stored elsewhere.

3.3 It All Comes Down to Security and Privacy

Security must be strong and built in from the beginning in order to protect against theft of data and identity. Privacy enhancing technologies can be incorporated in the infrastructure, the access technologies and the entire usage scheme. But security must still provide easy authentication and allow for lawful interception.

Generally speaking, private keys in the cloud cannot be considered as private or guaranteed to be stored in certain regions. Therefore, the agreements with the service provider and the different legislations must support this, but it is also important that the architectural design takes into account protection against the threats and misuse of the infrastructure, thereby providing the needed level of security. Legal intervention and security guidelines have an increasingly focus, but in reality it is mostly a matter of the technical possibilities in the protection against theft and misuse of data and identity.

Furthermore, attention is needed on establishing trusted IT-components in the cloud. The company non-confidential key data is moved to the cloud (the confidential ones must be stored locally). Thereby, the companies do not have physical control over the data as they are stored centrally. This means that if there are any problems, the company is dependent on the global trouble tickets instead of the conventional IT department [8]. Furthermore, the individuals may only be minor players in setting demands to the providers, but together, as a crowd, they will have the power to put the requests forward.

Different levels of trust can be incorporated via the Service Level Agreement (SLA) between the SME and the cloud service providers to guarantee the right Quality of Service (QoS) level; a QoS level that may cost money, but still a very low cost compared to the cost of loosing data. Furthermore, issues on licensees, ownership of data software must be considered in order for the SME to protect it-self in case of losing a cloud based service provider. In principle, the back-up of the data are made elsewhere in the internet, but if not, how to ensure that data are not simply lost for good?

As Werner Vogels from Amazon expresses it: “everything falls all the time. We lose whole datacenters. Those things happen”—So we need a platform and an infrastructure that are reliable enough not to be affected by those breakdowns.

In order to convince the SMEs to apply cloud computing to provide the internet based services, it is necessary to understand the user mind set. Everything internally might be considered as something very controllable, while it might be questionable with external services (see Fig. 6).

As already said, the cloud has a number of advantages both for the service provider and the SME. The SMEs just have to be convinced and understand what is appropriate behavior and philosophy. It is necessary to focus on how services on the internet, like Facebook, Twitter and others, always keep part of our social history. Therefore, it is worth questioning whether we are willing to open up for the same level of information when it comes to our professional life. Once again, if the data are available on the internet, they can be traced.

The on-going trend changing the infrastructure to a cloud based infrastructure, a trend that started recently as a result on the presence of a suitable platform for storage, sufficient computing power and an appropriate infrastructure in selected areas. This means that the roll-out of the cloud will continue with more and more services and companies providing cloud infrastructure and components hereto, like Microsoft, Cisco, HP and Amazon.

Last, but not least, it is necessary to take into account whether it is legal to use certain services and from where. Services like Pirate Bay are legal in some countries, but not in others—but are they illegal in the country from which they are accessed, or in which they are stored. This is an issue that must be raised due to ever on-going outsourcing of services.

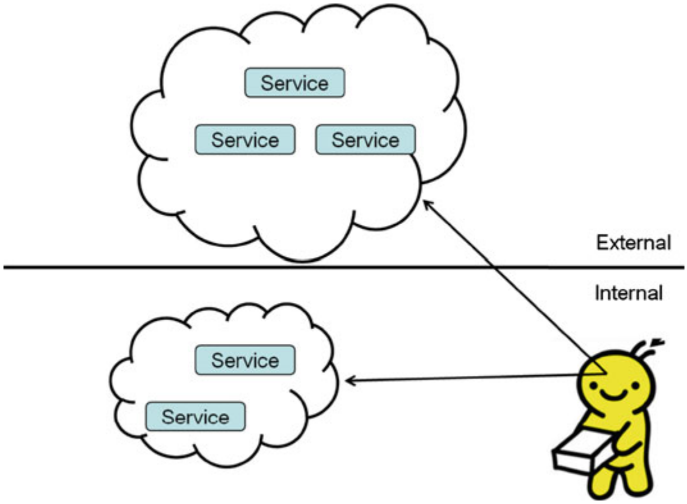

Fig. 6 Concerns from an end-user perspective (standardisation, trust, who owns the data, reliability)

4 The Infrastructure–a Prerequisite to Accommodate Internet of Things and Cloud Computing

In the visions for the Internet of Things (IOT) and Cloud Computing, an underlying assumption is that there exists an ICT infrastructure that can potentially support the required connectivity between any two entities and provide a sufficient level of capacity and quality, independent of the actual locations.

IoT can be seen as a natural extension to the "always on" concept for the personal communication, where the goal has been to provide global location independent communication, in the first place for telephony services and later on, with the all IP based service, further extended to all kinds of IP integrated services. This extension is a step in the direction to include all various kinds of machine to machine communication in the first face driven by specific service segments like in the health sector, the transport sector, etc. An influential parameter is the fast evolution of new technologies for sensor networks and RFID, both with a very attractive price/performance ratio.

The infrastructure for IoT deals mainly with the user's end-systems requirements. Compared to this, cloud computing needs more considerations of the support of the global backbone infrastructure in order to increase the sustainability and robustness to ensure uninterruptable services. The infrastructure needs to be flexible to meet the requirements for rapid changes in the traffic patterns and new services, hence pointing to new methods and principles to meet the restructuring and scalability issues.

The ideal picture of the future presents a borderless world with seamless service provisioning on a global scale across many differently owned and operated ICT infrastructures.

The majority of present infrastructure was originally build as a cobber based network for telephony services, amended by cable TV networks and with wireless access systems for the mobile services at the end of last century. The global, regional and local backbone structures has been replaced primarily with high speed fiber optical cables and complemented with satellite communication and other wireless technologies for remote locations. The replacements are mainly short term market driven gradual upgrades of point-to-point capacity with short pay-back time and only little consideration seems to have been given to a more fundamental revision of the network structures in order to meet long term requirements like the ones we are facing with the above mentioned new trends.

The requirements to support these new demands call for a general revision of the architecture for the ICT infrastructure. Some of the foreseeable problems and recommendations for solutions were pointed out in [9].

The liberalization of the telecommunication market has been a great success in creating the fast growing market for new services on a global scale. Unfortunately, the general lack of separating infrastructure and services has lead to a number of parallel nontransparent sub-optimized infrastructures. Opposite to the situation for many of the mobile wireless operators, there are today in most countries no regulations forcing the infrastructure operator to provide geographical coverage or to meet specific service obligations to the public at large.

The general understanding of the fundamental role of global ICT infrastructure coverage and the potential inclusion of all citizens is beginning to enter the world debate. Many questions rise in the domain on multilateral legal agreements as well as guaranteed and trusted commitments.

Politicians are looking for regulatory models as alternatives to the past monopolies recognizing that the unregulated infrastructure has lead to a new kind of de-facto monopolies controlled by the strongest service providers. The challenge is to find a model that on the one side supports the competitive market structure and on the other side respects the need for a global marketplace for application services independent of the individual infrastructure operators on fair and equal terms.

EU has recently started initiatives to meet the increasing requirement for documented and guaranteed service provisioning beyond the "best effort" level. Demanding services in for example the health sector requires a substantial upgrade of the infrastructure in order to build trusted systems.

In particular, some countries with a large portion of rural or poor areas like Sweden and India have taken special initiatives to prevent a digital divide of the populations:

> In Sweden, this initiative, based on public–private cooperation, has led to a massive roll out of fiber optical access cables in the rural and remote areas, providing potential equal service levels for the rural areas as well as the densely populated areas.
>
> In India, the government follows a plan that is supposed to provide fiber optical connectivity to the more than 700.000 villages in 2012. Although the general economical power of the individuals in the villages is very low, this initiative is seen as a very important step forward by providing e-education, e-agriculture, e-health etc.

The "Rural Area problem" is not a static problem. Rural area is here defined as an area with less potential access capacity than the average access capacity available for the society at large. An area can over time become rural if the general capacity demand grows in the society, and the available infrastructure is unable to meet the demands by technical upgrades. This situation is typical for a country like Denmark, a country that has been leading in broadband coverage, mainly based on xDSL access. Already now, larger parts of the population are rural in this sense. Recent studies at Aalborg University, Denmark, applying new methods to determine the degree of the problem has documented that the problem is far more widespread than the official statistics present. Part of these studies also shows that parts of larger town areas already belong to the rural category.

Taking the expected requirements for service quality, including availability, into consideration, the situation for rural areas will be even worse unless new initiatives are taken. Here, an initiative to provide a new architecture covering a converged and cooperative solution for the wired and wireless networks might be the key to find a sustainable solution.

5 Conclusions

As stated in the beginning of the paper, an all digitized service infrastructure must be accessible anytime, at any device, at any connection and from any place at a reasonable and affordable prize. In principle, it is what we expect from the internet, but in reality it sets a number of demands. These demands relate both to the physical infrastructure and to the various aspects of the usability of the provided services. Services must be available seamlessly at any device and anywhere.

This requires, among others, that resources must be shared in an intelligent way by distributing the computer processing power in computer centers, building a suitable infrastructure and providing smooth access for the users independent of the actual access service provider.

Data is not only stored at one place, but must be replicated at multiple data centers in order to provide the required response time for the end-user as well as necessary protection of data. The same account for applications, etc. The only way to meet this is to avoid "Rural Areas" and hence provide a well qualified infrastructure that allows for low latency and sufficient bandwidth—a complex task for the engineers, but easy from an end-user perspective.

The same infrastructure should also provide a platform that allows the SME to use e-business services. This requires more than an infrastructure that interconnects to all relevant identities, as the some of the SMEs themselves lack sufficient IT competences as well as acquisition on the appropriate IT infrastructure, being cloud based or not.

It was also mentioned in the paper, that only 20% of the SMEs in e.g. Denmark applies EDI, while other 40% applies NemHandel, a standard that is being migrated into the paneuropean PEPPOL project. Therefore, a number of national activities have been launched to support the remaining 40% to apply e-business. One of them is Center for innovative e-business (center for iBiz). Center for iBiz is a collaboration between the two Applied Science Technology Centers: Danish Technologies Institute and Delta. Center for iBiz has the purpose of strengthen small and medium sized companies in applying IT in the business processes by increasing awareness and knowledge of e-business and e-procurement. Hereby, it is the target to lower one of the barriers: lack of IT competence and ignorance regarding the many new possibilities with modern e-Business.

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Author Biographies

Christian Kloch Senior Consultant at Danish Technological Institute within Information and Communication Technology, especially ambient assisted living, intelligent transport systems, wireless communication, tagging technologies and Software Defined Radio. Christian Kloch has more than 15 years of experience within the telecommunication industry. In his career, Christian Kloch has held various positions including technical specialist for wireless access technologies, technical manager for the Ericsson Competence Center for Point-to-MultiPoint Radio Network Design. At TeliaSonera, Christian Kloch developed the technical strategy for Telia's mobile network and its evolution from 2G to 3G. From 2006, Dr. Kloch was product manager at Anritsu for a portable network and performance analyzer for both the mobile network and the fixed network. Christian Kloch is a Senior Member of IEEE and the Past Section Chair of IEEE Denmark. He is appointed scientific research evaluator at the Danish National Advanced Technology Foundation and Technical Reviewer of various publications, e.g. "IEEE Transaction on Antennas and Propagation".

Ebbe B. Petersen is center manager at the e-business innovations-center, Danish Technological Institute. He is recognized as one of the first European e-business pioneers who makes business (r)evolutions in companies as well as in the public sector and new startups. A digital strategist, futurist and facilitator of combining business solutions in the new infrastructures, media, standards and technology in an innovative way that makes high Return Of Investment (ROI). Furthermore is his flair for technology combined with his technical skills providing him with the right ingredients for managing technical projects effectively and efficiently, with the ability of understanding technical challenges as well as identifying technical opportunities to suit the business needs. Further detailed information about Ebbe B. Petersen can be found online http://dk.linkedin.com/in/ebbepetersen or just follow his stream on http://twitter.com/ebbepetersen.

Ole Brun Madsen is born in 1942 in Denmark and received his M.Sc. in Mathematics & Computer Science from the University of Copenhagen. (1962–1972) researcher and from 1968 head of the Computer Science Laboratory at The Royal Danish Academy of Fine Arts in Copenhagen. (1972–1981) head of the Development Department, RECAU, the Regional Computing Centre at Århus University. (1981–1996) Head of the Data Network Section and Head of the Network Infrastructure Strategy section at Jutland Telephone. (1996–1999) Manager for Infrastructure Network Technology and Strategy at TDC, Tele Denmark. (1999-) Professor in Distributed real-time Systems, (2004–2010) as Head of NetSec, Networking and Security section, (2004–2010) Head of CNP, Center for Network Planning and (2004-) Co-director for CTIF, Center for TeleInFrastructur at Aalborg University. He has been project leader for a number of national and international R&D projects and acted in high level advisory tasks within the European Commission on the R&D framework programs in DGXIII and with United Nations UNDP activities. Present research is focused on Infrastructure Architecture and Modeling Tools for Network Analysis and Design.