Reducing our electronic footprint – is the cloud the answer?

Looking to the future – 5G and the cloud

Highlights from ICT 2013
foreword

welcome to net-cloud future! This unique round-up of developments – both policy and technological – looks at the key issues and questions surrounding the cloud, and presents the results of some exciting and striking EU-funded research and innovation projects.

The European Commission outlined its strategy for getting the most out of cloud computing and giving Europe a leading edge in the September 2012 Communication “Unleashing the Potential of Cloud Computing in Europe”. The Strategy defines actions that could create a significant number of additional jobs and that could also boost the EU GDP far beyond usual expectations. It will do this by focusing attention on standards, voluntary certification, safe and fair contract terms and through a genuine partnership between the European Commission, EU Member States and industry.

Just over a year since the Strategy was launched, stakeholder working groups, including the Cloud Standards Coordination (CSC), hosted by the European Telecommunications Standards Institute, have been set up and are already producing good results, such as the mapping of cloud computing-related standards. The ETSI CSC report was presented during a conference in Brussels on 11 December 2013.

The European Cloud Partnership, one of the pillars of our Cloud Computing Strategy, has also taken off, under the chairmanship of Toomas Hendrik Ilves, President of Estonia. The third Steering Board meeting recently took place in Berlin, alongside the launch of the pioneering Cloud-for-Europe FP7-funded pre-commercial procurement initiative.

The Strategy also calls for a more robust international dialogue on the cross-border use of cloud services. Considerable progress has also been made here. A number of joint research activities have already been agreed with Japan and Brazil, and teams are gearing up to start work under Horizon 2020 in 2014/15.

As Horizon 2020 gets underway, I am confident that we will see more international partnerships, more breakthroughs and increased competitiveness in Europe thanks to cloud computing. Within the industrial leadership pillar of Horizon 2020, over €13 500 million is set aside for investment in ‘leadership in enabling and industrial technologies’ (LEITs). A large part of this will be invested in ICT, including in cloud computing.

Ultimately, the cloud has the potential to revolutionise the way those using data work, create huge savings for both the private and the public sectors, increase efficiency and even reduce the environmental impact of computing. The cloud is clearly here to stay.

We hope you enjoy reading the articles that we have selected for you. And if you weren’t already aware of the economic benefits of the cloud, we hope we have managed to convey some of our excitement, and to explain why we see investment in the cloud as an investment in our future.

Mário Campolargo
Director of Net Futures
@MarioCampolargo
Our EU Cloud Strategy has taken off and is in mid-flight. This edition of net-cloud future will give you a glimpse of ongoing activities and developments in this area – enough to whet your curiosity as to what comes next! A recent highlight was the 14 November 2013 launch of Cloud-for-Europe, a “pre-commercial procurement” initiative, in Berlin. Both Commission Vice-President Neelie Kroes and President of Estonia Toomas Hendrik Ilves were present for the launch (see pages 8 and 9). This initiative certainly marks an important milestone in the implementation of our Cloud Strategy!

And there is more to come: cloud and software research has a budget of €125 million for 2014/2015 within Horizon 2020. The programme has various funding instruments making it possible to further explore cloud infrastructures and services, boost public sector productivity and innovation, and also develop tools and methods for software development. The European Council concluded in October 2013 that “several strategic technologies such as Big Data and Cloud Computing are important enablers for productivity and better services”. This is strong recognition of the strategic importance of the cloud.

Curious? Please browse our magazine to find out about recent, current and future developments and research in our area!

Ken Ducatel,
Head of Unit Software & Services, Cloud

CONTENTS

WHAT’S UP IN CLOUD POLICY
UNLEASHING THE POTENTIAL OF CLOUD COMPUTING 4-5
EUROPE ON THE CLOUD – THE WAY FORWARD 6
CLOUD SELECT INDUSTRY GROUP 7
CLOUD COMPUTING ACROSS EUROPE:
PUBLIC LAUNCH OF THE CLOUD-FOR-EUROPE INITIATIVE 8-9
SAFE AND FAIR MODEL SERVICE CONTRACTS TO BOOST CLOUD COMPUTING 10
DRIVING COMPETITIVENESS, CREATING JOBS 11
CYBER SECURITY: KEEPING CLOUD COMPUTING SAFE 12-13

WHAT LINKS WITH OTHER AREAS AND POLICIES
ENTREPRENEURS HEAD FOR THE CLOUD 14
HOW GREEN IS THE CLOUD, NEW TOOLS FOR GREENER SOFTWARE, 15
TACKLING NEW ENVIRONMENTAL CHALLENGES 15
EARLY DAYS FOR THE PUBLIC SECTOR AND THE CLOUD 16

WHAT’S UP IN CLOUD RESEARCH?
FP7 RESEARCH ACTIVITIES IN SOFTWARE, SERVICES AND THE CLOUD: HELIX NEBULA, OPENNEBULA, OPTIMIS, SRT-15, MOSAIC, CUMULONIMBO, MOBICLOUD, MO-BIZZ 17-22
FEEDBACK FROM ICT 23-25
CELAR-BASED RESEARCH PAPER TAKES BEST PAPER AWARD 26
VISION CLOUD AT IBC 2013 27

WHAT’S NEXT IN CLOUD POLICY AND CLOUD RESEARCH?
CLOUD AND THE NEED FOR SPEED 28
5G AND THE CLOUD 29
GOING GLOBAL – INTERNATIONAL COOPERATION 30-31
A PARTNERSHIP MADE FOR THE CLOUD – INTERVIEW WITH ESTONIA’S PRESIDENT, TOOMAS HENDRIK ILVES 32-33
CLOUD COMPUTING IN HORIZON 2020 34-35
THE EUROPEAN CLOUD STRATEGY
THREE PILLARS/KEY ACTIONS:

KEY ACTION 1:
■ Cutting through the jungle of standards to promote interoperability and strengthen consumer confidence in cloud services. Standards are essential for seamless communication and data portability, they help avoid customer lock-in and promote competition.

KEY ACTION 2:
■ Safe and fair contract terms and conditions to build up fair and transparent practice for the provision of cloud contracts. This is needed not only for consumers and small firms, who are offered take-it-or-leave-it contracts, but also for service level agreements between larger corporations and public authorities.

KEY ACTION 3:
■ Establishing a European Cloud Partnership to drive innovation and growth from the public sector. The Partnership brings together industry expertise and public sector users to work on common procurement requirements. Pooling procurement requirements can bring efficiency gains and reduce costs for national budgets, while further strengthening interoperability.

UNLEASHING THE POTENTIAL OF CLOUD COMPUTING

Cloud computing gained pace in Europe during 2012 and 2013, and many services – such as web-based e-mail and social networks – are in the cloud. But it is still early days, and the impact of the cloud on business is expected to soar in coming years.

Businesses are set to benefit from cloud computing at two levels. It has the potential to reduce information technology costs, and it gives creative companies an opportunity to develop new and sophisticated IT services. Moreover, the Cloud Strategy has the potential to create an additional 2.5 million jobs in Europe, and to boost EU GDP by €160 billion (around 1%) by 2020.

As with the internet, cloud computing has been developing for some time and, from an IT perspective, will evolve further. But unlike the internet, cloud computing is at an early stage of development. This means that the various stakeholders can still influence the legal framework, ensuring that businesses and users are able to benefit from both the demand and supply side of cloud services.

The EU’s policy on cloud computing falls under the Digital Agenda initiative, and is based on the ‘Unleashing the Potential of Cloud Computing in Europe Strategy’, unveiled in September 2012. The overall goal is to make Europe cloud-active, as well as cloud-friendly, in order to stimulate the uptake of cloud computing to the benefit of customers and suppliers alike. The Strategy draws attention to priority areas such as safe and fair contract terms, standardisation and forging a partnership between industry and the public sector. Work over the last year has already borne fruit.

The Strategy took shape after thorough analysis of the overall policy, regulatory and technology landscapes within Europe. It was also the culmination of more than 18 months of broad stakeholder consultations.
CUTTING THROUGH THE JUNGLE OF STANDARDS

Under the Strategy’s first key action, “cutting through the jungle of standards”, the Commission will work with the European Union Network and Information Security Agency (ENISA) and other relevant bodies to assist in the development of EU-wide voluntary certification schemes for cloud computing (including data protection) and establish a list of such schemes by 2014.

Implementation began with the creation of an expert group on certification under the Cloud Select Industry Group (C-SIG), bringing together representatives from a number of cloud suppliers and other industry stakeholders. The group has already compiled industry recommendations on how to work with voluntary cloud certification schemes, as well as a list of existing certification schemes with cloud relevance.

Both were presented to the Steering Board of the European Cloud Partnership (ECP) at their second meeting in July 2013. ENISA will now work to streamline and validate this work.

The Commission has also invited ENISA to include certification actions in its work programmes for 2013 and 2014. ENISA has already produced a draft report on cloud certification and auditing from security perspective. It has also contributed to the mapping of cloud computing security standards in collaboration with the European Telecommunication Standards Institute (ETSI).

The Commission has also tasked ETSI with identifying the necessary standards for security, interoperability, data portability and reversibility, among other areas, by 2013. The Cloud Standards Coordination (CSC) process started in December 2012 with a view to producing a draft report on existing cloud standards, including their relevance to different stakeholders’ needs (SLAs, interoperability and security and privacy) by summer 2013. The preliminary report, listing more than 100 relevant use cases, was presented at a stock-taking meeting in April 2013. The final one was presented in December 2013. The ETSI CSC process was open to everyone.

SAFE AND FAIR CONTRACT TERMS AND CONDITIONS

Ensuring contract terms and conditions are consistent will increase consumer trust and thus encourage a wider take-up of cloud computing services. The Strategy calls for action not only at the level of consumers and small firms, who get take-it-or-leave-it contracts, but also at the level of SLAs between professional users.

Getting this off the ground, the Commission has started working with stakeholders to develop model contract terms and conditions that will facilitate cross-border transactions in the single market. A separate expert group, set up by the Commission’s DG Justice, has been asked to identify safe and fair contract terms and conditions for consumers and small firms using the cloud. The group had its first meeting in November 2013.

In February 2013, a sub-group on service level agreements was established within the C-SIG. The group began by drafting a checklist intended to help IT resource directors ask the right questions and get the right answers when procuring cloud services. The initial drafts were presented to the European Cloud Partnership Steering Board in July 2013. Since then, the group has agreed on an initial set with 11 attributes that define standard options for SLAs and contracts. Templates for service level agreements should be ready in the first half of 2014.

The Strategy gives the Commission a mandate to work with industry to agree on a code of conduct for cloud computing providers that will support a uniform application of data protection rules. A sub-group on code of conduct on data protection within the C-SIG involving representatives from cloud suppliers and other industry stakeholders, has drawn up a draft version. Now this version will be revised, sent for approval by the Article 29 Working Party and presented to the Commission by the end of 2014.

The Commission will also review standard contractual clauses applicable to transfer of personal data to third countries and will call upon national data protection authorities to approve the Binding Corporate Rules for cloud providers. The C-SIG will be actively involved in the revision of the standard contractual clauses.

THE EUROPEAN CLOUD PARTNERSHIP (ECP)

Also given “key action” status within the Strategy is the creation of a European Cloud Partnership (ECP). The initiative brings together industry experts and public sector users to work on common procurement requirements for cloud computing.

A high-level Steering Board representing EU countries and cloud service providers is advising the Commission. It is chaired by the President of Estonia, Toomas Hendrik Ilves, and includes 19 representatives from public and private organisations. The Steering Board provides advice on cloud computing to Commissioner Kroes.

At their 4 July 2013 meeting, the Board discussed the PRISM revelations and their possible fall-out for cloud computing in Europe. A major risk, due to a loss of trust, is fragmentation of the cloud market into separate national market segments. This would be a step backwards for the single market, for the critical mass needed to develop cloud computing fully, and for both European industry and customers.

The Steering Board in which six EU countries are present supported urgent action to shore up cloud computing adoption in a single and competitive market, alongside measures to ensure data security and confidentiality for the benefit of both users and suppliers.

The ECP Steering Board at their meeting on 14 November 2013 in Berlin welcomed an announcement on the pre-commercial procurement project “Cloud-for-Europe” (C4E). Within the project, funded under the ICT theme of the Seventh Framework Programme (FP7), a consortium of 24 public and private organisations will develop and test cloud computing procurement requirements. The C4E project was launched on 14 November 2013 in Berlin.
EUROPE ON THE CLOUD - THE WAY FORWARD

3.1 and 3.4 million jobs
potential for jobs created (directly and indirectly) over 5 years and 10 years respectively (Federico Etro)

370 000 new businesses
over 5 years and over 450 000 over 10 years
The largest impact is expected on sectors such wholesale, retail trade, real estate as well as other financial and business activities (Federico Etro)

~ 20% reduction in costs
for most organisations that adopt the cloud (IDC)
What is even more important is the change in cost structure that cloud brings. While one of the main obstacles for businesses (and market entry) is the high up-front and non-recoverable (sunk) costs necessary in terms of capital spending (CAPEX), the cloud allows companies to save on fixed costs related to ICT. This not only reduces barriers to entry and promotes business creation, but also promotes competition and job creation.

€940 billion
added to the EU GDP over 2015-2020 (IDC)

Access anywhere, anytime, from any device.
Unlimited computing power on demand.
Reduced capital investment in “on premises IT”.
Common IT solutions and standards.
Secure, trusted and competitive services.

CLOUD SELECT INDUSTRY GROUP

It is cloud computing users and suppliers who have the most up-to-date knowledge and expertise on both cloud technology and services, and on how the cloud market is developing. When implementing policies for such a young market, which is still taking shape, close collaboration with industry is indispensable.

Involving these stakeholders in the design and implementation of the European Cloud Computing Strategy makes obvious sense. The European Commission is making this happen through the Cloud Select Industry Group (C-SIG) and its subgroups, which were set up following the publication of the European Cloud Computing Strategy in September 2012.

The subgroups were tasked with providing key input on cloud computing certification, service level agreements and a code of conduct on data protection for cloud computing services.

Representatives from more than 50 different suppliers, cloud computing service users and other stakeholders have been collaborating in these subgroups throughout 2013. Concrete results are already visible. For example, the subgroup on the code of conduct drew up a draft version of a code of conduct on data protection for cloud computing providers, which has already been presented to the “article 29 working party” – an advisory body on data protection involving, among others, representatives of national data protection authorities – for feedback.

Moreover, the subgroup on certification mapped and analysed existing certification schemes for information security relevant to cloud computing, and produced a draft glossary of terms and definitions to be used in service level agreements.

A little over a year since the publication of the European Cloud Computing Strategy, the work of the C-SIG entered a new phase with the October 2013 plenary meeting. Stakeholders collaborating within the subgroups presented and discussed their intermediate results and looked ahead to the future. The European Union Network and Information Security Agency (ENISA) also attended, along with cloud computing service users.

Tangible results from the different C-SIG subgroups are expected in early 2014.

Overview of the EU Cloud Strategy and the C-SIG subgroups:
Cloud-for-Europe (C4E) is a key piece in the European Cloud Computing Strategy. The public sector initiative will investigate the cloud procurement requirements of public organisations using pre-commercial procurement across Europe. It is a double partnership, on the one hand between public sector organisations, and on the other with industry.

President Ilves and Vice-President Kroes were in town for the third meeting of the European Cloud Partnership Steering Board. This focused on the follow-up to the October 2013 European Council, in which Heads of State highlighted the importance of the work done by the European Cloud Partnership and called for the framework conditions for a single market for cloud services to be developed.

**THE IMPORTANCE OF TRUST**

The C4E launch conference was attended by about 200 participants, many of whom came from the private sector. The two days were sub-divided into six sessions. Opening keynote addresses were delivered by President Ilves, Vice-President Kroes and the German Federal IT Commissioner and State Secretary, Cornelia Rogall-Grothe. The second session focused on a single European market for cloud services. It was no surprise that trust and data security came out as overarching concerns.

Discussions explored the merits of economy of scale versus the relative safety of keeping data in domestic services. It is clear that a trustworthy cloud environment across Europe is a basic requirement for cloud usage to take off.

**COOPERATION AND DIVERSITY**

Another session focused on the public sector cloud across Europe. Many countries have already embarked on a variety of cloud initiatives: some have developed an overall policy; others have taken steps towards quick cloud adoption in small chunks, to ‘bootstrap’ the market. Some countries have sought to lay the foundations for trust and security, while others are working on providing the operational means for full-blown end-to-end cloud solutions. The Cloud-for-Europe initiative provides a cooperation platform where those behind the different approaches can come together to exchange experiences and consolidate best approaches and operational requirements for public sector adoption.

Obviously cloud computing is not only a market issue. It should also be adequately positioned within the digital service infrastructure. This was discussed in a dedicated session, with a focus on standards and the re-use of components from different areas and across borders – the future will bring a mix of cloud use models. Ensuring an open transition and growth path is a key priority for the public sector.

High tech SMEs are a key feature of Europe’s emerging cloud industry and most public administrations have a specific requirements and a local focus. Can Europe’s cloud SMEs therefore be the first to respond to the emergent demand for cloud sourcing government IT? In this context, session 5 addressed service provisioning models. Concrete examples presented at the conference illustrated that SMEs can be very successful in providing specific cloud services, spanning from infrastructure to brokering. Given the nature of the European IT landscape, the role of SMEs in cloud provisioning is of particular importance for the European economy and offers promising opportunities.
The conference was wrapped up with a look at the overall question of how to prepare the way ahead for the cloud in Europe. Although we are entering new territory, we can draw upon lessons learnt from past digital developments. Interoperability and security should be built in from the start, while data protection and compliance with relevant standards are inherent requirements, along with service level agreements and portability. Public sector procurers can and should be a driving force for a trustworthy European cloud space. And SMEs should tailor their services to satisfy customer needs.

**EPILOGUE**

An important objective of the European cloud strategy is to create an environment that helps public sector organisations to procure cloud computing services within a dynamic single market. The objective is not to regulate this market, but to mobilise it, to help the public sector to procure in an informed manner and get maximum value for money.

The C4E initiative has to be seen in this light. The public sector has to make well-considered procurement decisions and put forward requirements that drive technological and business decisions towards the use of best-available-technologies at competitive prices. This is what C4E is about, as a partnership between public sector organisations across Europe and using pre-commercial procurement with industry. Usage scenarios and service catalogues for cloud adoption are in development.

The next steps will be to transform these insights into specific work streams and requirements for the Cloud-for-Europe initiative, and the conference was very enriching in putting all the issues and options on the table.

Further reading:
SAFE AND FAIR MODEL SERVICE CONTRACTS TO BOOST CLOUD COMPUTING

The heads of informatics departments regularly exercise tight control over the technical specifications for traditional on-premises or outsourced IT data storage and processing facilities and services. But taking full advantage of cloud computing, in terms of near-infinitely scalable and flexible IT capabilities, requires considerable acceptance of off-the-shelf services.

As a result it is more difficult to specify the exact service offer; and this, combined with reduced legal certainty for the customer, cedes direct control over data centres. It also makes the specification of service level agreements (SLAs) and eventual contracts with cloud providers different and therefore challenging for corporate cloud buyers.

TAKE IT OR LEAVE IT?
What are these challenges? There may be unforeseen costs and risks hidden in the terms and conditions of such services. The use of “take-it-or-leave-it” standard contracts might be an optimal cost-saving solution for the provider, but they are not necessarily the best option from the customer’s perspective. Standard SLAs often fail to address the operational and legal risks inherent in cloud-based service offerings. For example, they may not deliver the right performance outcomes, or might shift many significant risks to the customer.

The Public Consultation Report on Cloud Computing was drafted by the Commission during the preparation of the Cloud Computing Strategy. This document and the results of the study “Quantitative Estimates of the Demand for Cloud Computing in Europe and the Likely Barriers to Take-up”, underline that the need for SLA model contracts at the European level is shared across all respondent groups. This is addressed by the second “key action” within the European Cloud Strategy which calls for the identification and development of consistent solutions for contract terms and conditions to increase consumer trust, and thus encourage wide take up of cloud computing services. The Strategy states that this should be done not only at the level of consumers and small firms, who are offered ‘take-it-or-leave-it contracts’, but also at the level of service level agreements between professional users.

STAKEHOLDER INVOLVEMENT – EXPERT ADVICE
To get key actions in place, the Commission has started to work with industrial stakeholders to develop model terms and conditions for SLAs with the aim of facilitating cross-border transactions in the Single Market.

In February 2013 a subgroup of the Cloud Select Industry Group (C-SiG) on Service Level Agreements was established (see pages 5 and 7). The subgroup is drawing up a checklist intended to help IT resource directors ask the right questions, and to make sure they get the right answers when procuring cloud services. The initial drafts were presented to the European Cloud Partnership Steering Board in July 2013. The initial set of 11 important attributes to define standard options for SLAs and contracts were agreed by the group. The main goal is to develop the templates for service level agreements and present them to the Steering Board in the first half of 2014.

In parallel, the Commission set up an expert group in summer 2013 to work on safe and fair conditions for cloud computing contracts. This will make it easier to improve contractual arrangements for consumers and small firms. The group has had the first meeting in November 2013, where main fields for the future discussion were identified. The main aim of this group is to identify best practices for cloud computing contracts for consumers and small firms and work towards ensuring that terms and conditions in cloud computing contracts are safe and fair.

---

4 http://ec.europa.eu/justice/contract/cloud-computing/index_en.htm
What’s up in cloud policy?

**Driving competitiveness, creating jobs**

With data production growing by a staggering 40% every year, it is clear that we have entered the era of Big Data. It has even been said that we now create the same volume of information every two days as was created between the birth of civilisation and 2003!

From the retail sector, to transport, financial services, health, energy and manufacturing – Big Data can generate value. The advent of technologies able to analyse these data can make information more transparent and usable, provide a more detailed picture of performance or customers (allowing more tailored products or services) and increase the accuracy of forecasting.

**Keeping up with the cloud**

But technological progress alone is not enough to ensure Europe’s economy makes full use of data. During the ICT 2013 Conference, European Commission Vice-President Neelie Kroes called for a European public-private partnership on Big Data to create a coherent European data ecosystem that stimulates research and innovation around data, as well as the uptake of cross sector, cross-lingual and cross-border data services and products¹. This should improve data use, potentially transforming Europe’s service industries and significantly increasing their efficiency. The value of data will then be translated into growth and jobs, which ultimately benefit the entire EU economy.

Public authorities are also prolific data producers and users, and the cloud presents an opportunity to procure services cost effectively, share data efficiently with other agencies and make public data freely available to citizens – a concept known as ‘Open Data’. The Commission has been proactive here, recently revising its Public Sector Information Directive to facilitate data re-use and limit charges.

For any organisation to use such extensive datasets meaningfully, it requires secure networks able to distribute large amounts of data in real time – and a storage solution. Cloud computing storage is both efficient and affordable. To keep up with the explosion in data, the European software industry must now develop new skills, advanced technologies and innovative business models. In human capacity, Europe has some catching up to do – while the number of digital jobs is growing by more than 100 000 every year, the number of ICT graduates and skilled workers is shrinking.

**Skilling up for the digital age**

It is estimated that Europe’s ICT sector will be looking to fill 900 000 vacancies by 2015, and many of these in cloud computing, where a new generation of innovative start-ups is flourishing.

The European Commission has launched a Grand Coalition for Digital Jobs. Seeking to get some of Europe’s 26 million unemployed into work while simultaneously preparing the continent for the soaring demand for ICT skills, the initiative asks companies to make pledges in five key areas:

- Training and matching for digital jobs to ensure skills meet business needs;
- Helping those with skills work where they are needed, avoiding shortages and surpluses in different locations;
- Recognising qualifications, regardless of which country awarded them;
- Raising awareness of the rewarding opportunities within the digital sector;
- Upgrading education systems so that more people have the opportunity to acquire ICT skills.

Action here will benefit businesses in view of the returns that cloud computing will bring. Small companies in particular will see significant savings in software and computing, and will be able to tap into computing resources when needed without making upfront large capital investments.

Advanced and sophisticated attacks with high-profile targets often make the media headlines. Famous examples include:

- **2009**: Operation Aurora was a complex attack on Google, Adobe, Juniper, Rackspace and Yahoo aimed at modifying the source code (the crown jewels); the attack shocked the industry.

- **2010**: Stuxnet – a sophisticated virus, spread via USB, that targeted Siemens programmable logic controllers (PLCs) used in Iranian nuclear fuel enrichment plants.

- **2011**: Millions of euros were stolen from the EU's carbon emissions trading accounts via simple spear-phishing for passwords in 2010. Just a year later, after additional log-in security had been added, the site was hacked again, with a further 30 million euros being stolen.

- **2013**: Adobe was forced to warn almost 3 million customers that their credit card details had been stolen. Around 40 gigabytes of source code were also stolen. Note that in these examples we mention specific companies and products, but this is not to suggest that these companies have weak security practices or that other companies have not had security breaches.

**EXPLOITING WEAKNESSES**

Most cyber attacks are quite mundane and do not make the media headlines. They are carried out with off-the-shelf tools, targeting normal citizens and small and medium-sized enterprises. PCs are fairly easy to infect (even with up-to-date antivirus software), making them an easy entry point for large-scale online bank robberies. High Roller (2012) showed how fraudsters have come when they were able to steal roughly 60 million euros out of bank accounts. These coordinated attacks were:

- highly automated – automatic victim search, fast attacks;
- smart – circumventing banking sites' two-factor authentication schemes;
- targeted – but in an automated way; only business accounts with high balances were targeted, in an attempt to stay beneath antivirus companies' radars.

Following the High Roller case, the European Union Agency for Network and Information Security (ENISA) issued a blunt recommendation, which was echoed widely: "banks: assume user PCs are infected".

In addition to problems with securing end-users' PCs, the connection between a PC and a website can also be attacked:

- The implementation of HTTPS is quite vulnerable to attack, and the safety net (warnings, revocation, et cetera) is not adequate. This provides opportunities for 'man-in-the-middle' (MitM) attacks like in the Diginotar case. The impact on Iranian citizens is not known, but it is feared that private conversation of Iranians were wiretapped. Mikko Hyponen of F-Secure, for example, argued that people probably died as a consequence of the attack.

Also many websites are vulnerable to attack. Tactics include SQL injection (malicious structured query language statements are injected, for example giving instructions to transfer data to the attacker) and XSS (client-side scripts are manipulated so that a website functions in a different way). Infamous examples of breaches of websites include:

- **2011**: A group of hackers calling themselves LulzSec carried out a 'hack-a-day' for 50 days, demonstrating that even government organisation sites were easy to hack into. Hacks often started with SQL injection.

- **2011**: In the Netherlands, after a series of government sites were breached, journalists renamed October 'Hacktober', reporting on a new security breach every day of the month.

- **2012**: Millions of weakly hashed LinkedIn passwords were found on auction sites.

As governments, companies and individuals increasingly use and rely on network and information systems, the frequency of security breaches is increasing and also the impact of such incidents. This has put cyber security at the top of the agenda in many EU countries.
What's up in cloud policy?

A lot of work remains to be done: we are learning that it is hard to implement network and information systems securely. On a more positive note, there are new ICT products and developments which offer important opportunities for improving security. Smartphone and tablets, for example, have a special way of delivering software to end-user devices: appstores. In the smartphone/appstore model apps are first reviewed and checked before users can install them. This could prove an important security benefit. Social media reputation systems (if implemented securely) can be used to establish better trust between users on the internet.

SECURITY OPPORTUNITIES IN CLOUD COMPUTING

Also cloud computing presents opportunities to reduce security risks. In the past, customers would mostly run their applications on local servers, on their own premises. In such a setting the burden of securing systems, patching, updating, hardening, falls on the customer. But in cloud computing IT is outsourced and consumed online, as a pay-as-you-go service. While this does introduce security risks, the cloud also presents security opportunities, as highlighted in ENISA’s 2009 cloud computing risk assessment.

Generally speaking, cloud providers can implement high-end security, while spreading the costs across multiple customers, making them more affordable. Measures include: geographical spread datacentres; spare resources for rapid scaling and usage peaks; continuous monitoring and 24/7 incident response teams; and secure software development processes. Japan, for example, promotes cloud computing as a way to bolster resilience to major natural disasters.

Of course, that does not mean that cloud computing is without risk. ENISA’s past cloud papers provide guidance on how to procure cloud services securely. For SMEs, for example, the main risks arise during outsourcing due to a lack of governance and control. When outsourcing, it becomes more important to have clear agreements, inter alia on security and liability.

ENISA’S CLOUD COMPUTING WORK

To increase the adoption of cloud computing in Europe, the European Commission issued a cloud strategy in 2012. Recognising that security is a key concern for cloud customers, ENISA works closely with the Commission to support this strategy. This year the agency will publish white papers on securing governmental clouds and incident reporting for cloud services. ENISA is also working with the Commission and industry to support the use of voluntary certification schemes for security. Cloud services are also gaining relevance from a CIIP perspective (Critical Information Infrastructure Protection). The adoption of cloud computing effectively moves multiple IT resources to a (smaller) number of platforms and datacentres (see diagram). Security might be less expensive this way, but if attacked, the impact could be high. The incident with Tieto, a Swedish ICT provider, is a good example – following a security incident in 2011, pharmacies across Finland could not operate for weeks. The proposed EU directive on network and information security mentions large cloud providers as potentially critical for the digital society.

Always when there are new IT products and developments, it is tempting for information security professionals to focus on the new risks. But it is important not to forget the security risks of existing technology. This is not the time to stay put. ENISA will continue to work with industry and government experts to help customers leverage the security opportunities of cloud computing, and at the same time mitigate the risks.

Startups are an engine for economic growth, but getting them off the ground has traditionally required more than entrepreneurial spirit. Would-be entrepreneurs needed capital to hire talent, to market their idea, to hire office space and to invest in materials or technology to make an idea happen.

Web entrepreneurs have a distinct advantage over their older style counterparts because their activities require much less infrastructure. And now that they can tap into the cloud – a key enabling technology – even technology requirements have diminished. Some startups are not just using the cloud, but providing cloud services themselves.

It is therefore unsurprising that web entrepreneurship is gaining pace. According to the Boston Consulting Group¹, the internet economy in G-20 countries will grow at an annual rate of 8% over the next five years. In developing markets, annual growth is expected to be even higher, at 18%.

SUCCESS STORIES

Looking to lift Europe out of the current economic downturn, the EU is stepping up its support for startups, innovators and entrepreneurs, which have the potential to boost innovation and economic growth, creating thousands of jobs along the way.

European success stories include:
- Greenclouds (www.greencloudsonline.com) – the Netherlands – maximising spare capacity on cloud servers;
- Catchoom (www.catchoom.com) – Spain – an image recognition provider for augmented reality, gaming, publishing, retell etc.;
- Dream Broker (www.dreambroker.com) – Finland – an online company offering cloud-based software for creating, editing and sharing videos online.

A HELPING HAND

With its StartupEurope initiative (http://ec.europa.eu/digital-agenda/en/startup-europe), the EU is supporting web entrepreneurs by raising awareness and visibility, networking relevant actors across Europe and improving the structure of the EU’s web landscape. Notable achievements include:

- The Leaders Club – a group of leading European tech-entrepreneurs that has published a Manifesto for entrepreneurship calling on the European Commission and national governments to take action in 22 key areas that will help more web-entrepreneurs achieve success.
- Two prizes have boosted the visibility of web businesses. TechAllStar (http://techallstars.eu/) selects 12 promising European startups and takes them to Europe’s biggest startup events. Europioneers (http://europioneers.com/) recognises Europe’s best tech-entrepreneurs.
- Support for networking opportunities by bringing together:
  - startup accelerators (programmes offering funding, office space, design support, marketing, mentoring etc.);
  - investors;
  - relevant corporations and education organisations.

Crowdfunding and co-working space networks also provide valuable support, while a visual mapping of the startup ecosystem in Europe will help policy-makers direct support where it is needed most.

The Commission also earmarked €100 million for small companies and web entrepreneurs looking to use innovative internet technologies for new services and applications. The funding was released with one of the final Seventh Framework Programme (FP7) calls for proposals, from the public-private-partnership on the “future internet”.

This trend is also set to continue under the next research framework programme – Horizon 2020. A €10 million call for proposals targeting web entrepreneurs will be published in 2014, falling under the ICT section of the “leadership in enabling and industrial technologies” pillar of Horizon 2020.

¹ BCG, The $4.2 Trillion Opportunity – the internet economy in the G-20, March 2012
**WHAT LINKS WITH OTHER AREAS AND POLICIES?**

**HOW GREEN IS THE CLOUD?**

While the cost of computing power is decreasing every year, the cost of energy is not. In the future, it is expected to account for a significant share of the cost of owning and running a computer.

The Digital Power Group estimates that the world’s ICT ecosystem uses around 1,500 TWh of electricity, which is equal to the entire electric generation of Japan and Germany combined – and as much electricity as was used for global illumination in 1985\(^1\). Coal is the world’s largest source of electricity.

Is the cloud the answer? The energy costs of transferring data can be high, while the installation and electricity costs of running data centres can be steep. The power used by PCs, tablets and smartphones to download data from the cloud must also be factored in.

But by optimising the use of both equipment and cooling (which eats up a significant share of the energy consumed – from data centre air conditioning to a PC’s fan), the cloud can help reduce the environmental impact of computing. And the advantages of pooling are growing: technological developments mean that one server is now able to carry out multiple workloads simultaneously.


**NEW TOOLS FOR GREENER SOFTWARE**

While computer manufacturers have sought to slash the environmental footprint of hardware – with success – for decades, attacking energy consumption from the software side is relatively new, and has so far focused predominantly on extending battery life for mobile devices.

The EU-funded ASCETIC project (www.ascetic.eu) is designing novel methods and tools to help software developers optimise energy efficiency and minimise the carbon footprint created by designing, developing, deploying and running software in the cloud.

The goals include models for green and efficient software design, parameters and metrics for energy efficiency, and new methods to measure energy use in software development.

By the time the project finishes in 2016, the team will have created an open-source cloud stack (infrastructure-as-a-service platform) providing energy efficiency at software, platform and infrastructure layers.

In the meantime, models and methods will be tested in two real-world applications:

- an end-to-end multimedia cross-channel solution for news agencies, broadcasters and publishers that handles large volumes of information;
- a product life-cycle management system for the building sector enabling the design and construction of prefabricated buildings using collaborative software.

**TACKLING NEW ENVIRONMENTAL CHALLENGES – THE POLICY APPROACH**

The EU’s mission to reduce the environmental impact of ICT is not new. Back in 2009 the European Commission called on industry to implement a “progressive decarbonisation process” to reduce the energy intensity and carbon emissions involved in production, transport and sales of ICT equipment and components.

But the onus is not only on industry to think green. Turning attention to the cloud, the Commission called on governments in 2012 to “address the environmental challenges of increased cloud use by agreeing, with industry, harmonised metrics for the energy consumption, water consumption and carbon emissions of cloud services by 2014.”

With its Communication “Unleashing the potential of cloud computing in Europe” (http://ec.europa.eu/digital-agenda/en/european-cloud-computing-strategy), the Commission stressed the need for comparability between the energy reporting methods used by cloud service providers. This is needed to assess the overall impact of increased data flow and cloud computing on the environment.

International standards are beginning to appear, and around 30 major ICT-players have voluntarily tested those designed to measure environmental footprint. But while some organisations are using international standards, the pace of deployment is slow.

So far, efforts have focused on standards for measuring the ICT-sector’s footprint. DG CONNECT has worked with DG Environment to ensure ICT-specificities are preserved in any future legislation.

The Commission is also investing in research to reduce the cloud’s carbon footprint. The hope is to reduce the electricity consumption of the large data centres behind the cloud, and to make both hardware and software more efficient. Breakthroughs in each area will, together, make Europe the home of green computing.
Governments have been using ICT for several decades, but are often doing no more than imitating old procedures online. They are also timid in their approach to cloud services, as the EU-funded study conducted by IDATE and Technopolis on ‘Analysis of cloud best practice and pilots for the public sector’ shows. This means they are not reaping the benefits: a significant reduction in upfront installation costs, lower IT maintenance outlays, up-to-date software, and more efficient use of computing resources.

The economic crisis is an opportunity for the public sector to overhaul how it uses ICT – to adapt internal processes while reducing its administrative burden and carbon footprint. The impact will be felt among citizens, companies dealing with the public sector and civil servants.

The countries examined by the consortium (Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Portugal, Spain, the UK) have prioritised different applications, adopting either a citizen or employee focus, and opting for vertical, critical or sensitive approaches. Choices also vary on type of infrastructure (public or private cloud), relationships with e-government applications (development from scratch or migration of existing applications), and global policy.

The study clusters the approaches into three models: procurement and marketplace; resource pooling; and standalone applications. They differ mainly at the levels of infrastructure and centralisation, implying a trade-off between level of control (to ensure better technical performances or security) and short-term savings.

**THE PROCUREMENT AND MARKETPLACE MODEL**

relies on a procurement framework that makes it easier to purchase cloud solutions in the marketplace.

**Where?** Operational in the UK. The Netherlands and Portugal are developing a similar model.

**Approach:** Cost savings and improving the local economy through getting local cloud suppliers more involved. The general philosophy is to turn to the market to boost cost savings, through external providers’ applications and even infrastructure (this model mostly uses the public cloud). Standardised processes and procedures increase efficiency, which is easier to monitor in terms of actual adoption and savings targets.

**THE RESOURCE POOLING MODEL**

involves a common central infrastructure and/or platform that reaches across administrations.

**Where?** Spain, with numerous applications around the Sara (public administration) Network. Also deployed in France, Belgium and the Netherlands. Projects in other countries do not yet have the right breadth in scope and ambition to adopt this model.

**Approach:** The priority is to get the private cloud infrastructure right first, allowing for later developments to support critical or sensitive applications. The common infrastructure should facilitate cooperation between ministries, and lead to higher savings in the long term through the amortisation of infrastructure and scale economics.

**THE STANDALONE APPLICATIONS MODEL**

refers to isolated applications developed by individual ministries. There is no real central coordination (even when a central policy exists).

**Where?** Denmark and Italy, and to a lesser extent Germany and Austria (small projects like e-mail), France (Chorus) and the UK (NHS).

**Approach:** In most cases, ‘cloudification’ of existing applications is the priority. Applications may have advanced features, often implying advanced requirements and requiring back-up systems. Adopting the cloud is driven by cost savings. Investments are generally limited as there is no need to start from scratch. Projects are only launched when return on investment and the potential of scalability have been identified. This model is pragmatic and allows for faster development, at least in the short term. This is the model followed by the majority of projects today.

---

Today's internet is at a crossroads. In addition to the rise in users and the interactions between them, the way in which we use the internet is evolving to take account of new developments, from big data and content, to the Internet of Things, cloud computing and the Internet of Services. Such developments will take us to a new era of digital societies and economies based on agile, adaptive and dynamic collaboration between organisations, communities and individuals with ubiquitous and instantaneous access to information.

The challenge for Europe is to maintain its leading role in research on cloud computing, software and services. Pioneering work in these areas can promote European industry's competitiveness and promote growth and jobs throughout the European Union. From 2007, when the first FP7 call was launched, 97 projects under the areas of software engineering, Internet services and cloud computing were funded with a total of €356 million.

The main goal has been and remains accelerating the development and deployment of cloud computing and increasing Europe's ability to design and deliver innovative internet services.

Over the past seven years, research and innovation projects in these areas have spearheaded the development of novel cloud architectures and technologies introducing, among other innovations, intelligent resource management and agile elastic scalability.

Furthermore, several research activities have focused on the implementation of advanced service platforms which exploit the capabilities of innovative software engineering tools and methods in order to deliver composite internet and cloud services. In addition, particular attention was given to the development of open source software solutions.

Research activities were framed by a large set of Coordination and Support Actions. Such activities were focused on collaboration among research projects, standardisation, training, outreach and dissemination in the areas of cloud computing, software and services.

Two of our current projects are funded under the Competitiveness and Innovation Framework Programme (CIP). Both focus on mobile business applications using the cloud, see descriptions on page 22.

The following pages present just some of the projects funded in these areas under FP7 and CIP.

For more on FP7 projects in the areas of software, services and clouds, see https://ec.europa.eu/digital-agenda/en/node/6287
What's up in cloud research?

OpenNebula has played an important role in driving and supporting the transition to cloud computing and thus accelerating the pace of innovation in Europe.

A technology spin-off of the FP7 Call 1 project RESERVOIR, OpenNebula (http://opennebula.org) started initially as a University of Madrid initiative in 2005 before transforming into the open-source community ‘OpenNebula.org’ two years later. Its many innovative features address the business requirements of leading companies across multiple sectors.

Through a series of EU-funded cloud research projects, OpenNebula has now been enhanced with new functionalities. For example, StratusLab extended the platform to address the needs of supercomputing and grid sites, while 4CaaSt is improving elasticity and quality of service.

Additionally, OpenNebula is being used as reference open stack for cloud computing in several large research and infrastructure projects, such as BonFIRE, EGi or Helix Nebula, which are building pan-European multi-cloud infrastructures.

OpenNebula is a very active open-source project with a large user base: more than 5 000 downloads per month and thousands of deployments, including by industry leaders and leading research and supercomputing centres. Development is driven by its community, which is best placed to determine desirable features, and also by other international research projects.

Crucially, OpenNebula has played an important role in driving and supporting the transition to cloud computing and thus accelerating the pace of innovation in Europe. Many large companies, research centres and public entities are using OpenNebula to cut costs, to improve their existing IT services, or to support new innovative services.

OpenNebula is also an open cloud enabler – it is helping many smaller players in the ICT industry, mainly SMEs, to be cloud active by lowering the barrier to entry and thus enabling companies to build their own cloud. In many cases, paying a licence fee for commercial software is simply not an option, so the choice comes down to open-source cloud or no cloud.

Find out more at the next OpenNebula conference, taking place from 2 to 4 December 2014 in Berlin. Not sure what to expect? Check out the blog on the September edition http://blog.opennebula.org/?p=5268

Helix Nebula

Scientific research is entering a new era: unprecedented amounts of data, together with near-infinite computing power, are accessible to researchers all over the world through e-infrastructures. This new era is characterised by a new paradigm: e-science. Computation-intensive science involving analysis of massive data sets, e-science is making possible discoveries that otherwise would remain elusive to humankind. The cornerstones to this new chapter in the history of science are distributed computing and data infrastructures.

Very aware of the benefits of cloud computing for e-science, the Helix Nebula project was launched by key European players to challenge the approach to e-infrastructure deployment that has dominated over the last 25 years.

Cloud-based services for science could become a billion-euro-business in the near future.

Within the Helix Nebula project, the European Organisation for Nuclear Research (CERN), the European Molecular Biology Laboratory (EMBL) and the European Space Agency (ESA) – together with industrial stakeholders – have deployed three pilot applications in the cloud:

- EMBL is developing a portal for the cloud-supported analysis of large and complex genomes that will facilitate genomic assembly and annotation, allowing deeper insight into evolution and biodiversity across a range of organisms.
- ESA is developing the SuperSites Exploitation Platform, which enables the analysis and interpretation of the large datasets needed to understand the processes behind geohazards such as earthquakes and volcano eruptions.

These three pilots have opened the door to new target domains for the science cloud. Three new applications are in the pipeline for deployment in three different scientific fields: weather forecasting, oceanic research and neuroimaging. Helix Nebula currently involves more than 35 organisations and foresees expansion to include more public and private sector partners.
OPTIMIS

The OPTIMIS project developed an ‘infrastructure-as-a-service’ software package enabling organisations to externalise services and applications to ‘best-execution venues’ in the cloud. The results cover the full cloud service lifecycle (service construction, cloud deployment and operation).

The project’s results, known as the “OPTIMIS Toolkit”, can be divided into three main groups:

- **OPTIMIS Base Toolkit**, with general functionalities, including an integrated development environment (IDE) and programming model, and which takes into account trust, risk, eco-efficiency and cost (TREC);
- **OPTIMIS Service Provider Tools** that enable service providers to implement, package, deploy and operate services;
- **OPTIMIS Infrastructure Provider Tools** able to manage the infrastructure (virtual machines, servers, data storage, etc.) required to operate services.

The Programming Model and IDE enable OPTIMIS users and companies of all sizes to build and run cloud services in the most appropriate venue. Quality of service is evaluated using a range of technical and non-technical factors provided by the OPTIMIS TREC Engine.

OPTIMIS gives service providers the option to either orchestrate cloud services from scratch, run legacy apps on the cloud, or make intelligent deployment decisions based on how they prioritise trust, risk, eco-efficiency and cost. Together, the tools reinforce security, compliance with data protection rules and green legislation. They also give service providers the option to develop once, and then deploy services across all types of cloud environment – private, hybrid, federated or multi-cloud.

Using OPTIMIS can introduce huge efficiency gains. Infrastructure management is simplified as most processes are automated. But importantly, control over decision-making is retained. The various management features within the toolkit make infrastructures adaptable, reliable and scalable. Organisations may easily use both multi-cloud and federated cloud infrastructures, which means they may use resources from multiple providers as they see fit in a transparent, interoperable, and architecture-independent fashion.

[www.optimis-project.eu](http://www.optimis-project.eu)
SRT-15

Cloud computing allows companies to use computational resources without having to invest or even maintain their own data centres. This creates plenty of new business opportunities. However, the flexibility of cloud computing comes with a price as data must be encrypted in order to prevent data leakage. Encryption, and in particular processing encrypted data, imposes a great deal of effort for many companies using cloud resources, leaving many potential business opportunities unexploited.

Within the SRT-15 project, the consortium developed a content-based publish-subscribe system targeting the public cloud environment and guaranteeing privacy through encrypted data processing as well as availability, i.e., preventing data loss through novel fault tolerance techniques. The University of Dresden has established a start-up exploiting these promising results through its StreamMine3G platform: https://streammine3g.inf.tu-dresden.de.

The objective of the SRT-15 platform was to develop a highly efficient and dependable content-based publish-subscribe system that does not reveal any details of the processed data. The system is highly scalable and can adjust to fluctuating workloads when dealing with large volumes of highly dynamic data as well as tolerate faults.

PRIVACY

Privacy within the SRT-15 platform is ensured through homomorphic encryption – a specific form of encryption that allows different parties to work with data on a shared platform without being able to access or even unencrypt other participants’ data. Such data originates from various types of data sources and is processed within the SRT-15 platform in a secure manner and then sent to sinks located across the globe.

DEPENDABILITY

The continuously increasing number of components within computer systems, alongside the growing volume of data being processed daily in such systems, increases the risk of hardware as well as software failures. An error in a single component can generate and reproduce catastrophic failures in complex systems. The SRT-15 consortium developed appropriate algorithms to protect such systems from errors through early detection preventing the propagation and corruption of data.

FLEXIBILITY AND EFFICIENCY

Today companies face a flood of data originating from various applications and services, ranging from simple RFID events to complex business events or financial transactions. In such scenarios, the data processing platform layer does not always know in advance the volume of data to be analysed in real time. The team addressed this challenge using the flexible and elastic architecture of Complex Event Processing (CEP) technology to process high volumes of fluctuating data in real time and efficiently.

http://srt-15.unine.ch/technology

MOSAIC

App developers need no longer select one cloud service provider – and its range of facilities – at development phase thanks to the open-source platform developed by the mOSAIC project. Too often, a developer selects a particular provider, only to find that services needed later are not available. The app must then be re-configured. With mOSAIC, developers are able to select the most appropriate cloud service at deployment phase.

Using mOSAIC’s Cloud Ontology, its Semantic Engine, its vendor-agnostic application processing interface (API) – which specifies how some software components should react with one another – application developers can specify service requirements and communicate them to the platform.

The Cloud Agency acts as a multi-agent broker, searching for services and matching them with those needed by the application. App developers and maintainers are even able to postpone their decision on cloud service procurement until runtime. Applications benefit by being matched with the best-fitting cloud services.

The platform steps up competition between cloud providers, but also gives returns in the form of an opportunity to reach previously unreachable customers. The platform also offers a solution to vendor lock-in, which is discouraging the adoption of cloud computing on a large scale.

mOSAIC is one of the first multi-Cloud resource management platforms to help developers implement portable applications. Compared with the few alternatives on offer, it has the advantage of being a mostly open-source solution. This is expected to be of interest to academic institutions and their spin-offs as a means to deploy experimental cloud environments on their premises and then seamlessly move results into real cloud environments during the production phase.

mOSAIC is primarily targeting cloud resource consuming app developers such as SMEs and bigger cloud application providers, cloud consumer industries, public authorities (especially those responsible for the procurement of cloud resources and services), open source developer communities, and individual cloud developers such as researchers, computer science students and teachers.

http://mosaic-project.eu
CumuloNimbo has solved the issue of scalability of transaction processing in cloud computing. Current cloud computing practices sacrifice data consistency for scalability, increasing the complexity of building applications on top of such platforms when strong consistency guarantees are needed.

With CumuloNimbo, companies will drastically reduce the complexity of the applications they develop, as well as related personnel costs for developing and maintaining applications. This is thanks to the transparent scalability for transactional data management provided by CumuloNimbo.

The project ended in September 2013. Project coordinator UPM, together with other project partners, is now setting up a start-up to commercialise the results:

**Transparent ultra-scalable transactional processing for cloud data management** – Current cloud computing infrastructure is not able to scale with transactional processing and so loses transactional properties. Companies incur high personnel costs due to the higher complexity of developing cloud applications without transactional support. Using CumuloNimbo’s results, companies developing cloud applications will scale their transactional data management in a totally transparent way, resulting in significant cost-cutting for cloud application development.

**Scalable SQL processing** – Many companies developing cloud applications have opted for NoSQL data stores to circumvent the lack of scalability of regular SQL databases. However, this approach increases the costs of cloud application development due to the lower level interfaces provided by NoSQL data stores and their lack of powerful query capabilities. Using the CumuloNimbo technology, cloud application development companies will be able to perform full and powerful SQL queries and scale their workloads. This will result in a significant drop in development time and costs for cloud applications.

**Highly concurrent NoSQL data store** – Current NoSQL data stores such as HBase (used by Facebook, Yahoo, etc.) are optimised for offline batch processing. When they are used for online workloads they exhibit low concurrency, which forces the use of many more nodes than needed for a given load. The new NoSQL data store created in CumuloNimbo has been designed for online workloads, so companies are able to reduce the number of nodes used and save computational resources in the pay-per-use public cloud model. This cuts costs for cloud resources.

[www.cumulonimbo.eu/](http://www.cumulonimbo.eu/)
CIP PROJECTS
MOBICLOUD & MO-BIZZ

Mobile clouds integrate cloud computing and wireless networks to improve the functionalities of mobile devices. Their evolution has been triggered by the growth of the mobile application market and the demand for more sophisticated applications that require more processing power. There is certainly a focus on the consumer market, but mobile applications have a growing importance for business processes management.

Mobile clouds provide new business opportunities for both mobile operators and cloud providers, as well for innovative SMEs, which are the main players in the development of mobile applications. Many obstacles to widespread take-up do however remain. These range from efficient management of data traffic to interoperability across platforms and devices; security and privacy issues; and a lack of skills and training needed to create a large community of developers.

The linking up of distributed cloud infrastructures and machine to machine (M2M), sensor networks and the Internet of Things (IoT) is also leading to interesting research and market opportunities.

In the context of the EU’s Competitiveness and Innovation Programme (CIP), a small call for proposals was launched in 2012 and two projects were selected for funding: MobiCloud and MO-BIZZ.

Expectations are high. The projects’ results have the potential to become best practices that trigger further deployments and research in this area under future Horizon 2020 calls.

MOBICLOUD

MobiCloud focuses on mobile applications for business-critical scenarios, incorporating context-aware data based on the user’s situation. The team looked in particular at industries where collaborative mobile applications can support more efficient organisational processes – for example, by optimising the dispatch of workers in the field based on real-time information.

The project is developing four showcase examples addressing different industrial applications (city transit, rail operations, interim staff management and construction) in which end-users equipped with smartphones or tablets can access a portfolio of services stored in the cloud. MobiCloud provides a composite screen (mobile mash-up) that aggregates data from various corporate IT systems. Depending on context (location, role, skill set, available colleagues, etc.), the application displays different services that react in real-time to changes (work orders, fault reports, alerts).

The MobiCloud consortium has already released a new software development toolkit (SDK) that enables developers to create cross-platform and context-aware mobile workforce applications in the cloud.

MO-BIZZ

MO-BIZZ is seeking to step up cloud computing support for mobile business applications. Their use cases focus on sectors with a need for real-time business processes and intelligence: construction, energy, retail and transport. The problem today is the lack of a simple technology framework that allows businesses to rapidly develop and make services available to customers using cloud-based mobile services. MO-BIZZ is trialling this new mobile, cloud-based service paradigm based on the innovative re-use of technology already available to the partners, and it is developing a business model and rapid service configuration capability.

The MO-BIZZ vision is to launch a European cloud platform for business apps, to build a strategic global approach to the mobile cloud, and to forge efficient cooperation that creates a vibrant community of developers.

The project involves two main communities of users:

- App developers and IT providers that want to deploy their business apps and access mobile network assets with minimal effort, adding value to the services they provide to their customers;
- Companies from key industries (especially SMEs) interested in understanding how to make the most of mobile cloud applications as productivity boosters and wishing to adopt mobility as a way to enhance competitiveness.

www.mobizz-project.eu
The ICT event is organised every two years by the European Commission’s Directorate-General Communications Networks, Content and Technology (DG CONNECT). It brings together researchers, policy makers, academia and others from all over Europe. The event offers many opportunities to discuss, experience and showcase results from projects under the EU’s Research and Innovation Framework Programmes.

The event showcased projects and results from the Seventh Framework Programme (FP7) and the Competitiveness and Innovation Framework Programme (CIP) that both finished at the end of 2013. It was also a great opportunity for the Commission to introduce its new research and innovation programme Horizon 2020, focusing in particular on its ICT activities.

ICT 2013 took place in Vilnius, Lithuania, and was prepared in close and fruitful collaboration with the Lithuanian Presidency of the EU Council. With more than 5 000 participants, it is clear that there is a real interest out there in DG CONNECT’s activities! From the conference at large, the 153 networking sessions and 186 exhibition stands, we have selected some of particular interest for cloud enthusiasts.

Two separate sessions presented the scope of the topics, their expected impact and funding instruments foreseen. One session grouped the two cloud topics: ICT-7, “Advanced cloud infrastructures and services”, and ICT-8, “Boosting public sector productivity and innovation through cloud computing services”. A second session addressed topic ICT-9, “Tools and methods for software development”. Both sessions were well attended by the research community.

Chairs of the Cloud Computing Expert Group (Keith Jeffery and Lutz Schubert) also made a presentation on the cloud computing research challenges for the future, while eGovernance Academy Estonia communication coordinator Marit Lani spoke about cloud pre-commercial procurement in the context of the Cloud-for-Europe project. Professor Klaus Pohl, representing the Networked European Software and Services Initiative (NESSI) European Technology Platform, spoke on research challenges for software systems and software engineering.

Cloud session http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=11632
Software development tools session http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=11633

CONFERENCE SESSION “UNLEASHING THE POTENTIAL OF FUTURE INTERNET & CLOUD COMPUTING”

The last day of ICT2013 saw the conference session “Unleashing the potential of Future Internet & Cloud Computing towards a digital single market: technological challenges & essential policies”. The session – which proved a great success – presented how future internet and cloud technologies could leapfrog Europe to innovation and entrepreneurship. Moderated by Mário Campolargo, Director of the Net Futures directorate, the speakers were Wim De Waele – CEO of Iminds; Stephan Fischer – SAP AG, Senior VP of TIP Strategic Innovation; Roberto Saracco – Head of EIT ICT Labs-Trento Node; and via video link from San Francisco, Pascale Vicat-Blanc – CEO of LyATISS. They presented success stories, future technological challenges, current EU policies and barriers to creating a European digital single market for future internet and the cloud. Questions addressed topics such as obstacles and opportunities for the entrepreneurs in Europe, and the innovation potential of open source software.

http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=10452

CUMULONIMBO/COHERENTPAAS

CumuloNimbo has brought scalability to cloud databases and offered elasticity to cloud users. For ICT2013, CumuloNimbo partnered up with the new FP7 project COHERENTPAAS. Both showcased their apps, which have been tailored for various users: members of the general public interested in cloud computing, scientists interested in cloud scalability with consistency plus ease of use for traditional technologies, and companies interested in exploiting new business opportunities. Visits to the booth helped the teams establish interesting new contacts from all over Europe.

http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=10719

WEBINOS

Webinos provides an open source, open governance platform for running web based cross-domain applications. Its ICT2013 booth provided an insight into webinos-based applications from various domains. WebinosTV demonstrated an easy and amusing way to master digital content, while other applications had visitors experiencing home automation, eHealth, eFitness, automotive and smart city solutions. The demonstration booth attracted not only researchers and university representatives but also a huge number of commercial companies. The constant flow of visitors from these different sectors and their interest in cooperation gave the booth a real dynamism.

http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=10940
MOBICLOUD
MobiCloud is developing a European Corporate Appstore. The context-aware application container will be deployed in a smartphone or tablet able to connect securely to corporate systems via a cloud-hosted platform. ICT2013 enabled the team to network with researchers and industrial partners, and to disseminate initial results: a mobile site diary application for the construction industry built in collaboration with Costain (UK) and a suite of workforce apps for the public transport industry built for Tågkompaniet (Sweden). Around 100 visitors expressed interest in following the project’s results and accessing the MobiCloud software development kit. A large Polish construction group signed up for a free trial of the site diary application.

http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=10704

SOCIETIES
The SOCIETIES project is bridging the gap between the virtual and physical world by enabling the formation of dynamic mobile communities. The team put on a number of demonstrations, from crowd tasking to facial recognition integrated with social networking, disaster management support with the Jacket, and managing a conference experience using the SOCIETIES RELEVANCE app. The team received a great deal of feedback and established new contacts with multiple business sectors, allowing them to identify new potential exploitation routes for the SOCIETIES software.

www.ict-societies.eu/
http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=11126

CLOUDWATCH
CloudWATCH is a 24-month Support Action aimed at accelerating cloud adoption across the European Union. Its hub, www.cloudwatchhub.eu, offers practical, independent advice and legal tips, helping people from all sectors understand and evaluate the benefits of cloud. CloudWATCH also fosters interoperability and portability of data to ensure broader choice and fairer competition. The CloudWATCH EU Innovation Cloud Hub, showcased 22 European initiatives on long-term R&D, SME innovation and uptake. The team appreciated the informative networking experience and the way in which people from business and research shared their work in new areas.

http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=11144

OPEN SOURCE SOFTWARE: OSSMETER, MARKOS & PROSE
The “Open Source Software: Peeking Backstage” brought together a selection of projects, increasing the audience’s understanding of open-source software and informing decision makers about the latest developments in automated measurement and open-source software analysis. Booth visitors were numerous and included delegates from universities, public and private sector from Europe, Canada and Japan.

- OSSMETER (Automated Measurement and Analysis of Open Source Software www.ossmeter.eu) used infographics to illustrate facts and statistics on the development, size, use and evolution of popular open source software (e.g. Epsilon, Tomcat, Firefox). The statistics were extracted using tools developed within OSSMETER.
- The MARKOS (Market for Open Source – An Intelligent Virtual Open Source www.markosproject.eu) demo showed off the project’s first prototype, which allows FLOSS developers to search open source forges (collaboration platforms) on the web accurately, filtering by software entity (class, method, package, library etc.), relationships (inheritance, linking etc.) and licence model (reciprocal or academic compatibility with specific licences). Different copies of the same entity are shown only once when used/copied in different projects. The results also provide information on licence compatibility issues and their root causes.
- PROSE (A platform for hosting FLOSS projects www.ict-prose.eu) demonstrated its Software Forge Platform, which will assist the EU ICT community in the development and release of Open Source software. A number of visitors to the PROSE booth committed to evaluating the platform as a project tool for development support and software dissemination.

http://ec.europa.eu/digital-agenda/events/cf/ict2013/item-display.cfm?id=10771
CELAR-BASED RESEARCH PAPER TAKES BEST PAPER AWARD

Drafted by a team of researchers from the “ATHENA” Research and Innovation Center (D. Tsoumakos, I. Konstantinou and N. Koziris) the paper, entitled “Automated, Elastic Resource Provisioning for NoSQL Clusters Using TIRAMOLA” was submitted with high hopes to the 13th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing (CCGrid’2013). CCGrid serves as an international forum for sharing recent research results and technological developments in large scale systems.

Awards in the categories best Doctoral Symposium paper, best poster, and best presentation were at stake. The three best paper nominations were:

1. “PARTIALLY SEPARATED PAGE TABLES FOR EFFICIENT OPERATING SYSTEM ASSISTED HIERARCHICAL MEMORY MANAGEMENT ON HETEROGENEOUS ARCHITECTURES”
   from B. Gerofi, A. Shimada, A. Hori and Y. Ishikawa

2. “RESILIN: ELASTIC MAPREDUCE OVER MULTIPLE CLOUDS”
   from A. Iordache, C. Morin, N. Parlavantzas, E. Feller and P. Riteau

3. “AUTOMATED, ELASTIC RESOURCE PROVISIONING FOR NOSQL CLUSTERS USING TIRAMOLA” [WINNER]
   from D. Tsoumakos, I. Konstantinou, C. Boumpouka, S. Sioutas and N. Koziris

The ATHENA team was thrilled to win the best paper award, which ranked its work the best of 57 accepted submissions and 257 proposed submissions.

The work presents a complete system for elastic resource management within NoSQL clusters that operate over Cloud environments. NoSQL is an agile database form able to cope with unstructured, unpredictable data. The team modelled elastic actions in real-time as a Markov Decision Process (MDP – a mathematic framework for modelling decisions). The approach can be used to resize any NoSQL cluster in real time and optimise performance without human involvement. The system, named TIRAMOLA, is an open-source project (http://tiramola.googlecode.com).

The notion of automated, elastic resource allocation, as well as the TIRAMOLA system architecture, are central to the FP7 CELAR project, which seeks to extend elasticity modelling and automated control from NoSQL clusters to any cloud-based application.

www.celarcloud.eu
In traditional hierarchical file systems, information is stored in a tree structure – a directory path leads to where files are stored. Within this directory, files are typically located by name. While this approach more or less works on your local computer, (‘what was the name of that file again and where did I put it?’), it does not scale well to a cloud environment, where new information is continuously stored by multiple sources.

VISION Cloud stores its information as objects that contain not only data (e.g. the bits of a photograph), but also both user- and system-defined metadata. User-tagged objects not only allow for powerful searches, but also for an association between logically linked objects. Metadata and relationships can then be used to locate relevant objects among vast volumes of stored data.

Another of VISION Cloud’s major innovations is the concept of ‘storlets’ – units of computation. Storlets can be used to transparently perform data operations, such as reformatting image files or analytics to support Big Data. The impact of storlets is substantial – stored data can be processed locally, and no longer needs to be transferred over the network to a local computer, processed and then put back onto the storage server – all of which incurs both network transfer costs and latencies.

VISION Cloud partner RAI, Italy’s public broadcasting company, has been using a prototype version of VISION Cloud in-house to provide a cutting edge, cloud-based means to improve media production. The results were recently demonstrated at IBC. Drawing over 50,000 visitors and 1,400 exhibitors, IBC is Europe’s largest media tradeshow.

VISION Cloud’s demonstration used its novel innovations, such as storlets, to automatically transcode uploaded videos to different formats, rich metadata and content networks. This facilitates the location of all data related to a particular news topic, cloud-based billing and cloud-based team collaboration.

**What’s next in cloud policy and cloud research?**

**Cloud and the need for speed**

Much has been said about cloud computing as a game changer. In reality, without speed, cloud computing is far less interesting. Media lockers and advanced platforms are two of the most popular cloud services for both individuals and businesses. Both require fast broadband, allowing users to access cloud services at any time, from any device and from any geographic location.

There is a large and diverse customer base that can support a wide range of cloud computing services, as long as broadband infrastructures provide easy access.

Participants at a workshop on cloud and broadband at the Dublin Digital Agenda Assembly in June 2013 agreed that cloud is the killer app for broadband. High download and upload speed, low latency and ubiquitous availability will drive the take-up of cloud services — and cloud services are already driving demand for fast broadband.

But the EU’s 144 million fixed broadband lines do not reach the 24% of households without an internet subscription. A lack of ubiquitous high-speed broadband access may cripple cloud adoption by end-consumers unable to access cloud services, and thus restrict the potential market reach of companies and start-ups using them. Moreover, a poor broadband connection cuts time spent online, as users are unable to take advantage of services on the web.

High-speed broadband is essential not only for the cloud, but also the EU economy. It is estimated that a 10% rise in broadband penetration would increase European GDP by 1-1.5%. This is addressed by the EU’s Digital Agenda for Europe, a ‘flagship initiative’ within its Europe 2020 strategy for a smart, sustainable and inclusive economy. The strategy seeks to get every European using the web, and sets out a plan for ensuring Europe is competitive in the 21st century.

The Digital Agenda defines three broadband targets:

- basic broadband for all by 2013;
- Next Generation Networks (NGN) (30 Mbps or more) for all by 2020;
- 100 Mbps subscriptions or higher for 50% of households by 2020.

The first target has been achieved, partly due to satellite coverage. The second and third targets will require large investments, mainly by private operators, who are currently pursuing different technological options when upgrading their networks. In Europe, FTTC (fibre to the cabinet) and VDSL2 technologies are often preferred, while ‘fibre to the premises’ (FTTP) is rarer. Deployment of 4G mobile services is starting in a number of EU countries.

To reap the full benefits of cloud computing, it is important to expand the fibre footprint, taking into account the economic viability and deployment costs (higher for FTTH than FTTC). Expanding coverage is especially important for SMEs, which need a symmetrical connection to perform an increasing number of business operations.

---

1 Digital Agenda Scoreboard 2013
Cloud computing provides an excellent backend for applications on mobile devices giving access to resources such as storage, computing power etc., which are limited in the mobile device itself. Cloud users are also able to access cloud services at any time, from any device and from any geographic location.

Today’s users are streaming more content directly to their mobile devices. They are also increasingly demanding, expecting the same access speed on-the-go as they have at home with their high-speed broadband connection. But the increasing need for a high data transfer rate and for lower latency requires a more developed wireless infrastructure.

Beyond 4G, the next generation wireless networks (many are already calling them 5G), should deliver the best that cloud can offer. This fifth generation is still at an early stage of definition, and the common “vision” has yet to be defined at global level before the first commercial products are deployed around 2020. It is clear that 5G will have to support huge mobile traffic volumes, expected to be 1 000 times larger than those today: mobile data rates will be measured in multiples of gigabits per second. It will also have to cope with a proliferation of new and complex applications and services, many of which are unknown today.

New wireless technology is also expected to deliver latency of less than five milliseconds end to end. This speed, combined with the expected pervasive coverage of reliable networks, will create opportunities for companies to deploy many new real-time services that cannot be delivered over today’s wireless networks.

Even network functions like signal processing and path computation will use the benefits of cloud principles: they will be virtualised and out-loaded to network management clouds. This will make network operating easier, reduce end-to-end energy consumption and open the way to new flexible communication services.

The importance of 5G for future developments, like broadband, cannot be underestimated.

Mobile devices such as smart phones and tablets are now the preferred (and sometimes only) way for increasing numbers of people to access the internet. If this trend continues, wireless and mobile internet access will dominate.

GOING GLOBAL INTERNATIONAL COOPERATION IN THE CLOUD

The European Commission’s communication “Unleashing the Potential of Cloud Computing in Europe” (http://ec.europa.eu/digital-agenda/en/european-cloud-computing-strategy) calls for a more robust international dialogue on safe and seamless cross-border use of cloud services. High on the agenda are stronger international dialogues and coordination on issues such as standards, service level agreements (SLAs), certification, service interoperability and data portability.

Through ongoing ICT international dialogues, the European Commission is currently discussing aspects of key cloud-based services with the USA, Japan and Brazil. This includes certification, model contract terms for cloud computing services and standards. All sides are looking into closer collaboration.

For research and innovation, the plan is to progress towards joint technological approaches and reach consensus on future standards. This will guarantee a minimum level of interoperability and portability. The result will be more competition in the cloud services market.

A number of joint research initiatives are already in place with Japan and Brazil; further work will begin under Horizon 2020 in 2014/15. Joint projects will address topics such as cloud interoperability and data portability, which were identified as areas of common interest through consultations with industry in all relevant countries.

ON THE POLICY SIDE:

EU-Japan
Policy collaboration activities with Japan started two years ago through various workshops in Tokyo and Brussels, either alongside the EU-Japan ICT dialogues or on other occasions. Ongoing discussions in the context of the EU-Japan structured dialogues have attempted to focus on areas where there is a chance of concrete outcomes – standards, SLAs and certification.

A second EU-Japan ICT Dialogue took place on 4 December 2013 in Brussels. Aspects of cloud computing policy were discussed and both sides agreed to carry on with the collaboration activities and include the industry’s views in their discussions the following year. Prior to this dialogue, an informal meeting took place on 2 December between the Japanese Industry Federation (Keidanren) and the Cloud Select Industry Group (C-SIG) to exchange information and discuss possibilities for more concrete collaboration on aspects of cloud policy. Both sides have agreed to work closely in the next year with a view to setting up a bilateral industry working group that will provide support and industrial feedback to the policy dialogues.

EU-Brazil
Policy collaboration was bolstered through a workshop in Brasilia in November 2013. The focus was on identifying barriers that may preclude the adoption of cloud-based services in the EU and in Brazil. It also identified concrete joint initiatives to minimise such barriers. A series of recommendations have been put forward to strengthen cooperation, including the establishment of an EU-Brazil working group involving representatives from the Brazilian Ministry of Science Technology Innovations, the Ministry of Planning, the European Commission and the private sector, in order to advance EU-Brazil policy cooperation.

The group will draft a position paper based on the recent workshop and organise a follow-up working session in the first half of 2014. Since the Brazilian Ministry of Planning faces public procurement challenges similar to those of Europe, both sides also agreed to promote liaison between the Ministry’s pre-commercial procurement initiatives and the EU’s Cloud-for-Europe project.
EU-US

Cooperation is ongoing in the context of EU-US structured dialogues, which focus on areas where there is an opportunity for concrete outcomes, such as exchange of best practices, common contractual aspects, SMEs, cloud standards mapping and interoperability.

Bilateral negotiations on a Trade and Investment Transatlantic Partnership (TTIP) also began in July 2013 and continued in November and December 2013.

IN RESEARCH...

EU-Japan

Research collaboration is yielding significant results. A first EU-Japan coordinated call for proposals was published under FP7, resulting in a number of interesting joint projects. They got underway in June 2013 at the official launch event in Tokyo. ClouT, for example, is drawing on cloud computing and the Internet of Things to create smart cities (see below). A second EU-Japan coordinated call is due in 2014/2015, addressing:

- Technologies combining Big Data and Internet of Things in the Cloud
- Access networks for densely located users
- Optical communications
- Experimentation and development on federated Japan – EU testbeds.

These topics were agreed between the Commission, Japan’s Ministry of Internal Affairs and Communication and Japan’s National Institute of Information and Communications Technologies.

EU-Brazil

An EU-Brazil coordinated call on cloud computing, including security aspects, is foreseen for 2014/2015. Ensuing projects will develop innovative technologies for cloud-based service provision that take security concerns into account. This is part of the third Coordinated Call jointly funded by the EU and Brazil, which focuses on Advanced Cyber Infrastructures. This collaboration is expected to advance cloud-centric applications for Big Data, and go some way towards facilitating policy coordination between the EU and Brazil. It will subsequently be expanded to other partners in Latin America.

The Brazilian programme “Science without Borders” has issued a Call for Brazilian researchers who wish to be hosted by European partners involved in eight ongoing FP7 ICT projects (Call 10) in the cloud computing sector.

GIVING CLouT TO SMART CITIES

ClouT is the first joint research project between the EU and Japan on cloud computing. The objective is to integrate cloud computing and Internet of Things approaches, providing an efficient communication and collaboration platform that exploits all possible information sources on smart cities. This will help stakeholders prepare urban areas to tackle emerging challenges such as efficient energy management, economic growth and development.

The project will build a smart city infrastructure with a huge processing and storage capacity for data from trillions of sources that are integrated in the cloud via virtual services and are interoperable. It will also build a set of platform level tools and services to facilitate application development, deployment and supervision for the Internet of Things. ClouT services will be tested during field trials in four pilot cities: Santander and Genova in Europe, Mitaka and Fujisawa in Japan.
A PARTNERSHIP MADE FOR THE CLOUD

Estonia’s President, Toomas Hendrik Ilves, has been chair of the Steering Board of the European Cloud Partnership since its inception in November 2012.

There are of course many potential action points, some of which – such as reforming European data protection laws – are already ongoing. Those efforts are necessary to facilitate EU-wide commercial activities.

At the same time, there is a need for further initiatives that specifically improve the quality, security and trustworthiness of cloud services – that do not rely on legal changes. The creation of reference codes of conduct that cloud providers could adopt voluntarily is one such example: such codes would improve transparency for consumers, and provide a clear statement of their rights and privacy expectations. The identification of shared security standards is also important, to improve the reliability of cloud services.

A key barrier right now is the reluctance to host data outside one's own national borders. This is detrimental to achieving the benefits of scale that the cloud offers. Currently there are laws in place that restrict governments' use of cloud. Most importantly, this reluctance is entirely unjustified: with appropriate security measures, such as the use of advanced encryption tools, data can be just as secure on foreign servers as within your own borders. The EU needs to act to counter this trend toward the nationalization of the cloud.

Estonia is often seen as one of the frontrunners in the adoption of new ICT solutions. Are Estonian public services using cloud solutions? And what benefits have you seen in practice?

Estonia has indeed been an early adopter of ICT in a number of areas, and the cloud is no exception. We've already introduced the basic tools we need to drive innovative services, such as our electronic identity card and a service bus that allows Estonian administrations to securely exchange trusted data, and these are enabling a shift towards cloud services. We've implemented signing-in-the-cloud services that allow citizens to sign any electronic document using eID cards or mobile phones. These types of services enable new innovations and show Estonians how easy it is to use cloud services.

The key is secure, government guaranteed authenticated ID, and legislation that promotes the effective development and use of e-services: first, we have a law that the government cannot ask for data that it already has, and second, the citizen is the owner of his or her own data, she has control over who has access to her data and for what purposes. In these times, the sense of security and trust is crucial for the governments to be able to go ahead with developing e-services, without trust the political will to do so is hard to find. Legislation in the rest of Europe needs to be updated to create the trust and the political will to go ahead.
Is it possible for public sector services to use cloud computing on a large scale? Wouldn’t there be a risk of public services breaking down completely if technical problems occur?

On the contrary, one of the main advantages of the cloud is that it can improve resiliency. The case of Fukushima, with lots of data lost after the earthquake, indicates how important a backup outside your own borders can be. We are also vulnerable to external threats, as we in Estonia saw during the DDoS attacks against our public and private websites in 2007. However, even though several websites – banks, government sites, online media – were impaired for a while, our government provided encrypted e-service system remained, and has remained ever since, uncompromised.

Much of the economic potential of cloud computing comes from the ease with which data can be exchanged internationally, and flow from data centres in one country to the next. Are cross-border clouds possible for the public sector as well, since this would mean potentially sensitive governmental data being moved outside of national borders? Are there any pilot cases in Estonia?

It’s a sensitive problem, to be sure: no one wants to move their crucial services or data to a location that they can’t fully control. The public sector plays a particularly important role on that point, since we manage large amounts of personal data relating to all of our citizens. That’s a trusted position that we must protect at all times.

But that does not mean that moving some services and data to service providers outside your own borders is entirely impossible. The key question is control: if you can be certain that your data is placed with a trustworthy host, who cannot access it without your permission, and if the necessary technical and legal conditions are implemented to ensure that this trust isn’t violated, then cross border clouds in the public sector are entirely possible. The goal should be to ensure security, not to keep data within a border.

In fact, Estonia and Finland have been working on a project to interconnect our clouds, beginning with our VAT databases. Finland has decided to adopt the existing estonian system, and we will develop the systems’ next phase together. This will be a genuine cross border cloud, with all related benefits. All Member States should look into such an approach, since it’s the only way to make crucial services and data disaster-proof.

Much of the public debate today revolves around the public’s trust (or lack thereof) in cloud computing, against the backdrop of national security incidents unveiled by whistle-blowers like Edward Snowden. What can be done to ensure that confidential information in the cloud remains confidential?

This all comes back to the core question of trust. Part of this solution comes from appropriate technical and legal solutions to ensure that data in the cloud isn’t up for grabs. This is why European initiatives on this point are so important: we need to ensure that there are common standards and processes to secure cloud data.

Key to any secure digitally based system is a secure and trusted identity. In other words one needs to absolutely sure that whoever accesses the system is who they say they are. Without this, all systems are vulnerable.

A second point is transparency: it’s not only necessary for clouds to be secure; they must also be seen to be secure. In Estonia we have been able to create trust and goodwill with a large part of our population by being secure and transparent: in the Estonian system, all entries leave a trail, and any Estonian can use his or her eID card to find out who’s been accessing their data and why. And our system uses a high level of encryption – RSA 2048 – that would take some forty years for even the NSA to break, using current technology. That kind of security-and-transparency-through-technology is needed to show EU businesses and citizens that their trust in the cloud is justified.

But we also need to remember that confidentiality is not necessarily the most important security issue. We also need to ensure data integrity, the fact that no one changes the data in the process of transfer. While violating privacy may be uncomfortable, violating data integrity can be life-threatening, and seriously dangerous to people and whole societies. It is not only storage and access, but the whole process that must be adequately protected.

Advanced security often comes at a high cost. Isn’t there a risk that European cloud service providers will be priced out of the market if they have to meet high standards for secure, high-quality and reliable cloud services, as the European Council has recommended?

Not necessarily. While high quality security isn’t free, it also creates significant added value. When it comes to sensitive data and services, the cheapest cloud solutions can become very expensive when the cost of incidents is factored in.

Furthermore, there’s also the flipside of the coin: strong security is a differentiator, something that you can sell on the market. If EU cloud providers can be shown to be more secure than their competitors, then this is an advantage that they can use to sell services internationally.

Finally, not everyone needs the highest level of security. Non-sensitive data can be stored without the highest level of security. Payroll or pension figures for a large company presumably would not require the same level of security as people’s health records.

What are your hopes and expectations for the outcomes of the ECP’s work?

The ECP is working with a real sense of urgency. Cloud computing is not a technology of the future; it’s the technology of today. The ECP needs to provide results that cloud vendors and cloud users can adopt right away, results that will help grow the market and drive new innovations. We need to become a leading cloud provider and cloud adopter in the global market. This is the only way to maintain a strong and competitive economy in a challenging environment. Ultimately, that is the target for the ECP’s work.
CLOUD COMPUTING IN HORIZON 2020

While some implementations of cloud-based services are now found in the marketplace, many technical challenges still remain unresolved – leading to businesses missing out on countless opportunities. The European cloud market is heterogeneous, dispersed and fragmented. But it is also very flexible. This, combined with the continent’s vast expertise, gives Europe the chance to lead the way in cloud technology – by stepping up investment in research efforts.

While private sector research tends to capitalise on immediate gains in terms of satisfying customer demand, EU-funded projects focus more on the challenges of particular importance over the longer term. This focus will give Europe a competitive advantage, and will help shape the cloud ecosystem.

Funding has already been earmarked for cloud research under the new EU research programme Horizon 2020 running from 2014 until 2020. For cloud and software related projects, the Commission will call for research proposals addressing specific themes identified by expert groups and a stakeholder consultation as the most pressing challenges, or providing the greatest opportunities.

In 2014/2015, some €120 million will be available for research on advanced cloud computing infrastructure and services as well as on tools and methods for software development. Supplementary investment of €5 million during this period will help to intensify cooperation with Brazil and Japan on cloud computing topics.

STAKEHOLDERS SET PRIORITIES

The Research Expert Group on Cloud Computing for Europe produced three reports between 2010 and 2012 identifying the major gaps and challenges for future research and development in advanced cloud technologies. The outcome of the 2012 reports provided a foundation for the research topics for Horizon 2020.

Working on this basis, the unit “Software & Services, Cloud” within the Directorate Net Futures of DG Communications Networks, Content and Technology launched a fully-fledged public consultation on the research and innovation challenges in the domain of cloud computing, software and services. There was a large response to this consultation which allowed us to identify the key research and innovation to be addressed within the Horizon 2020 work programme for 2014/2015:

**TOPIC ICT 7 – 2014: ADVANCED CLOUD INFRASTRUCTURES AND SERVICES**
- Research and innovation actions on high performance heterogeneous cloud infrastructures, federated cloud networking, dynamic configuration, automated provisioning and orchestration of cloud resources, automated discovery and composition of services, cloud security;
- Innovation actions on platforms for trusted cloud systems.

**TOPIC ICT 9 – 2014: TOOLS AND METHODS FOR SOFTWARE DEVELOPMENT**
- Covering software tools and methods for large, complex and data-intensive systems as well as software architectures and tools for highly distributed applications.
CLOUDS ON THE HORIZON

Horizon 2020 is structured around three pillars focusing on excellent science, societal challenges and industrial leadership. Within the industrial leadership pillar of Horizon 2020, over €13 500 million will be channelled into ‘leadership in enabling and industrial technologies’ (LEITs). A significant proportion of this will support ICT projects, including those focusing on cloud computing.

Research carried under the LEIT heading will have the potential to underpin innovation across many industries and sectors, where it is possible for Europe to either build or maintain a technological lead over the rest of the world. It is obvious why the cloud fits in well here – the cloud has the potential to revolutionise the way software is delivered and data is managed, create huge savings for both companies and the private sector, increase efficiency and even reduce the environmental impact of computing.

More information
Research Expert Group on Cloud Computing reports:

Public consultation:

HORIZON 2020 IN BRIEF
- €79 billion over 7 years
- Focused on excellent science, industrial leadership and tackling societal challenges
- Simplified procedures
- More emphasis on innovation
- Dedicated funding for SMEs
- Investing in ideas for growth and jobs
