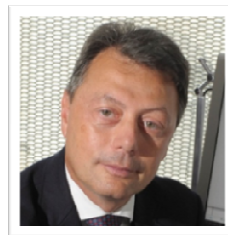
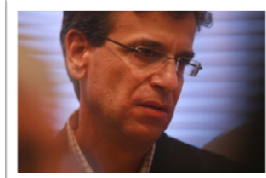


RESERVOIR



Nurturing Innovative Thinking
Views from some of the Pioneers behind RESERVOIR



Source: OGF.eeig, March 2011

The research leading to RESERVOIR results has received funding from the European Commission's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 215605. For more information, please contact reservoir@cetic.be

Interview with Eliot Salant, RESERVOIR Coordinator and Benny Rochwerger, Architect, IBM Haifa



How would you describe the value-add of RESERVOIR?

One of the very real outcomes of RESERVOIR are the very good relationships across the board, leading to new, stronger partnerships. Some of the problems we have tackled have been really tough from an engineering point of view. These problems have been tackled by a team of experts from Europe and Israel. As problems become much more complex, solutions need to be more comprehensive. This is where team effort is the real winner and is becoming more important than ever.

Academic institutions doing pioneering research have a lot to gain from exposure to real-world industry needs. This is what has a real impact on industry. Tackling some of the problems of tomorrow and not only of today is what brings mutual benefits. Our partners from academia have set up a test bed to configure the hardware and software. The funding behind that is a real winner for these partners who now have a Cloud environment they can continue to use. Their students can also gain real benefits from working across geographical boundaries. We've hosted overseas students at our facilities here in Haifa and the University of Umea is now working with SAP on a data cloud project. Our collaboration with SAP has enabled us to work locally and build a solution around specific needs, in this case, for complex enterprise applications. This experience has served as a catalyst for SAP to create new partnerships in a way that both complements and builds on their role in RESERVOIR.

What are the main technological takeaways?

The framework developed is a blue print to build a RESERVOIR Cloud with the codes and architecture specifications need to do so. Cloud providers can now build an even bigger Cloud with the balancing of workloads, lowering costs, moving workloads across geographic locations through a federation of Clouds. There is a clear value-add for end-users and a group of companies that are providing new, more cost-effective services based on RESERVOIR technologies. Industry has provided a clear route to gain revenue from spin-out technologies.

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IBM has provided a case study to understand how Cloud computing can be taken forward. European companies and academic institutions are enabling all sorts of organizations with new products, know-how and training.

From a broader perspective, Europe has gained from the set of artefacts that have been produced and distributed in open source code. Most RESERVOIR outcomes have been published as scientific papers, generating a total of 70 publications and public documents. RESERVOIR has also committed to open standards. It is this combination of open standards and open source software that is helping businesses but also assisting future research on Cloud computing.

Interview with Eliezer Levy, Director and Mor Sagmon, SAP Research, Haifa



What benefits has SAP Research gained from RESERVOIR?

Our collaboration with IBM is a major success story and would not have been thinkable without RESERVOIR. At the outset of RESERVOIR in 2008, IBM already had a significant presence in Haifa, whereas SAP had just set up their facilities. RESERVOIR helped the company take root in Israel, which is strong in terms of hi-tech and talent pool. RESERVOIR has tapped into SAP Research and IBM skill sets. Without the support of the Commission it would not have been possible to pool this talent, nurture and build on it. The joint IBM-SAP Research stand at CEBIT 2009 offered a great showcase for this partnership where the two companies demonstrated the early promise of RESERVOIR with great visibility for two companies that also had their own stands at the event. The commission has played a key role in facilitating this collaborative partnership in an open manner. We are grateful to the Commission for this support.

The partnership has grown from strength to strength thanks to an internship at the IBM facilities. Spending one day a week there proved to be a really positive experience. Benny Rochwerger, the RESERVOIR Architect, was key in building a team spirit, sharing know-how, helping to build the strong relations that have been so vital to the success of the project. This personal approach was very important and we really appreciate their hospitality. The group has grown and now boosts nine people. The partnership has laid the foundations on which to build new collaborative work, such as the VISION Cloud project.

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RESERVOIR has brought together human resources, experts in hardware, software, test-bed experts. This team has helped generate a lot of energy, shaping new ideas and approaches. This is definitely the way to go forward. While Cloud computing is the common denominator, the same achievements could apply to any R&D work where moving forward together is key.

What are the main technical & business gains?

Participating in RESERVOIR was a strategic natural investment for SAP. From a business perspective, the partnership has been key in the shift towards on-demand Software as a Service, which is crucial in today's economy. The market trend is the shift away from large, on-premise and expensive licenses to cloud as a service over the net. SAP legacy applications are the heaviest on-premise products so it is crucial to take the lead in this trend. New services are based on subscription fees, reducing operational costs. The economics are clear: on-demand and Software-as-a-Service driven by the increasing need to be as efficient and flexible as possible. Cloud offers opportunities to reduce costs as part of a strategic process. The customer and the company both have much to gain from this game-changing technology.

Technically speaking, SAP and IBM are complementary companies rather than peers – an application provider working alongside a hardware provider. Cloud-native business applications are new offerings meant a priori to be Cloud apps. Of course, not everything is thanks to RESERVOIR but the project has given us hands-on experience.

With RESERVOIR, important steps have been made in delivering better services for businesses and eGovernment, where energy-efficient data centres bring savings in cooling and services rendered. Elasticity is an important aspect of what we have focused on, that is, the ability to increase or lower compute based on demand. If we need 10 servers at peak, we can switch them on and off as needed. This is the building block of the Cloud – it is energy efficient by definition. What's more, data centres can be located in cool places.

In a nutshell, it really comes down to the new know-how that has been built and what customers can gain as a result in the long term. RESERVOIR has been fundamental in the short term to make an impact in terms of modeling service components, as well as in the longer term, as the driving force behind a fundamental change in the market place.

Interview with Juan Cáceres, Telefonica



How has Telefonica gained from its role in RESERVOIR?

Telefonica is a worldwide telecommunications operator, providing services in Europe and South America, as well as in partnerships with China Unicom. RESERVOIR has offered an important opportunity to evaluate how Cloud can best be used in the sector, how computing components can be designed into the architecture that has been developed and ultimately how Cloud can provide a global solution integrated into our world-wide services. Service provision is now in line with the company's global strategy for Cloud services.

RESERVOIR is a success story where the know-how of all partners has enhanced existing expertise, generating new ideas on services we can offer our customers.

What is the focus of the new services?

The new services are underpinned by data centres located in different places. For instance, the Miami data centre could serve customers in South America and also serves as a support centre to assist deployment. An important step has entailed defining the federation of resources, legal and security issues.

The services are primarily targeted at enterprise, businesses of all sizes, built around their specific needs and very much focused on Quality of Service (QoS) and value-add. Security is very important for our customers. Security plays a key role in fostering trust.

RESERVOIR achievements have helped drive investments at corporate level. Telefónica has planned far-reaching investments globally with a budget doubling EC investment in RESERVOIR over the same number of years.

What role do standards play in all of this?

Telecomm operators are very concerned about standards to demonstrate the will to avoid vendor lock-in. This is also one of the main concerns surrounding Cloud in general. Integrating the components of different vendors is key to arriving at standardized interfaces.

Telefónica is committed to driving standards. We are part of the Distributed Management Task Force's Cloud Management Group. A cloud API has been submitted and proposed as a standard. The plan is to adopt this over the next few years. We are also part of the Open Grid Forum's Open Cloud Computing Interface, which was spearheaded by RESERVOIR.

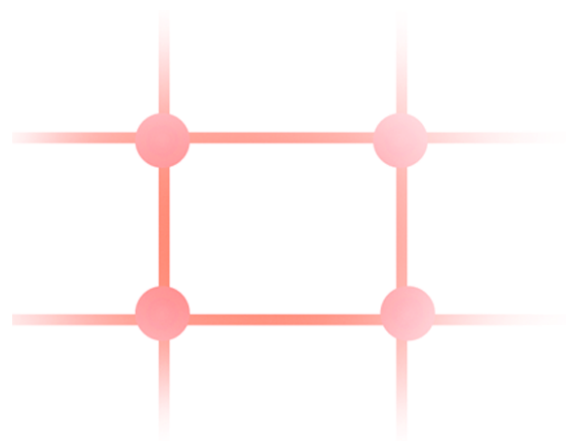
In general terms, it is key to understand how to ensure solutions cater for target communities, such as SMEs and ensure high quality for large enterprises. A common reference architecture is crucial for standards. Cloud governance is also very important from the architecture point of view. Once the product has been developed, it is important to define standard interfaces.

How would you sum up RESERVOIR achievements and what is needed moving forward?

Virtualization and Cloud were really at the early stages when the project was conceived. RESERVOIR has played a key role in taking ideas to a higher level, proving the skeptics wrong.

RESERVOIR has played a crucial role in defining the basis for Cloud infrastructure. More R&D is needed to improve some aspects, such as Quality of Service, security and integrated virtualized networks. We have achieved a lot here but more integration is needed. New projects are picking up on this.

More research is also needed to develop more complex environments hiding all the complexity of virtual machines coupled with improvements for scalability and solutions with more capabilities. Part of the return on investment for the European Union lies in assisting future research on Cloud Computing.



Interview with Antonio Puliafito, professor at the University of Messina



What tangible benefits have been gained from academia-industry collaborative partnerships?

RESERVOIR has been fundamental in bringing together people from enterprise and research to gain new competences and know-how on distributed computing, especially Cloud computing along with new kinds of services for Europe.

Connecting with new people interested in similar challenges is strategically important at both European and national levels to capitalize on investments and shape where we're heading in the years to come. From the perspective of an academic, working with industry offers important opportunities to adopt new approaches to the development of software, advancing networking and infrastructure. Research can learn a lot about how industry R&D is managed with its emphasis on software development to come up with better solutions more quickly. On the other hand, industry can learn new ideas from research. It's about how good ideas can rub off on team members. Together we can build enterprise-quality resources and services, so the benefits work both ways. It is definitely the right way to go.

How is the expertise you gained in RESERVOIR feeding into other or new initiatives?

Alongside RESERVOIR, I am coordinating a national project called Cloud@Home: a New Enhanced Computing Paradigm, financed by the Italian Ministry of University, aimed at breaking down the barriers of volunteer computing while enabling the sharing of general services. As a flagship project, RESERVOIR is the forerunner of a number of new European initiatives on Cloud computing. We are taking our expertise forward in the VISION Cloud: Virtualized Storage Services Foundation for the Future.

Interview with Mauro Pezzè, professor at the University of Lugano



In your view, where does the ultimate value-add lie in terms of academia-industry partnerships?

We've worked with IBM Haifa on a number of projects, including RESERVOIR, and are taking forward new partnerships. One of the main benefits is the opportunity to do research in a setting that places strong emphasis on real-world needs and industry quality. Hands-on experience means that academics can validate their research directly with experts from enterprise and engage in a two-way dialogue that is based on common terms of reference.

If R&D is very short term, it is not usually exploitable at academic level because it is too commercially focused. This is where an industry think tank leading a European project comes into play, coming up with a vision and ensuring that vision brings about fundamental changes, in this case, business computing and public services. New ideas and new technologies have cropped up along the way. Many of these new ideas were not conceivable when we set out three years ago. Analyzing the problems as a team has brought new insights, which in turn has meant coming up with new techniques and new solutions. This has impacted positively on our research. A good example is the best paper award in July 2010 at the International Conference of Web Engineering, one of the top conferences in the field. This achievement would not have been possible without RESERVOIR as it was the project's R&D work that generated the idea in the first place.

Working in a large project brings a number of benefits. These benefits should not be seen just in economic terms but rather as funding that backs a good team capable of coming up with new solutions. Members of that team include undergraduates and PhD students who have gained a valuable understanding of Cloud computing and virtualization technologies. They have since graduated, completed their PhDs and found new jobs, building on their experiences. One of our students had the opportunity to work at the IBM facilities in Haifa, working closely with peers from other countries.

In your view, what are the key success factors for projects like RESERVOIR?

Gaining information and generating new ideas that would not otherwise have been possible is key to seeding new research and spinning out new initiatives and technologies. A clear understanding of the problems at stake and drawing on the competences of a strong team are equally important in taking research to the next level and as part of the knowledge value chain.

I would certainly rank RESERVOIR among the top 5% of collaborative projects we've been involved in. In my view, the top three ingredients are

- I.** People working on the project with the skills and will power for open discussion in a collaborative spirit.
- II.** Good management – making sure the group is compact and getting them focused. In terms of people management, IBM has done a great job.
- III.** Interesting or hot topic – the newer the topic, the more ideas and insights are generated. This is a driving force and catalyst for forward-thinking academic institutions.

Interview with Erik Elmroth, professor at University of Umeå



What benefits has your institution gained from RESERVOIR?

My department focuses on technology issues in distributed systems and research in Cloud computing. When RESERVOIR started, we were faced with a whole new set of partners. One of the key achievements has been the strong relations that have been built over the last three years, leading to a number of spin-off projects like VISION Cloud and Optimis. We're involved in both of these new European projects, which are well placed to build on the competences and tools that have been developed in RESERVOIR. VISION Cloud is aimed at doing for storage what RESERVOIR has done for compute. Optimis deals with a higher level of Cloud service management for both service and infrastructure providers.

Many of these developments would not have been possible without a enthusiastic exchange of new ideas, exploring new angles and interweaving these angles with perspectives from industry. As an academic institution, we've been able to come up with formulations in areas that are for the most part new for us.

We're now also working closely with SAP Research on a new project with one of our PhD students being supervised by an SAP employee.

In summary, industry can leverage new solutions academics come up while academic research can take place in an industrial context, so it works both ways. Both perspectives and competences are needed to make real progress in European R&D.

Interview with Philippe Massonet, CETIC on Risks & Rewards



By working with large IT companies and academic partners, CETIC has been able to gain new knowledge particularly on the direction in which the Cloud computing market is moving, whereas before our knowledge of the Cloud was more academic in focus.

RESERVOIR has made some very important technology breakthroughs by focusing on the virtualization layer which lies on top of the physical infrastructure alongside the virtual networks, hypervisors, firewall and all the other tools needed. Security plays an important part in all of this as we're dealing with technologies that are for the most part new. Isolation is key so as to ensure that the data and machines of one customer are not accessible to another customer.

CETIC has brought to RESERVOIR important insights into security, one of our areas of expertise, which is key to addressing one of the current barriers to wider adoption. Our expertise is very much linked to a number of studies that have been conducted in recent years with particular reference to the security risks associated with using the Cloud. One of the difficulties lies in "connecting

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to” what Cloud is by definition. Customers find it difficult to understand exactly what the provider controls, because they are blind to what is behind it all. Providers control the management of virtual tools. Providers want to keep the infrastructure as simple as possible so they don’t want their customers to go in and change that infrastructure. Customers want to know that their data is safe.

One of the main lessons learnt is that there should be a lot of negotiation between the customers and providers to reach acceptable levels of understanding. This is because Virtual Machines and data are inextricably bound up with loss of control, not being able to go behind the scenes, the lack of accountability and liability. Some customers may not even be informed if there is a breach of data. This means that the relationship between the customer and provider is very important in terms of what the customer wants to know and what the provider is willing to disclose or commit to.

Questions customers invariably ask are: “where’s my data?”, “where are my Virtual Machines?”, “has the service been sub-contracted to a cheaper provider without me knowing?” So the big issues are transparency, liability and accounting, which ultimately comes down to trust.

Here at CETIC we’re playing an important part in bringing insights into risk management, as well as asking important questions such as does it make sense to outsource my asset application? What alternative options do I have? Is the application critical? What is the provider willing to commit to in terms of security, Quality of Service and costs? This risk management process is important across different deployment models.

CETIC’s expertise benefits potential users at three different levels:

- I.** Analyzing what the Cloud is and the best approach on a case-by-case basis. This is important for companies who are still thinking about whether to move to the Cloud.
- II.** On the operational level, explaining how an organization might set about building their own Cloud infrastructure.
- III.** Training to use that infrastructure. This has been in synergy with the Complutense University of Madrid. The approach has been twofold: providing a conceptual framework, explaining the architecture but also helping them install some of the software so they can use the infrastructure. The conceptual framework comes with some hands-on experience.

This offers organizations a more complete understanding to enable them to define a more effective adoption strategy and road map. Local companies can position the Cloud in their specific context and analyze the risks at stake.

What tips can we offer to anyone interested in delving deeper into security and risk management?

There are three types of risks associated with Cloud computing: policy and organizational risks, e.g. vendor lock-in; legal risks, e.g. data protection and technical risks, e.g. isolation failure.

CETIC has worked with the European Network and Information Security Agency, or ENISA for short, on risk assessment frameworks for small and medium-sized businesses and government departments. Four fundamental reports are available to anyone interested in exploring these issues further:

- I. Survey – An SME perspective on Cloud Computing, November 2009

<http://www.enisa.europa.eu/act/rm/files/deliverables/cloud-computing-sme-survey/?searchterm=Cloud%20Computing>

- II. Cloud Computing Information Assurance Framework, November 2009

<http://www.enisa.europa.eu/act/rm/files/deliverables/cloud-computing-information-assurance-framework/?searchterm=Cloud%20computing>

- III. Security and Resilience in Governmental Clouds – Making an informed decision, January 2011

<http://www.enisa.europa.eu/media/press-releases/governmental-cloud-in-the-eu-new-agency-report/?searchterm=Security%20and%20Resilience%20in%20Governmental%20Clouds%20%E2%80%93%20Making%20an%20informed%20decision>

- IV. World Economic Forum: Exploring the future of Cloud computing: Phase II, Stakeholder consultation: key issues for discussion, first draft, November 2010, final report forthcoming

<http://www.enisa.europa.eu/media/news-items/wef-cloud-computing/view?searchterm=Cloud%20computing>