VENUS-C: a ground-breaking user-centric cloud infrastructure for Europe

VENUS-C (www.venus-c.eu) has successfully put the requirements of end-user communities – such as researchers and SMEs – at the forefront of development, providing scalable and interoperable cloud resources that combine both open source and commercial solutions to offer the best of both worlds. With co-funding from the EC under FP7, this two-year project is one of the first cloud initiatives to feature in the European Digital Agenda (DAE).

Fabrizio Gagliardi, Microsoft Research Connections EMEA, VENUS-C chair and one of originators of the initiative says: "*I am delighted that the European Commission has acknowledged the significant contribution that VENUS-C has made to the European scientific community, by clearly demonstrating benefits of clouds over grids in terms of cost-effectiveness, flexibility and ease of use. We are also very pleased that our support of small businesses has been so effective in enabling the creation of a start-up and helping small companies grow their business in difficult economic times*". The €4.5 million funding from the Commission has been supplemented by Microsoft investments in Azure resources and manpower, demonstrating a viable, cost-effective and sustainable alternative to supporting European end-user communities."

"*Cloud computing empowers researchers in a number of different ways, enabling them not only to accelerate scientific discovery but also do new science they could not have done before*", explains Andrea Manieri, the VENUS-C project director from Engineering (*Ingegneria Informatica*) in Italy. A notable achievement of VENUS-C has been to provide the resources needed by researchers who traditionally did not have access to adequate computing resources. "*These researchers number in their thousands for each traditional supercomputer user. They are the so-called 'long tail' of the scientific user distribution and their work helps society in many different ways. They often leverage their research work to create start-up companies, utilising the power of the cloud, with an obvious impact on the EU economy.*"

Innovatively; the VENUS-C approach has been guided by the requirements of end-users: researchers from across Europe working in seven different scientific fields, from bioinformatics to civil engineering and civil protection. This compelling range of applications is complemented by an additional 15 pilot applications, were selected through a European-wide call for proposal. Together, their cloud computing requirements have steered the infrastructure design and validation process.

"Newcastle University is indebted to the expertise and resources provided by the VENUS-C Project to further its research in scalable Drug Discovery. Scientists have been able to develop QSAR (Quantitative structure-activity relationship) models at a previously impossible scale which will help to produce more benign chemicals and more targeted pharmaceuticals. Collaborations between SMEs, multinationals and academic partners are being actively pursued to demonstrate the impact made by the VENUS-C project", says Simon Woodman, Newcastle University.
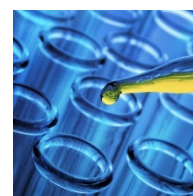
"Our approach to 'openness' has been to tie together user requirements and provide solutions and services that are more efficient and cost effective in the everyday work of our end-users. Our open-source components are available on the VENUS-C website with the aim of fostering further development. On top of this we have shared best practices and have leveraged open standards developments", explains Professor Ignacio Blanquer, from Polytechnic University in Valencia, who served as the VENUS-C community manager. *"Thanks to the collaborative work between the Barcelona Supercomputing Center, the Royal Technical Institute (KTH), Engineering and the Microsoft Research Advanced Technology Labs Europe (EMIC) on key areas of standards and interoperability, VENUS-C shows striking success in using standards for job submission (BES/JSDL established protocols), OCCI for clouds, CDMI (Cloud Data Management Interface) for storage, as well as security and accounting standards"*, notes Professor Geoffrey Fox, Indiana University and one of the six renowned international experts who have guided the project's progress.

New European user communities benefit from the cloud

Getting new communities to use VENUS-C in production has been important in demonstrating its value-add for the wider European research community and ensuring sustainability. In this respect, the civil protection and emergencies application has been a remarkable success. *"VENUS-C, with its forest fire risk and behaviour application in cloud computing, provides a valuable means to emergency and civil protection agencies to prevent and fight wildfires at an advanced level of operational and cost efficiencies, showing potential for many regions across the globe",* explains Professor Kostas Kalabokidis from the University of the Aegean.

Bringing cloud radiotherapy planning to hospitals also introduces a new community to the cloud. *"Our experience in VENUS-C demonstrates the value of the cloud in bringing innovative services to hospitals with radiotherapy facilities while ensuring a high level of safety, reliability, security and trustworthiness, which are crucial for any healthcare solution"*, says Carlos Mouriño from CESGA, a Spanish supercomputing centre.

Another new area is social media assessment. *"Cloud4Trends is a micro-blogging and blogging localised content collection and analysis framework used to detect currently popular topics that reveal users' interest.* We will continue to leverage VENUS-C *to support and attract more users and handle simultaneous large-scale experiments on large metropolitan geographic areas"*, explains Athena Vakali, a professor at Aristotle University in Thessaloniki.

New European start-ups and innovation hubs

Thierry Priol, Inria and a VENUS-C advisor highlights the tangible benefits of VENUS-C for small companies: *"the achievements of VENUS-C are impressive and have helped demonstrate that the cloud is effective in providing computing power, not only to the research community, but also to small companies for which HPC systems are not economically affordable"*. Molplex Ltd, a UK start-up, is one of the small companies to have benefitted from the project. *"VENUS-C has provided large and stable computing resources at low upfront cost, enabling us to speed up the development of safer and more effective drugs against a range of serious infectious diseases including Dengue, TB and Malaria"*, notes Vladimir Sykora, CIO and co-founder.

Furio Barzon from *Collaboratorio*, a consulting company for architects and civil engineers, perfectly illustrates how cloud goes hand-in-hand with an entrepreneurial spirit. He explains, *"VENUS-C has worked exceptionally well as a venture incubator for the Green Prefab system, enabling us to combine development with global market activities that have led to a the creation of a new start-up, Green Prefab, and* HUB-E (www.hub-e.com), an *innovation hub, for civil engineering with open and private platform and infrastructure service models leveraging VENUS-C. Playing a pioneering role in our profession has been very exciting with early investors negotiating*
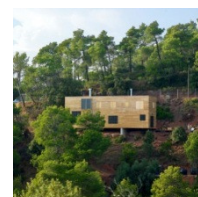
initial seed funding of $1 million. The cloud module based on VENUS-C could be implemented very soon".

"Thanks to our work in VENUS-C we are now exploring the opportunity to provide Architrave, our cloud-based solution for the structural analysis, as an additional service to enrich the HUB-E portfolio of services and applications" , notes José Alonso, Technical University of Valencia. Emanuele Naboni, an associate professor at the Royal Danish Academy, says *"our involvement as a pilot in VENUS-C has changed our approach to research and opened up new opportunities to deploy online services that will enable the wider end-user community to assess the eco-efficiency of buildings. This sets the basis for our development of online tools that support energy performance-based design decisions at the very early stages of architectural design"*.
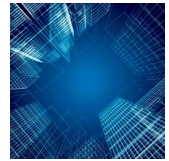
VENUS-C was co-funded by the GÉANT and e-Infrastructure Unit, DG Information Society and Media of the European Commission (now part of DG Connect) with Microsoft investments in Azure resources and manpower through Redmond and its European research centres. The 14 partners in VENUS-C are: Engineering SpA (Italy), Barcelona Supercomputing Center (BSC, Spain), Centre for Computational and Systems Biology (CoSBI, Italy), Collaboratorio (Italy), European Chapter of the Open Grid Forum (OGF.eeig, UK), Microsoft Research Advanced Technology Labs Europe (Germany), Microsoft Innovation Center – Greece, Microsoft Research Ltd (UK), National Research Council of Italy (CNR, Italy), Newcastle University (UK), Royal Institute of Technology (KTH, Sweden), Technion (Israel), the Technical University of Valencia (Spain) and the University of the Aegean (Greece). The 15 new pilots are represented by Aristotle University (Department of Computer Science and the Geophysics Lab, Greece), Athena Research (Greece), CESGA (Spain), CIEMAT (Spain), DFRC (Switzerland), Heriot-Watt University (UK), Molplex (UK), Royal Danish Academy (Denmark), Royal Holloway (UK), Stockholm Brain Institute (Sweden), University of Applied Sciences (Switzerland), University of Cyprus (Cyprus), University of Malaga (Spain), University of Westminster (UK). The University of Manchester is one of the voluntary experts with free access to VENUS-C resources.