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Toward the 'Future Internet', experiment by experiment

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You may not notice as you surf the web, but the internet is a clunky thing, built on a mixed bag of technologies, some of them decades old. Upgrading such a vast network is no easy task, though the same trial-and-error approach that led to the internet's creation now promises to keep it expanding and improving in the future, thanks in part to EU-funded research.

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'Experimentally driven research is now seen as being very important in many fields. It led to the creation of the internet and it will be very important for the "Future Internet",' argues Serge Fdida, a professor in the network and performance group at University Pierre et Marie Curie in Paris.

But for researchers and developers to experiment with new technologies, from content delivery methods to wireless communications and location-awareness, they need somewhere to run tests and measure the results. In effect, they need a high-performance, adaptable, scalable, low-cost and easy-to-use playground. Thanks to the efforts of the EU-supported initiative, 'An open, federated laboratory supporting network research for the Future Internet' (OneLab), they now have one.

Based primarily on the results of two projects, OneLab (2006-2008) and OneLab2 (2008-2010), which were supported with combined funding of around EUR 8.2 million from the European Commission, the OneLab initiative is today offering the telecommunications and internet research community access to a range of innovative tools and testbeds.

Among them is PlanetLab Europe, the European branch of a global network of open computers available for the development of new network services. With more than 300 virtual server nodes spread across the continent, PlanetLab Europe is already being used by almost 2,000 researchers and constitutes one of the most realistic platforms available for trial deployment and experimentation,

with services such as distributed storage, network mapping, peer-to-peer systems, distributed hash tables and query processing.

A key part of PlanetLab Europe's development and its interconnection with similar resource platforms in the United States and Asia is the concept of federation, introduced by the OneLab researchers and now becoming increasingly popular in other research disciplines.

A federation of testbeds

'There are lots of testbeds out there: every testbed has its own value but they are only used by the people who develop them - and have a very short lifespan because usually they are established for a specific purpose and used only while the funding for them lasts. However, at the same time, it is completely useless to try to design a testbed that will fit everyone's needs - it's just impossible, each community has different requirements, the wireless community would like one thing, distributed systems developers want other stuff, the cloud community would be different again... and so on,' Prof. Fdida, the coordinator of OneLab, explains. 'But because there are commonalities, our approach was therefore to bring these testbeds and the organisations behind them together in a federation system, enabling technology to be reused, helping developers avoid repeating mistakes and reinventing the wheel, enabling them to share best practices, and aggregating funding to benefit from the multiplier effect.'

Besides the far-reaching and diverse array of testing resources offered by PlanetLab Europe, the OneLab team also followed the same approach to establish more focused testbed platforms, among them NITOS for real-time wireless testing, ETOMIC for high-precision measurement of network capabilities, and DIMES to study the topology of the internet.

'One of the main challenges was to advance the idea of federation as being critical for the design of a Future Internet facility,' Prof. Fdida says. 'There are issues related to governance, trust, authentication, resource description, user access, scheduling of tests, isolation of experiments to avoid excessive resource use, monitoring and data collection... in sum, a multitude of software and architectural challenges. But the benefits of a federated system are obvious, not least that it offers the research community easy access to many resources at much lower cost in terms of testbed development time and money.'

In establishing their federated platform, the OneLab team developed a range of publicly available testbed components, from open source software to hardware packages, as well as measurement tools, enabling any developer to use the underlying technology to set up their own testbed, and, if they choose to, join the federated platform.

Today, a significant part of the core software underlying all of the PlanetLab platforms, including the original one in the United States, has been developed in Europe. And it has also started to be used commercially. Orange Poland, formerly Polish Telecom, for example, has further developed the software and is currently using it for its content delivery network.

Meanwhile some of the tools are also being transferred in M-Lab, an open, distributed server platform for researchers to deploy internet measurement tools set up by Google. And the OneLab team have also launched a spin-off project with EU funding called OpenLab, bringing together the essential ingredients for an open, general purpose and sustainable, large-scale shared experimental facility.

In addition, the project partners have started to work with the European Institute of Innovation and Technology (EIT), which has launched a programme of Knowledge and Innovation Communities (KICs)

integrating higher education, research and business in key areas. Specifically, the OneLab researchers are willing to offer their federated platform to students in the masters' programme of a KIC which is focused on ICT, giving them the opportunity to get familiar with the concepts of the 'networking domain' using the PlanetLab facility.

'In my view, developing this further is not just about research and innovation, it's also about education. And our collaboration with the KIC ICT will give young, talented students the opportunity to use very diverse, cutting-edge technology, ' Prof. Fdida says.

In the long run, the OneLab coordinator sees the team being in a position to fully evaluate the benefits of their work and approach within the next two to three years, and in the meantime OneLab will continue to evolve, cooperating and competing with similar initiatives such as GENI in the United States and a soon-to-be-launched platform in China.

OneLab and OneLab2 received research funding under the European Union's Seventh Framework Programme (FP7).

Links to projects on CORDIS:

- [FP7 on CORDIS](#) [2]
- [OneLab2 project factsheet on CORDIS](#) [3]

Link to project's website:

- ['An open federated laboratory supporting network research for the future internet' project website](#) [4]

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- [European Commission's Digital Agenda website](#) [5]

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