



Towards a collaboration and high-level federation structure for the FIRE Facility

Executive Summary

Working Group on modular federation of FIRE Facilities

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Within the context of the European FIRE initiative and the 7th Framework Programme, in Europe several consortia are developing prototypes of experimental facilities to support research on the Future of the Internet. Under the next Call of FIRE, within the ICT Work Programme 2009/10, provision is made for further R&D projects to mature the concept of “federating test-beds” and to provide experimentation services to the European Future Internet research community at large.

The goal for experimental federated test-beds is to enable large scale and diverse experiments with Future Internet technologies from components to complete systems, and to validate and compare them with existing current or other evolving solutions. Many test-beds exist, but they have been shown difficult to sustain, one reason being that it is difficult to maintain over long time a strong community of experimenters using the resource.

The ongoing FIRE facility prototyping projects (Onelab2, Panlab II, Federica, Wisebed and Vital++) show very promising developments in terms of federating these testbeds and making them more sustainable through offering them to the broader research community. These FIRE prototyping efforts are mostly independent, with different - though overlapping - objectives and target customers (experimenters). They are "loosely coupled" through the support action FIREworks, whose major role is to orchestrate and stimulate strategy discussions for FIRE and to support networking within the FIRE stakeholder community and between this community and the user communities, as well as other related initiatives in the EU Member States and abroad.

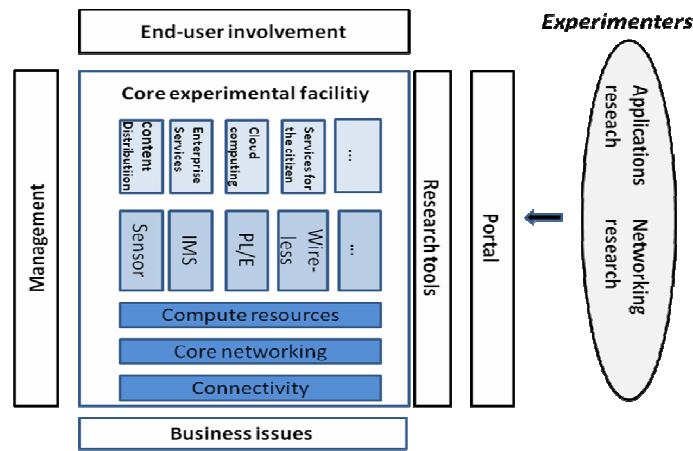
A federation of test-beds aims at creating a physical and logical interconnection of several independent experimental facilities or test-beds to provide a larger-scale, more diverse and/or higher performance platform for accomplishing advanced tests and experiments. Test-bed federation is used to temporarily create a rich environment for test and experimentation to the increase benefit of the experimenters beyond individual independent test-beds. Federation is defined by the presence of at least some common objectives of the testbeds to be federated; without common objectives a federation is meaningless. Federation supports access to several platforms, networks and services for testing in broader context, e.g. for scalability, interoperability or system-level testing. It enables trial and evaluation of service concepts, technologies, system solutions and business models. Federation strategies can be described as horizontal (e.g. supporting large scale experiments with different diversity of end-users) or vertical (e.g. supporting experiments across networking and service platform layers). The relationship between testbeds can also be seen in terms of being peers or having a customer-provider relationship. Even another way is seeing them in a layered relationship as underlay or overlay.

Federation is already taking place at project level (e.g. Onelab2 is federating its PlanetLab-Europe resources with PlanetLab-Central and PlanetLab-Japan), or bilaterally between projects (e.g. PlanetLab-Europe and Panlab both use the Federica resources).

The working group is suggesting a high-level federation and collaboration framework which shall become the glue between the individual facility projects allowing for sharing of tools and resources in a customer-friendly way. Administrative overhead ("red tape") for the simple case of a customer just wanting to use one facility must be kept at a minimum. All current and all future FIRE facility projects are recommended to subscribe to this collaboration framework and pro-actively contribute to its future evolution. Rather than creating one single monolithic and inflexible facility, this dynamic high-level



federation and collaboration framework shall allow each individual FIRE Facility project to fully focus on its own objectives and group of customers, while at the same time collaborating with the others towards a wider and larger-scale offering in a customer-friendly way.



The suggested high-level federation and collaboration framework consists of the following components:

- The **core experimental facility** shall contain application services platforms, networking test-beds, compute resources and networking connectivity. Resources can be physical, virtual and/or emulated. In terms of ownership they can be public or private. The core facility is to be considered the heart of FIRE.
- **Management tools** and policies are the support for the test-bed providers to create standards for test-bed interfaces and federation mechanisms. Those should be used to supervise the usage (and misuse) of the federated facilities.
- **Business issues** include handling business cases for test bed providers and experimenters. It includes issues such as sustainability (in terms of capital and operational expenditure), cost of usage, IPR protection, standardization, and methods for sharing scarce resources. Business issues will be important for commercial test-bed providers and experimenters with pre-commercial products.
- A **portal** is required since the experimental facility is normally not self sufficient to attract experimenters and to evolve beyond the first set of experiments. A portal will make it easier to find and utilize a test-bed or a set of federated test-beds that is the most appropriate for the experimenter. The portal shall aid in combining different test-beds into the test-case environment needed. One overall aim is to allow one stop shop of test-bed facilities, and discovery and support of both novice and advanced users. The portal could eventually support brokering of facilities and reservation of usage when facilities are scarce. Since this is still a research topic, active support of experimenters will need human interaction (e.g. a “FIRE desk”).
- The **experimenter** is the customer bringing in test-cases that will use the experimental facilities. The experimenters are found in the networking, services and application research communities. The network research community will develop security technology, protocols etc. Application and service researchers will develop new software services and platforms for domains like entertainment, gaming, e-health, and enterprise systems etc. that use new networking technologies.
- A group of “**end users**” is part of an experimental facility and in many cases the driving force for innovation in the future internet area. The end-users will create critical mass and user feedback in experiments. End-users are both individuals carrying a mobile device and enterprises participating in an experiment. The **end-users** are found in e.g. living-lab communities or large corporations participating in an experiment.



- **Research tools** support measuring and obtaining results from tests. These tools include test result repositories, statistical packages for analysis, simulation tools, tools for user emulation, traffic generation tools etc. All tools should be shared (as much as possible) between test-beds and experimenters to allow comparison of test-results between different researchers.

This framework and improvements to the FIRE facility are recommended to be implemented as follows:

- Establish a collaboration structure between different FIRE facility projects according to the different modules of the collaboration framework. The major objectives are:
 - to make tools and testbed resources available across facilities as far as possible, as demanded by the experimenters and to agree on and implement federation of resources;
 - to tackle jointly important implementation, development and research issues cutting across different facility projects, e.g. high level federation of resources, common brokering, etc.;
 - to market the FIRE Facility and its projects under one overall "corporate identity";
 - to increase customer-friendliness and stimulate broad and innovative use of the FIRE facility;
 - to create incentives for test-bed providers, protect IPR and implement other business issues;
 - to act in the area of standardization of test-bed description and interfaces.
- Put joint effort into the development of a **portal** that supports one-stop-shop of testing facilities. The portal shall describe test-beds facilities to sufficient detail and help to discover what test-bed or combination of test-beds to use. Since this is very difficult to fully automate, it is suggested to have a manned FIRE portal "desk" from which an experimenter could get support in creating a single or federated test-bed for his/her test-cases. The portal service should also collect and consolidate customer comments and needs.
- Add **new capabilities** to the experimental facilities (e.g. application service platforms to bring more experimenters with new networking requirements, networking research on issues as optical and cognitive radio) to support experimentation at all layers as well from a system perspective.
- Support the federation and collaboration with European national and international projects and initiatives, to open the door towards experimentation with even larger scale and higher diversity, whether at individual project level or at the level of the FIRE initiative.
- Create quality and demand-driven mechanisms for test-bed operators outside of FIRE to federate their resources and provide them within the FIRE framework.
- Provide experimentation facilities both for research projects but also for large-scale trials, in the context of projects and initiatives under in the evolving Future Internet Public Private Partnership Initiative.
- All future projects must foresee from the outset sufficient resources to implement the collaboration and high-level federation framework.

Crucial for the successful implementation of the proposed high-level federation and collaboration framework is a powerful FIRE office, which takes the lead in implementing the framework. The office should be the balancing factor between the goals of the individual projects and the common goal of federation. The office should be led by a FIRE "architect" or a small "architectural steering board" who stimulates and coordinates the collaboration. The architect or the members of the board should be neutral and independent from the FIRE facility projects. They should have the profile of being able to discuss and mediate between strong project leaders at eye level. All FIRE facility projects should be formally represented in a FIRE Office project. A FIRE office project should chair the collaboration under each component of the framework, co-ordinate or run the FIRE portal service, co-ordinate standardization in terms of open source standards like for GUIs or in terms of contributions to standardization bodies, co-ordinate PR for the FIRE facility, coordinate collaboration with other initiatives in Europe and beyond including Geant; represent FIRE in initiatives like Joint Technology Platform or Public Private Partnership on the Future Internet.

Full report available under <http://cordis.europa.eu/fp7/ict/fire>