FIREWORKS

Report on FIRE Initiative

Editor:	Susanna Avéssta
Deliverable nature:	<Report (R) >
Dissemination level: (Confidentiality)	<(PU)>
Contractual delivery date:	
Actual delivery date:	15.11.2010
Suggested readers:	Consortium partners, European Commission Services, FIRE Community
Version:	1.0
Total number of pages:	20
Keywords:	Testbed federation, networks, experimental facility, federation, governance

Disclaimer

The commercial use of any information contained in this document may require a license from the proprietor of that information.

Neither the FIREworks consortium as a whole, nor a certain party of the FIREworks consortium warrant that the information contained in this document is capable of use, or that use of the information is free from risk, and accept no liability for loss or damage suffered by any person using this information.

Impressum

[Full project title] Future Internet Research and Experimentation - Strategy Works

[Short project title] FIREworks

[Number and title of work-package] WP3 FIRE Initiative

[Document title] Report on FIRE Initiative

[Editor: Name, company] Susanna Avéssta, DIMES Association

[Work-package leader: Name, company] Anastasius Gavras, Erescom

[Estimation of PM spent on the Deliverable] 0.5

List of authors

Company	Author
DIMES	Susanna Avéssta, Jerker Wilander, Jacques Magen
EURESCOM	Anastasius Gavras, Milon Gupta
UPMC	Serge Fdida

Table of Contents

1 Introduction

Networks are the neural system of our society as the Internet keeps revolutionizing the world: the way we work, exchange, interact, communicate and behave. Equally, we revolutionize the Internet, the way it works, exchanges, interacts, communicates and behaves. Our needs, use and visions make it evolve into Future Internet. A man is heuristic and discovers through experimentation. FIRE (Future Internet Research and Experimentation) offers a discipline, a platform and tools for trying out Future Internet. FIRE works for users.

Research into new paradigms and the comprehensive test facilities upon which the ideas are experimented together build a key resource for driving European research into future networks. This environment enables both incremental and disruptive approaches, supports multi-disciplinary research that goes beyond network layers, scholastic dogmas and public-private discussions. It provides a core infrastructure, and also a playground for future discoveries and innovations, combining research with experimentation.

The decision to establish FIRE initiative within FP7 took place four years ago. The first scouting for experts to define a strategy for that new initiative started in November 2006. The first FIRE expert group gathered in Paris in January 2007 hosted by UPMC, the call was out in the following summer and first FIRE projects selected early 2008. Now FIRE Strategy has been revisited two times, latest in February - April 2009 and the first FIRE projects are coming to their end, the second wave of projects just took off.

The heterogeneous and modular field of Future Internet Research and Experimentation with its national and international stakeholder groups requires community and cohesion building, information sharing, and a single point of contact to co-ordinate and promote the FIRE approach with respect to the following main axles:

There is an increasing demand from both academic and industrial communities to bridge the gap between visionary research and large-scale experimentation, through experimentally-driven advanced research consisting of ‘iterative’ cycles of research, design and experimentation of new networking and service architectures and paradigms addressing all levels, including horizontal research on issues such as system complexity and security.

This approach needs the set-up of large-scale experimental facilities, going beyond individual project testbeds, which are also needed as validation tools, i.e. for interoperability issues. They would help in anticipating possible migration paths for technological developments, which may be potentially disruptive; in discovering new and emerging behaviours and use patterns; as well as in assessing the socioeconomic implications of new technological solutions at an early stage.

FIREworks support action was launched in April 2008 to coordinate and promote FIRE Initiative, in particular along the following objectives.

1. FIRE Strategy

   FIREworks facilitated and stimulated the strategy development of two dimensions:

   - Promoting experimentally-driven, visionary research on new paradigms and networking concepts and architectures for the future internet. What research, what type of testbeds?
   - Building a large-scale experimentation facility to support both medium and long-term research on networks and services by gradually federating existing and new testbeds for emerging or future internet technologies. How to federate?

2. FIRE Community

FIREworks creates a sustainable forum for testbed actors in the area of the future internet, including networks and services:

- FIRE Office will be founded for serving the FIRE Community members in administrative issues, such as maintaining information on testbeds, enabling exchange of information within the Community, organising events, promoting testbeds and their development and raising awareness on FIRE
- FIRE Initiative will be launched to continue the work specified and started in the project

The outcome of FIREworks in these challenges is to deliver required information between stakeholders, and in specific, between projects about the needs, prerequisites and criteria for experimentally-driven research, and a roadmap for a European large-scale experimentation facility. The ultimate objective of FIREworks SA was to ensure both tighter collaboration of testbeds with the aim to improve overall testing features and provision of a higher number of testing services in Europe.

2 FIRE Strategy

FIRE Strategy once created in spring 2007 has been regularly revisited by experts of the field, facilitation provided in collaboration with Commission services and FIREworks. This has resulted in FIRE White Paper, published in June 2009. In addition to specific FIRE Expert group meetings, in numerous workshop and events organised by FIREworks FIRE strategy has been exercised and discussed (FIREweeks 2008-2010, FIA-FIRE sessions 2008-2010). All these statements are recorded in FIREworks website in connection with the respective event. The latest major report (internal) produced in FIREworks, FIRE Portfolio analysis (completed in November 2010) discusses strategic issues for FIRE and gives recommendations for actions to be taken. Few main characteristics of FIRE can be highlighted

- FIRE keeps research and its facilitation together. FIRE is about both experimentally-driven research and providing facilities for this. It is a circle where researchers define the needs for the facilities to support their research, hence providing the blueprint for the facility builders. It is the researchers who participate in the testbed and tool development, finally experiment and give feedback about the experimentation and its facilitation.
- Multidisciplinary approach: Real innovation often comes at the intersection of different disciplines. Moreover, the Internet is a complex system, depending on a multifaceted interrelation between technologies, users, services and applications. Carefully evaluating these interrelations is key to harnessing and exploiting the full potential of the Future Internet for the economy and society at large. Non exclusive examples of such cross-fertilisation are:
    - To apply bio-inspired principles to network design, which for instance can exploit the presence of redundancy, random patterns or even noise in the system to obtain extreme robustness and reliability, for instance in unpredictable environments.
    - To explore means by which networks can change, learn and develop spontaneously.
    - To apply concepts from the dynamic process of optimisation involved in neural development to the paradigmatic exploration of concepts for the new Internet.
    - To apply findings from social psychology experiments to capture or predict human interaction. Taking into account the interdependency of the users is crucial in order to optimise future communication systems.
    - To apply traditional market or economic rules, such as try, buy, change, borrow Future Internet services as is done today with material commodities.
- Clean-slate versus incremental approaches: New technological solutions may follow either an incremental approach or a “clean slate” approach. Whereas FIRE experimental facilities are obviously meant to be open to both types of approaches, the research carried out under FIRE addresses mainly more visionary though not necessarily disruptive approaches; more risky but at the same time more likely to yield significant improvements.
- Research content - open, bottom-up: There should be no boundaries for the research, but rather the freedom to address any emerging or radically new but promising concepts to address the fundamental limitations of the current Internet. This can span all layers of the communications protocol and levels of the value chain, from the network connectivity up to service architectures – and, of course, explore different paradigms which might not be based on layered models.

- To the date FIRE has little internal overlap between major projects. To further avoid this, especially FIRE facilities need synchronization, resource optimization, and common efforts in order to offer customers the best possible service and ensure their sustainability beyond project life times.
- It is important not to impose an abstract goal of federation when there are no use cases for combining two or more specific testbeds. Motivation for cooperation needs to stem from the mutual benefit and shared goals.
- A common, dynamic and user-friendly interface would be an added value and serve not only customers but also ensure a higher usage rate of the facilities.
- Researchers need correct and timely knowledge about the available resources, easy access, high usability and appropriate tools to run and monitor their experiments.
- FIRE differs from GENI in that FIRE emphasizes the value as seen by an end-user, at the edge of the Internet, with its applications or services, while GENI is focusing more on basic infrastructure technologies.
- Promoting the FIRE concept, activities and community worldwide: FIREworks has worked for making FIRE globally known. FIRE Initiative was in its cradle when FIREworks started. Liaison within Future Internet constituency, with national initiatives, with various platforms (e.g., ETPs, Celtic) and international counterparts (e.g., GENI, AsiaFI) has been high in the strategy agenda. It can be said that FIRE is known, some key-actors well recognised and FIRE offering becoming more tangible and accessible, as the first projects have matured and delivered first results. More about FIRE Liaison in Chapter 5
- This leads to what form of coordination and governance structure would suit for best FIRE Initiative that FIREworks has studied. The outcome is: as simple and democratic structure as possible, ensuring all involved parties benefiting from the engagement. These have been set as main principles and as a result the governance structure described more in detail in Chapter 4 and its two bodies: FIRE Office and FIRE Architecture Board. The deliverable D3.2 describes the services provided by the planned FIRE Office, which is to be ran by the follower of FIREworks, the next support action responsible for the coordination of FIRE.

The work according to these lines have started, with new projects coming into the picture, the strategy evolves, objectives get higher. **Internet Science was introduced** as a new discipline supported by FIRE Initiative, capturing the multi-disciplinary nature of Future Internet research.

3 FIRE Facility

3.1 Requirements

For experimentally-driven research related to the Future Internet, researchers need an experimental facility for validating their research on networks, service architectures and paradigms. The FIRE Initiative addresses the emerging expectations, which are being put upon the Internet, by providing a research environment for investigating and experimentally validating highly innovative and revolutionary ideas. This environment is called FIRE Facility and it consists of several FIRE projects developing an experimental facility for open use. Each project develops a large-scale testbed or a federation of testbeds, and they contribute to the common FIRE Facility offering with their developed facilities. Hence the FIRE facility offering not only originates from various sources, but also with different usage policies. It has been addressed that a common, dynamic and user-friendly interface would be an added value and serve not only customers but also ensure a higher usage rate of the facilities.

What concerns FIRE large-scale experimental facilities, the purpose of FIRE Initiative is to join forces to allow for the most efficient bilateral (and multilateral when and if appropriate) collaboration, reduce duplication of work, share experiences and best practices and work for the future of experimental research. In light of this, the main objectives are as follow:

To move the FIRE Facility towards a more customer-driven, dynamic, effective, sustainable, easy-to-access and easy-to-use experimental platform

- Establish a collaboration structure between the different FIRE facility projects according to the collaboration framework defined by the corresponding Working Group in the Architecture Board; and co-ordinate and support these projects in implementing developments and performing other activities related to this high-level federation framework,
- Support the development of a portal supporting a one-stop-shop for accessing the testing facilities,
- Identify potential new capabilities that should be added to the existing experimental facilities,
- Promote and support collaboration with European, national and international projects and initiatives on experimental facilities, as well as testbed operators outside of FIRE to federate their resources and provide them within the FIRE framework.

To intensify the collaboration amongst the FIRE Community (all FIRE projects, all related stakeholders, such as other testbeds, testbed initiatives, customers of testbeds (projects, researchers from academy and industry))

- Help bring customers to the facilities (e.g. by supporting the “Open Call” process),
- Establish an information channel and a widely recognised forum to spread knowledge on various FIRE-related research topics and achievements relevant to experimentally-driven research on the future internet (academic and industrial),
- Promote and develop the FIRE approach of researchers performing future internet experimentation of the facilities,
- Build and maintain links with similar actions internationally,
- Promote FIRE as a channel for - and support of – research.
- FIRE as a channel for - and support of – research.

These objectives can be achieved by:

- Setting up and operating a FIRE "front office" which will act as an entry point into all European FIRE activities for projects and researchers, in addition and in complement to the direct contacts with each IP;
- Strengthening the co-ordination and collaboration among the IPs developing test facilities and selected in respective ICT Calls of objective 1.6; and

An effective testbed should be used by both experts in the technology, which it exposes and those who just want to integrate that technology with higher or lower levels in an application stack. It must be robust enough for reliable, reproducible tests by the first category of users as well as for durable prototypes needed to expose new functions to end users.

FIRE experts Jerker Wilander, Scott Kirkpatrick, Jacques Magen and Dirk Trossen have constructed a diagram (Figure 1), which captures the set of issues which must be dealt with by a single testbed or (by recursion) by a federation of testbeds. This also provides a simple way of categorizing the issues that must be addressed to support real external users:

- "User facing clearinghouse " is the way a facility is discovered, how you can be authenticated as a user and how the access to the facility can be defined. This is not only a list of facilities it is also the ability to create an understanding in what way a facility may be used.
- "Terms & conditions" includes the cost to use a facility, the acceptable use policy, frequency and duration of use.
- "Security & Privacy" defines both the ability to protect the IPR of the experimenter and the facility provider. It also includes methods to protect privacy of a traffic data.
- "Operational & Research Monitoring" are the functions to start, stop and meter experiments and other operational aspects of experiment control.
- "Define, simulate and control experiments" is the process of creating and supporting the experimental development process.
- "User support to grow the market for test beds" is the process to make public what facilities are available and when, announce federated facilities and promote use of facilities for other user groups.
- "Deployment of resources" is the process of creating the virtual test bed for an experiment where both physical and software resources will be bound to an experiment.

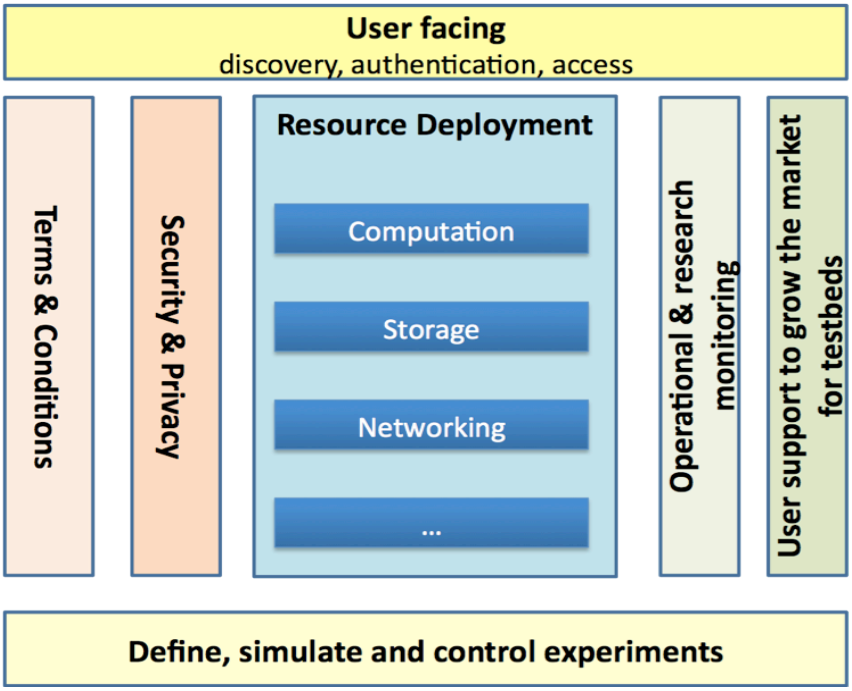

Figure 1 – FIRE experimenter requirements on facilities

Note that this does not mean that it is necessary that all test beds investigate all these features; they should however take advantage of the work, which is done in other test beds and/or in common so that all features are available in their test bed. These functions are required for a successful FIRE federated facility. A federation of testbeds aims at creating a physical and logical interconnection of several independent experimental facilities or testbeds to provide a larger-scale, more diverse and higher performance platform for accomplishing tests and experiments. A collaboration/federation framework is not about having rigid control of all aspects. On the contrary, the aim is to have flexibility and preserve the autonomy and character of the components/projects. In this sense, high-level federation does not at all mean to agree on the same control plane, but rather to allow resource sharing and collaboration towards establishing a sustainable customer-friendly facility. It is important to maintain the major goal of each individual testbed project, which is to create innovative solutions for testing and to support their community of experimenters, while at the same time also contributing to the common goal of collaboration and federation of experimental facilities.

3.2 Today

In spring 2009 four FIRE experts, Jerker Wilander, Jacques Magen, Piet Demeester and Phuoc Tran-Gia made a study of all FIRE facility projects running, namely OneLab2, PII, FEDERICA, WISEBED and Vital++. The goal was to identify premises for high-level federation structure among FIRE facility projects, also to identify potential overlaps, synergies and white spots in the offering. This report is FIREworks deliverable D2.5 Draft Concept and Architecture of the FIRE Experimental Facility, but also published as a separate paper under the title: Towards a collaboration and highlevel federation structure for the FIRE Facility. The report depicts the following facility landscape as in Figure 2.

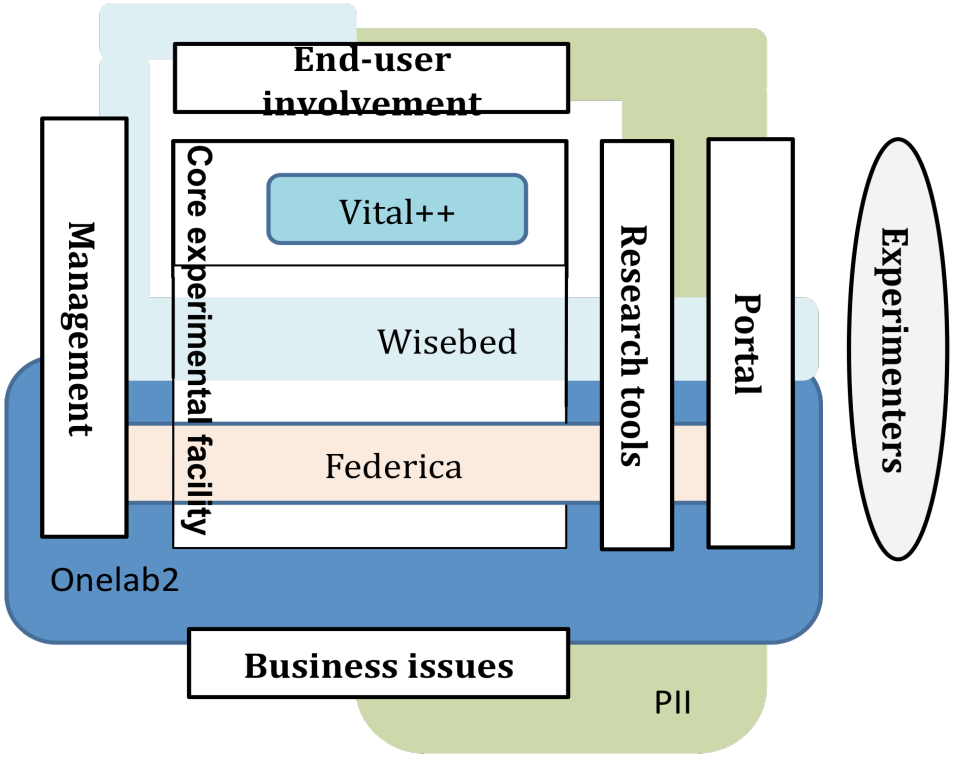

Figure 2: map of existing facility prototypes on collaboration structure.

OneLab2 (PlanetLab) federation is based on bottom-up Slice Federation Architecture (SFA), whereas PII (Panlab) has top-down approach in federating heterogeneous testing sources. The latter have centralized the control of the resources, which they federate in a single clearinghouse. In contrast to this approach, SFA defines independent clearinghouses, each of which can allocate and manage resources, and in which identity, authorization and privacy policies are carried out. SFA's clearinghouses can be federated, giving SFA the potential to manage much larger scales. It will thus be possible to include commercial test beds controlled by their own clearinghouses, which can impose localized access and usage policies.

During the latter half of 2010 the second wave of FIRE projects (FP7 ICT Call 5) have been launched. Therefore the landscape looks as illustrated in Figure 3.

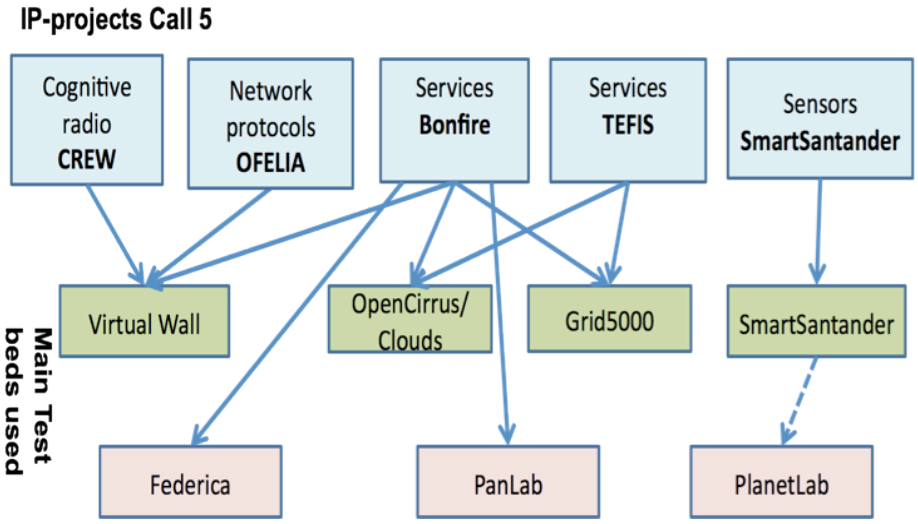

Figure 3 - FIRE Facilities and new projects from FP7 ICT Calls 2 and 5 respectively

FIRE experimenters in the second round of facility projects will have more complicated requests than earlier. Federating heterogeneous test facilities while introducing new technologies, while keeping it all simple for the sake of outside users, will impose a greater need of collaboration between projects. An experimenter will need support in order to be able to work and this will become more paramount when further federation of facilities will occur.

In Call 2 some of the issues mentioned in Chapter 3.1 have been addressed in the projects, but mostly not deployed to the extent that a user community outside the project itself is able to use the facility. The discovery utility in Panlab and the Teagle brokering tool used for deployment of experiments is still not publically available. The sliced-based facility architecture as defined in PlanetLab and used by Onelab for the definition of its services is a technology used by many today. However, the extensions to further shareable facilities have been in use only a short period of time.

Experimental facilities have different major goals, meeting the needs of diverse and sometimes non-overlapping sets of users. One set of classifications could be:

- Methods for end user involvement and end user experiments as found in user innovation research (discussed in PII, planned in STREPs of Call 5).
- Application development and conformance testing (PanLab/PII, Tefis and Bonfire).
- Core networking research (Federica, OneLab, Ofelia).
- Networking component technology (Wisebed sensors, SmartSantander, OneLab and also available in Crew).
- Aspects of networking and/or to create a facility to be used for networking (DTN as in N4C, P2P as Vital++, cognitive radio as in Crew).
- Architecture studies are a special case, where no test facilities have been made open to other experimenters (exemplified by several Call 2 STREPS).

3.3 Future plans

The Portfolio analysis addresses very concrete recommendations in three areas, namely the immediate steps to be taken by FIRE coordination (FIRESTATION) and call 5 projects, missing elements for call 7 and 8 preparation, and challenges for the unit in charge of FIRE in achieving the vision of sustainable large-scale experimental facilities.

Immediate Steps for FIREStation – Portals, Federation, and the Open Calls

- A common portal is a required tool to improve usage. However, deployment and control of an experiment makes it necessary to find intermediate stages when defining and implementing shared tools. It might also become necessary to support more than one (but not many) competing approaches to the problem.
- The selection on use of facilities when heterogeneous federation is required has to be a decision based on implementation cost and goals/interest of the involved individual facilities. As a result, the combinations (projects, use cases, and users) leading to the most exciting advances are and will be rare. These must be cultivated.
- There has been progress in top-down federation in FIRE projects, while SFA (in FIRE + GENI) has shown potential for scalability in bottom-up federation. FIRE should address the integration of these two approaches.
- It is necessary to clarify how the open calls are to be coordinated. The FIRE Office (i.e. FIREstation) and the IP projects must each have influence on which projects are chosen. The procedures for the open calls need to be formalized and explained to the IPs, to align the selection process with the overarching vision of a federated experimental facility.
- Sharing/interconnecting data, not only resources, is crucial since it will enable sharing of data across experiments. Benchmarking and repeatability of experiments is key to experiments of high quality and scientific impact. This will put requirements on format, storage, and access to experimental input data and results. It also will require comparable methods for measurement. Data archiving will become increasingly important as user projects evolve. Standards and shared tools in this area should be organized once the shape of the experiments performed under the open calls is visible.
- Sustainability of each FIRE experimental facility shall be studied in the context of a sustainable FIRE federated facility.
- FIRE coordination should take the lead in identifying appropriate levels of user support and ensuring that the best practices are shared across the FIRE portfolio.
- This coordination overall needs to be streamlined in the light of the upcoming PPP and the Calls 7 and 8. Less is more!

Missing Elements – for Call 7 and Call 8

- Optical networking and equipment found at the edge (e g hand held terminals) are still underrepresented in the FIRE portfolio. Also the application efforts address computational resources but not storage (possibly “in the network”) of the large amounts of data consumed or generated.
- A vision of end-to end support for the FIRE users need to be integrated into the requirements of Calls 7 and 8. Put the FIRE customer at the center of these efforts, with measurements of usage and value to the end-user (both developers and true end-users) as key to success – see below in challenges to the FIRE unit.
- Calls 7 and 8 shall explicitly indicate the relative weight of user support for the projects proposing to build the future FIRE facility.

Challenges to the FIRE Unit

- It is important to establish metrics for facilities with respect to inter-project collaboration and user attraction – these need to become the main review criteria for technology progress.

As a consequence, if collaboration and attracting external users remains modest, projects need to be terminated earlier in order to eliminate wasted efforts that are not used in the wider FIRE environment!

- Experiments in heterogeneous federation must be encouraged and probably become a strong requirement in future calls. As a consequence, there is a need to establish metrics for facility usage that establish strong barriers against unnecessary re-implementation of facilities and tools that already exist. These metrics need to be a major foundation for any experimental research project.
- Establish efforts to create a sustainable facility outside the current project structure since concerns about availability when an experiment is ready, and sustainability after funding terminates will restrict the value of any FIRE facility. Only true sustainability (

4 FIRE coordination and governance

FIRE Initiative is challenging to govern due to its fragmentation and actors' temporary and competing nature. That is, FIRE projects developing and supporting FIRE facilities have to apply for funding every 24 - 36 months, presumably competing against other FIRE projects. Yet, cooperation for a common strategy and roadmap, sharing expertise, interface and platforms, integration and joint development are primordial for a demand-driven, cost-effective, up-to-date and user-friendly FIRE facility that can meet the evolving technical challenges. This implies that the governance structure can be heavy or overloading FIRE projects. However, it needs to have a mandate to steer and moderate the development and integration of the FIRE Facility, the joint initiative to facilitate experimentally-driven research on networks, service architectures and paradigms. The governance model needs to be agile and encouraging, to create a positive turmoil within which FIRE projects benefit from the cooperation instead of experiencing it as an extra burden.

Consequently, the FIRE governance model consists of only two main bodies: FIRE Office and FIRE Architecture Board. FIRE Office is to serve and manage, operative, communicative issues, provide support for the whole FIRE community. FIRE Architecture Board is a democratic entity, consisting of equal members of each running FIRE project and deciding on the strategy and implementation of the FIRE Facility evolution.

4.1 FIRE Office

FIRE Office will be the operations centre for all FIRE activities, for the FIRE Initiative in close cooperation with Commission services, the respective unit in EC in charge on FIRE. FIRE Office will be established under the following FIRE support action, that is, FIRE Office will be the core activity in the call 5 FIRE support action in charge of general FIRE coordination.

FIRE Office will pro-actively discuss with research projects their large-scale experimentation requirements and help to initiate tests on existing testbeds. When no single existing testbed is able to support the intended test, FIRE Office will - together with the research project and the Architecture Board - examine if a combined response from several testbeds could meet the requirement (i.e. leading to the notion of a "federation" of testbeds), or if the development of an extension to an existing testbed would be feasible.

The other instrument to facilitate and moderate the dialogue and interaction between customers and the test facilities are the regular Workshops, held in conjunction with FIA events and FIREweeks. These aim to inform and to cross-fertilise ideas and best practices, and identify developments to the FIRE facilities that would contribute to the customer-driven approach. Aside from physical meetings, interaction and discussion will take place via the interactive FIRE Forum, which is a supported and moderated virtual "meeting place", i.e. a professional social network, or a modern Wiki tools (LinkedIn groups, etc).

FIRE Office takes care of the daily operational contact for FIRE. FIRE Office serves as an entry point; it will operate and maintain a public portal (Website) that presents existing testbeds and their capabilities, and will offer Help Desk services for novice experimenters or those requiring the services of more than one testbed. When, and if, a more advanced type of portal becomes available from one or more of the IPs (e.g. one with an automated or semi-automated brokering service for reserving resources across multiple testbeds), this will be incorporated into the portal by the FIRE Office. However, the FIRE Office has a non-technical, administrative function. FIRE Office will forward the more technical questions to the Architecture Board. The Architecture Board would then provide a response, or will decide that new developments are required to respond to the requirement, by one or more of the projects running experimental facilities. In such a case, it would provide a calendar for the implementation.

4.2 FIRE Architecture Board

The FIRE "Architecture Board" is in charge of strengthening the coordination and collaboration among the projects developing FIRE test facilities, including for demand-driven extensions. The Board decides and agrees upon tasks and activities that shall be shared and coordinated among test facility projects for the benefit of the whole FIRE community.

The main objectives of the Architecture Board are to support the development of heterogeneous federation of experimental facilities, and to support harmonisation and extension of the future and existing experimental facilities in FIRE.

The main activities foreseen for the Architecture Board are as follow:

- Looking at the requirements from users which are forwarded by the FIRE Office, and decides and agrees upon how and when one or several FIRE test facilities could respond to such requirements. This activity may be regarded as a "Level 2" Help Desk service for FIRE customers i.e. when the response needs further analysis and possible additional developments that could not be directly provided by the FIRE Office in charge of "Level 1" Help Desk service. The response will be channelled back to the users through the FIRE Office.
- Discussing and deciding on any other issues related to a more efficient collaboration and shared development between facility projects. It is worth noting that the Architecture Board does not perform such additional developments; it rather suggests who should do it and when. This means that the main responsibility of the Board lies in helping and supporting the IPs in coordinating in the most efficient manner tasks and activities that will be beneficial to the whole FIRE community and that can be shared among IPs.
- Evaluate, disseminate and possibly collaborate with relevant initiatives in Future Internet research and experimentation for the benefit of the FIRE initiative, whenever requested from FIRE Office.

In addition, the FIRE Architecture Board also intends to be a proactive entity. It shall therefore also perform such activities as:

- Further define the Concept of "Modular High-level Federation", initially defined in the Report "Towards a collaboration and high-level federation structure for the FIRE Facility", and have it implemented by the IPs in a coordinated and efficient manner, while demonstrating that each shared development is actually responding to users' requirements and/or that it avoids replication of work.
- Further define and promote the concept of "experimentally driven research". In order to do this, it liaises with research projects such as FIRE STREP projects but also potentially with other research projects, which could promote such a concept. This activity is performed in close relationship with the FIRE Office.
- Draft and update a common roadmap of FIRE test facilities all along the course of the project. This could be used by FIRE Office to either better respond to users' requirements or to use this document to more efficiently prepare requirements to be analysed by the Architecture Board.
- Define how and when the FIRE test facilities could become self-sustainable altogether. Supporting the PPP projects and future experimental research requires indeed a sufficient level of trust that the FIRE experimental facilities will live long enough. Sustainability of experimental facilities is a question that can certainly be shared among the various facilities even if each of them may have different plans and business models. The Architecture Board could help define some common policies and help towards a common "sustainability roadmap". Support from the External Experts Advisory Group could be particularly interesting here, also because the experts are involved in other initiatives and could bring some level of experience of what is being done elsewhere.

In order to successfully achieve all these tasks, the FIRE Architecture Board brings together one representative from all running facility project (i.e. initially the ones from FIRE Call 2 and Call 5), who agree to participate. The Architecture Board is composed of "full members" as follows:

- One "Chairman". The role of the Chairman is to chair the Architecture Board.
- One "Moderator". The moderator's role consists in helping to achieve consensus on all issues, edit the documents to make them more comprehensive to everyone, and draft minutes when required. It also includes making the link with the FIRE Office.
- One "technical" representative from each running facility project who will agree to participate. Considering the main objectives and activities of this Board, it is suggested that "Technical Managers" or people with an equivalent position within the facility projects are appointed in the Board. The decision however lies with each facility project.

Only running IPs can be members of the Architecture Board. As soon as an IP is completed, it does not participate any longer in the Architecture Board.

In addition to these full members, other people could be appointed as "observers". Observers, coming from other relevant projects, will be requested to provide inputs and contributions whenever deemed appropriate. However, unlike the FIRE facility projects, they will not be a full member of the Board as their project is not directly linked with the shared activities and developments requested by the Board.

5 Visibility of FIRE and liaison

5.1 Awareness on FIRE

As FIRE decided to become acknowledged and known since its start, several actions were taken. FIRE Initiative has organised annually a series of events collocated in the same place and in consecutive days following EU Presidency as a location.

In 2008 during French Presidency the launch of Initiative was organised by Commission services, FIREworks and OneLab2 in Paris. The official launch of the 14 FIRE projects was celebrated at the FIRE Launch Event where stakeholders and experts around the world were invited to share views and build synergies between the numerous Future Internet initiatives targeted to long-term disruptive research and experimentation. European, US and Japanese thoughts and plans were discussed involving both academia and industry. FIRE Community was fortified through several events taking place at the same week with nearby premises. FIRE Strategy was developed through discussions and especially in the Strategy workshop organised to brainstorm the requirements for the European Experimental Facility. Altogether six events and more than 500 participants involving FIREweek 2008 was a success for FIRE Community.

In 2009 the Swedish Presidency was kicked-off in Lulea with the conference "FIRE & Living Labs – Future Internet by the people, with support of the Swedish EU presidency, organized by the European Commission DG INFSO, FIREworks, the CO-LLABS project and the Centre for Distance spanning Technology at Luleå University of Technology, in cooperation with the FIRE portfolio projects and the European Network of Living Labs. The focus of the event was on multidisciplinary and participatory experimental research of Future Internet. For organising the series of events on the first week of July FIRE joined forces with Living Lab community and one of the topics is to address how FIRE and the Living Lab movement can work jointly together and to discuss where and how users can bring added value for Future Internet research to best contribute to European competitiveness and growth. FP7 ICT call 5 will publicly announced at the event. Despite the remote location and the holiday season in Northern Europe this second FIREweek gathered 330 participants, from 30 nationalities, 70 speakers, 22 parallel sessions, 9 review meetings, 8 project meetings and ITU-T task force meeting on future networks, in addition to 11 preparation meetings. It was another success for FIRE Community.

In 2010 Spanish Presidency was concluded in Barcelona, where the conference "FIRE week – future internet research and innovation" was held in association with the Spanish EU presidency, Commission services, FIREworks and University Pompeu Fabra.. The conference was a meeting-place of the FIRE community focusing the mission to engage people, users as co-creators in the development of new successful and innovative products and services. Both FIRE and SAC had project reviews in accordance to the main event and workshops under the theme. Following the FIREweek tradition, also Barcelona attracted community and attendance was at the same level as the past two years.

In addition to annual FIREweeks, FIRE has participated and contributed to 6-monthly Future Internet Assembly ever since the first one held in Bled March 2008. FIRE has organised in every FIA breakout sessions, interacted with FIA constituency to best understand the user needs and to inform and update on FIRE activities and experimental facilities. FIREworks representatives and FIRE projects have been active in FIA Book contribution and lately in FIA Roadmapping as well.

In addition to this FIRE has been in contact with relevant national initiatives (e.g. France, Finland, Germany, Spain, Sweden), GEANT (TERENA, Dante, NRENs), Eureka-Celtic, ETPs and FI PPP. Various conferences and workshops have been attended: FIRE has been represented in organiser role (e.g. technical committee), given invited talks or exhibited.

5.2 International activities

FIRE is not only an initiative that needs to get global attention, it serves the global community of future internet research. The future internet is global research challenge and architectures developed and experimented need a global scope and facilitation. It is even anticipated that the breakthrough innovations and ideas do not grow in our secured welfare environment, we need to get out to collect them, stay involved in the emerging development as tightly as possible. US and North-East Asia were identified at the negotiation phase as the most prominent regions to match interests and have plans synchronised with the given limitations of time and resources. However, liaison and linkages have gone beyond that, and it could be said that in terms of WP4 FIREworks have exceeded the expectations to a large extent. Beyond promised scope are the southern part of Asia, Australia and South-America, where in particular OneLab2 has carried out a substantial effort and brought FIRE into awareness.

The Japan-EU cooperation had a quick and massive start in June 2008 organised event in Brussels attracting over 200 participants worldwide, including high-level people from Ministry of Internal Affairs and Communications and NICT. A follow-on event was held October 19-22, 2010, out of the project lifetime, but preparation and organisation were powered by the FIREworks project. The work has been substantial on a project level with several axels, CoreLab (PlaneLab Japan) and Tsinghua testbed being federated to OneLab2, and YRP (Yokosuka Research Park) getting connected to PII facilities through Dimes facilitation. Japanese researchers are keen on forming international alliances, especially in terms of next generation mobile communications. The competition on winning standards in large markets motivate for cooperation. Korea and China have been orderly liaised, and by UPMC and Dimes several links to both in academia and industry are active and contacted on a regular basis. Interactions, signed Memorandums of Understanding and cooperation plans have been put in place with Chinese, Korean and Thai colleagues on behalf of OneLab2, its global federation leads way for facility providers internationally. Recently established new connections via Japanese Chinese Broadband Association (JCBA) might offer the boost for Chinese counterparts to establish sustainable collaboration means for mutual benefit. NICTA in Australia being a OneLab2 consortium member offers new opportunities to establish links between Europe and Australia. South-American liaison was in the EC agenda during this second project period, and a workshop was organised in Sao Paolo. In addition, the links to various research organisations under PlanetLab theme were further developed.

Cooperation is tightest and most advanced with GENI initiative in US. Several events have been organised and invited talks to respective parties' conferences kept. The cooperation base is growing and cooperation on a project level intensifying. A few European FIRE actors were in the consortia that received GENI funding from the Solicitation in February 2009 (spiral 2). Cooperation pairs on a project level have been identified: PlanetLab/VINI-OneLab, iLab.t-Emulab, ORCA-PII. On the other hand the US initiative OpenFlow landed in FIRE as a result of call 5 in the OFELIA project. The latest more technical workshops organised together with GENI (in May 2010 in Princeton and in September 2010 in Brussels), as well as the project level engagement, presented use cases (e.g. T. Zseby: Multipath routing experiments in federated testbeds) and carried out experiments demonstrate the need for international testbed federation and close interaction with GENI.

6 Conclusions

FIRE Initiative turns soon four years. It's an energetic toddler who stands and runs well, gives a lot to his environment, but has still some road to walk, bumps to hit along the way, until it manages and supports others on its own. The FIRE offering is already today versatile and more variety is being built the coming months. The greatest challenge will be to find a sustainable model to secure the offerings meeting the rich and evolving user requirements. This can happen through collaboration of each party: vertically between users and facility providers, and horizontally with different facility providers. The collaboration requires coordination, that in its turn, requires means and fair rules (e.g. metrics) to ensure multilateral benefit for all projects and stakeholder groups involved. Meeting the requirements of users, inviting enough users to sustain and develop the facility, federation challenges across heterogeneous and competing field, are just some more challenges to mention.

FIRE Initiative had a change of shift in coordination as FIREworks stepped down and FIRESTATION took over. FIRESTATION has ambitious objectives managing the federation of FIRE facilities. With committed parties involved, right support from Commission, well-defined milestone objectives, the agreed and shared (most importantly) goal can be achieved.

