

Trade-offs and responsibilities in Phases 2 and 3 of the FI-PPP Program

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Objectives

The FI-PPP is specified in three Objectives of the 2011-12 FP7 ICT Work Programme:

- Technology Foundation (Obj 1.7): development of software 'generic enablers' for the Future Internet, which can be used as a common Future Internet Core Platform (CP);
- Use Cases (Obj 1.8): specification and implementation of use cases, generating requirements for the CP, and validating and demonstrating the value of the Future Internet in experiments and trials;
- Capacity Building & Infrastructure Support (Obj 1.9): identification, classification and integration of infrastructure capacities to support experiments and trials, and federation of infrastructures to provide a pan-European facility for Phase 3 pilots.

Obj 1.7 started in Phase 1 of the FI-PPP, and is being handled by the FI-WARE project, which also overlaps with first year of the Phase 2 of the FI-PPP. Obj 1.8 and Obj 1.9 also started in Phase 1, being handled by a number of Use Case projects and the INFINITY project respectively. The implementation of both objectives will be carried forward by new projects in Phase 2 (from now on referred as Trial projects and the Capacity Building project respectively). Obj 1.7 and Obj 1.8 will be further continued in Phase 3 by a dedicated Technology Foundation Continuation project, and a Use Case Expansion process involving new user communities, entrepreneurs and developers. All the mentioned projects will be globally referred as 'FI-PPP implementers'.

This white paper has been produced following discussions within the FI-PPP Architecture Board¹ of the requirements that need to be met by the different Objectives of the FI-PPP programme. It is intended as a guide to Phase 2 proposers (of both Trial and Capacity Building projects), indicating where they should be clear about their approach(es) and what assumptions (if any) they are making about other parts of the FI-PPP programme.

A wide range of possible solution approaches is possible, reflecting different trade-offs for addressing architectural, operational or socio-economic issues. Indeed, the Architecture Board has found that some Use Case projects lean towards different ways to resolve the trade-offs, so that the FI-PPP may have to allow for some variation between usage areas. These different approaches should be reconcilable with a coherent definition of roles and responsibilities for each of the Objectives in the FI-PPP programme for aspects such as accommodation, provision and operation of infrastructures, FI-WARE Generic Enablers operation, maintenance and software support, as well as user support and training. We also note that coherency may be difficult to achieve where projects start at the same time, e.g. between the Trials and Capacity Building project in Phase 2. Each project then has to be planned without certain knowledge of the other(s).

¹ This paper is based on a variety of viewpoints raised in FI-PPP Architecture Board and other cross-project discussions, but does not necessarily reflect the official views of all the partners in the FI PPP.

The goal of this paper is to highlight the trade-offs and identify a coherent distribution of roles and responsibilities that may help to drive next phases in the implementation of the FI-PPP programme. Submitters of proposals to Objectives in Phase 2 and 3 of the FI-PPP programme are encouraged to consider this information while designing their proposals.

Trade-offs in the implementation of the FI-PPP Programme

The FI-PPP Architecture Board has found in its discussions that different approaches could be taken, corresponding to different trade-offs and agreements, and leading to challenges in different parts of the FI-PPP programme. The trade-offs arise in three main areas:

- the technical approach for implementing Use Case and Trial projects using FI-WARE Generic Enablers on available infrastructures;
- the operational approach for deploying and running the experiments and trials;
- the way social, legal and economic requirements and constraints are addressed.

Here we illustrate the issues by describing the major trade-offs in each area, and indicate how this leads to challenges for FI-PPP implementers which may need to be addressed at programme level. The technical, operational and social, legal and economic trade-offs are not independent in the majority of the cases. In this white paper, we consider approaches at either end of the range to illustrate the issues; of course in practice a range of intermediate solutions is also possible. The trade-offs and the associated issues and challenges are also summarised at the end of this white paper.

Technological trade-off: FI-WARE integration

One of the tenets of the FI-PPP is that Use Case Trial projects leverage as much as possible on the Future Internet Core Platform, first developed by the FI-WARE project and then, afterwards, evolved by the Technology Foundation Continuation project. Another of the tenets of the FI-PPP is that they leverage previous investments in infrastructure capacity, e.g. existing infrastructure, research test beds, etc. One first trade-off derives from the fact that the FI-PPP Use Case and Trial projects may incorporate infrastructure that already has a working software stack, data exchange model and control procedures which may not be compatible with the software technologies on which Generic Enablers of the FI-WARE platform is based [1].

In this situation, one approach would be for infrastructure owners to retain their existing software stack. In this case, FI-WARE generic enablers would only be installed if compatible with the existing software stack. Some of the functions of FI-WARE may then be provided (in a different way) by existing or alternative software, or in the form of services at a complementary infrastructure. With this approach, trials would typically need to *accommodate* the integration of multiple sites, which altogether may host the required set of FI-WARE components, and may need to accommodate alternative implementations of some FI-WARE features in some cases. The opposite extreme would be to push infrastructure operators to deprecate their existing software and *converge* on common FI-WARE components. To fully converge on FI-WARE will be expensive for infrastructure operators and is therefore unlikely. An intermediate option is to run FI-WARE alongside the legacy software stack of each infrastructure, using virtualisation techniques to grant both access to the underlying physical resources.

The choice of approach can only be decided by infrastructure capacity providers, but the impact creates challenges in other areas of the FI-PPP such as individual trials or collections of trials that use the infrastructure capacity. For example, Figure 1 shows four trials: #1 and #3 each run

at a single site while #2 and #4 run across federated sites. Site A has replaced all its software by installing a FI-WARE instance, Site B has retained its original software, using FI-WARE only to provide enhancements, and with some FI-WARE features are supported by alternative implementations. Site C has chosen to run its original software stack and a FI-WARE stack together, e.g. by using a virtualisation approach. Life is easiest for the infrastructure operator at Site B as they make the fewest changes in their software, but this depends on enough FI-WARE components being compatible with their legacy software. If this is not the case then trials #3 and #4 that involve Site B may have to use alternatives to FI-WARE (as in trial #3), which goes in contradiction with the tenant of trying to use as much FI-WARE Generic Enablers as possible, and/or use FI-WARE Generic Enablers provided by other sites as services (as in trial #4). The approach at Site B makes life more difficult for Use Case and Trial projects (Obj 1.8), but the approaches at Sites A and C impose requirements on their operators who will have to deploy or migrate to a FI-WARE compatible base software stack, or operate a virtualization platform with two different base software stacks, with assistance of the Capacity Building project.

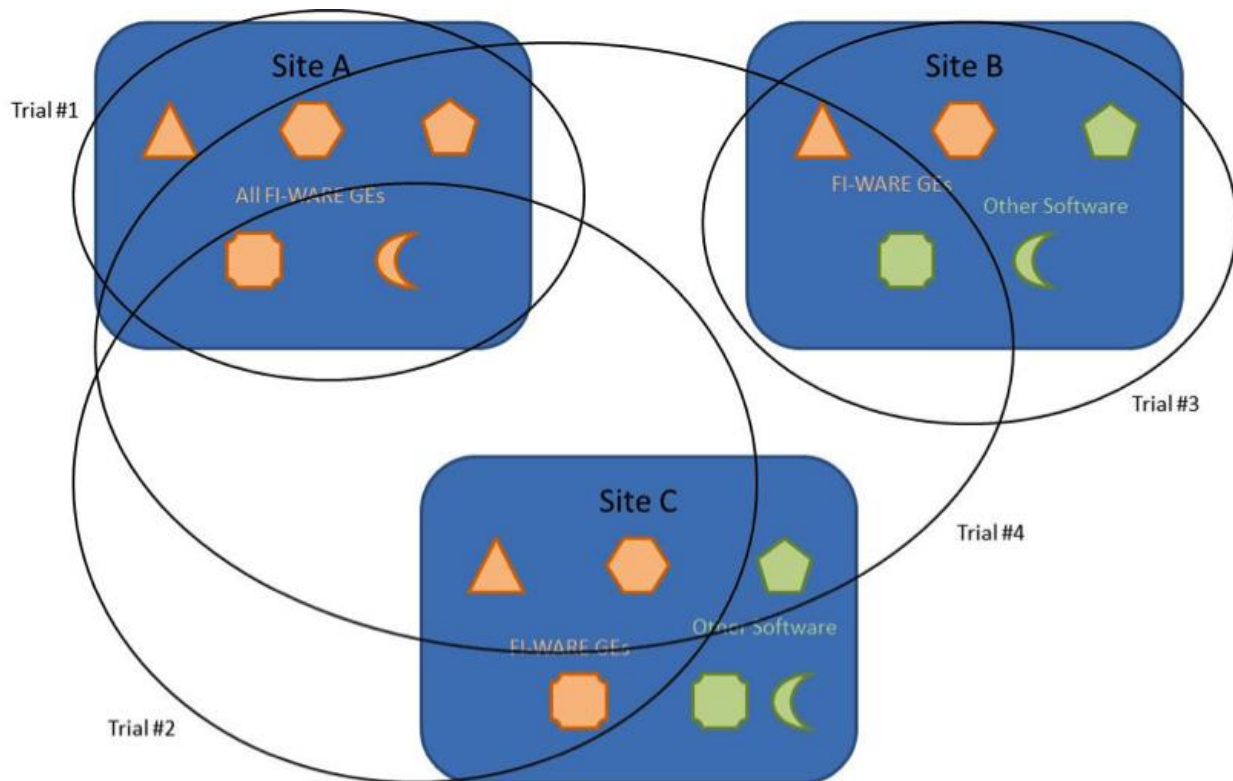


Figure 1. Accommodation versus Convergence

Operational trade-off: shared or specific backend facilities

The FI-PPP is concerned as much with Future Internet operation as with technologies. To be successful, solutions must be deployed and shown to be sustainably usable by all stakeholders (end users, service and infrastructure operators, etc). This has to be achieved in Phase 2 trials, as it is a pre-requisite for a successful expansion in Phase 3. But here too there are different approaches reflecting different trade-offs between implementation and operational costs and between cost and quality (including security) of services.

Most Future Internet applications involve the creation of data (content, sensor data, user inputs, etc), often as a result of real-world interactions. Value is generated by the distribution and processing of this data, e.g. to provide richer user experiences, to optimise real-world operations, or to improve the effectiveness of other activities such as advertising. The processing required to generate value is carried out in a 'backend' system, implementing functionalities distributed across a set of dedicated sites. A typical trial will depend on an ecosystem of infrastructure facilities connected to this backend system.

One approach is shown in Figure 2, in which a single FI-PPP Datacentre Facility and complementary common FI-PPP related sites (e.g., a ID provider site or a site where the FI-WARE Location GE is hosted) are shared between all the trials. Backend functions can be hosted there using the FI-WARE Cloud Hosting capabilities, as it will be composed of general purpose, commodity storage and processing hardware accessible over the Future Internet. Some of the FI-WARE GEs may also be hosted there, offering their functions "as a Service" (e.g., most of the Data/Context Management GEs, IoT backend GEs, etc). Each trial would also need some other facilities, including all 'in-the-field' elements, which might be provided by trial-specific facilities, or more generic experimental facilities such as those established in the Future Internet Research and Experimentation initiative (FIRE).

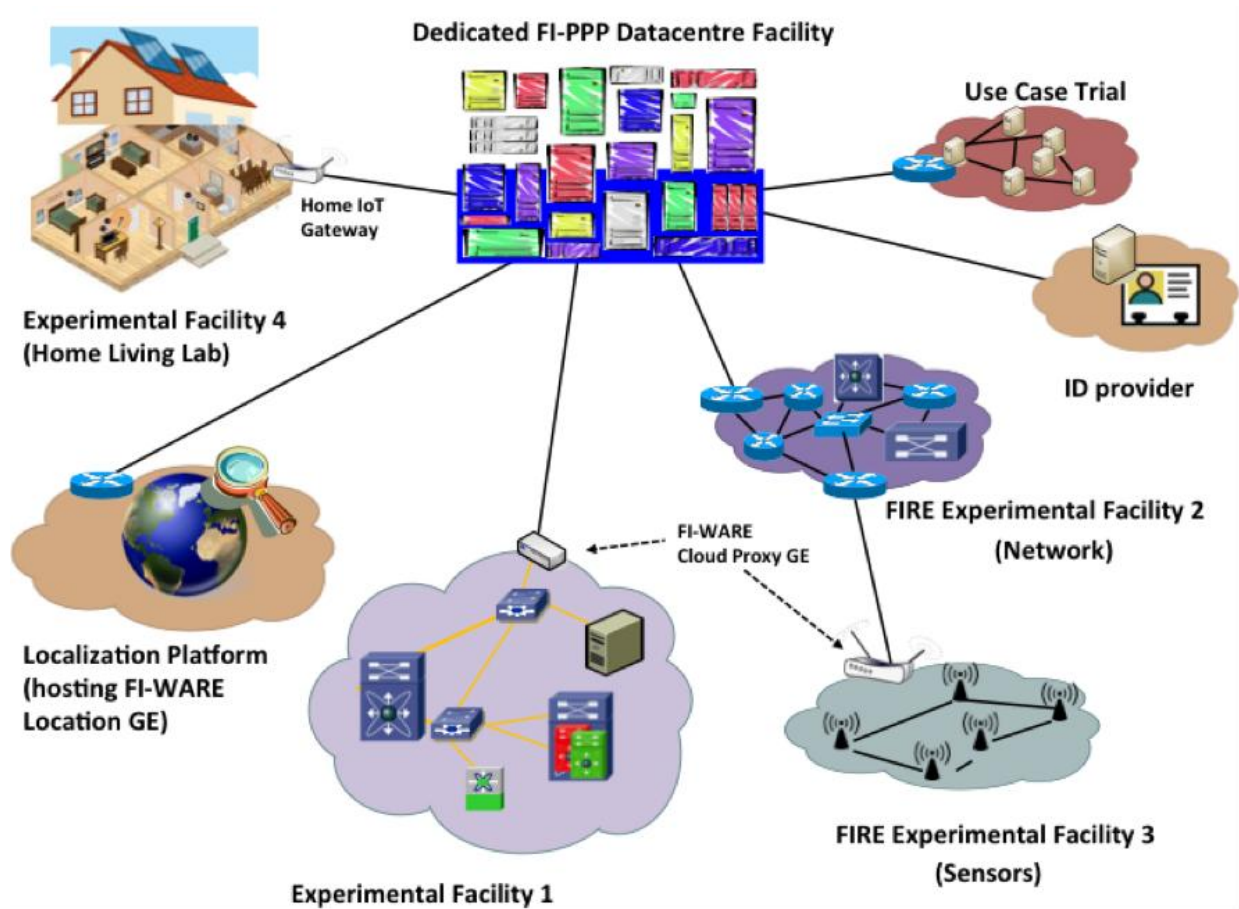


Figure 2. An FI-PPP trials ecosystem

Trial projects may find a single data centre easy and cheap to use (especially if provided for free by the Capacity Building project), leaving more resources for application and scenarios, though there would be some overheads for coordination of the shared facility. However, at least some

Phase 1 Use Case projects see this as unrealistic. There are many reasons for this, e.g. they may find that being co-tenants with other applications hosted in one particular jurisdiction poses unacceptable security risks, or makes it impossible to satisfy domain- and location-specific legal or regulatory requirements. One way to deal with some domain- and location-specific legal and regulatory requirements could be to setup a pan-European network of federated FI-PPP Datacentre Facilities and complementary sites distributed across countries where Trials are going to be deployed, essentially replicating the architecture depicted in Figure 2 and federating the resulting infrastructures. But still there may be Trial projects where usage of a common and shared infrastructure is not feasible and this fact has to be taken into account when defining roles and responsibilities of the different FI-PPP implementers.

Having a common shared pan-European infrastructure made up of a network of federated FI-PPP Datacentre Facilities and complementary sites would be simplest for Obj 1.7: FI-WARE developers could target a single base software stack (see above), and the Technology Foundation Continuation project in phase 3 would find it easier to support and maintain the software at limited number of sites. Deployment of Trial projects in Obj 1.8 may also be simpler if they all use this common infrastructure running the latest software, assuming it can support the service provider's network and hardware requirements. Finally, the Capacity Building project in Obj 1.9 will only need to integrate and federate a limited set of Backend Datacentre into the pan-European test and experimental infrastructure for the FI-PPP program.

Of course, supporting backend requirements for many Trial projects at each Datacentre would not be cheap, even with support from FP7 funding. There may not be enough Datacentres willing to provide enough capacity for the whole programme, unless users from Obj 1.8 contribute to the costs or additional funding is found. Using a single data centre (or a single cluster of data centres) may also distort the conditions under which application experiments evaluated, by emulating a monopoly or cartel situation. To demonstrate sustainability, it may be necessary to develop a competitive marketplace for Future Internet data centre providers. These issues are likely to become more important in Phase 3, when the scale of operation is expected to dramatically increase while remaining socio-economically sustainable.

Socio-economic trade-off: legal compliance

Legal and regulatory compliance is itself an area where trade-offs are possible. For example, the legal framework guaranteeing privacy has been harmonized across Europe. All EU member states are signatories to the European Convention on Human Rights, and EU directives have been used to specify a common approach for protecting the right to privacy in the acquisition, storage, processing and transmission of personal data.

One approach to ensuring privacy might be to agree a unified set of compliance requirements that should be met by all use case trials. This could be based on the EU directives, plus additional requirements to meet other obligations imposed by national legislation. However, EU directives do not force member states to introduce the same laws; they only define privacy issues that must be addressed by national legislation. Some variation does exist between member states, e.g. in the balance between individual rights and community values such as security or public health. Use case participants will be subject to national laws (not EU directives), so it may be better to allow each use case trial to define its own privacy requirements.

Once again, the trade-off between harmonized or heterogeneous compliance strategies leads to challenges for different parts of the programme. Harmonization would allow a single compliance

approach to be supported by FI-WARE developers, and homogeneous procedures between trial sites. However, harmonization would mean meeting a superset of requirements that may arise in any member state or application sector, which may be difficult to achieve, and more costly than supporting a range of different options catering for different local needs. Harmonization may also make it more difficult to decide who is legally responsible if the agreed approach turns out not to be sufficient in a specific application domain or jurisdiction.

Similar concerns arise with other socio-economic considerations, including the need for ethical operation (in a research context and subsequently), establishment/compliance with technical standards, or business models for socio-economic sustainability including aspects such as licensing, copyright fees and EULAs all of which may vary across jurisdictions. For example, if one could specify a reasonably small set of business models and standards that should be used in Phases 2 and 3, it would be reasonably easy for infrastructure operators and FI-WARE to support them via a harmonization approach. But this may be too restrictive if the FI-PPP is to demonstrate socio-economic sustainability, since many application sectors have their own standards (e.g. the INSPIRE initiative), and different external factors and business constraints may apply in different jurisdictions and application sectors.

FI-PPP Roles and Responsibilities

The approach adopted by each Use Case and Trial project after considering the several trade-offs described before must take into account the roles and responsibilities to be assumed by all parties for aspects such accommodation, provision and operation of infrastructures, FI-WARE Generic Enablers operation, maintenance and software support, and user support and training.

These roles and responsibilities will be different depending on whether the infrastructure where a given FI-WARE Generic Enabler is going to be deployed is specific to a given Trial project (or limited set of Trial projects) or it is considered part of a common shared infrastructure setup by the Capacity Building project. The following tables summarize these roles and responsibilities, elaborating on who carries out and pays what, respectively.

	Upgrade of infrastructure	Deployment, configuration and provisioning of GE ²	GE Operation and 2nd level support ³	GE Lab support ⁴
GE on trial-specific infrastructure	Trial with potential support from CB ⁵	Trial with potential support from CB	Trial	FI-WARE (year 3) then TF ⁶ . Both in best-effort manner unless contracted SLA.

² GE = Generic Enabler (provided by a set of FI-WARE software components, or a legacy platform).

³ 2nd level support comprises the analysis, isolation, diagnosis and reporting of problems.

⁴ GE lab support comprises the development and publication of patches to reported problems.

⁵ CB = Capacity Building project (Phase 2).

⁶ TF = Technology Foundation project (Phase 3).

	Upgrade of infrastructure	Deployment, configuration and provisioning of GE ²	GE Operation and 2nd level support ³	GE Lab support ⁴
GE on shared infrastructure	CB	CB	CB (year 3), then TF	FI-WARE (year 3) then TF. Both in best-effort manner unless contracted SLA.

Table 1. Who carries out the different activities

	Upgrade of infrastructure	Deployment, configuration and provisioning of GE	GE Operation and 2nd level support	GE Lab support
GE on trial-specific infrastructure	Trial with % of potential support from CB covered by CB	Trial with % of potential support from CB covered by CB	Trial	FI-WARE (year 3) then TF unless contracted SLA.
GE on shared infrastructure	CB	CB	CB (year 3) then TF, though some pay-per-use schema may be needed, depending on levels of demand.	FI-WARE (year 3) then TF unless contracted SLA.

Table 2. Who pays for the different activities

Trial projects in phase 2 have to assume in their planning that the pan-European test and experimental infrastructure on top of which FI-WARE and Trials will run will not be ready until beginning of year 4 of the FI-PPP program, i.e., beginning of the second year of phase 2. Operational support for FI-WARE on any shared infrastructure capacity may not be available until some months later, because this is expected to come from the Technology Foundation Continuation project in phase 3. Of course, infrastructures available to UC projects since Phase 1 are likely to be operating before this, and the Capacity Building project should establish the means to federate capacity by the end of year 3 of the program.

On the other hand, Trial projects in phase 2 need to plan where they will develop and test their Trials before their actual deployment in operation. That is, a testing/certification environment may be needed in parallel to the operational environment where trials will run involving real users. In this respect, Trial projects may rely on the FI-WARE Testbed Datacentre Facility offered by the FI-WARE project in phase 1, but this will require that the Capacity Building project in Phase 2 takes responsibility for federating the FI-WARE Testbed with the specific experimentation facilities that each Trial may need to connect to the FI-WARE Testbed for testing/certification purposes. The tables presented above also apply to roles and responsibilities regarding testing/certification, though FI-WARE would replace the Capacity Building project in all what respects the FI-WARE Testbed Datacentre Facility.

Recommendations to the Mission of the CB and TF Project

The FI-PPP Architecture Board discussions have shown that a wide range of approaches and trade-offs could be used in Phases 2 and 3, but some recommendations can be made to Phase 2 proposers.

FI-WARE and later the TF project are expected to provide a reference test bed which can be used by UCs for development and compliance testing. This test bed is not guaranteed to meet any particular level of service, and the use of it in the pilots later is highly discouraged

The CB project is expected to provide capacity that is of general interest at a level sufficient to actually use it by all UC projects during Phase 2. The CB project is also expected to establish contact with operators of other infrastructure once the needs of specific UC projects are known, and provide support for their integration including provision of federation services that may be needed (e.g. for security federation, marketplace operation, etc). At the end of Phase 2, the operation of shared capacity and support for wider integration should pass to the TF project.

The UC projects are expected to allocate the budget needed to install, run and maintain the infrastructure and services specific to their pilots. In particular, the UC projects are expected to allocate the adequate resources which will allow the infrastructure owners to participate in the FI-PPP (that is: CB/TF should pay for people providing training & support for infrastructure capacity integration and operation, but not for the people working on the infrastructures).

For clarification: the CB project is not expected to provide concrete plans for interfacing any site-specific infrastructure which UC projects may be able to use afterwards, because it is not possible to determine what will be needed until after the CB and UC proposals have been evaluated. The CB project (and later the TF project) need not finance any developments other than integration with the FI-WARE architecture, nor provide high-capacity data centre facilities for UC projects that have high computational or storage requirements.

For practical reasons, it may be appropriate for the CB or FI-WARE to provide infrastructure capacity or other services that should be the responsibility of the UC projects. In this situation, some mechanisms should be developed for transferring costs to UC projects if the demand for these services is significant. For example, if a UC project requires high-volume, real-time video stream processing, the UC project should provide the capacity for this, or be prepared to cover the costs if the CB project does so.

References

For more background information, see the European Research Future Internet PPP[2], the FI-WARE Product Vision[3], and Materialization approach[4], and the INFINITY infrastructures repository.

[1] The FI-WARE Project will publish the description of base technologies on top of which deployment of each Generic Enabler will be certified at the same time the first FI-WARE Testbed will be made available.

[2] http://ec.europa.eu/information_society/activities/foi/lead/fippp/index_en.htm

[3] https://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/FI-WARE_Product_Vision

[4] https://forge.fi-ware.eu/plugins/mediawiki/wiki/fiware/index.php/Materializing_the_FI-WARE_Vision