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Roadmap for Pan-European Laboratory

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Abstract

The objective of the Panlab project is to define a general framework for the interconnection of independent test-beds and laboratories and to facilitate the establishment of a Pan-European laboratory. The concept of such a Pan-European laboratory is based on the federation of distributed interconnected test laboratories and test-beds that provide required facilities for broad range of testing capabilities for technologies, product interoperability and telecommunications services.

This third Panlab project deliverable D1.3 (Roadmap for Pan-European Laboratory) presents the necessary milestones and time schedule, with different aspects (legal and organization issues, infrastructures, operations as well as service offering), for the establishment of the Pan-European Laboratory, from the initial steps up to the full-scale operation.

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[Editor: Name, company] Jean-Claude Imbeaux, France Télécom

[Work-package leader: Name, company] Jean-Claude Imbeaux, France Télécom

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List of authors

Company	Author
Alcatel	Olivier Martinot, Olivier Audoin
Dimes	Susanna Avéssta
Eurescom	Halid Hrasnica, Anastasius Gavras
Fokus	Sebastian Wahle, Fabricio Gouveia, Thomas Magedanz
Synchromedia	Mohamed Cheriet
Italtel	Francesco Romeo
Nokia	Juha Saarnio
Telefonica I+D	Ana Sobrino, Lourdes Calvo
Thomson	Denis Mischler
France Télécom	Jean-Claude Imbeaux
RAD	Yuri Gittik

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Definitions of terms

Term	Definition
Pan-European Laboratory (PEL)	A concept of enabling Pan-European testing services for a demo/trial and evaluation of new technologies, system solutions and telecom service concepts
PEL Activities	Actions and processes that are launched and carried out within the PEL framework.
PANLAB	An FP6 Specific Support Action (SSA) that defines the PEL vision and roadmap and facilitates implementation of the PEL activities.
PEL Partner	An entity that participates in PEL activities by providing testing or any other supporting services.
PEL Customer	An entity that uses (consumes) any service provided by the PEL. Customers typically carry out R&D projects, implement new technologies or products, or introduce new telecom services.
PEL Community	Is composed of Partners and Customers, along with other relevant participants from the industry, research and supra-governmental institutions, for example, EU organizations.
PEL mechanisms	A set of rules and procedures that enables effective collaboration between PEL partners as well as cooperation with PEL customers.
European Technological Platforms (ETP)	Special European task forces (industrial initiatives) targeting definition and implementation of comprehensive research agendas in a few strategic sectors in the ICT area, to be conducted in Europe within FP7.
Eureka ICT clusters	Long-term, strategically significant industrial initiatives aiming the development of generic technologies of key importance for European ICT competitiveness. Initiated by industry in close collaboration with national funding authorities, clusters bring together large companies, SMEs, research institutes and universities, sharing both the risk and benefits of innovation.
Roadmap	A preparatory document containing a coarse grain planning of the necessary steps (phases) that shall be executed over a certain period of time to accomplish a vision. A roadmap is used to plan large and long term endeavours and helps partitioning an endeavour into smaller achievable steps with measurable impact.
Test-bed	An environment which allows experimentation and verification for research and development projects. A test-bed should provide rigorous, transparent and replicable testing and in this document is always used in the context of new information and (tele-) communications technologies for networks and services.
Test-bed federation or federated test-beds	Interconnection of two or more independent test-beds for the creation of a richer environment for testing and experimentation, and for the increased multilateral benefit of the users of the individual independent test-beds. The federation is never static but evolves over time and based on the requirements of its users.

Executive summary

The objective of the Panlab project is to define a general framework for the interconnection of independent test-beds and laboratories and to facilitate the establishment of a Pan-European laboratory. The concept of such a Pan-European laboratory is based on the federation of distributed interconnected test laboratories and test-beds that provide required facilities for broad range of testing capabilities for technologies, product interoperability and telecommunications services.

As a first step of the study, the ICT "ecosystem" and its potential evolution has been analysed and considered as the background for the development and future operation of the Pan-European Laboratory.

Then a vision for the Pan-European Laboratory has been developed, to define what could be this Laboratory in terms of organization and functionalities, who will be the participants, and which mechanisms are required for effective operation. The main "implementation" principle is federation of test-beds.

Based on this vision, the necessary milestones and time schedule for the establishment of the Pan-European Laboratory, from the current vision up to the full scale operation, are identified here to build a roadmap. Time schedule includes three phases (concept and establishment of PEL, initial operation and full scale operation) and the milestones are grouped according to different approaches: legal aspect and organization, infrastructure, operational process, and service offer (with a separation between services to partners and services to customers).

Now that the vision and the roadmap developed in the first work package are available, they will be used in the second work package for the detailed definition of the Pan-European Laboratory, to produce the framework for its future implementation.

1 Introduction

The operation and management of the federation typically spans over multiple networks and multiple administrative domains and is a challenging task requiring professional support from both industry and organisations with experience of operating large networks. The following issues need to be addressed:

- **Openness:** Federation implies openness at all levels, including provision, implementation and use. Concerning provision, the Pan-European Laboratory must be open for any test-bed of the European test-beds ecosystem. There are many related issues which make the implementation of openness a challenge. These include Intellectual Property Rights (IPR), how to exchange results and what may be shared, the standardisation of interfaces, common procedures, usage policies, etc. The implementation could be done through open source tools and open hardware design details which will enable easy replication, interfacing and inter-operation among various test-bed components, and consequently, would increase the overall Panlab effectiveness and impact. Use should be open to any relevant European and worldwide initiative under fair access terms.
- **Excellence:** The federation principle promoted by Panlab aims for “best of breed” and must assure excellence of the capabilities of the federation from various aspects. These aspects include among others (i) degree of innovation, (ii) measurable quality or compliance to essential standards, (iii) diversity, and (iv) scale or geographic coverage. Criteria must be developed that allow a transparent evaluation of excellence, and also the re-classification of a test-bed as a commodity and thus its retirement from the federation.
- **Management:** Managing federated test-beds is complex, but necessary for achieving scale, diversity, cost-efficiency, and, last but not least, to improve the sustainability and quality of the individual test-beds and the federation as a whole. The traditional network management objectives apply for the management of federated test-beds as well.
- **Governance:** Interconnecting different test-beds belonging to different administrative domains means granting access to remote resources that are owned by different stakeholders. This has the consequence that a legal framework must be in place that governs this relation and which must include among others: handling of IPR, definition of confidentiality and trust, process for resolution of conflicts and handling of the misuse of rights or neglecting obligations, etc. In order to lay the foundation for establishing a long-term sustainable test-bed federation, a legal entity is necessary. This legal entity must manage the different relations, possibly manifested as contracts, between the stakeholders that interconnect their resources in the scope of the federation.

The roadmap consolidates the necessary milestones, showing how and when the Panlab vision can be established. This roadmap does not consider explicit available test-bed facilities that can be part of the federation and hence the specific Pan-European Laboratory offering, since the concept targets to be technology agnostic and not dependent on specific test-beds suited for particular technologies or services. Nevertheless a number of general facilities and tools required for a long-term sustainable operation are described in the infrastructure section.

1.1 Incremental Deployment

Figure 1 illustrates in a coarse grain manner the three major phases and two principal gates of the Pan-European Laboratory deployment. These phases are distinguished by:

1. the level of maturity and richness of service offering to customers
2. the status of an organisation as a legal entity for operating the main functions of the PEL and offering the services to customers

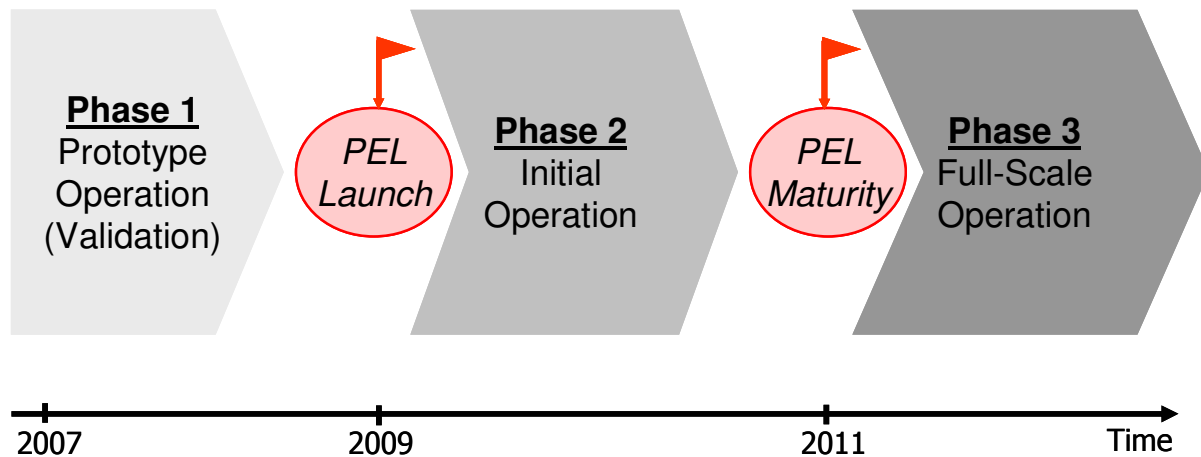


Figure 1 Incremental deployment of Pan-European Laboratory

Phase 1 - Prototype Operation

During Phase 1 the services and operation of the PEL are validated through prototype (pilot) operation within the well defined boundaries of a collaborative project. During this phase the rules and procedures developed in the Panlab SSA project are applied and feedback is sought for the purpose of improving these. Furthermore a number of essential tools must be developed that support basic operations for the next phase. In this phase the role separation of customers and providers is defined by a contractual relationship for the execution of a certain test case may not exist. In fact it may not need to exist, due to the collaborative project framework within which the prototype phase should be operating. During the prototype phase also the specifications of the necessary interfaces at the administrative and technology domains are developed and applied. Finally a process for quality assurance is defined, which will include the metrics for supporting decisions as to whether a certain test-bed or laboratory facility can be included in the service offering.

During or by completion of the prototype phase the PEL is launched as a legal entity. The end of the phase is defined by the “**PEL Launch**” gate.

Phase 2 - Initial Operation

In phase 2 the legal entity assumes initial normal operation and is able to offer services to test-bed providers and test-bed customers in the following areas:

- For the test-bed providers the services provided by the PEL include support and management of legal documentation and contract relationships and the development and maintenance of a catalogue of functional elements included in the offering. In order to ease the description of the assets the PEL can support the identification of unique and coherent sets of functional elements for inclusion in the offering as well support the constant awareness and assurance to offer state-of-the-art services.

In support for the technical requirements of necessary interconnections the PEL supports the test-bed providers to provision the needed interfaces at the domain boundaries, to define the security policies for enabling remote access and manages the access constraints. This phase includes also the marketing of the service offering for the test-bed providers and the promotion of the service offering.

- For the test-bed users the services provided by the PEL include similarly support and management of legal documentation and contract relationships. In addition the PEL provides support and consultancy for the specification of needed test-bed configurations and identifies the functional elements in the federation which can provide the needed functions. The PEL provides, via the test-bed search engine facility Teagle, support for the discovery and localisation of the required functional elements and executes also a feasibility check of the specified customer configuration, and provides

access to the necessary technical specifications for accessing the offered test-bed services. Finally support is provided for the documentation of the testing results.

In both cases the PEL manages the financial settlement between test-bed providers and test-bed customers.

The end of the phase is defined by the “**PEL Maturity**” gate.

Phase 3 - Full-Scale Operation

In Phase 3 the service offering is extended towards broader and richer functionality of the tools necessary for operation. Major additional functions that are offered in this phase include the technical possibility for automatic identification, discovery and configuration of test-beds based on formal descriptions of the services that the test-beds’ functional elements are exposing and the specifications of required test-bed functionality. Furthermore in this phase full knowledge management tools are deployed, which assure long term archiving of testing results, configurations and other meta-level relevant information within the restrictions of the IPR regime and enable reproducibility of tests and comparability of testing results.

1.2 Enablers for PEL Operation

The subsequent sections in this document will provide further details about the service offering in each phase. In order to be able to provide the envisaged services in each phase certain “enablers” have to be available. Generally, these enablers include the following major elements (that are called “milestones” in the document):

Phase 1

- Legal, technical and operational framework available from the Panlab Specific Support Action

Phase 2

- Organisation as a legal entity for managing contracts and relationships as well as engage in contracts
- Operational tools such as Teagle, collaboration tools, identity management
- Service descriptions of services provided by the test-beds in the federation
- Specification of requirements to join the federation
- Specification of the technical infrastructure
 - How to join the federation and interconnect if necessary
 - How to access the services of the federation
- Identity management for assets and stakeholders
- Controlled remote management access

Phase 3

- Automatic identification and discovery of test-beds’ services
- Automatic configuration and provisioning of test-beds
- Repository for test results and long term archiving
- Knowledge management tools

1.3 “Granularity” of the Roadmap

The Roadmap outlined in this document provides more details (“fine granularity”) for relatively near-term Phases 1 and 2 and remains more general (“coarse granularity”) for the rather distant Phase 3. This is the case because the further development of services which can be offered from the PEL towards both the test-bed providers as well as the test-bed customers are depending on the experience and the future expectations of these stakeholders, that will be gained and verified during the two initial Phases. Especially the evolution of how services are offered and consumed in the ICT industry may supersede current assumptions and business models, which form the current foundation of the Panlab Vision.

2 Service Offers

In this section, the milestones to be achieved within the process of ‘Service Offering’ and its definition are presented. There are two different sub-sections of Service offering, one corresponding to partners and another one to customers.

2.1 Service Offering to Partners

The required milestones to elaborate on the Service Offering to partners are the following:

1. Draft Specification of service offer
2. Proof of concept of service offer
3. A partner able to express availability in Teagle
4. Availability of mechanisms to find customers
5. Availability of usage logs
6. Availability of mechanisms to find experts
7. Test-bed certificate

1. Draft Specification of Service Offer

Draft specification of service offer will describe services to be provided by PEL. The document should define each type of offered services, such as: Test-beds, Tools, Consultancy services, Certificates, etc.

This document will define also a template to be used for each partner to present a Service in order to achieve a standardized method. Some suggested points to be included in this template are shown below:

- Type of service
- Detailed technical description
- Partner who offers the service
- Technical requirements to offer and to use the service.
- When the service is going to be offered (time schedule).
- ‘Economical cost’ (real or virtual) of the service.
- Documentation related to the service:
 - Offered by the partner
 - Required to the customer

2. Proof of Concept of Service Offer

It is advisable to make a final proof of the way of specifying a service offer. This can be done in a first step by simulating a real exchange of services between partners, who may preferably be members of the PANLAB project, to allow the refinement of the requirements for service offer. This first step requires working on the process by producing an analysis of the exchange on the basis of success criterion to be defined.

3. A partner able to express availability in Teagle

This milestone will ensure that a partner can express through Teagle that it offers a specific equipment, network, user set for PEL tests. The partners will describe their services by using the standardized template defined in the Specification of Service Offer document. The required infrastructure will be ready to be used by the partners so that the partners will be able to show and to offer their services through Teagle.

4. Availability of Mechanisms to find Customers

There will be mechanisms to make easy to the partners to find potential customers. There will be information about the known customers, with services usually required by them, their activities, their interests, etc. This will allow the partners to guess the future necessities of the customers so that the partners can anticipate and offer attractive services to the customers. The partners will be able to

contact the potential customers by using mechanisms offered by PEL. There will be also a forum, moderated by a PEL member, where partners can express their opinion about what/how/when to offer to the customers.

5. Availability of Usage Logs

A tool to obtain usage logs will be available for PEL partners (and probably for external observers). When the offered Services are in use, there will be a log tool in Teagle where the partners can show the records of events resulting from their services usage, including a historic tracking of use. The usefulness of such logs file will be tested against a number of representative use cases to be defined.

6. Availability of Mechanisms to find Experts

There will be mechanisms to allow the partners to find experts in required areas, in order to share knowledge or collaboration between partners. There will be a database of expert profiles accessible to all the partners. An expertise forum of different areas will be offered to the partners to discuss technical matters joining efforts to be more competitive utilizing synergies between the partners.

7. Test-bed Certification

The partners will be able to express the requirements to be fulfilled by a test site in order to obtain a PEL certificate. Moreover, there will be tools, procedures and mechanisms to check the conformity of test-sites to be certified.

2.2 Service Offering to Customers

The required milestones for service offering to customers are the following:

1. Draft Specification of service offer
2. Detailed specification of service offer
3. Basic service offer
4. Availability of mechanisms to show needs
5. Testing Consultancy Services
6. Interoperability testing services
7. Open testing
8. Experimental testing
9. Certification

1. Draft Specification of Service Offer

This document will describe the expected PEL service offer in order to publicize PEL between potential customers.

2. Detailed specification of Service Offer

This document will contain a full specification of the service offer:

- Availability of test-beds.
- Type of test offering: final-user services, interoperability and performance.
- Testing consultancy services (PEL office defines testing plan and gives technical guidance) versus Testing tools and ‘do it yourself’
- PEL Certification services.
- etc.

A further aim of this document is to show to the customer the whole spectrum of the Service that will be offered by PEL, with the intention that they start to realize the benefits of using PEL.

3. Basic Service Offer

This milestone is intended to provide the first Services Offering to customers. The first services to be offered in order to ensure a basic PEL operation are listed as follows:

- Specification and description of interfaces, with the necessary deepness level, of all in PEL included test-beds and labs to ensure smoothly connections with customers and between test-beds. Appropriate proof mechanism should be provided as well.
- Interconnection of test-beds and customers via various networks (public, commercial, different technologies, etc.) ensuring particular tests and experiments.
- Assistance for test set-up and troubleshooting.
- Resource allocation of test-beds and networks in order to avoid bottlenecks.

4. Availability of Mechanisms to show Needs

There will be mechanisms to allow the customers to explain what services they need, what they would desire to obtain in PEL, or what they will need from PEL in a near future. Besides, customers will be able to express their opinion with respect to how their expectative are fulfilled by services in use. Summarizing, this milestone consists of providing mechanisms to ensure a fluent dialogue between PEL and the customers in order to obtain customers feedback.

5. Testing Consultancy Services

It would be possible for customers to request to PEL, a complete consultancy service, what would be carried out by internal PEL/PEL Office or external resources. This service will produce a testing plan, provide selected testing tools, develop the complete tests process and produce an assessment on the results.

6. Interoperability Testing Services

It will be provided the capability of interoperating, by using specified interfaces, between testing services with different standards, reference implementation, etc.

7. Open Testing

For simple test scenarios, PEL would provide a public service offer based on open software solutions, free of charge or with a minimum charge, to allow customers to obtain a simple and quick answer for their requirements. Information and result will be shared between all the users.

8. Experimental Testing

The aim of this milestone is to supply a place for using experimental and unproven testing techniques. It would be possible to do *blind test* where anonym customers and providers can interact.

9. Certification

There will be a procedure to obtain (for a specific customer, technology, methodology, etc.) a 'PEL Certified' label. This certification will assure that the requirements imposed by PEL are fulfilled and therefore the product, device or service is inline with a particularly tested standard or specification and achieves a certain quality. It is advisable to collaborate with standardization organizations.

3 Definition of Milestones

3.1 Organization

As is already stated in Panlab deliverable D1.2 “Vision for a Pan-European Laboratory”, interconnection of different test-beds belonging to different administrative domains means granting some level of access to remote resources that are owned by different stakeholders. This has the consequence that a legal agreement must be in place that governs the rights and obligations of all stakeholders involved. Such a legal framework must include among others: handling of intellectual property rights (IPR) and definition of confidentiality and trust, process for resolution of conflicts and handling of misusing rights or neglecting obligations, etc. Furthermore, and in order to pave the ground of establishing a long-term sustainable Pan-European Laboratory (PEL), a legal entity will have to be established as well as a PEL Office to deal with day-to-day operation of the PEL, including all associated test-beds and laboratories, and relations with users of PEL services.

Definition of entities and agreements to be established in order to ensure a legal form of the Pan-European Laboratory will be discussed in details in WP2, Deliverable 2.1 “Legal framework”. Here, we present milestones to be achieved within process of establishing a PEL organization and its definition through different legal documents and agreements. Below is the list of related milestones:

1. Creation of legal framework for PEL
2. Definition of necessary legal documents
3. Establishment of PEL organization
4. Creation of PEL Office
5. 1st PEL membership and business model
6. Review of PEL legal and organizational structure
7. 2nd PEL membership and business model

1. Creation of Legal Framework for PEL

Concept for legal framework of future PEL organization will be one of the main outcome from Panlab project, which will be created within WP2. The legal framework will describe organizational principles and basic legal aspects of PEL, including concepts and basic principles to be applied to the following two groups of required legal documents:

- Legal documents defining status and working procedures of Pan-European Laboratory and PEL Office
- Legal documents necessary for operation of the Pan-European Laboratory

2. Definition of Necessary Legal Documents

Here, various legal documents, defined in the legal framework (see Milestone No. 1 above) will be drafted with necessary level of details. Thus, organizational legal documents, such as Article of PEL association, Rules of procedures for various PEL bodies, and Agreement on PEL Office, will be ready for final negotiations among founders of future PEL organization. At the same time concepts for PEL membership, business, and costs models will be ready to support creation of the PEL organization.

All legal documents, mentioned above, will be created within Panlab project. Further legal documents, more important for PEL operation will be completed after creation of the PEL organization (see related Milestone 3 below).

3. Establishment of PEL Organization

PEL organization will be established by stakeholders, which come from relevant industry areas, interested public bodies (on European and national levels), and research institutions, building so-called core group of the Pan-European Laboratory organization. The core group has to express willingness to create PEL organization with a long-term perspective and support its activities within a longer time period. The core group should accept PEL framework (see Milestone No. 1) and has to agree on drafted legal and status documents (see Milestone No. 2). Here, all legal and operational documents necessary for PEL operation should be completed. Furthermore, the core group has to agree on basics

business model, which will be developed in details after formal PEL establishment and creation of corresponding PEL Office. Thus, the PEL will be ready to start its operation, to offer its services, and to enlarge organization by involvement of new PEL members.

4. Creation of PEL Office

PEL Office will be created in accordance with principles provided by Milestones 1-3. It will include finalisation of necessary legal framework directly related to PEL Office and its establishment. Thus, PEL Office will be ready, from legal point of view, to start its work as an operational entity, established by the PEL.

5. 1st PEL Membership and Business Model

Following successful creation of PEL and PEL Office (Milestones 3 and 4) as legal entities, in order to ensure an economically efficient PEL, it will be necessary to specify a PEL membership model including membership fees and rules for, possibly, different membership categories. Furthermore, all costs aspects should be resolved to be able to define a business model for first operational phase of PEL.

6. Review of PEL Legal and Organizational Structure

During and after first operational phase of PEL (approximately a 3 years period), the legal and organizational PEL structure should be observed. Finally, after this experience a reviewed PEL structure will be defined.

7. 2nd PEL Membership and Business Model

In the same way, as stated above (Milestone No. 6), the first PEL operational phase should be used for improvement of PEL membership and business models.

3.2 Infrastructure

The technical definitions and specification for the required Infrastructure that will run the PEL will be described in details in Deliverable 2.2 “Technical Infrastructure”. In this section we present the milestones for achieving the functional infrastructure of PEL. These are:

1. Draft Concept for PEL infrastructure
2. Specification of PEL infrastructure
3. Basic PEL infrastructure
4. Extended PEL infrastructure and Tool Package version 1.0, including Teagle v1.0
5. Future evolution of the infrastructure
6. Fully implemented PEL infrastructure, including Tool Package and Teagle v2.0

1. Draft Concept for PEL Infrastructure

The technical infrastructure concept is the requirements posed by the infrastructure that need to be implemented in the PEL in order to run the entire architecture. It describes the information necessary for accomplishing different tests (e.g. technology, equipment interoperability), PEL implementation requirements (e.g. protocols, technologies, limitations) and general service testing possibilities. In this phase, Teagle concept draft is outlined, and includes:

- Test-bed metadata specification that should be available in Teagle;
- Teagle interfaces and functionality;
 - User interface description;
 - Test-site interface description;
 - Administrative (control, monitor, maintenance) interface description.

Teagle is a web service that provides the means for a customer to express the testing needs and get feedback on where, how and when testing can take place. The web service enables finding a suitable site for one’s testing needs. It does this through a database of partner test-beds and Living Labs. The objectives of Teagle in its fully operational form are to manage the complete set-up, necessary resource reservations and needed interconnections of any foreseen testing needs.

2. Specification of PEL Infrastructure

The final technical infrastructure specification is completed at this stage. From the produced documents the PEL partners should know what is necessary in terms of technical equipment, interfaces, etc. to join PEL and to operate a PEL Partner test-bed.

3. Basic PEL Infrastructure

Basic elements of PEL infrastructure, ensuring its initial operation, have already some components implemented. Thus, a basic PEL Office and a number of test sites are available and the first tests of the infrastructure and searching tests are possible. At this milestone it is possible to:

- Verify equipment functionality
- Verify services functionality
- Provide basic interconnection and control functionality
- Create sample configurations of testing services
- Provisioning of state-of-the-art collaboration tools, such as conferencing facilities, application sharing, etc.

4. Extended PEL Infrastructure and Tool Package Version 1.0, including Teagle v1.0

Most parts of the realization of the technical infrastructure are done. Tool package and Teagle versions 1.0 are in operation. This milestone includes the provisioning of the following functionality, tools and Teagle capabilities:

- Meta-model for description of services offered by a test-bed, including any usage constraints
- Repository to store information about available test-beds and their services that are part of the PEL offering
- Interface to Teagle to register available test-beds and their services
- Interface to Teagle to identify and locate needed services
- Tool via a Teagle interface to create testing configurations based on the repository of test-beds and services
- Identity management service
- Provisioning of interfaces for usage logging, security management, performance monitoring and troubleshooting
- Testing results documentation support tools
- Repository of results for long term archiving purposes

5. Future Evolution of the Infrastructure

During the prototype and initial phases of PEL operation, the experience and feedback from all involved stakeholders, test-bed providers and customers, is captured and used to derive requirements for the future evolution of the infrastructure. In particular the following areas will become important:

- Considerations for diversification of the infrastructure
- User experience and qualitative analysis of services' impact on societal goals

6. Fully implemented PEL Infrastructure, including Tool Package and Teagle v2.0

The technical infrastructure fully supports the PEL operation. Teagle version 2.0 is fully operational and more PEL procedures can be handled purely (and almost fully automatic) through Teagle. In particular this milestone includes the provisioning of extended functionality, tools and Teagle capabilities such as:

- Inherent Teagle support for automatic discovery of services
- Inherent Teagle support for test-bed configuration and provisioning
- Test-beds' services are offered as web services enabling advanced orchestration of test-bed configurations
- Management tool to ensure efficient scheduling of PEL resources and test-beds

- Specification of an abstract control and management framework for PEL
- Implementation and provisioning of concrete control and management functions as relevant for the different constituents of the federation, as appropriate under an abstract umbrella framework
- Knowledge management tools that operate on the repository of results enabling reproducibility and comparison of testing results
- Other capabilities and functions as a result of the requirements on future evolution of the PEL infrastructure.

3.3 Operations

The operational procedures needed for interconnecting different test-beds in order to successfully perform testing must be identified and defined properly. These procedures should be standardized and enforced by all the participants for implementing consolidated solutions. The operational aspects are tightly connected to Organizational matters, Infrastructure and Service offerings. E.g., various specifications of operational rules and procedures will directly define requirements for the PEL technical infrastructure. Thus, many of the activities and milestones are connected and overlapping, but the viewpoint varies depending on which side the event is considered. In this chapter Operational aspects answer the question 'How the PEL is to be run', with the following milestones:

1. Concept for PEL operation
2. Organisation of PEL Office
3. Specification of basic operational rules
4. Interconnection of external federated test-beds and test networks
5. Virtualisation of resources
6. Operational rules for automatic PEL procedures
7. PEL showroom
8. Organisation of "Testing Weeks"

1. Concept for PEL Operation

Beside organisational and legal rules to be established for PEL as well as specification of necessary technical infrastructure and tools, this concept will define all elements necessary for PEL operation by using the established organisational and legal rules and the available infrastructure. This document will include:

- Basic requirements on PEL Office
- Draft PEL operational procedures
- Requirements on tools and API's to be used for PEL operation
- Draft PEL user manual
- Initial trouble shooting and operation observation procedures

2. Organisation of PEL Office

Here, tasks to be allocated to PEL Office and its working procedures will be defined. This will include consideration of appropriate location(s) for the Office personal and necessary technical infrastructure, such as data bases and servers. A further aspect to be defined will be estimation of needed technical and administrative stuff as well as possible financing solutions.

3. Specification of Basic Operational Rules

Basic operational rules to be specified in details, in accordance with concept provided by milestone No. 1, including first user manuals for both test-bed providers and customers will be necessary to enable start of PEL operation in its initial phase.

4. Interconnection of External Federated Test-beds and Test Networks

As PEL needs to be defined dynamic and flexible, mechanisms and preparations for possible other types of extensions than just including more members should be taken into account. E.g.

interconnection to the other test-bed federations and coordinated Living Labs networks could be defined at the next stage.

5. Virtualisation of Resources

To provide specific testing services from technical point of view and support specific testing requirements (e.g. hidden testing) it will be necessary to ensure appropriate mechanisms for virtualisation of both resources and services. This specification will be also used to outline particular requirements on the technical infrastructure.

6. Operational Rules for Automatic PEL Procedures

As it will be provided by development of the PEL technical infrastructure, various tools, such as Teagle and management tools, will be used in order to automate usage and creation of PEL services. Therefore, besides operational rules defined for initial PEL operation (milestone No. 3), it will be necessary to adapt and extend PEL operational procedures ensuring application of such tools.

7. PEL Showroom

In order to promote its own testing services and operational spectrum, PEL will establish a corresponding showroom - centralised or decentralised / fixed or mobile – demonstration facility. The PEL showroom will be also used to promote and demonstrate opportunities of newly developed technologies.

8. Organisation of “Testing Weeks”

“Testing weeks” and similar events will be used to promote periodically PEL testing opportunities. Furthermore, depending on actual technology development and interests of the research communities, testing events dedicated to particular equipment or technology will be organised. In the same way, various service and equipment interoperability testing events will be established.

4 Time schedule

This table presents the time schedule for the major phases and the corresponding milestones defined in previous sections. The classification (legal and organization; infrastructure; operations service offering) and the numbering of the milestones is unchanged.

Phase	Period	Milestones				
		Service Offerings		Legal and Organization	Infrastructure	Operations
		To Partners	To Customers			
I	H1 2007			1. Legal framework		
	H2 2007		1. Draft service offer	2. Legal documents	1. Draft concept	1. Operational concept
	H1 2008	1. Draft specification	2. Specification of service offer	3. PEL Organisation established	2. Infrastructure specification	2. Organisation of PEL Office
	H2 2008	2. Proof of concept	3. Basic service offer	4. PEL Office created	3. Basic infrastructure	3. Basic operational rules
II	2009		4. Mechanisms to show needs	5. 1 st membership model		4. Interconnection of external federated testing facilities
	2010	3. Ability to express availability in Teagle	5. Consultancy services		4. Extended PEL infrastructure	5. Virtualisation of resources
	2011	4. Mechanism to find customers 5. Logs usage	6. Interoperability testing 7. Open testing	6. Review of PEL structure	5 Future infrastructure evolution	6. Operational rules for automatic operation
III	2012+	6. Mechanisms to find experts 7. Test-bed certification	8. Experimental testing 9. Certification	7. 2 nd membership and business models	6. Fully implemented PEL infrastructure	7. Showroom 8. Testing weeks

5 Conclusion

In Panlab deliverable D1.2 “Vision for Panlab”, several aspects of a future Pan-European Laboratory (PEL) have been discussed, in order to derive the basic requirements on how the future PEL can be realised from the organisational and technical point of view. Thus, legal, infrastructural, and operational capabilities, including services that can be provided by a future PEL organisation have been identified as basic elements to be established, ensuring full operation of the PEL.

The Roadmap for Panlab, presented in this deliverable, specifies a way for realisation of the PEL through the achievement of a number of milestones, necessary to create an appropriate PEL structure and an associated infrastructure including operational rules. Based on the incremental steps for the implementation of the PEL different levels of and possible service offerings are identified. In order to establish a PEL organisation by a group of interested stakeholders, necessary legal aspects, such as legal status of the PEL and the PEL Office, have to be solved and business and membership issues have to be defined and reviewed during development and expansion of the PEL. To ensure efficient operations of the PEL and the enforcement of the operational rules by the PEL Office, a necessary PEL infrastructure will be necessary and which will have to provide appropriate management and scheduling tools and efficient user interfaces (e.g. Teagle). The service offering will be developed from basic to more sophisticated services in accordance with the potential growth of the PEL organisation and the number of participating test-beds and facilities as well as the evolving capabilities of the available infrastructure within the PEL to support various testing scenarios.

The development of the PEL can be divided into the following three phases:

- Phase 1 – ending with a clear concept for future development of PEL and an established PEL organisation, including a PEL Office ready to offer basic testing services by using necessary infrastructure and applying defined operational rules.
- Phase 2 – ending with a PEL ready to offer various testing services by application of advanced tools and user interfaces as well as to start providing services under commercial conditions.
- Phase 3 – representing a fully operational PEL which can exist as an economically self-sustainable organisation.

A significant part of the first phase containing the first specification of (i) legal and organisational, (ii) technical and infrastructural, and (iii) operational frameworks for PEL will be completed in the Panlab specific support action, mainly within work package 2.

The Establishment of a PEL organisation and a PEL Office as well as finer specifications of infrastructural and operational needs, including set up of basic testing infrastructure and service offer, should be done simultaneously and shortly after Panlab project with involvement of interested organisation to establish the PEL, and the public sector, including significant effort from EC, to support these activities.

The second phase, which will include necessary technological development to ensure PEL operation and activities on cooperation of a large number of test-beds with the PEL organisation, will need support from both the private and the public sectors, in a partnership, in order to establish a long-term sustainable PEL and PEL office.

Further development of necessary tools and improvement of PEL services and procedures, belonging to the third phase, could need support from both the private and public sectors. However a substantial investment of the PEL itself can also be expected in this phase.