



PSIRP

Publish-Subscribe Internet Routing Paradigm

FP7-INFISO-IST-216173

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Dissemination and Exploitation Plan

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Executive summary

Introducing a radical paradigm shift to the Internet requires wide and efficient engagement with the key stakeholders of the industry and academia. This document provides the plan as to how the PSIRP project intends to engage the community, what are key dissemination venues and topics.

The document describes planned engagement workshops, collaboration within the communication community and main forums for publications. The first version of the document focuses on the dissemination activities and provides only initial and tentative ideas for project results exploitation. Further versions of the document will cover the exploitation aspects deeper after the project results are sufficiently stable and their deployment incentives are investigated.

1 Introduction

For a project like PSIRP that is aiming for a radical paradigm shift on the architectural level of the Internet, it is essential to not only disseminate unilaterally, but engage with the leading parties of the industry and academia to create an early feedback loop. Hence, the project is expected to benefit substantially from involving external parties in discussions, e.g., around architecture, implementation choices, innovative applications, but also economic impact and deployment.

The first steps of engagement are the identification of relevant parties and publish the foundation concepts as soon as they have reached stability and passed internal evaluation and approval. This document supports the alignment of the dissemination of the project results to maximize the impact of the results to the industry and academia at large.

The document will be updated during the course of the project. The next scheduled update is at the end of the first project year. The detailed partner exploitation part of the deliverable is intentionally deferred to later phases of the project as the exploitation relates closely and benefits from the results of D4.6, "Final Evaluation Report on Deployment Incentives and Business Models". Therefore this first version of our plan concentrates on the industry engagement and dissemination of the results, and the exploitation plan part is only indicative and will be detailed after the project results will be sufficiently stable.

1.1 Abbreviations

CDN	Content Distribution Network	PSIRP	Publish Subscribe Internet Routing Paradigm
CFP	Communications Futures Program	RTFM	Rendezvous-Topology-Forwarding-Mediation
DTN	Delay Tolerant Network	SSA	Strategic Support Action
ISP	Internet Service Provider		

2 Engagement with Stakeholders

Engagement with a wide set of stakeholders is crucial given the nature of our project. For this purpose, PSIRP employs two main mechanisms. Firstly, we intend to organize external exploitation and engagement workshops. Secondly, we intend to establish an innovation process that invites external partners and stakeholders to innovate on our PSIRP platform.

The following sections describe both of these mechanisms.

2.1 Industrial Engagement Workshop

2.1.1 General Objective and Target Audience

The *objective* for the workshop is to engage in a dialogue with stakeholders (such as corporate, regulatory, end user and others) in order to influence the adoption of PSIRP ideas and receive valuable feedback on the validity and importance of our ideas for different sectors. The *target audience* of the event are open minded strategy-level industrial representatives from the manufacturers and ISPs side as well as the content and vendors side. We also intend to engage regulatory and end user stakeholders to widen the audience. Careful selection has to take place in order to craft an audience critical, yet open minded enough to absorb the input given in the workshop.

Parts of the technical speakers will be recruited from within PSIRP. In addition, we consider inviting external speakers (and audience) from other efforts such as in NSF FIND, other FP7 projects, or nationally funded research projects.

2.1.2 Concrete Workshop Idea

One concrete idea for an engagement workshop arises from the discussions with STL partners, the organizers of the Telco2.0 [6] event series. The target audience of these events maps naturally onto our envisioned target, i.e., strategy-level industrial stakeholders. The following paragraphs outline the current state of our plans to organize such workshop.

2.1.2.1 What is Telco2.0?

Telco2.0 is an initiative that follows the wave of Web2.0, i.e., renewal of the telecommunications sector proposition through the mash-up of new services based on new (Web services) technology.

2.1.2.2 Why is Telco2.0 interesting?

Telco2.0 organizes regular brainstorming events for a high-level audience similar to the one envisioned for our events. The brainstorming is usually stimulated by presentations and table discussions. The table discussions feed back to the panellists through an electronic system and are discussed in the open audience after the table discussions finish. However, the Telco2.0 organizers are open to adapted versions of this brainstorming mechanism.

2.1.2.3 Proposed event

Following an initial meeting with Norman Lewis and Simon Torrance, the founders of the Telco2.0 initiative, the following ideas around a Telco2.0-coorganized workshop on the Future Internet emerged.

- **Date:** end of 2008 or beginning of 2009, in combination with a wider Telco2.0 event.
- **Place:** Usually, the events take place in London.

- **Level of Audience:** CxO and corporate strategy are targeted for this event. The idea is to directly invite about 20 to 25 persons with the intention that they draw in additional (appropriate) people from their organization with a maximum number of 100 people.
- **Type of Audience:** Apart from inviting the usual telecommunication industry representatives, such as manufacturer and operators, service and content providers are seen as a desired audience in addition to other 'neighbouring' value chains like retail, health, and others. Also, regulators are intended to be invited.
- **Format:** A very engaging format is desired, i.e., presentations with engaging brainstorming discussions. STL partners provide dedicated electronic equipment to their events that can be utilized for this purpose.
- **Content:** The intention is to organize two sessions, one around PSIRP and another around the FP7 project Trilogy in order to make it more attractive for the audience, under the umbrella of 'Future Internet'.
- **Speakers:** About 5 speakers per session in order to not overload the audience. STL partners strongly felt that a mixture of 'academic' and business speakers is required for attracting the audience. The suggestion is 2 industry, 1 external academic (discussions with various researchers are ongoing), 2 project people from 'industry,' hopefully somebody with enlightening thoughts from that perspective (aim is high level speaker).
- **Branding:** STL partners (and therefore the Telco2.0 initiative) is intended to serve as an organizer with co-organizers being the Trilogy [8] and PSIRP projects, and potentially MIT (if possible),

2.2 Application Innovation Process

Another important aspect of engaging with external partners and stakeholders is the creation of innovation in the application space. It is generally understood that PSIRP does not have the resources necessary to showcase the wide applicability of what the architecture and its paradigm shift potentially can bring. As a result, we intend to establish an innovation process in the application space that will allow for attracting the applications we need in order to showcase what we will have developed. The efforts within PSIRP will then be limited to facilitating and enabling this innovation process, directly work with partners, feed potential requirements into the project and so on.

Hence, the innovation process intends to ensure that external partners will innovate on top of the PSIRP stack, by building applications that showcase the possibilities outlined in our vision.

For this, the following steps are taken:

- Select a group of external partners with which PSIRP will directly collaborate in application development and development support, similar to that described in Section 4.4.
- Collaborate with external initiatives and projects, such as the FIRE (Future Internet Research) initiative and the Onelab2 project, to facilitate experimentally-driven research on top of PSIRP technology.
- Develop a set of applications with these external partners that will demonstrate the appeal of the PSIRP platform.
- Hold frequent workshops with external partners to facilitate application development and disseminate the implementation results.
- Establish a community development process with bug reports, requirements input, wish list and so on, that is directly fed into the implementation efforts for the upper and lower layer PSIRP implementations.

It is worth mentioning that a similar innovation process will be applied for the adaptation of the PSIRP lower layer implementation onto a variety of link layer technologies, as this is an equally resource intensive task that cannot be completed within the lifetime of the project.

3 European Initiatives

PSIRP is expected to participate within European initiatives towards the Future Internet, within reasonable limits with respect to travel and time commitment.

3.1 Future Internet Assembly (FIA)

After an initial meeting in Bled (31.03.2008, Slovenia), the Future Internet Assembly is shaping up as a major concertation event outside the normal ICT summit series. PSIRP is committed to contribute appropriate dissemination material into this initiative as it develops. Most likely candidates for material are the PSIRP vision, candidate architectures and demonstrators. Although the unclear nature of governance and operation of the FIA makes it impossible to commit to particular contributions, it is expected that these contributions will happen in the form of position papers and demos/posters at future FIA events.

3.2 EIFFEL

Another European initiative is the EIFFEL specific support action (SSA), aiming at facilitating the dialogue between explorative and evolutionary research towards the Future Internet. Regular think tank meetings are planned within EIFFEL, inviting recognized experts in particular fields of expertise to contribute to the discussions within the EIFFEL think tank.

It can be expected that individual members of the PSIRP consortium could be invited to these think tank meetings to provide insight into new forms of internetworking as envisioned by PSIRP. Due to the expected exposure of the EIFFEL think tank, such invitations can be seen as a valid dissemination route for the entire consortium and its results. Very good relations to the EIFFEL SSA exist since three PSIRP partners are caretakers of the EIFFEL SSA.

3.3 FIRE

Due to the experimentally-driven approach that PSIRP is envisioning in its solution development, the FIRE (Future Internet Research) initiative is seen as being relevant for dissemination within the European Future Internet initiatives. Early contacts have been made through invitations to project members to participate in FIRE expert group meetings. Presentations to the FIRE expert group can raise the visibility for PSIRP results in this segment of research and they will further establish important links to the experimental research community (see also Onelab2 relation in Chapter 4 of this document).

3.4 IST concertation & consultation

Due to the visibility of PSIRP as a consortium and specific PSIRP partners in the European Future Internet initiatives, it is further expected that individual members of PSIRP will be invited to various IST concertation and consultation meetings. While these invitations are usually issued towards individuals as experts, these meetings can be seen as an opportunity for disseminating PSIRP results, in particular at the vision and architecture level.

4 Engagement with Individual European Projects

Given the collaborative nature of the EU framework programmes and many national funding programmes, it is only natural that engagement with other existing and future efforts within these programmes can be seen as a valid route of dissemination for PSIRP.

The following European projects have been identified having complementing and compatible interests with PSIRP and therefore form a potential basis for engagement.

4.1 CHIANTI

The CHIANTI project (FP7-ICT-2007-1/ 216714) aims for improving the experience of mobile users by hiding lower layer disruptions from the application layer (and therefore provide a seemingly seamless operation to the end user). The project develops prototype implementations of user devices and infrastructure components as well as service platforms and middleware. It will study how the applications should be written so that they would genuinely work in an environment with lots of short-term (seconds...minutes) connectivity fluctuations. For this, the CHIANTI project seeks collaboration, among others, in defining requirements for longer-term Future Internet protocol development.

A joint workshop between CHIANTI and PSIRP took place on the 23rd of May 2008, in Helsinki and identified the following specific topics as common interests between the two projects:

1. Content delivery mechanisms.
2. How to make applications and application protocols to work in challenged environment.
3. How to move application protocols to DTN-based (and perhaps PSIRP-based) asynchronous communication platforms.
4. Opportunistic content sharing, storage, and retrieval.

4.2 REDI: Rethinking the Design of Internet Application Protocols for a Mobile Future

A project funded by a grant from Teknologiateollisuus ry in Finland and hosted by Helsinki University of Technology (prof. Jörg Ott). The project is adapting and enhancing application protocol design to (a) support delay-/disconnection-tolerant operation to increase robustness and better support mobility and (b) to make application protocols aware of underlying networking characteristics so that they can take sensible decisions about their mode of operation and communication.

4.3 DISTANCE

A project funded by the Academy of Finland and hosted by Helsinki University of Technology (prof. Jörg Ott). The project develops generic support for application-specific functions in intermediate nodes in Delay-tolerant Networking (DTN) environments. Concrete examples include the distributed storage and retrieval of content using hints from the application as well as opportunistic support for application-specific routing and forwarding policies.

4.4 Summary of the PSIRP-CHIANTI-REDI-DISTANCE workshop

As mentioned above, a half day workshop between the PSIRP, CHIANTI, REDI, and DISTANCE projects took place on Friday the 23rd of May with some 15 persons attending. The four projects presented their results so far and some of the relevant problems, identifying many potential areas of co-operation. The following tentative action list was drafted:

1. PSIRP will provide the lower layers and possibly also the upper layers implementation to the other three projects, with the intention of the projects porting some of their applications over the PSIRP stack. One potential target would be to work towards a common API that would allow both DTN and PSIRP/RTFM to be used as alternatives.
2. Dmitrij Lagutin will form a joint security group (probably he, Jukka Ylitalo, and Teemu Kärkkäinen from RED1). This group will arrange a joint security workshop some time in the Fall, preferably co-located with some other workshop so that many people from both sides could participate.
3. Mikko Särelä from PSIRP will arrange a joint workshop on resource control and lateral error correction, with special focus on using micro-economics for understanding these. The time is open, but probably in the Sept.-Oct. time frame, again preferably co-located with some other event.
4. Jörg Ott from the CHIANTI project will arrange a joint workshop on the cross-area of routing and caching. Time open, but probably in the Sept.-Oct. time frame, again preferably co-located with some other event.

4.5 N-CRAVE

The N-CRAVE project exploits network coding to enhance the capacity and robustness of wireless networks. Its objectives include the development of a proof-of-concept for network coding in dynamic wireless network environments, use of network coding for the design of complexity-aware protocols for a wide range of medium access, optimization and security constraints and the development of peer-to-peer profiles and solutions that use network coding to improve application-driven performance.

In this field, PSIRP intends to investigate the possibilities and impact of network coding and caching to reduce the need for actual data traffic over the network.

To deepen the collaboration, a researcher exchange is planned between some of the participating partners of the two projects.

4.6 4WARD

The 4WARD project [7] intends to design inter-operable and complementary families of network architectures through a set of radical architectural approaches. The co-existence of multiple networks on common platforms is planned through applying carrier-grade virtualization of networking resources. The utility of networks is enhanced by self-management. A new information-centric paradigm in place of the old host-centric approach is developed to improve application support. The developed solutions will embrace the full range of technologies, from fibre backbones to wireless and sensor networks.

Hence, PSIRP and 4WARD share a common interest for information centric networking, more specifically how information objects are accessed and identified, how information objects interact, what interaction patterns should be supported and where the corresponding functionality is placed in the network.

A meeting with the 4WARD project is planned for the later half of the first project year to more deeply identify common areas of investigation and potential for collaboration.

4.7 Trilogy

The main objectives of the Trilogy [8] project are to develop unified control architecture for the Future Internet that can adapt to local operational and business requirements, to develop new technical solutions for key Internet control elements and assess commercial and social control aspects. Some of these objectives relate quite well to the paradigm shift towards publish-subscribe that forms the basis of PSIRP.

Collaboration in critical areas like congestion control and pricing is planned through direct partner collaboration in these areas.

4.8 Onelab2

Onelab2 (FP7 IP) continues the work of Onelab (an FP6 STREP) in the area of experimental research platforms. Onelab has been establishing the European partition of PlanetLab since 2006. Planetlab offers a global-scale Internet research platform, relevant for Future Internet research and also often seen as the basis for the US GENI efforts.

Onelab2 will start in September 2008, continuing the build-out of Planetlab in Europe. Furthermore, Onelab2 will be expanding into customer areas of contemporary research, large-scale publish/subscribe being one of them. PSIRP is being considered a lead customer project for Onelab2, i.e., working with Onelab2 on requirements to make Planetlab ready for the investigation of pub/sub solutions.

This customer relationship is seen as an important route for dissemination of PSIRP findings to the larger research community. With this, we can not only foresee the larger scale testing of PSIRP results but also the possibility of early adoption of results and solutions developed in PSIRP through a larger research community. Together with the open source licensing within PSIRP, this is likely to spur adoption of any solution developed in PSIRP. In this, it is important to note that a PSIRP partner (BT) is leading the work package on data-centric networking in Onelab2, the WP responsible for the customer relationship with PSIRP.

Furthermore, with the increasing importance of PlanetLab for pre-deployments (e.g., Polish Telecom uses PlanetLab for CDN pre-deployments), this is likely to open doors for industrial engagements as well.

5 Engagement with International Initiatives, Projects and Universities

5.1 Communications Futures Program @ MIT

Two industrial partners in PSIRP, namely NSN and BT, have been involved in the Communications Futures Program (CFP) [4] at MIT since its start in 2004. The consortium has involvement from MIT CSAIL, Sloan and MediaLab, i.e., three major institutions at MIT. People involved include Dave Clark, Karen Sollins, David Reed, Andy Lippman, Charlie Fine, and Bill Lehr. The work is organized in working groups, some of which are led by academia and industrial co-chairs. Each WG organizes its work according to the wishes of their contributing members, ranging from frequent phone conferences over full-day workshops to the regular plenary (usually twice a year).

The CFP consortium has proven to be a valuable stage for engagement in many areas and can therefore be used effectively for engagement with academia as well as industry. Although CFP is generally closed to members of the consortium, there are frequently invites for external partners from industry and academia to join and contribute to the discussions.

Two pieces of recent work are particularly relevant to PSIRP, namely the work within the Privacy and Security WG and the work in the Value Chain Dynamics WG. The former one is co-chaired by Dirk Trossen and is currently discussing the issue of identity in information networking. The discussions are semi-public, i.e., work is flowing in and out of the WGs (since there are no IPR issues attached to the topic) with a first whitepaper released on this issue, see [9]. We can expect a fruitful potential exchange of ideas in this area in the future.

The work in the Value Chain Dynamics WG targets the development of a methodology for evaluating dynamic changes in value chains, based on particular case studies (service offerings). The resulting toolkit is currently devising a framework for studying these cases and is currently extended in parts with underlying system dynamics models to place some hard

analysis against the cases. This work is potentially useful for the socio-economic analysis of the work in PSIRP.

5.2 FIND/GENI

The US NSF (National Science Foundation) programs FIND (Future Internet Design) and GENI (Global Environment for Network Innovation) are the most relevant US initiatives for PSIRP dissemination and collaboration. Many contacts exist to major players in these initiatives, such as through David Clark (through CFP), Scott Shenker (through ICSI and Finland) and many others on individual basis.

FIND organizes regular brainstorming workshops, similar to the envisioned EIFFEL events. It is likely (as it happened already in the past) that individual project members will be invited to these workshops to share their views and particular PSIRP results to the assembled research community. This is an excellent cross-Atlantic dissemination activity.

The GENI links are largely seen through the corresponding activities in Europe, such as FIRE (on initiative level) or Onelab2 (on project level). The connection of GENI to PlanetLab makes these contacts even easier. Furthermore, the PSIRP partner BT is currently member of the GENI Wireless System WG with the possibility to directly feed into GENI views.

5.3 University of Campinas

The Department of Computer Engineering and Industrial Automation (DCA), School of Electrical and Computer Engineering, at University of Campinas (Unicamp), is currently engaged in co-operation with Ericsson. The work focuses at a new Internetworking architecture, based on explicitly identified data items and forwarding paths rather than communicating end-nodes. In this information-centric architectural proposal, Unicamp seeks a scalable solution to maintain the required state at forwarding nodes, in order to establish and optimize the data delivery paths. In this context, the identifiers form a flat name space. The identifier space associated to the forwarding paths present serious challenges in terms of memory size and aggregation capabilities. For example, through adopting a per-interface Bloom Filter approach as a starting point for an efficient data structure for optimized publish/subscribe based content delivery, Unicamp plans to study and design feasible solutions that aim to maintain memory and computation costs at a minimum level. The system needs to maintain and update the state at the indirection points for routing information-based messages, based on the flat identifiers of the messages themselves. Specific aspects to be considered relate to how to manage the forwarding topology and to enable a rendezvous function, forming the envisioned data-centric architecture.

While both, the Unicamp networking project and PSIRP, target a relatively similar information oriented networking architecture, Unicamp especially focuses on content delivery while PSIRP aims to balance between interactive communications and CDNs, both of which will require new mechanisms. Given this similar ground of ideas, the potential for co-operation between the Unicamp's project and PSIRP looks promising. Initial steps have been taken to organize efficient information transfer via researcher exchange between Unicamp and Ericsson (LMF).

5.4 HSNLab @ BUTE

The High Speed Networks Laboratory at the Budapest University of Technology and Economics is a strategic university partner of Ericsson (ETH). As HSNLab is always looking for new research directions, there is a big potential for cooperation between PSIRP and HSNLab.

Three HSN topics are especially relevant considering PSIRP's goals and potential technologies. Firstly, PSIRP could benefit from HSNLab's activities in social networking based P2P overlay systems, aligning with the goal of PSIRP to devise a networking solution taking into account social aspects for scoping information. Although PSIRP attempts to develop a

native network layer solution instead of an overlay, collaboration might be beneficial for both parties, especially if PSIRP can utilise the relatively strong HSNLab competence in P2P systems and P2P overlay routing.

Secondly, some HSN activities relate to routing on flat labels, which might provide useful input to PSIRP in this area. Although the research in HSNLab focuses on routing on flat end-point identifiers, it is only a small step towards forwarding content based on topology-independent identifiers.

Third, auto-configuration and self-management is a research topic where HSNLab is active and could be useful for PSIRP, especially considering PSIRP's target for a nice bootstrapping solution of end-hosts.

Another potential collaboration is the ability of HSNLab to implement applications within our outlined application innovation process. ETH as a local partner has the possibility to provide guidance towards new MSc (or even PhD) thesis topics for HSNLab in alignment with desired PSIRP applications.

6 Journal, Conference Publications and External Presentations

Apart from scientific publications, the project will also actively seek opportunities to give external presentations at various conferences through talks and/or panels. The project members have discussed and identified the initial list of the conferences and journals we would like to submit our work (see the table below).

The consortium has also established the basic publication processes and rules for the consortium. These processes are described in a project internal wiki-page, which is also used to coordinate the collaborative efforts in writing publications and planning dissemination.

Table 1. List of planned Publication Venues

Venue	Submission deadline	Comments
Mobile ICT Summit 2008, http://www.ict-mobilesummit.eu/2008/ .		RTFM: Publish/Subscribe Internetworking Architecture. Mikko Särelä (LMF), Teemu Rinta-aho (LMF), Sasu Tarkoma (TKK-HIIT).
Cambridge Security Protocols Workshop (SPW 2008),	submitted on March 17, 2008.	Towards Understanding Pure Publish/Subscribe Cryptographic Protocols. Nikander, Pekka (LMF), Marias, Giannis F. (AUEB-RC). Cambridge Security Protocols Workshop (SPW 2008),
Mobiarch 2008, The 3rd ACM International Workshop on Mobility in the Evolving Internet Architecture	Submitted on March 31, 2008	
Internet of Things, http://www.iot2008.org , 27-28.03.2008		
Concertation meeting, Brussels, 11.03.2008.		PSIRP project presentation. Karila, Arto (TKK-HIIT)

ANCS 2008, San Jose, California, USA	June 16, 2008 (Paper registration and abstract) Full paper deadline: June 23, 2008	
HotNets-VII, Calgary, Alberta, Canada	July 12, 2008 (11:59pm Pacific Daylight Time)	
INFOCOM 2009, Rio de Janeiro, Brazil	August 22, 2008 (required) Full paper due: August 29, 2008 (firm deadline)	
SIGGCOM 2009 Barcelona, Spain	Jan/Feb 2009	

7 Open Source Software Licensing

One essential outcome of our work revolves around implementations of concepts and solutions developed in PSIRP. As it is known from other initiatives, open sourcing software solutions is an essential step in building a community around the ideas underlying these solutions.

Hence, PSIRP decided very early on, i.e., as part of its project proposal and embedded into our Consortium Agreement, that the preferred dissemination mode for software developed in PSIRP will be based on open source contributions. This is expected to get the involvement of the external developer community, stimulating our envisioned application innovation process (see Section 2.2). As outlined in this process, involvement of external developers is desired in the area of PSIRP applications as an essential way to showcase the new paradigm provided by the architecture.

The project will select a group of external partners with whom to collaborate directly in application development and to demonstrate the appeal of the PSIRP platform. However, the open sourcing dissemination strategy of PSIRP will allow any developer to openly develop solutions for the PSIRP environment.

7.1 Open Source License

The project has decided to use a dual-licensing model. All code is shared among partners or distributed externally under the same license. The license text that must be included in every code file written in the project can be found on the project Web site.

The license text that is included in all code written in the project states that the user of the code can select either BSD or GPLv2 license, whichever suits best the user needs.

As an exception, if pieces of code that are originally under other licenses are used in the project, they have to be clearly marked and listed in the project Web pages in the relevant section. The distribution of such code needs to follow the conditions of the original license. For example, if Linux kernel code is modified to support pub/sub code, the original license in Linux mandates the usage of GPL for the pub/sub code.

7.2 Components to be published as open source code

The realization of the PSIRP architecture progresses in consequent iterations. After every iteration, we expect to release a set of foundation components of the architecture. Following is a tentative list of software features that will be released after every iteration:

Iteration one that ends at M16: initial implementations of network attachment and forwarding modules

Iteration two that ends at M22: initial implementations of the upper layer and rendezvous

Iteration three ending at M27: reference implementation for RTFM.

More details about the implementation and prototype work in PSIRP can be found in [5].

8 Exploitation Plan per Partner

While it is still too early to plan for dedicated exploitation activities, as the overall architecture is still under development, a strong set of initial exploitation approaches have been identified and documented in this section. However, it should be mentioned that a more dedicated exploitation plan will be drafted based on the deployment incentives and business model studies that are to be done in work package 4 and documented in D4.6.

8.1 LMF+ETH

Internal dissemination

In the PSIRP project a pure Pub/Sub network is designed and evaluated and the operation is demonstrated with a prototype. The target architecture has completely different characteristics than the currently used IP based Internet. Using the developed prototype we can show the concept, which provides a new way for delivering data from the producer to the Consumer, in operation. For decades, the transmission of data between hosts has been traditionally based on end- to-end connections, and it may be difficult to change the way of thinking to something completely different. The prototype developed is one concrete way of showing that it may pay off to throw the old model away, and think differently.

There exists other research projects, such as 4WARD, that are addressing, among other issues, network virtualization. The virtualization environment is usually based on IP networks. Providing a new networking architecture on top of the virtualization environment may not only generate valuable feedback for the virtualization system, but also valuable feedback about the Pub/Sub networks, when run in virtualized environments.

Working in a clean slate way provides researchers a unique environment, where old protocols do not set restrictions on the possible solutions. Thus, the research environment gives the researchers a possibility for developing their thinking in a different way, allowing the wildest ideas to come up, test them, and find them either useful or not practical. The lessons learned from this kind of experiment needs to be disseminated internally, to teach people, especially engineers, how it is possible to solve problems, and show especially to researcher why it is important not to limit ourselves to the traditional solutions even if there are some restrictions from existing technology. Once the clean-slate native solution is designed, the project will also try to implement the architecture over existing networking protocols and equipment. This process teaches us how to evolve current systems towards new solutions which is seemingly impossible to achieve today.

The architecture design process of a Future Internet could be very useful when other network architectures are designed in the future like mobile telecommunication architectures or fixed-mobile convergence networks (FMC). The skills acquired by project participants might be useful for such designs even long after the project has finished.

The economic models of the current Internet are already fixed in some level. Adopting a different architecture that is based on publishing and subscribing data, caching information in the network and transmitting it differently, i.e. not in end-to-end fashion, may provide new economic models where actions in the network are based on compensation. The development of these models provides one possible view of the economics in the future networks. The results of the research work can be disseminated internally in different venues, providing the relevant people information about the possibilities of future networking models, and how the new environment could be utilized in creating business. For example, the project may even identify new business roles in the networking layer (e.g. cache services, rendezvous services)

This may also affect the product development, and give new hints what types of products may be needed in the future.

As Ericsson as a multi-national company is participating in PSIRP through two of its branches (LMF from Finland and ETH from Hungary), the joint project work may improve the internal communication and co-operation between branches and may positively influence the information flow. This may result in more efficient operations within the global Ericsson company.

External dissemination

During the project the results of the research are published in different conferences. While it is expected that the work with similar issues will continue after this project has concluded, the conference participation will most likely continue, and future research results may give a path from the early results developed in this project towards more concrete proposals, and, if the results of the project show that the new architecture is better than the old one, even to standards and wide deployment of the new architecture.

The nature of the PSIRP project is such that it generates a natural co-operation with universities. This opens the possibility to disseminate the project results and work experiences by holding courses at local universities around future networking issues. This may have a positive impact on educating the future generation of telecommunication network engineers and researchers. On the long run, this future generation may provide the basis for innovation in the next decades.

Besides universities, the project encourages professional co-operation with other companies on the same area, including vendors and operators, and this might improve the global position of these European companies.

8.2 BT

BT Research and Venturing (BT R&V), as part of BT Group plc. actively performs networks and application research in many areas, funded by public sources as well as internal lines of business. The efforts in PSIRP in particular are embedded, within BT R&V, into a larger research programme on information networking. This programme is led by Dirk Trossen, BT's PI for PSIRP, and will particularly serve as a BT dissemination and exploitation vehicle for the PSIRP work in the following way:

Dissemination of PSIRP results

The radical paradigm shift, as proposed by PSIRP, requires an inter-industry collaboration for driving forward the vision laid out by this project. Such collaboration and consensus is of utmost interest to BT as a service provider in order to achieve the required consensus and wide-spread internetworking of solutions within our own markets. Hence, BT intends to take a strong role in the dissemination of the project results.

Dedicated results are expected to be primarily disseminated via (high profile) conference publications. BT has a strong tradition on supporting publications to these venues. Furthermore, internal communication channels, such as the renowned BT Technology Journal, are intended to be used in order to address the BT internal but also external expert audience. In addition, BT intends to support activities to engage with other research efforts in this space within the UK, Europe but also internationally. BT's strong ties to the UK academic audience and the connections to major US universities are seen as potential routes for this engagement. Dedicated examples of these connections are engagements with the UK Next Generation Networks group (out of Sussex University), the Cambridge MIT Institute (CMI), the Communications Futures Program at MIT and dedicated collaborations with University College London, to name only a few.

In addition to the dissemination towards the technical audience, it is also in BT's strong interest to address the corporate (business) audience in order to jumpstart the required re-thinking in the corporate strategy sector. BT intends to take a strong leadership role in the

organization of the industrial engagement workshop (see Section 2.1), which directly addresses corporate strategy level audience of major industry players. The fundamental technical results but in particular the economic impact studies of PSIRP are expected to be disseminated in that way.

Exploitation of PSIRP Results

In addition to disseminating the findings of this project (and therefore stimulating the required industry-wide engagement), BT intends to investigate several options of directly exploiting the PSIRP results. As mentioned above, the PSIRP efforts are embedded in wider internal research efforts on information-centric networking. Within these efforts, we intend to investigate direct integration of the results into complementary areas such as sensing and RFID. As for the latter, the team partially active within PSIRP has been involved in the EU FP6 project BRIDGE on RFID technology and has been driving major architectural components such as the discovery service for serial-level discovery of RFID items. We will investigate the impact that a PSIRP internetworking solution might have on this area with the potential to influence necessary standardization bodies such as EPCGlobal, the ITU and the IETF very early on. In the sensing area, we will investigate a potential change in uptake for sensor solution through a paradigm shift as proposed in PSIRP. Other areas of investigation will include higher layer concepts such as the knowledge enterprise and the Semantic Web, both areas with a strong tradition within BT's research.

Beyond BT's research organization, we will investigate the integration of PSIRP's longer term view into shorter and medium term propositions for information-centric networking. Enterprise service buses are already in the offering of BT's lines of business and we will be working to integrate the PSIRP results with these propositions towards a sustainable short/mid/long term story towards our customers. Direct ties of BT's PSIRP team to relevant BT lines of business and technology strategy teams are important in achieving this goal.

Another exploitation aspect arises from the intended PSIRP collaboration with Onelab2, the experimental research platform efforts within FP7. As a direct partner in Onelab2, we will investigate the possibility to establish a private PlanetLab partition within BT, allowing for the evaluation of upcoming technology propositions such as the PSIRP results. This allows for a much faster exploitation in general and for PSIRP in particular (since PSIRP will serve as the initial test case). In this, BT intends to directly work with external partners through the envisioned application innovation process (see D3.1) in order to attract the desired applications onto such platform.

8.3 NSN

Nokia Siemens Networks envision a 100-fold increase in traffic over the world's networks in the next coming years. In order to keep the costs and gains in balance, innovation across the entire ecosystem is needed. Solutions for meeting the 100-fold traffic challenge are based on technological innovations in both flat architecture and optimized modular products.

The experimental work done in the PSIRP project complements related activities within the company by exploring architectural alternatives to media distribution services. Media distribution is traditionally done in dedicated networks (e.g. CATV, DVB-T), but also increasingly as an application on IP networks (IPTV). The dedicated networks and IP networks are fundamentally different, and it is likely that straight-forward adoption of the current IP networks for media distribution will not yield the best possible outcome (e.g. resource utilization, service quality). The Publish/Subscribe Internet Routing Paradigm being investigated in the PSIRP project is one promising architecture alternative, where the media itself, not the physical nodes in the network, are in the center of the network functionality. Depending on the project results, NSN seeks to evaluate the utility of the PSIRP architecture for future media distribution scenarios.

NSN sees the name-based routing architecture (rendezvous) in PSIRP as a promising platform for future networking regardless of the underlying networking technologies (pub/sub

or legacy networks), as it captures the pub/sub service model being provided to applications, and allows for rich policy, metadata and context mediated coordination between clients and the available services in the network.

The inter-domain aspect of the PSIRP architecture emphasizes the functional co-operation between competing network operators. Understanding the potential shifts in this interface in the future may prove fundamental for the telecom and datacom business environment. Even seemingly small changes in the incentive structure, as likely resulting from fully-developed data oriented networking architecture, may lead to game-changing effects in the global network business landscape. However, as such changes happen over time, it is essential that the PSIRP architecture be compatible with the current network business structure to begin with.

All of the above will be considered for NSN internal vision and strategy processes. Concrete outcomes of such processes for the near term include potential joint and/or dedicated research collaborations with the PSIRP partners and others in the Future Internet area.

8.4 TKK-HIIT

Dissemination of PSIRP results

HIIT is a separate research institute under Helsinki University of Technology and the University of Helsinki. During the project, the researchers of HIIT will publish their results in scientific conferences and journals. HIIT is also actively involved in cooperation with other researchers in nationally and internationally. Meetings with our partners will provide lots of opportunities to disseminate the results.

TEKES has donated first-year funding for the Future Internet (FI) programme of the Strategic Center of Excellence in Science, Technology and Innovation in ICT (Finnish acronym ICT SHOK), where HIIT is a key partner. The total volume of the work planned for the first year (1 April 2008-31 March 2009) is some 50 person-years and is expected to grow significantly in later years. The results of PSIRP are directly applicable here. There are also plans regarding a national Future Internet testbed, to be federated under the EU FIRE initiative as a part of a pan-European federated testbed. This will provide a platform for large-scale experimentation with PSIRP.

Exploitation in teaching

Many of the researchers of HIIT are also teaching at Helsinki University of Technology or the University of Helsinki. Seminars and special courses will be arranged, where the prototype developed and/or a simulated environment will be used to have students develop and test applications in a pure publish/subscribe environment.

There is currently one researcher in the HIIT team preparing his doctoral dissertation based on the work he is doing in the project and we are looking for another Ph.D. student to work in the project.

Exploitation in future research

HIIT is an inter-disciplinary organization with ongoing work in other research areas besides Future Internet, including Algorithmic Data Analysis, Network Society and Probabilistic Adaptive Systems. We expect the paradigm shift represented by PSIRP to have an impact in also these areas and lead into interesting inter-disciplinary projects.

Possible start-ups

The prototype implementation of the PSIRP architecture created in the project is intended to be made available under suitably liberal software licenses. This provides a good basis for product development not only by the partners but also by SME's and possible start-ups. We

expect that there is a good probability that at least one start-up company can be founded in Europe based on the results of the project.

8.5 RWTH

RWTH Aachen University and the Department of Wireless Networks are actively performing research funded both from public sources as well as directly by companies in the domains touched by PSIRP activities. This leads to following dissemination and exploitation paths for the project outcomes.

Dissemination of PSIRP results

As an academic partner RWTH will be heavily involved in the dissemination activities of the project. We plan to participate to writing of common papers on architectural and topics on overall design, as well as focused technological contributions on specific research work carried out in the project. We primarily target high-level conferences and workshops together with journal publications as our dissemination grounds, but also expect to carry out dissemination through direct meetings with companies and research institutions. We will also leverage other projects for disseminating relevant results on focused topics. For example, our planned work on network coding is highly relevant to other wireless networking research RWTH is involved with, providing ample opportunities for joint dissemination of results. We plan also to disseminate our results towards newly established German research Excellence Cluster UMIC (Ultra High-Speed Mobile Information and Communication) which is funded by DFG and German Federal Government at the level of ca. 35 M€ and operating in RWTH Aachen as a collaborative effort of a number of engineering and computer science departments. We also plan to disseminate results in part towards a cognitive radio project called Aragorn which could benefit from the various technological solutions developed in PSIRP.

Exploitation in teaching

The publish-subscribe approach of PSIRP to internetworking represents a potential paradigm shift in wide-area communications, and is in any case an interesting alternative to the end-to-end request-reply model that has become so predominant in the current internet. Our experiences in PSIRP will be used to enhance our teaching of communications networks principles and evolution on these points, especially in our advanced internetworking courses. We are also planning to incorporate some of the PSIRP technologies as parts of the network programming laboratory courses we are running, when permitted by the progress in implementation activities. Finally, we anticipate several M.Sc. thesis topics to arise in our PSIRP work, and at least one doctoral thesis will be heavily based on our activities in the project.

Exploitation in future research

PSIRP represents a major investment and commitment in internetworking research on our parts, and is expected to form a strong basis for future activities in this field. This includes not only smaller, individual research projects potentially funded through, e.g., the German science foundation (DFG), but also further collaborative research projects. We are also actively participating to research projects of different foci, but in which information centric networking is of major relevance. Many of our cognitive radio and sensor networking research projects fall into these categories. Our plan is to actively take technological contributions and lessons learned in PSIRP towards these other projects. Central element in these plans is formed by open source releases of different implementations effected in PSIRP, also including contributions to various simulation tools.

The department and its staff are also actively consulting and advising major international companies in this field, and we believe that experience gained from PSIRP can be used to enhance our exploitation through consulting and professional (on fee) courses. The group and its members have also a track-record on spinning off research based start up companies. We will carefully evaluate with partners the suitable possibilities also in this domain.

8.6 IPP-BAS

The Institute for Parallel Processing at Bulgarian Academy of Science (IPP-BAS) has a leading position among the scientific institutions in Bulgaria in the fields of Computer Science. The IPP-BAS actively performing research funded both from public sources as well as directly by companies in the domains touched by PSIRP activities. This leads to following dissemination and exploitation paths for the project outcomes.

Dissemination of PSIRP results

IPP-BAS is an academic partner and will be involved in the dissemination activities of the project. We plan to participate to writing of common papers on architectural and topics on overall design, as well as focused technological contributions on specific research work carried out in the project.

We primarily target high-level conferences and workshops together with journal publications as our dissemination grounds, but also expect to carry out dissemination through direct meetings with companies and research institutions. IPP-BAS's strong ties to the Bulgarian academic audience and the connections to major Bulgarian universities are seen as potential routes for this engagement.

Exploitation in teaching

Our experiences in PSIRP will be used to enhance our teaching of communications networks principles and evolution on these points. We are also planning to incorporate some of the PSIRP technologies as parts of the network programming courses we are running, when permitted by the progress in implementation activities. Finally, we anticipate several M.Sc. thesis topics to arise in our PSIRP work, and at least one doctoral thesis will be heavily based on our activities in the project.

Exploitation in future research

Important research areas for IPP-BAS are analysis and development of tools for network monitoring and QoS; research in Grid infrastructures and technologies related to the security and performance. PSIRP represents a major investment and commitment in internetworking research on our parts, and is expected to form a strong basis for future activities in this field. This includes not only smaller, individual research projects potentially funded through, e.g., the Bulgarian government, but also further collaborative research projects.

8.7 AUEB-RC

The Athens University of Economics and Business—Research Centre, and the Mobile Multimedia Laboratory (MMLab) in particular, perform leading research in areas aligned with the PSIRP project (e.g., there are more than 1000 citations to publications by Prof. G. C. Polyzos with his students and around 300 for Dr. G. Xylomenos). AUEB-RC/MMLab is highly committed to PSIRP, with 3 faculty and 7 Ph.D. and M.Sc. and undergraduate students involved, and it plans to disseminate and exploit project results as follows:

Dissemination of PSIRP results

AUEB-RC plans to disseminate PSIRP results through various avenues, but mainly through refereed publications in workshops, conferences and journals. In addition, our participation in PSIRP, our research and its results are included in a prominent place of our Web site which is visited by prospective graduate students and companies interested to recruit students and collaborate on various projects; we have also presented our PSIRP work with a poster during our department's Research Day with visitors from the scientific community from all around the Athens area. Moreover we target the creation of free, open-source applications that will incorporate PSIRP results, changing the way users utilise current Internet services.

Exploitation in teaching

The novel areas explored in the context of this project will find their way into the graduate and undergraduate curricula of the University (e.g., through class projects investigating alternative communication models) and will lead to new undergraduate, M.Sc. and Ph.D. thesis topics. Throughout the duration of the project students at all levels will be involved in carrying out research, but mostly at the graduate level, as part of their M.Sc. theses and Ph.D. dissertations. In addition, mainly security oriented results will find their way to specialized courses offered to companies and individual participants (in the form of continuing education or skills advancement courses).

Exploitation in future research

AUEB-RC has a strong track record of carrying out and publishing original research in the areas of telecommunications and Internet technologies and in particular in multimedia broadcasting and multicasting technologies, cellular communications, WLANs, and next generation architectures, as well as, in network and system security and performance evaluation. PSIRP achievements as well as the experience that will be gained throughout that project will boost and enhance our research, strengthen our competitiveness in all these areas, leading to innovative research results that will be widely publicized via conference and journal articles.

9 References

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