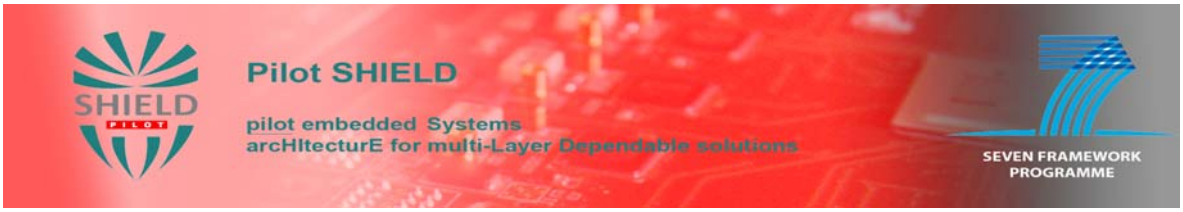

Project no: 100204

pSHIELD

pilot embedded **S**ystems arc**HI**tectur**E** for multi-**L**ayer **D**ependable solutions

Instrument type: Capability Project

Priority name: Embedded Systems / Rail Transportation Scenarios

Exploitation Plan

For the pSHIELD-project

Deliverables D7.2.1

Partners contributed to the work:

CWIN – Norway
SESM – Italy
ASTS – Italy
CS – Portugal
SE – Italy
THYIA – Slovenia

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Dissemination Level		
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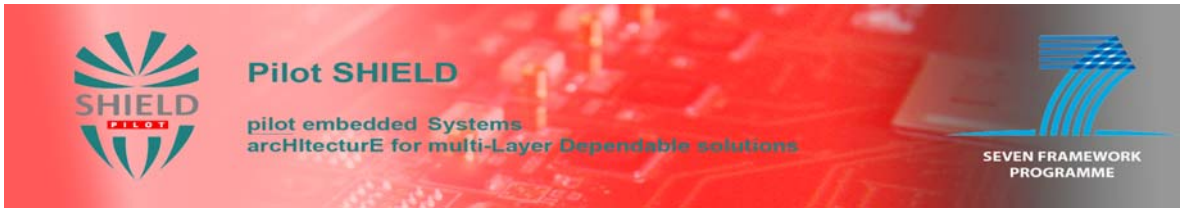
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	



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Draft A	25 February 2011	Initial Draft Structure
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Issue 2		Incorporates comments from issue 1 review

Contents

Glossary

ESs	Embedded Systems
SPD	Security Privacy Dependability
FSK	Frequency-Shift Keying
AFSK	Audio Frequency-Shift Keying
UCS	Use case Scenario
HW	Hardware
SW	Software

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1 Introduction

The pSHIELD project deliverable D7.2.1 “Exploitation plan” is prepared in frame of Work Package 7 and its Task 7.2. The target of this task is to promote and facilitate the exploitation of the achieved results. The exploitation plans of all the consortium participants are presented.

The exploitation is expected to be in many business segments such as Transportation, Automation and Manufacturing Industry, Health, etc.. One driving force for the exploitation will be the convincing proof-of-concept prototypes and demonstrators that will be developed in pSHIELD. Another one will be the exploitation strategies that will be devised for the projects results that could be submitted for standardization.

2 Exploitation plan

The exploitation plan focuses on the promotion of the SHIELD framework, highlight the advantages of using it in different SPD emerging applications as well as in enhanced SPD needs coming from the applications already addressed in the project.
SHIELD will give opportunity to industries and SMEs to acquire know-how and the possibility to exploit results in order to reach the following (but not limited to) main objectives:

- Consolidate the competences
- Identify new possible application scenarios of SPD technology
- Introduce new commercial products
- Contribute to regulatory bodies with an effective services and technology architecture proposal

The current section describes, at partner level, the exploitation plan, both for academia and industries.

2.1 Individual industrial exploitation plans

Below are listed selected individual industrial exploitation plans.

2.1.1 Ansaldo STS

The results provided by the application of the pSHIELD platform to the railway security system will have an impact not only on the quality of the system developed, but also on the design and development costs. Concerning the increase in system quality, pSHIELD will likely improve the advantage of the security system in terms of resiliency, availability and scalability with respect to competing products, and this should have a positive marketing impact. Concerning the reduction in development costs, pSHIELD will significantly reduce the time to market since it enables design modularity with possible reusability of components and it also allows for a quicker verification and assessment of the overall system. Furthermore, due to the generality of system architecture, the results can be applied to other dependability critical systems (e.g. those used for railway supervision and management, railway bridges, freight cars, all infrastructure surveillance) developed by our company.

From the business point of view, Ansaldo STS aims at exploiting pSHIELD results in its wide worldwide market. Security system demand is more and more increasing every year and responding to such a demand is often mandatory to acquire a complete integrated system, especially in the railway. The developed prototype extends Ansaldo STS security product portfolio and integrates, with the security management system, already developed by our company. This monitoring infrastructure prototype is expected to be an attractive product for potential customers due to its originality, resiliency, cost-effectiveness, easy installation and maintenance. All these factors contribute to keep low the time-to-market as well as the acquisition and operational costs for the customers.

A dissemination action will be also carried out inside our company in order show achievable benefits to departments in charge of adopting new development and product platforms, through conferences, workshop and internal meeting.

2.1.2 Critical Software

PSHIELD project results have proved useful and the following two main ways of exploitation at CSW are planned:

1. General use of PSHIELD results and knowledge horizontally e.g. in current projects, with the expected value of improved methodologies and tools (indirect use);

2. Through new products, tools and services that can be marketed directly to other organizations (direct use).

Indirect use of PSHIELD results is planned from the following results and knowledge:

- New competences in SPD Methods that allow direct application of security in networked embedded systems development projects.
- Combined use of Security, Privacy and Dependability in the context of heterogeneous Embedded Systems together with CSW knowledge in formal methods and, more precisely (SysML) in the first phases of the software development.
- Capability of using the pSHIELD composable framework during modelling of SPD aspects in given desired software in the initial development stages, improving efficiency and reliability.
- The modelling will facilitate cross-project and cross company reuse of SPD components.
- CSW is a CMMi level 5 company, its quality management process will incorporate new methodologies arising from PSHIELD. CMMI-based process improvement includes identifying the organisation's process strengths and weaknesses and making process changes to turn weaknesses into strengths.
- The pSHIELD composable Framework – since it works like a knowledge data base with problems, scenarios and with the purpose to hide Embedded Systems heterogeneity it can be applied every time a new project starts, particularly the SPD multi-layered approach.
- Modularity and expandability - The possibility of abstracting parts of the whole pSHIELD network as well as the integration of different components, and as such can be integrated in future projects.

Direct use of PSHIELD results is planned from the following results and knowledge:

- Integration of results in the CSW eXception Product - add capabilities in the development of safety critical design - CSW is well-known by its V&V services in the safety critical domain. With PSHIELD results in SPD methods and framework it is expected that this product can go a step forward and increase general security capabilities in the design and production of high integrity software development services, targeted at testing embedded software SPD characteristics through fault injection.
- CSW builds and markets a dedicated command-and-control platform for civil protection, space and security application – designated as the C&C framework – this framework also considers the integration with intelligent networked objects e.g. WSN networks. As such the integration of pSHIELD SPD features in C&C for networked embedded contexts is a strong possibility in the C&C technical roadmap.
- CSW is also currently developing projects related to electric vehicles charging networks and vehicle-to- vehicle and vehicle-to-network communication and specific applications. Again the integration of pSHIELD SPD features in this context is highly likely.

2.1.3 Eurotech

Eurotech has followed pSHIELD dissemination plan for results promotion, participating to dissemination activities related both to academic and industrial contexts. The main target of these activities is to increase and deepen the knowledge and experience on SPD in the area of high performance embedded computing in Europe. This target has been achieved participating to scientific workshops and conferences (i.e. Artemis CoSummit), publication of tutorials and whitepapers for professionals related to SHIELD results, through communications and promotional activities on the media and on the Eurotech web site. Dissemination will include also the establishment of relationship and synergies with existing and new networks of excellence and with clusters/groups focusing on pSHIELD topics (starting from nShield), both in Europe and world-wide. pSHIELD project represents an opportunity to increase Eurotech Group presence in high performance embedded computing markets, with a particular attention to all the application contexts requiring a high level of SPD. pSHIELD results will foster the identification of

guidelines that will suggest and drive the evolution of Eurotech Group products in markets with SPD requirements: the project represents an investment for the future in terms of research and know-now.
Eurotech R&D center ETH Lab and FinMeccanica Group are directly interested in the exploitation of technologies, approaches and solutions identified and developed in the project with respect to four main areas: High Performance Embedded Nodes, Reconfigurable SPD Hardware, Mobile and Rugged High Performance Embedded Systems. The exploitation activities in these fields will put in clear evidence the SPD capabilities of the new products and will have an import social impact, accelerating the public acceptance of pervasive system in everyday life. Finally, SHIELD's results will be used by Eurotech HPC Business Unit and ETH Lab in further research activities referring to the mentioned areas of scientific interest.

2.1.4 Hellenic Aerospace Industry

With the pSHIELD project, partners of the consortium will have the opportunity to participate in the design of an innovative communication platform, conveying information from sensors to centralized infrastructures, for the management of critical operations or situations. The technological framework refers to Embedded Systems and their utilization in an environment with adequately increased SPD levels during operation. A basic notion and desirable feature of pSHIELD regards the possibilities to abstract components from the platform and create pSHIELD subsystems, depending on the needs of specific applications.

This composability is what partners, especially the industrial ones, wish to, firstly, consolidate and later exploit in the form of a SHIELD prototype. pSHIELD product can be incorporated in individual company business plans or form the basis for a common consortium exploitation plan, that will include implementation of applications in specific business areas.

A wide diversity of industrial control activities can be served by ESs and WSNs, including supervision of assembly line, energy management, automation, process control and inventory tracking. The concept of integrating heterogeneous platforms exploiting their composability capabilities, aims at offering optimized resources management, through the "ad-hoc" formation and collaboration of sub-networks, according to each time needs and availabilities. The consortium will investigate the possibility of utilizing the outcomes of pSHIELD in the development of a series of industrial control applications. A brief description of the most important expectations and requirements for such applications, through representative examples, follows.

Located in a heavily polluted industrial zone, HAI will rely on the use of wireless sensor networks in the effort to mitigate the conditions for the company itself, the neighbouring industries and the area inhabitants. *Environmental improvement* can be achieved by reducing the release of toxic substances responsible for air and water pollution. Sensor networks can be used to monitor these unwanted releases. A collaborative grid can be formed with the installation of sensors in the nearby plants also, granting the possibility of dynamically configured sensor networks, according to occasional environmental needs.

HAI, being a sizeable organization, is especially interested in an effective *energy management* mechanism. Sensors and actuators can be used, firstly to monitor the indoor conditions and possible losses in the energy balance and subsequently to control the energy distribution or take corrective actions. Composability offers the possibility of different user panels and administrative schemes. For example, an energy management center could supervise the distribution of resources in the plant. Alternatively, in a more generalized format, many involved parties could play a hierarchical role, from the power provider company to a regional or a building block administrator.

Logistics is an aspect of industrial life, which HAI believes can be substantially benefited from the use of sensor networks with synthetic capabilities. Tagging on materials allows the sharing of useful information (ID, location) between all involved parties in the procedures of manufacturing, transporting, storing and ordering products. Collaborative sensor networks render these products traceable all along the path between assembly line and customer delivery.

HAI, for example, will investigate the possibility of embodying pSHIELD exploitation perspectives in its current evolving business plan. Prominent application areas in this plan are Infrastructure Security and Border Surveillance, having a lot in common with urban railways protection and Voice/Facial recognition (two of the selected SHIELD application topics). The development of high reliable *security* systems applicable in various aspects of social life, are in the front line of priorities. Cameras and sensors can be used to detect hazardous and illegal actions (e.g. border crossings). The devices usually have to be

deployed at remote in between distances and far from the operation center, on mountainous or harsh terrains, etc. If they are able to be organized, through their heterogeneity, with great composability, enhanced overall situational control and awareness for authorities could be possible.

Another application in the same domain concerns the prevention of natural disasters and their impact in public *safety*. Cameras and thermal sensors are used for the notification of abnormal conditions and derivation of alarms. The critical operations of fire fighting, involves the communication of a number of authorities, from fire and forest inspection departments to local communities, ministries, police and governmental crisis operation centers. Their effective organization, vital in these situations of high emergency, could be assisted with a composable SPD network platform, allowing each part to have access to the kind of information of its specific interest.

pSHIELD is expected to contribute significantly in the implementation of these business plans, since its values and concepts (security, privacy and dependability in the context of embedded systems) are of great importance in this area. Furthermore, the results of demonstration will depict platform capabilities, limits and commercial potentialities, while simultaneously they will guide us to the future research field and improvements.

2.1.5 SELEX Elsag

SELEX Elsag will exploit the pSHIELD project results in several activities related with Intelligent ES Nodes, Smart Transmissions, secure and dependable service middleware and information aggregation solutions for Embedded Systems distributed over IP network infrastructures. SELEX Elsag has a key-role within the European Secure SOftware defined Radio (ESSOR) project that sets its targets on providing architecture of Software Defined Radio (SDR) for military purposes and a military High Data Waveform (HDR WF) compliant with such architecture, thus offering the normative referential required for development and production of software radios in Europe. The results from pSHIELD project will be used in order to deliver guidelines which are related to the validation and verification of waveform portability and platform re-configurability, setting up a common security basis to increase interoperability between European Forces.

A real Intelligent Communication Node was internally developed by SELEX Elsag by using the embedded system architecture studied within pSHIELD project. This embedded system is able to run cognitive algorithms developed by academic partners, thus turning a standard communication node in a real cognitive device that is able to sense and process environmental data and to adapt its internal parameters for adapting to specific working conditions and react to possible threats.

Studied techniques and algorithms are currently used for developing cognitive devices for military applications at National and European levels.

2.1.6 SESM - Finmeccanica

SESM - Finmeccanica will exploit the pSHIELD project results applying the new approach of FPGA Run Time Reconfiguration of ESs investigated during the project. This will allow improving the products and services offered by SESM in the market of communications at airports.

Designed during the project SPD Power Node framework, together with its implementation in build at SESM FPGA Power Node Prototype, constitute a solid base for future SPD ESs developments. Also whole pSHIELD layers architecture may speed up time to market of new products. But important element in real world applications of pSHIELD solutions is prior standardization and certification of proposed architecture.

2.1.7 Tecnologie nelle Reti e nei Sistemi T.R.S. S.p.A

T.R.S. S.p.a. will take advantages from the research results on data distribution systems. New services and products will be delivered deploying DDS software in COTS and embedded systems.

A major exploitation is expected to develop a Decision Support software module, which uses these technologies, which TRS is developing in Vessel Traffic Monitoring domain.

Advancements in semantic technologies expected in pSHIELD project have already been introduced in some TRS products. Further development of such technologies are used in a number of research projects in TRS.

2.1.8 THYIA d.o.o.

THYIA's plan of the exploitation is addressed toward SPD-WSNs and nano, micro/personal sensor nodes for a range of security applications in different market domains. Through Social Mobility Networking (SMN) scenario, the implementation of pSHIELD project has the potential to bring new service to market. The scenario can bring in significant economic benefit by reducing cost in the transport sector.

THYIA is aiming to explore embedded technology and SPD approach that are key technologies for SMN scenario. An indoor and outdoor demonstrator will be developed in which a heterogeneous network infrastructure will be used for proof of the concept for these scenarios. The short range communication will be achieved by 60 GHz radio, optical fiber technology, and power electrical grid that allow continuity of services over different access technologies. Exploring new SPD technologies for such complex system infrastructure is a primary aim of THYIA in this project. For testing some sensor technologies (e.g., smart dust and video surveillance) the use micro and nonoelectronics that required 3D integration is required.
The table below gives some motivations why 3D integration for embedded system design is important.

Miniaturization	Case for 3D	Caveats
Miniturisation	Stacked memories. "Smart dust" sensors.	For many cases, stacking and wirebonding is sufficient
Power Consumption	In certain cases, a 3D architecture might have substantially lower power over a 2D	Limited domain. In many cases, it does not
Memory Bandwidth	Logic on memory can dramatically improve memory bandwidth	While memory bandwidth can be improved dramatically, memory size can only be improved linearly
Mixed Technology (Heterogeneous) Integration	Tightly integrated mixed technology (e.g. GaAs on silicon, or analog on digital) can bring many system advantages	Though might justify 3D integration, this driver might not justify vertical vias., except for the case of imaging arrays

Thus, the main interest of THYIA in the exploitation plan lies in testing SMN scenarios targeted in nSHIELD, and the use of specific sensor platforms, and other devices that will be delivered in the market after the termination of the nSHIELD project.

2.2 Individual academic exploitation plans

Below are listed selected individual academic exploitation plans.

2.2.1 Mondragon Goi Eskola Politeknikoa:

Results will be used in the context of teaching activities at the University (at computer science and telecommunication engineering degrees and postgraduate lectures). This teaching material will also be offered as industry courses. Mondragon University acts as a R&D supplier for (it is in fact a subsidiary of) Mondragon Corporation Cooperativa, one the 10 main industrial groups in Spain. In this scope, Mondragon University plans to develop advanced courses and seminars to train personnel from local companies during the first two years after the project and also the dissemination of the results by means of publications.

- **Engineering: Computer Science Degree.**

"Security" is one of the modules of the Computer Science degree.
http://www.mondragon.edu/es/estudios/grado/ingenierias/informacion-grado-ingenieria-en-informatica/materias-coordinacion-vertical/Descripcion%20materias%20-%20COORDI.%20VERTICAL_Sistemas%20Operativos,%20Sistemas%20Distribuidos%20y%20Redes.pdf

- **Postgraduate: Master degree in New Information and Communications Technologies.**

"Security in information and communication systems" is one of the modules.
http://www.mondragon.edu/es/estudios/doctorado/tecnologias-de-la-informacion-y-las-comunicaciones/master-oficial-en-tecnologias-de-la-informacion-y-las-comunicaciones

2.2.2 Università di Genova

University of Genova was able to publish obtained pSHIELD results in referred International conferences and journals focusing particularly on the study and development of innovative SPD metrics as specified by the Dissemination report. The ISIP40 research group of the University of Genova has currently two PhD students (Sk. Shariful Alam, “Opportunistic Spectrum Sensing and Transmissions in Cognitive Radio” (tentative title), PhD thesis, to be finished in Q4.2013 and Kresimir Dabcevic working on “Security Threats and Detection Techniques in Cognitive Radio Networks”, PhD thesis, to be finished in Q4.2014) studying and developing innovative algorithms for secure resource management at transmission level through environment awareness, self-reasoning, self-healing and learning capabilities.
University of Genova is responsible for large scale simulation scenarios in the European Secure SOftware defined Radio (ESSOR) project. pSHIELD results will be exploited within this project that sets its targets on providing architecture of Software Defined Radio (SDR) for military purposes and a military High Data Waveform (HDR WF) compliant with such architecture, to deliver guidelines which are related to the validation and verification of waveform portability and platform re-configurability.
The ISIP40 group of the University of Genova is currently coordinating the Erasmus Mundus Joint Doctorate on Interactive and Cognitive Environments (EMJD-ICE http://www.icephd.org) an EU project for financing PhD scholarships. One of the research areas agreed with other partners in the consortium is focused on Networked Embedded System. In this area, pSHIELD results will be exploited dealing with various technological issues concerning embedded systems and networks of the future, which represent a very important basis for the development of many intelligent and pervasive applications. From a scientific-technical point of view, the course provides insights on topics such as simulations of networks, design of processors and embedded systems, communication networks and smart sensors. Seasonal schools and workshops will be organized (the first summer school was organized in September 2011 in Klagenfurt (AT), while the second will be organized in Italy in September 2012) with specific tracks focused on SPD related concepts in Networked Embedded Systems.
Finally, the demonstrator that was developed by the University of Genova and SELEX Elsag within the pSHIELD project will be internally used as a basis for further scientific activities and MSc, PhD related research activities.

2.2.3 Università di Roma

University of Rome “La Sapienza” will exploit the results of the pilot project mainly for didactic and teaching purposes. In particular, as outlined in the dissemination report, many master degree theses have and are expected to profit from the documentation and the background coming from the pSHIELD project.

Moreover, project results will be exploited to upgrade and update the programs of several courses and to hold thematic seminars on these matters both at universities and in the companies.

In particular during the course of “Technologies for Automation”, in the context of Computer Science degree, the concept of “composability” has been introduced to the students from an academic perspective, by rising interesting discussions about the mathematical tools at the basis of the formulation of the problem, as well as the potential industrial application of this concept.

Starting from that, participation to this project (at least by disseminating its results) will allow new generation engineers to acquire know-how on control theory and informatics and more specifically on secure resource management over heterogeneous embedded systems networks. If the SHIELD concepts will become a reality, and a standard, then the new generation of engineers will be prepared to face this challenge.

This project will give the chance to reinforce the already existing cooperation and to create new links with the universities, manufactures and operators involved in the project with the target to stimulate these companies towards advanced research topics.

In particular strong relationship have been consolidated and/or created with SelexElsag and Tecnologie nelle Reti e nei Sistemi to focus the research activities on semantics and middleware, by leveraging also the involvement in other projects or the preparation of new proposals together. The long term aim of this relationship is to: i) achieve the consolidation and standardization of these concepts and ii) the creation of new product to translate the SHIELD project into a tangible revenue for the involved stakeholder (more ambitious).

Finally, dissemination has been and will be also assured by extensive publications especially on the major international reviews and conferences and by the participation to the main events organized by the European Union as well as by other institutions.

3 Conclusions

Deliverable D7.2.1 represents consortium participants' plans according to the exploitation of project results. It should be highlighted that farther development of pSHIELD ideas is expected in new project nSHIELD, so some exploitation results may be achieved as a result of pSHIELD work continuation in frame of nSHIELD project.

References

[1] Technical Annex for ARTEMIS JU pSHIELD project number SP6 100204