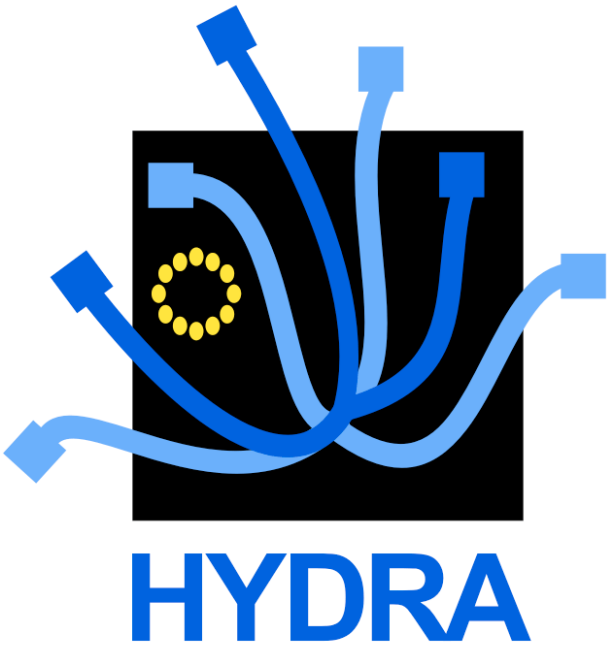

The Hydra project is co-funded by the European Commission within the Sixth Framework Programme under contract IST-2005-034891

Newsletter No. 04

http://www.hydramiddleware.eu

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April 2009

Hydra's Status Quo

The HYDRA project develops middleware for networked embedded systems that allows developers to create ambient intelligence applications based on wireless devices and sensors. Through its unique combination of Service-oriented Architecture (SoA) and a semantic-based Model Driven Architecture, HYDRA will enable the development of generic services based on open standards.

Embedded systems are widespread. Bill Gates said in 2003 that every US citizen is using 150 embedded systems every day[1]. This is not a surprise because mobile phones, TVs, cars, home appliances, healthcare devices or building automation systems are based on embedded systems. They are interconnected in networks of many devices and form the building blocks of the future Internet of Things.

Embedded systems technologies have a high intersection potential. Thus they are deployed in all relevant market sectors and have a major impact on the way these sectors work and collaborate, how they will develop, and how successful their products will be on the world market. Manufacturers are thus increasingly seeking to network their own products with other systems in order to provide higher value-added solutions for their customers.

Hydra's project vision to create the most widely deployed middleware for networked mobile and embedded systems allowing producers to develop cost-effective and innovative applications for new and already existing devices is still valid.

The Hydra project has developed a Software Development Kit, a Device Development Kit and will integrate these in an Integrated Development Environment to support software as well as hardware developers in their work to produce cost efficient and innovative ambient intelligence services and applications.

The third project year has consolidated the middleware components and the prototypes in the home automation, e-health and agriculture domain that make use of the intelligent service layer provided by the middleware. Application developers do not need to deal with the particularities of the devices and can access its functionality in a systematic and standardized way.

Feedback from developers sustain our view that manufacturers and systems integrators will be enabled to build devices and systems that can easily be networked and increase their flexibly to create cost-effective high performance solutions. Developers appreciate the ease to integrate devices and sensors into a distributed infrastructure. And it helps them in taking care of privacy and security requirements.

The third project year has been crucial to increase Hydra's visibility, awareness, and impact. The project has been nominated one of the top ten EU-Projects at the ICT-Event in Lyon (November 25th–27th 2008) and has successfully shown its abilities at GSMA Mobile World Congress in Barcelona (February 16th–19th 2009) and the CeBIT 2009 in Hannover (March 3rd-8th 2009). Subsequently Hydra has been invited to several European high-level events and international conferences on energy efficiency and on wireless sensors and co-operating objects (see Hydra – present in the World) and to become part of several EU initiatives like the Future Internet Assembly and the Cluster of European projects on the IoT. These clusters aim to promote a common vision of the IoT and to discuss the future of the Internet.

Contact:
Dr. Markus Eisenhauer

Company:
Fraunhofer FIT

Email:
markus.eisenhauer@fit.fraunhofer.de

[1] Vp. Microsoft: The Disappearing Computer by Bill Gates, 2003. http://www.microsoft.com/presspass/ofnote/11-02worldin2003.mspx, 24.09.2009.

Hydra's Open Source activities

An outcome of the Hydra project is a reference implementation of the Hydra middleware in form of a Software Development Kit (SDK), a Device Development Kit (DDK), and an Integrated Development Environment (IDE). These tools will be made available as Open Source Software.

The decision to publish Hydra under an open source license refers back to the project proposal. Due to public funding the results of the project are intended to be made available to the public. Though constraining possible business models, software greatly profits from open source; a fact that more and more IT companies like SUN, IBM, and SAP have recognized.

But releasing software as open source is not only about putting the zipped sources on some website. To harness the potential of an open source community diverse problems of technical, legal, organizational and motivational natures have to be solved. Smaller problems may be the technical ones like where to put Hydra source code so that it is easily accessible. Here SourceForge is a good starting point, which will ensure availability of the sources even after project funding ends. Legal issues like the choice of a common software license, for example, under which Hydra will be distributed, are also settled: after several open source licenses were investigated and compared the project board decided in favour of the LGPL (Lesser GNU Public License) for FLOSS (Free/ libre/ open source software).

Contrary to popular belief, many successful open source projects have rigid structures. A small core developer team follows strict development guidelines much like true commercial software development. For example, the high security standards of the Apache2 web server would not be achievable if not each and every change was reviewed by experts of the respective code area before being applied. It goes without saying that for most projects only a small part of all contributors have commit rights. If the project is organized as a Meritocracy, one has to earn commit rights through previous contributions. Compared to a research project this is quite a different culture. This transition from a research frame to commercial standards must be accomplished.

Finally, there is the problem of attracting an active community quickly. The Hydra consortium is successful in advertising the Hydra software through its dissemination activities targeted at scientific and industrial audiences. Several companies and institutes have already requested access to the software. But activities did not yet address the OSS community. It is important to open up the sources soon so that the community sees progress and commitment under the leadership of a trustworthy organization: We inspect the options to form a Hydra Foundation. During the remainder of the funded period the Hydra consortium gives enough momentum to the project to proliferate on its own.

After all, documentation and code quality come into play. Early adopters expect to get the software up and running quickly without much hassle and configuration efforts: check out, build, and run. Nothing is more frustrating than having to fumble around for hours before being able to test the software. And, of course, the software must be modifiable and maintainable.

Here Hydra has serious advantages over other research projects because quality assurance has been an important objective since project start. Formalized and innovative requirements management, shared version management and a test-driven development paradigm with continuous integration are only a couple of Hydra's quality procedures. Also a quality manager constantly monitors and measures software development. Results and identified issues are reported back to the involved partners directly and also in official reports. Additionally, considerable research in software engineering and quality management was made and is still being carried out.

Stay tuned to the next Hydra newsletter where we present more details on the open source release of the Hydra middle-

ware which is planned for the end of December 2009.

Contact:
Christian Prause

Company:
Fraunhofer Institute for Applied Information Technology

Email:
christian.prause@fit.fraunhofer.de

Validation Results of the 2nd Hydra Development Cycle

The Hydra validation plan defines a series of three different assessment studies, one per Hydra prototype and iteration. The present article reports a summary of the results of the second assessment. The *objects of the evaluation* are the DDK and middleware prototypes. However, since some requirements – which resulted in being partial supported or not yet supported in the prototypes developed in the first iteration – need to be validated again, the second assessment also considered the last version of the SDK. According to the validation plan, every validation cycle assesses components that are not considered as the final ones, but as the partial release of a subsequent delivery of improved prototypes.

The *validation methodology* has been built and applied by the comparison between an expected impact - described in Hydra with the means of the user requirements, - and how the real prototype or application behaves. In detail the validation methodology verifies that each selected user requirement criterion has reached the threshold level, or whether the requirement has been partially met or not.

Starting from the initial list of requirements, each WP first confirmed the possibility to assess them or not and then identified the major ones on which to apply the testing procedure, eventually integrating or substituting the initial list in case new requirements were added, old important ones had been left out or the previous selected group was not adequate or sufficient. The selection of the requirements to be validated has been fulfilled by considering the following parameters:

- effective implementation of the requirements (in respect to the actual timing or status of the project),
- relevance for the overall architecture (cross related features) and
- requirement type and priority.

The assessment procedure has been applied from the (potential) Hydra user, who is a developer or a software expert able to recognise if the promised features and properties of the Hydra middleware are met. The environment selected for the validation was the software laboratory of the Hydra partners, where potential developer users, were selected to carry out the assessment.

83 requirements have been assessed within the 1st and 2nd validation cycle.

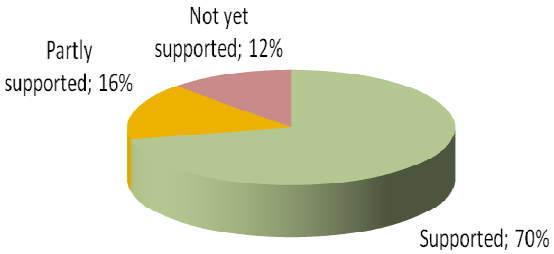

Figure 1 – Results of the 1st and 2nd validation cycle

It is worth to highlight that the number of supported requirements was improved compared to previous cycle (at that time 52% of the requirements were supported). In particular, the number of requirements “not yet supported” has decreased from 31% to 12%. Specifically, in the second validation cycle, in total 57 requirements have been assessed:

- 22 requirements have been re-assessed, because they were not yet

or partly supported in the first validation cycle.
- 35 requirements have been assessed for the first time.

Focusing on the re-assessed requirements only, we can state that 12 requirements out of 22 (54%) moved from not yet supported to supported or partly supported, or moved from partly supported to supported. This shows a substantial improvement in the development of the SDK and middleware in the last year.

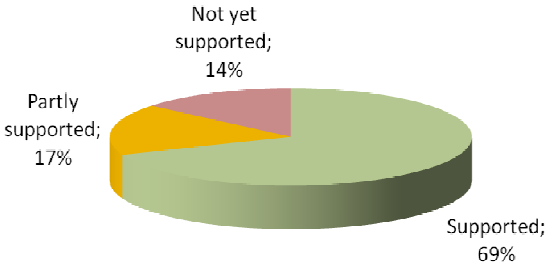

Figure 2 - Re-assessment of requirements

Notice that the success rate for the new requirements of this second validation cycle has improved compared to the success rate of the first validation cycle from 52% to 69% in the second validation cycle. These validation outcomes clearly show that the Hydra platform implementation is properly (and with an increasing speed) pursuing the target objectives. Most likely, the improved know-how of researchers and developers about the involved technologies and features of the platform helped to achieve these improved results.

Finally, it is worth to highlight that this is just an intermediate result. The next validation cycle should confirm (and possibly improve) the obtained results, following the current development trend.

If you would like to have further details, or even better if you would like to test the Hydra prototypes and be involved in the Hydra validation, please do not hesitate to contact us.

Contact:
Alessio Gugliotta

Company:
Innova Spa

Email:
a.gugliotta@innova-eu.net

Sustainable business models in networked e-health services

Healthcare expenditure in Europe is significant and rising faster than overall economic growth itself. E-Health programs are considered Europe-wide as major instruments for supporting new disease management strategies, but they have generally failed getting past the pilot phase. One recognised reason for this is the lack of business models for such e-health services. The Hydra project conducted a one-day high level workshop at Siemens in Berlin in order to shed light on how sustainable business models could be developed that will satisfy all stakeholders.

A general trend in Europe is the emphasis on providing chronically ill in their own home in response to patients' and their families' wishes. Such developments depend to a great extent on well functioning services but even more on the acceptance of a sustainable economic framework for all stakeholders.

The provisioning of e-health and e-homecare differs between the EU Member States: "Hospitalisation at home" has been introduced in France, in the UK rehabilitation care is increasingly being carried out at community level or at home rather than at hospitals; and Kaiser Permanente in the US, one of the earliest adaptors of telemedicine, has developed the concept of "Home as the Hub". Just to name a few of the many healthcare organisations working with remote monitoring and telemedicine, who have realised business cases for achieving acceptable cost-benefit ratios with these new services.

In the trail of the extensive ICT developments within the healthcare systems in Europe in recent years, there is a fertile environment for the introduction of yet more comprehensive services for improving healthcare and making healthcare providers more effective. But the valorisation of new ICT services in healthcare is becoming more and more focused on real value creation. Every new product has to provide a viable cost-benefit ratio to the healthcare provider or it has to provide real, measurable advances in medical practice in a prioritised area.

The situation is even more obscure as seen from the supply chain of manufacturers, service providers and operators, pharmaceutical companies, suppliers of healthcare products, etc. The ubiquitous nature of an eHealth infrastructure and the dynamisms of services orchestration are the core features of the future Internet of Things and Services. Understanding the business framework in this ecosystem is an essential prerequisite for the successful deployment and exploitation of new eHealth services and applications.

To shed light on the possible business models to be deployed by users of the Hydra middleware, a one-day high level workshop was organised in Berlin, Germany on 8 June 2009. High-level experts from a range of different stakeholders in Germany, Denmark, Italy and the UK were invited for the workshop. The participants represented diverse stakeholders such as clinicians, solution providers, system integrators, component manufacturers, and healthcare economists.

The workshop was initiated with a lecture on networking systems and devices – visions and possibilities in the Internet of Things and Services. The lecture described how the Hydra middleware could facilitate advanced, networked services for monitoring and interaction with patients in their homes. A set of healthcare scenarios was also presented that lead into the discussions that followed.

The scenarios covered 1) Multi-parametric monitoring of health parameters in outpatients with chronic diseases, 2) Self-management and personalised risk as-

sessment for people at risk and 3) Therapy, rehabilitation and exercise monitoring.

After the presentations, the rest of the day was devoted to expert discussions on three topics.

Firstly, the experts discussed scenarios for innovative healthcare applications & provisioning of e-health services. During this discussion the limitations and opportunities of networked healthcare applications were discussed from a clinical point of view and attempts were made to identify how the technology could best be used to serve medical purposes.

The discussion then turned to identification of the business framework, actors and stakeholders in healthcare management. The experts identified a series of early adopters of networked eHealth services. These early adopters will later be used for the development of business models for Hydra enabled applications.

Finally, the experts attempted to estimate the potential value and revenue streams, pricing models and cooperation strategies in eHealth applications. Not surprisingly, this area is very complex and no definitive answer could be found. However, the Hydra business modelling tool will be able to perform various simulations under different conditions allowing us to assess the potential revenue streams in future services.

The workshop was hugely successful and the vast amount of information collected from the experts and the discussion is presently being analysed and sets of business cases are being developed. The results of the work will be published in a public deliverable “Business models in Healthcare”.

The public deliverables can be downloaded from the Hydra website at www.hydra-middleware.eu.

Contact:
Jesper Thestrup

Company:
In-JeT

Email:
jth@in-jet.dk

Workshop: Hydra Business Models for the Energy Domain

Since 1998 the energy market in Germany has been exposed to deregulation measures. Other European energy markets are facing the same challenges. Legal conditions are forcing utility companies to offer smart metering solutions and time- and load-dependent tariffs to the end customers. In addition, utility companies are also facing a growing ecological awareness, rising oil and gas prices and customers who are willing to change their energy provider more quickly. This development forces them to develop new innovative products which are compliant to the social and political requirements, and which improve energy efficiency.

Utility companies and governmental organizations strengthened their activities to fund more alternative types of energy-sourcing like sun, wind and water. But coal and oil are still of importance. Nevertheless, the alternative energy types force utility companies to change their way of thinking because they are mainly produced peripheral. In addition, the peripheral energy production of private customers has lead to a new stakeholder on the market, a so called “prosumer”.

Prosumer:
A prosumer combines the two roles consumer (s.o. who consumes/ demands power) and producer (s.o. who is producing power). An example of a prosumer is a private household equipped with solar panels on the roof of its house. The produced amount of solar energy will be fed into the public power grid. At the same time the private household requires energy for its home facilities.

Besides the peripheral energy production that is very difficult to forecast, there is the volatile energy demand of the local customers. Utility companies must be able – even under these circumstances – to provide a sufficient amount of energy in every moment, in order to cover the energy demand. Therefore they have to produce more energy than demanded in order to balance the load profile as well as to buffer unpredictable energy peaks. Otherwise the power grid would collapse.

In addition, the cost of the energy production and distribution varies across the day. Therefore at certain times (e.g. in the night) energy is cheap (since energy demand is low) whereas at noon energy is usually expensive (since the energy demand is high). Certain appliances at the customer side permit for a hysteresis function. A heating might be switched off at certain intervals (i.e., when energy is expensive) while still meeting the customer demands (i.e., temperature should be in a specific configurable range).

Hysteresis:
Hysteresis characterizes a system, whose output parameters do not only dependent on the type of the input parameters but also from the history of the input parameters. Thus a system with hysteresis has a memory.

Therefore utility companies are looking for innovative IT solutions that help them to optimize energy production and distribution in order to improve the energy efficiency. Peripheral intelligent embedded systems like smart meters can make adequate contributions to handle the in-time provision of energy with respect to the current energy demand as well as the management of flexible prices. At the same time they can also enable an efficient handling of resources. These smart meters are able to gather the customers’ energy demand in real-time. This information as well as the forecast of the available primary energy can be matched in order to gain more energy efficiency. Smart meters are a door opener for companies to deliver new services to the customer households. Currently, there are still some issues about the actual value of the benefits provided by the integration of smart meters into the energy supply chain and into the house infrastructure, and about the distribution of costs and benefits of smart metering solutions among the involved market stakeholders.

Due to this development on the energy markets the Hydra consortium is organizing a business modelling workshop which

will take place on the 16th October 2009 at Siemens in Berlin. Various international energy experts representing the complete energy value chain are invited to this workshop in order to initiate an open discussion about innovative technologies that can be applied within the energy domain.

The purpose of the workshop is to create awareness of Hydra among experts in the field and to gain their input with respect to requirements, challenges and added values of smart metering solutions. In order to guideline the discussion business ideas have been developed.

One idea addresses the adjustment of the energy consumption with respect to the current load profile. This means that Hydra technology can help to manage the adoption of the energy consumption behaviour. In times of energy peaks, utility companies can send a signal via the metering service provider to the energy consuming household to reduce the energy consumption. A context engine that is incorporated in the Hydra middleware is managing the adjustment process. The context engine is able to consider customer preferences regarding certain devices and energy prices. This adjustment process could be based on a contractual agreement between the households and the utility companies. As compensation for the interference of the utility companies the households could receive a monthly discount on their energy bill.

If you are interested in joining the workshop discussion, please contact us.

Contact: Florian Roehr

Company: Siemens AG, Siemens IT Solutions and Services, C-LAB

Email: florian-roehr@siemens.com

Hydra – present in the world

The Hydra project has been invited to several workshops, congresses and events in the last months. Hydra continued its tour throughout the world, always boosted by the European Commission, presenting a portfolio of services and applications in the contexts of e-Health, agriculture, energy efficiency and ambient intelligence.

The Hydra project, represented by the Project Coordinator, Dr. Markus Eisenhauer, the Technical Manager, Peter Rosengren and Pablo Antolín Rafael, was invited to participate with an energy efficiency demonstrator in the **ICT 2020 Energy Efficiency** High Level Event held in Brussels in March, where the most influent policy and business decision-makers in the field of ICT for Energy Efficiency, including also researchers and engineers interested in shaping Europe's future, were present.

ICT4EE:

The High Level Event on ICT for Energy Efficiency is organised by the European Commission's Information Society and Media Directorate-General, in cooperation with the Czech Presidency of the European Union. The initiative aims to match the EU targets towards reducing carbon emissions by 20%, increasing the share of renewables in energy consumption to 20% and saving 20% of the EU's energy consumption. This event aims to gain visibility for the potential of ICTs in enabling energy efficiency across the economy and in particular it will show how ICT-based innovations may provide one of the potentially most cost-effective means to achieve the 2020 energy and climate targets.

The presented Hydra demonstrator allows for intelligent and energy efficient management of light in a house, including electric lights, blinds and canopies to meet the needs of the user. The set of applications, named “Give me light”, “Follow me light” and “Bye, stand bye”, is deployed in a digital home living lab, “Casa Domótica”, that Telefónica I+D owns on its premises in Boecillo (Valladolid, Spain). The application, built on top of the innovative Hydra middleware, takes into account the location of the user and the available natural light in order to take the most appropriate decision in every situation. The Hydra demonstrator was selected to be included in the VIP guided tours for politicians and speakers of the event.

Then, in June, the Hydra project was invited to assist to the **IEEE Secon** in Rome, where we followed with our dissemination activities, with both the energy efficiency application explained above and the e-Health demonstrator. The latter presents a self-monitoring system, which includes the use of different medical devices, such as a blood pressure device, a glucometer or a weight scale. All the devices are controlled by a PlayStation 3 where the Hydra middleware is deployed. This allows a remote monitoring of a patient’s vital signals at home. The demonstrator includes an iPhone application for the patient and a Tablet PC for the physician that monitors remotely the vital constants of the patient.

Moreover, in September, Hydra continued to enlarge its presence in important events as it was invited to the 20th anniversary of the **Tyrrhenian International Workshop on Digital Communications** held in Pula (Sardinia, Italy). The project was presented by the Project Coordinator Dr. Markus Eisenhauer. The Internet of Things was chosen as the overall conference topic this year.

Finally, and one week after the Tyrrhenian International Workshop on Digital Communications, the European Commission explicitly invited Hydra to be present in the "Networked Embedded Intelligence" workshop in the context of the **EU-Brazil Information Society Dialogue** in Sao Paulo (Brazil). According to Jorge Pereira, Project Officer of the Hydra project, "The award-winning demonstration of the Hydra project is essential to show the type of advanced applications we envision!". The Hydra project was present in Brazil with both the e-Health and the energy efficiency demonstrations and with a traceability application in the agriculture domain, called "From Farm to Fork". In this scenario the meat of cows can be tracked back from the supermarket to the farm, making use of RFID technologies. This particular application has been very well accepted by the Brazilian ICT community, as meat traceability is a hot topic in the domestic market. Hydra's participation resulted in new overseas collaboration opportunities and was a brilliant dissemination opportunity.

Contact:
Dr. Markus Eisenhauer
Peter Rosengren
Pablo Antolín Rafael

Company:
Fraunhofer FIT
CNET
Telefónica I+D

Email:
markus.eisenhauer@fit.fraunhofer.de
peter.rosengren@cnet.se
par@tid.es

Outlook for the next months

Planned workshops, conferences and exhibitions

12th – 16th October 2009 –
*FIT has planned to attend the **ACM EMSOFT 2009** International Conference on Embedded Software in France.*

16th October 2009 –
Siemens is organizing an exploitation and business modelling workshop for ambient energy efficiency solutions on the basis of the Hydra middleware that will take place at the Siemens facilities in Berlin. Within the workshop potential business ideas will be discussed with international experts of the energy domain.

New Hydra Publications

A Policy Model for Secure Information Flow
Published by: Adedayo O. Adetoye and Atta Badii, School of Systems Engineering, University of Reading, UK
[Download paper]

Ambient Healthcare System
Published by: Heinz-Josef Eikerling, Gernot Gräfe, Florian Röhr, Siemens AG, Siemens IT Solutions and Services, C-LAB and Walter Schneider, University of Paderborn C-LAB, Germany
[Download paper]

An Evaluation of the NSGA-II and MO-Cell Genetic Algorithms for Self-management Planning
Weishan Zhang and Klaus Marius Hansen, University of Aarhus, Denmark, University of Iceland, Reykjavík
[Download paper]

Towards Open World Software Architecture with Semantic Architectural Styles, Components, Connectors
Weishan Zhang, Klaus Marius Hansen and João Fernandes, University of Aarhus, Denmark, University of Iceland, Reykjavík:
[Download paper]

Contact:
Florian Röhr

Company:
Siemens AG, Siemens IT Solutions and Services, C-LAB

Email:
florian-roehr@siemens.com

Hydra Consortium Partners

CNET SVENSKA AB
DANDERYD, SWEDEN

FRAUNHOFER - APPLIED
INFORMATION TECHNOLOGY, DE

FRAUNHOFER - SECURE
INFORMATION TECHNOLOGY, DE

IN-JET APS
BIRKERØD, DENMARK

INNOVA S.P.A.
ROME, ITALY

SIEMENS AG
SIEMENS IT SOLUTIONS AND SERVICES, C-LAB
PADERBORN, GERMANY

T-CONNECT S.R.L
TRIESTE, ITALY

TECHNICAL UNIVERSITY OF KOSICE,
KOSICE, SLOVAKIA

TELEFONICA I+D SA
MADRID, SPAIN

UNIVERSITY OF AARHUS
AARHUS, DENMARK

UNIVERSITY OF READING
READING, UNITED KINGDOM

UNIVERSITY OF PADERBORN
PADERBORN, GERMANY

Imprint
Fraunhofer Gesellschaft (Project Coordinator) on behalf of the Hydra Consortium:

FIT - Fraunhofer Institute for applied Information Technology
Dr. Markus Eisenhauer
Schloss Birlinghoven

53754 Sankt Augustin, Germany