
## Project N$^{o}$: 610456

# *D7.3a Report on Using and Disseminating the knowledge (version I)*

## *July 10, 2015*

**Abstract:**

This document defines the dissemination objectives for the EUROSERVER project, as well as the different targets for all its activities, the dissemination tools, the interaction with similar projects. It defines also how the actual activities support exploitation. First, the project impact is described from different perspectives: strategic, societal, industrial. Then it focuses on exploitation, at first in the global project perspective, and then systematically detailed by each partner.

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| **Involved Partners** | |
| STM, ARM, NEAT, TUD, BSC, FORTH, CHALMERS, ONAPP | |

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The EUROSERVER Consortium consists of the following partners:

| Participant no. | Participant organization names | short name | Country |
|---|---|---|---|
| 1 | Commissariat à l'énergie atomique et aux é2nergies alternatives | CEA | France |
| 2 | STMicroelectronics Grenoble 2 SAS | STGNB 2 SAS | France |
| 3 | STMicroelectronics Crolles 2 SAS | STM CROLLES | France |
| 4 | STMicroelectronics S.A | STMICROELECTRONICS | France |
| 5 | ARM Limited | ARM | United Kingdom |
| 6 | NEAT | NEAT | Italy |
| 7 | Technische Universitaet Dresden | TUD | Germany |
| 8 | Barcelona Supercomputing Center | BSC | Spain |
| 9 | Foundation for Research and Technology Hellas | FORTH | Greece |
| 10 | Chalmers Tekniska Hoegskola AB | CHALMERS | Sweden |
| 11 | OnAPP Limited | ONAPP | Gibraltar |



## Revision history

| Version | Author | Notes |
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| 0.1 | I. Dor | creation |
| 0.2 | Y.Durand | update |
| 0.3 | J. Thomson | Update of OnApp Exploitation activities |
| 0.4 | M. Katevenis<br>P. Stenström | Update of FORTH Exploitation activities<br>Update on Chalmers planned events |
| 0.4 | D. Fuin | Update on ST exploitation activities |
| 0.6 | J Goodacre | Update following replacement of Eurotech by NEAT |
| 0.7 | D. Dutoit<br>R. Gauguey<br>P. Stenström | Update program collaboration section<br>Update on patent section<br>Update on patent section |
| 0.8 | P. Stenström | Update on Chalmers exploitation activities |

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| 0.9 | E. Matus | Update on TUD exploitation activities |
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| 1.1 | P. Carpenter & J. Subirat | Update on BSC exploitation activities |
| 1.2 | G. Tecchiolli | Update on NEAT exploitation activites |
| D7.3a, v2.0 | I. Dor | Finalized version |
| V3.0 | P. Stenström & G. Tiecchiolli | Updates on Chalmers and Neat exploitation activites |

# Contents

# Introduction

Effective dissemination of project outputs is of great importance to EUROSERVER partners and will be closely linked to the project's success. This document sets out how the knowledge generated during the EUROSERVER project will be disseminated and used. It includes the general objectives which dissemination activities are intended to achieve, the methods by which these will be carried out and the metrics with which they will be measured. It contains also the partners' preliminary intentions towards exploiting the project results to support their own activities, as documented in the project Description of Work.

The dissemination strategy falls under WP7, which is divided into three main strands:

- Communicating project progress to a wide audience
- Establishing the de-facto standard for specifications and models developed during the project through publications and knowledge transfer to industry partners
- Exploitation activities

The inclusion in the project of worldwide research centers and well known universities provides a clear path to immediate dissemination of EUROSERVER outcomes through conferences and publications, as well as through teaching new students who will be the architects of future systems.

The difficulty in finding and recruiting skilled engineers is a reality in Europe and western countries. This requires training and development of students and junior engineers. Although EUROSERVER is technically challenging it is foreseen that there will be opportunities for junior engineers and PhD students to participate in the project, not only having a direct contribution to the project, but learning from a diverse set of companies in order to realize changes that will have an impact on society. This training is invaluable and assists not only the consortium but also the next generation of scientists, engineers and designers.

Since the project requires the creation of a functional prototype a commercial deployment of such a prototype would be comparatively simple and as such the applicability to market is high. The chiplet concept supports and encourages reuse and could be aimed at multiple target markets with limited NRE cost and effort. Different I/O configurations allow the same base compute chiplet to be used in a variety of different device configurations, across different applications without incurring the significant reimplementation costs associated with current 2D IC design and manufacturing. The partners in the project have selected key individuals that have a strong bearing on company policies. These individuals and the companies have been selected not only for their understanding of the technical challenges required and the ability to meet them but also such that they can help alter the direction of the company roadmaps.

The present document reports the use and the dissemination of EUROSERVER knowledge. This corresponds to the first version and covers the first 18 months of the project.

# General objectives

The main objectives of the dissemination activities undertaken as part of WP7 outlined in this document are as follows:

- To ensure visibility among key project stakeholders
- To raise awareness of the project, the issues it raises and project outcomes among a wider audience, especially potential end users
- To engage key groups such as PhD students, engineers and businesses and encourage their participation in the project
- To influence the IT industry in terms of the energy efficiency and total cost of ownership of their products
- To establish the de-facto standard for specifications and models developed over the course of the project
- To exploit EUROSERVER outcomes with industrial partners

# Target audience

This section lists the target groups of the EUROSERVER project. The project should be able to attract the attention of the following groups:

- EUROSERVER partners
    - Researchers, technical management, senior management, sales, marketing
- Scientific community involved in the topics related to the project, as well as end users of the possible technology to be developed
- European IT Industry vendors of servers and microservers
- Cloud computing service providers
- Research organizations
- Stakeholders
- Policy makers
- Related EU and International Projects: HiPEAC, Mont-Blanc, DreamCloud, FIPS, POLCA, PRACE
- General public

# Expected impacts

## *Strategic impact*

The EUROSERVER project will have a broad, strategic impact at the European level in opening and fostering an ecosystem across both business and research.

The main impacts expected of the project are the followings:

1. Reinforced European technological leadership and industrial competitiveness in the design, operations, and control of embedded systems with performance-density and low-power requirements, key for growth into Internet of Things (IoT) and System on Silicon (SoS) solutions.
2. Growth of the competitiveness of European technology suppliers across the computing spectrum; in particular for data-centre servers with improvements of an order of magnitude in the total cost of ownership, performance-density and energy-efficiency.

3. Improved system characteristics: energy/cost efficiency, performance-density, compute deployment, nanotech enabled software, security, safety, resource sharing architectures and platforms solutions.
4. Increased take-up of European computing technologies in industry, in particular from SMEs
5. Improvements in the efficiency of application software development by breaking the dependence on dual expertise for application development and customization for advanced computing systems.
6. Reinforced open source ecosystem in both the micro-server cloud computing application domain and embedded use through the required enablement and optimization.

## *Societal impact*

A few of the industrial or societal domains where EUROSERVER can have a large impact are listed below.

1. **Cloud Services**. With the massive move of society to mobile compute, whether through the smartphone, tablet or simply Internet connected devices; the requirements of the cloud are going to expand. Today the cost of building the cloud and the associated power requirements are already forcing companies to deploy their data-centre in the most inhospitable and remote locations. The required growth must be addressed by a step-change in approach to delivering these services. The EUROSERVER approach through micro-servers will address the cloud's compute requirements through increased performance-density, lower operationally power requirement and subsequently will lower the total cost of ownership enabling the markets required growth.

2. **Embedded Servers.** To enable and deploy intelligent systems and services, it is also necessary to create the interfaces and compute of an embedded system. Becoming known as IoT or SoS, these compute networks and systems need the capabilities of embedded servers. Although Europe today is strong in embedded computing, especially across telecom, automotive and air, to secure those markets, and to ensure their growth as these solutions extend into these IoT/SoC solutions, it will be necessary to continue to increase their compute capabilities to increase their intelligence and connectivity while maintaining their strict power consumption requirements. The EUROSERVER approach through micro-servers will step-change the performance capability of these solutions while maintaining their embedded power requirements. The integration techniques of the micro-server device will bring the latest technology to the embedded markets with volumes too small to afford the development of such advanced solutions. This will not only enable the embedded use of such technology but also opens opportunities for innovation in the embedded market where Europe is strong with SME and end market customers.

3. **Medicine and life sciences.** Genomic therapy and personalized medicine are more and more envisaged as very powerful tools. The explosion of biomedical information (for instance EBI saw its data volume jumped from 6,000 TBytes in 2009 to 11,000 TBytes in 2010 with more than 4.6 million requests per day) leads to a huge increase in storage and processing capability to go through all of these data. Drug discovery pipeline requires scanning of more than 100,000 molecules per day to check their potential effect. Identification of potential drug candidates

for identified disease targets will be fuelled by next generation of energy efficient servers. In this trend EUROSERVER can really bring an innovative solution that will allow in the future such complex processing available for your own doctor and then provided a more efficient and targeted medicine locally and immediately.

4. **Energy.** Needs in term of improved safety and efficiency of the facilities (especially for nuclear plants) and also for optimizing the overall energy infrastructure in order to reduce waste require a lot of monitoring and data collection. The smart grid approach strongly relies on the monitoring in real time of the users' needs in order to match offer with demand. In this type of systems a lot of data are generated and have to be processed in real time. To that respect EUROSERVER micro-servers will allow very efficient solutions with the right form factor in an energy budget capable of keeping competiveness for the energy supplier operators.
5. **Enterprise.** The demand for more and more accurate and pertinent data in enterprise is everywhere. For example:
   - Just taking into account our mailboxes, it is now Giga Bytes of data which are flowing through them per month. Adding on top of this all the ERP systems and the huge amount of information generated inside and outside of the company, there is a huge demand for a never ending amount of data to be stored and processed. Most of the companies are now limiting email capacity, for instance, because of the level of CAPEX but more because of the level of OPEX it represents.
   - The new business and technological scenarios created by the "Internet-of-Things" or "Smart-Environments" paradigms are creating an increasing demand of both distributed and centralized light-weight servers to manage the huge amount of data generated by sensors, devices and appliances. Since enterprise customers must be enabled to manage their portfolio of wired or wirelessly connected devices either through preconfigured web portals or existing back office systems, such new generation embedded servers with a suitable software stack can be considered as a crucial component of the modern concept of Enterprise infrastructure.
6. **Population aging.** There is a clear trend in trying to keep aging people at home in order to decrease health cost. This is strongly linked to the capacity of the various health systems to manage huge volume of data. Assuming 10Kbyte/day per person for the population above 65 this represents more than 200GBytes per day in 2020 which has to be stored and investigated every day. This estimation clearly excludes video data which, if it has to be taken onto account, could lead to 100 to 1000 more data and then reach 200Tbytes per day. To that respect EUROSERVER can bring a real competiveness in providing a solution allowing exploitation of all these data at a reasonable cost. This type of approach is absolutely mandatory for such eco-system which is very fragmented and which needs very efficient solution in order to get a large adoption.

## *Industrial Impact*

EUROSERVER paves the way for making performance computing available to the applications, either remotely by increasing the data-centre capabilities, or even locally with embedded servers. In this respect, numerous industries can benefit from EUROSERVER innovations.

1. **Fundamental and applied research**. For instance the ATLAS detector, at CERN, with its millions of sensors generates more than a PBytes per second which needs to be stored and analyzed to allow progress in science in order to fuel industry innovation 10 to 15 years away from now. For sure regarding the energy need, for such a large instrument like LHC, storage is not the first line in term of electricity consumption. But this need of recording, monitoring and storing a lot of data is ubiquitous in a large number of research labs in Europe. For a large majority of them the computer infrastructure is becoming a very important level of OPEX which has to be taken into account very carefully in order to avoid a limitation in research activity in the future. EUROSERVER with its aggressive objectives of performance, energy consumption, and form factor can help to overcome such limitations and thus to keep Europe at the leading edge of research in a lot of domains.
2. **Automotive** for which for instance crash test needs to be improved with more accurate body and tissue modeling therefore leading once again to an explosion of the amount of data manipulated. Even inside cars there are now more and more devices which are connected that manage a large volume of data. To that respect and thanks to its aggressive objectives, EUROSERVER can bring innovative approaches allowing micro-server embedded solutions in cars.
3. **Smart Environments**. Physically a smart environment is a smart space populated by interconnected sensors, devices, and appliances with the capability to self-organize itself, and to provide services and complex data to the people/entities who physically traverse this space. Such smart space is usually fed by services provided by a hierarchical infrastructure of interconnected servers operating on-the-field and in data-centres. This scenario is changing the way new public and private infrastructures are built in many application domains from transportation to healthcare, from safety to utilities, etc. and, thanks to its holistic approach, EUROSERVER can significantly contribute with a cost-effective solution that can be used in all the layers of such application domain.
4. **Aeronautic**. The more and more accurate modeling of an aircraft in its environment and the addition of lot sensors on a plane generate once again a huge increase in volume of data. The management of most of these data has to be made on board and in real time. EUROSERVER with its aggressive low energy and dense processing performance can bring solution to this new challenge.
5. **Finance.** Algorithmic trading and deep financial technical analysis generate large amounts of data. For instance financial operators in London during the Olympic Games in 2012 had to find solution for data back-up in order to deal with potential electricity shortage.

# *Pathway to exploitation*

## Opportunities for commercial exploitation

EUROSERVER is tailored for a current window of opportunity: The 50B dollar server market is growing, as shown by the projection below:


**Figure 1: Worldwide micro-server shipment forecast**

Cloud segments are expected to grow dramatically.

Still, the enterprise server market dominates but has saturated, but upcoming opportunities – Internet of things and "big data" – will likely sustain the growth. Within this market, micro-server (<45W and less complex server boards) shipments are expected to grow by a factor of 50 between 2011 and 2016 (HIS iSuppli).

EUROSERVER strategy fits into the market trends:

- Technically, it is following research indications to match massive core-level parallelism.
- It aligns with the technology inflection point by offering highly optimized, low cost compute units.
- It leverages key innovations offered by tier-1 experts in server technology.

## Primary technological results to be reused by the partners

1. Next Generation Compute System Architecture

The scale-out and scalable heterogeneous compute is a key outcome for ARM and ST. The memory model utilizing a virtual-capable shared global address space completes the solution.

2. Nanoscale Integration

The project demonstrates the concretization of the integrated "Chiplet" concept, the heterogeneous silicon interface bridging adds value to the solution.

3. Software Architecture and Frameworks

The project offers a testing and prototyping platform for the "Unimem" memory hierarchy. Resource sharing and system wide reallocation have not yet reached the status of industrial solutions.

4. Applicability of solution

The device PCB realization itself is development system for embedded micro-servers such as wireless base stations, as well as for scale-out servers suited for cloud services

# Exploitable results

## *Enablers*

### Hardware Prototypes

The updated project plan is to build a compute reference board that contains the required test and integrity test capabilities so that both embedded and data-centre designs can be quickly and efficiently turned around from the reference test board.

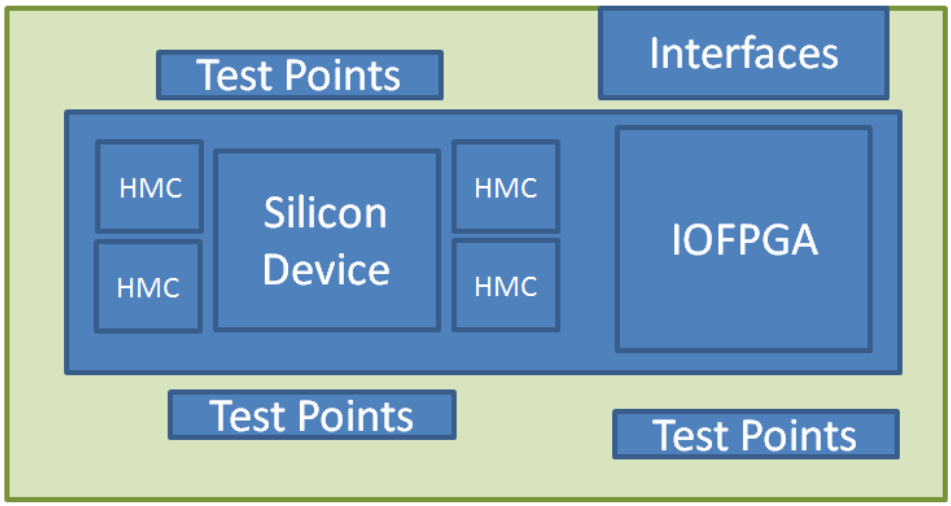


**Figure 2 : example layout of the reference design with integrity and test points external to reference area**

The level of exploitation depends heavily on how close the reference is to the design of a real product:

- If the chip set is mature, especially if IO performance reaches its objectives, it may be used for customer trials by ST and NEAT. With the integrity test point demonstrating the quality of the adopted design rules.
- Even if the prototype component technology maturity is not sufficient for qualifying as a product, it can still be used for alpha evaluation by the partners, and as demonstrators in industrial fairs and congresses.

### Software Studies and prototypes

The systems software stack of EUROSERVER introduces new technology at four layers:

- The native Linux OS
- The hypervisor
- The runtime system and associated libraries
- The applications themselves with new applications

**Licensing**

Each of these layers has its own innovations, as discussed in the corresponding deliverables. For exploitation purposes certain layers exhibit also certain limitations. The main limitation is that the native Linux kernel and the hypervisor have a GPL license. Therefore, code modifications in these systems are bound by the same license. The overall framework for releasing code and the different components of the systems software is:

- The native Linux OS, hypervisor:

  Patches and kernel modifications will become by necessity GPL. Loadable modules can use partner-specific licensing schemes.

- The runtime system and associated libraries:

  Here also, Partner specific schemes may be used as there is no limitation in the licensing scheme.

- The applications themselves with new applications:

  Here also, Partner specific schemes may be used as there is no limitation in the licensing scheme.

**Open source**

Certain stack components will become open source, based on current partner discussions. For instance OnApp is planning to release as open source the extensions to Xen and FORTH the patches to the Linux kernel memory allocator.

**Software Prototype, results of WP4**

The partners involved in WP4 will deliver a system software stack that is adapted for the EUROSERVER architecture. As such, the main use of the stack will be to demonstrate the validity of the research ideas and to be used for subsequent research. Individual partners are planning to feed results in their own infrastructure and plans.

## *Program collaborations*

EUROSERVER provides a European foundation and ecosystem for scalable, low-power and low-cost approach for computing. Several forthcoming H2020 projects in the area of “HPC Core Technologies” are aligned with EUROSERVER concept and would include EUROSERVER technology:

- ExaNoDe: focuses on the delivery of the initial compute element for HPC application system deployment.
- ExaNeSt: focuses on the physical deployment (housing & cooling) supporting the required compute density along with its storage and interconnect services.
- ecoSCALE: focuses specifically on integrating and exposing the acceleration capabilities of FPGA's.

The EUROSERVER project has common participants across these various consortiums. Moreover, these H2020 projects will be coordinated by EUROSERVER partners: CEA for ExaNoDE, FORTH for ExaNeSt and ecoSCALE.

The consortium has organized a workshop within the HiPEAC conference in January 2015, and invited potential partners (more details in § Dissemination).

## *Exploitation plans per partner*

This section describes the exploitation action plans for the partners that have currently identified potential exploitation activities. To systematically focus the exploitation efforts, a classification of different exploitation types has been devised, see Table 1.

**Table 1: Exploitation Types**

| Number | Type | Description |
|---|---|---|
| 1 | New Business Product | Based on the work the project, partner develops IP in the form of software algorithms, components or software services, including hardware devices. Partner might reuse any EUROSERVER output as agreed in the CA and introduce a product as a commercial offering in the market place. This could be as existing partner or as a spin up/out. |
| 2 | New Business Service | Partner develops and provides a service to the relevant industry. |
| 3 | Additional Consultancy or Training Services | Partner develops their knowledge and offers consultancy or training services to industry therefore wins new business as a direct result of developing this capability. |
| 4 | Internal Exploitation | Partner develops internal capability and exploits the knowledge and methods developed within EUROSERVER. |
| 5 | Internal or External Influence | Partners are able to influence key stakeholders based on EUROSERVER results either internal to their organizations or external |
| 6 | Influence Standards | The EUROSERVER Consortium influences relevant industry standards. |
| 7 | Open Source | EUROSERVER develops and releases some of its results as software |
| 8 | Additional Research Funding | Winning additional research funding to pursue further research based on EUROSERVER results. |
| 9 | Achievement of Academic Qualifications | Leveraging EUROSERVER research to complete a MSc or PHD |

This list will be expanded as new exploitation types are identified.

### CEA

CEA-LETI has been designing hardware/software IPs and 3D integrated circuits for highly demanding applications, mainly in the embedded systems area. Within the EUROSERVER project, CEA-LETI will enlarge its scope to servers, enrich its technology portfolio.

Specifically, CEA-LETI will refine its expertise for on-chip system interconnect, and gain new experience in server memory subsystems: the new memory technologies offer huge possibilities for building the future computing systems, and CEA will exploit its in-house technological expertise and work with the other partners to design the optimal memory IPs for on-chip caches, memories and memory controllers.

| **Action ID** | CEA-01 |
|---|---|
| **Action Type** | New business product |
| **Description** | License under-patent technology (sw/hw) for inter node communication (RDMA) to firms willing to use our scale-out node architecture. |
| **Goal/Opportunity** | Transfer research results to industry |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | CEA, third parties |
| **Status** | Planned |
| **IP Issues** | None |

| **Action ID** | CEA-02 |
|---|---|
| **Action Type** | Internal Exploitation |
| **Description** | Use systems software prototype of modified OFED RDMA stack for subsequent research activities. |
| **Goal/Opportunity** | Advance further the state of the art in research |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | Different groups at CEA |
| **Status** | Initiated |
| **IP Issues** | Deal with GPL restrictions of the OFED Open Fabric Alliance stack |

| Action ID | CEA-03 |
|---|---|
| **Action Type** | Additional Research Funding |
| **Description** | Use IP and prototypes of EUROSERVER to address problems related to inter-node communication or I/O virtualization. |
| **Goal/Opportunity** | Advance further the state of the art in research |
| **Priority** | Medium |
| **Likelihood** | High |
| **Parties Involved** | Different groups at CEA |
| **Status** | Initiated |
| **IP Issues** | None |

| Action ID | CEA-04 |
|---|---|
| **Action Type** | Achievement of Academic Qualifications |
| **Description** | PhD thesis : Hardware support for inter-process communication within a multi-core System on Chip |
| **Goal/Opportunity** | Research and training of highly qualified personnel |
| **Priority** | Medium |
| **Likelihood** | High |
| **Parties Involved** | CEA |
| **Status** | Planned |
| **IP Issues** | None |

### STMicroelectronics

The exploitation foreseen by ST is basically in two key fields, business and technology. From the business perspective, EUROSERVER will help develop new target markets but will also importantly sustain some already existing ones. In the research excellence and technology field, EUROSERVER will allow ST to stay at the leading edge in some technologies areas. Basically there are 3 main areas for exploitation from ST point of view.

- **Evolution of STB (Set-Top Box) Business.** Even if ST is recognized as a worldwide leader in this market the competition is very strong and the need for new feature is pushing very aggressively the technology. It is now difficult to sell a pure STB able to make just video decoding. Customers are expecting a lot more features and the emerging of a personal cloud at home with the data explosion is strongly pushing to home gateway and even micro server like solutions. The selection of a chiplet in advanced FDSOI silicon technology coming from this division to fuel the innovation activity in EUROSERVER is a proof of the commitment of the company to support this type of evolution and to stay a key player even in a very changing environment.

| **Action ID** | ST-01 |
|---|---|
| **Action Type** | New Business Product |
| **Description** | Evolution of STB (Set-Top Box) |
| **Goal/Opportunity** | Exploitation of advanced FDSOI silicon technology. |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | Different groups at ST |
| **Status** | Planned |
| **IP Issues** | None |

- **Validation of new technologies.** Even if there are no specific developments of very advanced new silicon technology in EUROSERVER, the design, manufacturing, testing and validation of multiple heterogeneous chiplets is a real challenge. To that respect EUROSERVER is intended at providing the right framework to allow validation of this new technology approach in order to allow later on an industrial deployment when needed.

| **Action ID** | ST-02 |
|---|---|
| **Action Type** | New Business Service |
| **Description** | Maturation of new silicon technologies |
| **Goal/Opportunity** | Industrial demonstration vehicle |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | Different groups at ST |
| **Status** | Planned |
| **IP Issues** | None |

- **Definition of new architecture**. Moving to multiple chiplet solution with 64 bits architecture is a major change as, up to now, ST was used to provide 32bits solutions only. To that respect EUROSERVER, with the help of all the other partners, will allow ST to understand the requirement for an efficient micro-server solution and will help in defining the right architecture from a performance, power consumption and form factor point of view. This is a major point absolutely needed to position ST as a player in this new micro-server market.

| **Action ID** | ST-03 |
|---|---|
| **Action Type** | Internal or External Influence |
| **Description** | New micro-server architecture |
| **Goal/Opportunity** | Complete development of an innovative solution |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | Different groups at ST, ARM, EUROSERVER Academic partners |
| **Status** | Planned |
| **IP Issues** | None |

- **Valorization in networking domain**. A certain number of technological innovations are key for the networking domain. Among the most important ones we can underline:
    - Integration of an HMC controller
    - Prototyping of a scalable AXI extension
    - SiP prototyping in view of cost reduction

These key features allow the definition of very performant systems providing differentiation for ST solutions.

| **Action ID** | ST-04 |
|---|---|
| **Action Type** | Internal or External Influence |
| **Description** | Key features for networking applications |
| **Goal/Opportunity** | Complete development of an innovative solution |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | Business units interfacing with key players in networking solutuons.. |
| **Status** | Planned |
| **IP Issues** | None |

### ARM

ARM anticipates that the project will steer in a direction to deliver the design requirements and techniques required to enable ARM based platforms to be commercialize around the Compute Chiplet solution. Specifically, the logical and physical design requirements for the chiplet to interposer to I/O interconnect, the logical design structure and the associated standardize software stack.

| **Action ID** | ARM-01 |
|---|---|
| **Action Type** | Internal or External Influence |
| **Description** | New architecture for ARM-based devices |
| **Goal/Opportunity** | Integration Technology maturity, availability of new interconnect and IO solutions |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | ARM, ST, LETI |
| **Status** | Planned |
| **IP Issues** | None |

A primary goal of the ARM compute unit is to provide a standard unit of compute for software. Standardization of such compute units will accelerate and reduce the risk in the adaptation of compute into new markets while reducing the cost of entry and associated non-recurring design costs.

| **Action ID** | ARM-02 |
|---|---|
| **Action Type** | New Business Product |
| **Description** | Development of a standard compute component |
| **Goal/Opportunity** | Improve market penetration for ARM64 product |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | ARM, ST, NEAT |
| **Status** | Planned |
| **IP Issues** | None |

With the holistic goals of the project to address the full software stack, as well as the fabrication techniques, the project will also enhance the ARM ecosystem to better address multiple markets. ARM will directly exploit the software efforts of the project to further enable the Open Source software ecosystem onto ARM based designs such as the ARM Generic Firmware and associated standardization efforts around UFEI.

| Action ID | ARM-03 |
|---|---|
| **Action Type** | Internal or External Influence |
| **Description** | Development of a SW stack for ARM 64b compute |
| **Goal/Opportunity** | Develop ARM software ecosystem |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | ARM, OpenSource community |
| **Status** | Planned |
| **IP Issues** | None |

### NEAT

The expected main outcomes from the EUROSERVER project for NEAT are the identification of the key design rules and elements (technology, components, architectures, processes) both required to design form-factor board level components that will enable the new class of micro-servers enabling new convergences between embedded computing and ICT.

Neat consider the participation to the EUROSERVER initiative an important activity for many reasons:

- It helps to increase the company portfolio of technological skills and know-hows in high-end electronics that is crucial to increase the company competitiveness in the markets where Neat is already present;
- It provides the company with new IPs that can be reused in current and future Neat developments;
- It puts Neat in touch with an important network of research organizations and industrial players that are currently defining the status-of-the-art of the electronics market in the computing domain.

Besides the indirect effects in terms of both increase of competiveness and presence in the market resulting by the exploitation of the benefits described in the point above, the EUROSERVER **project is considered by Neat a project with a strategic value**. In fact, Neat is currrently defining a new business strategy that is explicitely addressing the micro server market and where the platform architected and implemented by the EUROSERVER consortium will be used directly to start seeding activities in the market and indirectly to create products suitable for the microserver market after the development activities necessary to make the EUROSERVER platform suitable for the market as a product.

| Action ID | NEAT-01 |
|---|---|
| **Action Type** | Internal or External Influence |
| **Description** | Identification of re-usable key components for micro-servers suitable for market seeding activities and customer presentations. |
| **Goal/Opportunity** | Leverage development effort, rationalize architectures |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | NEAT and its customers |
| **Status** | Planned |
| **IP Issues** | None |

Moreover such strategy is linked to an external commercial initiative that aims at establishing a new company addressing the world-wide micro server market. Within this project, that will enter the executive phase in the second half of 2015, NEAT will support the product design and manufacturing activities thus re-using the know-hows and skills developed in the EUROSERVER project and transforming the EUROSERVER hardware and software platforms into product candidates after having negotiated the licensing of needed IPs with the consortium partners.

| Action ID | NEAT-02 |
|---|---|
| **Action Type** | New Product |
| **Description** | Optimization of the EUROSERVER hardware and software platform and transformation in a product suitable for the micro server market. |
| **Goal/Opportunity** | Leverage development effort, exploit business opportunities |
| **Priority** | high |
| **Likelihood** | high |
| **Parties Involved** | NEAT and its partners |
| **Status** | Planned |
| **IP Issues** | None |

### TUD

TUD will evaluate the micro-server chiplet/interposer technology by running a Cloud RAN (CRAN) application. Results will be used to specify and further improve Cloud RAN software stack as well as hardware technology. Especially, energy efficiency and performance are regarded. It will strengthen the already available expertise at TUD developing leading edge base band algorithms and suitable hardware. We plan to apply the expertise to improve base station design by using the energy efficient micro-server and provide prototypes to industrial partners. Furthermore, we plan to educate and prepare students to develop telecommunication applications and their adaptations towards an efficient hardware implementation. The CRAN framework developed within EUROSERVER project will

be exploited for further research within 5G Lab Germany. Moreover, TUD will look for the opportunity to startup company using the results of EUROSERVER project (Note that Vodafone Chair TUD successfully started 14 companies within 15 years in the wireless domain some of them acquired by Philips, NXP, Intel, National Instruments, Actix).

| **Action ID** | TUD-01 |
|---|---|
| **Action Type** | Achievement of Academic Qualifications |
| **Description** | PhD thesis on novel radio access computing architectures and system management exploiting EUROSERVER general purpose nodes. |
| **Goal/Opportunity** | Research and training of highly qualified personnel |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | TUD |
| **Status** | In Progress |
| **IP Issues** | None |

| **Action ID** | TUD-02 |
|---|---|
| **Action Type** | Achievement of Academic Qualifications |
| **Description** | Master thesis on scheduling dataflow applications on micro-server architectures |
| **Goal/Opportunity** | Research and training of highly qualified personnel |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | TUD |
| **Status** | Initiated |
| **IP Issues** | None |

| **Action ID** | TUD-03 |
|---|---|
| **Action Type** | Internal or External Influence |
| **Description** | Promotion of EUROSERVER results regarding CRAN protocol processing to network providers (NGMN) and base station manufacturers. |
| **Goal/Opportunity** | Contribution to the evolution of radio access architecture |
| **Priority** | Medium |
| **Likelihood** | Medium |
| **Parties Involved** | TUD |
| **Status** | Initiated |
| **IP Issues** | None |

| **Action ID** | TUD-04 |
|---|---|
| **Action Type** | Additional Research Funding |
| **Description** | Use CRAN framework of EUROSERVER to address tactile and industrial internet research area. |
| **Goal/Opportunity** | Advance further the state of the art in research |
| **Priority** | Medium |
| **Likelihood** | High |
| **Parties Involved** | TUD |
| **Status** | Initiated |
| **IP Issues** | None |

### BSC

Due to significant overlap between the data centre server and HPC architecture markets, it is in the strategic interest of BSC to participate in collaborative projects for data centre. HPC research has traditionally been at the forefront of computing, and techniques first invented for HPC have later appeared in servers; e.g. vector/SIMD, cache hierarchy, distributed memory and NUMA.

| **Action ID** | BSC-01 |
|---|---|
| **Action Type** | Achievement of Academic Qualifications |
| **Description** | PhD thesis on common secure virtualization layer to support programming model and OS use cases enabled by unimem |
| **Goal/Opportunity** | Research and training of highly qualified personnel |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | BSC |
| **Status** | In Progress |
| **IP Issues** | None |

| **Action ID** | BSC-04 |
|---|---|
| **Action Type** | Achievement of Academic Qualifications |
| **Description** | PhD thesis on interconnect energy proportionality and topology |
| **Goal/Opportunity** | Research and training of highly qualified personnel |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | BSC |
| **Status** | In Progress |
| **IP Issues** | None |

The COMPSs framework allows portable, maintainable development of applications for grid and cloud computing, and we are keen to promote its wider adoption. It is therefore important to apply COMPSs to a wide range of application domains. In addition, the COMPSs framework is in use in production runs at the BSC, in the BSC private cloud (IaaS) and in our TOP500 cluster (MareNostrum).

| **Action ID** | BSC-02 |
|---|---|
| **Action Type** | Open source |
| **Description** | COMPSs framework developed for EUROSERVER will be released with Apache open source licence |
| **Goal/Opportunity** | Contribution to open source software stack |
| **Priority** | Medium |
| **Likelihood** | High |
| **Parties Involved** | BSC |
| **Status** | In Progress |
| **IP Issues** | None |

As a result of this project, EMOTIVE Cloud (BSC's IaaS solution) will be enhanced to support ARM-based platforms, as an initial proof of concept. If this proves to be feasible, we will focus our efforts in performing the same adaptation to OpenStack (free and open source Cloud Computing software platform), while support to EMOTIVE Cloud will be ceased. The BSC will then develop the VM Manager, an open source component equipped with scheduling policies to optimise the placement of VMs and services in the provider's resources with regards to the energy efficiency metric. The VM Manager will be integrated with the OpenStack ecosystem. Our goal is to exploit the complexity and diversity of hardware platforms and software applications with these policies.

| **Action ID** | BSC-03 |
|---|---|
| **Action Type** | Open source |
| **Description** | Energy-aware virtual machine scheduler will be released with open source licence |
| **Goal/Opportunity** | Contribution to open source software stack |
| **Priority** | Medium |
| **Likelihood** | High |
| **Parties Involved** | BSC |
| **Status** | In progress |
| **IP Issues** | None |

A power model based on the offline collection and processing of user-space available metrics with Machine Learning techniques will be developed by BSC. It will be internally used by the VM Manager mentioned above to perform power forecasts when deciding the placement of VMs, although it will be a completely independent entity. The methodology and tools to generate it will be released with open source license.

| **Action ID** | BSC-05 |
|---|---|
| **Action Type** | Open source |
| **Description** | Methodology and tools to generate a power model will be released with open source license |
| **Goal/Opportunity** | Contribution to open source software stack |
| **Priority** | Medium |
| **Likelihood** | High |
| **Parties Involved** | BSC |
| **Status** | In progress |
| **IP Issues** | None |

By means of the results from this project, BSC intends to position itself as a referent in the research topic of energy-aware management of data centres, thus allowing us to increase our collaborations

with other research institutions, or to establish consultancy contracts with companies interested in deploying our management solutions in their infrastructures.

### FORTH

FORTH-ICS promotes the commercial exploitation of R&D results by providing services, licensing products to industrial partners, contracting with industrial partners to jointly develop new products, and participating in spin-off companies and joint ventures. FORTHnet S.A., a spin-off company that FORTH-ICS created in the 90's, is today one of the major Internet Service Providers in Greece, and is quoted in the Athens Stock Exchange.

In the last 10 years, the CARV Laboratory of FORTH-ICS, which carries out the EUROSERVER work at FORTH, has been involved in three spin-off / commercialization efforts, and we are always eagerly looking for opportunities to expand this portfolio. Among these, a subsystem in the storage software developed in FORTH, dealing with Solid-State-Disk (SSD) Caching, has been successfully commercialized, through a large international company.

In the case of EUROSERVER, FORTH-ICS/CARV has been and is always in contact with companies and individuals with a track record in high-tech start-up / commercialization activities, in Europe and world-wide, in order to promote the commercialization of the IP that FORTH is generating within EUROSERVER in the hardware and systems software architecture and implementation domain, with an emphasis around the Unimem concept and its powerful and very promising applications. Based on these contacts, FORTH is very optimistic that such commercialization is in fact imminent.

FORTH targets to commercially exploit several results that it has generated and continues to further develop and refine within EUROSERVER, as listed below. FORTH has also applied for a patent on this IP, as also listed below:

| **Action ID** | FORTH-01 |
|---|---|
| **Action Type** | Additional Research Funding |
| **Description** | Use IP and prototypes of EUROSERVER to further develop hardware and systems software solutions for micro-servers to be applied in multiple domains |
| **Goal/Opportunity** | Advance further the state of the art in research |
| **Priority** | High |
| **Likelihood** | 100% |
| **Parties Involved** | CARV Laboratory of FORTH-ICS |
| **Status** | Already planned, in the ExaNeSt and ExaNoDe FET-HPC projects |
| **IP Issues** | None |

| **Action ID** | FORTH-02-HW |
|---|---|
| **Action Type** | New business product |
| **Description** | License Hardware IP blocks to firms that will enter the micro-server market |
| **Goal/Opportunity** | Transfer research results to industry |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | FORTH, third parties |
| **Status** | Currently available IP blocks:<br>• *Shared Ethernet NIC (and SSD)*: FORTH has designed and implemented a virtualized Ethernet NIC, which can be shared transparently in hardware by multiple OS or VMs running on the same or different coherence islands. While the current hardware design depends on Xilinx IPs, FORTH is planning to use only FORTH's IPs in future designs. Similar to the shared Ethernet NIC, FORTH is planning to provide an IP core for shared IO storage.<br>• *Local-to-Global Address Translation*: FORTH has designed and implemented the first version of a local-to-global address translation and routing mechanism, which is used in order to provide Global Address Space in the system by routing remote memory accesses initiated by a coherence island to the appropriate destination (other coherence island) in the system. Next versions of the IP core will provide finer-grained translation schemes.<br>• *Hierarchical Interconnect*: The current EUROSERVER routing infrastructure interconnects multiple instances of the Xilinx AXI interconnect. However FORTH is planning to design and implement its own energy-efficient hierarchical interconnect that will supersede the existing one. The new interconnect will support quality of service and multiple virtual channels.<br>• *AXI-based Chip2Chip IP block*: FORTH has designed and implemented an AXI chip-to-chip IP core, which can bridge two devices over a 64-bit AXI4 interface and/or a 64-bit AXI Stream interface. The bridging function allows all AXI and AXI Stream channels to operate independently by forwarding per-channel data and control information in compliance with AXI per-channel Valid-Ready handshake. The current IP core supports two modes: one with 40 LVDS pairs physical interface and another with 20 LVDS pairs physical interface. Future designs will also support multi-lane high-speed serial physical interfaces.<br>• *FMC Fan-Out daughter card*: FORTH has designed a daughter card that can be used to connect up to four Microzed boards[1], four 10Gbit/s serial SFP+, and one 4-lane PCIe to a VITA-57 HPC FMC connector. This |

[1] http://zedboard.org/product/microzed

| **Action ID** | FORTH-02-HW |
|---|---|
| | daughter card can be employed in order to build an A9 multi-core system consisting of multiple interconnected Microzed boards. There is no other similar daughter card available in the market today. |
| **IP Issues** | Some of the IP blocks are derivatives of IP blocks by Xilinx. |

| **Action ID** | FORTH-02-SW |
|---|---|
| **Action Type** | New business product |
| **Description** | License systems software layers to firms that will enter the micro-server market |
| **Goal/Opportunity** | Transfer research results to industry |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | FORTH, third parties |
| **Status** | Currently available and under development items:<br>• *IO Virtualization Support*: FORTH has developed an Ethernet device driver for the aforementioned shared Ethernet NIC, which takes full advantage of the hardware assisted virtualization support. Moreover FORTH will develop a device driver for the shared IO storage.<br>• *Sockets over RDMA*: FORTH plans to provide a custom Sockets-over-RDMA library, which takes full advantage of the energy-efficient UNIMEM architecture, instead of the existing power-hungry Linux TCP/IP stack which consists both of a user-space component (part of the standard C library) and a substantial in-kernel subsystem. FORTH has already started working on the implementation of the Socket-over-RDMA library using the HW primitives provided by the EUROSERVER architecture.<br>• *NUMA-aware linux on ARMv8*: While NUMA is supported by Intel-based servers, NUMA is not supported in ARM-based environments yet. FORTH is planning to be the first to port the NUMA linux library onto ARMv8 taking advantage of the NUMA-like UNIMEM architecture. |
| **IP Issues** | Deal with GPL restrictions of the Linux kernel |

| **Action ID** | FORTH-03 |
|---|---|
| **Action Type** | Internal further Exploitation until ready for new business product |
| **Description** | Patent application in Congestion Management for Interconnection Networks |
| **Goal/Opportunity** | Advance further the state of the art in research with the goal of solving an important problem in real systems |
| **Priority** | High |
| **Likelihood** | Good |
| **Parties Involved** | CARV Laboratory of FORTH-ICS |
| **Status** | Within Subtask 3.3.3, FORTH has defined and is further developing a novel method for dynamic (source) rate regulation that is appropriate for low-cost implementation in hardware and for low-latency reaction to changing traffic characteristics. It only requires *per-flow* hardware in the sources (e.g. DMA engines for EUROSERVER), while inside the network the hardware used does *not* need any per-flow state. Rates are regulated according to the well-known and highly desirable max-min fairness (MMF) criterion, which is highly efficient in its use of available network bandwidth, highly dynamic in nature, and fully fair. FORTH has filed a provisional patent application on this novel method:<br>• "*Dynamic Max-Min Fair Rate Regulation Apparatuses, Methods and Systems*": USPTO Provisional Patent Application Number *62,054,866*; filed on 24 September 2014. |
| **IP Issues** | Need to file the definitive application before 24 September 2015. |

| **Action ID** | FORTH-04 |
|---|---|
| **Action Type** | Achievement of Academic Qualifications |
| **Description** | Master theses in efficient and transparent user-space inter-process communication in micro-servers |
| **Goal/Opportunity** | Research and training of highly qualified personnel |
| **Priority** | High |
| **Likelihood** | Two completed, others planned |
| **Parties Involved** | FORTH, University of Crete |
| **Status** | Two MSc theses completed (March 2015):<br>- John Velegrakis: *Operating System Mechanisms for Remote Resource Utilization in ARM Microservers*<br>- Dimitrios poulios: *Low-Latency Implementation of Network Sockets over Remote DMA* |
| **IP Issues** | None |

## CHALMERS

| Action ID | CHAL-01 |
|---|---|
| **Action Type** | New business product |
| **Description** | Licensing of memory compression technology to firms that will enter the micro-server market.<br>Specifically,<br>• Chalmers is developing a memory compression technology within the EUROSERVER project that promises to use memory resources 3X more efficiently which can yield substantial increase in cost-performance and energy efficiency for micro-servers.<br>• Chalmers is collaborating with FORTH to align this technology to the virtualization technology that will be offered in the EUROSERVER project.<br>• Two project members have participated in a custom discovery workshop based on the business canvas model to verify assumptions regarding value proposition, potential markets, and business models to commercialize the technology.<br>• Chalmers has been granted a national project (from VINNOVA) to explore commercialization opportunities of its memory compression technology.<br>• A spinout company with the purpose of commercializing the IP, Zeropoint Technologies AB, has been incorporated in Sweden with an exclusive license agreement to the inventors at Chalmers.<br>• Two patents have been filed to secure a unique position.<br>• ZeroPoint Technologies have made many visits with potential customers including Google, Facebook, AMD, nVIDIA, Samsung and Qualcomm with keen interest in the technology. |
| **Goal/Opportunity** | Transfer research results to industry |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | CHAL, ZeroPoint Technologies AB |
| **Status** | In progress |
| **IP Issues** | Exploration of license and protection policy |

## ONAPP

OnApp is a public cloud infrastructure provider that builds and provides a cloud software platform solutions based on multiple layers of cloud services. OnApp solutions enable providers to stay

profitable and competitive by launching their own unique Cloud, Storage or CDN services, quickly, easily and cost-effectively. The main product is a platform that allows users to control and manage their own cloud services in a simple way.

"OnApp Cloud Product is understood to have the most paid deployments in production, with a claimed 900, followed by CloudStack, CA AppLogic and VMware" - 451 Research.

OnApp CDN Product - 172 Points of Presence in 113 cities across 43 countries.

The OnApp Federated Market was released as an alpha version as part of OnApp version 3.2 in Q1 2014. In Q3 2014, OnApp acquired SolusVM to add 2000 providers to the Federation MarketPlace.

As part of the exploitation plans described below, OnApp intends to make the technologies developed as part of EUROSERVER available to its customers.

OnApp will strongly promote the micro-server vision proposed in EUROSERVER through the development of the Microvisor architecture. By developing software that will work with existing software products and also new products, OnApp will promote micro-servers in general by offering new technologies to its large, global, public hosting customers, offering an alternative to standard x86 servers on offer currently.

OnApp will work with ARM and the other partners in EUROSERVER to promote the adoption of low-power, energy efficient hardware designs that use multiple distributed cores to provide improved system-level efficiency and lower power usage for typical workloads.

| **Action ID** | OnApp-01 |
|---|---|
| **Action Type** | New Business Products / New services |
| **Description** | New product(s) and/or upgrades to existing products for public cloud service providers, based on micro-server architecture support. |
| **Goal/Opportunity** | Improved performance for micro_server type systems (e.g. low power, low resource cores) by reducing Dom0 overhead. |
| **Priority** | High |
| **Likelihood** | Medium-High by the end of project |
| **Parties Involved** | OnApp – Core and Emerging Product Teams. |
| **Status** | Prototype / proof of concept<br>Update 2015-05-27; No Change |
| **IP Issues** | Developed by OnApp so none foreseen |

| **Action ID** | OnApp-02 |
|---|---|
| **Action Type** | New and updated Business Products / New services |
| **Description** | Enabling virtualization platforms to use energy metrics that are provided from hardware and improving UI features, will allow dynamic workload migration to hardware in order to improve the overall power efficiency of the data centre (e.g. to enable automatic power down of certain parts of the data centre when idle).. |
| **Goal/Opportunity** | Power-aware workload distribution in public cloud hosting DCs |
| **Priority** | ~~Medium/High~~ Low/Medium |
| **Likelihood** | Medium/High |
| **Parties Involved** | OnApp – Core and Emerging Product Teams. FORTH, BSC. |
| **Status** | Research / early stage<br>Update 2015-05-27; Lowered priority |
| **IP Issues** | UI features will be limited to OnApp product but the algorithms and heuristics will be platform independent and open such that other platforms can develop based on the ideas. |

In a report in 2007, EPA estimated that data-centre consumed about 61B kWh of electricity in 2006-equivalent to 1.5% of total US electricity consumption. In a report by Maki Consulting of the Data Center Alliance presented at the DG Connect workshop (Environmentally sound Data Centres: Policy measures, metrics, and methodologies) this figure in 2014 has reached 2% globally. Reducing idle servers and increasing the effectiveness of idle servers is seen as one way of increasing data centre efficiency. Exploitation activity - OnApp-02 – looks to improve on the state of the art.

| **Action ID** | OnApp-03 |
|---|---|
| **Action Type** | New and updated Business Products / New services |
| **Description** | Data -centre infrastructure management as described in OnApp-02 will be assisted with improved distribution and management of VM resources at large scale within the data centre. Through better management tools, CIOs and data centre managers will have improved visibility of the whole system and be able to manage resources more efficiently. |
| **Goal/Opportunity** | Large scale VM distribution and management using lightweight MicroVisor clustering |
| **Priority** | Medium |
| **Likelihood** | Medium/High |
| **Parties Involved** | OnApp, FORTH, BSC. |
| **Status** | Early<br>Update 2015-05-27; No Change |
| **IP Issues** | UI features will be limited to OnApp product but the algorithms and heuristics will be platform independent and open such that other platforms can develop based on the ideas. |

| **Action ID** | OnApp-04 |
|---|---|
| **Action Type** | Internal Exploitation |
| **Description** | Expertise and knowledge in the micro-server space will be fed into other parts of OnApp, allowing for promotion of the ideas company wide. Power awareness and energy efficiency will then start to be added to the relevant roadmaps. With new products this will then lead eventually to marketing and sales around the micro-server vision as proposed by EUROSERVER. |
| **Goal/Opportunity** | Promote low energy, high-efficiency micro-servers internally to OnApp |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | OnApp – Emerging Technology, Management, Sales, Marketing Teams |
| **Status** | Early stage – ideas proposed. Some knowledge of the systems is being disseminated internally.<br>Update 2015-05-27; Members of Emerging Technology team are being involved in Microvisor development. Discussion of Microvisor at company strategy and policy level. |
| **IP Issues** | N/A |

| **Action ID** | OnApp-04b |
|---|---|
| **Action Type** | Internal Exploitation |
| **Description** | Related to OnApp-04. Caching has been worked on in the context of EUROSERVER to improve performance access to thinly provisioned resources via the Microvisor platform. |
| **Goal/Opportunity** | Promote technology re-use in existing technologies/products |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | OnApp – Emerging Technology, Management, Sales, Marketing Teams |
| **Status** | Update 2015-05-27; New exploitation activity. Work on caching is ongoing and being merged into Integrated Storage Product and Microvisor Platform. |
| **IP Issues** | N/A |

| Action ID | OnApp-04c |
|---|---|
| **Action Type** | Internal Exploitation |
| **Description** | Related to OnApp-04. Storage I/O performance has been worked on in the context of EUROSERVER through the research and development of ATAoE technology. Removing performance overhead of networking stack for small packet forwarding that limits current storage platforms. This will be integrated into Integrated Storage product. |
| **Goal/Opportunity** | Promote technology re-use in existing technologies/products |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | OnApp – Emerging Technology, Management, Sales, Marketing Teams |
| **Status** | Update 2015-05-27; New exploitation activity. Work on ATAoE is ongoing and being merged into Integrated Storage Product and Microvisor Platform. |
| **IP Issues** | N/A |

| Action ID | OnApp-05 |
|---|---|
| **Action Type** | Open Source |
| **Description** | Data centre infrastructure management as described in OnApp-02 will be assisted with improved liquidity of VM resources within a coherent system and also throughout the data centre. Through better management tools, CIOs and data centre managers will have improved visibility of the system and be able to manage resources more efficiently.<br>OnApp have been in communication with the Xen community via mailing lists and also attendance of Xen Hackathons and are working to provide the source code changes for the Zedboard / MicroZed ARM A9 platforms to the Xen community. |
| **Goal/Opportunity** | Releasing extensions to Xen community for Discrete Prototype hardware. Promotion of ideas of EUROSERVER to the Open Source community |
| **Priority** | High |
| **Likelihood** | High |
| **Parties Involved** | OnApp, FORTH |
| **Status** | Establishing links with community and providing source code<br>Update 2015-05-27; Xen-PV port originally from Samsung modified by OnApp and uploaded to xenbits as part of open source plan. http://xenbits.xen.org/gitweb/?p=people/julianchesterfield/xen.git;a=summary<br>OnApp attended/participated at Xen Hackathon (May 29th-30th 2014, Rackspace, London) |
| **IP Issues** | Features developed by OnApp have been provided as agreed with WP leads, FORTH. Further technology developments provided in collaboration with other partners may pose IP challenges. |

| Action ID | OnApp-06 |
|---|---|
| **Action Type** | Additional research funding |
| **Description** | A large amount of experience and training has resulted already from working on EUROSERVER. It is envisaged that this will lead to new and updated products as described in other exploitation activities.<br>By working on the products, new ideas and possible collaborative efforts may be planned. |
| **Goal/Opportunity** | Using the knowledge and experience gained through EUROSERVER, work on extensions of the ideas proposed through secondary projects or new proposed projects in the area. |
| **Priority** | Low/Medium |
| **Likelihood** | Low/Medium |
| **Parties Involved** | OnApp + Other interested partners |
| **Status** | Early stage<br>Update 2015-05-27; Microvisor development will likely continue and be used in Superfluidity Project (H2020-ICT-2014-2 – 671566). Two proposals that are under consideration by EC also propose to leverage Microvisor technology - ' CANTO ICT-04-2015, Customised and low power computing (Research and Innovation Action)' and 'SERFER ICT-30-2015, Internet of Things and Platforms for Connected Smart Object'. |
| **IP Issues** | None – Future work |

## *Patents & IP issues*

| partner | Title | Patent application number | Date | Comment |
|---|---|---|---|---|
| FORTH | "*Dynamic Max-Min Fair Rate Regulation Apparatuses, Methods and Systems*" | USPTO Provisional Patent Application Number *62,054,866* | September 24th, 2014 | MMF-Rate Congestion Management |
| CEA | "*Procédé d'exécution d'une requête d'échange de données entre des premier et deuxième espaces d'adressage physiques disjoints de circuits sur carte ou puce" /*<br>*"Methods and apparatus for data exchange between two systems without any common physical address space"* | N° E.N. :<br>15 51012 | February 2nd, 2015 | |

| partner | Title | Patent application number | Date | Comment |
|---|---|---|---|---|
| CHALMERS | "*Methods, Devices and Systems for Data Compression and Decompression*" | Swedish Patent with the application number 1550644-7 | May 21st, 2015 | |

## Dissemination strategy

A summary of the dissemination activities is listed in Table 2.

**Table 2: Overview of the dissemination and exploitation activities**

| Objectives | Activities |
|---|---|
| To disseminate generally understandable information about the project idea, approach and results | - Public website, including press release and project abstract<br>- Brochure, various presentations<br>- Electronic newsletters<br>- Attending events related to the outcomes of EUROSERVER |
| To interact with stakeholders, other researchers in the field and the general public | - Wide dissemination on the website of the public deliverables, jobs offers, potential collaborations, news, etc.<br>- Submitting collaborative, peer-reviewed publications and depositing them into an online repository, making efforts to ensure open access within 6 months after publication<br>- Careful and strategic revision of the plan for the use and dissemination of foreground<br>- Electronic newsletters<br>- Participate and publish articles at relevant, top-tier conferences, such as Usenix ATC, ASPLOS, EuroSys, MICRO, OSDI, SOSP<br>- Presentation and demonstration of prototypes in supercomputer events, i.e., ISC – June, Europe, and Supercomputing – November, US. in partner booths. |

| Objectives | Activities |
|---|---|
| To push scientific and technological innovations for uptake by market actors, increase the acceptability of understanding for uptake by market actors, increase the acceptability of understanding of the field | - Dissemination of confidential and restricted deliverables having a direct potential use for end-users and other stake-holders (following protection of results and signature of non-disclosure agreements)<br>- Business-to-business communication in dedicated end-user magazines.<br>- Disseminating project results at working groups and strategic committees beyond the consortium through... |

The first step of the dissemination plan has been to design and build the project website which plays a major role in informing public awareness and opinion. It details the project objectives, its partners and its results. The website also displays the required brochure and poster and the updates on the results of publicly shared deliverables. Regular editions of the project brochure and flyers are provided to partners for distribution at trade fairs, conferences and other meetings.

The partners disseminate the findings of EUROSERVER to the scientific and industrial communities though traditional channels including follow-on press releases, peer-reviewed publications, and specialized websites and participating in well-known scientific conferences.

Through the WP7 activities associated with the creation of specification documentation, the commercial participant associated with the IP and design of associated devices will be able to build on the ARM ecosystem to further broaden the attractiveness of EUROSERVER technology based design. This market pull will in turn extend the market opportunity for the initial participants of the project through their time to market advantage and experience in developing such solutions.

To monitor and evaluate the effectiveness of communication and dissemination activities within EUROSERVER, a set of data will be collected and analyzed. All project partners will contribute. The table below is a synthesis of the definition of data to collect together with the target figures.

**Table 3 : Dissemination metrics and target**

| Description | Measure | Target |
|---|---|---|
| International events (fairs) | Name, date and location of events<br>What was presented (prototype, presentation, poster...) | Embedded World Conference (Nuremberg - DE)<br>International Supercomputing Conference (Leipzig - DE)<br>Cloud Computing Expo (Santa Clara - US)<br>Supercomputing (USA) |
| Scientific conferences | Number of papers produced that were submitted to a scientific conferences<br>Number of papers accepted | Application: ICDCS, IEDM<br>Circuit design: DAC, DATE, ESSIRC/ESSDERC<br>Embedded: DATE, ESWEEK, HiPEAC |

| Description | Measure | Target |
|---|---|---|
| | | HPC: ACM TACO / HiPEAC, ACM ICS, HPCA, ISC<br>Storage: MSST, FAST, ISSCC<br>System/Architecture: ACM TACO / HiPEAC, ISCA, MICRO, HPCA, ICS, ASPLOS, Usenix ATC<br>OS: EuroSys, ASPLOS, OSDI, SOSP |
| Dedicated workshop | Number of people actively participating | A specific EUROSERVER workshop will be organized during the last year of the project to present the project achievements and to discuss the beyond state of the art topics. |
| Journal Publications | Number of papers produced and submitted<br>Number of papers accepted | ACM Tran. on Architecture & Code Optimization (TACO), IEEE Tran. on Computers (TC) |
| Project web site | Number of visits<br>Number of requests for further information | The website will display the required poster and also updates on<br>the results of publicly shared deliverables |
| Press releases | Number of press releases issued<br>Number of media inserts<br>Number of individual press impacts | |

# *Project Image*

## Logo

The main image of the project is the design of the logo presented below.


**Figure 3: project logo**

The logo image was designed to suggest a stylised version of a manycore server, while the colour green was chosen to reflect the sustainability and enery-saving objectives of the project. The font was chosen to give the text a clean, modern feel. This branding will be applied across the dissemination channels of the project, including the website, press releases and any material produced to publicise events.This logo has been approved by all EUROSERVER partners.

### Project Templates

Project templates for deliverables and PowerPoint presentations are available under the project repository.


**Figure 4: project templates available in the WP1 folder**

### Publication acknowledgement sentence

When appropriate, following acknowledgment paragraph should appear in the text of journal papers or conference proceedings:

> This research project is supported by the European Commission under the 7th Framework programme under the "Information and Communication Technologies" theme, with grant number 610456.

## *Management of Intellectual Property Rights (IPR) for dissemination*

The detailed terms, rights and responsibilities of the partners concerning intellectual property are detailed in the Consortium Agreement.

However, dissemination of the foreground will be carried out as swiftly as possible. Nevertheless, special efforts will be made so that dissemination doesn't endanger the protection and use of the foreground (IP) by partners in line with the confidentiality clauses of the Consortium Agreement, all

project results will be considered confidential at first. Partners who would like to disseminate research results will transmit a summary to all partners prior to the expected dissemination date as *defined in the Consortium Agreement. Any partner can raise an IPR issue concerning the summary of research results.*

## External website

The project website plays and will play a major role in informing public awareness and opinion. It details the project objectives, its partners and its results. The website will displays the required poster and also updates on the results of publicly shared deliverables.

The website http://www.EUROSERVER-project.eu/ has been active since Feb. 2014. Its first version contains basic information, and as yet no deliverable or foreground information. Its front page is displayed below:


**Figure 5 : project website front page (1st version)**

## Events and Conferences

The partners disseminate the findings of EUROSERVER to the scientific and industrial communities through traditional channels including peer-reviewed publications, specialist websites and participating in scientific conferences in the field of computer architecture, information technology, embedded computing, etc. Presenting the latest updates of the project at such events, meetings or workshops will be an effective means of involving industry leaders in standards discussions early on. The list of targeted academic/industrial events includes conference and networks of excellence is listed above.

The list of events and conference attended is listed below in table 4 and the planned events are listed in Table 5.

**Table 4: EUROSERVER – Attended Conferences/events**

| dissemination : past events | | | | | |
|---|---|---|---|---|---|
| date | event | where | type | partner | what |
| Nov 22, 2013 | 10th workshop on virtualization in high peformance cloud computing (VHPC SC13) | Denver (USA) | workshop | ARM | Invited talk |
| Dec 10, 2013 | Next Generation Computing Systems: components and architectures for a scalable market | Brussels (BE) | workshop | CEA, ST | Project overview+ 3D technology |
| Jan 20, 2014 | HiPEAC 2014 | Vienna (AT) | conference | EuTECH, CHA, CEA, FORTH, BSC | Project presentation poster |
| Jan 28, 2014 | Final workshop of the Next Generation Computing Roadmap Study | Brussels (BE) | workshop | CEA | Technology overview |
| Feb 9-13, 2014 | ISSCC | San Francisco (USA) | conference | ARM | Invited talk |
| Apr 14, 2014 | Semba | Pont-en-Royans (FR) | workshop | CEA | Invited pres. Technology overview |
| May 15, 2014 | HiPEAC Computer system week | Barcelona (ES) | thematic session | FORTH | Organization of "Microserver and Virtualization" thematic session |
| May 19, 2014 | Xen project Hackathon | London (UK) | conference | OnApp | Promoted EuroSERVER, Microserver concepts |
| May 31 - June 8, 2014 | MSST 14 | Santa Clara (USA) | conference | FORTH | Paper presentation "Jericho Achieving Scalability Through Optimal Data Placement on Multicore System" |
| Jun 14-18, 2014 | ACM/IEEE ISCA'14 | Minneapolis (USA) | conference | CHALMERS | Paper presentation "SC2: a statistical compression cache scheme" |
| Jun 18-21, 2014 | Workshop on Parallel I/O Optimization | Hamburg (DE) | workshop | FORTH | Invited talk "Jericho Achieving Scalability Through Optimal Data Placement on Multicore System" |
| Jul 7-11, 2014 | MPSoC 14 | Margaux (FR) | conference | TUD | Invited talk "Datalow models and runtime environment for CRAN applications" |
| Jul 7-11, 2014 | MPSoC 14 | Margaux FR) | conference | FORTH | Invited talk "NUMA-like Achitecture for Microservers" |
| Jul 7-11, 2014 | MPSoC 14 | Margaux FR) | confererence | ARM | Invited keynote |
| July 13-19, 2014 | ACACES 2014 | Fiuggy (IT) | conference | FORTH | Poster presentation "Towards Operating System Support for Remote Memory Usage on ARM Microprocessers" |
| Aug 17, 2014 | DSD 2014 : Special Session on European Projects (EPDSD) | Verona IT) | conference | BSC/CEA/... | Project technical presentation |
| Oct 1, 2014 | CFAED Research festival | Dresden (DE) | event | TUD | Demonstration of TUD's "Dataflow multi-core platform for telecom" |
| Oct 9, 2014 | HiPEAC computer system week | Athens (GR) | confererence | ARM | Talk |
| Oct 9, 2014 | HiPEAC computer system week | Athens (GR) | conference | FORTH | Presentation "Euroserver: Fast, Energ-efficient Microserver communication in the EuroSERVER project" |
| Oct 9-10, 2014 | Vodafone Innovation Days | Dusseldorf (DE) | event | TUD | Demonstration of TUD's "Dataflow multi-core platform for telecom" |
| Oct 22, 2014 | 26th International symposium on computer architecture and high performance computing (SBAD-PAD) | Paris (FR) | symposium | ARM | Invited talk |
| Oct 27-29, 2014 | SOC'14 | Tampere (FI) | conference | TUD | Presentation "Adaptative Runtime Management of heterogeneous MPSoC: Analysis, acceleratio and silicon prototype" |
| Nov 3-5, 2014 | ACM SoCC'14 | Seattle (USA) | conference | FORTH | Poster + paper presentation "Vangard Increasing Server fficiency via Workload isolation in the storage IO Path" |
| Dec 2014 | Electronic Times interview | international | interview | ARM | interview |
| Dec 2, 2014 | IEEE 3DIC Conference | Dublin (IR) | conference | ARM | Keynote |
| Jan 20, 2015 | HiPEAC 2015 | Amsterdam (NL) | conference | all | Workshop oganization "Greencomputing Node for European Micro-Servers" |
| Jan 20, 2015 | HiPEAC / EuoSERVER workshop | Amsterdam (NL) | conference | FORTH | Paper presentation "Sofware mechanisms for ARM microserver internal/external communication using memory and RDMA" |
| Jan 20, 2015 | HiPEAC / EuroSERVER workshop | Amsterdam (NL) | conference | OnApp | Paper presentation "A Hypervisor architecture for microservers" |
| Jan 21, 2015 | HiPEAC 2015 | Amsterdam NL) | conference | all | Poster presentation |
| Feb 13, 2014 | UC Berkeley award ceremony 'IEEE' milestone for the RISC porject | Berkeley USA) | award ceremony | FORTH | Invited talk "Interprocessor communication and its interface to the memory hierarchy" |
| Mar 9-11, 2015 | ARTEMIS/ITEAC co-summit 2015 | Berlin (DE) | conference | BSC/CEA/FORTH | Project presentation poster |
| Mar 19, 2015 | UKDF | Manchester (UK) | conference | ARM | Invited talk |
| Mer 23, 2015 | ARM Internal strategy workshop | Cambridge (UK) | workshop | ARM | Workshop participation |
| Apr 10, 2015 | Innovate UK EEC SIG AGM | Manchester UK) | confererence | ARM | Invited talk |
| Apr 15, 2015 | Coolchips | Yokohama (JP) | conference | ARM | Keynotes |

**Table 5: EUROSERVER – Planned Conferences/events**

| dissemination : planned events (short term) | | | | | |
|---|---|---|---|---|---|
| date | event | where | type | partner | what |
| Dec 5-9, 2015 | IEEE Int. Symp. On Microarchitecture | Honolulu | Conference | Chalmers | HyComp: A Hybrid Cache Compression Method for Selection of Data-Type-Specific Compression Methods |
| Dec 5-9, 2015 | IEEE Int. Symp. On Microarchitecture | Honolulu | Conference | Chalmers | A Scalable Address Extension of DDR4 for Large-Capacity Memories |

## Education and Training

Participation or organization of activities specifically connected to education and training such as research exchanges, seminars or training courses are planned within the project duration.

A EUROSERVER Workshop has been organized during HiPEAC 2015 (Amsterdam, 22/01/2015) entitled "*EUROSERVER : Green Computing Node for European Micro-Servers*". Two speakers were invited: Boris Grot (University of Edinburgh / School of Informatics) and Antonios Motakis (Virtual Open Systems) and four papers were presented by EUROSERVER partners. The program of the workshop is detailed in Annex 2.

Theses or masters are conducted among the partners with topics directed connected to EUROSERVER project. The list below displays details of them.

**Table 6: EUROSERVER – List of thesis**

| dissemination : theses | | | |
|---|---|---|---|
| date | Partner | Phd/Master | topic |
| Sept 2015 (expected) | CHALMERS | PhD Eng | Memory compression |
| Jun 2014 | CHALMERS | Lic Eng | Hybrid (DRAM/NVM) memory systems |
| May 2015 (expected) | CHALMERS | MSc | Memory compression |
| May 2015 (expected) | CHALMERS | MSc | Memory compression |
| Feb 2014 | CHALMERS | MSc | Memory compression |
| Jan 2014 | BSC | PhD | Heterogeneous architecture<br>Interconnect Energy Saving on Microserver workloads |
| Jun 2014 | BSC | PhD | Heterogeneous architecture<br>Virtualization techniques for the exploitation of resources across coherence islands |
| Apr 2015 | FORTH | MSc | OS support for using remote memory and network interface on a system with an RDMA-capable interconnect |
| Apr 2015 | FORTH | MSc | Sockets-based communication over an RDMA-capable interconnect |
| Jan 2015 | TUD | PhD | Data management, optimization for telecom MPSoC |
| Jan 2015 | TUD | PD | Multiprocessor, achitecture for data intensive applications |
| Mar 2014 | TUD | PhD | MPSoC runtime system |

## Journals

At least one joint EUROSERVER journal publication is expected to be submitted, either near the beginning of the project, to outline the EUROSERVER vision, or near the end, to describe the project outcomes. Suitable journals include ACM Transactions on Computer Systems, Future Generation Computer Systems and IEEE Micro.

Mentions to EUROSERVER will also appear in publications. The list below displays some of them.

**Table 7: EUROSERVER – List of journal publications and press releases**

| dissemination : journal publications | | | |
|---|---|---|---|
| date | publication | content | reference |
| March 2014 | PanEuropean Networks "Science and technology" issue 10 | paragraph "green computing node" about EUROSERVER | http://www.paneuropeannetworks.com/ST10/ |
| 28 March 2014 | Press release | Europe invests realising next-generation green computing for micro-servers and scalable compute | Spanish press release |
| October 2014 | EETimes | article on the HiPEAC microservers session and thus EuroSERVER project | http://www.eetimes.com/author.asp?section_id=36&doc_id=1324294 |
| January 2015 | EETimes | European server project promotes ARM on FDSOI | http://www.electronics-eetimes.com/en/european-server-project-promotes-arm-on-fdsoi.html?cmp_id=7&news_id=222923411&page=0 |

## Press releases

Press releases (table 8) are one of the most effective ways of communicating the existence of the project to a specific target audience (general public and related institutions) by attracting attention to the project's progress and its achievements. The initial press release is the most important one, because it defines the EUROSERVER project objectives as well as its working plan. There may be further press releases during the project. In the middle of the project there could be a press release to explain the project's progress, and at the end of the project, a press release for the scientific results. All press releases and press impacts will be uploaded on the project website. For more details, please read D 7.2 where the complete press strategy has been defined.

The first press release was released on March 27th 2014 with the content given in Annex A: Text of press release, at the end of this document. It was sent to HPC Wire, Scientific Computing World, Technology Review, Wired, ComputerWorld, eWeek, The Register, GreenComputing Report, ISGTW.

Further details are given in D7.2 (Press Release Along with Project Web Site Address).

## Contributions to standards and policy developments

The EUROSERVER consortium already has significant expertise in participating and leading standardization activities at an individual partner level. This knowledge and experience will be harnessed for the benefit of the standardization activities of the project.

There are many standardization bodies that are related to energy efficiency of datacenters. In the US the certification standard is LEED from the US Green Building Council. In Europe and in particular the UK, the BREEAM Standard has had the largest following. BREEAM and LEED have been used for datacenters but the standards are not so useful after the initial building design has been completed. Ongoing energy use and the real operating costs are large in proportion to the initial costs and as such these standards have limitations that the industry has reacted to by developing other, more targeted standards.

The EC have a code of conduct for datacenters but as it is a self-certification system the British Computer Society created the Certified Energy Efficiency Datacenter Award (CEEDA) that was launched at the end of 2010.

There is also an emerging pan-European standard that is being developed by Building Research Establishment (BRE), Centre Scientifique et Technique du Bâtiment (CSTB) and other leading groups for efficient building design and construction, the Sustainable Building Alliance.

EUROSERVER would look at further investigating the standardization bodies that are currently used and would look to promote further standards from the perspective of the operating efficiency of hardware. EUROSERVER is well placed to participate in standards bodies and also promote modifications to existing standards.

## Dissemination Pack

The acknowledgement of the EC funding sources will be included in all dissemination materials with the following sentence:

> This research project is supported by the European Commission under the 7th Framework programme under the "Information and Communication Technologies" theme, with grant number 610456.

### General Brochure

A one-page general presentation is available on the project repository. The general brochure provides information about the project, its objectives and future achievements and its. The format of the brochure is a single-sided A4 sheet, so that interested Project Partners can easily download and print for their own dissemination purposes. It can be distributed in all events or local actions to scientific and industrial contacts defined by each partner.

### Generic poster

A generic poster was initially designed for the HiPEAC 2014 conference. It is represented below:

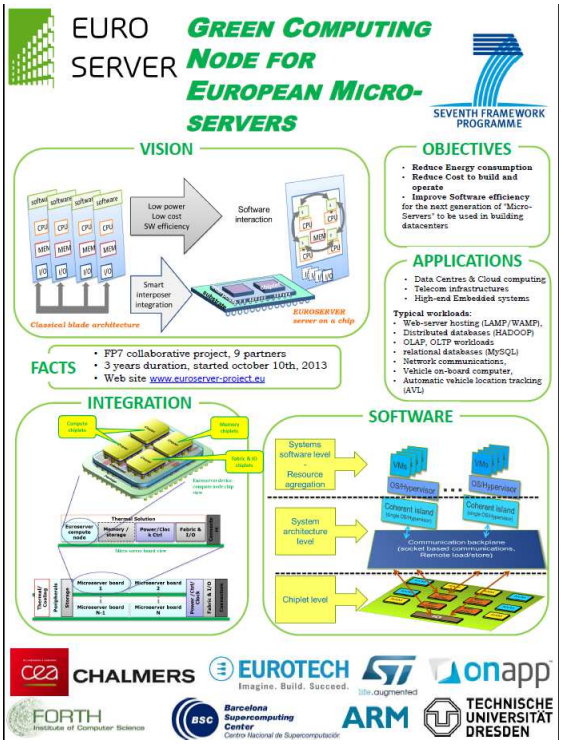


**Figure 6: HiPEAC 2014 – EUROSERVER poster**

It has been updated for HiPEAC 2015 and Figure 7 just below is the latest version.

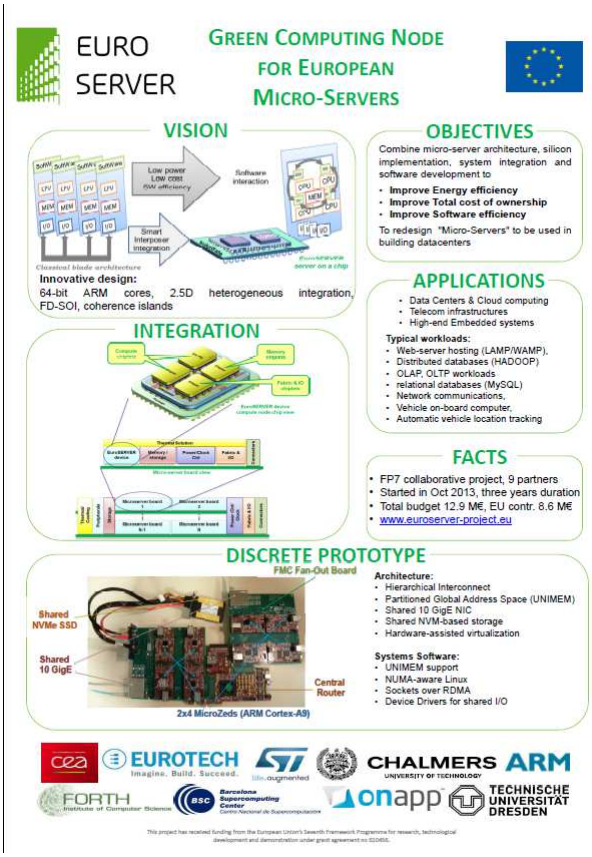


**Figure 7: HiPEAC 2015 – EUROSERVER poster**

Both posters are available on the project repository.

# Annex A: Text of press release

INTRODUCING: THE EUROSERVER PROJECT

**Europe invests realizing next-generation green computing for micro-servers and scalable compute:**

27 March 2014

The EUROSERVER project brings together under the support of the European FP7 ICT funding program world-class industrial and academic expertise to design and prototype technology, architecture and systems software for the future generations of energy-efficient reduced-cost micro-servers and scalable compute platforms

Data centres, and computing in general, are driving the Information Society worldwide and are one of the key resources for innovation and leadership of European industry. As data centre traffic and workloads continue to grow, data centre scaling is increasingly constrained by existing server technology due to insufficient server density, high power consumption and high total cost of ownership (TCO). This is why EUROSERVER has taken to reconsider the basic components and fundamental system architecture of future technology and the resulting server platforms, by architecting and proving their suitability through delivering into a full prototype system.

There are three key axes to the EUROSERVER approach. Firstly, the project will use the low-power 64-bit ARM Cortex™ processors fabricated using the FDSOI fabrication technology, an ideal silicon platform for data centre workloads. Secondly, the project will advance the state-of-the-art in 3D silicon-on-silicon and multichip module package integration, placing multiple silicon "compute chiplets" on an active silicon interposer, while also integrating multiple gigabytes of memory within package together improving fabrication yields, compute density, reduced energy consumption and significantly reducing the cost of acquisition and ownership. Thirdly, EUROSERVER proposes a new backwards compatible system software architecture that allows resource virtualisation and sharing of global memory and I/O between multiple compute nodes while delivering new memory models that will enable the future generation of more efficient and high-performance software paradigms.

EUROSERVER is a three-year project coordinated by Commissariat à l'énergie atomique et aux énergies alternatives (CEA) with a managed budget of 12.9 million euros, including 8.6 million euros funded by the European Commission's FP7 Programme plus significant indirect support from the industrial partners.

The three main project objectives are:

- To reduce energy consumption by: (a) using low-power 64-bit ARM cores, (b) reducing the core-to-memory distance through silicon interposer and packaging technology, and (c) while improving energy proportionality.
- To reduce the cost to manufacture, build and operate, by: (a) improved manufacturing yield through 3D integration of multiple chiplets on an active silicon interposer, and (b) small size of the packaged interposer module, and (c) and energy-efficient semiconductor process (FDSOI).
- To improve software efficiency through next-generation system software that (a) manages the resources in a server with a common global address space and (b) isolates and protects multiple

workloads from each other when they share resources such as I/O, storage, memory, and interconnects.

"The EUROSERVER prototype will demonstrate how the proposed approach can improve energy efficiency by a factor of ten, by 2020" says Yves Durand, EUROSERVER project coordinator. The prototype will be evaluated using workloads for (a) data centres and cloud computing (LAMP, WAMP, HADOOP, MySQL), (b) telecom infrastructures (network communications), and (c) high-end embedded systems (vehicle onboard computer, automatic vehicle location tracking [AVL], advanced security and surveillance).

EUROSERVER brings together a European consortium, joining industrial technology providers, universities and research centres: Eurotech (Italy) as the system integrator, ARM (UK) as the world leader in embedded high-performance processor IP, and STMicroelectronics (France), Europe's leading semiconductor company, as well as OnApp (Gibraltar), which provides a complete IaaS platform for hosts, telcos and MSPs. In addition to the technology providers and users, EUROSERVER brings application and computer and memory architecture expertise from Barcelona Supercomputing Center (Spain), TU Dresden (Germany), FORTH (Greece) and Chalmers (Sweden).

EUROSERVER was launched in September 2013. More information is available at the project's website at www.EuroSERVER-project.eu.

# Annex B: EuroSERVER workshop program – HiPEAC 2015

*EUROSERVER : Green Computing Node for European Micro-Servers*

22 January 2015

The workshop goal is to explore the alternative to EUROSERVER main innovative topics (i.e. memory management, distributed execution, IO virtualization and power management) and to confront the project vision with other projects or industrial perspectives

Agenda

2pm – 2.45 pm « **Towards PetaRAM servers with Scale-Out NUMA** »
by Boris Grot (School of Informatics, University of Edinburgh)

2.45pm – 3.15pm « **Platform device assignment to KVM-on-ARM Virtual Machines via VFIO** »
by Antonios Motakis (Virtual Open Systems)

3.15pm – 3.40pm **« Microvisor : A Scalable Hypervisor Architecture for Microservers** »
contributions from X. Ragiadakou, M. Alvanos, J. Chesterfield, J. Thomson, M. Flouris - OnApp
*presented by Julian Chesterfield*

*3.40pm – 4pm ~Coffee break~*

4pm – 4.25pm « **Software Mechanisms for ARM Microserver Internal/External Communication Using Shared Memory and RDMA** »
contributions from D. Poulios, J. Velegrakis and M. Marazakis – Institute of Computer Science (ICS)-FORTH.
*presented by Dimitrios Poulios*

4.30pm – 4.55pm « **Energy-aware Scheduling for Task-based Applications** »
contributions from F. Juarez, J. Ejarque and Rosa M. Badia – Barcelona Supercomputing Center (BSC)
*presented by Jorge Ejarque*

5pm – 5.25pm**« Blaze Memory : A highly Efficient Memory Compression Add-on in Server Systems** »
contributions from A. Arekalis, C. Alverti and P. Stenström – Department of Computer Science and Engineering, Chalmers University of Technology
*presented by Per Stenström*