Project N°: 610456

D7.1a Exploitation Plan

Annex to D7.1 Plan for Using and Disseminating the Knowledge (Preliminary)

November 04, 2014

Abstract:

This document is an annex to the dissemination Plan. It defines how the actual activities support exploitation. First, the project impact is described from different perspectives: strategic, societal, industrial. The second part 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, EUROTECH, 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 énergies 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	EUROTECH SPA	EUROTECH	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
0.1	Y.Durand	creation
0.2	partners	Inclusion of "exploitation plans per partner"
0.3	P.Stenström, I.Dor	Final review

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Contents

Introduction

The present document is an addition to the preliminary version of EUROSERVER Plan for Using and Disseminating the Knowledge, which complete version is scheduled at Month M18.

It contains partners' preliminary intentions towards exploiting the project results to support their own activities, as documented in the project Description of Work.

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 following:

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.

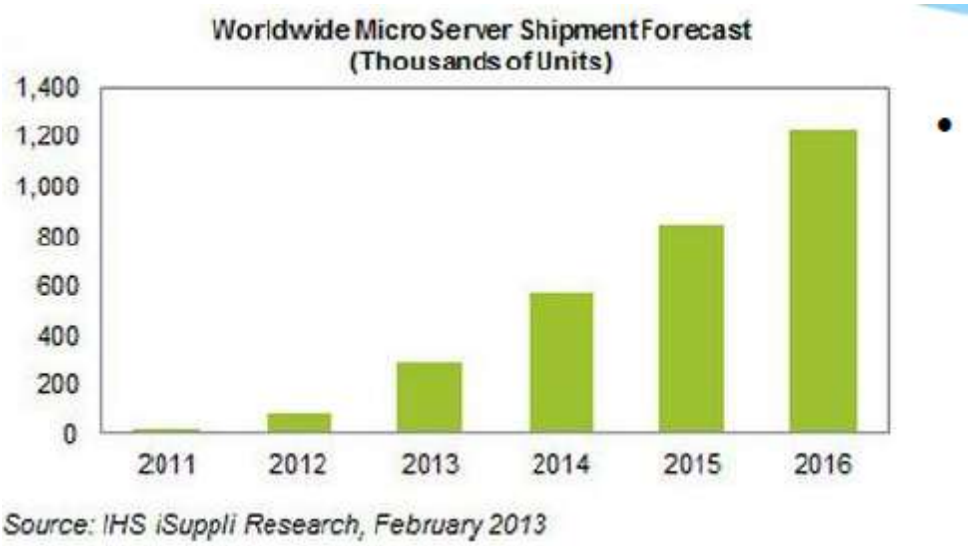
Pathway to exploitation

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 :

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) .



Source: IHS iSuppli Research, February 2013

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-mappable 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 project plan is to build both embedded and data-centre prototypes, comparable to the examples shown just below.

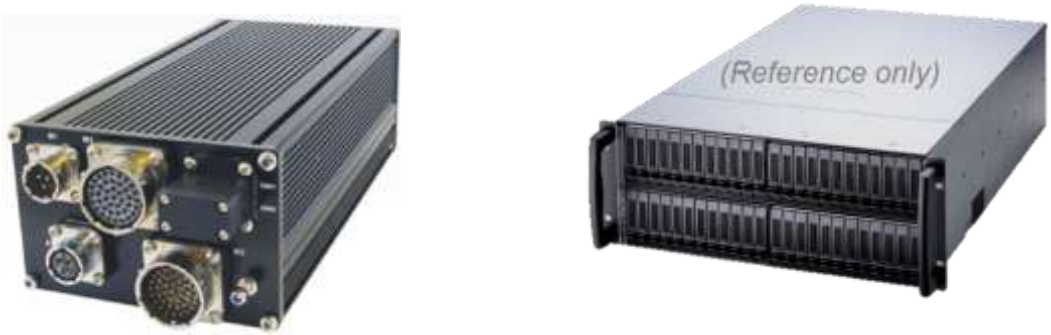


Figure 1 : example of embedded server and enterprise server by EUROTECH

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

- If the chip set is mature, especially if IO performance reaches its objectives, it may be used for customer trials by EUROTECH, at least in the embedded version of it.
- Even if the prototype 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 licence. 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

At the time of writing, there is not enough concrete results available to allow effective sharing with other projects. However, potential collaborations have been identified:

- Technologies developed within EUROSERVER, such as the hardware architecture and the unified memory model, could be reused in a H2020 proposed project called EUROEXA.
- The consortium will organize a workshop within the HiPEAC conference in January 2015 and invite potential partners.

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

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 platforms
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, EUROTECH
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

EUROTECH

The expected main outcomes from the EUROSERVER project for EUROTECH are the identification of the key elements (technology, components, architectures, processes) both new and re-usable and the optimal combination among them to design and develop a new class of micro-servers enabling new convergences between embedded computing and ICT.

Action ID	EUROTECH-01
Action Type	Internal or External Influence
Description	Identification of re-usable key components for micro-servers, for high-end modular embedded systems, for HPC systems
Goal/Opportunity	Leverage development effort, rationalize architectures
Priority	high
Likelihood	high
Parties Involved	Different companies at EUROTECH Group
Status	Planned
IP Issues	None

Leveraging the outcome of the projects, the synergies between our know-how and solutions on embedded computing and HPC will result in a multiplication business advantage effect.

The focus on low-power will provide in-the field HPC-class computation power for demanding application in different markets where portability/mobility and battery life make the difference.

Action ID	EUROTECH-02
Action Type	Internal Exploitation
Description	Development and exploitation of HPC class low power technologies based on ARM 64 bit architecture
Goal/Opportunity	Leverage development effort, deployment of low power solutions
Priority	high
Likelihood	high
Parties Involved	Different companies at EUROTECH Group
Status	Planned
IP Issues	None

EUROTECH expects that EUROSERVER will pave the path for a new class of high configurable, cost and energy efficient servers exploiting the micro-server architecture higher the company portfolio proposal for data centre and specifically for Cloud Computing Platform.

Action ID	EUROTECH-03
Action Type	New Business Product
Description	Development and exploitation of ARM 64 bit based enterprise server solution
Goal/Opportunity	Validation of micro-server technologies suitable for data-centres
Priority	high
Likelihood	medium/high
Parties Involved	Different companies at EUROTECH Group, third parties
Status	Planned
IP Issues	None

TUD

TUD will evaluate the micro-server chiplet/interposer technology by running a Cloud RAN 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.

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 Cloud-RAN protocol processing to network provider and base station manufacturer.
Goal/Opportunity	Contribution to the evolution of radio access architecture
Priority	Medium
Likelihood	Medium
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

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	CompS 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, which is the BSC's IaaS solution, will be enhanced to support ARM-based platforms and with scheduling policies to optimise the scheduling and placement of VM and services in the provider's resources considering the energy efficiency metric. Our goal is to exploit the complexity and diversity of hardware platforms and software applications in 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

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 will use this project to identify potential components that may evolve into new products and services, as it has happened in the case of FORTHnet and the more recently licensed technologies. Of particular interest in this direction is systems software for servers that do not support full coherence and new persistent memory technologies that are starting to be introduced to today's server memory hierarchies.

Action ID	FORTH-01
Action Type	Additional Research Funding
Description	Use IP and prototypes of EUROSERVER to address problems in the systems software stack for micro-server architectures
Goal/Opportunity	Advance further the state of the art in research
Priority	High
Likelihood	High
Parties Involved	Different groups at FORTH
Status	Initiated
IP Issues	None

Action ID	FORTH-02
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	Medium
Parties Involved	FORTH, third parties
Status	Planned
IP Issues	Deal with GPL restrictions of the Linux kernel

Action ID	FORTH-03
Action Type	Internal Exploitation
Description	Use systems software prototype of modified Linux for subsequent research in micro-servers
Goal/Opportunity	Advance further the state of the art in research
Priority	High
Likelihood	High
Parties Involved	Different groups at FORTH
Status	Initiated
IP Issues	None

Action ID	FORTH-04
Action Type	Achievement of Academic Qualifications
Description	Masters thesis in efficient and transparent user-space inter-process communication in micro-servers
Goal/Opportunity	Research and training of highly qualified personnel
Priority	High
Likelihood	High
Parties Involved	FORTH, University of Crete
Status	In Progress
IP Issues	None

CHALMERS

Based on background brought to bear in EUROSERVER, Chalmers is developing a memory compression technology within the EUROSERVER project that promises to use memory resources 4X more efficiently which can yield substantial increase in cost-performance and energy efficiency for micro-servers. Chalmers is collaborating with FORTH to align this technology to the virtualization technology that will be offered in the EUROSERVER project. In the meantime, Chalmers has applied for a national project to explore commercialization opportunities of its memory compression technology. At the time of writing, the project has been selected for an interview between the P.I. and the agency. This project, if finally accepted, will use the well established business canvas model to verify assumptions regarding value proposition, potential markets, and business models to commercialize the technology. If successful, a commercialization path will be explored as part of this national project.

In parallel, we are prototyping the support needed to incorporate the memory compression technology on EUROSERVER selected prototype boards.

Action ID	CHAL-01
Action Type	New business product
Description	Licensing of memory compression technology to firms that will enter the micro-server market
Goal/Opportunity	Transfer research results to industry
Priority	High
Likelihood	High-Medium
Parties Involved	CHAL, third parties
Status	Initiated
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
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
Likelihood	Medium/High
Parties Involved	OnApp – Core and Emerging Product Teams. FORTH, BSC.
Status	Research / early stage
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
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.
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. 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
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. 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
IP Issues	None – Future work