

ALMARVI

“Algorithms, Design Methods, and Many-Core Execution Platform for Low-Power Massive Data-Rate Video and Image Processing”

Project co-funded by the ARTEMIS Joint Undertaking under the

ASP 5: Computing Platforms for Embedded Systems

ARTEMIS JU Grant Agreement no. 621439

D7.6 - Dissemination Report (Intermediate)

Due date of deliverable: September 30, 2015

Start date of project: 1 April, 2014

Duration: 36 months

Organisation name of lead contractor for this deliverable:

TUE

Author(s): Dip Goswami, Marc Geilen, Twan Basten

Validated by:

Version number: 2.0

Submission Date: 25-09-2015

Doc reference: ALMARVI_D7.6_Disseminationplan_report.docx

Work Pack./ Task: WP7 task 7.2

Description: This document reports the dissemination activities in the ALMARVI project over M01-M18.
(max 5 lines)

Nature:	O, R		
Dissemination Level:	PU	Public	X
	PP	Restricted to other programme participants (including the JU)	
	RE	Restricted to a group specified by the consortium (including the JU)	
	CO	Confidential, only for members of the consortium (including the JU)	

DOCUMENT HISTORY

Release	Date	Reason of change	Status	Distribution
V0.1	25/08/2015	First draft	Draft	CO
V0.2	01/09/2015	Updates from all partners are included	Draft	CO

Contents

1. Introduction	3
2. ALMARVI website and content	4
3. Scientific publications	7
4. Participation in public events, tutorials and workshops	10
5. Organization of public events, tutorials and workshops	11
6. Conclusions	13
Appendix: conferences and journals	14

1. Introduction

This document describes the dissemination activities performed under the ALMARVI project in the first eighteen project-months (i.e., M01-M18). The dissemination activities are performed as per the strategy and the plan outlined in the deliverable D7.3 (Dissemination strategy and plan). The key goal is to increase the applicability and visibility of the ALMARVI project results. The dissemination activities are driven keeping the following two objectives of WP7 in mind (reference: D7.3):

- Dissemination of the ALMARVI project results in the relevant communities through publications in premier conferences and journals, special sessions at relevant conferences/symposiums/workshops, dedicated ALMARVI technical workshops, information days, press releases, etc.
- Demonstration of the project results to the relevant/target audience (customers, business parties, related research groups, etc.) in the ALMARVI demonstration workshops.

With the above objectives, as reported in D7.3, ALMARVI targets three different communities: the general public, the scientific community and the industrial community. Along this line, the key dissemination activities are performed in three directions:

- Website (Target: the general public, the scientific community, and the industrial community): The ALMARVI website contains and maintains the overview of the project, latest news, publications etc. Further, we equipped the website with **Google analytics** to track the statistical information related to the visibility of ALMARVI project. The Section 2 describes the website and the details of statistical information obtained from the Google analytics over the reporting period.
- Scientific publications (Target: the scientific community and the industrial community): Along this line, a special emphasis is given on project scientific publications in premier conferences and journals with a special focus on embedded systems. As reported in D7.3, the academic partners are more active in national and international scientific publications while the industrial partners are more focused on outreach activities and demonstrations at the national level. Section 3 describes the achievements in terms of scientific publications and outreach over the reporting period.
- Seminars, workshops and tutorials (Target: the industrial community and the scientific community): Along this line, there are two categories of activities. First, as a part of ALMARVI dissemination activities, various partners participated in a number of public events. Section 4 describes the participations in various public events supported by the ALMARVI project in the reporting period. Second, various partners organized a number of public events to further disseminate the ALMARVI results. Section 5 describes the activities in terms of organizing public events in the reporting period.

In the following, we present the specific achievements made in terms of dissemination in the period of M01-M18 along the above directions.

2. ALMARVI website and content

As already reported in D7.3 and can be noticed in the ALMARVI website (www.almarvi.eu), the website contains overview of the projects, objectives, work packages, details of the consortium, contacts along the latest news and details of the publications. It is maintained and regularly updated.



In particular, we would like to provide the details on the following two updates:

1. Publications

All public domain disseminations including journal, conference publications and Technical reports are included in the website.

- Open software:** The following open software are being in used by various partners in ALMARVI project. These software are linked to ALMARVI website. In the following, we provide a brief description of the software which further helps to understand their importance in ALMARVI.

- ❖ **vfTasks open-source parallelization library:** VF maintains <http://sourceforge.net/projects/vftasks/files/vftasks/> -- vfTasks which is a library with a C API containing the following features: - Manage worker thread pools - Inter-thread streaming communication channels - 2-D synchronization for parallelized loops It does not depend on any other libraries other than libc and the pthreads library. The latter can however be easily replaced with custom threading and memory allocation solution, allowing vfTasks to be ported to an embedded CPU or DSP processor. For more information, visit <http://www.vectorfabrics.com/technology/vftasks>. vfTasks is developed by Vector Fabrics (<http://vectorfabrics.com>) and complements Vector Fabrics' Pareon product (<http://vectorfabrics.com/products>) that helps to parallelize a C/C++ application.
- ❖ **TCE (tce.cs.tut.fi):** TUT maintains TTA-based Co-Design Environment (TCE) which is a toolset for designing and programming customized processors based on the Transport Triggered Architecture (TTA). The toolset provides a complete retargetable co-design flow from high-level language programs down to synthesizable processor RTL (VHDL and Verilog backends supported) and parallel

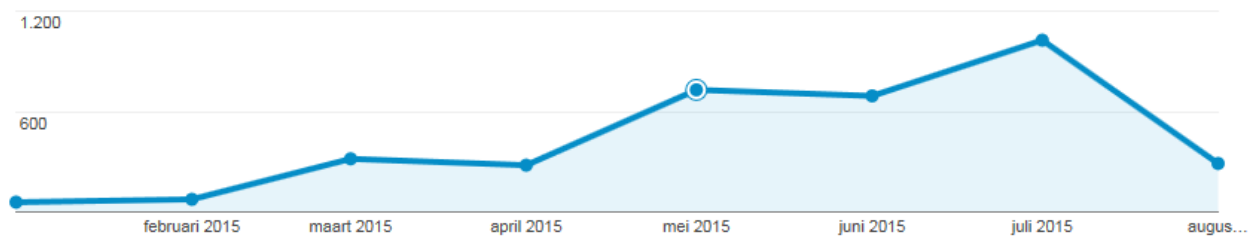
program binaries. Processor customization points include the register files, function units, supported operations, and the interconnection network.

- ❖ **POCL** (pocl.sourceforge.net): TUT uses Portable Computing Language (pocl) which aims to become a MIT-licensed open source implementation of the OpenCL standard which can be easily adapted for new targets and devices, both for homogeneous CPU and heterogeneous GPUs/accelerators. IT uses Clang as an OpenCL C frontend and LLVM for the kernel compiler implementation, and as a portability layer. Thus, if your desired target has an LLVM backend, it should be able to get OpenCL support easily by using pocl. The goal is to accomplish improved performance portability using a kernel compiler that can generate multi-work-item work-group functions that exploit various types of parallel hardware resources: VLIW, superscalar, SIMD, SIMT, multicore, multithread.
- ❖ **rVEX** (rvex.ewi.tudelft.nl): TUDelft maintains p-VEX which is an reconfigurable and extensible Very-Long Instruction Word (VLIW) processor. It is part of the overall "Liquid Architectures" research theme within the Computer Engineering Lab at TU Delft, The Netherlands. The p-VEX processor architecture is based on the VEX ISA. The main concept of our design is to be able to dynamically adapt the hardware design to match requirements from the applications and the operating environment. In this manner, resource utilization can be improved for energy savings or increased performance, e.g., by executing additional programs on the "freed" resources. Consequently, our design can be seen as a large wide-issue (up to 8) VLIW processor or as several 2-issue VLIW cores. Our designs have been used also in several courses given at TU Delft and we can make this material available for professors at other institutes upon request.
- ❖ **SDF³** (<http://www.es.ele.tue.nl/sdf3/>): TUE developed and maintains SDF³ toolchain. Synchronous dataflow (SDF) is a modelling formalism that allows design-time analysis of multiprocessor applications. SDF³ is the tool support for SDF based analysis of throughput and latency, and it provides solution to binding and scheduling questions on microprocessors. The recent versions support Cyclo-Static Dataflow (CSDF) and Finite-State-Machine-based Synchronous Dataflow (FSMSADF).
- ❖ **TRACE** (trace.esi.nl): TRACE is a Gantt chart visualization tool capable of presenting (large sets of) activities on resources (and dependencies between them) as a function of the time. Moreover, it allows visualizing multi-dimensional design spaces for easy comparison of design options. Various recent features (e.g., critical path analysis, distance analysis etc.) on TRACE were developed as a part joint activities between TUE and TNO-ESI and are being used in ALMARVI project.

Apart from the above open software, there are few more relevant software being used by ALMARVI partners, e.g.,

- ❖ **OpenCV** - <http://opencv.org/>
- ❖ **scikit-learn** - <http://scikit-learn.org>
- ❖ **scikit-image** - <http://scikit-image.org/>
- ❖ **Python Imaging Library** - <http://www.pythonware.com/products/pil/>

Visibility (using Google Analytics): As already mentioned, we measured the degree of visibility using statistics obtained using **Google Analytics**. Over the period June 2014 to August 2015, **3744 users** enter the ALMARVI website and there has been **4928 page views**. The following figure shows the monthly breakup of users in 2015.



3. Scientific publications

In the following, we report the scientific publications supported by the ALMARVI project so far. A number of technical articles are already published and several dissemination activities are already confirmed (or accepted) at various venues over the last eighteen months. All publications supported by ALMARVI contain the following ALMARVI acknowledgement: "This research is supported by the ARTEMIS joint undertaking under grant agreement no 621439 (ALMARVI)."

Scientific publications by various partners in M01-M18:

- I. Pöllänen, B. Braithwaite, T. Ikonen, H. Niska, K. Haataja, P. Toivanen, and T. Tolonen, "Computer-Aided Breast Cancer Histopathological Diagnosis – Comparative Analysis of three DTOCS-based Features: SWDTOCS, SW-WDTOCS, and SW-3-4-DTOCS", *4th International Conference on Image Processing Theory, Tools, and Applications (IPTA'2014)*, Paris, France, October 14–17, 2014
- D. Goswami, D. Müller-Gritschneider, T. Basten, U. Schlichtmann, S. Chakraborty "Fault-tolerant Embedded Control Systems for Unreliable Hardware," International Symposium on Integrated Circuits (ISIC), Singapore, 2014 (December)
- T. Ikonen, H. Niska, B. Braithwaite, I. Pöllänen, K. Haataja, P. Toivanen, J. Isola, and T. Tolonen, "Computer-Assisted Image Analysis of Histopathological Breast Cancer Images Using Step-DTOCS", *14th International Conference on Hybrid Intelligent Systems (HIS 2014)*, Kuwait, December 14-16, 2014
- B. Braithwaite, H. Niska, I. Pöllänen, T. Ikonen, K. Haataja, P. Toivanen, and T. Tolonen, "Optimized Curve Design for Image Analysis Using Localized Geodesic Distance Transformations", *IS&T SPIE Electronic Imaging*, San Francisco, California, USA, February 8–12, 2015
- I.Szentandrás, M. Zachariáš, J. Tinka, M. Dubská, J. Sochor, A. Herout, "INCAST", International Symposium on Mixed and Augmented Reality ISMAR 2015, Fukuoka, Japan, October 2015
- Article in the ARTEMIS-IA news, March 17, 2015: artemis-ia.eu/news/almarvi.html
- H. Kultala, T. Viitanen, P. Jääskeläinen, J. Helkala, and J. Takala, "Compiler Optimizations for Code Density of Variable Length Instructions," in Proc. IEEE International Workshop Signal Process. System, Belfast, UK, Oct. 20-22 2014, pp. 127 – 132.
- T. Viitanen, H. Kultala, P. Jääskeläinen, and J. Takala, "Heuristics for Greedy Transport Triggered Architecture Interconnect Exploration," in Proc. International Conference Compilers Architecture Synthesis Embedded System, New Delhi, India, Oct. 12-17 2014.
- K. van Gend, Vector Fabrics, "Cut Power Consumption by 5x Without Losing Performance", LinuxCon 2014, Düsseldorf, Germany, Oct. 13-15 2014.
- Zliobaite, I.; Hollmén, J.; Teittinen, J.; Koskinen L.; "Towards hardware-driven design of low-energy algorithms for data analysis" ACM SIGMOD Record archive, Volume 43 Issue 4, December 2014, Pages 15-20.
- Turnquist, M.J.; Hienkari, M. ; Makipaa, J. ; Koskinen, L. ; "A Fully Integrated Self-Oscillating Switched-Capacitor DC-DC Converter for Near-Threshold Loads" Accepted to The IEEE ASSCC 2015 (Asian Solid-State Circuits Conference).

- M. Hradiš, J. Kotera, P. Zemčík and F. Šroubek, “Convolutional Neural Networks for Direct Text Deblurring”, Proceedings of The British Machine Vision Association and Society for Pattern Recognition BMVC 2015, Swansea, UK, 2015, pp. 1-13.
- J. Kotera, F. Sroubek, B. Zitova, "PSF accuracy measure for evaluation of blur estimation algorithms", in International Conference on Image Processing (ICIP), 27. -30. September 2015, Quebec City, Canada, 2015, accepted for publication.
- **SAMOS XV, 2015 Special session on “Mid-Term Results of the ALMARVI ARTEMIS project”** organized by J. Takala and Z. Al-Ars includes the following publications:
 - “Multi-Constraint Multi-Processor Resource Allocation” by A. R. B. Behrouzian, D. Goswami, T. Basten, M. Geilen, H. Alizadeh Ara (**TUE**)
 - “GPU Implementation of an Anisotropic Huber-L1 Dense Optical Flow Algorithm Using OpenCL” by D. Buyukaydin and T. Akgun (**ASEL**)
 - “Using VLIW Softcore Processors for Image Processing Applications” by J. Hoozemans, S. Wong and Z. Al-Ars (**TUD**)
 - “Power Optimizations for Transport Triggered SIMD Processors” by J. Multanen, T. Viitanen, H. Linjamäki, H. Kultala, P. Jääskeläinen, J. Takala, L. Koskinen, J. Simonsson, H. Berg, K. Raiskila and T. Zetterman (**Multi-partner collaboration: TUT, UTU, NOK**)
 - “Current Analysis Approaches and Performance Needs for Whole Slide Image Processing in Breast Cancer Diagnostics” by I. Pöllänen, B. Braithwaite, K. Haataja, T. Ikonen and P. Toivanen (**UEF**)
 - “Performance evaluation of image noise reduction computing on a mobile platform” by J. Hannuksela, M. Niskanen and M. Turtinen (**VIS**)
 - “Video Chain Demonstrator on Xilinx Kintex7 FPGA with EdkDSP Floating Point Accelerators” by J. Kadlec (**UTIA**)

Outreach activities, keynote and presentations by various partners in M01-M18:

- **Keynote at IS&T/SPIE Electronic Imaging 2015, San Francisco, California, United States, February 8 - 12 2015**
 - Speaker: **Filip Sroubek UTIA (Czech Republic)**
 - Title: **Advances in image restoration: from theory to practice**
- **ASELSAN:** ASELSAN intends to present one or two posters/papers in the national conferences and universities in Turkey. Moreover, ASELSAN is planning to participate in a workshop on parallel processing where specific scientific ALMARVI concepts will be presented.
 - **Lead:** Toygar Akgün
 - **NVIDIA GP-GPU meet up in Turkey**
- **Hurja Solutions** aims attend to international fairs when new applications developed in ALMARVI are ready for demonstration. Towards this, it had attended **Slush 2015** which is detailed in Section 4.
 - **Lead:** Antti Väänänen

- **Nokia** aims to participate in a number of international and national fairs and workshops. Along this line, NOK gave a presentation on their results under ALMARVI in a **workshop at WEEE** organized by UTURKU (detailed in Section 5).
 - **Lead:** Heikki Berg

- **CAMEA** aims exhibit with its own booth in a number of national and international trade fairs. Current results of the ALMARVI project such as hardware demos (e.g. object detection in ZYNQ and so on) were shown in **Expotraffic 2015**, **Intertraffic 2015** and will be presented in ITS World Congress Bordeaux – detailed in Section 4.
 - **Lead:** Lukas Marsik

- **Presentation** by **Lauri Koskinen (UTURKU)** at **TUE** in May, 2015 on “Adaptive ultra-low power (ULP) processing“. As a part of collaboration under ALMARVI, Lauri Koskinen gave a public presentation and as a followup, possible collaborations are being discussed being these parties.

- **Invited talk** by **Fatih Ugurdag (OZyegin)** at **IEEE EAST-WEST DESIGN & TEST SYMPOSIUM** in September, 2015.

4. Participation in public events, tutorials and workshops

In the following, we summarize the participation in public events, tutorials and workshops by the ALMARVI partners in the reporting period.

- **Participation and presentation Artemis/ECSEL Brokerage 2015 Event by UEF**, Amsterdam, Netherlands by Pekka Toivanen and Keijo Haataja.
- **Participation in Slush 2015 event in Helsinki:** Hurja Solutions attended to look for new business opportunities for services and applications which are developed in ALMARVI project.
- **Participation in ICTexpo 2016 event in Helsinki:** Hurja Solutions attended to look new business opportunities for services and applications which are developed in ALMARVI project.
- **Participation in Expotrafic 2015 in Moscow:** Tomas Bia (collaborator of CAMEA) attended a number of talks and had fruitful discussions regarding technology addressed in ALMARVI project. The audience was various industrial bodies and customers.
- **Participation in Artemis - ITEA II Co-summit** in March, 2015 by UTIA and UEF at Berlin Congress Center, Germany, ALMARVI booth
 - Lead: Jiri Kadlec, Pekka Toivanen, Keijo Haataja, Lauri Väättäin, and Maarit Tamminen
- **Participation in Intertrafic in Istanbul 2015 by CAMEA (27.-29.5.2015):** Poster presenting intermediate results of ALMARVI project by Lukas Marsik and Tomas Bia. The audience was various industrial bodies and customers.
- **Participation in Intelligent Traffic Systems (ITS) World Congress Bordeaux by CAMEA (5.-9.10.2015) by CAMEA**

5. Organization of public events, tutorials and workshops

In the following, we report the dissemination by organizing in public events, tutorials and workshops in the ALMARVI partners.

- **Special session in SAMOS 2015 on ALMARVI**

Session Organizers: Zaid Al-Ars (TUDelft, Netherlands), Jarmo Takala (TUT, Finland)

Description: The expected participants include international technology experts, healthcare and security industry representatives, image processing device manufacturers, end users, industry and research representatives as well as the project partners. The special session published 7 papers by partners on individual work and collaborative work between different partners.

- **ALMARVI Workshop at Ozyegin University** in 2015 in Istanbul, Turkey

Organizer: OZYEGIN (Fatih Ugurdag) and Aselsan (Toygar Akgün)

Description: Application of ALMARVI results in parallel processing, and effective GPU programming and its application to video processing with target audience university researchers, doctoral candidates and graduate/undergraduate students

- **Organizing Workshop at WEEE by UTURKU:** 3rd Workshop on Energy Efficient Electronics and Applications in 10-12 September 2015, Helsinki, Finland.

Organizer: Lauri Koskinen (UTURKU)

Description: The objective of the workshop is to bring together experts, from both industry and academia, to discuss the challenges and the latest trends in the development of low-power and ultra-low-power embedded systems. In addition to the workshop, an optional student day will be organized in September 10th. The day includes two separate courses on high-level processor design: Designing TTA processors with TCE (tce.cs.tut.fi) and Constructing Hardware in a Scala Embedded Language (<https://chisel.eecs.berkeley.edu/>).

- 10th September (student day): Course on TTA architectures
- 11th September (Workshop day 1: 2 ALMARVI related presentation (Nokia, TUT)
- 12th September (Workshop day 2): ALMARVI related presentation (Phillips Healthcare)

- **Tutorial in ESWEEK in October, 2015 in the Netherlands** by TUE and TUDelft (and TNO). The tutorial and the presented work is supported by ARTEMIS projects **621429 EMC2** and **621439 ALMARVI**

Organizer: Dip Goswami (TUE)

Speakers: Teun Hendriks (TNO), Zaid Al-Ars (TUDelft) and Dip Goswami (TUE)

Title: “Design Challenges in Compute-intensive Mixed-criticality Systems: System, Platform and Application Perspectives”

Description: This tutorial is composed of three parts: System perspective (Part 1), Platform perspective (Part 2) and Application perspective (Part 3). At the system-level, architectural design and deployment challenges will be illustrated based on an industrial use-case stemming from the collaboration between TNO (www.TNO.nl) and NXP (www.nxp.com), and extended with results of TNO’s research in the European Artemis project EMC2 (artemis-emc2.eu, grant no. 621429). Next, at the platform-level, the tutorial will draw its

motivation from the healthcare domain, iXR in particular, and illustrate results from the ongoing European Artemis project ALMARVI (almarvi.eu, grant no. 621439). Finally, at the application-level, the tutorial will discuss various performance and trade-offs analysis methods for embedded control systems while considering shared implementation platforms. Results will be shown from the ongoing activities under both the EMC2 and ALMARVI projects.

Details: <http://www.es.ele.tue.nl/~dgoswami/ESWeek2015Tutorial.pdf>

6. Conclusions

This document has described the dissemination activities under ALMARVI project in M01-M18. All project related updates are disseminated via the website. Further, the dissemination activities were performed in two directions. First, the scientific results were published in premium journals/conferences. Over this period, more than 15 peer-reviewed articles are published and presented in high-quality international. Second, the scientific results and products were demonstrated by both participating and organizing various public events. So far, two workshops and one tutorial were organized to disseminate the results of ALMARVI. ALMARVI partners have shown their visibility in various national and international forums reaching all three categories of targets – the general public, the scientific community and the industrial community. Moreover, there are at least 5 open software/tool-chains are being used/developed/extended/shared by the ALMARVI partners.

Appendix: conferences and journals

1. DATE: Design, Automation & Test in Europe
2. DAC: Design Automation Conference
3. EMSOFT: International Conference on Embedded Software
4. RTAS: Real-Time and embedded technology and Applications Symposium
5. IEEE CCV: IEEE Conference on Computer Vision
6. CASES: International Conference on Architectures, Compilers and Synthesis of Embedded Systems
7. IEEE ICASSP: IEEE International Conference on Acoustics, Speech, and Signal Processing
8. ISSCC: International Solid-state Circuit Conference
9. ICIP: International Conference on Image Processing
10. CAIP: International Conference on Computer Analysis of Images and Patterns
11. WSCG: International Conferences in Central Europe on Conference on Computer Graphics, Visualization and Computer Vision
12. IPTA: Inverse Problem – from Theory to Application
13. HIS: Healthcare Infection Society
14. SAMOS: International Conference on Embedded Computer Systems: Architecture, Modeling and Simulations
15. ARITH: IEEE Symposium on Computer Arithmetic
16. FPGA: International Symposium on Field-Programmable Gate Arrays
17. VISAPP: The International Conference on Computer Vision Theory and Applications
18. ACIVS: Advanced Concepts for Intelligent Vision systems
19. ICPR: IEEE International Conference on Pattern Recognition
20. BMVC: British Machine Vision Conference
21. FPL: The International Conference on Field Programmable Logic and Applications
22. SCCG: Spring conference on Computer Graphics

23. IEEE TPAMI: IEEE Transactions on Pattern Analysis and Machine Intelligence
24. IEEE TC: IEEE Transactions on Computers
25. IEEEETCST: IEEE Transactions on Control Systems Technology
26. IEEE TCAS: IEEE Transactions on Circuits and Systems
27. IEEE TVLSI: IEEE Transactions on Very Large Scale Integration (VLSI) Systems
28. IEEE TIP: IEEE Transactions on Image Processing
29. ACM TODAES: Transactions on Design Automation of Embedded Systems
30. ACM TECS: ACM Transactions on Embedded Computing Systems
31. JSA: Journal of Systems Architecture
32. JRTIP: Journal of Real-Time Image Processing