



Technology Transfer in Computing Systems

D2.3: TTI Report 3

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Introduction

This deliverable describes the results of work package 2, Technology Transfer Infrastructure (TTI). This work package is coordinated by UGent, and consists of the following tasks.

- *TT workshops (Task 2.1: lead partner TUD)*
- *Feedback and connection service (Task 2.2: lead partner IMC)*
- *TETRACOM website (Task 2.3: lead partner UPISA)*
- *Newsletter and Press Releases (Task 2.4: lead partner UGENT)*
- *TETRACOM main workshop (Task 2.5: lead partner UGENT)*

In order to reach the widest possible European academia and industry community with the TTI offering, TETRACOM leverages the well-established HiPEAC Network of Excellence, in which various TETRACOM contractors play leading roles. On one hand, this concerns utilization of large-scale HiPEAC media like the newsletter or mailing lists. Moreover, several TTIs can be organized together with regular HiPEAC community events.

Task 2.1: TT workshops

Lead partner: TUD

Organization of semi-annual workshops with invited high-profile speakers from various domains relevant to TT (such as market analysts, consultants, VC representatives, company founders, industry managers with significant R&D background, experienced academic TT actors). The goal of TT workshops is to inform academic and industrial participants about TT basics such as creating opportunities, success stories, legal frameworks, market analysis, funding sources etc. The workshops will be organized as half-day events at various European locations, possibly collocated with HiPEAC events. They will be open to the Computing Systems research community at large. Based on experiences with HiPEAC meetings, typical TT workshops are expected to attract around 50 participants. Each workshop will produce informal handouts to be distributed via the TETRACOM web site.

TETRACOM presentation during the HiPEAC workshop in Budapest

Title: Technology Transfer in Computing Systems: The TETRACOM Approach
Time: Monday 22 June 2015 during the HiPEAC Workshop at Budapest University of Engineering and Economics
Organizers: Rainer Leupers and Koen De Bosschere

Motivation and objectives:

This session introduced the TETRACOM FP7 Project, which is tightly related to HiPEAC and is of interest to the entire HiPEAC community. It featured a project overview as well as examples of successful Technology Transfer.

Audience: The workshop attracted more than 40 attendants, PhD students and professors from Hungarian Universities, industrial and governmental representatives, users of HPC and administrators of existing computing resources in Hungary.



The poster features logos for HiPEAC (Compilation Architecture), the Budapest University of Technology and Economics (Műegyetem 1782), and the Faculty of Electrical Engineering and Informatics. The title is 'HiPEAC Workshop on Building Partnership'.

Faculty of Electrical Engineering and Informatics
 Budapest University of Technology and Economics
 June 22, 2015 BME Bldg. I. Room IE224

Program

Section 1: Research networks and collaboration – building long term partnership to access EU research grants		
9:00 – 9:15	Gábor Péceli (BME Rector)	Welcome message
9:15 – 9:45	Koen De Bosschere (UNI-Gent)	HiPEAC Network
9:45 – 10:00	Rainer Leupers (RWTH Aachen)	RWTH research
10:00 – 10:15	Rainer Leupers (RWTH Aachen)	TETRACOM
10:15 – 10:40	Coffee break	
Section 2: Research activities in academia and industry		
10:40 – 11:00	Tamás Dabóczy (BME MIT)	Dynamic Integration of Cyber-Physical Systems
11:00 – 11:20	Zsolt Szepessy (evopro Ltd.)	REPARA Software Development Framework for Heterogeneous Architectures
11:20 – 11:40	János Végh (UNI-Miskolc)	Enhancing Single Processor Performance using Qausi-threads on Many-core Processors
11:40 – 12:00	Ábel Vámos (ERICSSON Ltd.)	Real-Time Services in Cloud
12:00 – 13:30	Lunch	
Section 3: Research activities in academia and industry		
13:30 – 13:50	Tamás Kovácsházy (BME MIT)	Precision clock Synchronization in High Performance and Embedded Computing
13:50 – 14:10	László Bakó (UNI-Petru Maior)	On the feasibility of low resource-cost embedded optical flow extraction implementations
14:10 – 14:30	Tamás Raikovich (BME MIT)	Partial Reconfiguration in Image Processing Pipeline
14:30 – 14:50	Péter Molnár (MTA SZTAKI)	A new Merit for Measuring Effectivity of Parallelization
14:50 – 15:20	Coffee break	
Section 4: Research presentations and discussions		
15:20 – 15:40	Tamás Krébesz (BME MIT)	Application of Reconfigurable Software Defined PXI Platform for the Performance Evaluation of Wireless Communication Systems
15:40 – 16:00	Gábor Wacha (BME MIT)	Program Slicing Based on Runtime Data Flow Measurements
16:00 – 16:20	Gábor Kovács (BME IIT)	Marker Based Visual Navigation of Mobile Robots on Hybrid Embedded Platform
16:20 – 16:40	Tamás Kökényesi (BME AUT)	FPGA Based HIL Simulation in Power Electronic Applications
16:40 – 17:00	Ádám Cseh (NI Hungary)	High Performance Embedded Architecture in Practice: matching the application driven needs to the system constrains

Entrepreneurial Course taught at the ACACES2015 Summer School

Title: From Solo Performance to a Symphonic Orchestra
 Time: Sunday 12 to Saturday 18 July 2015 in Fiuggi, Italy
 Teacher: Koen Bertels, TU Delft

Koen Bertels, TETRACOM partner, is professor of Computer Engineering at Delft University of Technology. His research interests are heterogeneous multicore computing and recently he got involved in the new research center on quantum computing, QuTech. He is bootstrapping the CE-lab's research activities in that area. He is responsible for the EE bachelor graduation project where students have to write a business plan for the technology they are working on for their Bsc EE thesis.

He founded a software company and recently started a spin-off based on research results in the field of heterogeneous multicore processors. He is involved in the FP7 Tetracom project which is experimenting with new instruments to improve the transfer of technology from academia to industry. He is also teaching a course on High Tech Startups to Msc students which has already led to at least 5 companies being started by the students following it.

Content: Have you ever flirted with the idea of starting your own company and to use your expertise and knowledge for something other than a paper? Or do you think that setting up a company is only for the lucky few because they were born as entrepreneur or because it runs in the family? In this course, we explore what it takes to setup a company. When to do it and how to do it are the key questions and by making a mini business plan, we had a first attempt at setting up a company. The outline of the course is:

Lecture 1: Basics of the business plan & guidelines for the 10 slide mini-business plan

Lecture 2: Marketing essentials

Lecture 3: HBS business case: Bang Networks : the first customer

Lecture 4: Presentations & feedback

Audience: The ACACES2015 Summer School was attended by 188 people both from academia and industry. A large part of them were PhD students but a number of senior researchers both from inside and outside the EU also attended the school. A total of 25 students completed the entrepreneurial course at the ACACES2015 Summer School.

Evaluation: All participants were asked to fill in a survey after the summer school. They gave the entrepreneurial course a very good rating of 4.81 on a maximum of 5.

Fourth Workshop on Transfer to Industry and Start-Ups (TISU)

Title: Fourth Workshop on Transfer to Industry and Start-Ups

Time: Tuesday 19 January 2016 at the HiPEAC 2016 Conference in Prague

Organizers: Rainer Leupers and Koen Bertels

Motivation and objectives: The fourth TISU Transfer to Industry and Start-Ups Workshop was organized by TETRACOM in Prague on 19 January 2016 during the HiPEAC 2016 Conference, where speakers reported their experiences in technology transfer, and in particular some success stories of TETRACOM project. Moreover, the visitors enjoyed a poster session with all TTPs funded within the TETRACOM initiative.

Audience: Tentative participating groups and/or projects: All HiPEAC2016 participants from academia and industry interested in Technology Transfer. The HiPEAC2016 Conference was attended by 650 participants of whom 65 registered for the TISU workshop.

Agenda:

- Introduction (Rainer Leupers, RWTH and Koen De Bosschere, UGENT)
- Gesture Detection On-Loading for Next Generation Sensor Subsystems (Christian Haubelt, University of Rostock)
- My experience with starting a company (Martin Danek, Daiteq)
- CE certification of Wearable Multifunctional Body Sensor (Roman Trobec, Jožef Stefan Institute)
- dividiti: increasing the efficiency and reducing the cost of computing (Anton Lokhmotov, dividiti)
- The BlueBee experience (Koen Bertels, TU Delft)
- ENRICH, how to obtain good search results in web pages (Josep L. Larriba-Pey, UPC BarcelonaTech)
- Seeing the invisible (David Harvey, Liverpool John Moores University)

TTP poster session at HiPEAC2016

Title: Poster Session of the already started TETRACOM Technology Transfer Projects

Time: Tuesday 19 January 2016 at the HiPEAC 2016 Conference in Prague

Organizers: Rainer Leupers and Koen De Bosschere

Motivation and objectives:

Building dynamic economies that are based on the creative application of human knowledge is currently an aspiration all around the world. As part of this effort, Europe has been investing a lot of resources in different programs (e.g., FP7, ENIAC, ARTEMIS) to stimulate research and innovation. However, the impact of such programs on the overall European economy is still below the targets/expectations. For instance, the number of startups born from these research programs, still remains limited. By showing the results of the already successfully started TTP's, we wanted to stimulating people to transfer their knowledge in own business ideas and startups.

Audience: Tentative participating groups and/or projects: All HiPEAC2016 participants from academia and industry interested in Technology Transfer. The HiPEAC2016 Conference was attended by 650 participants.



TETRACOM Paper presented at the DATE Conference in Dresden

Title: Technology Transfer in Computing Systems: The TETRACOM Approach
Time: The DATE Conference took place from 14 to 18 March 2016 in Dresden.
Organizers: Rainer Leupers

Motivation and Objectives: This paper describes TETRACOM's experimental concept and project structure by using the novel instrument of Technology Transfer Projects (TTPs). Each TTP performs a well-defined bilateral transfer activity between one European academic partner and one industry partner. It summarizes preliminary lessons learned after more than two project years and successful management of 30+ individual TTPs.

Publication: The paper "Technology Transfer in Computing Systems: the TETRACOM approach" was published by IEEEExplore:
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Technology Transfer in Computing Systems: The TETRACOM Approach

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Abstract—TETRACOM is an ongoing EU FP7 Coordination Action with the ambition to boost small to medium scale academia-to-industry technology transfer in all domains of computing systems. The project primarily operates via competitive open calls for individual *Technology Transfer Projects* (TTPs). Each TTP performs a well-defined bilateral transfer activity between one European academic partner and one industry partner. TETRACOM coordinates all TTPs and provides technology transfer advice and co-funding. This paper describes TETRACOM's experimental concept and project structure. It summarizes preliminary lessons learned after more than two project years and successful management of 30+ individual TTPs.

Keywords—*technology transfer*

I. TETRACOM MOTIVATION AND ORIGIN

The following definition comes close to TETRACOM's notion of technology transfer:

"Technology transfer ... refers to the formal licensing of technology to third parties, under the guidance of professionals employed by universities, research foundations and businesses, in departments focused on these activities." [An Inventor's Guide to Technology Transfer, Massachusetts Institute of Technology (MIT)]

TETRACOM is partially rooted in HiPEAC, a strategic European Network of Excellence in computing systems (www.hipeac.net). In 2011, HiPEAC initiated an expert roundtable to discuss new avenues in European technology transfer from academia to industry. The European Commission has very high expectations on industrial impact of funded R&D projects, in particular within the new Horizon 2020 framework. Unfortunately, the flow of new technologies from EU R&D projects into industrial innovations and products is still far from optimal. It was concluded that *technology transfer (TT)* in computing systems could be improved in various ways:

Establish realistic TT marketplaces: Given the structure and dynamics of typical EU collaboration

projects it might be unrealistic to expect that some project delivers innovation as a whole and right at the end of the project. Naturally project proposals contain "exploitation plans" written with good intentions, but these plans are rarely in the focus during the project duration, and finally tend to be neglected when the project fades out. Obviously there are a few notable examples where an EU R&D project in its entirety "exited" into a new business. However, as a consequence of the scientific dimension of R&D and its inherent risk, it is more realistic to assume that the "average project" generates high-potential technology or even breakthroughs in some fields while it fails in others. Thus, the main TT potential is centered in some specialized, individual technologies or IPs, for which a relatively small base of worldwide potential adopters exist. Moreover, the TT market is quite ad-hoc, and the adopter of a newly developed technology might be spatially and/or temporally disconnected from the original R&D project and its consortium. This motivates the organization of *TT marketplaces* which provide a forum for balancing TT supply and demand, disseminating best practices and, most important, to provide incentives for actually making TT happen, given the associated overhead. TETRACOM can be seen as organizer, moderator, and sponsor of such a marketplace.

Select the right TT granularity and volume: Especially in academia, TT is often misconceived as necessarily generating sustainable business and continuous growth via spin-off or start-up companies. In fact, there is great wealth of start-up oriented entrepreneurial programs, workshops, trainings, awards, and the like at national and EU level. While such initiatives are definitely inspiring and useful, their success rate is limited: For instance, the underlying technology might have a too small target market, there might be no adequate founding team, or necessary venture capital investments cannot be acquired. In such a situation, a more promising approach is enabled via customized bilateral TT: An academic provider transfers a specific IP or technology (e.g. a software tool or a hardware IP block) to an industrial receiver, who intends to utilize this technology within new or improved products or processes. The two partners enter into an agreement that precisely defines the TT contents, duration, and

how to bridge the TRL gap, while also covering IPR and legal issues and a fair compensation to the technology provider. In fact, TETRACOM's major instrument, the *Technology Transfer Projects* (TTPs, as described in section III), is designed to precisely serve such a scenario.

In 2013, after several refinement rounds and further expert consultations, TETRACOM was launched as an official EU FP7 project with the mission to implement the above ideas for improved and more effective TT. The purpose of this paper is to outline how such an experimental TT-oriented "pilot project" can be conceived and to provide an intermediate status report with preliminary dos and don'ts.

II. PROJECT STRUCTURE

Formally, TETRACOM is an EU FP7 Coordination Action with duration of three years (Sep 2013- Aug 2016) and a budget of approx. 2 Mio. Euros. The project consortium consists of eight "founding partners", which also form the Steering Committee, as well as a number of more loosely connected "TTP partners", which accumulate over the different rounds of open TTP calls. The project is structured into four work packages (WPs):

1) Competitive open calls for TTP proposals: TETRACOM targets the entire European computing systems community. The project issued three open calls for TTP proposals and distributed them via different channels, e.g. the HiPEAC mailing list, as well as via numerous public events. Since the co-funding level for individual TTPs is relatively low (typically 10-50k Euros), *the submission and evaluation scheme is kept very efficient and lightweight*. Each call is open for 6 weeks, proposals are limited to 3 pages, and evaluation takes 6 weeks maximum, too. In total, TETRACOM spends approx. 1.3 Mio. Euros on TTPs.

2) Infrastructures for stimulating new TT: Next to usual infrastructure facilities (e.g. project web site, social media, and regular newsletters), this WP comprises a *Central Help Desk* for "TT newcomers" and generally all proposers seeking advice on maximizing their TTP proposal quality. Moreover, TETRACOM runs a series of successful *TT workshops*, often co-located with major European computing events like DATE or the HiPEAC conference.

3) Individual TTPs: This WP is merely a "container" for hosting all individual TTPs. It has been conceived to match the relatively static FP7 project rules with the high dynamics implied by the TETRACOM concept.

4) Project management: This WP comprises the usual strategic and day-to-day management facilities.

Moreover, TETRACOM relies on the feedback of a high-profile *Industrial Advisory Board*, which partially compensates for the fact, that by construction the TETRACOM consortium deliberately does not include any non-academic partners.

III. THE TTP CONCEPT

Individual *Technology Transfer Projects* (TTPs, Fig. 1) constitute the core instrument of TETRACOM. The TTP concept originates from typical bilateral academia-industry collaboration scenarios in the domain of computing systems: A research entity R has developed a certain technology or IP for solving a technical problem, often within a publicly funded project. Some company C has a similar problem in their current R&D activities and gets interested in R's general solution approach. The requirements are analyzed in detail, and as a result R and C may sign a bilateral R&D or license agreement to make the technology available to C under certain conditions and for an appropriate compensation. In most cases this requires R to perform additional services, usually under tight timing constraints, around the licensed technology to actually bridge the TRL gap between the original prototype and a working solution for C, and in order to provide the required technology support and training.



Figure 1: Bilateral technology transfer via TTPs

In order to make this concept sufficiently concrete within a formal EU project context, the following *rules for TTPs* were defined:

There are two partners involved: One partner has to be from a publicly funded research entity (typically a university or polytechnic), the other one has to be privately funded (i.e. typically a company). This reflects the most frequent TT scenario, where the two-partner scheme guarantees focus, confidentiality, and exclusivity.

The two partners have signed a bilateral legal agreement to perform a certain TT activity: TETRACOM does not get involved (and even cannot be normally due to confidentiality reasons) in negotiations of these individual agreements. The agreement merely serves as a proof that the TT is actually intended or taking place, since the agreement has passed all internal legal hurdles of the TTP partners.

The total project duration is between 3-12 months: Due to the tight industrial schedules, academia-industry collaboration on a concrete TTP rarely takes more than a year. If a TTP only focuses on licensing

of a specific existing technology, its duration can also be very short. However, TETRACOM assumes that a basic level of service and training is always involved, which leads to the minimum duration of 3 months.

The total project budget is between 20k-200k Euros: The lower bound is intended to neglect low-volume "mini TTPs" and to focus on projects with some critical mass. The upper bound is motivated by the fact that partial TTP funding (up to a certain percentage) via TETRACOM is naturally limited by its total budget. TETRACOM sponsors granted TTPs with up to 50%, i.e. 10k-100k Euros. *This contribution is paid only to the (academic) research partner of a TTP, since the industry partner will indirectly benefit from the TTP by construction.*

Many sample TTPs are described on the project home page www.tetracom.eu. Following TTP proposal submission within the regular open calls, all proposals are externally evaluated by at least one academic and one industrial reviewer. The *evaluation criteria* are as follows:

TTP impact: To what extent will the proposed TTP lead to added value according to the following?

- Probability of scientific publications
- Probability of a resulting start-up foundation (if applicable)
- Number of users inside the company
- Quality improvement of products and processes (e.g. efficiency, performance, power consumption)
- Potential for subsequent sustainable partnership
- Potential for enabling new products

Soundness of TTP concept: Are the proposed TTP concept and its associated work plan realistic within the given budget and time frame?

Quality of the research/industry partner combination: Is it likely that the proposed combination will succeed in its TT goals, given the academic and business profiles of the two partners?

Resources: Are the proposed resources sufficient and well justified altogether? Is the industry partner's contribution sufficiently significant to substantiate his interest in the proposed TTP? TETRACOM requires that the *industry partner contributes at least 50% of the total project budget.*

The evaluation leads to a ranking of submitted TTP proposals, where the score on impact has highest weight. In case of ties, some secondary criteria apply, e.g. a The Steering Committee fine-tunes the ranking list according to necessities and grants TTPs until the respective call budget is exhausted. Afterwards, all TTPs of a given call are synchronously kicked off, are performed locally by the partners with minor

TETRACOM interaction, and finally deliver an abstract and an impact report after project conclusion.

IV. PRELIMINARY RESULTS AND OBSERVATIONS

While TETRACOM has also organized numerous well-attended infrastructure events (e.g. TT workshops), *we focus on the results of the TTPs here*, which form the most novel and experimental part of the project. TETRACOM currently runs, or has completed, 33 individual TTPs. Out of these, 11 are performed by the founding partners, while 22 were granted to third parties after the first two open TTP calls. Another 12-14 TTPs are expected to be granted around Nov/Dec 2015 after the third and final open call. Thus, altogether, TETRACOM will meet its initial goal of coordinating up to 50 TTPs in total.

The first two open calls received 74 TTP proposals, resulting in a total acceptance rate of 30%. The average co-funding of TTPs by TETRACOM is around 25k Euros, but there is considerable variance. Some further key statistics are summarized in the table below. More information is available via the project web site or the public TETRACOM deliverables.

	Call 1	Call 2
Submissions	31	43
Countries involved	13	12
SME involvement	45%	74%
Proposals from new EU member states	3	9
Average requested funding (EUR)	30,000	28,000
Average matching industry funding (EUR)	27,000	32,000
Average TTP duration (months)	9	9

In May 2015, a first systematic impact analysis has been conducted on the basis of 8 TTPs already concluded at that time. The analysis showed already quite considerable and tangible project outcomes. All finished TTPs delivered a comprehensive impact questionnaire for this purpose. The most concrete findings were as follows:

- The TTPs contributed to 6 *publications* in international journals and conferences.
- 14 TTP-specific *presentations* at workshops or trade shows took place.
- 1 TTP result will be donated as an *open source* tool.
- 2 TTP-related *patent applications* have been filed.
- Most TTPs delivered new professional or educational *training activities and materials*.
- There were already 2 very concrete cases of TTP-related technology adoption by the company

partner in the form of *new products*. 4 company partners reported internal *process improvements*.

- 2 TTPs reported an immediate impact on *sales projections* and *VC investment acquisition*.
- 4 *additional jobs* have been created with the TTPs' industry partners.
- All TTPs reported improved opportunities for *sustainable academia-industry partnerships*, e.g. in the form of follow-up TTP proposals or other grant applications.
- 4 TTPs traced back their project to a previous or ongoing *publicly funded research grant*.
- All TTPs reported a *TRL elevation* by 2 levels.

Further impact evaluations will be performed towards the project end, based on a much larger set of completed TTPs by then. For now, the following *intermediate conclusions* can be drawn:

What works well:

TT marketplace concept: The great community response to the open TTP calls indicates that there is indeed a significant market for computing systems TT in Europe. TETRACOM provides a platform for boosting and structuring it. Via its infrastructures, like TT workshops, presentations, and individual consulting, TETRACOM stimulates very concrete TT activities and helps to actually implement them by providing a monetary incentive.

TTP concept: TETRACOM deliberately does not support long-term R&D activities with uncertain outcomes. These are left to the "traditional" R&D project instruments. Instead, all TTPs must have a precise focus in order to maximize the industrial impact. The TTP concept enforces this by the strict two-partner scheme, relatively short project durations, and the fact that all TTPs must revolve around the transfer of some pre-existing IP.

Proposal handling: Given the limited average TTP funding of 25-30k Euros at a 30% acceptance rate, proposers obviously cannot be asked to submit complex, lengthy proposals with all the usual bells and whistles. Likewise, the "time-to-transfer" has to be very short in order to meet the TT market dynamism and ad-hoc opportunities. TETRACOM TTP calls are open for 6 weeks, proposals are limited to 3 pages, and successful proposers can begin with their TTP after another 6 weeks of review and granting procedures. The formal accession to the consortium is largely handled "offline".

What could be improved:

TTP profile definition: Due to the novelty of the concept, some setup time was required to clearly communicate the structure and constraints of "desired" TTP proposals. For instance, this concerns the precise

definition of "academic" and "industry" partners (there are entities in between) as well as the fact that a TTP needs to be more than just yet another "mini R&D project". The optimal "embedding" of a TTP into an ongoing longer-term academia-industry collaboration contract has also been an issue on various occasions. Another observation is that the project could benefit from a clearer thematic focus. Since TETRACOM currently addresses TT in virtually all domains of computing, the individual TTP topics are quite scattered. More impact might be achieved via TETRACOM-like projects that only focus on e.g. low power, HPC, embedded SW design, chip design etc.

Inter-TTP synergies: Once granted, TTPs run more or less freely to their conclusion at the two partners' sites. TETRACOM mostly plays an administrative and observer role in this phase. Currently, there is no instrument yet for systematically monitoring possible synergies and suggesting corrective actions to the TTP partners. Therefore, some impact opportunities might be missed. Moreover, a sharper thematic profile, as mentioned above, would also help to implement synergetic TTP structures.

Formal TTP administration: Under FP7 rules, TTP partners have to join the project consortium, which implies considerable administrative effort. TETRACOM aims at hiding this as much as possible from the TTP partners, but simplification is certainly desirable. The new H2020 concept of "third party funding" will probably help in this respect. Moreover, the EU funding rules usually imply that at most 50% of the total project budget can be spent by any form of "unknown" partners. This unnecessarily limits the flexibility in the highly dynamic domain of individual TT, and a larger maximum percentage should be permitted for sake of higher efficacy.

Impact measurement: "Impact" is a key concern today in all EU projects, so TETRACOM spent considerable effort on the definition of its optimal impact criteria. Some of them are quite precise and numerical (e.g. publications, revenue increase, or new jobs created), while other ones are "softer", such as TRL or sustainability. More effort is needed (actually for all EU R&D activities) to further optimize the preciseness of the impact metrics. Another concern is that much impact is only manifested after longer time periods, e.g. when TT results are turned into a new industrial product, which often requires passing many time-consuming hurdles. The impact measured for TETRACOM TTPs should partially be attributed to their foregoing R&D projects. Likewise, TETRACOM cannot measure TTP impact beyond its project duration. Thus, fairer and more long-term impact measurement techniques should be conceived.

TETRACOM Booth at the DATE Conference in Dresden

Title: TETRACOM booth
Time: The DATE Conference took place from 14 to 18 March 2016 in Dresden.
Organizers: Rainer Leupers

Motivation and Objectives: In addition, TETRACOM had a booth at the exhibition (EP2): In the exhibition area dedicated to European projects, interested experts were welcome to learn more about the project and its Technology Transfer Projects (TTPs) at the booth. TETRACOM experts showed their TTP posters and informed interested visitors on their funded work during the entire conference days

Audience: The DATE 2016 Conference and Exhibition received 1400 registrations from 50 countries.



Exhibition floor talk at the “EU Projects Special Session: Towards Better EU-projects – Success Stories” at DATE 2016 (Anton Lokhmotov)

Title: Collective Knowledge: Towards R&D Sustainability
Time: Wednesday 16 March during the DATE Conference in Dresden
Organizers: Rainer Leupers, Grigori Fursin, Anton Lokhmotov, Ed Plowman

Motivation and Objectives : Research funding bodies strongly encourage research projects to disseminate discovered knowledge and transfer developed technology to industry.

Unfortunately, capturing, sharing, reproducing and building upon experimental results has become close to impossible in computer systems' R&D. The main challenges include the ever changing hardware and software technologies, lack of standard experimental methodology and lack of robust knowledge exchange mechanisms apart from publications where reproducibility is still rarely considered.

Supported by the EU FP7 TETRACOM Coordination Action, we have developed Collective Knowledge (CK), an open-source framework and methodology that involves the R&D community to solve the above problems collaboratively. CK helps researchers gradually convert their code and data into reusable components and share them via repositories such as GitHub, design and evolve over time experimental scenarios, replay experiments under the same or similar conditions, apply state-of-the-art statistical techniques, crowdsource experiments across different platforms, and enable interactive publications. Importantly, CK encourages the continuity and sustainability of R&D efforts: researchers and engineers can build upon the work of others and make their own work available for others to build upon. We believe that R&D sustainability will lead to better research and faster commercialization, thus increasing return-on-investment.

TETRACOM presentation during the SAE Workshop in Brussels

Title: The TETRACOM Project
Time: Monday 13 June during the Smart Anything Everywhere Workshop 2016:
Enhancing digital transformation in European SMEs'
Organizers: Rainer Leupers and Koen De Bosschere

Motivation and Objectives: The workshop brought together the ongoing innovation projects on "Advanced Computing", "CPS", "SSI" and "TOLAE" together with the actors in Europe such as SMEs, RTOs or industries interested in future collaboration to further develop the SAE ecosystem. The projects financed by the European Commission under FP7 ICT 2011 Call 7 (COLAE), ICT 2013 Call 10 (TETRACOM) and H2020 ICT Call 1 2014 (SMARTER-SI, GATEONE, CPSELABS, EUROCCPS) presented their first results, discussed lessons learnt and best practices.

Audience: This public workshop brought together high-level speakers from the European Commission and relevant industries, competence centers, and key players in European digital technologies to share ideas on topics related to the reindustrialization of Europe and the key role played by SMEs. In total, 92 people participated in this workshop.



TETRACOM presentation during the HiPEAC workshop in Krakow

Title: Technology Transfer in Computing Systems: The TETRACOM Approach
Time: Friday 17 June 2016 during the HiPEAC Workshop at AGH University of Science and Technology
Organizers: Rainer Leupers and Koen De Bosschere

Motivation and objectives: This presentation introduced the TETRACOM project and promoted its new model of technology transfer in the domain of computing systems in Europe.

Audience: The workshop attracted more than 35 attendants, PhD students and professors from Polish Universities, industrial and governmental representatives, users of HPC and administrators of existing computing resources in Poland.





Entrepreneurial Course taught at the ACACES2016 Summer School

Title: Technology-based Entrepreneurship
Time: Sunday 10 to Saturday 16 July 2016 in Fiuggi, Italy
Teacher: Geoff Gregson, Northern Alberta Institute of Technology

Geoff Gregson is an academic entrepreneur with extensive international experience in teaching and practicing entrepreneurship. He has started up and managed businesses in a diverse range of sectors, including ICT, digital media, tourism and sport science. He is currently Chairman of Axienta Ltd., an enterprise mobility company based in Malaysia and Sri Lanka and is a Board member of JB Equity, a Hong Kong-based private equity firm.

Geoff was a Director of the Centre for Entrepreneurship Research at the University of Edinburgh between 2005 and 2014, where he managed a portfolio of UK-based and international research projects. Geoff also taught and developed new programs on entrepreneurship, technology management, innovation leadership and new venturing, while working with enterprises across a number of technology sectors. He co-founded the Edinburgh Entrepreneurship Club, which has become Scotland's largest e-club.

Geoff currently holds the JR Shaw Chair in New Venture and Entrepreneurship at the Northern Alberta Institute of Technology in Edmonton, Canada. He is a Visiting Researcher at the Institute for the Study of Science, Technology & Innovation at the University of Edinburgh and was previously a Visiting Professor at EADA Business School in Barcelona, Spain. Geoff holds degrees from the University of Edinburgh (PhD, LL.M, MSc), University of Calgary (MBA) and the University of Alberta (BPE).

Content: The objective of this course was to engage participants in a lively and informative discussion on creating value through innovative ideas, technologies, entrepreneurial initiative and enterprise. The course covered lean-start-up lessons that include how to integrate powerful customer insights with actionable data, rapid experimentation, minimum viable product development and business model optimization. We also explored how to develop and sell new kinds of product to a market that does not yet exist. Participants had the chance to reflect upon their own entrepreneurial motivations and aspirations as we discuss market opportunities arising from new technologies, digital media and evolving business and consumer trends.

Session 1: Introduction to Tech-based Entrepreneurship

Session 2: Validating Ideas & Transforming Technologies for Market Application

Session 3: Business Models

Session 4: Entrepreneurial Marketing and Enterprise Development

Audience: The ACACES2016 Summer School was attended by 187 people both from academia and industry. A large part of them were PhD students but a number of senior researchers both from inside and outside the EU also attended the school. Of these participants, 57 completed the entrepreneurial course.

Evaluation: The students gave the entrepreneurial course at the ACACES2016 summer school a score of 3.73 out of 5.

Task 2.2: Central Help Desk

Lead partner: IMC

Organization and provision of a Central Help Desk service, offering support to ongoing TTPs and feedback to unsuccessful TTP applicants to improve their revised proposal. This process will be managed by IMC. The other contractors will assist by, for example, providing information that can assist ongoing TTPs as well as passing on comments of the reviewers to unsuccessful TTP applicants.

This service offers a one-stop help facility to support ongoing TTPs and to provide feedback to TTP applicants who are unsuccessful. It collects requests for help from ongoing TTPs, and organizes appropriate resources within TETRACOM or external to TETRACOM to address such requests. The service also coordinates with the evaluation process of TTP proposals, and arranges sending constructive comments from TTP reviewers anonymously to TTP applicants who choose to receive such comments. The service will include analysis and clarification of reviewer comments where appropriate. It will mention plans of future TTP calls to those who have expressed interest, and will provide suggestions about draft TTP proposals, especially the revised versions from unsuccessful TTP applicants. Help TTP proposers to maximize the quality of their future proposals, in particular clarify the profile of TTPs expected in TETRACOM.

The major activities and results were as follows.

The Central Help Desk came into operation after the evaluation of TTP call 2 was completed. We contacted 19 authors of proposals who were unsuccessful. Six of them accepted our assistance, and we supplied them with details about why their proposal was rejected, and suggested improvements based on the weaknesses that the reviewers highlighted. Two authors replied stating that they were now revising their proposal based on our feedback, and would be happy to use our services again when their proposal was ready; two other authors expressed interest in submitting new proposals, and would also seek our advice.

Subsequently two applicants contacted us with an updated version of their proposals, on which we provided detailed feedback to address possible reviewer concerns, as well as general advice based on successful applications in the TTP call 2. One of these proposals was successful in the TTP call 3; the authors acknowledged the benefits of the Central Help Desk in the message below.

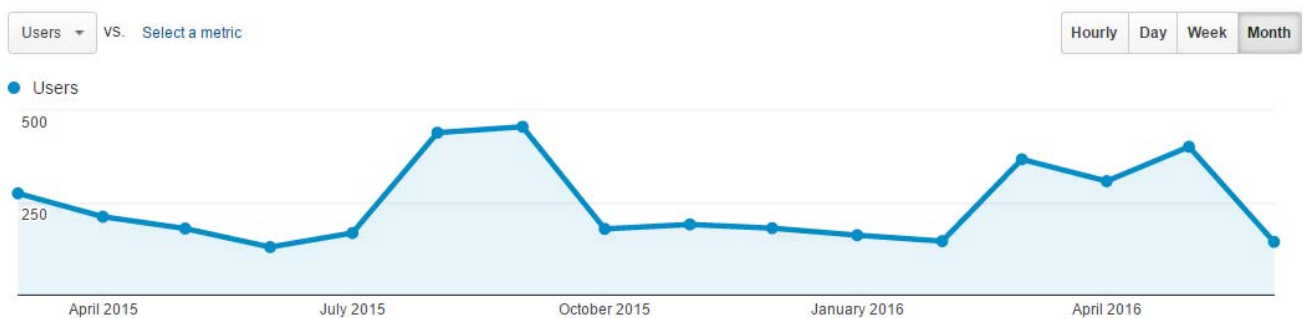
Task 2.3: TETRACOM WWW

Lead partner: UPISA

A lean, focused web portal is maintained, serving two major purposes: First, to provide information about TETRACOM itself, and to manage its TTP Eol's, current TTI events, and internal documents. Second, to act as a TT broker that allows for posting concrete academic offerings and industrial requests within a centralized place, and matching supply and demand in a partially automated way. For this purpose, the web site will feature an online exchange forum.

The TETRACOM website www.tetacom.eu was set up at the start of the TETRACOM project. The website is frequently updated with news, downloadable material and general information in order to spread the awareness about the TETRACOM project. It was also used to manage the calls for proposals (i.e. proposer registration, proposal submission, reviewer selection and review submission) and for sharing private documents and deliverables among project partners.

As example of the traffic generated by the TETRACOM website, Figure 1 shows the number of users that visited the website in the period 1 March 2016 – 15 June 2016. In that period, more than 3.500 different users established about 5.600 sessions. Among these users, the 62 % were new users that browsed the www.tetacom.eu website for the first time. The following figure shows the number of users per month in the period 1 March 2015 to 15 June 2016:



In mid-June, a major release of the TETRACOM website took place in collaboration with a professional web design company. The contents and the structure of the TETRACOM website were updated in this period. In particular, news about the project and the related events were added, as well as public downloadable material and private documents in the consortium restricted area (i.e. meeting minutes, deliverables, etc.). Moreover, the structure of the submission form was updated to reflect the new version of the proposal template established for the third and final TTP call and the funded project main page was completed with the list of

all projects and the downloadable poster and abstract document for each of them. Finally, a new main page called impact was added to report testimonials from TETRACOM beneficiaries and the first results of the impact analysis.

In mid-June 2016, just before the SAE EC workshop in Brussels, a major relaunch of the TETRACOM website (<http://www.tetracom.eu>) took place in collaboration with a professional web design company (Spectrum, <http://spectrum.io/en>). The focus was to provide up-to-date information on TETRACOM and its results to a wide audience at a glance, along with a modern website layout and content management system. Furthermore, the website was also conceived to preserve all important project information also beyond the duration of TETRACOM.

Task 2.4: Newsletter and press releases

Lead partner: UGENT

This task has been implemented in a more dynamic way than described in the description of work. We want to promote the results of the project, and technology transfer in general, as widely as possible, and through multiple channels.

1. *Publishing articles in the HiPEAC newsletter and HiPEAC Newsmail*
2. *The TETRACOM newsletter*
3. *TETRACOM on Twitter*
4. *TETRACOM Press release*
5. *TETRACOM covered in the press*

Publishing articles in the HiPEAC newsletter and HiPEAC Newsmail

Article in the HiPEAC Newsletter July 2015: "Collective Knowledge: A Framework for Systematic Performance Analysis and Optimization"

This article presented the outcome of a TTP. The newsletter was sent out to more than 900 subscribers by surface mail and was handed out to the 188 participants of the ACACES Summer School.

IN THE SPOTLIGHT

COLLECTIVE KNOWLEDGE: A FRAMEWORK FOR SYSTEMATIC PERFORMANCE ANALYSIS AND OPTIMIZATION

We present the outcome of a technology transfer project between the non-profit cTuning Foundation, France (Grigori Fursin) and ARM, UK (Anton Lokhmotov, Ed Plowman). The six-month project supported by the TETRACOM Coordination Action has resulted in developing from scratch the Collective Knowledge framework and validating it on realistic use cases, as well as forming a startup called *dividiti*.



Designing, modeling and benchmarking of computer systems in terms of performance, power consumption, size, reliability and other characteristics is becoming extraordinarily complex and costly. This is due to a large and continuously growing number of available design and optimization choices, a lack of common performance analysis and optimization methodologies, and a lack of common ways to create, preserve and reuse vast design and optimization knowledge. As a result, optimal characteristics are achieved only for a few ad-hoc benchmarks, while often leaving real-world applications underperforming. Eventually, these problems lead to a dramatic increase in the development, optimization and maintenance costs, increasing time to market for new products, eroding return on investment (ROI), and slowing down innovation in computer engineering.

Since 2012 the non-profit cTuning Foundation and ARM have been engaging in discussions on systematic performance analysis and optimization using statistical analysis, machine learning and crowd-tuning techniques. In November 2014, we started a six-month technology transfer project supported by the FP7 TETRACOM Coordination Action. The cTuning technology comprises a framework and repositories for collaborative and reproducible experimentation combined with predictive

analytics. This technology has been successfully used in several EU projects including the FP6 MILEPOST project.

The TETRACOM grant has allowed us to completely design and develop from scratch the fourth version of cTuning technology which we called Collective Knowledge (or CK for short). CK is a Python-based framework, repository and web service, supporting JSON interfaces and standard Git services such as GitHub and Bitbucket. CK allows engineers and researchers to organize, describe, cross-reference and share their code, data, experimental setups and meta information as unified and reusable components. CK users can assemble from components various experimental workflows, quickly prototype ideas, crowdsource experiments using spare computer resources such as mobile phones, and more. Importantly, CK allows experimental results to be exposed to powerful predictive analytics packages such as scikit-learn and R in order to speed up decision making via statistical analysis, data mining and machine learning.

During the project, we have successfully applied the Collective Knowledge framework to perform systematic analysis, data mining and online/offline learning on vast amounts of benchmarking data available at ARM. Our technology showed good potential to automatically find various important correlations between numerous in-house benchmarks, data sets, hardware, performance, energy and run-time state. Such correlations can, in turn, help derive

representative benchmarks and data sets, quickly detect unexpected behavior, suggest how to improve architectures and compilers, and speed up machine-learning based multi-objective autotuning.

Furthermore, our technology has also showed potential to enable collaborative research and development within and across groups. Therefore, we have released the Collective Knowledge framework under a permissive BSD license, and expect to grow the user community.

Finally, our positive results have motivated us to establish a UK-based startup called *dividiti* to accelerate computer engineering and research by further developing our technology and applying it to real-world problems.

Acknowledgments: We would like to thank the TETRACOM Steering Committee for accepting the project proposal and the TETRACOM manager Eva Haas for simplifying the paperwork. We also would like to thank our ARM colleagues Marco Cornero, Alexis Mather and Jem Davies for encouraging and supporting the project.

Further resources:

- <http://tetra.com.eu>
- <http://ctuning.org>
- <http://github.com/ctuning/ck>
- <http://hal.inria.fr/hal-01054763>
- <http://www.dividiti.com>

Grigori Fursin, cTuning Foundation

Article in the HiPEAC Newsmail October 2015: "Call for Tech Transfer Awards 2015"

The HiPEAC newsmail October 2015 was sent out to the more than 1700 subscribers of the HiPEAC mailing list.

HiPEAC News October 2015

Dear HiPEAC member,

After the successful Computing Systems Week in Milano in September, we are now focusing on the HiPEAC conference in Prague in January 2016. This will be the last event of HiPEAC3 and at the same time it will also be the kick-off activity of HiPEAC4.

Koen De Bosschere

Call for Tech Transfer Awards 2015

HiPEAC not only wants to encourage scientific excellence through publications in the HiPEAC award conferences, but also wants to stimulate the uptake of research results by industry. To reward and celebrate the transfer of research results into industry (be it through technology licensing or providing dedicated services to an existing company or through the creation of a new company), HiPEAC annually selects a number of members for a HiPEAC technology transfer award (1000 Euro cash for a first-time award). For more information and applications, visit <https://www.hipeac.net/research/technology-transfer-awards/>.

Submissions are welcomed until **24 November 2015**.



Article in the HiPEAC Newsmail June/July 2016: "TETRACOM: a key part of the EU's Digitising European Industry initiative"

The HiPEAC newsmail June/July 2016 was sent out to the more than 1700 subscribers of the HiPEAC mailing list.

HiPEAC News June/July 2016

Dear HiPEAC member,

After six months of HiPEAC4, I am glad to see that all new instruments that we have created kicked off, and are producing their first results. I am particularly happy with the success stories that reach us almost monthly now, and prove that our community is having real impact in the economy. My hope is that these stories will inspire the whole HiPEAC community to keep innovating relentlessly.

Take care,
Koen De Bosschere



TETRACOM: a key part of the EU's Digitising European Industry initiative

With 50 projects transforming cutting-edge research into market-ready innovations across 15 countries, [TETRACOM](#) has demonstrated its effectiveness of as key enabler of the European Commission's [Digitising European Industry initiative](#). Matchmaking research centres with industry representatives, stand-out results so far from the project, now in its third and final year, include 11 new products, five patent applications, seven open-source tools and the creation of 17 new jobs.

Read more on the [HiPEAC website](#).



Article in the HiPEAC Newsletter July 2016: "Leapfrogging the valley of death with TETRACOM"

The HiPEAC newsletter was sent out to 490 subscribers by post and was handed out to the 188 participants of the HiPEAC Summer School.

Leapfrogging the wall

You're a research institute with a great idea but no means of making sure it reaches the market, or you're a small enterprise with plenty of business expertise but no budget for research and development. Where do you turn? European Union-funded programmes such as TETRACOM are here to help, as these inspirational examples show.

TETRACOM: A SPRINGBOARD FOR START-UPS

Rainer Leupers, RWTH Aachen University,
TETRACOM Project Coordinator



The TETRACOM coordination action (www.tetracom.eu) provides new incentives for academia-industry technology transfer via focused, bilateral technology transfer projects (TTPs) across the whole of Europe. A total of 50 TTPs are being supported and co-funded, covering a multitude of ICT areas, such as the automotive sector, communications and multimedia, data analytics, health, industry 4.0, as well as safety and security. Each TTP brings together one academic partner and one industry partner and implements the transfer of a particular hardware or software technology or intellectual property (IP). The vast majority of TTPs involve industry partners from small/medium enterprises (SMEs), which have reported major benefits from TETRACOM through new products, significant cost savings, or improved processes.

Being a co-founder of several companies myself, I'm particularly glad that many TTPs have also helped European start-ups get off the ground by transferring key technologies that contribute to the core of their product offer. This article provides highlights of three such start-up companies, all of which have been supported by TETRACOM: Bluebee, a provider of highly efficient genomics analysis cloud services; Creonic, which offers advanced hardware IP blocks for 4.5G communications; and Xsensio, which is developing a groundbreaking 'lab-on-skin' device for next-generation healthcare. I'm excited to see this level of industrial impact from a European project and I cordially wish them long-term market success.

"SMEs report benefits from TETRACOM through new products, cost savings, or improved processes"

Key of death in Europe

ACCELERATING GENOME-BASED DIAGNOSTICS FOR CLINICAL USE

Zaid Al-Ars and Koen Bertels, Delft University of Technology (TUDelft)



Delft-based Bluebee was founded by (left to right) Vlad-Mihail Sma, Koen Bertels and Zaid Al-Ars



The rapid increase in throughput of DNA sequencing technology, coupled with the exponentially decreasing prices of DNA data acquisition, have resulted in a computational bottleneck in the analysis phase of genomics analysis pipelines. This bottleneck is hindering the deployment of these analysis techniques for clinical use to diagnose genetic diseases and propose personalized therapies based on the DNA profile of an individual.

To overcome this, we implemented a scalable, high-performance computational infrastructure specifically targeted towards the field of genome analysis, which enables hospitals, clinics and research institutes to manage their computational challenges. We augmented this high-performance infrastructure with field-programmable gate array (FPGA) and graphics processing unit (GPU)-accelerated pipeline components to improve the cost efficiency of the process and increase the throughput of the analysis.

These hardware-accelerated implementations of computationally intensive kernels run up to an order of magnitude faster than regular processors. TETRACOM funds were used to transfer some of the intellectual property developed at TUDelft for these kernels to our spin-off, Bluebee, where the kernels were integrated into the total application pipeline.

Commercial potential

The field of genomics is extremely promising, with huge potential to influence our society and revolutionize the medical domain. However, until recently it has been mostly restricted to the scientific community, addressing biological research questions. Over the last couple of years, a number of scientists have started using their research in clinical applications to diagnose and treat genetic diseases such as cancer. Deploying such computationally intensive techniques in a production environment sets stringent performance and cost requirements and opens up major potential for commercialization.

Certainly, the scalable, accelerated solutions which we've developed show the viability of these computational approaches to high-performance genomics. This is thanks to the abundance of potential parallelism that genomics applications contain, and the high computational intensity of the algorithms. Various genomics-related applications would benefit from the potential performance improvement achieved by applying scalable and accelerated computational techniques.

“Our scalable, accelerated solutions show the viability of computationally intensive approaches to high-performance genetics”

In our case, we found that the results of the integrated EU-funded project hArtes (Holistic Approach to Reconfigurable Real Time Embedded Systems), of which TUDelft was the scientific coordinator, were too good to remain unused. Hence we established a spin-off, Bluebee, which offers services based on technology directly related to the project. In the first phase, the emphasis of Bluebee was on trying to sell the core technology. However, as that turned out to be very difficult, we then made the switch to developing an end product. Although we initially undertook a very successful pilot in the financial industry, we

Technology transfer: TETRACOM

decided that computational genomics had more potential and was starting to take off.

The genomics analysis platform being developed by Bluebee provides a scalable, accelerated and secure private-cloud solution targeted at clinical application of genomics analysis techniques. The platform's scalability allows seamless increase of the throughput (i.e., allows more patients per hour to be analysed) when required by the clinic. Acceleration, on the other hand, allows for the latency of the analysis to be reduced (i.e., allows faster sample-to-diagnosis for a specific patient). Meanwhile, the platform's security features make it suitable for clinical use where privacy needs to be assured by law.



Bluebee private cloud

Launching a successful start-up

While relatively young, the market for clinical genomics has immense growth potential and is expected to have a significant impact on various aspects of daily life. Early players in the field have a strong influence on market development and are well positioned to capture a sizeable share of this growing market. In addition, the field of genomics focuses on creating value for society, specifically in the medical domain, an effort that is appreciated by all. 'Good science', as the slogan of Bluebee indicates, represents the ethos as well as the activities of the company.

Important factors when convincing investors to back Bluebee were the successful proof of concept and the fact that we managed to attract a highly experienced management team who were enthusiastic about the concept from the outset. It is no exaggeration to say that those were the game changers for Bluebee.

"A successful proof of concept and highly experienced, enthusiastic management team were game changers for Bluebee"

Some of the most important advice we could give to young entrepreneurs would be to follow your passion, to focus your efforts, and to keep an eye out for commercial opportunity. Fortunately, there is an increasing number of European funding programmes, such as TETRACOM, that can help ambitious scientists capitalize on their intellectual worth. Hopefully, we will have more programmes in this area to encourage more entrepreneurial activity in Europe and enhance Europe's global competitiveness.

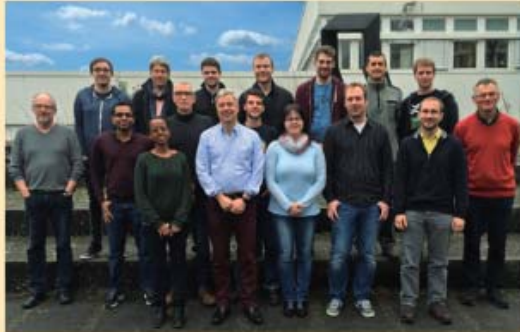
A TURBO CODE DECODER FOR NEXT-GENERATION MOBILE DEVICES

Christian Weis, University of Kaiserslautern

In addition to other research activities, the Microelectronic Systems Research Group at the University of Kaiserslautern has a great deal of experience (totalling more than 250 'person years') in designing and verifying high throughput channel decoders. This work centres especially on two high-performance, forward-error correction codes for efficient information transfer over communication channels: turbo codes and low-density parity-check (LDPC) codes. Essentially, these two types of code allow a high proportion of data to be transmitted reliably in the presence of data-corrupting noise.

Founded in 2010, Creonic is a spinoff of the Microelectronics System Research Group which designs and delivers intellectual property (IP) cores for integration in application-specific integrated circuits (ASICs) and field-programmable gate arrays (FPGAs). The focus is on complex signal processing functions for communication systems ranging from digital video broadcasting to LTE-A, the 'advanced' enhancement in the Long-Term Evolution (LTE) wireless communication standard.

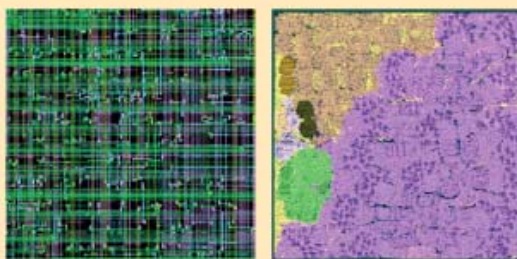
Technology transfer: TETRACOM



The Microelectronic Systems Research Group at the University of Kaiserslautern (left) worked with the Creonic team (right) to deliver new LTE turbo IP

In order to be competitive, Creonic needs to be able to provide the best LTE turbo IP core in the area of very largescale integration (VLSI) and communications performance. Through a technology transfer project supported by TETRACOM, the University of Kaiserslautern worked with Creonic to adapt the LTE turbo code decoder IP to the needs of Creonic's customers. The target markets centre on mobile chipsets and base stations – the transceivers which connect devices to one another – for 4.5G, the latest operational generation of mobile communications.

The main improvements with regard to the state of the art are smaller chips, which result in lower energy consumption and longer battery life. The first integrations for early customers have now been implemented, and further developments based on the current design will be made this year. The design will provide the basis for further developments in the context of the European Union's Horizon 2020 research and innovation programme and 5G mobile telecommunications.



Layout plot details (left) and hierarchy (right)

Conditions within the European Union are not currently favourable for technology transfer, as many small and medium enterprises (SMEs) simply cannot afford to incorporate additional research and development activities to foster innovation. Providing additional support is therefore essential to increase the

momentum of technology transfer. By allowing cost-efficient transfer of knowledge, TETRACOM lowers the commercial risk of developing innovative products in young companies. Without the support of TETRACOM, it would have been not affordable for Creonic to develop the LTE IP in such a short timeframe.

“Without TETRACOM’s support, it would have been not affordable for Creonic to develop the LTE IP in such a short timeframe”

ANALYSE YOUR SWEAT WITH XSENSIO'S LAB-ON-SKIN

Esmeralda Megally, Xsenio, and Adrian Ionescu, École polytechnique fédérale de Lausanne (EPFL)

The Nanoelectronic Devices Laboratory (NANOLAB) is a lab at EPFL in Switzerland that focuses on developing, designing and modelling energy-efficient nanoscale solid-state devices. NANOLAB has been at the forefront of European efforts to develop new sensing devices at the nanoscale. In 2014, Xsenio was founded as a spinoff of NANOLAB to commercially exploit novel field-effect transistor (FET) sensors in order to develop a wearable tool which senses biochemical information on the skin's surface (from electrolytes to metabolites, small molecules and proteins) to provide unprecedented real-time information about our health and wellness, in a simple and non-invasive way.

Sweat on the skin's surface can provide a wealth of information that is currently not exploited to support health care and wellness applications. Until recently, there was no technology available to continuously collect sweat and analyse its composition in real time, but recent advances in miniaturized sensing and computing have paved the way for a fundamental paradigm shift. The Lab-on-Skin™ chip being developed by Xsenio will collect infinitesimally small volumes of sweat and conduct repeated multi-parametric analysis in real time to provide meaningful information to the user.

Xsenio was looking for a novel on-body interface that would continuously collect and analyse sweat based on a multi-parameter sensing system. The challenge was to develop a technological solution combining nanofluidics and multiple sensing capability in a single system on chip with ultra-low power consumption. In particular, the smart chip should be able to operate in a wearable form 24 hours a day, seven days a week for many days in a row, which implies significant progress beyond the existing industrial state of the art.

Technology transfer: TETRACOM



Passive channeling of a drop of liquid through pumpless nanofluidic channels

Xsensio approached NANOLAB with a view to working in partnership on this project. Following multiple iterations, a common win-win path for joint development and innovation was identified.

Groundbreaking health applications

NANOLAB is developing a highly innovative zero-power, nanofluidic-on-sensor interface, which allows infinitesimally small sweat droplets to be pumped and channelled through its many capillary channels. The solution, which is based on organic and biocompatible materials that can be processed on silicon wafer carriers, neither relies on external power sources nor uses a pump.

Xsensio will now integrate this unique nanofluidics interface into a wearable form and adapt its functionality so that it can be used to analyse a range of different chemicals. The final result will be a versatile, wearable, fully chip-integrated, nanofluidic interface incorporating field-effect transistor (FET) sensors. This will be the first commercially available chip of its kind in a wearable format for lab-on-skin applications.

Sweat has only recently emerged as a truly valuable means of assessing key health data in real time, without resorting to invasive methods. We do not believe blood testing could or should be replaced: instead, we believe that sweat testing can and will become a powerful complement to blood testing, to monitor our health discreetly and to alert us when key signals start to behave differently. Xsensio is targeting a number of health and wellness applications around its unique Lab-on-Skin™ sensing platform, ranging from skincare sensitivities and sports-related electrolyte imbalances to cystic fibrosis and hypertension.



FInFET sensing chip

Xsensio positions itself as a business-to-business (B2B) company, undertaking research and development and commercial partnerships with large consumer care and consumer electronics companies. Over time, Xsensio will expand its portfolio of B2B partners to include medical technology and drug companies, in order to offer companion diagnostics tools for therapeutics.

TETRACOM: invaluable support for tech transfer

The TETRACOM grant has allowed Xsensio to achieve two goals: first, Xsensio will soon be able to add a key component to its final Lab-on-Skin™ sensing platform solution to make that solution truly wearable. Second, Xsensio will be able to capture the intellectual property (IP) arising out of the on-chip integration of the nanofluidics together with the sensors.

“TETRACOM provides SMEs and start-ups with a clear framework for collaboration with university labs”

Often, highly promising technologies do not progress beyond the invention stage, never becoming true innovations that disrupt the marketplace. The reasons are numerous, but the cost of making that transfer can be exorbitant, especially for small/medium enterprises and start-ups that cannot afford to allocate the time and resources necessary to work with a university lab. A programme such as TETRACOM is therefore excellent as it provides SMEs and start-ups with a clear framework for collaboration with university labs, one that provides milestones and deadlines and a lock-in of IP at the end of the collaboration.

“Xsensio is targeting health and wellness applications from skincare sensitivities and sports-related electrolyte imbalances to cystic fibrosis and hypertension”

TETRACOM Newsletter

TETRACOM Newsletter March 2015

The third TETRACOM Newsletter was sent out in March 2015 to the more than 1700 subscribers of the HiPEAC mailing list.

TETRACOM News March 2015

Dear colleague,

This newsletter issue offers you some information about TETRACOM's latest dissemination activities, such as the TISU workshop organized by Koen Bertels. We also organized a large poster show at the recent HiPEAC conference in Amsterdam, where results of many Technology Transfer Projects (TTPs) from TETRACOM were displayed and discussed with the conference attendees. These events are highly important, since technology transfer is not only about technology, but also about bringing the right players (technology suppliers and users) together to discuss joint opportunities and finally transform visions into new products.

The bilateral academia-industry TTPs form the core mission of TETRACOM, and we just closed the 2nd call for proposals. Mike O'Boyle presents the key statistics below. The great response indicates that there is a broad European market for this very focused and effective form of technology transfer. TETRACOM is now managing and co-funding around 30 individual TTPs. Four years after the the first TETRACOM ideas have been conceived "on a napkin", the project as a whole is now on a great path to success and wide impact.

Would you like to become part of this exciting story? The 3rd and final call for TTPs will be published in August 2015. As usual it will be open to all EU research institutions that have concrete plans for a transfer activity with some industry partner. The TETRACOM Steering Committee is looking forward to your proposals and is glad to consult in case of any questions.

Yours,
Rainer Leupers
RWTH Aachen University



Results of the second call for TTPs

The second call for Technology Transfer Projects (TTPs), for transferring university-based technology to a partner company having operations in Europe closed on December 31, 2014.

We were delighted with the response: 43 proposals were submitted from 12 different European countries. In total, the proposals requested 1.304.000 € TETRACOM funding, complemented by 1.371.000 € matching funding from the respective industry partners.

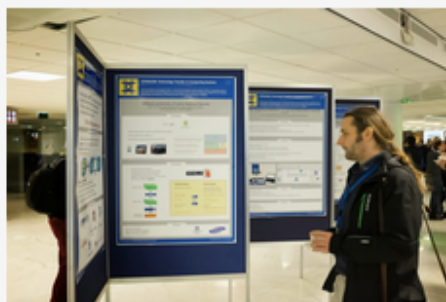
Every proposal was evaluated by 2 reviewers from an external panel of reviewers. In order to provide a balanced evaluation, one of the reviewers came from academia, the other from industry. Partners of TETRACOM were not involved in the reviewing process and were excluded from participating in the call.

The ranked proposals were then considered by the TETRACOM Steering Committee, which selected 13 proposals for funding, subject to contractual agreement. A provisional budget of 356.874 € was allocated for the accepted proposals. The TTPs will start as soon as possible.

More info on the [TETRACOM website](#).

TTP Poster Session

TETRACOM organized a poster presentation with all (concluded and ongoing) TETRACOM TTPs at the HiPEAC conference in Amsterdam on January 20, 2015. In total, 14 TETRACOM poster were presented during the Industrial Exhibition of the conference.



TETRACOM Workshop On Transfer to Industry and Start-ups

The third TETRACOM workshop took place during the HiPEAC Conference on January 20, 2015, in Amsterdam. The goal of the workshop was to bring together researchers interested in bringing their technology to the market and to better understand what instruments are available to do so. The workshop also reflected on ways to improve the transfer of EU research to industry: what instruments are needed and can be implemented efficiently to improve the transfer to industry.

More info on the [TISU page](#).

TETRACOM summer school course

Koen Bertels, TETRACOM partner, will give a course titled 'From Solo Performance to a Symphonic Orchestra' during the ACACES2015 Summer School from July 12-18, 2015, in Fiuggi, Italy. The course will consist of the following lectures:

- Lecture 1: Basics of the business plan & guidelines for the 10 slide mini-business plan
- Lecture 2: Marketing essentials
- Lecture 3: HBS business case : Bang Networks : the first customer
- Lecture 4: Presentations & feedback

For more info and registrations, visit the [ACACES page](#).



Agenda

- July 12-18, 2015, TETRACOM course during ACACES Summer School
- September 23, 2015, TETRACOM Main Workshop in Milano



Website



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TETRACOM Newsletter August 2015

The fourth TETRACOM Newsletter was sent out in August 2015 to the more than 1700 subscribers of the HiPEAC mailing list.

TETRACOM News August 2015

Dear colleague,

The TETRACOM project has been running for two years and, thanks to its unique approach to academia-industry technology transfer, is by now a well-established entity in the European computing systems project landscape. This has been reconfirmed also by a very successful 2nd project review meeting that took place in May 2015 in Oslo in conjunction with the HiPEAC CSW.

TETRACOM has been co-funding 30+ Technology Transfer Projects (TTPs) so far, and a lot of tangible impact has been generated, e.g. in the form of new or improved products, revenue increases, and/or newly created jobs in European ICT industries.

I'm particularly grateful to Eva Haas from RWTH Aachen for efficiently managing all financial and legal TTP matters, thus contributing much to the project success.

The TETRACOM team stays highly motivated, and we are looking forward to receiving your TTP proposals in the 3rd and final call, opening on Aug 15, where another 350k EUR will be granted for outstanding transfer activities.

Next to this, you are cordially invited to participate to other project activities, like the upcoming TETRACOM main workshop (see below).

Hope to see many of you on Sep 23 in Milano!

Yours,
Rainer Leupers
RWTH Aachen University



New Call for Technology Transfer Projects is open

The third call for Technology Transfer Projects (TTPs) was launched on 15 August 2015. Submit your TTP Proposals before **1 October 2015**. Proposals selected for funding will be notified in December 2015. A funded Technology Transfer Project (TTP) can typically last 3-12 months, and the total budget can span from 20k to 200k EUR, of which TETRACOM can pay up to 50% (10k to 100k EUR).

For more information and submission of projects, visit the [TETRACOM website](#).



TETRACOM Workshop in Budapest

A HiPEAC & TETRACOM Workshop on "Building Partnerships" was organized at the Faculty of Electrical Engineering, Budapest University of Technology and Economics (BME), on June 22, 2015. The workshop intended to offer a face-to-face meeting opportunity for HiPEAC and TETRACOM representatives, the local HiPEAC members and other professionals interested in cooperation possibilities with the HiPEAC Network of Excellence and the TETRACOM project.

TETRACOM course top-rated activity at the ACACES summer school!

Koen Bertels, TETRACOM partner, gave a course titled 'From Solo Performance to a Symphonic Orchestra' during the ACACES2015 Summer School from July 12-18, 2015, in Fiuggi, Italy. The course consisted of basics of business plans, financial planning and marketing essentials. It ended with a detailed discussion of the HBS business case : Bang Networks : the first customer

The ACACES2015 participants gave the TETRACOM course a score of 4.85/5 making it one of the highest-rated activities of the entire summer school.



TETRACOM Workshop On Transfer to Industry and Start-ups

The fourth TETRACOM workshop will take place on Wednesday September 23rd during the HiPEAC Computing Systems Week in Milano. The TETRACOM workshop will present some of the highlights of the TETRACOM project. So far, 31 TTPs have been funded by TETRACOM (on a total of 80+ submitted). Some of them will present their outcome at the workshop. Frank Gielen from iMinds, Belgium, Matthias Weiss from Intel Mobile Communications Technology Dresden, Max Lemke from Complex Systems and Advanced Computing, DG Connect, and 9 other speakers will share their view and experiences.

More info on the [workshop page](#).

The workshop is free, but [registration](#) is required.





Website



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Email

TETRACOM Newsletter January 2016

The fifth TETRACOM Newsletter was sent out in January 2016 to the more than 1700 subscribers of the HiPEAC mailing list.

TETRACOM News January 2016

Dear colleague,

This newsletter provides you with some information on two major project milestones in late 2015. First, a large-scale technology transfer workshop has been organized, embedded into the HiPEAC Computing Systems Week in Milano. Second, the 3rd open call for Technology Transfer Projects (TTPs) has been concluded, now co-funding another 16 highly focused bilateral academia-industry partnerships.

The 2016 project activities begin with managing the synchronous kick-off of the 16 new TTPs. TETRACOM will soon have 34 formal project partners (8 founding partners plus 26 TTP partners), and it coordinates 49 individual TTPs in total. While certainly imposing a few management challenges, these high numbers clearly indicate TETRACOM's wide acceptance in our community.

Another major activity will be the TETRACOM poster session at the HiPEAC Conference during Jan 18-20. Our ambition is to have all 49 TTPs represented by one poster, showing TTP motivations, solutions and impacts at a glance, thus providing a perfect TETRACOM "view from the top". If you plan to come to Prague, please use the opportunity to discuss 1:1 with the individual TTP partners about their experiences and innovations.

I wish you a Happy New Year and look forward to seeing you in the beautiful capital city of CZ soon!

Rainer Leupers
RWTH Aachen University
TETRACOM Coordinator



Results of the third call for TTPs

The third call for Technology Transfer Projects (TTPs) for transferring university-based technology to a partner company having operations in Europe, closed on September 30, 2015.

A total of 33 proposals were submitted from 13 different European countries. In total, the proposals requested around 1M Euros TETRACOM funding, complemented by a similar amount of matched funding from the respective industry partners (mainly SMEs).

Based on the results of external reviews, the TETRACOM Steering Committee selected 16 proposals for funding, subject to contractual agreement.

A provisional budget of 428.016 € was allocated for the accepted proposals. The TTPs will start as soon as possible.

For more information, visit the [TETRACOM website](#).

TETRACOM workshop on September 23, 2015 in Milano



The TETRACOM workshop took place on September 23, 2015 in Milano, Italy. In total, 56 participants from 35 institutions in 14 countries registered for the workshop. The workshop consisted of three keynotes and eight presentations about successful TTPs. The workshop demonstrated that small scale technology transfer can boost European academia-to-industry technology transfer (TT) in all domains of Computing Systems. More information on [the workshop page](#).

Learn more about the results of TETRACOM



TETRACOM currently runs, or has completed, 49 individual Technology Transfer Projects (TTPs). The three open calls for TTPs received 107 TTP proposals, with an overall acceptance rate of 36%. The average co-funding of TTPs by TETRACOM is around 25k Euro, but there is considerable variance. TETRACOM systematically analyses the impact of the TTPs and has established a dedicated page on its website with more info about this: [TETRACOM impact analysis](#)

TETRACOM Workshop On Transfer to Industry and Start-ups

The fifth TISU workshop will take place on Tuesday January 19th during the HiPEAC Conference in Prague. The workshop will present some of the highlights of the TETRACOM project. A selected number of the 49 TETRACOM TTPs will present their outcome during the workshop.

More info on the [workshop page](#).

The workshop is free, for attendees of the [HiPEAC conference](#).

TTP Poster Session

TETRACOM is organizing a poster presentation with all (concluded and ongoing) TETRACOM TTPs at the HiPEAC conference in Prague on January 19, 2015 during the Industrial Exhibition of the conference. It is an ideal opportunity to get an impression about the impact of small scale technology transfer projects as pioneered by the TETRACOM project.



Website



Twitter



Facebook



Email

TETRACOM on Twitter

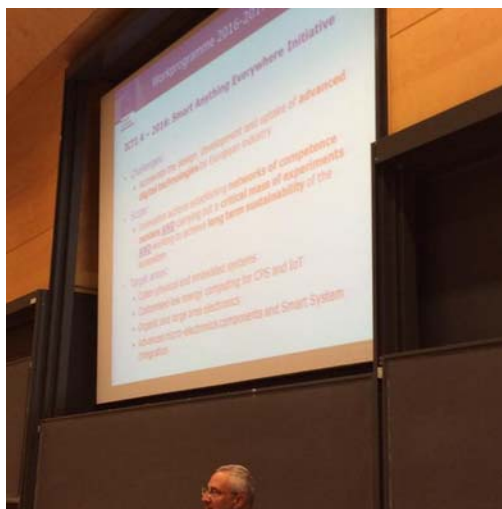
A TETRACOM account on Twitter was created in October 2013.

Some of the messages / retweets that have been sent out since March 2015:

- La @UCAM única en la Región seleccionada en @TetracomProject Enhorabuena @horacio_ps y quipo! <http://www.europapress.es/murcia/noticia>



- Estarán presentes también @ingeniatic @Abiopep @TetracomProject @voptica <http://fseneca.es/workshop-emprender/...>
- A glimpse into our near-future research topics, at HiPEAC CSW in Oslo, Norway @hipeac @UniOslo @NTNU @UiTromso



- TETRACOM at the EC Workshop 'communicating achievements in advanced computing' - engage into a TT project now!



- SCD community detection algorithm is now part of Sparksee 5.2 thanks to [@TetracomProject](#) - <http://ow.ly/Onf9v> [#graphdb](#) [#NoSQL](#)
- Rainer Leupers ([@RWTH](#)) explaining how the [@TetracomProject](#) can boost EU academia-to-industry TT in Budapest



- [@TetracomProject](#): 5 patent apps, 11 new products, 15 improved products/processes, 17 jobs created, new tech in 4 startups - R Leupers [#SAE](#)
- [@TetracomProject](#) delivers four-fold return on EU [#techtransfer](#) investment <http://bit.ly/29ubtWt> cc [@DigIndEU](#) [@DSMeu](#) [#computingsystems](#)
- HiPEACinfo 47 is out now! Ft. M Duranton [@CEA_Recherche](#) [@TetracomProject](#) [#techtransfer](#), [@axiom_project](#) + much more [https://www.hipeac.net/assets/public/publications/newsletter/hipeacinfo47.pdf ...](https://www.hipeac.net/assets/public/publications/newsletter/hipeacinfo47.pdf)
- Check out this article by [@dividiti](#) with info on collective knowledge + [@TetracomProject](#) [#SAE](#) [#DigitisingIndustry](#)
- Artículo sobre [@TetracomProject](#) en [@Byte_TI](#) (en español)



- TETRACOM is transferring tech from research centers to startups <http://bit.ly/29ubtWt>

TETRACOM press release

Press release published in June 2016: “TETRACOM delivers four-fold return on EU technology transfer”



TETRACOM delivers four-fold return on EU tech transfer investment

Aachen, 29 June 2016. – With 50 projects transforming cutting-edge research into market-ready innovations across 15 countries, [TETRACOM](#) has demonstrated its effectiveness of as key enabler of the European Commission’s Digitising European Industry initiative. Matchmaking research centres with industry representatives, stand-out results so far from the project, now in its third and final year, include 11 new products, five patent applications, seven open-source tools and the creation of 17 new jobs.

TETRACOM coordinator Rainer Leupers, Professor of Communication Technologies and Embedded Systems at RWTH Aachen, commented: 'Being a co-founder of several companies myself, I'm particularly glad that our project has also helped European start-ups get off the ground by transferring key technologies that contribute to the core of their product offer. I'm excited to see this level of industrial impact from a European project and I cordially wish them long-term market success.'

While the European Commission invests €25,000 per technology transfer project, TETRACOM will result in six-figure returns in cost reductions and new sales opportunities, according to many of the beneficiaries. Projects cover a range of fields of crucial importance to European industry, including communications and multimedia, industrial automation, health, safety and security, the automotive sector and data analytics.

While the European Commission invests €25,000 per technology transfer project, TETRACOM will result in six-figure returns in cost reductions and new sales opportunities, according to many of the beneficiaries. Projects cover a range of fields of crucial importance to European industry, including communications and multimedia, industrial automation, health, safety and security, the automotive sector and data analytics.

Among the examples of innovative technology generated thanks to TETRACOM funding are the following:

- **Turbo-charged genome analysis** thanks to a high-performance computational infrastructure by TU Delft spin-off Bluebee, providing healthcare professionals with the tools they need to diagnose genetic diseases and prescribe personalized therapies. The Dutch company's growing success was recently consolidated by €10 million in venture capital financing.
- **Faster video downloads** thanks to an accelerated video decoder, resulting in a new product for Greek company Think Silicon and a new spin-off from TU Berlin, Spin Digital.
- **Heart monitoring via your smartphone** offered by a wireless, wearable body sensor developed by the Jožef Stefan Institute in Ljubljana and commercialized by start-up Saving d.o.o.
- **Real-time sweat analysis for discreet health checks** through the zero-power Lab-on-Skin™ created by the École polytechnique fédérale de Lausanne and start-up Xsensio.
- **Smart glass-cutting techniques** enabled by the use of artificial intelligence to maximize glass production by Spanish SME AGC Flat Glass Ibérica while keeping energy consumption low, resulting in up to 40% performance improvements.

David Rueda of AGC Flat Glass Ibérica commented: 'The project has been very profitable for us. The optimization reduces losses and increases our competitiveness in the market. In gross numbers, we can save around €150,000 a year.'

In a further indication of TETRACOM's central position within the Digitising European Industry initiative, the project was hailed as a 'best practice' at the recent [Smart Anything Everywhere workshop on enhancing digital transformation](#), held in Brussels.

Further information:

www.tetacom.eu

Contact:

Rainer Leupers, TETRACOM coordinator
leupers@ice.rwth-aachen.de

TETRACOM has received funding from the European Union
7th Framework Programme under grant agreement no. 609491.



TETRACOM covered in the press

The Press Release "TETRACOM delivers four-fold return on EU technology transfer" was published on AlphaGalileo:

<http://www.alphagalileo.org/ViewItem.aspx?ItemId=166187&CultureCode=en>

TETRACOM article in SAE brochure

On the occasion of the "Smart Anything Everywhere Workshop: Enhancing digital transformation in European SME's" on 13 June 2016 in Brussels, a brochure collecting a number of success stories, was published.

SUCCESS STORIES

TETRACOM

Efficient, reliable and cheap computing – everywhere

PROBLEM AND SOLUTION

Everywhere – from tiny computers embedded in “things” even smaller than smart phones to enormous supercomputers – increasing the efficiency and decreasing the cost of computing is critical to innovation and wellbeing. Unfortunately, the sheer complexity and poor understanding of trade-offs (e.g. speed vs. energy efficiency vs. accuracy), combined with the cost and time-to-market pressures, typically lead to very incremental improvement of the next generation, as the design and optimisation potential can hardly be explored. This in turn results in over-expensive and under-performing and energy hungry computer systems.

To optimise the methodology to design new computer systems in an efficient way a sort of Wikipedia for computer design is needed that allows the community to share representative programs, data sets, tools and predictive models as reusable components, crowdsource and reproduce experiments, and apply predictive analytics to continuously grow knowledge about optimising computer systems. The cTuning foundation have developed Collective Knowledge (CK), an open framework, repository and methodology for reproducible and collaborative R&D, and released CK under a permissive license that was validated in a TETRACOM technology transfer experiment with ARM, the world-leading supplier of microprocessor technology. Using CK, ARM was able to obtain valuable insights into performance of its products in a fraction of the time required by conventional analysis.

HOW DID SAE HELP?

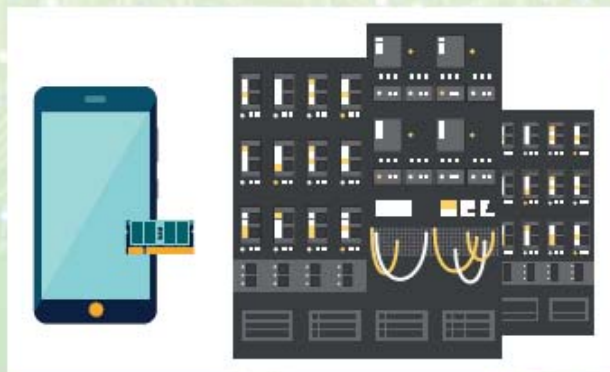
The SAE project TETRACOM helped in two significant ways: it provided know-how and funding to mature the CK solution and facilitated collaboration and validation with a major player in the computing arena. It was, therefore, paramount to showcase the potential of CK to spur the design of next generation, high performance and energy efficient computer systems.

IMPACT

The experiment demonstrated that adopters of the CK solution will dramatically increase the performance of their products (making them cheaper, smaller, faster, more energy efficient and more reliable), and thus save millions of euros within 2 years and tens of millions of euros within 5 years. To exploit the CK solution commercially, a start-up called **dividiti** was founded in 2015. Already now their clients include a cloud computing company and an automotive company from the Fortune 50 list. Based on the strong demand for their services, dividiti are projecting the revenue in the region of €300K in 2016. From 2 full-time co-founders, the headcount will be increased to 4 full-time staff and several part-time staff by the end of 2016. It is expected to double the headcount and quadruple the revenue in 2017.

End-user: ARM Limited (LE, UK)

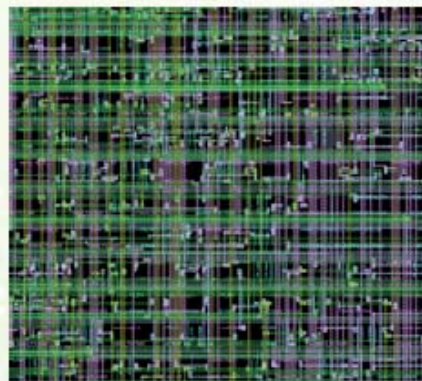
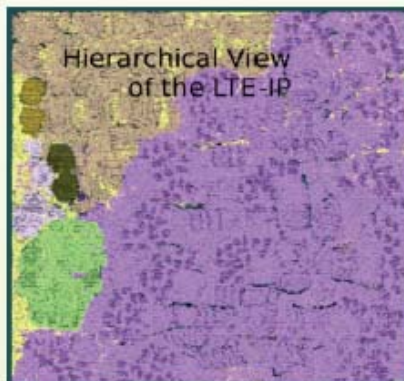
Technology providers: cTuning Foundation (RTO, UK) and dividiti (SME, UK)



SUCCESS STORIES

TETRACOM

A powerful LTE Turbo-Code Decoder – enabling component of next generation mobile technology



PROBLEM AND SOLUTION

Mobile Communication is one of the key technologies of modern information societies. Increased mobile communication and services require an ever increasing data throughput. Therefore, the next generation of wireless systems needs to provide for higher data rates greater than 16 Gbps, shorter delays (latencies), and even greater capacity. To meet the challenges of such future high throughput wireless systems an LTE Turbo-Code Decoder (Forward Error Correction – FEC) is required that has the capabilities to deliver these very high data rates being compliant with the mobile broadband standard specifications.

To make their existing solution future proof CREONIC teamed up with the University of Kaiserslautern in order to develop a cutting-edge LTE Turbo-Code Decoder solution within a technology transfer experiment of the TETRACOM project. The major technical advantages of the achieved new LTE Decoder solution are the small chip size, which leads to less energy consumption and an extended battery life. The higher throughput (> 1Gbit/s) enables mobile internet connection with a seamless user experience due to short response times and fast downloads. The architecture is highly scalable to fit perfect to the target application (e.g. base station or mobile device). The near ideal communications performance allows for a reliable communications even at places with poor network coverage. This decoder (see the figure above) is a near to marketable solution and will become a future product of CREONIC.

HOW DID SAE HELP?

The TETRACOM TTP (technology transfer project) enabled and financed the transfer of more than 250PY experience and knowledge of a renowned competence centre (the Microelectronic Systems Research Group at the University of Kaiserslautern) in designing and verifying high throughput channel decoders (FEC) to CREONIC. Due to the close cooperation and the established know-how exchange it was possible to generate a high quality, future-proof LTE Turbo-Code Decoder, which a very small company such as CREONIC would not have been able to design with its limited resources.

IMPACT

The LTE solution is one major step to enhance CREONIC's product portfolio towards a complete set of solutions of forward error correction cores. This provides CREONIC with the significant competitive advantage to serve its existing and new customers with highly sophisticated solutions. It is expected that CREONIC will increase its number of employees by 50% and its revenues by 20% until 2020 thanks to this TTP.

End-user: CREONIC (SME, DE)

Technology providers: University of Kaiserslautern (RTO, DE)

