
## Technology Transfer in Computing Systems

# D1.5: TETRACOM White Paper

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## TETRACOM origin and motivation

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:

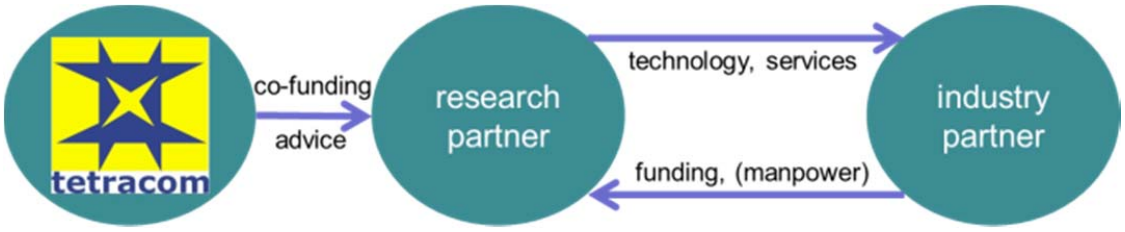
**Establish realistic TT marketplaces**: Given the structure and dynamics of typical EU collaboration projects it might be unrealistic to expect that some project delivers innovation as a whole and right at the end of the project. Naturally project proposals contain "exploitation plans" written with 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 the following section), is designed to precisely serve such a scenario.

## The TTP concept

Individual *Technology Transfer Projects* (TTPs, see figure below) 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.

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**: 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. *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.

## Key project results

While TETRACOM has also organized numerous well-attended infrastructure events (e.g. TT workshops), we have focused on the results of the TTPs here, which form the most novel and experimental part of the project. TETRACOM has completed 50 individual TTPs. Out of these, 12 are performed by the founding partners, while 38 were granted to third parties after three open TTP calls. The geographical distribution (regarding the individual TTP company partners´ sites) is illustrated in the map below, which highlights the true European scope of TETRACOM.


The open TTP calls received 107 TTP proposals, resulting in a total acceptance rate of around 30%. The average co-funding of TTPs by TETRACOM is around €25k, but there is considerable variance. Some further key statistics are summarized in the table below. More information is available on the project web site or the public TETRACOM deliverables.

| | TTP CALL 1 | TTP CALL 2 | TTP CALL 3 |
|---|---|---|---|
| **Submissions** | 31 | 43 | 33 |
| **Countries Involved** | 13 | 12 | 13 |
| **SME involvement** | 45% | 74% | 81% |
| **Proposals from new EU member states** | 3 | 9 | 9 |
| **Average requested funding (EUR)** | 30,000 | 28,000 | 29,000 |
| **Average matching industry funding (EUR)** | 27,000 | 32,000 | 30,000 |
| **Average TTP duration (months)** | 9 | 9 | 7 |

A systematic impact analysis showed 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 29 *publications* in international journals and conferences.
- 40 TTP-specific *presentations* at workshops, trade shows and regional forums took place.
- 12 TTPs contributed their results as open source software or services based on open source platforms
- 12 TTP-related *patent applications* have been filed.
- Most TTPs delivered new professional or educational *training* activities and materials.
- There were already 17 very concrete cases of TTP-related technology adoption by the partner company in the form of *new products* or *new features and services*. 12 company partners reported internal *process improvements*.
- 19 TTPs reported an immediate impact on *sales projections* and VC *investment acquisition*.
- 21 *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.
- Most TTPs traced back their project to a previous or ongoing *publicly funded research grant*.
- Most TTPs reported a *TRL elevation* by 2 levels, TRL 7 being the typical target.

With its 50 projects transforming cutting-edge research into market-ready innovations across 15 countries, TETRACOM has sustainably demonstrated its effectiveness as key enabler of the European Commission's Digitizing European Industry Initiative. It helped European start-ups get off the ground by transferring key technologies that contribute to the core of their product offerings. TETRACOM is particularly pleased to see more than 60% SME partners involved in TTPs, to observe that many TTPs translate into academia-industry mobility, new employment opportunities, strengthening competitiveness and in the

establishment and reinforcement of long-term collaborations (far beyond TETRACOM's project end) on a local, national and also on a multi-national level.


## Lessons learned and recommendations for future transfer instruments

### 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 provided a platform for boosting and structuring it. Via its infrastructures, like TT workshops, presentations, and individual consulting, TETRACOM stimulated very concrete TT activities and helped to actually implement them by providing a monetary incentive.

**TTP concept**: TETRACOM deliberately did not support long-term R&D activities with uncertain outcomes. These were 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 €25k-30k 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 were open for 6 weeks, proposals limited to 3 pages, and successful proposers began with their TTP after another 6 weeks of review and granting procedures. The formal accession to the consortium was 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 concerned 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 a TT framework could benefit from a clearer thematic focus. Since TETRACOM addressed TT in virtually all domains of computing, the individual TTP topics were quite scattered. More impact might be achieved via TETRACOM-like projects that only focus on e.g. low power, custom computing, HPC, embedded SW design, chip design etc.

**Inter-TTP synergies**: Once granted, TTPs ran more or less freely to their conclusion at the two partners´ sites. TETRACOM mostly played an administrative and observer role in this phase. There should be an instrument yet for systematically monitoring possible synergies and suggesting corrective actions to the TTP partners. Otherwise, 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, all academic TTP partners had 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/cascading 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 third parties. 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 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.