

# TestNet: Let's Test Together!

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**Abstract.** In this paper we briefly describe the main goals and organization of TestNet, a proposal for the creation of a Network of Excellence in the scope of the 6th Framework Programme of the European Community. TestNet: Integration of Testing Methodologies represents the joint effort of the different European testing communities to create a common framework to improve all the aspects of the testing process.

## 1 Rationale

Borrowing from [Dah95] we may say that throughout history, society has created increasingly complex systems that put themselves and their environment at risk. In fact, human-made catastrophes have increased in frequency and magnitude with industrialisation. Early designers were able to learn readily from mistakes, leading to important advances in different areas, such as transportation, architecture, and energy production. Unfortunately, the growing complexity of present-day systems and the critical application areas in which they are used have made it more difficult to avoid introducing the possibility of catastrophic failures. This is in particular true for modern software systems.

*Testing*, the process of checking that a system possesses a set of desired properties and behaviour, has become an integral part of innovation, production and operation of systems in order to reduce the risk of failures and to guarantee the quality and reliability of the software used. The activity of testing is already a flourishing area with the active participation of a large community of researchers and experts. Thus, there is a high level of consciousness of the importance and the impact for the future deployment and use of software and systems. There is also an awareness of an increasing need to automate the testing activity in all application areas, that this activity should be taken into consideration in all phases of the software and system life cycle, and that interoperability and standardisation rely on it. An important problem is that different testing communities use different methods. Roughly speaking, we can identify two testing communities: *Testing of software* and *testing of communication systems*. Until

very recently their research had been carried out with almost no interactions. So, there is an urgent need to co-ordinate research tasks and to find a synthesis between different techniques developed in isolation by each community. In other words, the different testing communities have realised the need to unify their research efforts to define a common framework to confront the above-mentioned problems. Another relevant problem is that the existing techniques and tools for testing are not adequately applied or even known in industry. Although scientific advances are needed in several areas, even well established technologies (as an example, code coverage measures) are rarely applied as they should. Testing activities are still very expensive and often relegated to the last stages of development, so that when time and resources start to be scarce, they are often partially sacrificed. We consider this to be a crucial problem, and believe that researchers in the field should urgently take two types of measures:

- to increase awareness in the area among the software and communication industries, and
- to make the test activities more cost/effective by developing better tools and by defining techniques seamlessly integrated into the development processes.

The research on testing has been reflected in several international conferences (e.g. *IFIP-FORTE/PSTV*, *IFIP-TESTCOM*, *IEEE-ICNP*, *ASE*, *ISSTA*, *IEEE-COMPSAC*). Further, standards bodies (e.g. *ETSI*, *ISEB*, *ITU-T*, *ISO*, *IETF*) have also dealt with testing. Unfortunately, these instruments lack the structuring effect that would arise from the organisation of a European Network of Excellence (NoE). We propose to establish a European Network of Excellence in the area of software testing that we call TestNet. The past, on-going and necessary future activities in the area of testing, as well as the importance of it in all application domains (communication services, nuclear power, transport, aeronautics, etc), make the subject of testing an important issue to be undertaken at the European level.

The subjects related to TestNet naturally fall into the priority thematic area 1.1.2 (*Information Society technologies*) and its research priority (1.1.2.ii *Communication, computing and software technologies*). The network will mobilise researchers and experts in the field of testing "mobile communications, consumer electronics and embedded software and systems" that is essential to assure that Europe remains a leader in the field and continue to offer innovative, integrated and adapted methods and techniques to tackle the growing complexity of software and communication systems and to prevent economic failures (maintaining cost-efficiency) or social catastrophes (maintaining reliability). The current European research situation is already mature for creating consensus and standardisation. So there is an urgent need for concerted actions in the field to maintain the competitive advantage of Europe. This effort will have an important impact in the production of secure high quality software based systems, reducing social and environmental risk in the areas these systems are used. For all these reasons we feel that the financial support from the EC would result in great advantages for the European community as well as its industry and research. The creation of a NoE will serve as a catalyst that will stimulate

collaborations between the main actors in the field and the achievement of the objectives described in the next section. It will have impact on the short term by stimulating the collaborations between the participants; in the medium term by reaching agreements and setting up projects and industrial platforms; and, in the long term by defining strategies and actions (standardisation, training, ...) that will extend the existence of the NoE and its impact beyond the present duration planned by this proposal. In addition, it is the objective of TestNet to encompass transversal applicability. Even though it mainly concerns the Information Society Technologies domain, it is also applicable in other priority areas such as the fields of aeronautics and nuclear energy. In fact, some of the participants are strongly involved in these areas and thus the impact of the results obtained will extend to them. We also plan to interact with other NoE's as well as with other projects working on real-time and performance aspects. In particular, we will collaborate closely with the British network *FORTEST*, the *Accompanying Measures on System Dependability: AMSD, ENCRESS* and *SECUREUBINET* (proposed networks on safety of critical systems that include testing) and the French research networks *RNRT* and *RNTL*.

Taking into account the previous considerations, we believe that for software and telecommunication systems testing the following aspects should be addressed:

- There is a great need to automate the testing procedure to reduce time to market and to improve software quality at the same time.
- There is a great need to define best practices that take into account different existing techniques in different domains that are applicable for industry.
- Testing techniques are not keeping up with software development techniques and processes. It is necessary to take up different trends in software development and study the impact of integrating testing techniques and their usability.
- Testing is not always taken into consideration as it should be. Universities and other educational institutions often do not include it in their curricula. In enterprises, the effort needed is often underestimated.

## 2 Objectives of TestNet

In addition to coping with the problems identified above, the main goal of TestNet is to integrate the knowledge accumulated by the most successful European teams working on testing so that the critical mass necessary to lead this area of research can be reached. Briefly, the main goals to be achieved by the network are:

1. Co-ordinate and bring together major European research groups from different testing communities and domains to strengthen and develop the collaboration in the area at the European level:
  - (a) by stimulating the technological transfer and sharing of experience,
  - (b) by co-ordinating research activities and defining its roadmap (medium and long term strategy),

- (c) by adapting activities to integrate their competencies taking advantage of the multi-disciplinary character of participants.
2. Promote testing as a well-defined and important activity in education, research, software engineering and industry.
  3. Promote the integration of different testing techniques and development tools. Stimulate the creation of open tool environments so that different test and development tools can be seamlessly connected.
  4. Promote innovation and take-up of new technologies through small and medium enterprises (SMEs) and through the creation of integrated projects where industry takes a leading role.

### 3 Approach and Planned Activities

In order to achieve the objectives we propose the following steps and organisation.

#### 3.1 Creation of Working Groups

The partners collaborate in working groups centred on different topics. The (tentative) list of topics is:

- WG1:** Interoperability and conformance testing platforms and application to heterogeneous networks (e.g., next generation communication networks, mobile and wireless communication systems).
- WG2:** Testing of embedded software and fault-tolerant and safety-critical systems (e.g., aeronautics and railway control).
- WG3:** Languages for systems and test description (e.g., UML, SDL, B, Z, MSC, TTCN).
- WG4:** Techniques and processes for the new paradigms of software development (e.g., component-based software testing and testing of product lines).
- WG5:** Theoretical foundations of testing (e.g., measures for quality of testing and quality of software).
- WG6:** Platforms for testing of industrial applications.

#### 3.2 Actions

In addition to the tasks carried out by each working group, we plan the following *cross-working group actions* to accomplish the goals of the NoE:

- *Roadmap for testing:* elaboration of a strategy for research and development in all the aspects and phases of the testing process.
- *Education and training:* elaboration of new curricula to integrate testing methodologies into university degrees. Many partners already propose specific courses on testing but they would benefit from a better overall vision more adapted to industrial and practical needs. Creation of Pan-European masters as well as a common Doctoral program.

- Elaboration of *best practices* applicable globally, but also specifically for each area, for obtaining reliable software and hardware.
- To *synthesise* and define the necessary *integration of practices and techniques* deemed necessary in the development and operation of critical software and hardware.
- Participation in the *definition of standards: ETSI, ISO, ITU-T, ISEB, IETF*, etc.
- Promotion of *common activities with enterprises*, with special emphasis on SMEs. In particular, creation of academia-industry laboratories in the countries having the necessary critical mass.

### 3.3 Scientific Committee

The NoE will have a steering committee composed of the main co-ordinator of the network, the responsible person for each cross-working action, and the co-ordinators of the working groups. There will be two additional members of the steering committee: a representative of industrial partners and an academic member responsible for technological transfer. This committee will meet on a regular basis every three/four months. However, extraordinary meetings may be deemed necessary if unexpected situations arise (e.g. conflict solving). The steering committee will have the following responsibilities:

- Organisation of joint workshops (i.e. including all the working groups) as well as open workshops (i.e. including participants outside the network). It is planned to organise these two events once a year (with a six months separation).
- Organisation of summer schools covering the different aspects and communities of testing.
- Co-ordination activities regarding external projects.
- Stimulation of the development of research projects among the participating members and establishment of IPR (Intellectual Property Rights).
- Integration of new partners.

### 3.4 Co-ordination Activities

Co-ordination activities and collaboration among partners are essential for the deployment and relevance of the NoE and so we consider them separately. First of all, activities already carried out in the field will be continued and further stimulated by organising meetings and discussions. In addition to the co-ordination activities charged to the steering committee, partners will carry out the following activities:

- *Working Group Meetings* (approximately every 6 months). They will serve not only to promote collaborations but also to refine medium and long-term research strategies to tackle the various aspects of testing from different perspectives.

- Organisation of *training* and *exchange* of researchers and students (short and medium term).
- *Share of resources*, establishment of a common knowledge base and shared tool base. Organisation of video/audio conferencing, a web site, and other interactive working tools.
- *Promotion of results* and *efforts* undertaken through presentations, publications, participation in standard bodies and existing conferences, contests to stimulate the participation of young researchers and teams.
- *Stimulation of a two-way transfer* of technology and experience between research institutions and enterprises participating in different application areas.

### 3.5 Management of TestNet

The co-ordinator of the network will be in charge of its management. Given the dimension of the network, she will be helped by a full-time manager. In addition, the responsible persons for cross-working group actions together with the working group co-ordinators will participate in the management decisions. The management committee will be responsible for the administration, the financing, and the budget of the network. It guarantees that the network's terms of reference are respected. In case of problems or modifications, it is the role of this committee to react and initiate the corrective actions rapidly.

In addition to the management committee, an *external council* will be created to organise external evaluations and peer review of the research results and collaborations. In particular, they will control the quality of work and deliverables by assuring that the review and validation of documents, software and integration results is correctly carried out.

## 4 Partners in TestNet

In order to achieve the stated goals, TestNet will include the most renowned experts and research bodies across Europe in the fields of software testing and testing of communication systems as well as in applications to industry. All of the people have worked for at least ten years in their respective field of knowledge (in most cases this experience is even more extended) and most serve as members of the program committees of international conferences related to testing. We have intentionally limited the size of the network such as to include only partners whose experience is both solid and strongly relevant to the purpose of the network. The number of researchers will be around 180.

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