European Cooperation in the field of Scientific and Technical Research - COST -

Secretariat

Brussels, 30 November 2007

COST 258/07

MEMORANDUM OF UNDERSTANDING

Subject : Memorandum of Understanding (MoU) for the implementation of a European Concerted Research Action designated as COST Action IC0703: Data Traffic Monitoring and Analysis: theory, techniques, tools and applications for the future networks

Delegations will find attached the Memorandum of Understanding for COST Action IC0703 as approved by the COST Committee of Senior Officials (CSO) at its 169th meeting on 15 - 16 November 2007.

MEMORANDUM OF UNDERSTANDING
for the implementation of a European Concerted Research Action
designated as

COST Action IC0703

DATA TRAFFIC MONITORING AND ANALYSIS: THEORY, TECHNIQUES, TOOLS AND APPLICATIONS FOR THE FUTURE NETWORKS

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the Technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 299/06 "Rules and Procedures for Implementing COST Actions" (or in any new document amending or replacing it), the contents of which the Parties are fully aware of.

2. The main objective of the Action is to increase the quality and the impact of European research in the field of Traffic Monitoring and Analysis (TMA).

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at 110 million EUR in 2007 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

5. The Memorandum of Understanding will remain in force for a period of four years calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter V of the document referred to in Point 1 above.

TECHNICAL ANNEX

A. ABSTRACT AND KEYWORDS

Modern packet networks are highly complex and ever-evolving objects. Understanding, developing and managing such environment is difficult and expensive in practice. Traffic Monitoring and Analysis (TMA) has always been seen as a key methodology to understand telecommunication technology and operation, and the complexity of the Internet has attracted many researchers to face traffic measurements since the pioneering times. The recent advances in the field of TMA suggest that evolved TMA-based techniques can play a key role in the operation of real networks. Today, the lack of insight and early recognition of emerging risks and/or performance issues can expose the network infrastructure to stability and security problems. TMA is therefore the basis for prevention and response in network security, as typically the detection of attacks and intrusions requires the analysis of detailed traffic records, e.g. packet traces.

This Action will coordinate both Research Groups and Network Operators active in the field of TMA, promoting the development of novel techniques and focusing the research efforts towards commonly recognized problems, thus driving the research towards real-world applications. It will foster the adoption of common monitoring tools and analysis platforms, so as to catalyze the emergence of a European de-facto standard for traffic monitoring, ultimately increasing the impact of European research in the field.

Keywords: Internet, Traffic Monitoring, Traffic Analysis, Network Measurements, Security, Traffic Classification.

B. BACKGROUND

B.1 General background

Research on Internet Traffic Monitoring has surged in the last few years, enabled by the availability of capture hardware (monitoring cards, wiretaps) and large storage solutions at accessible cost. There are currently several research groups involved in developing tools and methods to acquire, analyze and interpret traffic data from the live networks. These cover different network environments such as wired access, broadband backbone, campus WLAN, 3G cellular WAN, etc. The term Traffic Monitoring and Analysis (TMA) is used to refer collectively to such research activities.

The range of applications for TMA-based techniques is wide. TMA is the basis for large-scale performance monitoring, for network validation and troubleshooting, for detecting weaknesses and failures inside complex infrastructures and ultimately ensure a higher level of network robustness. TMA is the pillar to build network security as it offers the means to detect problematic events, deliberate and not, like attacks, intrusions, infections, anomalies or misconfigurations. In general, TMA is a fundamental aspect of network operation. Besides, it can feed the network engineering and (re)planning process, which are particularly critical in fast evolving environments as modern data networks.

TMA modules can be involved in shaping the services to the end customers, e.g. whenever resource assignment and billing schemes encompass a measurement-based component. TMA can regulate contractual agreements, e.g. by means of SLA verification. Finally, TMA has legal implications in terms of privacy protection and lawful interception practices.

In summary, TMA can play a role in virtually every aspect of the network lifetime. As a matter of fact, TMA emerged only recently as an important field for research and applications. In the specification of the Internet architecture (i.e. the TCP/IP protocol suite) TMA was practically absent, as the aspects related to traffic and network monitoring where marginal and limited to simple coarse mechanisms – namely SNMP and a few ICMP functionalities. In contrast, there is now emerging consensus that TMA will play a central role in the Future Internet.

B.2 Current state of knowledge

Current TMA research includes several different research directions and a wide range of potential applications. It is possible to classify them into the following main classes:

- Traffic Classification, Characterization and Modelling: designing and planning telecommunication networks was always based on traffic measurements, out of which traffic models and performance estimates are built. While this process proved to be reasonably simple in traditional, circuit-switched telephone networks, it revealed to be much harder in packet-switched data networks. This spurred a huge effort from the research community, which is far from the end. Traffic classification, characterization and modelling represent the key tools to understand the Internet, including users' habits, and application evolutions.

- Large-scale Performance Monitoring: to quantify the actual network performances at a large-scale, so as to reveal global drifts and/or local degradation, triggering intervention by the network staff; Quality of Service and Service Level Agreement monitoring are based on large-scale performance monitoring, and are today becoming more and more important.

- Network Tomography and Topology Discovery: to infer the status of internal network elements and connection links from a parsimonious number of measurement points; they can be used to detect network problems (e.g. failures, bottlenecks) in a cost-effective way.

- Anomaly and Intrusion Detection: to detect security threats, attacks, infections or misconfigurations and any other macroscopic event in the traffic pattern, deliberate or not, that require attention by the network administrators.

New TMA-based techniques can be successful and cost-effective in solving the real problems found in the operation of real networks. When integrated and consistently coordinated (e.g. using common tools) individual TMA techniques can collectively evolve towards a new paradigm for operating and engineering modern telecommunication networks in a cost-effective way. This vision requires a strong coordination - ideally a collective collaboration - between the various research groups active in the TMA field. Unfortunately, the current status of TMA research is extremely fragmented, particularly in Europe. Research groups tend to develop and use their own TMA tools/platforms, usually not portable and scarcely reusable by others.

A by side consequence is that most research results (e.g. classification and detection algorithms) are hardly validated or simply replayed by independent users, thus missing the opportunity to be verified, improved and eventually applied in real systems. Notably, the lack of independent validation should be regarded as a serious scientific deficit, especially for analysis methods that are ultimately aimed at handling real data: independent validation only gives credibility to what would otherwise be only theoretical results. At the same time, the lack of common platforms and reliable tools has hampered the transfer of the research results to the industry. As a consequence TMA research has fallen short of leveraging the operating practice of real networks.

Several research groups have access to operational networks, academic or commercial - for instance R&D teams within network operators, but also academic teams holding private collaborations with the former. These groups are gaining important operational experience, i.e. knowledge about the issues and problems encountered in real network environments. They are likely to follow a problem-driven approach in shaping their research, from the very choice of the problem to address up to the vision of a potential practical application. Other groups without access to real network infrastructures tend instead to take a curiosity-driven research path, generating potentially more visionary solutions but often missing the possibility of concrete application and real-world verification.

Research on TMA is well exposed to inter-disciplinarity and cross-fertilization. Researchers analyzing Internet traffic are importing methods and concepts developed in other fields, e.g. statistics, signal processing, data mining, and even econometrics. On the other hand, TMA research can generate value for other fields of science and technology. Consider that no other complex system can be measured at such large scale and fine-grain accuracy as the Internet today. The Internet is now a magnificent "source of data": it produces measurement data that are incomparable in volume and rate to any other measured system on earth. The need to handle such huge data poses technological challenges that are likely to generate solutions to be later adopted in other fields ("technological fallout"). On the scientific side, the challenge of interpreting singularly large volumes of complex data, often with real-time constraints, calls for the development of new advanced analysis methods that, again, can be later exported to other scientific fields.

B.3 Reasons for the Action

From the above discussion it should be clear that research on TMA has an enormous potential, on both the scientific and technological side. However, such potential has not been fully achieved insofar. The main obstacles appear to be: fragmentation of the research, lack of common framework and tools, gap between problem-driven and curiosity-driven research, poor sharing of precious operational experience. The correct strategy to mitigate such deficits is to work within the research community, setting a process to promote coordination, to achieve focus on a commonly agreed research agenda, to converge towards a common framework of tools and technological platforms, to share operational experience. The key to achieve these goals is bottom-up consensus building. The COST Action is the most appropriate means to implement this strategy. It ensures the right level of flexibility to its participants, thus preserving the necessary level of freedom in individual research activities, while offering sufficient means for the constitution of a coordinated "community" out of the set of research groups involved in TMA. The Action allows reaching the critical mass that is necessary to be recognized as the primary reference point for European research in the field of TMA (note that as many as 22 countries have expressed interest in this Action, with approximately 75 institutions involved).

This would in turn facilitate the coordination and exchange with researchers from other regions and/or other disciplinary fields.

B.4 Complementarity with other research programmes

The Action will interact with several other European initiatives on a complementary basis. These include: GEANT2, existing and future NoE/SSAs (LOBSTER, EMANICS, EuroFGI), the CELTIC initiative TRAMMS, future FP7 projects, the FIRE initiative, possibly other future COST Actions.

Details on the liaisons with individual initiatives are presented later in Section E3. The Action will play the role of a meta-initiative, serving as a coordination room between more focused initiatives within the specific field of TMA (e.g. FP7 projects). The Action will catalyze the adoption of the results from individual projects by the larger community and will foster cross-project communications.

Recall that one of the main objectives in the ICT work programme of FP7 is the topic of "future networks", were 200M€ are indicated in the work programme. Within this framework, most of the proposed projects will have to deal with traffic monitoring and analysis. The exchange between researchers working in these projects will be supported by the Action.

Notably, the List of Experts participating in the Action already includes representatives and institutions involved in most of the referenced initiatives. This would facilitate the communication and coordination. At the same time, it represents an indication that the Action does have the critical mass to play a central role in the research community.

C. OBJECTIVES AND BENEFITS

C.1 Main/primary objectives

The main objective of the Action is to increase the quality and the impact of European research in the field of Traffic Monitoring and Analysis (TMA). The first goal is to give coherence to the European research agenda in the field, by promoting factual coordination among the individual research groups, sharing of operational know-how (lessons-learned, problems found during practical deployment, ideas for real-world exploitation of TMA techniques, etc.). It will achieve a better focus onto commonly recognized problems of interest for real-world applications, i.e. realign the problem-driven and curiosity-driven approaches. The Action will foster the interoperability of the monitoring tools, data formats and analysis modules developed by the researchers. Special attention will be given to promote the testing and experimental adoption by the industry of the tools developed by academic groups. It will promote the adoption of common open platforms by the researchers, thus catalyzing the bottom-up emergence of a European de-facto standard for traffic monitoring. The combined result of such objectives will be to improve the practical applicability of the research results, i.e. to boost the adoption by the industry of the research results. Besides sharing the tools and the research outcome, the Action will foster the adoption and improvement of existing shared databases of information sources and traffic traces (e.g. MOME), that could be used as benchmarking dataset when developing and testing novel algorithms/tools/modules.

This will allow researchers to validate their results against a wider set of cases which are often limited by practical constraints. On the academic side, the Action will promote inter-disciplinarity and cross-fertilization. It will encourage the adoption in TMA research of methods and concepts already developed in other fields (statistics, econometrics, signal processing, data mining etc.).

C.2 Secondary objectives

The Action aims at becoming the main reference point for the European research in the field of TMA. This in turn would facilitate the launch of collaborations and joint activities with non-European entities in the field, e.g. CAIDA in US, and/or with the research communities of other fields. By representing the European-TMA community, it would also facilitate the coordination with other European projects and initiatives (e.g. GEANT2, FIRE).

C.3 How will the objectives be achieved?

The Action will implement the following instruments:

- Setup a TMA portal and associated electronic collaborations tools (thematic discussion forums and mailing lists) targeting also external audience;
- Organize regular coordination meetings (at least two per year, following each MC meeting) giving particular emphasis to technical discussions and presentations; representatives from EU projects and externals experts will be regularly invited to participate to the technical discussion;
- Organize a series of yearly workshops, inviting key speakers and lecturers from other scientific fields;
- Releasing a series of Annual Reports (total of four); specifically the initial Report is meant to offer an extensive survey on the state-of-art of TMA research and level of real-world applications;
- Organize summer schools (total of three) and seminars for young researchers.
- Organize short visits for senior participants (<1 month), and long-term visits for young researchers (1-3 months) to be allocated on a competitive basis.

C.4 Benefits of the Action

The high-level Action benefits can be summarized as follows (ref. Section B and C1).

- Increase the level of coherence to the European research agenda on TMA, hence its impact;
- Achieve a common framework of tools and platforms, hence set the basis for an European de-facto standards for TMA platforms;
- Increase the quality and level of inter-disciplinarity of TMA research;
- Improve the communication and know-how sharing between industrial and academic research groups, thus fostering innovation transfer and real-world application of the research results;
- Increase trans-national collaborations and exchanges, especially involving young researchers.

- Facilitate early dissemination of preliminary results; promote validation works

C.5 Target groups/end users

The first beneficiary of the Action will be the European research community at large. Researchers from other fields will find in the Action a unified reference point to explore inter-disciplinary collaborations, while researchers within the TMA field will benefit directly from a more coherent research agenda and common framework of tools, as explained above.

The convergence towards a unified technology framework for TMA will directly benefit the European industry players, including network operators, network equipment manufacturer, system integrators and software developers. The emergence of a de-facto European standard for TMA that is research-driven (rather than industry-driven as in most FP7 initiatives) would generate additional potential opportunities also for new companies rooted in the academic environment (e.g. spin-offs and/or joint ventures).

EU officials and people involved in EU initiatives would find in the Action a unified reference point regarding TMA research and applications.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The scope of the research coordinated by the Action includes a variety of specific topics that can be classified into the following applications:

- Traffic Classification, Characterization and Modelling: designing and planning telecommunication networks was always based on traffic measurements, out of which traffic models and performance estimates are built.
- Large-scale Performance Monitoring: to quantify the actual network performances at a large-scale, so as to reveal global drifts and/or local degradation, triggering intervention by the network staff; Quality of Service and Service Level Agreement monitoring are based on large-scale performance monitoring, and are today becoming more and more important.
- Network Tomography and Topology Discovery: to infer the status of internal network elements and connection links from a parsimonious number of measurement points; they can be used to detect network problems (e.g. failures, bottlenecks) in a cost-effective way.
- Anomaly and Intrusion Detection: to detect security threats, attacks, infections or misconfigurations and any other macroscopic event in the traffic pattern, deliberate or not, that require attention by the network administrators.

Traffic Classification, characterization and modelling is the primary means to understand both network user habits and applications, out of which design and manage the network infrastructure and services.

While this process proved to be reasonably simple in traditional circuit-switched telephone networks, it seems to be much harder in packet-switched data networks. In the Internet in particular, the client-server communication paradigm introduces correlation both in space and time, and Internet traffic exhibits much stronger time dependencies than telephone traffic. Furthermore, the continuous evolving of the Internet applications makes this process even stiffer. For example, the explosion of peer-to-peer applications and their adoption of cryptography techniques pose new challenges to the traffic classification and characterization. All of these spurred a huge effort from the research community, which is far from the end.

Once the traffic classification and characterization has been (possibly partly) solved, an infrastructure able to continuously monitor the network infrastructure must be designed and managed. Given the current trend towards larger networks and faster links, the large-scale Performance Monitoring problem is far from being solved. Indeed, the amount of information that must be collected and processed poses significant limitation to the actual implementation of a monitoring infrastructure. Designing, implementing and managing a monitoring infrastructure is therefore a key aspect that must be faced, addressing questions about what to monitor, how to monitor, where to monitor.

Moreover, a performance monitoring infrastructure will allow to setup network tomography and topology discovery, which allow to monitor internal network elements and to early detect failures or misbehaviours. The goal of network tomography and topology discovery is to get an updated picture of network elements status by using a reduced set of probes, be they active or passive probes. Simple topology or route discovery, or more complex bottleneck identification, are examples of typical network tomography problems.

Finally, routinely the network behaviour shows unusual events which need to be classified in order to choose the appropriate response. The main challenge in automatically classifying anomalies is that anomalies can arise from several reasons: malicious users, equipment failures, unusual but otherwise legitimate user behaviour. Another problem of automatic anomaly detection is that the events to be detected depend very much on the available data. A general system capable of automatically distinguishing between different types of anomaly that can show similar symptoms is an ambitious goal. A further element to be considered is that a general system cannot be restricted to identify a predefined set of events of known origin, but must be open to new anomalies, especially in the case of malicious ones. Clearly, anomaly detection is possible only building over the knowledge of “normal” behaviour, as obtained by efficient and accurate traffic classification and characterization, large scale monitoring and current status of the network.

D.2 Scientific work plan – methods and means

The Action aims to provide researchers with a fertile environment over which exchange their experiences and ideas. The internal organization of activities will be divided into three Working Groups (WG). These are meant to allow sharing of information rather than build tight containers. The vertical organization is more effective than the horizontal approach (i.e. topic-wise partitioning) in order to promote cross-fertilization and coordination – and possibly integration - between the various approaches.

The WGs are:

- WG1 : Monitoring and data collection technologies
- WG2 : Traffic Measurement and Analysis
- WG3 : Applications and practical exploitation

WG1 focuses on problems related to the traffic monitoring and data collection with the aim of defining a common format and database of traffic traces that can be shared among partners. Both software and hardware probes will be investigated, so that existing and new technologies can be made available and shared among partners. A common format for storing meta-information about the traffic traces will be defined and a shared database of real traffic traces will be created. The aim is to provide the research community a benchmarking dataset and related methodology useful to test, to verify and to validate algorithms, tools and modules. All the information will be made available to the partners and the research community, considering possible limitation due to privacy or IP related issues. This will allow an easy retrieval of information among partners that will be pushed to contribute to the database itself.

WG2 focuses on traffic measurement and analysis techniques. Researchers involved will investigate properties of the traffic traces collected at several measurement points as made available by partners by the means of WG1. Following a layered approach, traffic characterization will be performed at the packet (IP) layer, considering and revisiting the correlation characteristics of Internet traffic. Similarly, properties at both the transport (TCP/UDP) and the application/user layers will be investigated. The aim will be the modelling of the traffic at the different layers, so to offer the researcher a shared knowledge of what is the current traffic the Internet is carrying. Each partner will contribute to the common understanding of today traffic, so that a community of experts will be created. As in the past, traffic models will be instrumental to the performance evaluation of new protocols, applications, technologies that will be developed by the research community.

Building over the traffic characterization, novel classification techniques will be investigated. In particular, novel methodologies will be developed with the aim to circumvent cryptography techniques recently adopted by application developers. Indeed, cryptography makes it hard for traditional packet inspection mechanisms to be effective. For example, the traffic pattern at both the network and transport layer will be investigated, so to define and identify the typical behaviour of each source or application. Also in this case, the Action will provide support for the sharing of ideas, algorithm and tools among partners, and it will allow the creation of a group of TMA experts.

Once the typical source behaviour has been defined, it will then possible to identify misbehaving patterns, so that anomaly detection mechanism can be studied. By having access to the research results and to the benchmarking database provided by partners, it will be possible to test, share and review novel ideas and propose and study effective algorithms that can be instrumental to face the anomaly detection problem. Only by sharing the knowledge of such a complex scenario like the one posed by today Internet traffic it will be possible to succeed in this goal. The Action will therefore encourage the sharing of knowledge, and the creation of common tools to enable European researcher to face such a complex task.

WG3 aims therefore at enhancing the outcome of WG2 activities in order to provide a common set of tools and applications that efficiently implements the proposed algorithms. Indeed, today each research group has produced its own tools and instruments to face TMA problems. The Action will instead provide an excellent occasion to share those tools, to which partners will be encouraged to contribute, following an Open Source approach. This will provide both the research community and the telecom operators a set of application that will facilitate TMA tasks.

E. ORGANISATION

E.1 Coordination and organisation

Following the COST Guidelines, the Management Committee (MC) will be in charge of the overall supervision of the Action. The MC will have one Chair, one Vice-Chair and a Secretariat. MC Meetings will take place at least twice per year as described in Section F. Each MC Meeting will be open to participation by all the involved experts as non-voting members. The nominating COST countries are encouraged to nominate young researchers as MC members.

In the first meeting, the MC will nominate a special task force to setup and maintain the TMA-portal and the other electronic collaboration tools. The TMA-portal will be launched within month 6. The role of the TMA-portal is described in details later in Section H.

The Action will nominate an Editorial Task Force which will be in charge of coordinating the editorial production of the Annual Reports due at month 12, 24, 36 and 48. The first Annual Report (month 12) will contain an extensive state-of-art review of TMA research and a survey of the related applications.

Each Working Group will nominate a WG Steering Board (WGSB) which will coordinate the WG specific activities. The WGSB will organize the technical meetings to take place after each MC meeting. External key speakers, also from other disciplines and/or from industry, will be regularly invited to attend the technical meetings and to give seminars or talks.

The partners will be encouraged to freely create new small Focus Groups (FG), within or across Working Groups, where specific subjects are investigated. A great level of flexibility will be assured in the setup of FGs. Each FG will involve researchers from not less than three different countries. The ultimate goal of each FG is to support operational collaborations between the partners interested in specific topics: organize student/PhD exchanges, carry on joint laboratory activities, and produce joint publications. Young researchers will be encouraged to take an active role in starting and leading new FG. The achievements of each FG will be reported regularly to the WG and/or MC meetings. The MC and the WGSB will monitor the activities of the FG and assure inter-FG coordination, e.g. encouraging the adoption of common platforms. Where applicable, FG can request financial support for individual activities to the MC, which is the only entity responsible for the budget handling.

Half of the MC meetings will contain a Workshop, possibly connected to a suitable conference or held jointly with another event. All Workshops will be open to the general scientific/engineering public.

A Summer School will be organised every year starting from Year 2, conditioned to budget availability for such initiative. Target audience are PhD students and young researcher willing to face TMA activities during their research activities.

E.2 Working Groups

The work will be structured into 3 Working Groups (WG):

- WG1 : Monitoring and data collection technologies
- WG2: Traffic Measurement and Analysis
- WG3 : Applications and practical exploitation

The WG structure reflects the intrinsic vertical layering of the TMA process: acquisition of data from the network (WG1), extraction of information from the data (WG2) and exploitation (WG3). The vertical organization is more effective than the horizontal approach (i.e. topic-wise partitioning) in order to promote cross-fertilization and coordination – and possibly integration - between the various approaches.

E.3 Liaison and interaction with other research programmes

The Action will interact with several other initiatives.

- The FP6 GEANT2 project (Sep.2004-Mar.2009), within its Joint Research Activity 1 (JRA1) has developed a framework and associated software for piloting a set of existing network monitoring tools in a consistent way in a multi-domain environment. The software suite is called perfSONAR and is publicly available. The Action will encourage the adoption of perfSONAR as a research tool as well as the integration of new research results (e.g. analysis modules) within the suite.

- The MOME project (http://www.ist-mome.org) established a platform for knowledge exchange in the field of internet monitoring and measurements. It established a (still maintained) online database to exchange information on mo/me data and tools. This platform will be promoted and can be further used and enhanced within the Action.

- The Action will establish liaisons with the Networks of Excellence (NoEs) EMANICS and EuroNGI, promoting sharing of information and results.

- The Action will establish active liaisons with those projects that are focused on traffic measurements: LOBSTER (FP6), TRAMMS (CELTIC initiative) and the forthcoming FP7 projects in the area (e.g. the MOMENT project that is now in the negotiation phase).

- The Action will collaborate with the FIRE initiative that has been recently announced, on the basis of the common understanding that TMA will be a key component of the future generation networks.

Notably, the List of Experts participating to the Action already includes representatives and institutions involved in most of the referenced initiatives. This would facilitate the communication and coordination. At the same time, it represents an indication that the Action does have the critical mass to play a central role in the research community.

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerately involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.

Early-stage researchers will take an active role in the management and organisation of the Action itself, e.g. leading task-forces, taking on coordination responsibility. Young scientists will be solicited to act as MC members or otherwise participate to the MC meetings as auditors. The Action will favour budget allocation for the reimbursement of missions and travels of young researchers.

F. TIMETABLE

The Action will last four years. A minimum of two MC Meetings and one Workshop will take place every year. The Workshop is meant to give external visibility to the Action. It can be held in connection to relevant conferences or other events, including other COST activity meetings. Typically, the Workshops will take place jointly with one MC meeting. The schedule of MC Meetings and Workshops is summarized in Table 1. Each MC Meeting will take place during two days (exceptionally three) and will contain a general management assembly (half-day) plus a set of parallel technical meetings. Technical meetings are typically associated to WG, but can also be dedicated to specific topics. Additional technical meetings can be organized ad-hoc outside the MC Meetings if needed.

One Summer School for PhD students will be organized every year starting from Year 2.

The Action will organise a programme of short seminars inviting external experts as speakers, e.g. experts from other disciplinary fields and/or representatives from industry.

The first version of the Action portal will be ready after 6 months from the kick-off MC.

In Year 1, the Action will carry on an extensive survey of state-of-the-art of TMA research, with particular attention to inter-disciplinary research lines, as well as of the actual TMA practice among network operators. This activity will result in the first Report of the Action at the end of Year 1 which will serve as the basis for the planning of future activities. Two Progress Reports will be delivered at the end of Year 2 and Year 3, and the Final Report at the end of Year 4.

Month	What	Notes and Milestones
0	Kick-off MC meeting	Elect WG chairs, nominate task forces
6	2nd MC meeting	Presentation TMA portal (first version)
12	3rd MC meeting + 1st workshop	Delivery of 1st Annual Report
18	4th MC meeting	
24	5th MC meeting + 2nd workshop	Delivery of 2nd Annual Report
30	6th MC meeting	
36	7th MC meeting + 3rd workshop	Delivery of 3rd Annual Report
42	8th MC meeting	
48	9th MC meeting + 4th workshop	Delivery of Final Report

Table 1

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: Austria, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, The Netherlands, Norway, Poland, Romania, Portugal, Spain, Sweden, Switzerland, United Kingdom. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 110 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

The above calculation is based on an average of 5 person-years for each participating country.

H. DISSEMINATION PLAN

H.1 Who?

The intended targets for the dissemination of the Action results are:

- International research community involved in the TMA field;
- Researchers from other fields, e.g. data mining, statistics, signal processing, computer science;
- Industry players, primarily network operators and equipment vendors;
- Technical staff from academic networks and Public Exchange Points;
- EU projects and initiatives in the area of Networking.
- Standardization bodies, particularly the IPFIX working groups at IETF.

H.2 What?

The following means of dissemination will be used, with the modalities described in the next subsection:

- TMA-portal, thematic mailing list and discussion forums;
- Series of Workshops (one per year), with published proceedings;
- Technical reports and articles in peer-reviewed journals and conferences;
- Annual Reports from the Action;
- Contributions to standardization bodies, primarily IETF IPFIX wg;
- Organisation of special sessions international conferences.

H.3 How?

The first means of dissemination is the "TMA-portal". Besides serving as a centralized collaboration platform within the Action (e.g. for document sharing), the portal is aimed at becoming the most qualified online resource in the field of TMA, i.e. the natural point of reference for experts in the field, from both academy and university. The portal will publish all the material produced within the Action: scientific papers, technical reports, presentations, even informal summary notes from the technical meetings. The portal will be designed for interactive use with Web 2.0 technologies. It will include a wiki and news feeds, host discussion forums and thematic mailing lists, provide the possibility to post public comments about published articles. The TMA-portal will be launched within the first six months of the Action and will be kept continuously updated. A special task force will be set at the kick-off MC meeting to build and maintain the TMA-portal, and assure the regular update of its content. The Action will continuously monitor the popularity and the usage level of the portal through quantitative indicators, which will be revised at each MC meeting.

The Action will promote the active participation to the portal resources by its members and will promote the role of the TMA-portal as a central hub for other European initiatives in the field of TMA (e.g. FP7 projects).

The research results will be published in international journals and conferences where the Action support will be explicitly acknowledged.

The annual workshops organised by the Action, usually in conjunction with other major conferences, will include invited keynotes and lectures by external experts, particularly scientists from other discipliners and representatives from network operators, thus serving as a dissemination channel with them. The workshop material will be published in proceedings and posted on the TMA-portal.

The Annual Reports produced by the Action will be regularly published on the TMA-portal for public access. The Final Report will be published as a book.

The ultimate goal of the Action is to promote the bottom-up emergence of research-driven standards for traffic monitoring. However the Action will seek a liaison with selected standardization bodies, e.g. the IPFIX wg at IETF. It will encourage and coordinate the individual contributions by its members to these bodies (e.g. IETF meetings).

The Action will promote the organization of special session within international conferences on specific topics within the TMA scope. For example, special sessions could be devoted to scientific papers presenting validation works of previously proposed analysis methods and tools.