European Cooperation
in Science and Technology
- COST -

Secretariat

Brussels, 8 Decemberr 2011

COST 4175/11

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action IC1104: Random Network Coding and Designs over GF(q)

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 183rd meeting on 30 November 2011.

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

COST Action IC1104
RANDOM NETWORK CODING AND DESIGNS OVER GF(Q)

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 4154/11 "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 advance European research in the field of random network coding and designs over GF(q) by cross-linking a number of European expert groups from several distinct disciplines and areas in information and communication technology.

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 EUR 24 million in 2011 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 4 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.

A. ABSTRACT AND KEYWORDS

Random network coding emerged through an award-winning paper by R. Koetter and F. Kschischang in 2008 and has since then opened a major research area in communication technology with widespread applications for communication networks like the internet, wireless communication systems, and cloud computing. It allows transmitting information through a network by disregarding any of its topological features. As in traditional algebraic coding theory, two main research directions in random network coding are

1. existence and construction of good and optimal network codes,
2. efficient encoding and decoding schemes for a given network code.

Restriction to the so-called Grassmannian codes has proven to be advantageous and leads to the theory of designs over GF(q). Worldwide, there exists a larger number of workgroups focusing on this topic, which includes several groups located in Europe. This COST Action will set up a European research network and establish network coding as a European core area in communication technology. Its aim is to bring together experts from pure and applied mathematics, computer science, and electrical engineering, who are working in the areas of discrete mathematics, coding theory, information theory, and related fields.

Keywords: Random Network Coding, q-ary Designs, Optimal Code Construction, Decoding Algorithm, Large (Wireless) Networks and Cloud Computing.

B. BACKGROUND

B.1 General background

With the rapid progress of communication technology over the last years, a wide variety of communication scenarios became relevant. In particular, the demand for high-bandwidthchannels, as well as the use of a common channel for the communication between several sources and sinks, i.e. wireless network communication, pose new interesting challenges.

Contemporary communication and computation environments, like the internet, wireless communication, and cloud computing, are based on a certain mathematical model of the communication channel. This model is a directed graph carrying an information flow with possibly several information sources and sinks. In 2008, a seminal and award winning paper by R. Koetter and F. Kschischang provided the mathematical foundations for this communication scenario: an algebraic theory of network coding. Network coding has since then generated much interest among experts in information theory, coding theory, complexity theory, and cryptography.

In the communication model at hand, a projective geometry, i.e. the set of all subspaces of a finite vector space, serves as communication alphabet. It is equipped with a metric that can be derived from the rank function on the given projective geometry. A network code is defined as a subset of the given projective geometry, and similarly to the situation in traditional coding theory, there arise two conflicting goals:

1. maximize the number of elements in a network code (which at the same time will maximize the rate of information transmission), and
2. maximize the smallest distance between two codewords (which will allow for extensive error correction).

A particular family of network codes is that of Grassmannian codes. These codes consist of elements of the projective geometry having the same dimension. The investigation of Grassmannian codes is closely related to the mathematical theory of designs over GF(q). Here, GF(q) denotes the finite field with q elements. Sophisticated recipes have been provided to construct such designs, and hence the question of the construction of good network codes is in strong interrelation with results from the theory of designs over GF(q). Network coding and the theory of q-ary designs are therefore an emerging area of research as can also be seen by a number of research projects and conferences that are currently funded:

- Research Project of the Deutsche Forschungsgemeinschaft: “Coding Techniques for Transmitting Packets through Complex Communication Networks”, 2009 – 2013.
- Research Project of the Swiss National Science Foundation: “Algebraic Construction of Network Codes”, 2009 – 2011.

- Research Project of the Croatian Ministry of Science: “Combinatorial Designs and Finite Geometries”, 2007 – 2011.
- Research Project of the Israel Science Foundation: “Codes in Graphs Derived from Modern Concepts in Digital Communications”, 2008 – 2011.
- The 2011 International Symposium on Network Coding: “NetCod 2011”, July 25 – 27, 2011, Beijing, China.
- International Workshop: “Algebraic Structure in Network Information Theory”, August 14 - 19, 2011, Banff International Research Station, Canada.
- Workshop: “The Network Coding Applications and Protocols Workshop, NC-Pro 2011”, May 13, 2011, as part of the Networking 2011 Conference, Valencia, Spain.

From the above, it appears that there is a growing international research community engaged in initiatives that are funded in the framework of national research projects. There exist bilateral relationships for collaboration, however there is no European framework within which the network coding community could co-operate and manage its collaboration. This COST Action will provide a basis on which researchers from different horizons (mathematics, engineering, and computer science) can collaborate. This Action will also stimulate and promote scientific competition within this discipline in order to establish leadership at a European level. It appears to be the most appropriate setting due to its flexibility regarding new participants joining the Action while the project is in progress.

It needs to be emphasized that the research field at hand provides a strong competition for scientific excellence between researchers in Europe, the United States, and the Far East. The COST Action will be established in the right time to fund networking of research activities at a national level and creating synergies all over Europe. The benefit from this project and its associated activities are expected to be of scientific and of technological nature. The Action will help to bridge gaps between the three disciplines of mathematics, computer science and electrical engineering. At the same time the findings of research in this discipline will affect the broader scientific and technology community through its impact on global communication technology like the internet, wireless networking, and cloud computing.

As a result, it is of primary importance that researchers and developers from all three communities work together towards the development of new design and optimization methodologies for network coding. A COST Action is the appropriate framework for this, particularly as it promotes the required collaboration.

B.2 Current state of knowledge

Network coding originated with a seminal paper by Ahlswede et al. in 2000. *Random network coding* was proposed in 2003 as a new method for multicast or in cast networks. The crucial idea is that interior network nodes independently choose a random linear combination of the inputs to transmit the information to their outputs. It has been shown to be a very powerful tool for disseminating information in networks, yet it is susceptible to packet transmission errors caused by noise or intentional jamming. Indeed, in the most naive implementations, a single error in one received packet would typically render the entire transmission useless when the erroneous packet is combined with other received packets to deduce the transmitted message. It might also happen that insufficiently many packets from one generation reach the intended receivers, so that the problem of deducing the information cannot be completed. This was the motivation for Koetter and Kschischang to introduce coding concepts for errors and erasures in a random network coding setting. Their 2008 article was awarded the 2010 IEEE ComSoc & IT Joint Paper Award, and it opened a major new research area with interest to mathematicians, computer scientists, and engineers.

An important characteristic of the initial works on network coding was its dependence on the network topology. Indeed, until recently, a network code was designed per a particular network, and therefore, there was need to design an appropriate code for each network. Moreover, for a network with a topology changing over the time, it was sometimes impossible to use the same code through a longer period. This imposed significant limitations on the use of network coding, in particular for wireless and ad hoc networks, where the topology can change rather rapidly. The random network coding approach was a significant step toward robustness of the network code design. By introducing coding for random (or non-coherent) networks, the problem of network design was separated from the problem of code design. This opens a door to a wide variety of new possible applications of network coding, while defining a clear mathematical framework for the code design problem.

Worldwide, a number of workgroups is focusing on network coding; several of these groups are located in the United States and the Far East, whereas in Europe at least seven groups can be identified in this area. The different research emphasises of these groups are quite complementary. Among the most important questions that the COST Working Groups will address, the following are emphasized: 1) Establish upper bounds for Grassmannian codes, 2) Find efficient methods for encoding and decoding, 3) Incorporation of cryptographic aspects, 4) Code constructions, 5) Check mechanisms for structural equality of network codes.

The innovative nature of this COST Action is that it does not focus on a certain, application-oriented problem in the area of communication networks, but rather promotes the exchange and collaboration between experts with a wide variety of backgrounds. In many respects, network coding theory is still in its premature state and major breakthroughs will likely depend on the integration of expertise from different fields.

This Action will be the key to the establishment of a high-profile scientific European platform for random network coding, and it will constitute a stimulation of scientific competition within this area to establish a leadership on the European level. It should be noted that this research field has a strong competition for scientific excellence between European, Asian, and US based researchers. This COST Action enables the creation of synergies and the mobilisation of competencies all over Europe, and will therefore significantly strengthen the role of Europe in the domain of random network coding.

B.3 Reasons for the Action

Network coding and the theory of designs over GF(q) covers a wide range of research problems. It encompasses a large range of applications in wired and wireless communications, as well as in computational areas like cloud computing. Progress in this field of interest requires collaboration between researchers from Mathematics, Computer Science, and Electrical Engineering. The COST framework provides an ideal means to bring together researchers from all three communities in order to share as well as enhance their expertise through extensive collaboration. Researchers covered by the COST framework will enjoy the flexibility to pursue their respective research programmes funded under national funding agencies, whereas exchange between various groups in Europe will be vastly stimulated and supported by the Action.

This COST Action will also assist the professional advancement of young researchers by providing support for training schools at the affiliations of groups that have joined the Action.

B.4 Complementarity with other research programmes

From the list in B.1 it is apparent that there are several national research projects concerned with various aspects of random network coding. These usually include bilateral collaboration visits, however there is no forum for co-operation of the network coding community on the European level.

Furthermore, this Action will be linked to research efforts of several ongoing FP7 research projects, and it will act in a complementary manner to existing COST Actions, dealing with a variety of related communication and networking issues. A non-exhaustive collection of such projects, along with their starting years, is listed below.

- COST Action IC1101: Optical Wireless Communications - An Emerging Technology, 2011.
- SAPHYRE: Sharing Physical Resources & Mechanisms and Implementations for Wireless Networks. Funded under Seventh Framework Programme, 2010.
- N-CRAVE: Network Coding for Robust Architectures in Volatile Environments. Funded under Seventh Framework Programme, 2008.
- DAVINCI: Design and Versatile Implementation of Non-binary Wireless Communications based on Innovative LDPC Codes. Funded under Seventh Framework Programme, 2008.
- COST Action IC0803: RF/Microwave Communication Subsystems for Emerging Wireless Technologies (RFCSET), 2008.
- COST Action 293: Graphs and Algorithms in Communication Networks, 2004 (finished).

It should be noted that the focus of the Action is on research coordination while the calls within FP7 are focused on research and infrastructures.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The main objective of this Action is to advance European research in the field of network coding and designs over GF(q) towards a development and implementation of network codes of high quality, by cross-linking a number of European expert groups from several distinct disciplines and areas in information and communication technology. As a possible deliverable, this COST Action will foster the adoption of improved network codes as well as encoding and decoding algorithms in large networks. This will allow researchers worldwide to validate results against European standards set up by the participants of this Action.

C.2 Objectives

This COST Action aims to provide coherence to European research in the field of communication in large networks. It will promote collaboration between various research groups joining this Action. Coherent European research endeavour based on this Action will lead to a number of peer-reviewed publications and a major international conference in the field of random network coding and its applications.

Based on research simulated by this Action, a number of new (families of) network codes will be developed along with efficient encoding and decoding schemes. Simultaneously the theory of designs over GF(q) will be advanced as it is a source for network codes which are optimal or of high quality.

Specifically this Action intends to bridge gaps between the three disciplines of mathematics, computer science and electrical engineering. This will be achieved by extensive collaboration on research topics in network coding where the three disciplines complement each other. In this way, random network coding will emerge as a truly interdisciplinary science in communication technology.

This Action also aims at the development of highly qualified young academic offspring in the field of communication theory and technology. This will be accomplished by intensive scientific exchange of students among the participating institutions.

C.3 How networking within the Action will yield the objectives?

The majority of objectives of this COST Action will be accomplished through the organization and co-ordination of meetings. In the framework of this Action there will be one initial meeting, and two management meetings per year. In all meetings there will be a clear emphasis on organisational issues, scholarly activities and technical discussions. External experts from the United States and the Far East will be invited to attend meetings in order to serve as advisory instances.

The Action foresees the following concrete measures to achieve its goals:

- a project website containing results of current research and facilitating exchange of data,
- regular reports after each year describing the current state of research,
- workshop organization including workshop proceedings; four workshops are envisaged,
- one major conference in the 4th year with international audience,
- a final project report

C.4 Potential impact of the Action

This COST Action connects a number of European expert groups dedicated to highly relevant research topics in the algebraic theory of network codes. Joint work and progress on this rather recently established field will strengthen the role of Europe in this discipline, and at the same time it will stimulate the collaboration and exchange of expertise. Progress in the theory of network coding will advance mathematical and engineering methods of high technological impact.

The exchange of ideas from different fields can help tackling some of the open problems of central importance in information and coding theory, and at the same time, spark the interest of a broader community in mathematics and computer science for the problems that arise in these applied fields. The Action will particularly emphasize the role of interdisciplinary research and development; its contemporary and future applications will include efficient communication in networks like the Internet by faster and more reliable data transmission.

C.5 Target groups/end users

Over the last decade, various types of communication networks have become an integral part of our everyday life. The growing need to combine various types of information (such as data, voice and video) in one network has stimulated the growing interest in the development of fast and bandwidth-efficient data networks.

The random network coding approach allows to increase the network throughput while preserving the underlying physical network infrastructure. This method potentially leads to a more efficient utilization of the network bandwidth at a very low cost. This is why there is a lot of interest, both in the scientific community and in the industry, in the network coding area. Indeed, many ongoing research activities are taking place in universities around the world. There are also some attempts to implement various aspects of network coding in industrial communication applications.

The results achieved by this COST Action will be of high relevance for all providers of network communication, where the internet is particularly emphasized; it will also be of benefit for cloud computing providers like Google Apps and Amazon Web Services. An as important beneficiary of this Action will be the European research community in information technology. Researchers from different areas will find a high-impact opportunity for interdisciplinary collaboration.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

In the network coding model of R. Koetter and F. Kschischang (2008), a finite projective geometry, i.e. the set of all subspaces of a (finite) vector space, serves as communication alphabet. It is equipped with a metric that can be derived from the rank function of the given projective geometry. Information flow in the network at hand is performed in the following way: at a source, sequences of points (spanning the respective subspace to be transmitted) are inserted and passed along the edges of the underlying directed graph. In every vertex of this graph, random points in the span of points arriving via the incoming edges are selected and passed along the outgoing edges. In the information sinks, the span of the points arriving at the incoming edges is formed and considered as the received word. Random network coding seeks to make the information flow robust against losses (erasures) and erroneous insertions (errors).

A particular family of network codes is that of Grassmannian codes. These codes consist of subspaces that are all of the same dimension. The investigation of Grassmannian codes is closely related to the mathematical theory of designs over GF(q). Sophisticated recipes have been provided to construct such designs, and hence the question of the construction of good network codes is in direct dependency on results from the theory of designs over GF(q). Silva, Kschischang, and Koetter (2008) showed that a subclass of constant dimension subspace codes can easily be constructed by means of rank-metric block codes. The subspace codes preserve the distance properties of the underlying rank-metric code. Furthermore, minimum distance decoding of these subspace codes can be realised by an error-erasure decoder for rank-metric codes. A special class of rank-metric codes are Gabidulin codes, which were introduced by Delsarte (1978), Gabidulin (1985) and Roth (1991). Since they are the rank-metric analogs to Reed-Solomon codes, there exist several efficient decoding algorithms.

The most important research tasks to be co-ordinated by this COST Action will be the following:

1. Bounds on the size of network codes. It is particularly foreseen to obtain versions of the traditional Elias-Bassalygo bound, the linear programming bound, and other prominent existence bounds.
2. Development of encoding and decoding schemes. The decoding problem for a general (random) code is known to be NP complete. In front of this background there is a demand for efficient decoding algorithms based on structural network codes, e.g. spread codes, cyclic codes, orbit codes, and the class of Gabidulin codes. A promising new approach is the construction and decoding of convolutional codes based on rank-metric.
3. Cryptographic aspects. The design of a secure network coding scheme is a challenge of new nature, as the presence of the intermediate nodes lead to wiretap attacks or pollution attacks. In recent years, solutions have been proposed based on homomorphic hashing and homomorphic signatures.
4. Construction of network codes and Grassmannian codes. In order to construct families of good network codes and/or designs over GF(q), efficient computer based searches for optimal structures with certain assumptions on underlying symmetry groups will be undertaken.
5. Foundational aspects. Algebraic coding theory comes with a number of powerful theoretical tools, like MacWilliams' equivalence and weight enumerator theorems, mass formulae, Mattson-Solomon transforms and the like. An establishment of amended versions of these tools will vastly advance the theory and methods of network coding.

D.2 Scientific work plan - methods and means

This COST Action will provide research projects for five Working Groups which correspond to the research areas defined in the foregoing subsection:

1. Bounds on the size of network codes,
2. Development of encoding and decoding schemes,
3. Cryptographic aspects,
4. Construction of network codes and Grassmannian codes,
5. Foundational aspects.

The themes for the Working Groups are specifically designed to be open and flexible to future inclusion of new members to the Action, but also to allow members to participate in more than just one Working Group. The following presents a more detailed description of the areas covered by the Working Groups.

1. Bounds: Traditional algebraic coding theory is aware of a number of existence bounds for linear and non-linear error-correcting codes. Among the restrictive examples of bounds, one has to mention the Plotkin and Elias-Bassalygo bound, the sphere-packing bound, the Singleton bound, whereas bounds like the Gilbert-Varshamov bound and the BCH-bound are assertive and often provide construction mechanisms for good codes. This Working Group will focus on the mathematical task to formulate and prove amended versions of traditional bounds, or to provide new bounds for network codes. From possible assertive bounds it is expected that new construction methods will be provided to the benefit of the work in Working Group 4.

2. Encoding and Decoding: As in traditional coding theory, practicability of a network code results from the question if there are efficient encoding and decoding schemes. Whereas encoding is usually an efficient task for algebraically induced structures, decoding is a highly non-trivial task as it is not simply the reverse of encoding but also comprises the correction of the erasures or erroneous insertions that have occurred during transmission. This task is devoted to the computer science/engineering endeavour of designing efficient algorithms and will be influenced by the results introduced in the work of Working Group 4. As a new class of network codes, convolutional network codes based on rank-metric should be designed. For this purpose, the class of so-called Partial Unit Memory (PUM) codes will be used. PUM codes are convolutional codes based on block codes, which allows to estimate the distance parameters and to design efficient decoding algorithms based on the underlying block code. The construction of PUM codes based on Gabidulin codes should be investigated and an efficient decoding algorithm should be developed. For the application of random linear network coding, the rank-metric based PUM codes will be extended to subspace codes. This will be done in a way similar to Silva, Kschischang and Koetter's approach using rank-metric block codes.

3. Cryptography: Beside an improvement of communication reliability, the security aspect of network coding can be addressed separately. In fact, the design of a secure network coding scheme is a challenge of new nature, as the presence of the intermediate nodes lead to wiretap attacks or pollution attacks. During the recent years, solutions have been proposed based on homomorphic hashing and homomorphic signatures. The work on this aspect is of computer scientific/mathematical nature and will have major impact in communication via the Internet.

4. Constructions: Traditional coding theory is aware of two different construction issues, one of them a purely practical, where the other being more theoretical and particularly touching asymptotic aspects of coding. The former type of construction is interested in codes of small size and small length that come with efficient encoders and decoders and are ready for implementation in communication devices. The latter focuses on the existence of infinite families of codes for which information rate and error-correction capabilities are clearly bounded away from zero. Particularly in search of good network codes of relatively small size in small projective geometries intelligent searches based on assumptions on the inner symmetry of the code can significantly help the construction process. This task is of highly mathematical nature and requires strong computational power for the resulting searches. Judging the quality of its outcomes will require results from Working Group 1.

5. Foundations: Aspects of code equivalence, distance distribution and the like are important for classification and comparison of given network codes. They also provide powerful theoretical tools that facilitate successful work in Working Group 1 to 4. These questions are of mathematical nature and significantly impact the research field.

E. ORGANISATION

E.1 Coordination and organisation

This COST Action will be co-ordinated by a Management Committee (MC). This committee will consist of one Action Chair, one Co-Chair, and the MC members nominated from each participating country, according to the COST Guidelines. The nominating COST countries will explicitly be encouraged to nominate early-stage researchers as MC members.

The Action will start with an initial meeting, after which further MC meetings will take place twice a year as will be described later. The MC will be responsible for co-ordinating the editorial production of the Annual Reports at the end of each year.

The research lines of the Action will be monitored by the Working Groups (WG), through their respective Chairs and Vice-Chairs. The partners will be encouraged to welcome and accommodate new members and new applications. Young researchers as well as female researchers will be encouraged to take an active role in the organization of the Working Groups. The leaders of the Working Groups will attend WG meetings, which will also take place twice a year, as part of the MC meetings.

A Workshop (WS) will be organized once a year in parallel with the second yearly MC meeting. The WS will be open to the scientific/engineering community and will potentially be held jointly with other events or conferences. Experts external to the Action will be invited to give talks at the WS.

A website for the Action will be set up soon after the initial meeting. This website will assist in the exploitation and dissemination of the results of the Action, provide information about the Action objectives as well as milestones to the scientific community. In addition, it will serve as an internal tool for data exchange and communication of the partners, providing access to the various technical reports, job openings, related Ph.D. projects, and Short-Term Scientific Missions.

E.2 Working Groups

As mentioned earlier, this Action will establish 5 Working Groups based on a natural grouping of research projects in the theory and practice of network coding. Each Working Group will be co-ordinated by two chairs elected at the initial MC meeting. It will be encouraged that the leaders of each Working Group will be from different disciplines and from different affiliations, in order to ensure that members from all three mathematics, computer science, and engineering will get involved in Working Group management functions.

E.3 Liaison and interaction with other research programmes

Interaction with other European research programmes will be accomplished by studying specific problems in the focus of such research programmes. This desired interaction is the outcome of participation of the individual researchers within such programmes that are directly funding research. The outcome of such interactions will be joint publications as well as product development between partners of this Action and researchers external to the Action.

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

The Action encourages participation of early stage researchers to all of its co-ordination activities. Early stage researchers will also be invited to participate in MC meetings as guests. Finally, as part of the Action, scientific exchanges and visits (several weeks up to months) for young researchers will be allocated on a competitive basis. This way, the Action will encourage and support capacity building among early-career European researchers.

F. TIMETABLE

This COST Action will cover a duration of 4 years. It will start with an initial meeting where the Working Group leaders will be elected and where the relevant research directions will be defined. Following this initial meeting there will be a total of 8 Management Committee (MC) meetings and four workshops which corresponds to a frequency of two MC meetings and one workshop in each year. The MC meetings will be devoted to questions of co-ordination whereas the workshops are designed to provide visibility of the involved partners in the scientific community. Each management committee meeting will take place during one full day. Technical questions and discussions are usually reserved for the workshops, however can also enter the MC meetings, particularly if organizational aspects are linked to these questions. Each MC meeting will take place in a different participating country in order to smoothly distribute responsibilities and encourage co-operation. Finally, in the 4th year there will be a major conference with an international audience.

All activities of the Action will be carefully documented in annual reports, where the initial report of year 1 will be used to redesign plans for the future development if that applies. A final report containing a summary and evaluation of the Action will be issued at the end of year 4. It is expected that a flexible exchange of researchers among the different Working Groups will take place, and that highly-reputed scholars from academia and industry will be invited to attend the workshops. The tentative schedule of the MC meetings and workshops is summarised in the table below.

Month	Activities	Reports
0	Initial Meeting	Memorandum of Understanding (MoU)
6	MC Meeting	
12	1st Workshop and MC Meeting	Annual Report for Year 1
18	MC Meeting	
24	2nd Workshop and MC Meeting	Annual Report for Year 2
30	MC Meeting	
36	3rd Workshop and MC Meeting	Annual Report for Year 3
42	MC Meeting	
48	4th Workshop and MC Meeting	Annual Report for Year 4, Final Report
48	International Conference	Conference Proceedings

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: CH, DE, FR, HR, IE, IL. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 24 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.

H. DISSEMINATION PLAN

H.1 Who?

The following lists the intended targets for the dissemination of this Action:

- all participants of this Action,
- scientific offspring – early-stage researchers,
- the international research community in information and communication technology,
- communication industry,
- the general public.

H.2 What?

The following list contains the dissemination methods:

- the Action's website,
- annual reports,
- workshop and conference proceedings,
- peer-reviewed publications,
- outreach to the general public by giving open lectures on communication technology.

H.3 How?

Dissemination activities will be constantly monitored by the management committee of the Action and will be assessed in all annual reports of the Action. The results of the first dissemination conference will be carefully assessed with the help of professionals of the media in order to identify ways to improve the Action and new targets for the Working Groups. It is emphasized that opportunities will be taken to introduce communication technology towards the very young (high school students) showing the appeal of the area and the potential professional outcome.