



WORK AND BUDGET PLAN

All activities proposed in the Work & Budget Plan must respect the COST rules as described in the COST documents, in particular the COST Implementation Rules and the COST Vademecum, and be directed at achieving objectives stated in the Action's MoU and/ or implementing COST policies.

Grant Period (GP) information:

Grant Period n.	Grant Period Start Date	Grant Period End Date	Allocated budget	Agreement/ Amendment (n)
3	01/08/2014	31/07/2015	EUR 172.000,00	Agreement

I. ACTION PROFILE

Domain ¹	Action no	Action Chair
ICT	IC1104	Dr. Marcus Greferath
Action Title	Random Network Coding and Designs over GF(q)	

Action General Information²:

Draft MoU:	oc-2011-1-9471	Action Entry into Force ³ :	18/01/12
CSO approval date:	01/12/11	Start of Action ⁴ :	26/04/12
MoU:	4175/11	End of Action ⁵ :	25/04/16

Participating COST Member Countries and Cooperating State⁶:

Country	Date	Country	Date	Country	Date	Country	Date
Austria	13/11/2012	Belgium	05/07/2012	Bulgaria	21/03/2012	Croatia	20/12/2011
Denmark	02/04/2012	Estonia	19/11/2012	Finland	03/01/2012	France	07/03/2012
Germany	18/01/2012	Greece	13/03/2012	Hungary	19/11/2012	Ireland	16/01/2012
Israel	27/12/2011	Italy	05/04/2012	Luxembourg	10/10/2013	Netherlands	20/11/2012
Norway	19/03/2012	Portugal	20/06/2012	Serbia	02/03/2012	Slovakia	29/11/2012
Slovenia	23/06/2012	Spain	16/02/2012	Sweden	MC approved on July 6 th , 2014	Switzerland	24/01/2012
Turkey	20/04/2012	United Kingdom	01/03/2012	fYR Macedonia	10/10/2013		

¹ Allocated Domain for monitoring and assessment purposes

² Table to be copied from the Action Fact Sheet available for download on the Action page on the COST website

³ Entry into force is the date when 5 COST countries had accepted the MoU of the Action

⁴ The Action's start date is the date of its first Management Committee meeting.

⁵ The Action's end date is exactly four years from the start date of the Action.

⁶ Table to be copied from the Action Fact Sheet available for download on the Action page on the COST website



	Number
Participating COST Member Countries and Cooperating State	27
Participating inclusiveness COST Member Countries ⁷	11
MC Members	43

International Cooperation:

	Number ⁸
Near Neighbour Countries (NNC) participating in the Action	0
Institutions from NNC participating in the Action	0
International Partner Countries (IPC) participating in the Action	1
Institutions from IPC participating in the Action	1
Specific Organisations ⁹ participating in the Action	0

Action Objectives as defined in the MoU and level of Achievement:

Objective as described in MoU	Current Level of Achievement in % ¹⁰				
	0	25	50	75	100
1) 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.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	X	<input type="checkbox"/>
2) 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 endeavor 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.	<input type="checkbox"/>	<input type="checkbox"/>	X	<input type="checkbox"/>	<input type="checkbox"/>
3) Based on research stimulated 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.	<input type="checkbox"/>	<input type="checkbox"/>	X	<input type="checkbox"/>	<input type="checkbox"/>
4) 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	<input type="checkbox"/>	X	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

⁷ Current COST Member Countries targeted by the COST inclusiveness Policy: EU 13 (Bulgaria, Cyprus, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovenia, Slovakia), Bosnia and Herzegovina, Serbia, Turkey, the former Yugoslav Republic of Macedonia. In addition, to comply with the EC eligibility criteria for widening, Portugal and Luxemburg might be considered.

⁸ Update at the beginning of each Work & Budget Plan negotiation

⁹ EU Commission, EU Agencies, European RTD organisations and International Organisations (see COST doc. 4115/13)

¹⁰ Give an approximate estimation in percentage on the current level of achievement of each of the Action Objectives by clicking on the empty boxes. Update at the beginning of each Work & Budget Plan negotiation



where the three disciplines complement each other. In this way, random network coding will emerge as a truly interdisciplinary science in communication technology.					
5) 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.	<input type="checkbox"/>	<input type="checkbox"/>	X	<input type="checkbox"/>	<input type="checkbox"/>

Working Groups and Working Groups' Membership:

WG N.	WG Title	Total number of members ¹¹	Number from Inclusiveness Countries	From Industry	From international cooperation institutions	Number of ESRs	Gender balance (men/women)
WG1	Bounds on the Size of Network Codes	42	8	0	0	18	31/11
WG2	Development of Encoding and Decoding Schemes, Practical Aspects of Network Coding	35	12	0	1	12	28/7
WG3	Cryptographic Aspects of Network Codes	23	1	0	0	6	17/6
WG4	Construction of Network Codes and Grassmannian Codes	47	11	0	0	18	32/15
WG5	Foundational Aspects, Algebraic Methods in Random Network Coding, Distributed Storage	43	6	0	0	20	36/7

II. Work and Budget Plan for the Grant Period

Goals for the Grant Period

Please describe in the table below the goals for the given grant period and their relationship to the Objectives of the Action as defined in the MoU.

Grant Period Goal	MoU objective that it relates to
1) In terms of mathematical progress, one of the most important results of this Action during its first years, was the discovery of the existence of the (13,3,1) Steiner System over GF(2), and the explicit	See objective 3) in the Action objectives list above: Based on research stimulated by this Action, a number of new (families of) network codes will be developed along with

¹¹ Estimated number (update at the beginning of each Work & Budget Plan negotiation); those that are a member of more than one WG must be counted in each WG.



<p>construction of what are called Large Sets in Designs over $GF(q)$. Further work has been undertaken in order to explore the (non) existence of the putative (7,3,1) Steiner System. This seemingly “smaller” problem has in fact turned out to be the persisting and harder one. We envisage continued endeavor in this direction.</p>	<p>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. See also objective 2): Coherent European research endeavor 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. Objective 5) applies as well.</p>
<p>2) The efforts of WG2 during the first two years were mainly dedicated to bridging the gap between purely theoretical work and the corresponding practical aspects that need to be faced. In light of this WG2 will continue pursuing the goals of the initial years during the third year of this Action. Its main aspects are so far: a) Network coding for multimedia delivery, (b) Physical layer network coding.</p>	<p>See objective 4) in the Action objectives list above: 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. Objective 5) applies as well.</p>
<p>3) Working Group 3 will be continuing their study of signature schemes for network coding, rank metric codes and their uses in cryptography and cryptanalysis; applications to wiretap channels, secure distributed storage and information theoretic security; cryptography suitable for large networks (such as wireless sensor networks).</p>	<p>See objective 1) in the Action objectives list above: 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. Objective 5) applies as well.</p>
<p>4) Based on previous work by Gaston and a survey article by F. Oggier the interest in distributed storage has vastly grown in both the international research community and the respective working group of this Action. Also in the third year of this grant, progress is expected towards exploitation of other than finite field structures in network coding and storage; furthermore this group has vastly contributed to the field of locally repairable storage codes and will extend their efforts in this direction.</p>	<p>See objective 4) in the Action objectives list above: 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. Objective 5) applies as well.</p>

Tasks for the Grant period

Please describe, per Working Group, the tasks planned for the given grant period. Describe their relationship with the goals of the Grant Period.

	Tasks planned per WG for the given Grant Period	Grant Period goal(s) that it/they relate(s) to
WG1/4	Extend the explicit construction of families of	See item 1) in the above list



	designs over GF(q) and come up with concrete encoding and decoding schemes for the structures found.	of grant period goals.
WG2	Continue working on physical layer network coding and solutions close to hardware to enable practical use of the findings of this Action.	See item 2) in the above list of grant period goals.
WG3	Explore further the role of signature schemes along with an approach covering fully homomorphic encryption.	See item 3) in the above list of grant period goals.
WG5	Extend the Actions focus on distributed storage and Index coding so as to serve the Action's influence in the wider area of cloud services.	See item 4) in the above list of grant period goals.

Measures to implement COST Policies

In the table below describe the specific activities you are planning in order to promote the participation and contribution of those targeted in the COST Policies.

<i>Policy</i>	<i>Action Leadership (Chair, Vice Chair, WG Leaders, STSM manager, etc)</i>	<i>Membership of Action</i>	<i>Participation in Action activities</i>	<i>Event location/ organisation</i>
<i>Inclusiveness</i>	Vice Chair of Action comes from Croatia			Two out of three events in this GP are planned to be organized in inclusiveness countries.
<i>International Cooperation</i>		Australian Organization entered Action in 2013.		
<i>Industry involvement</i>				
<i>Gender</i>	2 working group leaders are female			One out of three events in this GO organized by a female member.
<i>Early Stage Researcher</i>			STSM are to be given to ESR with highest priority (as it was the case already)	

Use of COST Networking Tools for the Grant Period

Please describe the different COST Networking Tools (Meetings, Training Schools, STSMs, Dissemination) to be used during the Grant Period, by completing the following tables. Also, provide details on any Other Expenses related to Scientific Activities (OERSA).

When allocating funds to the different networking tools, the COST policies must be taken into account in particular, you must ensure that:





- the available funds are allocated fairly across the participating COST Member Countries and Cooperating State;
- priority is given to event locations in Inclusiveness Countries,
- that the industrial dimension is supported where relevant
- that sufficient funds are allocated in support of the participation of Early Stage Researchers (ESR) and ESR-focussed networking tools such as Training Schools and STSMs,
- that gender balance is taken into account, including in the allocation of funds/ grants/ reimbursement places

(1) MEETINGS

Please copy and complete the following table as many times as necessary (one table per meeting)

Meeting Type	MC meeting, WG Meeting and Workshop
Title of the Meeting	International Castle Meeting on Network Coding
Goal(s) of the GP it will serve	All goals listed above
Description of the activity and how it will serve the identified goal(s)	Invited lectures, short communications, informal discussions. 1 st day dedicated to WS on network coding (within conference), 2 nd and 3 rd for WG and Management Committee Meeting.
Identification of WGs involved	All 5 WGs
Contribution of the meeting from and to the WGs	Members from all working groups will have the opportunity to meet and enter technical discussions related to the goals listed above.
Information on targeted audiences/participants with special emphasis on COST Policies	Female and early stage researchers will be particularly welcome to present their findings.
Any other relevant information (eg. links to websites, any particular individual taking the lead in the activity, invited speakers, etc...)	Organised by Action members from the University of Aveiro, Portugal (Dr. Raquel Pinto, Dr. Diego Napp) http://icmcta.web.ua.pt/index.html
Specific Outputs and Outcomes	Publications in proceedings.
Location	<i>Palmela, Portugal.</i>
Date	<i>17.09. – 19.09.2014.</i>
Number of expected total participants	70
Number of participants to be reimbursed from COST funds	56
Average reimbursement (per participant) (EUR)	750,00
Total Reimbursement costs (EUR)	42.000,00
Local Organiser Support (EUR)	3.300,00
Total cost of the Meeting (EUR)	45.300,00

Meeting Type	MC meeting and Conference
Title of the Meeting	ALCOMA15
Goal(s) of the GP it will serve	Will serve all 4 goals listed above. Will also serve to attract more participants to the Action.
Description of the activity and how it will serve the identified goal(s)	Invited lectures, short communications, informal discussions. ALCOMA is a series of conference (http://www.algorithm.uni-bayreuth.de/en/research/alcoma2010/). The 2015





	edition will be run by the Action. Will be open to other participants.
Identification of WGs involved	All 5 WGs
Contribution of the meeting from and to the WGs	Emphasis on interdisciplinary discussions envisaged.
Information on targeted audiences/participants with special emphasis on COST Policies	Organizers plan to invite members from communications industry.
Any other relevant information (eg. links to websites, any particular individual taking the lead in the activity, invited speakers, etc...)	Organised by Actions members from the University of Bayreuth (Prof.Dr. Alfred Wassermann, Dr. Michael Kiermaier)
Specific Outputs and Outcomes	Conference proceedings; journal papers; involve ESR into interdisciplinary research.
Location	<i>Kloster Banz, Germany</i>
Date	<i>16.03.-20.03.2015.</i>
Number of expected total participants	90
Number of participants to be reimbursed from COST funds	56
Average reimbursement (per participant) (EUR)	1.050,00
Total Reimbursement costs (EUR)	58.800,00
Local Organiser Support (EUR)	5.600,00
Total cost of the Meeting (EUR)	64.400,00

Meeting Type	WG meeting
Title of the Meeting	Applications of Random Network Coding
Goal(s) of the GP it will serve	Goal 2) and 4) in the above list of goals.
Description of the activity and how it will serve the identified goal(s)	Informal discussions, round tables particularly dedicated to engineering aspects of the Action.
Identification of WGs involved	WG2 and WG5
Contribution of the meeting from and to the WGs	Organization and future planning of work inside WG2 and WG5.
Information on targeted audiences/participants with special emphasis on COST Policies	Mixed audience from various communities with particular emphasis on ESR and female researchers.
Any other relevant information (eg. links to websites, any particular individual taking the lead in the activity, invited speakers, etc...)	Organised by Action members from the University of Novi Sad, Serbia (Dr. Dejan Vukobratovic, Dr. Milos Stojakovic)
Specific Outputs and Outcomes	Interdisciplinary dialogue bridging gap between the theoretical and practical aspects of the Action.
Location	<i>Novi Sad, Serbia</i>
Date	<i>End of May 2015., 2 days</i>
Number of expected total participants	30
Number of participants to be reimbursed from COST funds	24
Average reimbursement (per participant) (EUR)	650,00
Total Reimbursement costs (EUR)	15.600,00
Local Organiser Support (EUR)	1.100,00

Total cost of the Meeting (EUR)	16.700,00
---------------------------------	-----------

Please copy and complete the following table for Dissemination meetings to a maximum of 2 per Grant Period.

Meeting Type	Dissemination Meeting
Title of the Conference	International Symposium on Information Theory (ISIT 2015)
Goal(s) of the GP it will serve	All 4 goals described above
Title of the oral contribution	tba (presenting the COST Action)
Presenter (name and position in the Action)	tba
Link to the conference website listing in the program the oral contribution	http://www.isit2015.org/
Specific Outputs and Outcomes	Presentation and Proceedings
Location	<i>Hongkong</i>
Date	14-19/06/2015
Total Reimbursement costs ¹² (EUR)	1600,00

Meeting Type	Dissemination Meeting at IETF- IRTF Research Group on Network Coding. Charter information can be found at: http://trac.tools.ietf.org/group/irtf/trac/wiki/nwcrq
Title of the Conference	Meeting of the Research group on Network Coding at IETF/IRTF yearly meetings (there are 3 meetings per year in three different big cities around the world).
Goal(s) of the GP it will serve	All 4 goals listed
Title of the oral contribution	Activities on Network Coding at the COST Action IC1104 "Random Network Coding and Designs over GF(q)"
Presenter (name and position in the Action)	Dr. Angeles Vázquez-Castro - WG2 leader
Link to the conference website listing in the program the oral contribution	Not yet available.
Specific Outputs and Outcomes	1.- Dissemination of the COST Action activities and results at an international forum of researchers from research institutions and main internet company players from all over the world. 2.- Foreseen a contribution from WG2 on practical aspects for signalling and protocols for implementing network coding on applications at different layers. This contribution may end being part of the internet protocols specific for network coding being targeted at the IETF/IRTF NWCRG
Location/Date	To be decided one of the following: - IETF 91 Honolulu - November 9-14, 2014 - IETF 92 Dallas - March 22-27, 2015

¹² Travel, accommodation & subsistence according to COST rules and up to EUR 500 contribution to conference fee if needed



	- IETF 93 Prague - July 19-24, 2015
Date	
Total Reimbursement costs ¹³ [1] (EUR)	900,00

(2) TRAINING SCHOOLS (TS)

Title of the Training School	n/a
Goal(s) of the GP it will serve	
Description of the TS and how it will serve the identified goal(s)	
Identification of WGs involved	
Specific Outputs and Outcomes	
Location	
Date	
Number of Trainees	
Average Trainee grant (EUR)	
Cost of Trainees Grants (EUR)	
Number of Trainers	
Average reimbursement of trainers (EUR)	
Total Reimbursement costs (EUR)	
Local Organiser Support (EUR)	
Total cost of the Training School (EUR)	

(3) SHORT TERM SCIENTIFIC MISSIONS (STSMs)

Number	10
Total cost (EUR)	19.200,00

(4) DISSEMINATION

Title	Publisher/provider	Cost (EUR)	Date of Release
Web Page Maintenance	GH institution	1.500,00	

(5) Other Expenses Related to Scientific Activities (OERSA)

Item	Cost (EUR)

Other OUTPUTS PLANNED FOR the Grant Period

Describe any other general output/outcome/result – not listed above - including reports, technical documents, publications and other forms of outputs and outcomes.

III. SUMMARY BUDGET



A. COST Networking Tools	EUR
(1) MEETINGS	128.900,00
(2) TRAINING SCHOOLS	0,00
(3) SHORT-TERM SCIENTIFIC MISSIONS	19.200,00
(4) DISSEMINATION	0,00
(5) OERSA	1.500,00
B. TOTAL SCIENCE EXPENDITURE (sum of (1) to (5)) AUTOMATIC SUM: Click in cell to the right and click button "F9" to update the autosum	149.600,00
C. FSAC (max. of 15% of B.)	22.400,00
D. TOTAL EXPENDITURE (B+C) AUTOMATIC SUM: Click in cell to the right and click button "F9" to update the autosum	172.000,00