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Bridging Resources and Agencies in Large-Scale Emergency Management

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Title:

Final Plan for Dissemination and Use of Foreground

Editor(s):	Approved by:
Dag Ausen, SINTEF Lyudmila Zaitseva, PLUS	Project Coordination Committee
	Classification: PU - Public

Abstract / Executive summary:

This report is part of the final project reporting and presents the plan for use and dissemination of foreground according to the guidelines set out for the final project report. This first part describes the dissemination measures, including an overview of scientific publications. The second part specifies the exploitable foreground and provides plans for exploitation and contains only the public information.

Throughout the whole duration of the project, BRIDGE consortium was very active in disseminating the project results. Close to a hundred publications, multiple conferences and workshops, dozens of articles in the popular press and TV reports are the outcomes of the BRIDGE dissemination efforts, which have been reflected on the project website. Besides, over two hundred first responders and emergency response personnel from Norway, Austria, UK, Germany, and other EU countries were involved in various BRIDGE events ranging from End-User Advisory Board meetings and participatory design workshops in the first half of the project to exploitation, testing, and training activities in the second half.

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Version History

Version	Description	Date	Who	Affiliation
0.1	Draft version	31.08.2015	Ausen	
0.2	Input from partners	25.09.2015	Ausen/ Zaitseva	
1	Approved by PCC	30.09.2015	Ausen	

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1 Introduction

The main objectives of WP13 are internal and external dissemination of BRIDGE-related results throughout the entire project. The basic tasks of WP13 has been to create awareness of BRIDGE and ensure local dissemination in strategic boards of participants, using flyers, brochures and the web site, attendance in seminars and congresses and organisation of seminars/workshops.

The dissemination of the results from the project has taken several forms and has used a variety of media. To ensure that dissemination objectives were met in a form agreeable to the consortium and beneficial for the business interests of individual participants, the consortium has approved a detailed dissemination plan before dissemination starts, reported in deliverable D13.1.

The dissemination efforts for the project began from day one with the establishment of a rich web site for publicity purposes. This has spread information of technical developments, events, publications and has also had the possibility to sign up for a project newsletter. In total, 6 newsletters have been produced throughout the project. These are attached to this report. The site also displays papers and presentations given by consortium members, whether at European conferences or workshops. The members of the project has also written academic and technical papers, to be presented at conference and trade shows, and published in leading academic and technical journals. BRIDGE has further organised a number of seminars and workshops, aimed at stakeholders from the area of disaster management. The first part of the report describes the dissemination measures, including an overview of scientific publications.

The second part specifies the exploitable foreground and provides plans for exploitation and contains only the public information from the partners.

2 Main dissemination activities

Throughout the whole duration of the project, BRIDGE consortium was very active in disseminating the project results. Close to a hundred publications, multiple conferences and work-shops, dozens of articles in the popular press and TV reports are the outcomes of the BRIDGE dissemination efforts, which have been reflected on the project website. Besides, over two hundred first responders and emergency response personnel from Norway, Austria, UK, Germany, and other EU countries were involved in various BRIDGE events ranging from End-User Advisory Board meetings and participatory de-sign workshops in the first half of the project to exploitation, testing, and training activities in the second half.

2.1 Publications

Being heavily research-oriented, BRIDGE consortium produced a high number of scientific publications. Thus, a total of eighty-four BRIDGE papers have been published so far, with two more accepted, six more submitted for review, and eight more still in preparation. The published papers appeared in peer-reviewed scientific journals, edited books or book series, conference or workshop proceedings, online scientific journals, and professional/popular journals and magazines. Five PhD theses and one scientific monograph were published by universities.

An overview of all BRIDGE publications is presented below, both in the table and sorted as articles/sections in books, papers in proceedings, PhD theses, monographs, and others publications. It should be noted that many of the BRIDGE conference/workshop papers listed below under *Paper in Proceedings of a Conference/Workshop* have also undergone peer review. Peer review processes for conferences and workshops are a regular quality assurance step in computer science; many papers belonging in this category received three reviews. In some cases, conference/workshop papers are ranked higher than journal papers due to low acceptance rates.

2.1.1 List of scientific (peer reviewed) publications

Template A1: List of scientific (peer reviewed) publications, starting with the most important ones

#	Title	Main author	Title of the periodical or the series	Number, date, or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers, if available	Is/will open access be provided to this publication?
1.	Social media for crisis management: clustering approaches for sub-event detection	Daniela Pohl	Multimedia Tools and Applications	74/8	Springer Netherlands	Netherlands	2015	1-32	10.1007/s11042-013-1804-2	No
2.	Online indexing and clustering of social media data for emergency management	Daniela Pohl	Neurocomputing	Available online 9 May 2015 (in Press)			2015		http://www.sciencedirect.com/science?_ob=ArticleListURL&_method=list&_ArticleListID=-859185985&_sort=r&_st=13&view=c&md5=36d57d1314aaeeae895b1899fd603cfe&searchtype=a	No
3.	How to do IT more carefully?: Ethical, Legal and Social Issues (ELSI) in IT supported crisis response and management	Monika Büscher	International Journal of Information Systems for Crisis Response and Management (IJISCRAM)	Vol. 6, Issue 4	IGI Global	United States	2014	iv-xxiii	ISSN 1937-9390	Yes
4.	How to Follow the Information? A Study of Informational Mobilities in Crises	Monika Büscher	Sociologica (Italian Journal of Sociology *on line*)	N. 1/2014		Italy	2014		10.2383/77044	No

5.	Nomadic Work: Romance and Reality. A Response to Barbara Czarniawska's 'Nomadic Work as Life-Story Plot'	Monika Büscher	Computer Supported Cooperative Work (CSCW)	Vol. 23, Issue 2	Springer Netherlands	Netherlands	2014	223-238	10.1007/s10606-013-9194-6	No
6.	Supporting Crisis Management via Detection of Sub-Events in Social Networks	Daniela Pohl	International Journal of Information Systems for Crisis Response and Management (IJISCRAM)	Vol. 5, Issue 3	IGI Global	United States	2013	20 - 36	10.4018/ijiscram.2013070102	No
7.	Agile Response and Collaborative Agile Workflows	Lisa Wood	International Journal of Information Systems for Crisis Response and Management (IJISCRAM)	Vol. 5, Issue 3	IGI Global	United States	2013	1-19	10.4018/ijiscram.2013070101	No
8.	Peripheral response: Microblogging during the 22/7/2011 Norway attacks	Sung-Yueh Perng	International Journal of Information Systems for Crisis Response and Management (IJISCRAM)	Vol. 5, Issue 1	IGI Global	United States	2013	41-57	10.4018/jiscrm.2013010103	No
9.	Risk Assessment On-Scene	Eivind L. Rake	Risk Management for the Future – Theory and Cases, book edited by Jan Emblemsvag	25/04-2012	InTech		2012	139-157	10.5772/45599	Yes
10.	Risk factors in emergency response: a review of investigations of emergency response in Norway	Gyrd Brændeland	International Journal of Emergency Management (IJEM)	Vol. 9, No. 2	Inderscience Enterprises Ltd	UK	2013	127	10.1504/IJEM.2013.055160	No
11.	Risk images as basis for decisions related to provision of public services	Geir S. Braut	Risk Management	Vol. 14, Issue 1	Palgrave Macmillan	Basingstoke, UK	2012	60-76	ISSN 1460-3799, ZDB-ID 22279829	No

2.1.2 Article/Section in an Edited Book or Book Series

Four contributions:

1. Monika Büscher, Michael Liegl and Vanessa Thomas (2015) Collective Intelligence in Crises. In *Social Collective Intelligence: Combining the Powers of Humans and Machines (Springer)*.
2. Christian Raffelsberger (2014) Combined Mobile Ad-Hoc and Delay/Disruption-Tolerant Routing. In *Ad-hoc, Mobile, and Wireless Networks* (Springer).
3. Daniela Pohl (2014) Information Propagation in Social Networks During Crises: A Structural Framework. In *Propagation Phenomena in Real World Networks* (Springer).
4. Lisa Wood and Monika Büscher (2012) On missed beginnings. In *Work, interaction and technology: a festschrift for Christian Heath* (Kings College).

2.1.3 Paper in Proceedings of a Conference/Workshop

At least 52 conference papers, most of them "peer reviewed" publications:

1. Sander van Splunter, Farideh Heidari and Frances M. T. Brazier, (2015) Enhancing Participation through Empowering Actor Autonomy in Workflow Management. In: *Proceedings of the 9th European Conference on IS Management and Evaluation (ECIME 2015), Bristol, UK, September 2015*
2. Liang Gao, Martijn Warnier, Sander van Splunter, Long Chen and Frances M. T. Brazier (2015), Architectural Complexity Analysis for Large-scale Emergency Rescue Management Systems: A Preliminary Study. In *Proceedings of the International Conference on Complex Systems Engineering, Connecticut USA, November 2015*.
3. Alan L. Moore and Friedrich Steinhäusler (2015) Unmanned Aerial Vehicle: Tool for first responders and terrorists. In *Proceedings of the 48th Session of the International Seminar on Nuclear War and Planetary Emergencies, Erice, Italy, 19-24 August 2015*.

4. Amro Al-Akkad (2015) Feasibility study of a mobile ad-hoc SOS system, In *Proceedings of the 15th International Conference on Innovations for Community Services (I4CS), Nürnberg, Germany, 8-10 July 2015*.

5. Katrina Petersen and Monika Büscher (2015) Technology in Disaster Response and Management: Narratives of Ethical, Legal, and Social Issues. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

6. Sung-Yueh Perng and Monika Büscher (2015) Uncertainty and Transparency: Augmenting Modelling and Prediction for Crisis Response. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

7. Xaroula Kerasidou, Monika Büscher and Michael Liegl (2015) Don't Drone? Negotiating Ethics of RPAS in Emergency Response. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

8. Catherine Easton and Monika Büscher (2015) The Role of the Privacy Impact Assessment in IT Innovation in Crises: An Example. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

9. Michael Liegl, Rachel Oliphant, and Monika Büscher (2015) Ethically Aware IT Design for Emergency Response: From Co-Design to ELSI Co-Design. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015)*.

10. Katrina Petersen, Monika Büscher, Maike Kuhnert, Steffen Schneider and Jenns Potterbaum (2015) Designing with Users: Co-Design for Innovation in Emergency Technologies. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

11. Fahd Bin Malek Newaz, Aslak Wegner Eide and Antoine Pultier (2015) Supporting First Responder In-Field Communication and Navigation Using Head-Mounted Displays. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

12. Michael Stiso, Aslak Wegner Eide and Antoine Pultier (2015) A Foray into the Use of Serious Games in Controlled Research on Crisis Management. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

13. Ida Maria Haugstveit, Eivind Rake and Aslak Wegner Eide (2015) Practitioner-Centered, Long-Term Evaluation of an ICT-based Triage System for Emergency Management. In *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015).*

14. Christian Raffelsberger and Hermann Hellwagner (2015) A Multimedia Delivery System for Delay-/Disruption-Tolerant Networks. In *Proceedings of the Fifth International Workshop on Pervasive Networks for Emergency Management (PerNEM 2015) held in conjunction with IEEE PerCom 2015.*

15. Friedrich Stenhäusler (2014) EU Efforts in Managing CBRN Terror Attacks. In *Proceedings of the NATO Advanced Research Workshop "Preparedness for Nuclear and Radiological Threats".*

16. Peter Askvig Havgar, Thomas Schwitalla, Jorgen Vallen, Aslak Wegne Eide, and Bjorn Anders Reutz (2014) Usability of a Shareable Interface in a Multiuser Setting. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction (NordiCHI'14).*

17. Christian Raffelsberger and Hermann Hellwagner (2014) Combined Mobile Ad-hoc and Delay/Disruption-Tolerant Networking. In *Proceedings of the 13th International Conference on Ad-Hoc Networks and Wireless (ADHOC-NOW 2014).*

18. Linda Katrine Andresen and Erik G. Nilsson (2014) Finding the Best Devices for Emergency Responders in Norway – an Empirical Study. In *Proceedings of the 11th International Conference on Information Systems for Crisis Response and Management (ISCRAM).*

19. Monica Büscher, Maike Kuhnert, Jens Pottebaum, Matts Ahlsén, Catherine Easton, Bernard Van Veelen, and Christian Wietfeld (2014) Cloud Ethics for Disaster Response. In *Proceedings of the 11th Internatinal Conferece on Information Systems for Crisis Resonse and Management (ISCRAM).*

20. Amro Al-Akkad, Christian Raffelsberger, Alexander Boden, Leonardo Ramirez, Andreas Zimmermann (2014) Tweeting 'When Online is Off'? Opportunistically Creating Mobile Ad-hoc Networks in Response to Disrupted Infrastructure. In *Proceedings of the 11th International Conference on Information Systems for Crisis Response and Management (ISCRAM)*.

21. Amro Al-Akkad and Christian Raffelsberger (2014) How Do I Get This App? A Discourse on Distributing Mobile Applications Despite Disrupted Infrastructure. In *Proceedings of the 11th International Conference on Information Systems for Crisis Response and Management (ISCRAM)*.

22. Amro Al-Akkad, Leonardo Ramirez, Alexander Boden, Dave Randall, and Andreas Zimmermann (2014) Help Beacons: Design and Evaluation of an Ad-Hoc Lightweight S.O.S. System for Smartphones. In *Proceedings of 2014 ACM annual conference on Human Factors in Computing Systems (CHI)*.

23. Friedrich Steinhäusler (2013) Innovative European Solutions in Managing the Mega-Crisis. In *Proceedings of the 46th Session of the International Seminars on Nuclear War and Planetary Emergencies.*

24. Daniela Pohl, Abdelhamid Bouchachia, Hermann Hellwagner (2013) Online Processing of Social Media Data for Emergency Management. In *Proceedings of 2013 International Conference on Machine Learning and Applications (ICMLA).*

25. René Reiners, Michael Falkenthal, Dierk Jugel, Alfred Zimmermann (2013) Requirements for a Collaborative Formulation Process of Evolutionary Patterns to Support Knowledge Management. In *Proceedings of EuroPLoP 2013 Conference*.

26. Zulkuf Genc, Sander van Splunter, Michel Oey and Frances M.T. Brazier (2013) Smart and Secure Sensor Data Sharing in Crisis Response and Management. In *Proceedings of 2013 IEEE/WIC/ACM International Joint Conferences.*

27. Tone Vold and Morten Wenstad (2013), Sustainable Training for Crisis – technology supported training for organizations. In *Proceedings of the 45th ESReDA Seminar on Dynamic Learning from Incidents and Accidents, Bridging the Gap between Safety Recommendations and Learning*.

28. Aslak Wegner Eide, Ida Maria Haugstveit, Ragnhild Halvorsrud, and Maria Borén (2013) Inter-organizational Collaboration Structures during Emergency Response: A Case Study. In *Proceedings of the 10th ISCRAM Conference*.

29. Monika Büscher, Lisa Wood, Sung-Yueh Perng (2013) A New Manhattan Project: Interoperability and Ethics in Emergency Response Systems of Systems. In *Proceedings of the 10th ISCRAM Conference*.

30. Monika Büscher, Lisa Wood, Sung-Yueh Perng (2013) Privacy, Security, Liberty: Informing the Design of EMIS. In *Proceedings of the 10th ISCRAM Conference*.

31. Christian Raffelsberger and Hermann Hellwagner (2013) A Hybrid MANET-DTN Routing Scheme for Emergency Response Scenarios. In *Proceedings of the 3rd International Workshop on Pervasive Networks for Emergency Management (PerNEM).*

32. Christian Raffelsberger and Hermann Hellwagner (2013) Hybrid MANET-DTN Networking and Its Potential for Emergency Relief Operations. In *Proceedings of SACS/SoCoDiS 2013*.

33. Daniela Pohl, Abdelhamid Bouchachia, Hermann Hellwagner (2012) Automatic Identification of Crisis-Related Sub-Events using Clustering. In *Proceedings of ICMLA 2012, International Conference on Machine Learning and Applications*.

34. Aslak Wegner Eide, Ida Maria Haugstveit, Ragnhild Halvorsrud, Jan Håvard Skjetne, Michael Stiso (2012) Key challenges in multi-agency collaboration during large-scale emergency management. In *Proceedings of AmI for Crisis Management Conference 2012*.

35. Lisa Wood, Monika Büscher, Leonardo Ramirez (2012) Response to Emergence in Emergency Response. In *Proceedings of AmI for Crisis Management Conference 2012*.

36. Friedrich Steinhäusler (2012) Gap Analysis of EU Counterterrorism Research Initiatives. In *Proceedings of the 45th Session of International Seminars on Nuclear War and Planetary Emergencies.*

37. Mass Soldal Lund, Atle Refsdal (2012) BRIDGE Risk Analyzer: A Collaborative Tool for Enhanced Risk Analysis in Crisis Situations. In *Proceedings of AmI for Crisis Management Conference 2012*.

38. René Reiners, Ragnhild Halvorsrud, Aslak Wegner Eide, Daniela Pohl (2012) An Approach to Evolutionary Design Pattern Engineering. In *Proceedings of PLoP 2012, 19th Conference on Pattern Languages of Program.*

39. Lisa Wood, Monika Büscher (2012) Reconfiguring Possibilities in Crisis Situations: An Agential Realist Approach to Participatory Design. In *Proceedings of the Participatory Design Conference*.

40. Alfred Zimmermann, René Reiners (2012) Pattern Innovation for Architecture Diagnostics in Services Computing. In *Proceedings of PATTERNS 2012, Fourth International Conferences on Pervasive Patterns and Applications.*

41. Lisa Wood and Monika Büscher (2012) On Missed Beginnings. In *Proceedings of the Workshop and International Conference on Video Analysis*.

42. Christian Raffelsberger, Hermann Hellwagner (2012) Evaluation of MANET Routing Protocols in a Realistic Emergency Response Scenario, 88-92. In *Proceedings of WISES 2012, 10th International Workshop on Intelligent Solutions in Embedded Systems.*

43. Monika Büscher, Lisa Wood, Bernard van Veelen,Sander van Splunter (2012) Agile Response and Collaborative Agile Workflows, 358-363. In *Proceedings of the 21st IEEE International Conference Collaboration Technologies and Infrastructures*.

44. Daniela Pohl, Abdelhamid Bouchachia, Hermann Hellwagner (2012) Supporting Crisis Management via Sub-Event Detection in Social Networks, 373-378. In *Proceedings of the 21st IEEE International Conference Collaboration Technologies and Infrastructures.*

45. Friedrich Steinhäusler (2012) Modern Crisis Management Tools. In *Proceedings of the Security Management and Society Conference*.

46. Sebastian Denef, David V. Keyson (2012) Talking about Implications for Design in Pattern Language, 2509-2518. In *Proceedings of CHI 2012, 30th ACM Conference on Human Factors in Computing Systems.*

47. Sung-Yueh Perng, Monika Büscher, Lisa Wood, Ragnhild Halvorsrud, Michael Stiso, Leonardo Ramirez, Amro Al-Akkad (2012) Peripheral Response: Microblogging During the 22/7/2011 Norway Attacks. In *Proceedings of the 9th International ISCRAM Conference.*

48. Amro Al-Akkad, Andreas Zimmermann (2012) Survey: ICT-supported Public Participation in Disasters. In *Proceedings the of 9th International ISCRAM Conference.*

49. Daniela Pohl, Abdelhamid Bouchachia, Hermann Hellwagner (2012) Automatic Sub-Event Detection in Emergency Management Using Social Media, 683-686. In *SWDM2012, First International Workshop on Social Web for Disaster Management.*

50. Monika Büscher, Lisa Wood, Sung-Yueh Perng (2012), Altruistic, Augmented, Agile: Public Crisis Response. In *Closing Conference "Dealing with the Disasters of Others"*.

51. René Reiners (2011) New Pattern Language Concepts for Designing UbiComp Applications Connecting to Cloud Services, 100-105. In *Proceedings of Informatik 2011: Informatik schafft Communities: Beiträge der 41. Jahrestagung der Gesellschaft für Informatik e.V. (GI), 4. - 7.10.2011 in Berlin.*

52. René Reiners, Irina Astrova, Alfred Zimmermann (2011) Introducing New Pattern Language Concepts and an Extended Pattern Structure for Ubiquitous Computing Application Design Support, 61-66. In *Proceedings of PATTERNS 2011, Third International Conferences on Pervasive Patterns and Applications.*

53. Silviya Dencheva, Christian R. Prause, Wolfgang Prinz (2011) Dynamic Self-moderation in a Corporate Wiki to Improve Participation and Contribution Quality, 1-20. In *Proceedings of ECSCW 2011, 12th European Conference on Computer Supported Cooperative Work.*

2.1.4 Thesis/Dissertation

BRIDGE has contributed to five PhD theses:

1. Christian Raffelsberger (2015) Analyzing and Improving Wireless Networking Protocols and Services for Emergency Response Scenarios. In *Alpen-Adria University of Klagenfurt*.
2. Daniela Pohl (2015) Supporting Crisis Management: Sub-Event Detection via Social Media Analysis. In *Alpen-Adria University of Klagenfurt*.
3. Amro Al-Akkad (2015) Working Around Disruptions of Network Infrastructures - Design and Evaluation of Mobile Ad-hoc Systems for Resilient Communication in Disasters. In *RWTH Aachen University*.
4. Marc Jentsch (2015) Ubiquitous Annotation Visualization - Concept and Rapid Prototyping Framework. In *RWTH Aachen University*.
5. René Reiners (2013) An Evolving Pattern Library for Collaborative Project Documentation. In *RWTH Aachen University*.

2.1.5 University Publication/Scientific Monograph

At least one contribution:

1. René Reiners (2014) An Evolving Pattern Library for Collaborative Project Documentation. In *Fraunhofer Series in Information and Communication Technology*.

2.1.6 Other publications

At least 17 other publications:

2. Friedrich Steinhäusler (2015) Advanced Situational Awareness: Part I. UAVs and Computer Systems in Emergency. In *Crisis Response Journal*, Vol. 10, Issue 3, 1 April 2015, pp 74-75.
3. Pierre Madl (2015) Advanced Situational Awareness: Part II. UAVs and Computer Systems in Crisis Management. In *Crisis Response Journal*, Vol. 10, Issue 4, 1 June 2015, pp 70-71.
4. Bukhtiar Mohsin (2015) Advanced Situational Awareness: Part III. UAVs and Computer Systems in Crisis Management. In *Crisis Response Journal*, Vol. 11, Issue 1, 1 September 2015, pp 70-71.
5. Amro Al-Akkad und Alexander Boden (2014) Kreative Nutzung der verfuegbaren Netzwerkinfrastruktur im Katastrophenfall / Creative Usage of Available Network Infrastructure in Disaster Situations. In *i-com - Zeitschrift für interaktive und kooperative Medien, Special issue "Interaktion und Kooperation im Krisenmanagement"*.
6. Monika Büscher, Sebastian Weise, Sung-Yueh Perng (2014) Periphere Kooperation am Beispiel der Anschläge in Norwegen 2011 / Peripheral Cooperation in Crises: Norway 22/7/11, in *i-com.*
7. Hermann Hellwagner (2014) The BRIDGE Project - Bridging Resources and Agencies in Large-Scale Emergency Management. In *IEEE STCSN E-Letter*.
8. Daniela Pohl, Abdelhamid Bouchachia, Hermann Hellwagner (2014) Crisis-related Sub-Event Detection based on Clustering. In *IEEE STCSN E-Letter*.
9. Monika Büscher and Michael Liegl (2014) Connected Communities in Crisis. In *IEEE STCSN E-Letter*.

10. Daniela Pohl (2014) Social Media Analysis for Crisis Management: A Brief Survey. In *IEEE STCSN E-Letter*.
11. Jan Havard Skjetne and Aslak Wegner Eide (2014) Bridging a Communication Gap. In *Gazette*.
12. René Reiners (2014) Using Evolving Design Patterns for Collaborative Requirements Engineering and Solution Documentation. In *STC Social Networking E-Letter*.
13. Monika Büscher (2013) *Sage advice? A note on The Cabinet Office Enhanced SAGE Guidance*. A strategic framework for the Scientific Advisory Group for Emergencies (SAGE), Lancaster University's Security Centre.
14. Ida Maria Haugstveit, Karen Ranestad, Maria Borén (2012) Samhandling og beslutningstaking i innsatsleders KO. In *Brannmannen (4), 22-23.*
15. René Reiners (2012) A Pattern Evolution Process - From Ideas to Patterns, 115-118. In *Lecture Notes in Informatics Informatiktage 2012.*
16. Peter Wahlgren (2011) Katastrofjuridik. In *Dagens Juridik.*
17. Peter Wahlgren (2011) International Cooperation in Crisis Management – A European Perspective, 9. In *CIP Report (9-12)*

2.2 Events

In the course of four years, BRIDGE partners have attended over a hundred different events to disseminate the knowledge about the project, its goals, and major achievements: fifty-five conferences and symposia, twenty-seven workshops and expert forum meetings, ten non-BRIDGE EU project meetings, six training exercises, and four exhibitions. In addition, BRIDGE also organized and co-organized several conferences, workshops and seminars, including:

- Ethical, Legal, and Social Issues (ELSI) Tracks at the 10th, 11th, and 12th editions of the International Conference on Information Systems for Crisis Response and Management (ISCRAM 2013, 2014, 2015); http://iscram2014.ist.psu.edu/node/23, http://itethicsincrisis.wordpress.com/iscram-2013/elsi-iscram-2013-2/,
- ELSI Workshop, ISCRAM 2015, Kristiansand, Norway, May 2015; http://iscram2015.uia.no/?page_id=1070 , , http://itethicsincrisis.wordpress.com/iscram-2013/elsi-iscram-2013-2/
- Parallel section at "Skandinavisk aktuttmedisin 2015", Trondheim, Norway, 17-18 March 2015, http://akuttmedisin2015.org/?page_id=2
- Nordic Conference on Disaster Mitigation, Stavanger, Norway, 26-27 September 2013; http://nordic-conference-on-disaster-mitigation.origo.no/
- Seminar "Crisis Management in Europe", Ghent, Belgium, May 2013
- Workshop "New Interaction Orders", New Mobile Publics, Lancaster, UK, March 2012;
- Workshop "Mobilizing Emergency Response", Lancaster, UK, September 2012;
- International Joint Conference on Ambient Intelligence (AmI), Pisa, Italy, November 2012;
- Seminar "Kommunikasjon og samhandling ved katastrofer", Oslo, Norway, December 2011;
- Workshop "Collective Intelligence and CSCW in Crisis Situations", Aarhus, Denmark, September 2011;
- Workshop "New Social Media and Crisis", Bielefeld, Germany, April 2011

2.2.1 Nordic Conference on Disaster Mitigation

The BRIDGE partners, SINTEF and RAKOS – together with the University of Stavanger – organised the Nordic Conference on Disaster Mitigation, http://nordic-conference-on-disaster-mitigation.origo.no/, hosted by the Stavanger University Hospital in Stavanger, Norway, on 26th-27th September 2013. This two-day conference with about 60 practitioners, researchers and policy-makers discussed how technology could be used as tools for first responders to mitigate disasters. The conference was arranged head-to-head with the Risavika exercise held in Stavanger by the local emergency services (September 25th) in order to practice collaboration in a mass-casualty incident. This exercise was also part of the background for the third demonstration. This gave the conference participants an opportunity to observe the exercise and even participate as volunteers. EUAB members were invited to share their professional experiences during the conference. Four EUAB-members gave the following presentations:

1. *Long term crisis management – the case from the chemical train crash event in Belgium* - Christian van DeVoorde, Fire Brigade Ghent, Belgium
2. *Security research from an end-users perspective* - Heiko Werner, Federal Agency for Technical Relief (THW), Germany
3. *How could technical concept cases have improved crisis management and communications in the Buncefield disaster?* - Inspector Barbra Campbell, Hertfordshire Constabulary, United Kingdom
4. *Could a large-scale exercise contribute as a learning tool and simultaneously be a validation tool?* - Eivind Rake, RAKOS/University of Stavanger, Norway

BRIDGE-partners presented preliminary results from the BRIGE project:

1. *A review of the Risavika exercise in Stavanger*, Managing Director Morten Wenstad, Crisis Training AS
2. *How to improve exercises*?, Ove Njå, University of Stavanger
3. *Agile Response: Designing for emergent interoperability*, Dr Monica Büscher, Mobilities.Lab, Lancaster University
4. *What did we learn from 22/7: Triaging: A new procedure & Emergency medical dispatch centre: How to increase the capacity by using modern technology*, by Jan Erik Nilsen, The National Center for Prehospital Emergency Medicine and Olav Eielsen, Regional Centre for Emergency Medical Research and Development, Stavanger University Hospital, Norway.

2.2.2 BRIDGE section at Scandinavian Acute Medicine Conference 2015

BRIDGE organized a section at the acute medicine conference in Trondheim 17-18 March 2015 with contributions for the BRIDGE partners RAKOS, CTAS and SINTEF. The title of the track was "Can new technology and innovation give better acute medicine?"

Presentations:

- *Can innovation and modern technology streamline current handling of major disasters*, Jan H Skjetne/Dag Ausen, SINTEF IKT
- *A presentation of the BRIDGE «concept-cases» and what they offer*, Jan H. Skjetne, SINTEF
- *What are the needs and demands of the health sector*?, Ida Maria Haugstveit, SINTEF
- *New eTriage monitor/bracelet for use in disasters and daily prehospita* use, Olav M. V. Eielsen, Stavanger University hospital / RAKOS
- *Evaluation: How to learn in the best possible way*?, Morten Wenstad, Crisis Training

2.2.3 *The EUAB Ghent seminar: Professional crisis responder driven discussion about disaster management; a review of cases*

At the 5th End User Advisory Board's meeting in Ghent, Belgium, 28-29 May 2013 a two-day seminar on disaster management practices across Europe was hosted by the Fire Brigade of Ghent.

The seminar aimed to critically examine disaster management cases that have occurred in Europe, by scrutinizing why disaster management operations sometimes are perceived as being successful while at other times they are not. At times actors involved in events assess them completely differently. The seminar, including a workshop, was multidisciplinary covering all the blue light services and personnel covering all decision levels; Gold, Silver and Bronze. 50 responders attended the seminar and workshop.

The seminar was an example of the end-users involvement to describe challenges in disaster management. At times actors involved in events assess them completely differently. The background for the Ghent seminar was four cases:

1. *Terrorist attack in Norway 22/7 2011*, presented by Professor Geir Sverre Braut, Stavanger University Hospital and Norwegian Board of Health Supervision.
2. *Flood in Central Europe (Poland, Hungary, Czech Republic and Slovakia) May 2010*, presented by Director Mariusz Feltynovski, National Centre for Coordination of Rescue and Protection of Population, Poland
3. *Earthquakes Southern Italy 2009 (L'Aquila)*, presented by Professor David Alexander, University College of London.
4. *Major fire in a derailed train with acryl nitrile into sewage system 2013, Belgium*, presented by Fire Chief, Ghent and EUAB member, Christian Van De Voorde

2.2.4 *BRIDGE - ValEDation Days*

Furthermore, three ValEDation Days have been carried out on three different partner locations (Alpine ValEDation Day in Salzburg, Austria, Low Countries ValEDation Days in Delft, Netherlands, and Nordic ValEDation Days in Oslo, Norway). The main purpose of ValEDation Days was threefold: Validation, Exploitation and Dissemination. This is why we called it ValEDation Days.

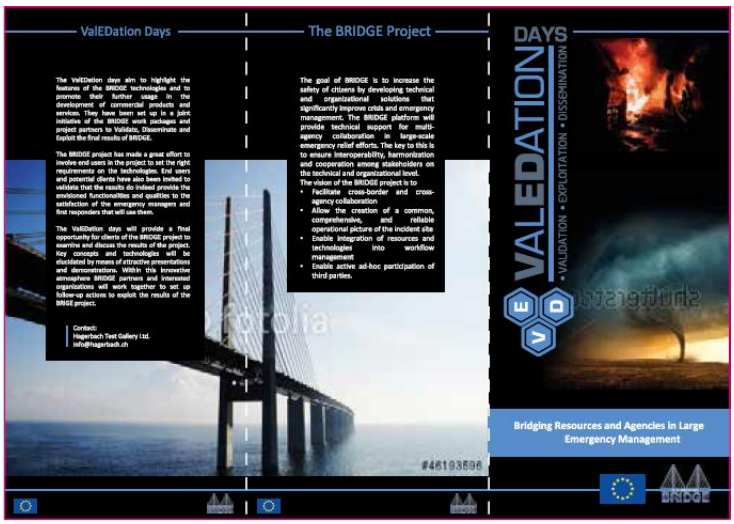


Figure 1: ValEDation Days Folder

There were three different focuses on the three ValEDation Days. The Alpine ValEDation Day was dedicated to advanced situation awareness and the networks needed to make collected data available. The central device was the unmanned aerial vehicle (UAV) equipped with several sensors, and providing environmental data relevant for the incident managers. Important stakeholders included fire fighters from the region as potential users of the UAV system in an incident.

At Nordic ValEDation Day Master, eTriage and the Trainings System were exposed to the critical eyes of fire brigades, police and medical services. The interest in the BRIDGE Concept Cases was very high, leading to follow up activities with the eTriage Concept Case with Norwegian Medical Services in Stavanger.

The Low Countries ValEDation Days have been dealing with the Concept Cases Adaptive Logistics, SWARM, Middleware and Information Intelligence. End users involved in this event were mainly from the consortium, in principle those decision makers who would enable and support the use of BRIDGE technologies on the way to produce useful tools for crisis management.

Through carrying out these ValEDation Days, this kind of dissemination was done on a very sound base of stakeholders, involving users of our products from the development phase until the utilization during incident management.

Figure 2: Dissemination activities during the Alpine ValEDation Days

2.2.5 BRIDGE demonstrations

A total of four demonstrations have been implemented as part of the BRIDGE project.

The second demonstration was conceived as a table-top demo of BRIDGE technologies with a specific emphasis on visualization and interaction. It was held in Stavanger (NO) and hosted by BRIDGE partner RAKOS (Regional Centre for Emergency Medical Research and Development at Stavanger Hospital). Around twenty representatives of the local emergency response services (fire, police, EMS) accepted BRIDGE invitation to attend the demonstration and provide their feedback to the new set of concept cases and technologies further developed in the project. Such strong involvement of the Norwegian first responder organisations is important to make sure that the project outcome meet the end-users' requirements regarding usability. At the end of the demonstration, the end-users took part in the BRIDGE Participatory Design workshop, helping the consortium elaborate on the user needs and co-design technologies.

Discussion of the BRIDGE Federated Control Room Support concept with the end-users

Figure 3: Discussions with end-users at demo 2

On September 25th 2013, BRIDGE conducted yet another demonstration in Stavanger (NO). The purpose of this third BRIDGE demonstration was to show the progress and results achieved in the BRIDGE project, with a focus on Collaboration Technologies operating in real life conditions.

The demonstration was organised in conjunction with a large exercise of the local first responder community at the Risavika harbour. The exercise was built around a complex terror attack scenario with about a hundred dead and injured at three different locations of the harbour. This mass casualty exercise with a high security risk component presented multiple challenges to the participating police, fire, and emergency medical services. The overall goal of the exercise was to strengthen collaboration between the different agencies and actors during major incidents involving armed police forces and requiring extensive coordination efforts.

The BRIDGE project was granted permission to participate in the exercise. CTAS training methodology concept (FRITS) was used throughout the whole training process, starting with analysing the training needs, defining different training activities (Workshops, table-tops, skills training and live exercises) resulting in an evaluation report for the live exercise. The project demonstrated and tested some of the technologies developed in BRIDGE in an environment of a possible emergency incident. The BRIDGE consortium participated in the exercise alongside the Norwegian first responders by providing them with the relevant BRIDGE technologies and following their application on scene with advice. MASTER, Robust and Resilient Communication, eTriage, SWARM, and FRITS Concept Cases were received with a lot of interest and positive critique by the emergency response professionals.

Figure 4: BRIDGE participated in the exercise Risavika 2013 (Stavanger, Norway) alongside the Norwegian first responders and provided them with relevant BRIDGE technologies and applications.

2.3 Media

BRIDGE partners put a lot of emphasis on communicating with the public about the project and its developments through the mass media means. This resulted in dozens of articles published in various printed European media (Neue Zürcher Zeitung, Der Standard, Salzburger Nachrichten, Crisis Response Journal, Ingeniør Nytt, Aftenposten Morgen, Kleine Zeitung, Tagesblatt, Stavanger Aftenblatt, Østlendingen, Sarganserland, etc.) and online journals, newspapers and news platforms (e.g., Berner Zeitung Online, Gizmodo, Endgadget, APA-Science, Alpha-Galileo, Salzburg24, News Medical, Dagens Medisin, NewScientist.com, St. Galler Tagblatt Online, etc.). Several BRIDGE experts were interviewed by various TV channels and two BRIDGE demonstrations were covered by the Swiss and Norwegian TV in the evening news. *BRIDGE Media Library* records at least 50 various communications between members of the BRIDGE consortium and the mass media means.

Geir Horn (SINTEF), Morten Wenstad (Crisis Training AS), and Eivind Rake (RAKOS) giving invterviews for Norwegian TV.

2.4 Exhibitions

2.4.1 BRIDGE at CeBIT 2015 in Hannover, Germany

CeBIT 2015 was held in Hannover, Germany, on 16-20 March 2015. Boasting an IT exhibition and a conference programme for professionals, CeBIT defines the latest IT trends, presents talks by high-calibre speakers and forward-looking panel discussions, and show-cases product innovations from all over the world. BRIDGE consortium partner Fraunhofer Institute of Applied Information Technology (Fraunhofer FIT) participated in CeBIT 2015 exhibiting two of its innovations developed in BRIDGE: eTriage and Help Beacons. Both concept cases attracted a lot of attention and evoked great interest among the visitors of the exhibition.

René Reiners at CeBIT 2015 (top); Marc Jentsch giving an interview to a TV channel (bottom left); and Erion Elmasllari showcasing eTriage to the visitors (bottom right). Photo courtesy: René Reiners.

2.4.2 BRIDGE at CP Expo 2014 in Genova, Italy

The BRIDGE project was part of the CP Expo 2014 and SRC Security Research Conference 2014, which took place at the Centro Congressi in Genova, Italy, 9-11 December 2014. The global expo-conference was organized by the European Commission with the purpose of providing visibility and business opportunities, and serving as a meeting point for industries and academic institutions working within the field of community protection. BRIDGE participated

in the exhibition as one of the European Commission's FP7 pro-jects. Aslak Wegner Eide and Ida Maria Haugstveit (both from SINTEF) were the BRIDGE project's representatives at the event.

BRIDGE was showcased at a stand where the project's technologies were demonstrated. Two project presentations were held, giving the audience an overview of the different concept cases and technologies of BRIDGE. The stand and the presentations attracted attention from many of the event's participants. Several stakeholders visited the stand: practitioners, academics, people from industry, and members of the European Commission. The project received positive feedback, and the BRIDGE technology was regarded as innovative and highly useful. The exhibition provided a good place for meeting with, talking to, and establishing connections to interested parties from different fields.

CPEXPO
COMMUNITY PROTECTION

2.4.3 BRIDGE at BSSAR 2014 in Heraklion, Greece

BRIDGE took part in the European Symposium on Border Surveillance and Search and Rescue Operations Technology (BSSAR 2014), which was organized by the Center for Security Studies (KEMEA) in Heraklion, Crete, 27-28 November 2014. One hundred and fifty representatives from international organizations, national authorities and services, academic institutions, research agencies, and end-users in both the public and private sectors from fifteen EU member states, participated in the Symposium. The results of ten European Research Projects (FP7) and two National Research Programs on border surveillance technology, ground and air survey, crisis management and search and rescue operations were presented during the event.

BRIDGE was presented through a plenary presentation and a BRIDGE booth. The Project Technical Coordinator, Evangelos Vlachogiannis (Fraunhofer FIT), gave a 20 minutes presentation focusing on the overall BRIDGE user-centered approach targeting to emergent interoperability (i.e., System of Systems). The presentation focused on a subset of concept cases (*Robust and Resilient Communication*, *Master*, *Dynamic Tagging/eTriage*, and *First Responder Integrated Training System (FRITS)*, on Ethical, Legal and Social Issues (ELSI) as a critical dimension, and on BRIDGE ValEDation approach and tangible results.

The BRIDGErs—Monika Buscher (Lancaster University), Michelle Burghardt (Versuchstollen Hagerbach, VSH), René Reiners (Fraunhofer FIT), Morten Wenstad (Crisis Training), Max Wietek (VSH) and Antoine Pultier (SINTEF)—had the opportunity to demonstrate the aforementioned concept cases in the BRIDGE booth, discuss them with interested participants, share experiences, mostly through BRIDGE videos, and consider potential future opportunities in the field.

2.5 Patents

Accepted patent
Patent: EP 2 814 299, submitted to: European Patent Office
Title: ***Method for organizing a wireless network***
Inventor(s): Al-Akkad, Amro; Ramirez, Leonardo; Zimmermann, Andreas
Application No./Patent No.: 13171881.9 - 1857
Applicant: Fraunhofer Gesellschaft zur Förderung der angewandten Forschungen e.V.
Date of Filing: 13.06.2013
Date of publication: 17.12.2014
Designated States: Europe (AL AT BE… SK SM TR)
URL: https://data.epo.org/publication-server/rest/v1.0/publication-dates/20141217/patents/EP2814299NWA1/document.pdf

Submitted patent
Submitted to: German Patent and Trade Mark Office
Title: ***Method, device and wireless network environment for data exchange***
Inventor(s): Al-Akkad, Amro; Ramirez, Leonardo; Zimmermann, Andreas
Application No./Patent No.: DE102014202758A1
Applicant: Fraunhofer Gesellschaft zur Förderung der angewandten Forschungen e.V.
Date of Filing: 2014
URL:
https://depatisnet.dpma.de/DepatisNet/depatisnet?action=pdf&docid=DE102014202758A1

2.6 List of dissemination activities

An overview of most of the dissemination activities during the project is reported in the table below.

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
#	Type of activities	Main leader	Title	Date/Period	Place	Type of audience	Size of audience	Countries addressed
1.	Presentations	PARIS-LODRON-UNIVERSITÄT SALZBURG	International Symposium on Crisis Management (ISCM) 2011	09/06/2011	Vouliagmeni - Athens, Greece	Scientific community (higher education, Research) - Industry - Civil society	100	International
2.	Posters	PARIS-LODRON-UNIVERSITÄT SALZBURG	Security Research Conference (SRC) 2011	19/09/2011	Warsaw, Poland	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	150	European (EU and non-EU)
3.	Presentations	STIFTELSEN SINTEF	CBRNE-Map Final Conference	08/09/2011	Brussels, Belgium	Scientific community (higher education, Research) - Industry	75	European (EU and non-EU)
4.	Presentations	LANCASTER UNIVERSITY	Honorary Doctorate Talk and Ceremony	16/09/2011	Roskilde University, Denmark	Scientific community (higher education, Research)	75	European (EU and non-EU)
5.	Presentations	STIFTELSEN SINTEF	18th ACM Conference on Computer and Communications Security	17/10/2011	Chicago, USA	Scientific community (higher education, Research) - Industry	150	International
6.	Presentations	STIFTELSEN SINTEF	Kommunikasjon og samhandling ved katastrofer (Expert Forum Meeting),	08/12/2011	Oslo, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	70	Norway
7.	Presentations	STIFTELSEN SINTEF	Åre Risk Event	13/03/2012	Åre, Sweden	Scientific community (higher education, Research) - Civil society - Policy makers	75	Sweden, Norway
8.	Presentations	VSH HAGERBACH TEST GALLERY LTD	5th International Symposium on Tunnel Safety and Security (ISTSS 2012)	14/03/2012	New York, USA	Scientific community (higher education, Research) - Industry	150	International
9.	Presentations	PARIS-LODRON-UNIVERSITÄT SALZBURG	Wiener Nuklearrechtskonferenz	15/03/2012	Vienna, Austria	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	75	Austria
10.	Presentations	PARIS-LODRON-UNIVERSITÄT SALZBURG	27th RAILPOL Conference	21/03/2012	Budapest, Hungary	Civil society - Policy makers	50	EU
11.	Presentations	PARIS-LODRON-UNIVERSITÄT SALZBURG	2nd International Symposium on Crisis Management (ISCM 2012)	29/03/2012	London, UK	Scientific community (higher education, Research) - Civil society - Policy makers	100	International
12.	Presentations	TECHNISCHE UNIVERSITEIT DELFT	21st European Meeting on Cybernetics and Systems Research (EMCSR)	10/04/2012	Vienna, Austria	Scientific community (higher education, Research)	50	European (EU and non-EU)
13.	Organisation of Workshops	LANCASTER UNIVERSITY	New Interaction Orders, New Mobile Publics - Specialized Workshop	13/04/2012	Lancaster, UK	Scientific community (higher education, Research)	30	European
14.	Presentations	STIFTELSEN SINTEF	Redningskonferansen 2012	07/05/2012	Oslo, Norway	Scientific community (higher education, Research)		Norway
15.	Presentations	STIFTELSEN SINTEF	European Public Safety Radiocommunication Group (PSRG) Coordiantion Meeting	10/05/2012	Oslo, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		European (EU and non-EU)
16.	Conference	PARIS-LODRON-UNIVERSITÄT SALZBURG	CBRNe Europe 2012 Light	21/05/2012	The Hague, The Netherlands	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	100	European (EU and non-EU)
17.	Presentations	LANCASTER UNIVERSITY	Centre for Mobilities Research - Research Day (Workshop)	30/05/2012	Lancaster University, Lancaster, UK	Scientific community (higher education, Research)	30	UK
18.	Presentations	LANCASTER UNIVERSITY	Materialities, Visualities, Securities Workshop	07/06/2012	University of Sussex, Brighton, UK	Scientific community (higher education, Research)		UK
19.	Presentations	PARIS-LODRON-UNIVERSITÄT SALZBURG	Urban Transport Security Meeting, EU DG Mobility and Transport	11/06/2012	Brussels, Belgium	Policy makers	50	EU Member States
20.	Presentations	FRAUNHOFER-FIT	IoT Week 2012 - IoT Exploitation Conference	18/06/2012	Venice, Italy	Scientific community (higher education, Research) - Industry	300	International
21.	Presentations	FRAUNHOFER-FIT	Project Management Institute - Chapter Meeting	20/06/2012	Wuppertal, Germany	Scientific community (higher education, Research) - Industry	80	Germany, Austria, Switzerland
22.	Press releases	FRAUNHOFER-FIT	Mastering Complex Emergencies - Katastrophenmanagement	02/05/2011	Fraunhofer FIT Annual Report 2010	Scientific community (higher education, Research) - Industry		Germany, EU Member States
23.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Eine Hilfe für die Helfer	06/07/2011	Der Standard (Austria)	Civil society - Medias		Austria
24.	Articles published in the popular press	UNIVERSITAET KLAGENFURT	Bei Hilfseinsätzen gut vernetzt	17/07/2011	Kleine Zeitung (Klagenfurt, Austria)	Civil society - Medias		Austria
25.	Articles published in the popular press	STIFTELSEN SINTEF	Nødetatene bruker ikke den nyeste teknologien	18/08/2011	Aftenposten Morgen (Norway)	Civil society - Medias		Norway
26.	Articles published in the popular press	STIFTELSEN SINTEF	Prepared for Major Disasters	25/08/2011	AlphaGalileo (Online Newspaper)	Scientific community (higher education, Research) - Industry - Civil society - Medias		International
27.	Articles published in the popular press	STIFTELSEN SINTEF	EU finances BRIDGE project to tackle major disasters	26/08/2011	News Medical (Online Newspaper)	Scientific community (higher education, Research) - Medias		International
28.	Articles published in the popular press	STIFTELSEN SINTEF	EU-prosjekt styrker terrorberedskap	29/08/2011	Dagens medisin (Online newspaper)	Scientific community (higher education, Research) - Medias		Norway
29.	Articles published in the popular press	Crisis Training AS	Bruker ikke teknologien	01/09/2011	Østlendingen (Norway)	Civil society - Medias		Norway

30.	Articles published in the popular press	HELSE STAVANGER HF	Terror og beredskap - hva vil vi?	28/09/2011	Stavanger Aftenblad (Norway)	Civil society - Medias		Norway
31.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Eine Hilfe für die Helfer	05/07/2011	derStandard.at (Online version of Der Standard newspaper)	Civil society - Medias		Austria
32.	Publication	STOCKHOLMS UNIVERSITET	International Cooperation in Crisis Management A European Perspective	13/07/2011	blawblaw.se website	Civil society - Medias		Sweden
33.	Articles published in the popular press	STIFTELSEN SINTEF	Redningsarbeidere skal bli mer moderne	29/08/2011	P4 (Lillehammer)	Civil society - Medias		Norway
34.	Press releases	VSH HAGERBACH TEST GALLERY LTD	When worst case scenarios become the default	31/10/2011	EU Research (Swiss Guide to European Research), Switzerland	Scientific community (higher education, Research) - Industry - Policy makers		Switzerland
35.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	First Responder	30/11/2011	Kriminalpolizei (Professional journal of the Austrian association of criminal investigators)	Civil society - Medias		Austria
36.	Articles published in the popular press	STIFTELSEN SINTEF	Må ha felles ledelse ved katastrofer	24/01/2012	Ingeniør Nytt	Industry - Civil society		Norway
37.	Press releases	ALMENDE B.V.	BRIDGE verbetert internationale samenwerking bij rampen	19/05/2011	BeveiligingsWereld	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		The Netherlands
38.	Articles published in the popular press	ALMENDE B.V.	Samen rampen bestrijden	27/05/2011	Automatiserings gids	Scientific community (higher education, Research) - Industry - Medias		The Netherlands
39.	Press releases	UNIVERSITAET KLAGENFURT	Koordination von Einsatzkräften im Katastrophenfall	28/06/2011	Klagenfurt University's Newsletter Research No. 3	Scientific community (higher education, Research)		Austria
40.	Publication	ALMENDE B.V.	Internationale samenwerking bij rampen in ontwikkeling	01/07/2011	Melding! June/July 2011, No. 6	Industry - Policy makers - Medias		The Netherlands
41.	Articles published in the popular press	Crisis Training AS	Liten bedrift - stort prosjekt	28/06/2011	Østlendingen	Medias		Norway
42.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Vorbereitung für den Ernstfall	06/07/2011	Medical Tribune, Vol. 43, No. 27	Scientific community (higher education, Research) - Medias		Austria
43.	Articles published in the popular press	STOCKHOLMS UNIVERSITET	Katastrofjuridik	10/08/2011	Dagens Juridik (Online newspaper)	Civil society - Medias		Sweden
44.	Press releases	HELSE STAVANGER HF	EU-prosjektet BRIDGE	01/06/2011	Årsrapport 2010 (RAKOS Annual Report)	Scientific community (higher education, Research) - Civil society - Policy makers - Medias		Norway
45.	Organisation of Workshops	LANCASTER UNIVERSITY	Urban Crisis Workshop	17/11/2011	London, UK	Scientific community (higher education, Research) - Industry - Medias	30	UK
46.	Presentations	LANCASTER UNIVERSITY	Cumbria Fire and Rescue Service Social Media Event	18/11/2011	Cockermouth, Cumbria, UK	Civil society	15	UK
47.	Organisation of Conference	LANCASTER UNIVERSITY	Pukklepop 2011 Symposium	02/03/2012	Hasselt, Belgium	Scientific community (higher education, Research) - Industry - Civil society	70	Belgium, EU
48.	Organisation of Workshops	LANCASTER UNIVERSITY	Mobilizing Emergency Response	10/09/2012	Lancaster, UK	Scientific community (higher education, Research) - Civil society	20	UK, Germany, EU
49.	Presentations	LANCASTER UNIVERSITY	Video Analysis Conference	05/07/2012	Bayreuth, Germany	Scientific community (higher education, Research)	20	EU
50.	Organisation of Workshops	STIFTELSEN SINTEF	Ambient Intelligence for Crisis Management	13/12/2012	Pisa, Italy	Scientific community (higher education, Research) - Industry - Civil society		International
51.	TV clips	Crisis Training AS	Testet nettbrett under øvelse	13/04/2013	Nyheter, TV-Addressa, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Norway
52.	Organisation of Workshops	HELSE STAVANGER HF	Disaster Management Seminar	29/05/2013	Ghent, Belgium	Scientific community (higher education, Research) - Industry - Civil society	30	EU, Norway, USA
53.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	Workshop Catastrophic Urbanism: Disaster, Emergency, Cities	28/05/2013	London School of Economics, London, UK	Scientific community (higher education, Research)	30	UK, EU
54.	Posters	UNIVERSITAET KLAGENFURT	Summer School on Social Media Modeling and Search	10/09/2012	Fira, Santorini, Greece	Scientific community (higher education, Research) - Industry	150	International
55.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	National ABC-Defense Conference	25/09/2012	Bern, Switzerland	Scientific community (higher education, Research) - Civil society - Policy makers	100	Switzerland
56.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	Biennial Conference of theEuropean Association for the Study of Science and Technology (EASST) 2012	20/10/2012	Copenhagen Business School, Frederiksberg, Denmark	Scientific community (higher education, Research) - Industry	325	EU
57.	Oral presentation to a scientific event	UNIVERSITAET KLAGENFURT	Automatic Identification of Crisis-Related Sub-Events using Clustering	12/12/2012	International Conference on Machine Learning and Applications (ICMLA) 2012, Boca Raton, Florida, USA	Scientific community (higher education, Research) - Industry	90	International
58.	Oral presentation to a wider public	VSH HAGERBACH TEST GALLERY LTD	Steering Board Meeting of the ITA-COSUF (International Tunneling and Underground Space Association)	13/02/2013	Arcadis, Amersfoort, Netherlands	Scientific community (higher education, Research) - Industry	10	International

59.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	7th Dresden Symposium: Hazards - Detection and Management	04/03/2013	Dresden, Germany	Scientific community (higher education, Research)	75	International
60.	Oral presentation to a scientific event	UNIVERSITAET KLAGENFURT	Hybrid MANET-DTN networking and its potential for emergency relief operations	15/03/2013	Workshop on Self-Organized Communication in Disaster Scenarios (SoCoDiS), Stuttgart, Germany	Scientific community (higher education, Research)	30	EU
61.	Oral presentation to a scientific event	UNIVERSITAET KLAGENFURT	A Hybrid MANET-DTN Routing Scheme for Emergency Response Scenarios	22/03/2013	IEEE International Conference on Pervasive Computing and Communications (PerCom 2013),San Diego, USA	Scientific community (higher education, Research) - Industry	200	International
62.	Oral presentation to a scientific event	UNIVERSITAET KLAGENFURT	Self-organizing Intelligent Network of UAVs (SINUS) project meeting,	25/03/2013	Klagenfurt, Austria	Scientific community (higher education, Research)	20	EU
63.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Innsbrucker Hofburggespräch - Use of Drones in Civil Sector	05/04/2013	Innsbruck, Austria	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	50	Austria
64.	Videos	PARIS-LODRON-UNIVERSITÄT SALZBURG	BRIDGE Project Promotion Video	14/02/2013	BRIDGE YouTube Channel	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International
65.	Videos	LANCASTER UNIVERSITY	Mobilising Emergency Response Workshop Video	25/02/2013	Lancaster University Website	Scientific community (higher education, Research) - Industry - Civil society		EU
66.	Videos	LANCASTER UNIVERSITY	What happens to mobilities in crisis?	29/01/2013	Forum Vies Mobiles Website, Mobilities Channel Video	Scientific community (higher education, Research) - Industry - Civil society - Medias		France, International
67.	Oral presentation to a wider public	PARIS-LODRON-UNIVERSITÄT SALZBURG	International Strategy for Disaster Reduction (ISDR) Workshop	11/04/2013	Vienna, Austria	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	200	Austria
68.	Oral presentation to a scientific event	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	"Reconstructing normality": The use of infrastructure leftovers in crisis situations as inspiration	25/11/2013	OzCHI '13: Augmentation, Application, Innovation, Collaboration, Adelaide, Australia	Scientific community (higher education, Research) - Industry - Medias	300	Australia, New Zealand, International
69.	Oral presentation to a scientific event	HELSE STAVANGER HF	Virtual organizations and integrated operations in crisis management	20/11/2013	Conference,Trondheim, Norway	Scientific community (higher education, Research) - Civil society	30	Norway
70.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Remotely operated PLUS-octocopter used as an aerosol measurement platform	02/09/2013	European Aerosol Conference (EAC 2013), Prague, Czech Republic	Scientific community (higher education, Research) - Industry	997	Europe
71.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Using real data for validation of 3D injury modelling	20/08/2013	2nd Wound Ballistics Symposium, UK Defence Academy, Shrivenham, UK	Scientific community (higher education, Research) - Civil society	150	UK, International
72.	Posters	PARIS-LODRON-UNIVERSITÄT SALZBURG	BRIDGE Concept Case Advanced Situation Awareness	20/08/2013	2nd Wound Ballistics Symposium, UK Defence Academy, Shrivenham, UK	Scientific community (higher education, Research) - Civil society	150	UK, International
73.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Innovative EU solutions for management of a mega-crisis	21/08/2013	46th Session of the International Seminars on Planetary Emergencies, Erice, Italy	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	140	EU, International
74.	Oral presentation to a scientific event	FRAUNHOFER-FIT	Requirements for a Collaborative Formulation Process of Evolutionary Patterns to Support Knowledge M	10/07/2013	EuroPLoP 2013, Kloster Irsee, Germany	Scientific community (higher education, Research) - Industry	100	Europe
75.	Exhibitions	FRAUNHOFER-FIT	4th European Civil Protection Forum: Disasters - Protecting and responding together,	15/05/2013	Brussels, Belgium	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	400	EU
76.	Organisation of Conference	STIFTELSEN SINTEF	Nordic Conference on Disaster Mitigation	26/09/2013	Stavanger, Norway	Scientific community (higher education, Research) - Industry - Civil society	60	Norway, EU
77.	Organisation of Workshops	CNet Svenska AB	Internet of Things Training Course	16/05/2013	Stockholm, Sweden	Industry	20	Sweden
78.	Organisation of Conference	LANCASTER UNIVERSITY	ELSI Track: Ethical, Legal, and Social Issues of Emergency Management Information	13/05/2013	ISCRAM 2013, Baden-Baden, Germany	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	200	International
79.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	Privacy, Security, Liberty: Informing the Design of EMIS	13/05/2013	ISCRAM 2013, Baden-Baden, Germany	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	200	International
80.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	A New Manhattan Project: Interoperability and Ethics in Emergency Response Systems of Systems	13/05/2013	ISCRAM 2013, Baden-Baden, Germany	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	200	International

81.	Oral presentation to a scientific event	STIFTELSEN SINTEF	Inter-organizational Collaboration Structures during Emergency Response: A Case Study	13/05/2013	ISCRAM 2013, Baden-Baden, Germany	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	200	International
82.	Oral presentation to a scientific event	VSH HAGERBACH TEST GALLERY LTD	ITA-COSUF Workshop (International Tunneling and Underground Space Association)	01/10/2013	Prague, Czech Republic	Scientific community (higher education, Research) - Industry	10	International
83.	Oral presentation to a scientific event	VSH HAGERBACH TEST GALLERY LTD	L-surF workshop	09/09/2013	Oslo, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	10	European
84.	Oral presentation to a wider public	PARIS-LODRON-UNIVERSITÄT SALZBURG	Advisory Board Meeting, Federal Ministry for National Defense	29/05/2013	Eggendorf, Austria	Scientific community (higher education, Research) - Civil society - Policy makers	100	Austria
85.	Oral presentation to a wider public	LANCASTER UNIVERSITY	Chief Fire OfficersAssociation Annual Conference 2013	08/05/2013	Cork, Ireland	Scientific community (higher education, Research) - Civil society	150	International
86.	Oral presentation to a wider public	STIFTELSEN SINTEF	Redningskonferansen 2013	06/05/2013	Oslo, Norway	Industry	100	Norway
87.	Oral presentation to a scientific event	Crisis Training AS	A review of the exercise in Stavanger	26/09/2013	Nordic Conference on Disaster Mitigation, Stavanger, Norway	Scientific community (higher education, Research) - Civil society	60	Norway, EU
88.	Oral presentation to a scientific event	HELSE STAVANGER HF	Could a large scale exercise contribute as a learning tool and simultaneously be a validation tool?	26/09/2013	Nordic Conference on Disaster Mitigation, Stavanger, Norway	Scientific community (higher education, Research) - Civil society	60	Norway, EU
89.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	Agile Response: Designing for emergent interoperability	26/09/2013	Nordic Conference on Disaster Mitigation, Stavanger, Norway	Scientific community (higher education, Research) - Civil society	60	Norway, EU
90.	Oral presentation to a scientific event	STIFTELSEN SINTEF	How can we facilitate a proactive and cooperative risk approach during emergencies?	26/09/2013	Nordic Conference on Disaster Mitigation, Stavanger, Norway	Scientific community (higher education, Research) - Civil society	60	Norway, EU
91.	Oral presentation to a scientific event	STIFTELSEN SINTEF	Common Situation awareness?	27/09/2013	Nordic Conference on Disaster Mitigation, Stavanger, Norway	Scientific community (higher education, Research) - Civil society	60	Norway, EU
92.	Oral presentation to a scientific event	FRAUNHOFER-FIT	The reconfiguration of Triage by introduction of technology	27/09/2013	Nordic Conference on Disaster Mitigation, Stavanger, Norway	Scientific community (higher education, Research) - Civil society	60	Norway, International
93.	TV clips	HELSE STAVANGER HF	Ny teknologi skal redde liv	24/04/2013	NRK TV - Distriktsnyheter Rogaland	Medias		Norway
94.	Web sites/Applications	HELSE STAVANGER HF	EU-prosjekt om katastrofe- og krisehåndtering: Ny teknologi utvikles og testes på SUS	25/04/2013	Helse Stavanger HF / Aktuelt / Nyheter	Civil society - Medias		Norway
95.	TV clips	HELSE STAVANGER HF	Storstilt terrorøvelse i Risavika	25/09/2013	Nyheter, NRK - Rogaland, www.nrk.no	Medias		Norway
96.	Web sites/Applications	STIFTELSEN SINTEF	Teknologihjelp i store katastrofer	27/09/2013	SINTEF website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Norway
97.	Web sites/Applications	ALMENDE B.V.	BRIDGE performs well during simulated terrorist attack	30/09/2013	Almende News, www.almende.com	Scientific community (higher education, Research) - Industry - Civil society - Medias		The Netherlands, International
98.	Articles published in the popular press	VSH HAGERBACH TEST GALLERY LTD	Wenn Smartphones Leben retten	22/09/2012	Neue Zürcher Zeitung	Medias		Switzerland
99.	Articles published in the popular press	VSH HAGERBACH TEST GALLERY LTD	Mit der Helmkamera ins Feuer	22/09/2012	St. Galler Tagblatt Online	Medias		Switzerland
100.	Articles published in the popular press	VSH HAGERBACH TEST GALLERY LTD	«Bridge» baut Brücken	22/09/2012	St. Galler Tagblatt Online	Medias		Switzerland
101.	Articles published in the popular press	VSH HAGERBACH TEST GALLERY LTD	Katastrophenhilfe geprobt	24/09/2012	Sarganserland	Medias		Switzerland
102.	Oral presentation to a scientific event	FRAUNHOFER-FIT	Design Pattern Engineering: An Evolutionary Approach Applied to the Emergency Response Domain	20/10/2012	PLoP 2012 - 19th Conference on Pattern Languages of Programs	Scientific community (higher education, Research)		International
103.	Oral presentation to a scientific event	STIFTELSEN SINTEF	Key challenges in multi-agency collaboration during large-scale emergency management	13/11/2012	AmI-12: International joint conference on Ambient Intelligence, Pisa, Italy	Scientific community (higher education, Research) - Industry		International

104.	Oral presentation to a scientific event	STIFTELSEN SINTEF	BRIDGE Risk Analyzer: A Collaborative Tool for Enhanced Risk Analysis in Crisis Situations	13/11/2012	AmI-12: International joint conference on Ambient Intelligence, Pisa, Italy	Scientific community (higher education, Research) - Industry		International
105.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	Response to Emergence in Emergency Response	13/11/2012	AmI-12: International joint conference on Ambient Intelligence, Pisa, Italy	Scientific community (higher education, Research) - Industry		International
106.	Articles published in the popular press	STIFTELSEN SINTEF	Samhandling og beslutningstaking i innsatsleders KO	24/09/2012	Brannmannen	Scientific community (higher education, Research) - Civil society - Medias		Norway
107.	Oral presentation to a scientific event	TECHNISCHE UNIVERSITEIT DELFT	Smart and Secure Sensor Data Sharing in Crisis Response and ManagementFull title of the publication	18/11/2013	WI-IAT 2013: Workshop on Sensing, Perceiving, and Understanding Actions, Atlanta, USA	Scientific community (higher education, Research) - Industry		International
108.	Oral presentation to a scientific event	FRAUNHOFER-FIT	The Reconfiguration of Triage by Introduction of Technology	27/08/2013	MobileHCI 2013: 15th International Conference on Human-Computer Interaction with Mobile Devices and	Scientific community (higher education, Research)	150	International
109.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Gap Analysis of EU Counterterrorism Research Initiatives	20/08/2012	45th Session of the International Seminars on Nuclear War and Planetary Emergencies	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	150	International
110.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	Reconfiguring Possibilities in Crisis Situations: an Agential Realist Approach to Participatory Desi	12/08/2012	Participatory Design Conference, Roskilde, Denmark	Scientific community (higher education, Research)		International
111.	Web sites/Applications	FRAUNHOFER-FIT	Better first response medical care during catastrophes	02/12/2013	Research News, Fraunhofer FIT website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International
112.	Flyers	HELSE STAVANGER HF	BRIDGE Concept Case Flyers	25/09/2013	Risavika Harbour, Stavanger, Norway	Scientific community (higher education, Research) - Civil society - Medias	200	Norway, EU, International
113.	Oral presentation to a scientific event	Crisis Training AS	Sustainable Training for Crisis – technology supported training for organizations	24/10/13	45th ESReDA Seminar, Porto, Portugal	Scientific community (higher education, Research) - Industry - Medias	100	International
114.	Web sites/Applications	FRAUNHOFER-FIT	Electronic Triage Bracelets Prioritize Who Needs Immediate Care	05/12/2013	Gizmodo (US design and technology blog)	Scientific community (higher education, Research) - Industry - Medias		US, International
115.	TV clips	STIFTELSEN SINTEF	Storstilt terrorøvelse i Risavika	25/09/2013	Nyheter, NRK - Rogaland, www.nrk.no	Civil society - Medias		Norway
116.	Web sites/Applications	STIFTELSEN SINTEF	Teknologihjelp i store katastrofer	27/09/2013	SINTEF Website, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Norway
117.	Web sites/Applications	ALMENDE B.V.	BRIDGE performs well during simulated terrorist attack	30/09/2013	Almende website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International
118.	Articles published in the popular press	FRAUNHOFER-FIT	Phone's Wi-Fi hotspot acts as SOS beacon in disasters	27/02/2014	NewScientist.com	Scientific community (higher education, Research) - Civil society - Medias		USA, International
119.	Articles published in the popular press	FRAUNHOFER-FIT	Your Phone's Wi-Fi Hotspot Could Act As an SOS Beacon in a Disaster	27/02/2014	Gizmodo.com	Scientific community (higher education, Research) - Industry - Civil society - Medias		USA, International
120.	Articles published in the popular press	FRAUNHOFER-FIT	Your smartphone's WiFi hotspot might double as a disaster rescue beacon	27/02/2014	Engadget.com	Scientific community (higher education, Research) - Industry - Civil society - Medias		USA, International
121.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Neues Managementsystem zur Koordination von Katastrophen-Hilfseinsätzen	12/09/2014	APA - Science	Scientific community (higher education, Research) - Civil society - Medias		Austria
122.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Uni Salzburg entwickelt Drohne zur Unterstützung bei Katastropheneinsätzen	12/09/2014	Salzburg24.at	Civil society - Medias		Austria
123.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Drohnen sollen Rettern das Leben retten	15/09/2014	Salzburger Nachrichten	Civil society - Medias		Austria, Germany
124.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Wenn Drohnen zu Hilfe eilen	17/09/2014	Der Standard	Civil society - Medias		Austria, Germany
125.	Videos	PARIS-LODRON-UNIVERSITÄT SALZBURG	Alpine ValEDation Days Field Test, St. Gilgen, Austria, 9 September 2014	17/10/2014	Youtube - BRIDGE FP7 Project Channel	Scientific community (higher education, Research) - Civil society - Medias		International
126.	TV clips	PARIS-LODRON-UNIVERSITÄT SALZBURG	Uni mal praktisch	21/01/2015	PlugIn - Uni-TV-Magazin - Folge 36, UniTV/Das Salzburger Unifernsehen, University of Salzburg	Scientific community (higher education, Research) - Civil society - Medias		Austria

127.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	CRJ preview: Enhanced situation awareness for complex disasters	23/02/2015	Crisis Response Journal Blog http://www.crisis-response.com/comment/blogpost.php?post=79()	Civil society - Medias		International
128.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Advanced Situational Awareness: Part I. Awareness Systems in Emergency Response	01/04/2015	Crisis Response Journal, Vol. 10, Issue 3	Civil society - Medias		International
129.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Advanced Situational Awareness: Part II. UAVs and Computer Systems in Crisis Management	01/06/2015	Crisis Response Journal, Vol. 10, Issue 4	Civil society - Medias		International
130.	Oral presentation to a scientific event	TECHNISCHE UNIVERSITEIT DELFT	Smart and Secure Sensor Data Sharing in Crisis Response and Management	18/11/2013	IEEE/WIC/ACM Int. Conf. on Web Intelligence and International Conference on Intelligent Agent Techno	Scientific community (higher education, Research)	250	USA, International
131.	Oral presentation to a scientific event	HELSE STAVANGER HF	The Norwegian Industrial Safety and Security Organisation Annual Conference 2013	03/12/2013	Fornebu, Norway	Industry - Civil society	250	Norway
132.	Oral presentation to a scientific event	UNIVERSITAET KLAGENFURT	12th International Conference on Machine Learning and Applications	04/12/2013	Miami, FL, USA	Scientific community (higher education, Research) - Industry	90	USA, international
133.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	EU FP7 CATO Project WP6 Meeting	05/12/2013	Salzburg, Austria	Scientific community (higher education, Research)	15	EU
134.	Oral presentation to a scientific event	HELSE STAVANGER HF	EU- project meeting Helse Stavanger HF/SuS	06/01/2014	Stavanger, Norway	Scientific community (higher education, Research)	30	EU
135.	Oral presentation to a wider public	VSH HAGERBACH TEST GALLERY LTD	ISTSS 2014 - 6th International Symposium on Tunnel Safety and Security	12/03/2014	Marseille, France	Scientific community (higher education, Research) - Industry - Civil society	240	EU, International
136.	Oral presentation to a wider public	HELSE STAVANGER HF	IKT-Forum 2014	25/03/2014	Bergen, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	150	Norway, EU
137.	Oral presentation to a wider public	PARIS-LODRON-UNIVERSITÄT SALZBURG	High Level Expert Group (HLEG) 17 - Idealer Flughafen der Zukunft	28/03/2014	Salzburg, Austria	Scientific community (higher education, Research) - Industry - Policy makers	35	Austria, Germany
138.	Oral presentation to a wider public	Crisis Training AS	Virtual Lab for Crisis Training - Workshop	03/04/2014	Stockholm, Sweden	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	40	Sweden, Norway
139.	Oral presentation to a scientific event	FRAUNHOFER-FIT	2014 ACM annual conference on Human Factors in Computing Systems (CHI'14)	26/04/2014	Toronto, Canada	Scientific community (higher education, Research) - Industry	3000	International
140.	Organisation of Workshops	PARIS-LODRON-UNIVERSITÄT SALZBURG	MARKA Project Training Course on 3D Modelling	12/05/2014	Kacaeli, Turkey	Scientific community (higher education, Research) - Civil society	50	Turkey
141.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	ISCRAM 2014	18/05/2014	Penn State University, USA	Scientific community (higher education, Research) - Policy makers	200	International, USA
142.	Oral presentation to a scientific event	FRAUNHOFER-FIT	ISCRAM 2014	18/05/2014	Penn State University, USA	Scientific community (higher education, Research) - Civil society	200	International, USA
143.	Oral presentation to a scientific event	FRAUNHOFER-FIT	ISCRAM 2014	19/05/2014	Penn State University, USA	Scientific community (higher education, Research) - Civil society	200	International, USA
144.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	FP7 CATO Project "Skyfall" Test Series	18/05/2014	Kamenna, Czech Republic	Scientific community (higher education, Research) - Industry - Civil society	40	EU
145.	Oral presentation to a wider public	STIFTELSEN SINTEF	Project Proposal Meeting Secure Societies	21/05/2014	Norges Forskningsråd, Norway	Scientific community (higher education, Research) - Policy makers	20	Norway
146.	Oral presentation to a wider public	PARIS-LODRON-UNIVERSITÄT SALZBURG	FP7 CATO Project "Cochobamba" Proof of Concept Field Exercise	02/06/2014	Salzburg, Austria	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	30	EU, Austria
147.	Oral presentation to a scientific event	ALMENDE B.V.	PAAMS 2014 Conference	04/06/2014	Salamanca, Spain	Scientific community (higher education, Research) - Industry	500	EU, International
148.	Oral presentation to a scientific event	UNIVERSITAET KLAGENFURT	International Conference on Ad-Hoc Networking and Wireless (ADHOC-NOW 2014)	22/06/2014	Benidorm, Spain	Scientific community (higher education, Research)	100	International, EU
149.	Organisation of Workshops	PARIS-LODRON-UNIVERSITÄT SALZBURG	BRIDGE Alpine ValEDation Days - Field Test	09/09/2014	St. Gilgen, Austria	Scientific community (higher education, Research) - Civil society	40	Austria, EU
150.	Organisation of Workshops	PARIS-LODRON-UNIVERSITÄT SALZBURG	BRIDGE Alpine ValEDation Days Dissemination Event	12/09/2014	Salzburg, Austria	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	30	Austria, EU
151.	Organisation of Workshops	THALES NEDERLAND BV	BRIDGE Low Countries ValEDation Days	10/11/2014	Delft, The Netherlands	Scientific community (higher education, Research) - Industry - Civil society	15	The Netherlands, EU
152.	Organisation of Workshops	STIFTELSEN SINTEF	BRIDGE Nordic ValEDation Days	19/11/2014	Oslo, Norway	Scientific community (higher education, Research) - Industry - Civil society	30	Norway, EU
153.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	The Values of Tourism Conference - the 23rd Nordic Symposium on Tourism and Hospitality Research	02/10/2014	Copenhagen, Denmark	Scientific community (higher education, Research)	200	Denmark, Sweden, Norway, Finland
154.	Oral presentation to a scientific event	STIFTELSEN SINTEF	8th Nordic Conference on Human-Computer Interaction (NordiCHI14)	26/10/2014	Helsinki, Finland	Scientific community (higher education, Research)	100	Norway, Sweden, Denmark, Finland

155.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	NATO Advanced Research Workshop Preparedness for Nuclear and Radiological Threats"	18/11/2014	Los Angeles, California, USA	Scientific community (higher education, Research) - Civil society - Policy makers	150	USA, International
156.	Oral presentation to a scientific event	FRAUNHOFER-FIT	Symposium on Border Surveillance and SaR Operations Technology (BSSAR 2014)	27/11/2014	Heraklion, Crete, Greece	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	150	EU
157.	Exhibitions	FRAUNHOFER-FIT	Symposium on Border Surveillance and SaR Operations Technology (BSSAR 2014)	27/11/2014	Heraklion, Crete, Greece	Scientific community (higher education, Research) - Civil society - Policy makers	150	EU
158.	Oral presentation to a wider public	STIFTELSEN SINTEF	CPExpo 2014 & SRC Security Research Conference 2014	09/12/2014	Genova, Italy	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	500	EU
159.	Exhibitions	STIFTELSEN SINTEF	CPExpo 2014 & SRC Security Research Conference 2014	09/12/2014	Genova, Italy	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	500	EU
160.	Oral presentation to a wider public	PARIS-LODRON-UNIVERSITÄT SALZBURG	BRIDGE Advanced Situation Awareness (ASA) Focus Group Meeting	06/02/2015	Salzburg, Austria	Scientific community (higher education, Research) - Civil society	20	Austria
161.	Exhibitions	FRAUNHOFER-FIT	CeBIT 2015 Conference & Exhibition	16/03/2015	Hannover, Germany	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	221000	Germany, EU
162.	Oral presentation to a scientific event	UNIVERSITAET KLAGENFURT	Fifth International Workshop on Pervasive Networks for Emergency Management (PerNEM 2015)	27/03/2015	St. Louis, Missouri, USA	Scientific community (higher education, Research)	100	International, USA
163.	Oral presentation to a wider public	PARIS-LODRON-UNIVERSITÄT SALZBURG	2nd ERNCIP Conference "Dissemination, Exploitation and New Initiatives"	16/04/2015	Brussels, Belgium	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	100	EU
164.	Organisation of Conference	LANCASTER UNIVERSITY	ISCRAM 2015 - Workshop "ELSI Narratives in IT Design for Disaster Response"	24/05/2015	Kristiansand, Norway	Scientific community (higher education, Research)	200	EU, International
165.	Organisation of Conference	LANCASTER UNIVERSITY	ISCRAM 2015 - ELSI Workshop	25/05/2015	Kristiansand, Norway	Scientific community (higher education, Research)	200	EU, International
166.	Oral presentation to a scientific event	LANCASTER UNIVERSITY	ISCRAM 2015	24/05/2015	Kristiansand, Norway	Scientific community (higher education, Research)	200	EU, International
167.	Oral presentation to a scientific event	STIFTELSEN SINTEF	ISCRAM 2015	26/05/2015	Kristiansand, Norway	Scientific community (higher education, Research)	200	EU, International
168.	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	8th Session of the International Seminar on Nuclear War and Planetary Emergencies	21/08/2015	Erice, Sicily, Italy	Scientific community (higher education, Research) - Industry - Civil society	150	International
169.	Oral presentation to a scientific event	FRAUNHOFER-FIT	15th International Conference on Innovations for Community Services (I4CS)	10/07/2015	Nürnberg, Germany	Scientific community (higher education, Research)	50	International
170.	Articles published in the popular press	PARIS-LODRON-UNIVERSITÄT SALZBURG	Advanced Situation Awareness Part III: Expert System	01/09/2015	Crisis Response Journal	Civil society - Medias		International

3 Description of exploitable foreground (public)

3.1 BRIDGE system (open source)

3.1.1 A system of systems approach

The vision for the BRIDGE project was to provide an infrastructure for a BRIDGE system of systems, i.e., a set of loosely coupled sub systems and services, with a minimum of global constraints and structures, but with a high degree of interoperability. This means that the middleware must be able to manage a very dynamic environment where services come and go in the network.

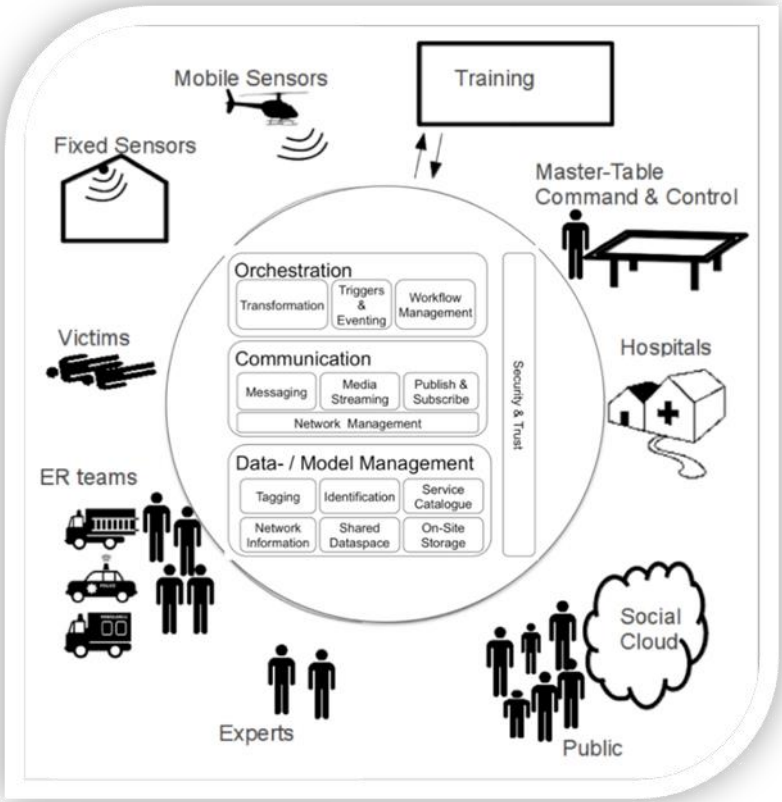


Figure 5: A BRIDGE system of systems with the BRIDGE system at the centre.

As BRIDGE is designed as a system of systems there is no specific BRIDGE system instance, rather the assembly of sub-systems and services in a BRIDGE configuration depends on the deployment context and scale, in real situations or in training.

The BRIDGE system of systems approach to the architecture has several consequences. At run-time BRIDGE is composed of set of loosely coupled sub systems and services, with a minimum of global constraints and structures. At the same time there must be an openness for inclusion of new resources (services, devices), implying compliance to standards. For this reason the middleware supports the EDXL messaging (de facto) standard family.

There are also a number of design time considerations for developers of BRIDGE client applications. A starting point is never to assume continuous resource and system availability, hence the BRIDGE platform must be assumed to operate under potentially disruptive conditions considering, e.g.

- Infrastructure failure, such as network component failure.
- Services and devices may become unavailable or operate with varying quality of service
- Congestion of communication channels and information/data overload

As a complement to the technical platform and the middleware, a set of Architectural Qualities (c.f., Deliverable D04.2) were compiled to serve as an guidelines for the design of the BRIDGE system of systems from different quality perspectives.

These were then made concrete in terms a set of proof of concepts applications, referred to as BRIDGE Concepts Cases, representing emergency management applications and users. The Concept Cases were developed to show and capture (emergency) user requirements while at the same time placing technical requirements and constraints on the middleware. As Concept Cases were developed and validated, parts of their functionality was factored out and integrated with the middleware services (c.f. centre of Figure 5) thus becoming available to other existing as well as future applications.

3.1.2 The Middleware Services and Components

The BRIDGE middleware services are enclosed by a physical communications layer at the bottom and an application layer at the top of the diagram respectively.

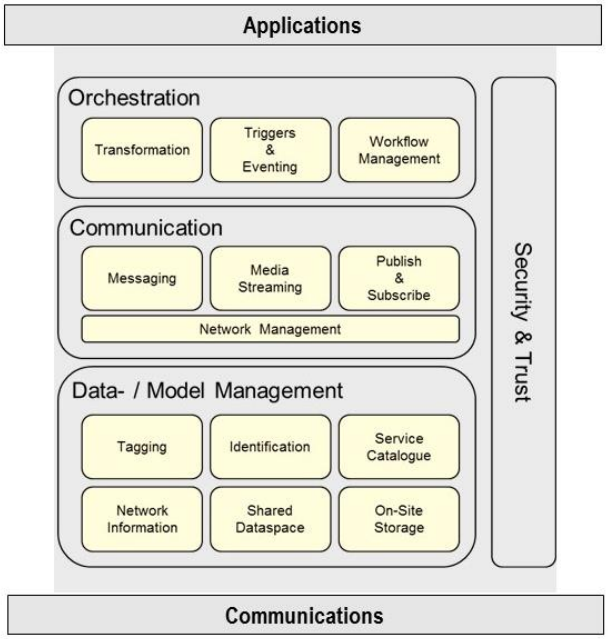


Figure 6: BRIDGE Middleware Service sub sets

The communications layer realizes several network connection technologies like ZigBee, Bluetooth or WLAN. The application layer contains user applications which could comprise functions like workflow management, user interface, custom logic and configuration details.

The BRIDGE platform offers a large collection of reusable core software components for developers to develop run-time applications. Based on these software components, the BRIDGE middleware services provide programming abstraction and functionality for developers. The middleware services are logically clustered in four sets of services:

- Orchestration
- Data- and Model Management
- Communication
- Security & Trust

These Middleware Services represent globally available functionality shared by all BRIDGE applications, and possibly external systems/actors. The internal structure of each component is determined by a design derived from the related set of requirements and hence determined by specific project work packages.

Orchestration services provide support for the composition of services and workflows. The main services are:

- Transformation: Provides generic format and structure transformation services.
- Triggers & Eventing: An event management subsystem, providing event channels, event taxonomies (types), and event log and history (based on extended LinkSmart).
- Workflow Management: Definition, storage and sequencing of activities and tasks (possibly based on standard workflow models). Supports the sharing and re-use of workflow plans.

Data- and Model Management services support the acquisition, storage and exchange of data, services and models emerging from diverse sources (sensors, systems, databases, public, experts, colleagues, etc.) on the fly. The main services are:

- Tagging: Provides functions needed for the annotation of any identifiable BRIDGE object (first responders, victims, buildings, data). This includes tagging with various sensor devices.
- Identification: Supports the unique identification of BRIDGE resource (actors, tasks, devices, etc.). Provides functionality to register and query resources.
- Service Catalogue: Provides access to BRIDGE middleware services as an entry point.
- Network Information: Provides information about the infrastructure objects/topologies/resources.
- Shared Dataspace: Provides a persistent data space for sharing and distribution among multiple clients.
- On-Site Storage: Provides access to large-sized data without going over the Internet and thus, with shorter response times.

Communication services provide functionality enabling distribution of data as well as invocations of services. The main services are:

- Messaging: Allows sending messages to actors based on their role, location, etc. Also support for broadcast messages to a certain group of receivers (e.g. all fire-fighters in an area).
- Media Streaming: Provides service for streaming media over the network.
- Publish & Subscribe: implements a message-oriented communication paradigm to provide greater network scalability and more dynamic network topology
- Network Management: provides functionality to change networks topology

Aspects of security and trust do not represent a focal point of research in the BRIDGE project as explicitly stated in the project description of work. However, the BRIDGE project addresses these aspects by exploiting the LinkSmart concepts and technology developed in the HYDRA project (funded by the European Commission). All aspects related to privacy are fully described in deliverable D12.1 – Privacy Protection and Legal Risk Analysis.

BRIDGE Common Information Space

The BRIDGE Service Catalogue is a common entry point to the middleware and the available services. The Service Catalogue, in combination with a BRIDGE Quality of Service Repository and a BRIDGE Resource Status Repository, is referred to as the BRIDGE Common Information Space. These repositories contain vital information for the BRIDGE workflow and QoS Management services.

The Service Catalogue registers and retrieves all resources active in BRIDGE. Upon registration, each resource gets assigned a unique BRIDGE ID. Methods to register and search the Service Catalogue are documented in BRIDGE Deliverables D05.2 and D05.3.

The Quality of Service Repository registers and retrieves information regarding the integrity constraints and service qualities of resources that are registered in the BRIDGE service Catalogue. The integrity constraint and service quality information follow a distinct syntax with interfaces to register and search the repository (c.f. BRIDGE Deliverable D07.4).

The Resource Status Repository maintains the status updates of resources that are registered in the BRIDGE service Catalogue. The relevant status aspects include the deployment status, the schedule, the time of the last status update, and, in case of physical resources, some aspects such as location and speed. The Resource Status repository registers and retrieves resource status information, using an interface specified in Deliverable D07.4.

3.1.3 Implementation platform

The BRIDGE middleware has been implemented using and extending the LinkSmart Middleware, and by integrating the specific software platforms provided by the technical partners in the project.

Many of the LinkSmart extensions made in BRIDGE are incorporated in the Open Source release available at https://linksmart.eu/redmine/projects/linksmart-opensource.

The development of the BRIDGE SWARM and MASTER concept case have led to several extensions of two popular open source products of Almende, namely the Eve agent-based development platform and the Vis.js browser-based visualization toolkit. Eve can be found at http://eve.almende.com/. Vis.js. can be found at http://visjs.org/.

3.1.4 Exploitation and dissemination of Open Source

Several of the LinkSmart extensions made in BRIDGE are incorporated in the Open Source releases available at www.linksmart.eu. These components will also be exploited as part of our LinkSmart-based IoT Platform offerings, with domain specific services. Some of these service offerings target eHealth/mHealth applications, Smart City and infrastructure monitoring.

Many parts of the BRIDGE systems were developed within the Open Source domain. This includes both the middleware layer but also the applications layer. Below a list of the repositories BRIDGE contributed to:

Repository	**Examples of BRIDGE part**
LinkSmart – www.linksmart.eu	BRIDGE middleware
Agentscape – www.argentscape.org	S2D2S Blackboard
Eve – http://eve.almende.com	SWARM – Situation aware Resource Management
ThingModel - https://github.com/SINTEF-9012/ThingModel	ThingModel synchronizes data and models in realtime over the network for multiple devices.
MobileMaster - https://github.com/SINTEF-9012/mobileMaster	HTML5 version of MASTER – situation awareness
Tina Framework - http://www.tinia.org	3D model rendering of critical infrastructure
PruneCluster - https://github.com/SINTEF-9012/PruneCluster	Method for clustering of icons on a map.
Pie menu for WPF - http://www.codeproject.com/Articles/522343/A-Pie-Menu-for-WPF	GUI element Pie menu for touch interfaces

3.2 Advanced Situation Awareness (ASA) system

The *Advanced Situation Awareness* (ASA) systems been developed in BRDIGE. It provides crisis managers with an innovative tool for information gathering and management. Usually, the first hour of a disaster is characterized by a flood of heterogeneous information, ranging from high quality data to scarce and unreliable information. ASA assists decision makers in providing an aerial view of the disaster area and environmental measurements, comparing measured data with national limits and international recommendations, calculating 3D- and 2D models, and issuing advice on optimal protection of first responders and members of the public.

ASA consists of three main components:

(1) *Sensor-equipped unmanned aerial vehicle* (drone) which can record live video and infra-red video of the situation on scene. Furthermore, its gas-, aerosol- and radiation sensors on board measure hazardous components in the atmosphere;
(2) Computer-based *EXPERT System* (ES) incorporates several large database, enabling the ES to compare the drone data with limits;
(3) Together with visual information from the cameras on board of the drone, the *Modelling Module* creates 3D models of buildings potentially damaged during the incident and at risk of collapsing, estimates the number of killed and injured persons on site and forecasts the spreading of toxic plumes as 2D model. The incident commander can retrieve all data on geo-referenced maps and – depending on the need for more detailed information – will be guided to increasingly more complex background information to support the decision.

4 Appendix - Newsletters

Newsletter 1-6

BRIDGE Newsletter

ISSUE 6 — JUNE 2015

BRIDGE is a collaborative project funded by the European Commission within the 7th Framework Programme (Call FP7-SEC-2010-1, Work Programme Topic 4.2-1: Interoperability of data systems, tools and equipment, Grant Agreement no. 261817)

Editorial

Dear Reader!

All projects come to an end, also the BRIDGE project. In December 2011 we welcomed you to follow our research, and now in June 2015 we have passed a successful final review and summarized four years of research and innovation. This final newsletter gives you a glance into the knowledge obtained by the partners.

The expectations for the project were high, expressed by this statement from the Commission back in 2011: "*BRIDGE will examine how we can obtain and use information as disasters develop, in order to give us a better joint understanding of the situation and thus enable us to make better decisions more rapidly.*" Through the 4th project demonstration held in Flums, Switzerland in May 2015, we demonstrated that we have reached these overall objectives. Even more important, the project presented concept cases and prototypes ready for market introductions. Some of these have already been evaluated in real operations over some weeks during the spring.

The BRIDGE middleware is an open-source software that supports the flexible assembly of emergency response systems into a 'system of systems' for agile emergency response. The middleware is described in one of the public deliverables. In this newsletter you can learn more about how the concept cases come together using the middleware supporting the BRIDGE scenario based on the Toulouse disaster in 2001. We also present an overview of the impressive project dissemination, from research publications and PhD theses to TV-interviews and exhibitions.

Please get in contact with us if you have questions or just want to discuss possibilities for collaboration in the future! We hope our efforts will help Europe to establish improved emergence response systems for the benefit of all European citizens.

Dag Ausen, SINTEF
Project Coordinator

In this issue:

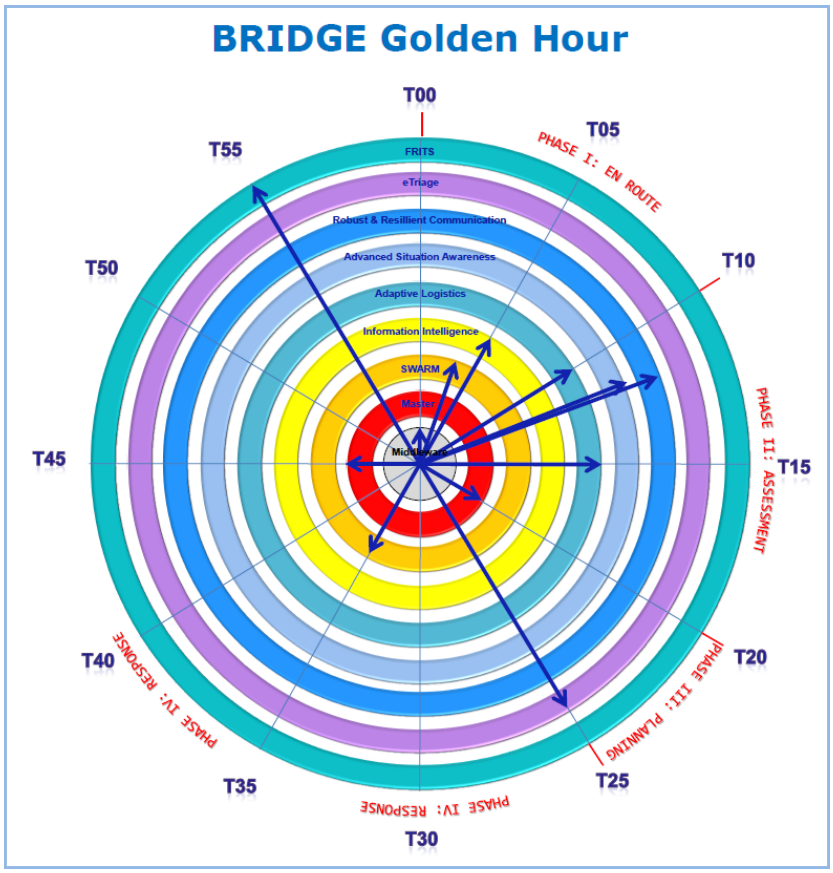
BRIDGE team, EUAB members, and evaluators after the final project demonstration in Flums, Switzerland, 20 May 2015. Photo courtesy: Maximilian Wietek (VSH).

BRIDGE Final Demonstration and Review Meeting

Fourteen BRIDGE partners gathered in Switzerland, for the fourth and final project demonstration hosted by the Hagerbach Test Galleries (Versuchstollen Hagerbach, VSH) in Flums on May 20-21, 2015. They presented emergency response systems developed in different work packages and demonstrated how they can interact to the representatives of the BRIDGE End-User Advisory Board and the project reviewers.

BRIDGE partners demonstrated a flexible assembly of emergency response systems supported by the BRIDGE middleware into a 'system of systems' for agile emergency response. Such 'systems' include BRIDGE concept cases, but also independent systems such as healthcare or vehicle registration records, building or environmental sensors, CCTV camera systems. The final concept cases that were demonstrated in Flums are:

- Adaptive Logistics;
- Advanced Situation Awareness (ASA);
- Dynamic Tagging of the Environment;
- First Responders Integrated Training System (FRITS);
- Information Intelligence;
- Master;
- Robust & Resilient Communication;
- Situation aWAre Resource Manager (SWARM).



BRIDGE Golden Hour with eight rings for concept cases demonstrated at different time slots in the sequence of their use in a simulated scenario.

Each concept case represents an end-user application whose implementation is based on individual parts and services of the BRIDGE middleware, and, therefore, each concept case represents an 'instantiation' of the BRIDGE middleware architecture and provides a specific perspective on the services offered by the BRIDGE middleware. To the producers of emergency response systems, BRIDGE middleware offers a consolidated set of software services organized in three layers that facilitate the orchestration of systems, the communication between such systems, and the management of data produced by such systems during an incident's lifecycle. The BRIDGE middleware forms the basis of all BRIDGE concept cases and underpins interoperability between different BRIDGE- and external systems.

Peeter Kool (CNet) talks about BRIDGE middleware, which underpins interoperability between different systems. Photo courtesy: Lyudmila Zaitseva (PLUS).

The demo was followed by the final review meeting, which was completed with a positive evaluation of the project results by the reviewers.

BRIDGE Scenario

BRIDGE innovations were demonstrated in the framework of a simulated technological disaster scenario, involving a powerful explosion and subsequent fire at a chemical facility. The scenario was developed based on the actual industrial accident, which happened in Toulouse, France, in September 2001, causing 30 fatalities and over 3500 injuries among the personnel onsite and general public outside of the facility.

This scenario was chosen to demonstrate how the system of systems developed in BRIDGE could be used after such a disaster and improve emergency response during its most critical early phase, i.e., the first - 'golden' - hour. All eight concept cases, plus the BRIDGE middleware, were shown at different timeslots (e.g., T5, T15, T35) of the *BRIDGE Golden Hour*, demonstrating both, the advantages of the new technologies and early stage prototypes in different phases of emergency response (e.g., en route, assessment, planning, response) and their interaction and interoperability as an integrated solution.

Thus, minutes after the detonation (T5), *Information Intelligence* starts gathering and analyzing tweets on explosions, damages, smoke cloud, etc. to help incident commanders gather operative information and identify potential sub-events requiring rescue efforts. Soon after (T12), the first fire brigade on scene flies the *ASA UAV* over the explosion site and sends the first images of the destruction, location of heat sources, and environmental sensor data from the toxic cloud. *ASA Expert System* analyzes the digital data

AZF site after the explosion. Photo courtesy: Grande Paroisse (http://www.azf.fr).

Toulouse Disaster

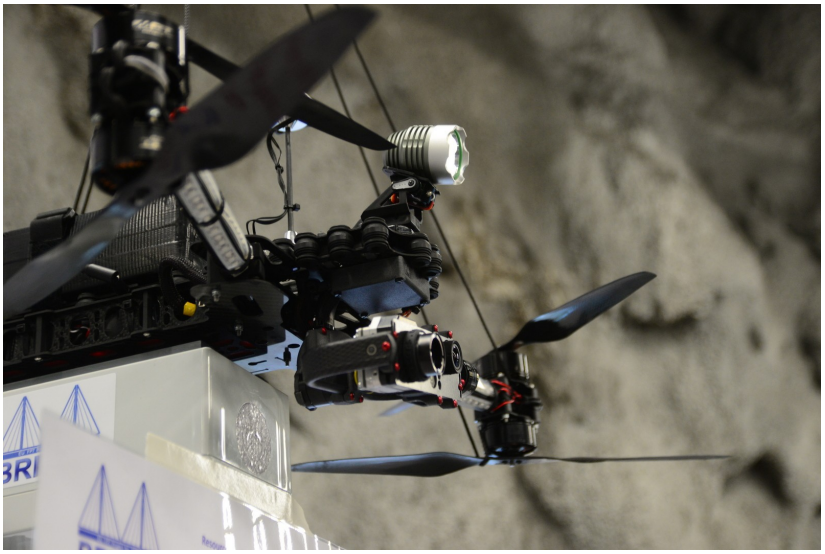
On September 21, 2001, at 10:17 on a Friday morning, a powerful explosion occurred at the AZF (*AZote Fertilisant*) fertilizer factory on the outskirts of Toulouse, France. The detonation could be felt 80 km away, and the Institute for Geophysics at Strasbourg registered the blast at 3.4 on the Richter scale, which makes it one of the biggest explosions in modern industrial history. The explosion produced a crater of about 65 m by 54 m in diameter and 7 m in depth. The TNT equivalent of the explosion was estimated in a range of 20–40 tonnes. It was established that between 20 and 120 tonnes of a stock containing more than 300 tonnes of ammonium nitrate refuse detonated at the plant.

The extent of damage was very large both on and off site. Many industrial buildings were demolished, and nearby residential buildings were in need of immediate evacuation. About 80 ha of the plant were largely devastated. Within a 3-km radius, some 27000 nearby homes were damaged, 11000 seriously, with crumbled walls and missing roofs. Windows were shattered over a radius of 5 km. Afterwards, about 40,000 damage claims were submitted to the insurance companies. The airport at Toulouse-Blagnac and the main railway station were closed and 90 schools in the area evacuated. 40,000 people—10 % of the city's population—were made homeless for a few days.

A cloud of dust and smoke formed as a result of explosion and drifted towards the city centre. At first, it was not known whether it was hazardous. Later, it was established that the release contained some toxic substances, including ammonia. Fortunately, the concentration of these chemicals did not pose serious danger to the population.

The event caused the loss of 30 lives, most of them plant workers. More than 3,500 people were injured as a result of the explosion, 50 of them seriously. Most injuries were due to shattered windows.

The investigation into the causes and circumstances surrounding the accident is still ongoing.



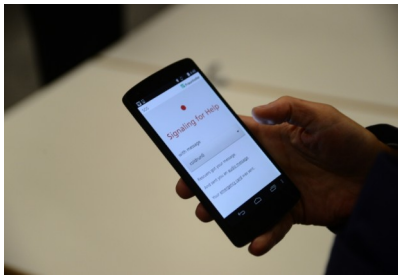
PLUS dual-quadrocopter with video and infrared cameras, and a sensor box. Photo courtesy: Alexander Boden (Fraunhofer FIT).

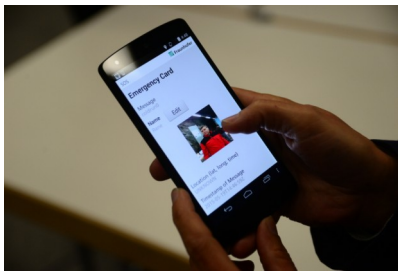
Ground-station with infrared and video images, and Expert System display.

received from the UAV and provides advice to the incident commander regarding personal protection equipment (PPE) for first responders and protective measures for public. *ASA Modelling Module* creates a plume dissipation model for the next few hours based on the current meteorological data, which should help make a decision on the areas to be evacuated. Both, the *Expert System* advice and the plume models are made available on the *Master* table and tablet PC.

Robust and Resilient Communication (RCC) concept is activated almost simultaneously with ASA (T13), upon arrival of responders on scene. In response to the disruption of network infrastructure at the incident site, responders start to deploy wireless network devices in order to establish a mesh of connected devices, i.e., *BRIDGE Mesh*. The network devices

2D plume dissipation models and expert system advice on PPE and public safety measures are sent from ASA to the Master via the BRIDGE middleware.

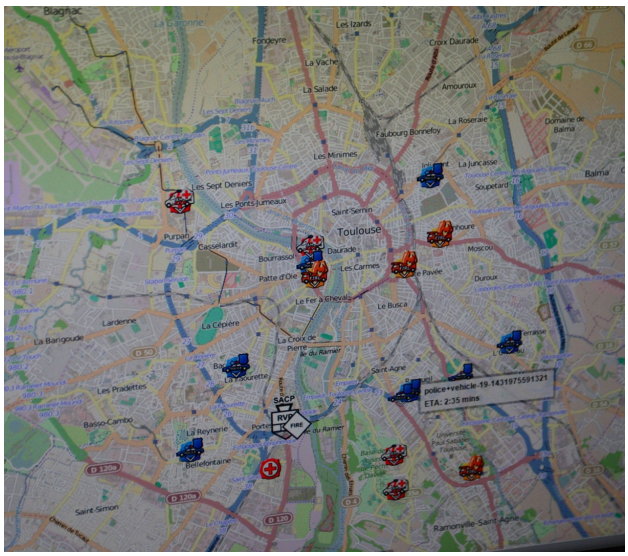




Christian Raffelsberger (Alpen-Adria Univerisity of Klagenfurt) and Amro Al-Akkad (Fraunhofer FIT) presenting RRC concept to project reviewers. Photo courtesy: Alexander Boden (Fraunhofer FIT).

provide different work interfaces (ZigBee, WiFi etc.) to enclose the heterogeneity of available devices at the incident site. People in distress use their smartphones to signal SOS via the *Help Beacon Victim App*. The SOS signal contains a message (e.g., 'Help Me') and optionally an emergency profile, which includes the time the SOS call was setup, the phone ID and, if available, the name, and GPS location. When the search and rescue team enters the disaster zone, some responders carry smartphones that run the *Help Beacons Responder App*, which searches for SOS calls on scene. In case such a SOS signal is found, the responder's phone connects to the victim's phone in order to notify the caller that his call has been discovered. If the connection is stable enough, the victim's phone can also send an emergency profile to the responder's phone. As soon as the responder's phone gets connected to the *BRIDGE Mesh*, collected SOS calls are sent to the *BRIDGE Master* and displayed on a map. Transmitting the collected SOS calls is enabled via the middleware services (S2D2S).

SWARM is a smartphone and cloud application for *Situation aWAre Resource Management (SWARM).* It enables the tracking and tracing of locations and status of resources in real time, and the management of tasks they have been allocated to perform. The application is intended to be distributed across all personnel and vehicles that take part in the emergency response effort. In the BRIDGE scenario of the final demonstration, *SWARM* is used during routine operations to monitor location and status of local emergency personnel. A *SWARM simulator* was used to simulate first responders around the Toulouse disaster area, using *SWARM* to track their status and to receive and respond to tasks (T03). A computer monitor (separate from the *Master table*) was used to give an overview of all simulated static and moving resources in and around the emergency area.

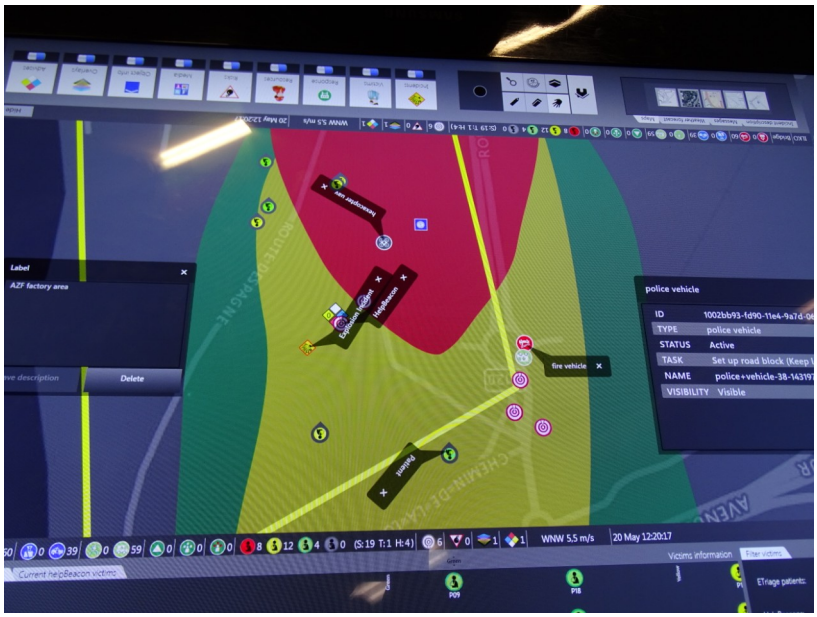


Left: Overview of simulated static and moving resources on the map of Toulouse. Right: Andries Stam (Almende) presenting SWARM. Photo courtesy: Alexander Boden (Fraunhofer FIT).

SWARM was integrated with the *Master* and with the *ASA Expert System* via the *BRIDGE Middleware*. Integration with the Adaptive Logistics Collaborative Actor Agent System (CWFGM services) was demonstrated as well. *SWARM* & *Master* show resources arriving on scene. Resources are registered both nationally and on European level. Resources can add themselves to the incident or be assigned by the incident commander or be assigned by entering the local network. This resolves the issue of unannounced and uncalled for arrivals by emergency responders, i.e., supports scalability.

Master is the visual portal to the BRIDGE System of Systems, which supports cooperation and overview. It consumes data from various sources (e.g., ASA, RRC, SWARM), supports incident commanders in obtaining situation awareness, and distributes incident information at different levels—operational and command levels. *Master* and *Middleware* enable integration of information from local authorities who, according to the Seveso Directive major-accident prevention policy (MAPP), have been provided with information sufficient to identify the dangerous substances, quantity and physical form, activity with it, areas and developments that could be the source of risk.

Aslak Wegner Eide presenting Master.
Photo courtesy: Alexander Boden.



Various masks on the Master table—resources, tweets, plume affected area.
Photo courtesy: Alexander Boden (Fraunhofer FIT).

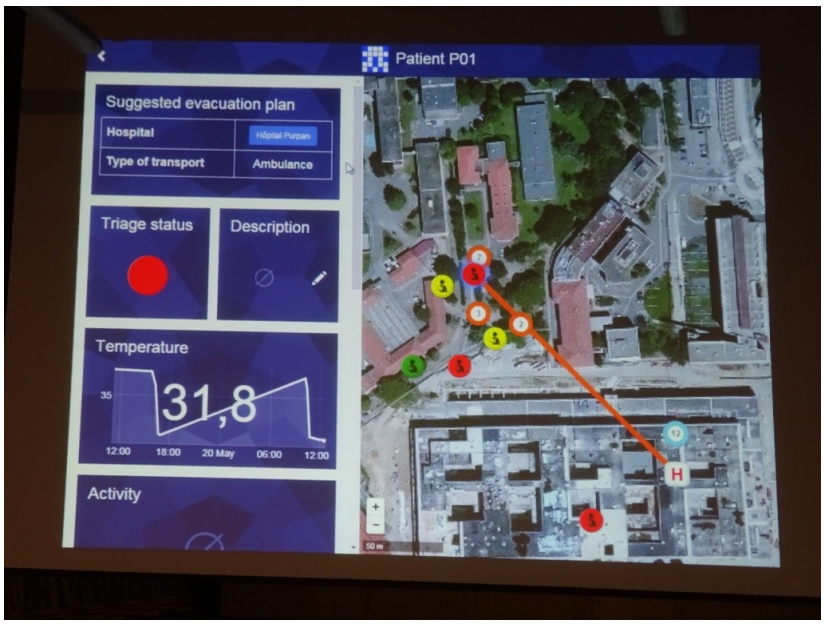
Left: Coloured, reflective, snap-on plastic bracelets for eTriage. Right: Erion Elmasllary (Fraunhofer FIT) demonstrating the eTriage system. Photo courtesy: Alexander Boden (Fraunhofer FIT).

At T25 first triagers on site start triaging the injured using the *eTriage* concept case developed by Fraunhofer FIT. *eTriage* supports the triaging process without any need for other communication networks, like mobile networks or internet. It provides overview of all casualties including information about their health or injury status. The main functionality includes triaging of victims in three categories as well as an ad hoc communication of the *eTriage* devices.

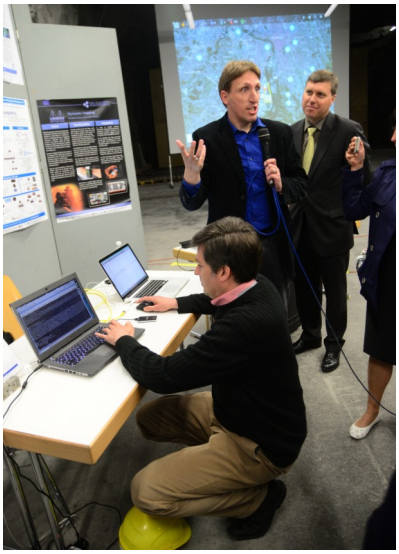
A coloured, reflective, snap-on plastic bracelet is augmented with microelectronic components for communication and location acquisition. Various sensors that do not need contact with the victim's body (e.g., air temperature, infrared, etc.) are added to the bracelets. The *eTriage* system is completed by apps for Android tablets and smartphones that allow to scan the bracelets, assign manual location data in case of no GPS coverage, show an overview of the bracelets' distribution and access their data.

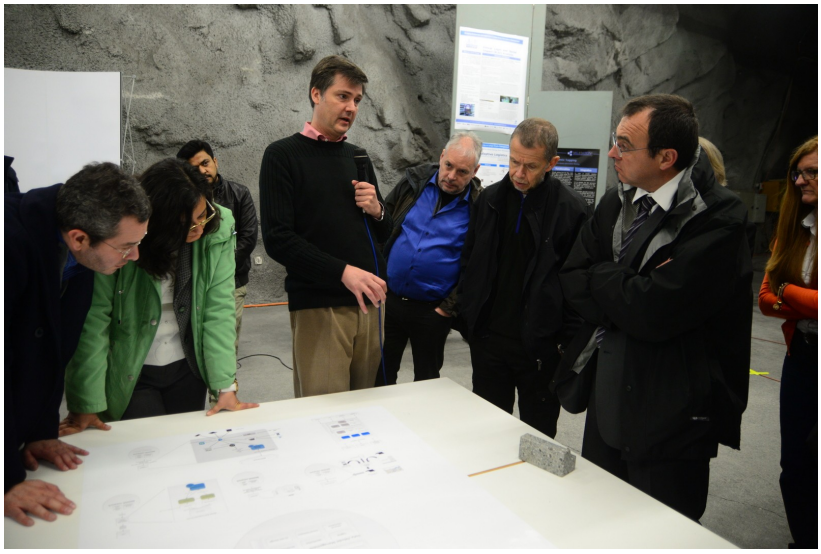
BRIDGE triage bracelets are conceptualised to turn on automatically as soon as they are pulled from the pack. They report position and category of the injured to the *Master*. Similar to the *RRC* concept case, data transmission is enabled via the *BRIDGE Mesh* and middleware services (S2D2S).

In areas without GPS, triagers can scan and set the position manually. In areas without network coverage, the bracelets are conceptualised to send triage data over the triage relays.



Patient data on an eTriage app for Android tablets.





Sander van Splunter (Technical University of Delft) and Bernard van Veelen (Thales NL) presenting Adaptive Logistics. Photo courtesy: Alexander Boden.

As paramedics gather casualties from the field to the assembly points, information is updated live on the *Master*. In case of electronics malfunction, the bracelet colours serve as a backup, which makes this triage system as reliable as the currently existing ones.

Adaptive Logistics is aiming for observing, controlling and managing the big amount of resources in a large scale incident. Dynamic response on changing situations should guarantee the best possible support to both incident managers and the teams acting on site.

Main functionalities of this concept case include the observation of movements of all kinds of resources as well as offering support in decisions to be made regarding consequences of logistic actions.

Chairman of the BRIDGE EUAB, Eivind Rake (RAKOS), providing his comments. Photo courtesy: Lyudmila Zaitseva.

BRIDGE Project Dissemination

Throughout the whole duration of the project, BRIDGE consortium was very active in disseminating the project results. Close to a hundred publications, multiple conferences and workshops, dozens of articles in the popular press and TV reports are the outcomes of the BRIDGE dissemination efforts, which have been reflected on the project website. Besides, over two hundred first responders and emergency response personnel from Norway, Austria, UK, Germany, and other EU countries were involved in various BRIDGE events ranging from End-User Advisory Board meetings and participatory design workshops in the first half of the project to exploitation, testing, and training activities in the second half.

Publications

Being heavily research-oriented, BRIDGE consortium produced a high number of scientific publications. Thus, before the end of June, a total of eighty BRIDGE papers were published, with six more accepted, seven more submitted for review, and eight more still in preparation, including two PhD theses. The accepted papers have been published in peer-reviewed scientific journals (8), edited books or book series (7), conference or workshop proceedings (60), and professional/ popular journals (5). Five PhD theses and one scientific monograph were published by universities. We are also proud that BRIDGE paper on *Help Beacons* presented by its main author Amro Al-Akkad (Fraunhofer FIT) at the 2014 ACM Annual Conference on Human Factors in Computing Systems (CHI'14) in Toronto, Canada in April 2014 received the *Honorable Mention Award*, indicating it had been identified by the CHI Associate Chairs as being among the top five percent of all submission.

Events

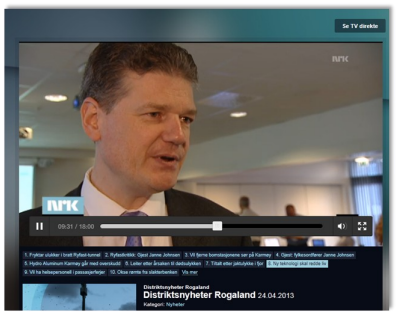
In the course of four years, BRIDGE partners have attended over a hundred different events to disseminate the knowledge about the project, its goals, and major achievements: fifty-five conferences and symposia, twenty-seven workshops and expert forum meetings, ten non-BRIDGE EU project meetings, six training exercises, and four exhibitions.

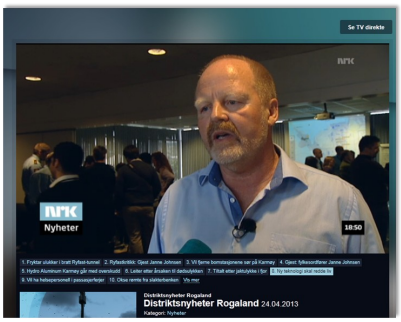
In addition, BRIDGE also organized and co-organized several conferences, workshops and seminars, including:

- International Joint Conference on Ambient Intelligence (AmI), Pisa, Italy, November 2012;
- Nordic Conference on Crisis Management, Stavanger, Norway, September 2013;
- Ethical, Legal, and Social Issues (ELSI) Tracks at the 10th, 11th, and 12th editions of the International Conference on Information Systems for Crisis Response and Management (ISCRAM 2013, 2014, 2015);
- ELSI Workshop, ISCRAM 2015, Kristiansand, Norway, May 2015;
- Workshop *New Social Media and Crisis*, Bielefeld, Germany, April 2011;
- Workshop *Collective Intelligence and CSCW in Crisis Situations*, Aarhus, Denmark, September 2011;
- Seminar *Kommunikasjon og samhandling ved katastrofer*, Oslo, Norway, December 2011;
- Workshop *New Interaction Orders, New Mobile Publics*, Lancaster, UK, March 2012;
- Workshop *Mobilizing Emergency Response*, Lancaster, UK, September 2012;
- Seminar Crisis Management in Europe, Ghent, Belgium, May 2013.

Media

BRIDGE partners put a lot of emphasis on communicating with the public about the project and its developments through the mass media means. This resulted in dozens of articles published in various printed European media (*Neue Zürcher Zeitung, Der Standard*, *Salzburger Nachrichten*, *Crisis Response Journal, Ingeniør Nytt, Aftenposten Morgen*, *Kleine Zeitung*, *Tagesblatt*, *Stavanger Aftenblatt*, *Østlendingen, Sarganserland*, etc.) and online journals, newspapers and news platforms (e.g., *Berner Zeitung Online*, *Gizmodo*, *Endgadget*, *APA-Science*, *Alpha-Galileo*, *Salzburg24*, *News Medical*, *Dagens Medisin*, *NewScientist.com*, *St. Galler Tagblatt Online*, etc.). Several BRIDGE experts were interviewed by various TV channels and two BRIDGE demonstrations were covered by the Swiss and Norwegian TV in the evening news.





Geir Horn (SINTEF), Morten Wenstad (Crisis Training AS), and Eivind Rake (RAKOS) giving invterviews for Norwegian TV.

BRIDGE at CeBIT 2015 in Hannover, Germany

CeBIT 2015 was held in Hannover, Germany, on 16-20 March 2015. Boasting an IT exhibition and a conference programme for professionals, CeBIT defines the latest IT trends, presents talks by high-calibre speakers and forward-looking panel discussions, and showcases product innovations from all over the world. BRIDGE consortium partner Fraunhofer Institute of Applied Information Technology (Fraunhofer FIT) participated in CeBIT 2015 exhibiting two of its innovations developed in BRIDGE: *eTriage* and *Help Beacons*. Both concept cases attracted a lot of attention and evoked great interest among the visitors of the exhibition.

René Reiners at CeBIT 2015 (top); Marc Jentsch giving an interview to a TV channel (bottom left); and Erion Elmasllari showcasing eTriage to the visitors (bottom right). Photo courtesy: René Reiners.

BRIDGE ASA in Crisis Response Journal

We are pleased to report that *Crisis Response Journal* has published two articles in a series of four on the *Advanced Situation Awareness (ASA)* system developed by Paris-Lodron University of Salzburg (PLUS) within the BRIDGE project.

The first article, entitled *Awareness Systems in Emergency Response*, came out in April in issue 10:3 of the journal. Friedrich Steinhäusler (PLUS) introduces the first part of a series describing a system that incorporates UAVs, a computer-based expert system and a modelling module to provide situational awareness in emergencies.

The second article, entitled *UAVs in Crisis Management*, came out in issue 10:4 of the journal. Pierre Madl (PLUS) describes how smart UAVs, carrying multiple sensors and cameras, help to provide advanced situational awareness for emergency responders in the field.

The two forthcoming articles will discuss the ASA expert system, which analyzes digital data received from the UAV, and the modelling module, which creates 3D models of structures onsite and 2D models of toxic plumes.

> *"Friedrich Steinhäusler says that the infamous fog of war also applies to civilian disasters, when incident commanders have to make far-reaching decisions based on a mixture of reliable data, half-truths, and erroneous information. This series looks at some ICT systems being developed to help them."*
>
> Awareness Systems in Emergency Response, *Crisis Response Journal*, Issue 10:3, April 2015

BRIDGE Scientific Results

PhD Thesis, RWTH Aachen University
15 June 2015

Amro Al-Akkad (Fraunhofer FIT) defended his PhD thesis entitled *Working Around Disruptions of Network Infrastructures—Design and Evaluation of Mobile Ad-hoc Systems for Resilient Communication in Disasters*.

PhD Thesis, RWTH Aachen University
19 February 2015

Marc Jentsch (Fraunhofer FIT) defended his PhD thesis entitled *Ubiquitous Annotation Visualization—Concept and Rapid Prototyping Framework* / Allgegenwärtige Anmerkungsvisualisierung – Konzept und Rahmenwerk für die schnelle Prototyperstellung.

ISCRAM 2015
24—27 May 2015

BRIDGE presented a whole range of contributions at the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2015) held in Kristiansand, Norway in May 2015. BRIDGErs Monica Büscher and Michael Liegl (Lancaster University) organised a special track on *Ethical, Legal and Social Issues (ELSI)* and a workshop on *Ethical, Legal and Social Narratives in IT Design for Disaster Response*.

A total of nine academic and insight BRIDGE papers were presented at ISCRAM 2015. They ranged from discussions of ELSI issues in the use of modelling and drones to an articulation of ELSI-Aware Co-Design methodologies, to supporting first responder in-field communication and navigation using head-mounted displays. Monika Büscher (Lancaster University) co-authored six papers presented at ISCRAM 2015—one in the ELSI Narratives Workshop and five in the ELSI track:

– *Technology in Disaster Response and Management: Narratives of Ethical, Legal, and Social Issues*, with Katrina Petersen (Lancaster University).
– *Uncertainty and Transparency: Augmenting Modelling and Prediction for Crisis Response,* with Sung-Yueh Perng (Maynooth University).
– *Don't Drone? Negotiating Ethics of RPAS in Emergency Response,* with Xaroula Kerasidou and Michael Liegl (Lancaster University).
– *The Role of the Privacy Impact Assessment in IT Innovation in Crises: An Example*, with Catherine Easton (Lancaster University).
– *Ethically Aware IT Design for Emergency Response: From Co-Design to ELSI Co-Design,* with Michael Liegl and Rachel Oliphant (Lancaster University).
– *Designing with Users: Co-Design for Innovation in Emergency Technologies,* with Katrina Petersen (Lancaster University), Maike Kuhnert (Technische Universität Dortmund), Steffen Schneider and Jenns Potterbaum (Universität Paderborn).

Three more BRIDGE papers were contibuted by SINTEF ICT. BRIDGErs Aslak Wegner Eide and Antoine Pultier (SINTEF) co-authored a paper with Fahd Bin Malek Newaz (University of Oslo), entitled *Supporting First Responder In-Field Communication and Navigation Using Head-Mounted Displays* and presented in the *Command and Control* track.

Michael Stiso, Aslak Wegner Eide and Antoine Pultier (SINTEF ICT) presented another BRIDGE paper in the Serious Gaming track entitled *A Foray into the Use of Serious Games in Controlled Research on Crisis Management*.

Aslak Wegner Eide (SINTEF ICT) co-authored his third paper at ISCRAM 2015 with BRIDGE colleagues Ida Maria Haugstveit (SINTEF ICT) and Eivind Rake (RAKOS) at the practitioner track. The title of the paper was *Practitioner-Centered, Long-Term Evaluation of an ICT-based Triage System for Emergency Management*.

PerNEM 2015
27 March 2015

Christian Raffelsberger (Alpen-Adria University of Klagenfurt) presented a BRIDGE paper at the Fifth International Workshop on Pervasive Networks for Emergency Management (PerNEM 2015) held in in conjunction with IEEE PerCom 2015 in St. Louis, Missouri, USA, on 27 March 2015. Hermann Hellwagner (Alpen-Adria University of Klagenfurt) co-authored the paper, entitled *A Multimedia Delivery System for Delay-/Disruption -Tolerant Networks*.

Social Collective Intelligence (Springer)
January 2015

Monika Büscher, Michael Liegl (Lancaster University) and Vanessa Thomas (High-wire) contributed a chapter—*Collective Intelligence in Crises*—to the book entitled *Social Collective Intelligence: Combining the Powers of Humans and Machines* (Springer).

Patent: EP 2 814 299

Submitted to: European Patent Office
Title: **Method for organizing a wireless network**
Inventor(s): Al-Akkad, Amro; Ramirez, Leonardo; Zimmermann, Andreas
Application No./Patent No.: 13171881.9 - 1857
Applicant: Fraunhofer Gesellschaft zur Förderung der angewandten Forschungen e.V.
Date of Filing: 13.06.2013
Date of Publication: 17.12.2014
Designated States: Europe (AL AT BE… SK SM TR)

You can find more on these and other project results at: http://www.bridgeproject.eu/en/bridge-results/

BRIDGE at a Glance

BRIDGE builds a system to support interoperability — both technical and social — in large-scale emergency management. The system serves as a bridge between multiple First Responder organisations in Europe, contributing to an effective and efficient response to natural catastrophes, technological disasters, and large-scale terrorist attacks.

"The project will look in particular at how cooperation among different agencies and organisations can be made more efficient at national and transnational level."

EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

The vision of the BRIDGE project is to:

- Facilitate cross-border and cross-agency collaboration
- Allow the creation of a common, comprehensive, and reliable operational picture of the incident site
- Enable integration of resources and technologies into workflow management
- Enable active ad-hoc participation of third parties

CONSORTIUM

The BRIDGE consortium consists of a well-balanced mix of cross-disciplinary academics, technology developers, domain experts and end-user representatives:

- Stiftelsen SINTEF, Norway
- Almende B.V., The Netherlands
- CNet Svenska AB, Sweden
- The Fraunhofer Institute for Applied Information Technology FIT, Germany
- Lancaster University, UK
- Crisis Training AS, Norway
- SAAB Training Systems, Sweden
- Thales Nederland B.V., The Netherlands
- Alpen-Adria University of Klagenfurt, Austria
- Paris-Lodron University of Salzburg, Austria
- VSH Hagerbach Test Gallery LTD, Switzerland
- Technical University of Delft, The Netherlands
- Stockholm University, Sweden
- Helse Stavanger HF, Norway

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Newsletter designed by Lyudmila Zaitseva

BRIDGE Newsletter

ISSUE 5 — DECEMBER 2014

BRIDGE is a collaborative project funded by the European Commission within the 7th Framework Programme (Call FP7-SEC-2010-1, Work Programme Topic 4.2-1: Interoperability of data systems, tools and equipment, Grant Agreement no. 261817)

Editorial

Dear Reader!

Emergencies cannot be fully eliminated. However, better organisation may at least help emergency workers and agencies to be more effective. Specifically, organisations and technologies would benefit from planned interoperability. Better agency and personnel cooperation potentially means more effective operations. Our contribution to this is to build a system and solutions supporting interoperability during large-scale emergencies. If these solutions can be used in daily life operations as well, the BRIDGE project may have given an important contribution to European crisis management.

This is the 5th Newsletter from the project; the last one will come in June, when we are about to close the project. Through this newsletter you will have a look into the BRIDGE ValEDation Days that took place in September and November 2014 at three different locations in Europe. Through these events the project has presented the features of the BRIDGE technologies to stakeholders within crisis management. The project partners have promoted the further usage of this knowledge to end-user representatives, governmental bodies and European companies, and discussed how to implement the results in commercial products and services. We hope you find this interesting and you are, of course, welcome to get in contact with us!

Dag Ausen, SINTEF
Project Coordinator

VALEDATION DAYS
• VALIDATION • EXPLOITATION • DISSEMINATION

BRIDGE team and stakeholders at the Alpine ValEDation event in Salzburg, Austria. Photo credit: Paul Burghardt (Thalels)

In this issue:

BRIDGE ValEDation: Validation, Exploitation, Dissemination

Catastrophes - whether natural or man-made - are difficult to predict and our society expects first responders to be always prepared to manage them in the best possible way. The BRIDGE project provides solutions to support crisis management and emergency response coordination. Through its work packages *Validation*, *Exploitation* and *Dissemination*, BRIDGE organised a series of *ValEDation Days* in Alpine, Nordic, and Low Countries to demonstrate and validate solutions for large-scale crisis management and bring them closer to the user.

The ValEDation days aimed to highlight the features of the BRIDGE technologies and to promote their further usage in the development of commercial products and services. They have been set up in a joint initiative of the BRIDGE work packages and project partners to validate, exploit, and disseminate the final results of BRIDGE.

The BRIDGE project has made a great effort to involve end-users in the project to set the right requirements on the developed technologies. End-users and potential clients have also been invited to validate that the results do indeed provide the envisioned functionalities and qualities to the satisfaction of the emergency managers and first responders that will use them.

The ValEDation days provided a final opportunity for stakeholders to examine and discuss the results of the project. Key concepts and technologies were highlighted in presentations and demonstrations. Within this innovative atmosphere, BRIDGE partners and interested organizations worked together to set up follow-up actions to exploit the results of the BRIGE project.

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Alpine ValEDation Days, St. Gilgen/Salzburg, Austria

The first in the series of the three planned events—*Alpine ValEDation Days*—were held in St. Gilgen and Salzburg, Austria, 9-12 September 2014. The validation part of the event was conducted on 9 September 2014 in St. Gilgen in cooperation with the volunteer fire service of St. Gilgen, Löschzug Winkl, and the local police. Two BRIDGE systems—*Advanced Situation Awareness (ASA)* and *Help Beacons*—were demonstrated and validated during the exercise organised by the Winkl fire-fighters. The exercise simulated a car accident with a subsequent fire and an explosion. Four volunteers acted as victims in this hypothetical scenario, which was pre-tested in August 2014.

Simulated car explosion (above left); Fire extinguishing (above middle); EUAB Members Thomas Larson (Sweden) and Johannes Schadwasser (Austria) observing the exercise on September 9, 2014 (above right). Photo courtesy: Maximilian Wietek (VSH). St. Gilgen volunteer firefighters and police after the test-exercise in August 2014. Photo courtesy: Lyudmila Zaitseva (PLUS).

Advanced Situation Awareness

The exercise in St. Gilgen started with a car fire, which was filmed and analyzed by the flying hexacopter. Subsequently, the exploding petrol tank of the vehicle was simulated using pyrotechnics. The *Hexacopter*, component of the *Advanced Situation Awareness* (ASA) system developed by Paris-Lodron University of Salzburg (PLUS), flew into the Hot Zone, filmed the incident site from above, and transmitted live video- and infrared images to the Incident Commander, together with the data on gas and particle measurements of the toxic plume carried out by on-board sensors. This information was used in the second ASA component, the *Expert System* software, which compares the measurement data with national limits and international recommended concentration values. These data were then used for the third ASA component, the *Modelling Module*. This module modelled the dispersion of the plume and forecast the atmospheric concentration in the potentially affected area on a digital map. This represented the basis for recommendations to the Incident Commander on safety issues concerning both, the first responders on scene (e.g., type of protective equipment needed) and members of the public living downwind from the incident site (e.g., sheltering or evacuation). VIS- and IR information was transmitted to the ground station and the Incident Command clearly identified the location of all victims on the incident site.

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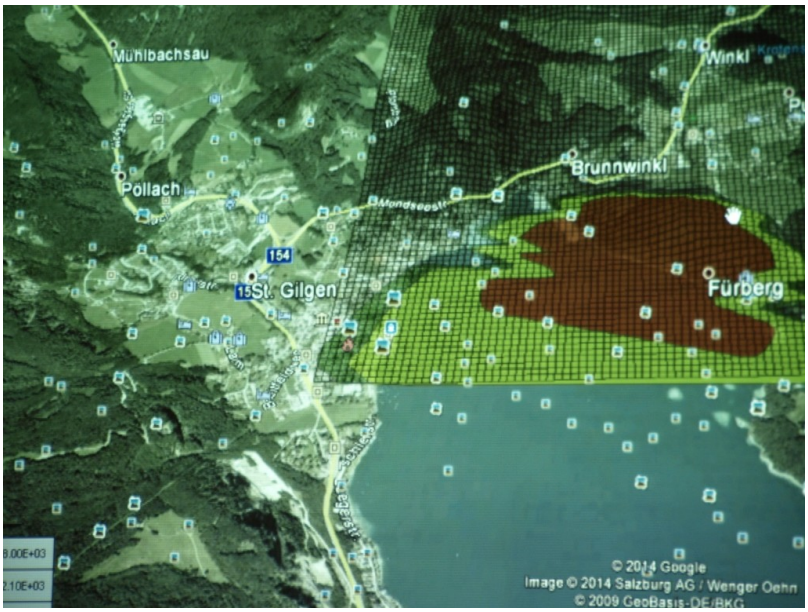
Hexacopter collecting visual and environmental data on site and transmitting it to ground station (above left); Work Package Leader Friedrich Steinhäusler and pilot Maximilian Kiefel (PLUS) (above right); Bukhtiar Mohsin (PLUS) analyzing data on Expert System (below). Photo courtesy: Maximilan Wietek (VSH).



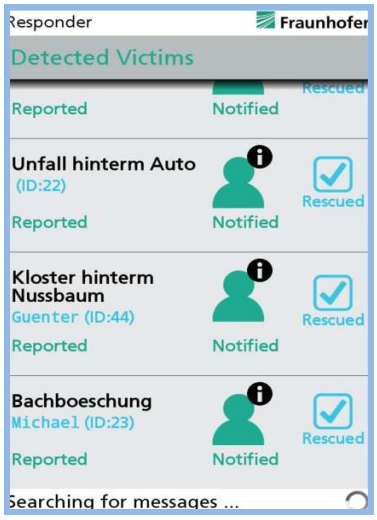
Plume dissipation model based on environmental and weather forecast data.

> ***"With the help of a weather map one could see, where the hazardous plume would be in half an hour and whether it would be necessary to evacuate certain areas."***
>
> Herbert Hausjell, Commander, Fire Station Winkl, St. Gilgen. In "Drohnen sollen Rettern das Leben retten," *Salzburger Nachrichten,* 15 September 2014

Help Beacons

The *Help Beacons* system, co-developed by the Fraunhofer Institute for Applied Information Technology (Fraunhofer FIT) and Alpen-Adria University of Klagenfurt, was the second BRIDGE concept case deployed during the exercise in St. Gilgen. Four persons acting as victims broadcasted distress signals by the use of the Help Beacons victim application. Two victims were already found with the help of the infrared camera on the hexacopter, and the remaining two that were out of sight of the UAV were then located by the Help Beacons responder application. In particular, the responder in the field and the incident commander leveraged the Help Beacons system in addition to their existing radio communication to better fulfil their mission.

Commander Hausjell using Help Beacons application. Photo courtesy: Max Wietek



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Amro Al-Akkad (Fraunhofer FIT) preparing for exercise. Photo courtesy: Max Wietek

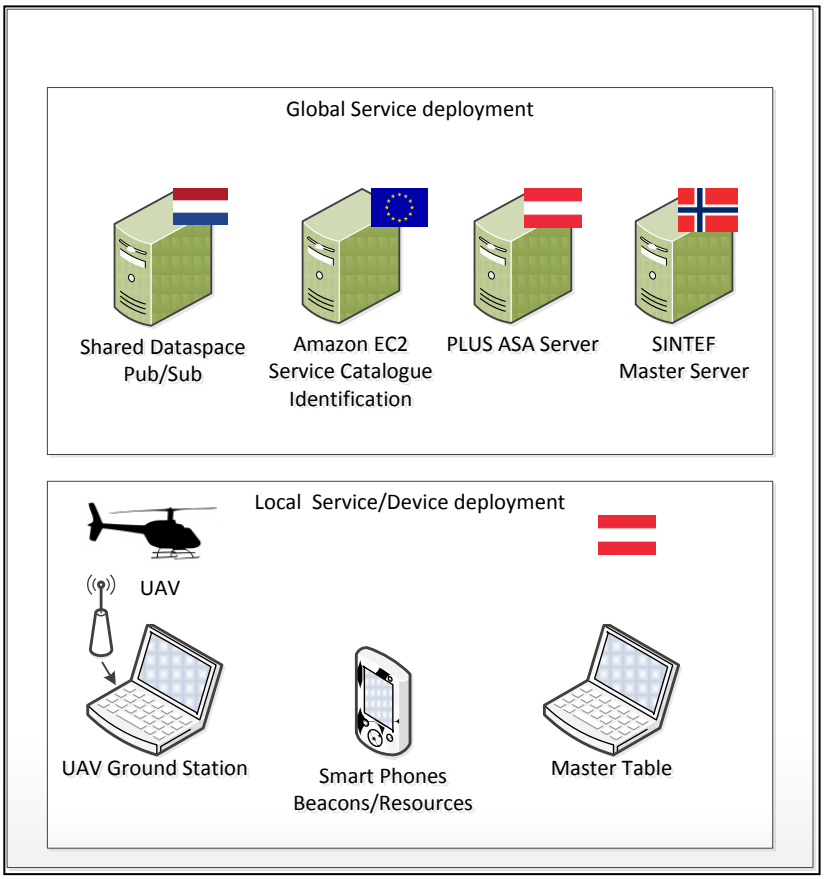
Master Integration with ASA

The third BRIDGE concept displayed in Austria was the Master system. In preparation for the Alpine ValEDation Days, the ASA was integrated with the BRIDGE network and the Master, which is a command and control information tool for use during emergency response. The following data from the ASA was integrated into the BRIDGE network and was displayed on the Master system:

1. Video feeds, both visual and infrared, from the UAV were shown on the Master.
2. Static images from the UAV.
3. UAV position was shown on the Master, allowing tracking the movement during flight.
4. Advice information from the ASA Expert System was shown on the Master, including the defined danger area.
5. Toxic plume forecast were integrated with overlay display in the Master map.

The integration of the ASA information into the BRIDGE network was primarily done using four BRIDGE middleware components:

1. **On-Site storage** provides a web server like functionality for the BRIDGE network. Information is published in the BRIDGE network using BRIDGE link format. The BRIDGE links can be used by members of the BRIDGE network to retrieve the information when needed.
2. **Transformation service** provides transformations from ASA internal data formats to the standard BRIDGE formats, i.e. EDXL and BRIDGE links.
3. **Network Service** provides access to the virtual private BRIDGE network.
4. **Shared Dataspace** is used for publishing and subscribing data on the BRIDGE network and in this case was used as the link between the Master and the ASA information.



Global and local service deployment.

The actual deployed BRIDGE system involved components deployed in multiple locations where the local services were running at the actual incident site in Winkl, while the global service deployment involved servers in Austria, Netherlands, Norway and finally the Amazon EC2 cloud.

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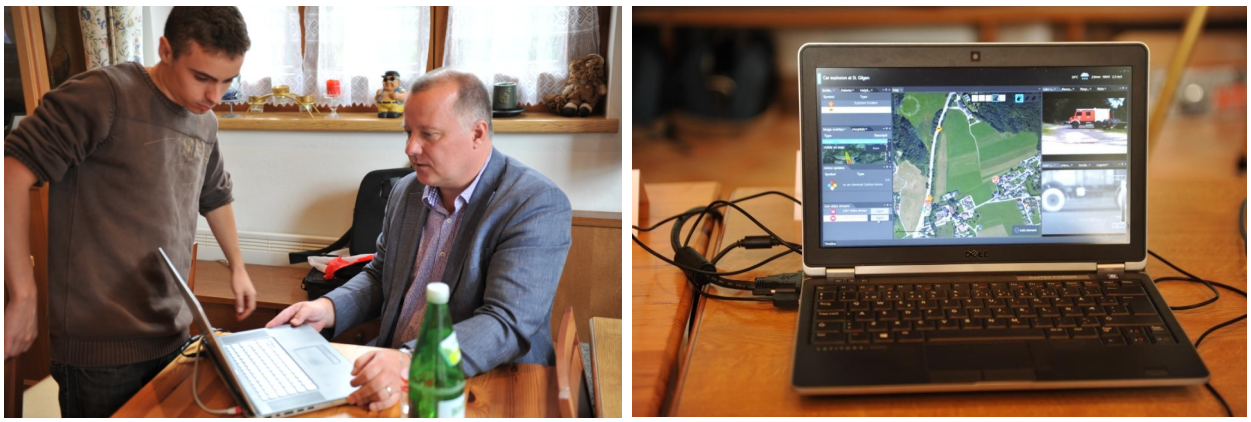

Peeter Kool (CNet) and Antoine Pultier (SINTEF) integrating ASA data into the BRIDGE network (left); ASA information displayed on Master PC (right). Photo courtesy: Maximilian Wietek (VSH).

Alpine Expoitation and Dissemination Event

The Alpine Exploitation and Dissemination event was hosted by PLUS in Salzburg, Austria, on 12 September 2014. Fifteen representatives of different agencies and organisations attended the meeting, including the Austrian Federal Ministry of Interior, Federal Ministry of Defence and Sport, Government of Salzburg Departments of Public Health and Disaster Management, Alpine Rescue Service, St. Gilgen Volunteer Fire Service, etc. Two members of the BRIDGE End-User Advisory Board (EUAB) also participated in the Alpine ValEDation Days.

Members of the BRIDGE consortium presented the project and its ASA and Help Beacons systems to the invited audience and showed a video of the validation test in St. Gilgen, which took place on the 9th of September 2014. The practical demonstration of the BRIDGE concepts included a live transmission of visual and infrared data stream from the PLUS hexacopter flying outside the university building into the meeting room. The participants were then given an opportunity to have a closer look at the UAV and the Help Beacons applications on the smartphones. In the final part of the event, the stakeholders shared their positive impressions with the scientists and technology developers.

Paul Burghardt (Thales) talking about BRIDGE exploitation plans (left); Paul Marouschek (Federal Ministry of Interior) providing his feedback (right).

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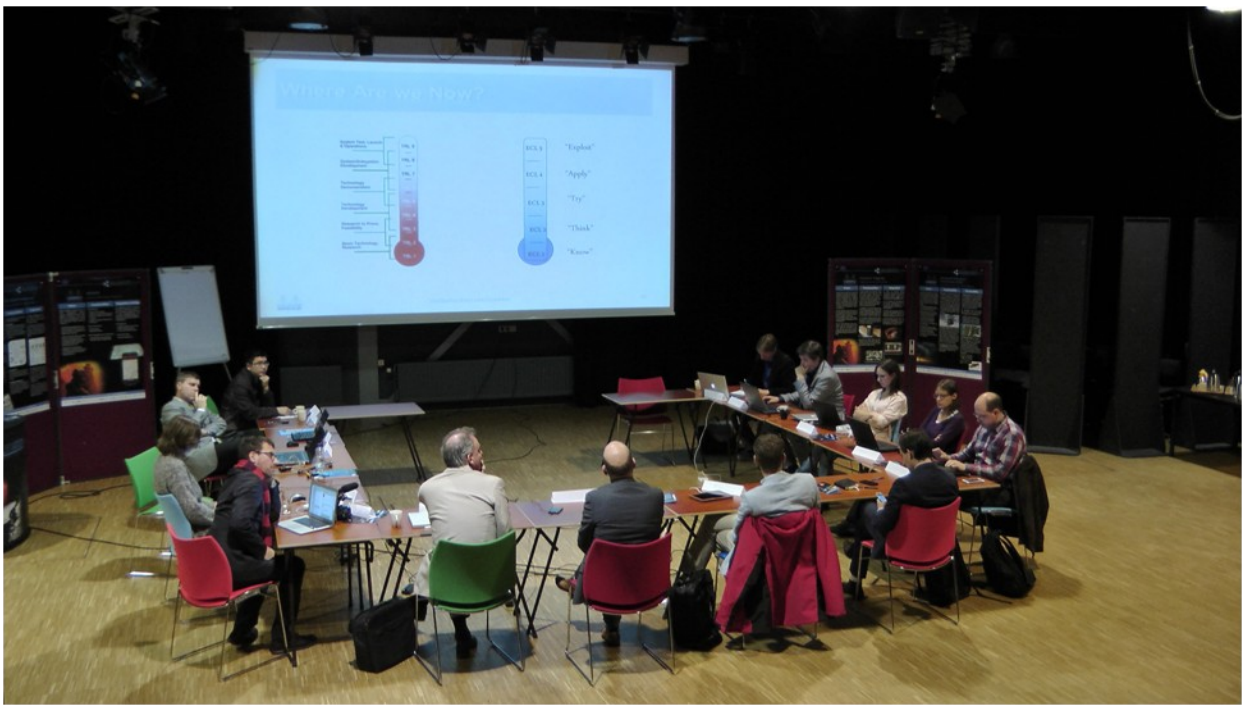
René Reiners (Frauhofer FIT) presenting Help Beacons (above left); Invited stakeholders and end-users (above right and below left); PLUS ASA team with the hexacopter (below right). Photo courtesy: Lyudmila Zaitseva (PLUS).

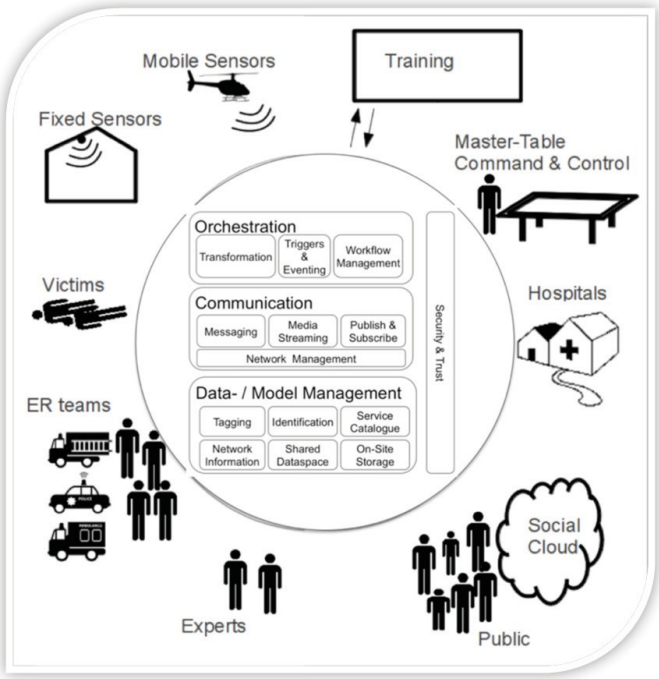
Low Countries ValEDation Days, Delft, The Netherlands



BRIDGE technology presented to senior business developers during the exploitation event in Delft.
Photo courtesy: Paul Burghardt (Thales).

The *Low Countries ValEDation Days* were held in Delft, The Netherlands, 10-14 November 2014. This program featured four of the nine main results of the BRIDGE project: (1) BRIDGE middleware, (2) *Adaptive Logistics*, (3) *SWARM*, and (4) *Information Intelligence*. In comparison to the functional applications presented at the Alpine and Nordic ValEDation days with respect to the (5) *Advanced Situation Awareness*, (6) *Help Beacons*, (7) *Master*, (8) *e-Triage,* and (9) *FRITS*, the Low Countries program focused on the Validation, Exploitation and Dissemination (=ValEDation) of infrastructural assets that enable interoperability between functional applications for end-users, making it possible to collaborate in large-scale emergencies.

On Monday, a full day was taken to validate the Adaptive Logistics concept case, which is mainly the result of collaboration between Thales, the TU-Delft, and Almende. The key assumption of this group was that large-scale emergencies will involve organizations and ICT systems from various agencies, possibly crossing national European borders. In such cases the acquisition of data for situation awareness, the creation of master overviews, the coordination of e-Triage and further emergency operations, will require the orchestration of many systems and services into cohesive, collaborative workflows. The adaptive logistics team has focused on technologies that enable just this. Particular attention was paid to the creation of a workflow language that makes it possible to mediate between the various organization-specific workflow systems. This has resulted in the BRIDGE Advanced Workflow Language (BRAWL). To be able to specify the quality requirements on any resulting workflows in terms of timeliness, reliability, availability and so on a supporting language was developed with which 'smart' operational constraints can be well formulated. While there is naturally a great deal to be done to further develop this, the End-User Advisory Board and the business developers confirmed that these assets are of critical value for the desired interoperability, for which the BRIDGE project was initiated.

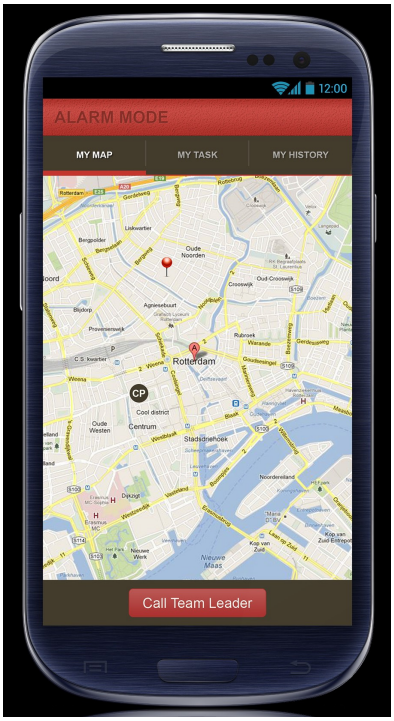


Software services offered by BRIDGE Middleware.

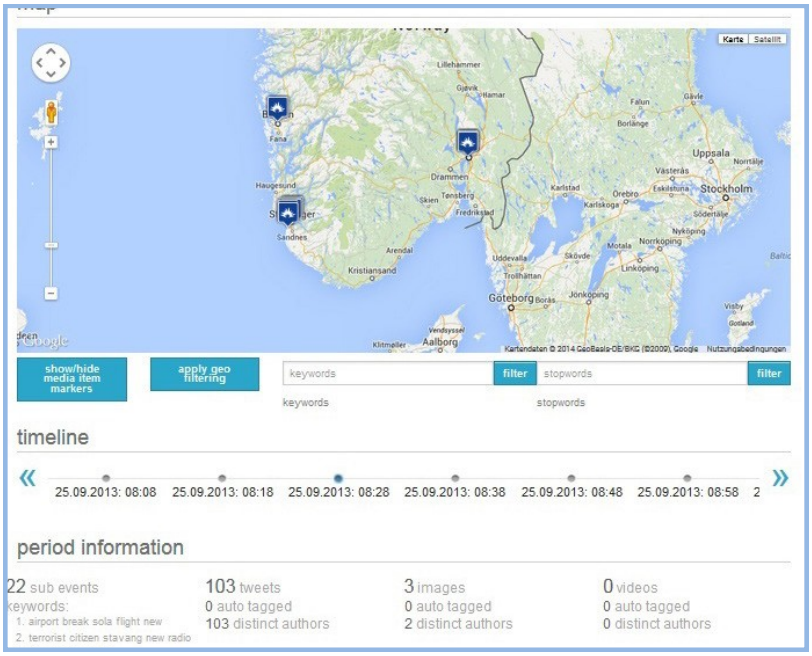
On Tuesday, again, a full day was reserved for the first initial validation of the BRIDGE middleware. This was developed in cooperation between the BRIDGE partners, featuring C-NET, Thales, the TU-Delft, ALmende, Saab, Fraunhofer, and SINTEF. This result of the BRIDGE project deserves special attention because it is crucial for enabling interoperability at a more infrastructural level. In fact, practically all of the BRIDGE concepts were meant to drive and test the BRIDGE middleware development.

During this Tuesday session the middleware was validated from this point of view: does it enable the desired interoperability of functional applications? It was concluded that the BRIDGE middleware essentially provides enabling services in the three main areas: *Orchestration*, *Communication*, and *Data Management*, and that these services were used and tested in the context of the functional applications such as e-Triage and Advanced Situation Awareness.

Wednesday was devoted to the validation of two results concerning the monitoring of human resources in the field (SWARM) and social media analysis in large scale crisis events (Information Intelligence). The SWARM application, mainly developed by Almende, ties into Adaptive Logistics with emphasis on gathering data on the status and well-being of first responders from various organizations collaborating in the field. It makes good use of the BRIDGE middleware, utilizing its capability to support agent-based applications. The parts of the BRIDGE middleware that it relies upon have already been deployed in commercial applications, making it possible to productize SWARM on a short term.



SWARM application.



Information Intelligence analyzing social media for sub-events in emergencies.

The Information Intelligence algorithms that were mainly developed by the University of Klagenfurt, make it possible to support common situation awareness in large-scale events, by discovering localized sub-events within the overall crisis. When such information on sub-events, that may require the special attention of the incident commander, becomes available in real-time via the BRIDGE Master, better informed decision making will become possible. The Information Intelligence has been tested and validated with large historical data-sets from social media companies on prior emergencies. It is now ready for further testing and validation with further data-sets and actual real world emergencies.

The ValEDation days were concluded on Thursday with an 'exploitation' day. In the Netherlands the choice was made to have an in-depth conversation with a number of senior business developers, rather than a full day of presentations and demonstrations with a large audience of emergency response professionals. This proved to be a very well spent day. There was in fact a great deal of appreciation for the results described above, especially because the functionality and qualities of the results were so thoroughly validated. Furthermore, the possible value of integrating inter-organizational workflows (with BRAWL) was fully recognized, as was the value of integrated human resource monitoring (SWARM) and the detection of sub-events within large-scale crises (Information Intelligence). On the whole, it was concluded that Thales would initiate follow-up events to further investigate the exploitation of the BRIDGE results in the Low Countries and explore possibilities of cooperation in the expected exploitation activities in the Nordic and Alpine countries.

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You can find more information on all BRIDGE Concept Cases on the project website at:
http://www.bridgeproject.eu/en/bridge-results/concept-cases.

BRIDGE Nordic ValEDation Day, Oslo, Norway

The *Nordic ValEdation Day* was organised in Oslo, Norway, on November 19, 2014. The purpose was to demonstrate the potential of the BRIDGE system with related concept cases for Nordic stakeholders. The focus was on three concept cases – *MASTER*, *eTriage*, and *FRITS (First Responders Integrated Training System)*. To ensure that the demonstration was relevant for the participants, the concept cases were demonstrated in the context of the international exercise HabourEX 2015, which will be held in Oslo in April 2015.

Twenty external actors from different organizations in Norway participated in the event. They were all key actors regarding introduction of collaborative systems for emergency management. The participants represented directorates of Health, police and emergency communication, Norwegian Police University College, Norwegian Industrial Safety Organisation (NSO), Joint Rescue Coordination Centres and local rescue units in police, health, and fire.

SINTEF CEO Unni Steinsmo opening the Nordic ValEDation Day in Oslo, Norway.
Photo courtesy: Jan H. Skjetne (SINTEF).

Aslak Wegne Eide (SINTEF) demonstrating Master table to Norwegian first responders during the Risavika exercise in 2013.
Photo courtesy: Jan H. Skjetne (SINTEF).

The Nordic ValEDation Day was opened by SINTEF CEO Unni Steinsmo and incident commander from Oslo Police Erling Olstad. Heiko Werner from the German Federal Agency for Technical Relief (THW), who is also on the BRIDGE End-User Advisory Board (EUAB), talked about the challenges and needs related to systems supporting co-operation and emergency management. The BRIDGE system and selected concept cases were then demonstrated.

The event ended with a plenum discussion. The feedback from the participants was positive. Their main question was related to when such products and services would be available. Issues on who would get access to different data, how secure and how agile such a system could be were also of great interest to the audience.

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BRIDGE at BSSAR 2014 Symposium in Crete, Greece

BRIDGE took part in the European Symposium on Border Surveillance and Search and Rescue Operations Technology (BSSAR 2014), which was organized by the Center for Security Studies (KEMEA) in Heraklion, Crete, 27-28 November 2014. One hundred and fifty representatives from international organizations, national authorities and services, academic institutions, research agencies, and end-users in both the public and private sectors from fifteen EU member states, participated in the Symposium. The results of ten European Research Projects (FP7) and two National Research Programs on border surveillance technology, ground and air survey, crisis management and search and rescue operations were presented during the event.

BRIDGE was presented through a plenary presentation and a BRIDGE booth. The Project Technical Coordinator, Evangelos Vlachogiannis (Fraunhofer FIT), gave a 20 minutes presentation focusing on the overall BRIDGE user-centered approach targeting to emergent interoperability (i.e., System of Systems). The presentation focused on a subset of concept cases (*Robust and Resilient Communication*, *Master*, *Dynamic Tagging/eTriage*, and *First Responder Integrated Training System (FRITS),* on Ethical, Legal and Social Issues (ELSI) as a critical dimension, and on BRIDGE ValEDation approach and tangible results.

The BRIDGErs—Monika Buscher (Lancaster University), Michelle Burghardt (Versuchstollen Hagerbach, VSH), René Reiners (Fraunhofer FIT), Morten Wenstad (Crisis Training), Max Wietek (VSH) and Antoine Pultier (SINTEF)—had the opportunity to demonstrate the aforementioned concept cases in the BRIDGE booth, discuss them with interested participants, share experiences, mostly through BRIDGE videos, and consider potential future opportunities in the field.

BRIDGE at CPExpo 2014 in Genova, Italy

The BRIDGE project was part of the CPExpo 2014 and SRC Security Research Conference 2014, which took place at the Centro Congressi in Genova, Italy, 9-11 December 2014. The global expo-conference was organized by the European Commission with the purpose of providing visibility and business opportunities, and serving as a meeting point for industries and academic institutions working within the field of community protection. BRIDGE participated in the exhibition as one of the European Commission's FP7 projects. Aslak Wegner Eide and Ida Maria Haugstveit (both from SINTEF) were the BRIDGE project's representatives at the event.

BRIDGE was showcased at a stand where the project's technologies were demonstrated. Two project presentations were held, giving the audience an overview of the different concept cases and technologies of BRIDGE. The stand and the presentations attracted attention from many of the event's participants. Several stakeholders visited the stand: practitioners, academics, people from industry, and members of the European Commission. The project received positive feedback, and the BRIDGE technology was regarded as innovative and highly useful. The exhibition provided a good place for meeting with, talking to, and establishing connections to interested parties from different fields.

BRIDGE Scientific Results

NordiCHI'14
26—30 October 2014

With four of his colleagues from the University of Oslo, Aslak Wegne Eide (SINTEF) co-authored a paper entitled *Usability of a Shareable Interface in a Multiuser Setting*, which was presented at the 8th Nordic Conference on Human-Computer Interaction (NordiCHI'14) in Helsinki. The paper reports on an experiment investigating how the number of simultaneous users affects the usability and user experience of a shareable user interface.

ADHOC-NOW 2014
22—27 June 2014

Christian Raffelsberger and Hermann Hellwagner (Alpen-Adria University of Klagenfurt) presented a paper at the 13th International Conference on Ad-Hoc Networks and Wireless (ADHOC-NOW 2014) held in Benidorm, Spain in June 2014. The paper, entitled *Combined Mobile Ad-hoc and Delay/Disruption-Tolerant Networking* presents a routing approach that combined MANET and DTN routing to provide a client routing in diverse networks. The combined routing approach can be used in well-connected networks as well as in intermittently connected networks that are prone to disruptions.

Fraunhofer Series in Information and Communication Technology—11 June 2014

René Reiners (Fraunhofer FIT) published his PhD thesis as a book in the Fraunhofer series in Information and Communication Technology. Entitled *An Evolving Pattern Library for Collaborative Project Documentation*, the book presents a collaborative pattern formulation and validation process that takes into account the special conditions of joint research projects.

ISCRAM 2014
18—21 May 2014

Yet again, BRIDGE consortium partners were active contributors to the annual ISCRAM conference. BRIDGErs Monika Büscher and Michael Liegl (Lancaster University) led the track on *Ethical, Legal and Social Issues (ELSI) in IT Supported Emergency Response*. Monika presented a BRIDGE paper, which explored key ELSI issues in utilizing cloud computing for disaster response and management. Entitled *Cloud Ethics for Disaster Response,* the paper was co-authored with Maike Kuhnert (Dortmund University of Technology), Jens Pottebaum (Universität Paderborn), Matts Ahlsén (CNet Swenska), Catherine Easton (Lancaster University, Bernard Van Veelen (Thales), and Christian Wietfeld (Dortmund University of Technology).

Amro Al-Akkad (Fraunhofer FIT) presented two papers at ISCRAM 2014—one in the Social Media track and one in the Practitioner track:

- *Tweeting 'When Online is Off'? Opportunistically Creating Mobile Ad-hoc Networks in Response to Disrupted Infrastructure* co-authored with his BRIDGE colleagues Christian Raffelsberger (Alpen-Adria University of Klagenfurt), Alexander Boden (Fraunhofer FIT), Leonardo Ramirez (Fraunhofer Headquarters) and Andreas Zimmermann (Fraunhofer FIT); and
- *How Do I Get This App? A Discourse on Distributing Mobile Applications Despite Disrupted Infrastructure* co-authored with Christian Raffelsberger.

Erik Nilsson (SINTEF) presented another BRIDGE paper on in the Command and Control Studies track, entitled *Finding the best devices for emergency responders in Norway—an empirical study.* The paper was co-authored with Linda Katrine Andresen (University of Oslo).

CHI'14
26 April—1May 2014

Amro Al-Akkad (Fraunhofer FIT) presented a paper at the SIGCHI Conference on Human Factors in Computing Systems (CHI'14) held in Toronto, Canada. The paper, entitled *Help Beacons: Design and Evaluation of an Ad-Hoc Lightweight S.O.S. System for Smartphones,* received the Honorable Mention Award, indicating that it was identified by the CHI Associate Chairs as being among the top 5 percent of all submission. The paper was co-authored with Leonardo Ramirez (Fraunhofer Headquarters), Alexander Boden (Fraunhofer FIT), Dave Randall (University of Siegen), and Andreas Zimmermann (Fraunhofer FIT). It presented the design and evaluation of a lightweight mobile S.O.S. system that facilitates ad-hoc communication between first responders and victims in emergency situations.

i-com—2014, Vol. 13, No. 1

Amro Al-Akkad and Alexander Boden (Fraunhofer FIT) co-authored a paper, entitled *Creative Usage of Available Network Infrastructure in Disaster Situations* (*Kreative Nutzung der verf[gbaren Netzwerkinfrastruktur im Katastrophenfall* in original), which appeared in the German-language *i-com* journal for interactive and cooperative media. The paper examined the challenges faced in situations of disrupted network infrastructures and how surviving portions of technology could be used to cope with these challenges.

CSCW—2014, Vol. 23, Issue 2

Monika Buscher (Lancaster University) wrote an article entitled *Nomadic Work: Romance and Reality. A Response to Barbara Czarniawska's 'Nomadic Work as Life-Story Plot'.* The article was published in *Computer Supported Cooperative Work (CSCW),* a journal that disseminates innovative research results and provides an interdisciplinary forum for the debate & exchange of ideas concerning theoretical, practical, technical, and social issues in CSCW.

STCSN E-Letter—2014, Vol. 2, No. 2

The IEEE STC (Special Technical Community) on Social Networking releases periodical E-Letters regarding special innovations and research topics covering social networks. The March 2014 issue of the STCSN E-Letter, dedicated to the topic "Social Media Analysis for Crisis Management", was guest edited by the Alpen-Adria University of Klagenfurt in the context of the EU FP7 BRIDGE Project. The E-Letter provided a project overview, described the social media analysis research and associated social, ethical and legal considerations in the BRIDGE project, and discussed related work and further activities worldwide on the use of social networks for crises management. Four BRIDGE-related articles were contributed to this issue:

- *The BRIDGE Project - Bridging Resources and Agencies in Large-Scale Emergency Management* by Hermann Hellwagner (Alpen-Adria University of Klagenfurt). This paper introduces the BRIDGE research on social networking: automatic detection of notable sub-events of a crisis from social networks.
- *Social Media Analysis for Crisis Management: A Brief Survey* by Daniela Pohl (Alpen-Adria University of Klagenfurt). This contribution summarizes important research work using social media analysis in the context of crisis management.
- *Crisis-related Sub-Event Detection Based on Clustering* by Daniela Pohl, Hermann Hellwagner (Alpen-Adria University of Klagenfurt), and Abdelhamid Bouchachia (Bournemouth University). This contribution focuses on the detection of sub-events, which are special hotspots of a crisis that emergency management teams must be aware of. This activity makes use of crisis-related information coming from citizens via social networks and thus contributes to building an improved operational picture in a crisis situation.
- *Connected Communities in Crisis* by Monika Büscher and Michael Liegl (Lancaster University). The paper discusses positive and negative frictions and avenues for socio-technical innovation that bridge between connected communities in crises and professional responders.

You can find more on these and other project results at: http://www.bridgeproject.eu/en/bridge-results/

BRIDGE at a Glance

BRIDGE will build a system to support interoperability — both technical and social — in large-scale emergency management. The system will serve as a bridge between multiple First Responder organisations in Europe, contributing to an effective and efficient response to natural catastrophes, technological disasters, and large-scale terrorist attacks.

"The project will look in particular at how cooperation among different agencies and organisations can be made more efficient at national and transnational level."

EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

The vision of the BRIDGE project is to:

- Facilitate cross-border and cross-agency collaboration
- Allow the creation of a common, comprehensive, and reliable operational picture of the incident site
- Enable integration of resources and technologies into workflow management
- Enable active ad-hoc participation of third parties

CONSORTIUM

The BRIDGE consortium consists of a well-balanced mix of cross-disciplinary academics, technology developers, domain experts and end-user representatives:

- Stiftelsen SINTEF, Norway
- Almende B.V., The Netherlands
- CNet Svenska AB, Sweden
- The Fraunhofer Institute for Applied Information Technology FIT, Germany
- Lancaster University, UK
- Crisis Training AS, Norway
- SAAB Training Systems, Sweden
- Thales Nederland B.V., The Netherlands
- Alpen-Adria University of Klagenfurt, Austria
- Paris-Lodron University of Salzburg, Austria
- VSH Hagerbach Test Gallery LTD, Switzerland
- Technical University of Delft, The Netherlands
- Stockholm University, Sweden
- Helse Stavanger HF, Norway

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Newsletter designed by Lyudmila Zaitseva

BRIDGE Newsletter

ISSUE 4 — DECEMBER 2013

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Editorial

Dear Reader!

It is a beautiful morning at the West-coast of Norway. Risavika Harbour, just outside Stavanger, is about to wake up to another busy day. A speedboat approaches the harbour. A few minutes later, four men in masks get off the boat and start shooting around. The scene is set for a terrorist attack. This event at Risavika Harbour in Stavanger was a training exercise for the local emergency services at different levels, hospitals, companies at Risavika Harbour, municipal authorities and other organizations. The overall goal of the exercise was to strengthen collaboration between the different agencies and actors during major incidents involving armed police forces and requiring extensive coordination efforts. The BRIDGE project was granted permission to participate in the exercise. The project demonstrated and tested some of the technologies developed in BRIDGE in an environment of a possible emergency incident.

This 4th Newsletter gives you a look into the 2nd and 3rd BRIDGE demonstrations, which took place during the Spring and Autumn of 2013. It also presents the BRIDGE Middleware supporting the assembly of emergency response technologies into a 'system of systems' for agile emergency response, together with the BRIDGE Concept Cases and Master table integration. We hope you find this interesting, and you are, of course, welcome to get in contact with us!

Dag Ausen, SINTEF
Project Coordinator

In this issue:

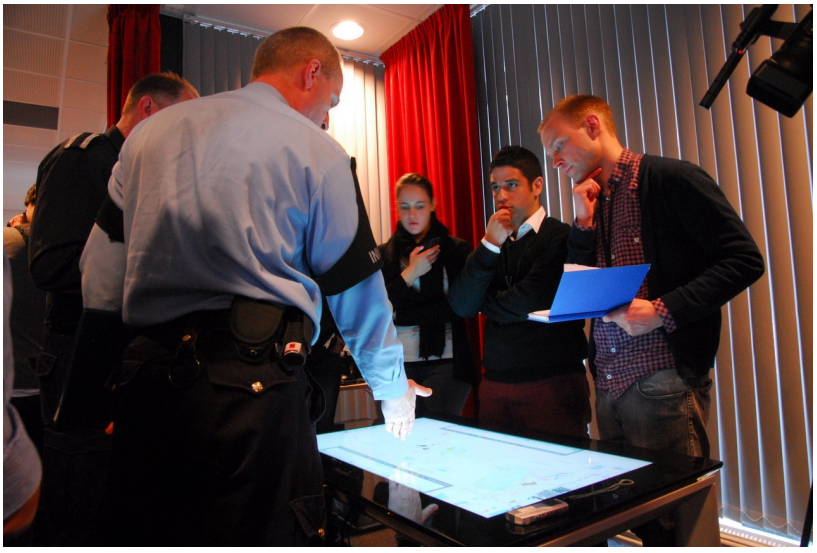
Risavika harbour exercise—location of the 3rd BRIDGE demonstration in Stavanger, Norway

2nd BRIDGE Demonstration: Visualisation and Interaction

Discussion of the BRIDGE Federated Control Room Support concept with the end-users

A total of four demonstrations has been planned in the BRIDGE project. The previous issue of the BRIDGE Newsletter (December 2012) described the first demonstration, conducted in September 2012 in the VSH Hagerbach Underground Test Gallery, Flums, Switzerland, which showed interoperability of single components of the BRIDGE system of systems under harsh tunnel conditions.

The second demonstration was conceived as a table-top demo of the improved BRIDGE technologies with a specific emphasis on visualization and interaction. It was hosted by BRIDGE partner RAKOS (Regional Centre for Emergency Medical Research and Development, Helse Stavanger HF) in St. Svithun Hotel, Stavanger, Norway, in April 2013. The location was chosen due to its proximity to Risavika harbour, where BRIDGE Demo 3 was planned as part of a simulated terror attack exercise in September 2013.



Norwegian first responders providing feedback on BRIDGE MASTER

The objective of the 2nd Demonstration was to check the robustness of the visualisation and interaction technologies, as well as the network connectivity and communication. Problems like interrupted power supply and failed communication were taken into account.

Around twenty representatives of the local emergency response services (fire, police, EMS) accepted BRIDGE invitation to attend the demonstration and provide their feedback to the new set of concept cases and technologies further developed in the project.

Such strong involvement of the Norwegian first responder organisations was necessary to guarantee that the result would meet the end-users' requirements regarding usability.

A demonstration is also seen as a marketing tool in order to bring innovation closer to the market, which is very important for the developer as well as for the end-user. This research community – end-user interaction is part of the demonstration work, leading to a high degree of impact of the created solutions.

The following BRIDGE concept cases were demonstrated in Stavanger:

- Adaptive Logistics;
- Advanced Situation Awareness (ASA);
- Dynamic Tagging of the Environment;
- Federated Control Room Support (FCRS);
- First Responders Integrated Training System (FRITS);
- Information Intelligence;
- MASTER;
- Robust and Resilient Communication;
- Situation aWAre Resource Management (SWARM).

While some of these are the modified versions of the old concept cases (e.g., Master, Information Intelligence, SWARM, FRITS, etc.), which have been upgraded to include new features and functionalities, some others (e.g., Adaptive Logistics, ASA) were developed after the first project demonstration in September 2012.

After the formal introduction to the concept cases, the end-users had the opportunity to try out the prototypes and shared their immediate impressions with the technology developers from BRIDGE. All the valuable comments provided by the emergency response professionals were collected and carefully analysed after the demonstration, leading to the further improvement of the concept cases.

At the end of the demonstration, the end-users took part in the BRIDGE Participatory Design workshop, helping the consortium elaborate on the user needs and co-design technologies.

Morten Wenstad (CTAS) explains the FRITS Concept Case to end-users

Daniela Pohl (University of Klagenfurt) describes Information Intelligence

End-users give their perspective on BRIDGE technologies

3rd BRIDGE Demonstration: Collaboration Technologies

Norwegian police, fire fighters and paramedics work together, attending to the casualties of a simulated terror attack

First emergency vehicles arrive at the incident site

On September 25th, 2013, BRIDGE conducted yet another demonstration in Stavanger, Norway. The purpose of this third BRIDGE demonstration was to show the progress and results achieved in the BRIDGE project, with a focus on Collaboration Technologies.

The demonstration was organised in conjunction with a large exercise of the local first responder community at the Risavika harbour. The exercise was built around a complex terror attack scenario with about a hundred dead and injured at three different locations of the harbour. This mass casualty exercise with a high security risk component presented multiple challenges to the participating police, fire, and emergency medical services.

The BRIDGE consortium was invited to participate in the exercise alongside the Norwegian first responders by providing them with the relevant BRIDGE technologies and following their application on scene with advice. *MASTER*, *Robust and Resilient Communication*, *eTriage*, *SWARM*, and *FRITS* Concept Cases were received with a lot of interest and positive critique by the emergency response professionals.

Members of the BRIDGE End-User Advisory Board (EUAB) and project reviewers from the European Commission were also invited to observe the exercise and the use of BRIDGE technologies in a simulated emergency situation. All the valuable feedback and lessons learned during the demonstration will be assessed by the consortium partners to further improve the BRIDGE Concept Cases.

Not all of the BRIDGE Concept Cases could be integrated into the exercise due to some logistical challenges. *Advanced Situation Awareness*, *Adaptive Logistics*, *Information Intelligence*, and *Federated Control Room Support* Concept Cases were demonstrated to the members of the EUAB and EU reviewers in the *Concept Case Cafe* after the Risavika harbour exercise on September 26th.

The subsequent pages of this newsletter will describe all the BRIDGE Concept Cases demonstrated in Stavanger, as well as the BRIDGE Middleware that makes it possible to assemble them into a 'system of systems'.

Concept Case Cafe: Christian Raffelsberger (University of Klagenfurt) and Amro Al-Akkad (Fraunhofer FIT) present their work to reviewers

BRIDGE Middleware

BRIDGE middleware supports the flexible assembly of emergency response systems into a 'system of systems' for agile emergency response. Such systems include BRIDGE Concept Cases, but also independent systems such as healthcare or vehicle registration records, building sensors, CCTV camera systems. The BRIDGE middleware forms the basis of all BRIDGE Concept Cases and underpins interoperability between different BRIDGE and external systems.

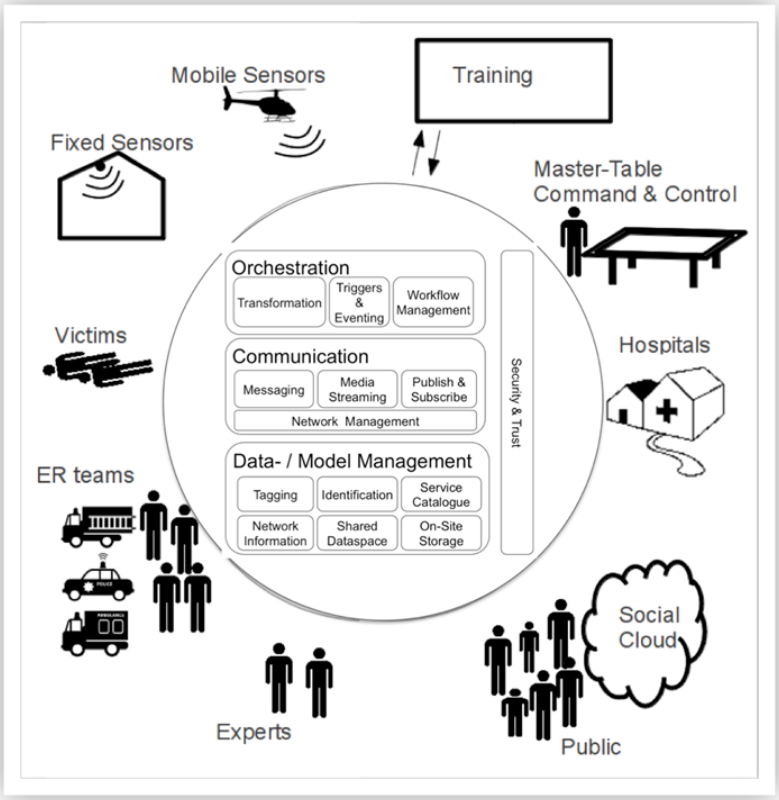
To the producers of emergency response systems, BRIDGE middleware offers a consolidated set of software services organised in three layers that facilitate the orchestration of systems, the communication between such systems, and the management of data produced by such systems during an incident's life-cycle.

Orchestration provides support for the composition of services and workflows.

Communication provides services enabling distribution of data as well as invocations of services.

Data Management supports the acquisition, storage and exchange of data, services and models emerging from diverse sources (colleagues, sensors, experts, public, etc.) on the fly.

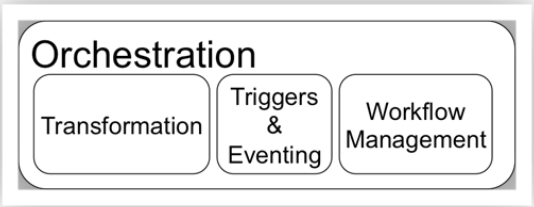
Security is provided by a combination of guidelines, models and supporting technologies including standards.

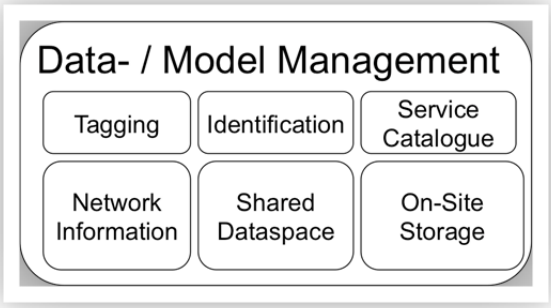


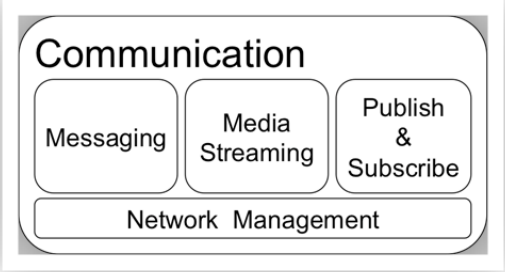
The functional coverable and delimitation of the middleware in terms of three broad categories of functions

The following services of the BRIDGE middleware were demonstrated in Stavanger:

- Messaging Service;
- Publish/Subscribe Service;
- Network Management;
- Triggering and Eventing;
- Workflow Management;
- Service Catalogue;
- Identification Service;
- On-Site Storage;
- Shared Data Store.







Orchestration, communication and data-/model management services

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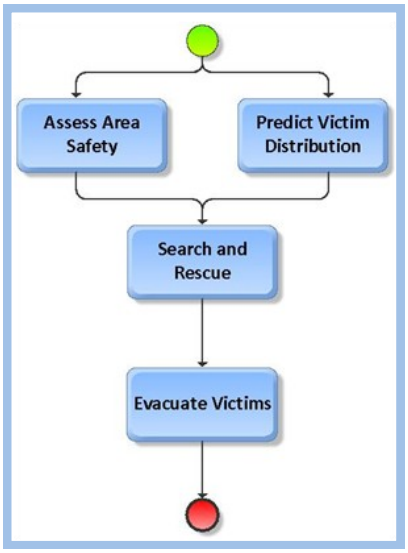
BRIDGE Concept Cases

Adaptive Logistics

In the BRIDGE concept case *Adaptive Logistics* we characterize large-scale emergency management operations as Complex Dynamic Multi-Agency Distributed Systems. We explore how we can coordinate the efforts deployed by all the systems' human participants and artificial components, in such a way that the BRIDGE system-of-systems as a whole displays coherent, goal-directed behaviour, realizing its goals effective and efficiently.

To organize a dynamic multi-agency collaboration we use workflows (or more specific: a 'WorkFlow Generation and Management (WFGM) sub-system'. To organize this collaboration the WFGM sub-system requires system awareness and specific capabilities to plan, instantiate, monitor and adjust activities. Advanced Logistics establishes a collaboration between various BRIDGE system components, including DEIN, *Situation aWAre Resource Management (SWARM),* the *Risk Analyser* Modeller and *Advanced Situation Awareness s*—Prediction Modelling.

The purpose of system awareness information is to make explicit what the capabilities of the emergency management responders and their technical systems are: what roles, causes and effects exist in the operation domain and what does the overall emergency management operation currently tries to achieve.



Operational workflow

The component does this by:

- Gathering knowledge regarding the capabilities and constraints of participating entities and their own characteristic approaches to resource deployment;
- Exchanging information regarding plans and intentions;
- Searching for collaboration opportunities;
- Dynamically keeping track of the current goals of the system.

In BRIDGE we explore the deployment of three WFGM mechanisms that collaboratively compute workflows to coordinate the BRIDGE efforts:

COMPASS/SMDS deploys a classic reasoning algorithm, iteratively constructing workflows that achieve a given system goal. From the generated workflows, the best matching the systems' current requirements is selected. This approach will yield good results for new complex goals that can not be pre-planned.

Bernard van Veelen presents *Adaptive Logistics* to BRIDGE EUAB

CoWS uses templates describing relevant domain information to construct workflows. The templates contain gaps that need to be filled in with other templates or services. This approach will show good results in environments where certain complex tasks occur frequently and can be specified at design time.

ATOM uses an opportunistic approach to planning and execution: based on a survey of the current situation and rough notion of how to achieve a goal, only the first (or, alternatively, next) step(s) are planned and executed. The planning of later steps is delayed, based on the idea that the situation may change. In BRIDGE we will use ATOM to coordinate the deployment of resources.

The WFGM mechanisms interact using the BRIDGE Annotated Workflow Language (BRAWL).

Instantiation: Once a workflow has been selected for execution, the WFGM system needs to configure the resources in the BRIDGE system of systems to execute that workflow.

Monitoring: Monitoring helps ensure the system accomplishes what it actually needs to accomplish and to detect failure to accomplish or deviation from agreed-upon qualities.

Adjustment: In case the monitoring mechanisms detect an (immanent) failure, the WFGM system has a number of options, depending on the nature and severity of the failure: Ignore, Reconfigure, Regenerate, Escalate, Reject.

During the 3rd BRIDGE Demo in Stavanger, it was demonstrated, using an operational workflow, how one could establish a collaboration between various BRIDGE system components. For simplicity, some of these services were simulated as their interoperability was already demonstrated during the 1st BRIDGE Demo in Flums, Switzerland, in September 2012 .

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Advanced Situation Awareness

Situation awareness is the single most important safety feature in any emergency situation. First responders are often thrown into an unfamiliar environment or situation, where a major emergency can be unfolding fast. Maintaining good situation awareness is crucial to their safety and effective emergency management.

BRIDGE Advanced Situation Awareness (ASA) assists first responders on scene in improving situational awareness by supplying real-time visual and other information on the extent and nature of the disaster and its consequences. BRIDGE ASA consists of the following three components: *Hexacopter*, *Expert System*, and *Modelling Module*.

The *Hexacopter* is an unmanned aerial vehicle (UAV) system consisting of

- Flying platform with six motors;
- Global Positioning System (GPS) and radar;
- Video and infrared cameras;
- On-board computer;
- Environmental sensors; and
- Ground control station.

The Hexacopter provides a live video from a bird's-eye-view perspective, a parallel infrared video, and real-time environmental sampling data, which help assess the magnitude of destruction, fires and health hazards to first responders and affected population. The UAV can be controlled manually or put into a pre-programmed automatic flight modus.

The *Expert System* is a software, used to automatically analyse the incoming environmental measurements data supplied by the Hexacopter to the Ground Station. The data is compared against national and international standards (e.g., World Health Organisation, International Atomic Energy Agency, International Commission on Radiation Protection, etc.), and combined with expert recommendations. The aim of the *Expert System* is to help the incident commander interpret the obtained environmental data and ease the decision-making in a complex emergency.

Unmanned aerial vehicle demonstrated to reviewers

The *Modelling Module* is used to create computer models of the incident site and of plumes in case of an uncontrolled release. It can draw on the pre-programmed generic models of reality-based structures contained in the *Critical Infrastructure Library* created in the BRIDGE project. This module enables the user to assess the physical damage to buildings, estimate the number of victims, and predict the dispersion of hazardous plumes based on metrological data.

The following components of the BRIDGE ASA were demonstrated in Stavanger:

- *Hexacopter*: Recorded video demonstration of the flying UAV with live digital and infrared video transmission;
- *Expert System*: Safety recommendations applicable to first responders;
- *Modelling Module*: Estimates of plume dispersion and damages due to explosives.

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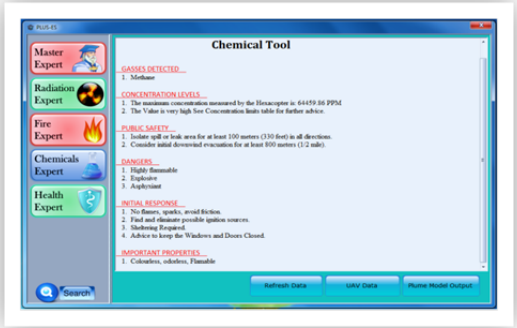
Ground control station



Chemical tool of the Expert System

Dynamic Tagging

BRIDGE Dynamic Tagging System assists first responders in marking and monitoring significant locations of the disaster site and in creating real-time situation awareness. It aims to ease the annotation of the field with digital information targeting at an improved spatial reference system and shared mental model for fire fighters. Such an annotated disaster site enriches the process of spatial sense making performed by first responders in the field.

Tagging the environment using symbolic icons

The tagging process is as follows:

1. In their exploration process of the incident site, first responders mark specific points in space either
   a. physically through the deployment of a sensor tag or
   b. virtually through some type of digital information such as a symbol, a voice recording, a text, etc.
2. The *Master* receives the sensor values or the digital information associated with a GPS position and visualizes them on the map.
3. Other first responder teams in the field use a mobile device with a map view or an augmented reality view to discover the information deposited by the former first responder team in the field.

The *Tagging Device* forms the main point of access for the dynamic tagging system and serves two purposes: First, the creation and deployment of dynamic tags in the form of digital information, and second, the exploration of already deployed dynamic tags.

The *Tagging Device* already offers a range of pre-built icons that the user can possibly exploit as tags. Each icon visually represents one possible situation that the user might like to report back to his team members and the command post through the dynamic tagging system. If the user selects one of these icons, the dynamic tagging system associates the current position to the respective icon and stores it in the database. At the same time this icon appears on the map of the Master. In a second optional step, the user might also want to bind a personal note with the selected and positioned icon. Such a personal note can consist in a voice recording, an image, written text or a drawing.

The *Tagging Device* is also to visualize the dynamic tags placed in the environment. Two different visualization modes are available: the map mode and the augmented reality mode (see images below). In the map mode, icons representing each dynamic tag are displayed on a map. For outdoors, a Google Map is used and the user's position is acquired by GPS. For indoors, the model of the building and roughly estimated positions are used.

The augmented reality mode presents the stream of the built-in camera with an overlay of abovementioned icons representing a dynamic tag. The user operates the *Tagging Device* as a "lens", scanning the environment by turning around and acquiring the digital information associated with a dynamic tag in his current view. Touching on one of the icons with the finger in either visualization mode, the user receives the digital information, either sensor data or human-made information (e.g. voice recording), on the screen or through the loudspeakers of the tagging device.

Sensor tags continuously measure environmental parameters such as air temperature, CO2 contamination, etc.. First responders can deploy these tags in the environment through clipping them to the relevant location or through throwing them towards a desired direction. Once activated, the tags acquire the exact GPS position and start to send a stream of sensor values to the command post.

In Demo 3 in Stavanger, *Dynamic Tagging* successfully demonstrated one aspect of tagging the environment, namely *eTriage* (i.e., tagging of victims). The interplay of triage components worked very well. Data transmitted by triage armbands was displayed on tablet PCs, smartphones, and the *Master*. A map view and an augmented reality view gave first responders and incident command a quick overview of the situation onsite, such as the clusters of severely injured casualties in different locations of the Risavika harbor.

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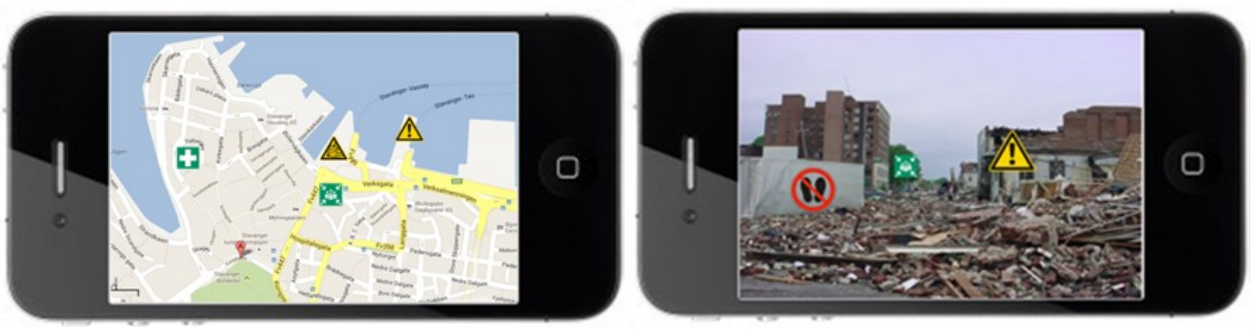


Left: Using the Tagging Device as a map viewer showing important tagged places
Right: Looking "through" the tagging device using the augmented reality mode

Federated Control Room Support

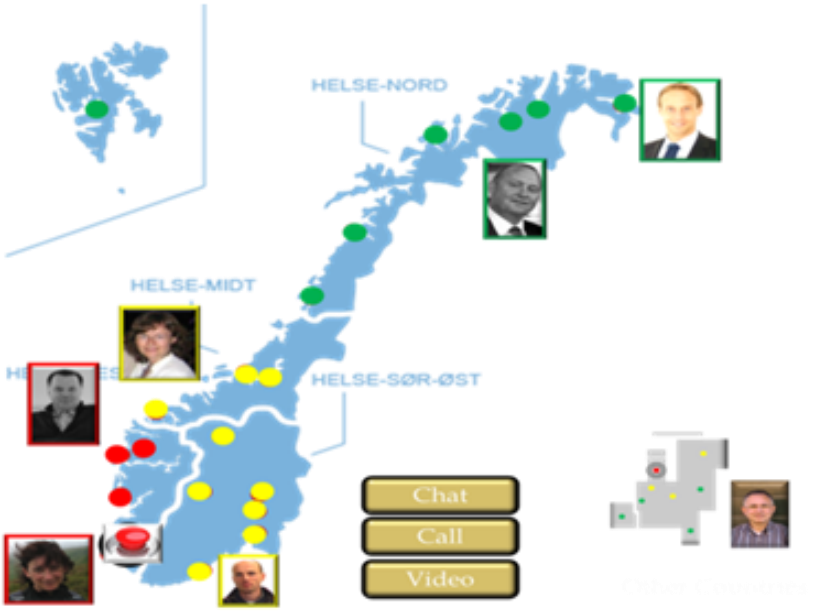
BRIDGE Federated Control Room Support (FCRS) makes it easier for multiple agencies to work together in complex emergency management operations. FCRS can be used to overcome the lack of interoperability between the actual (legacy) systems with which the many organizations at many locations must actually work.

BRIDGE FCRS provides support for four basic tasks:

- Team formation. The formation of cross-agency and cross-border teams that will work together on specific processes such as air-support for fire fighting, evacuation, search and rescue, or the transportation the wounded to hospitals.
- Team process monitoring. FCRS allows teams and commanders to monitor the activities of simple and more complex joint processes, involving multiple agencies, roles, tasks and systems.
- Team communication. FCRS allows participants in teams to easily communicate within a team via multiple modes of communication as they become available by means of the infrastructure: chat, messaging, telephone, and videoconference.

BRIDGE FCRS take a novel approach to the establishment of interoperability in ad-hoc teams across agencies and across borders. By taking a *capability-driven* approach that does not require joint standards and a common terminology right from the start FCRS makes it possible to achieve:

- **Emergent standard procedures** by evolving cross-agency operating procedures via practical emergence from the actually available capabilities that agencies have to offer.
- **Emergent standard terminology** by evolving cross-agency understanding of the capabilities to provide information and to conduct work by means of emergence from actual interactions involving the request and provision of services.



Geographical view of burn wound team

The *Team Formation Module* consists of software that makes it easy for commanders to assemble a team that is completely capable of handling all specific tasks that are required to get the main job done. The key mechanism that makes this possible relies on principles of *professional self-organization*, where each participant in the team takes responsibility for acquiring all the specific support he or she needs to complete the tasks by means of smartly structured requests and responses.

The *Team Monitoring Module* makes it possible for any team member to see what other team members are doing and what progress they are making. This is done by visualizing the flow of the smart requests and responses at different levels of detail. This allows teams to improve or reconfigure themselves when critical services run into difficulties.

The *Team Communication Module* provides easy access to available modes of communication within a specific team and process.

During Demo 3 in Stavanger, the FCRS concept was presented in the Concept Case Cafe and received a lot of positive feedback from the end-users .

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Process view of evacuation decision team

First Responders Integrated Training System (FRITS)

The main objective for FRITS is to establish an optimal learning and training methodology, supported by an integrated portfolio of sub-systems that will improve, through training, the quality of emergency response and crisis management in intra-agency and inter-agency operations.

FRITS uses BRIDGE developed methods and tools together with COTS (commercial off-the-shelf) technology to ensure flexibility and to provide scalability for different end-user needs. The concept is divided into modules, focusing on training, exercises and proper evaluation for improvements:

- Training methodology tools;
- Evaluation tools;
- Simulated training; live, virtual and constructive systems (COTS-technology);
- Integrated Training Environment.

By combining two or more of these modules, FRITS helps prepare all levels of responders (operational, tactical, and strategic) to improve their training and exercise activities. Also, by focusing more on using various virtual and constructive tools in addition to live exercises, a quantified cost-effective end-result is possible to achieve over a relatively short time-frame, ranging from base theory to large-scale multi-agency exercises.

Overview of the FRITS concept; various tools on the left hand side and human interaction to the right

The main training audience utilizes the concept for training outcome by the help of observers and evaluators using predefined templates and sets of evaluation criteria.

Last, but not least, there is a communication module that might be standard operational equipment and/or software based solutions in order to train communication between the actors. This may also be used to support the communication between exercise control center and observers during the exercise.

For over a year, Crisis Training AS (CTAS) has been heavily involved in the planning, execution and now in the evaluation of the combined Risavika exercise and BRIDGE Demo 3. The main objectives for this process have been to verify and further develop the structure and content of the FRITS learning and training methodology as well as to optimize the use of some of the sub-systems in the concept.

Through close collaboration with the regional experts, CTAS has received important knowledge confirming the need for a well structured learning and training methodology to achieve optimal learning. The process has been important to design the *MeTracker* (Methodology Tracker) as a web-based solution guiding the training and exercise responsible through each step in the learning and training cycle.

Demo 3 was also used to get a better understanding on how to optimize the initial preparation/education and usage of the developed observation and exercise management tool *AKKA*. The collected information from *AKKA* is now used to support the evaluation and learning process from the exercise.

A part of the Demo 3 process has also been to look into how virtual training can be a building block in an optimal learning and training process.

Morten Wenstad (CTAS) instructing the training audience on the use of FRITS

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Information Intelligence

In all emergency management phases information about the current situation is vital. People document any situation they are confronted with in social media. Hence, our aim with BRIDGE Information Intelligence is to introduce a tool that allows the automatic analysis of such media data in addition with live data from in-the-field and aggregates it in a sort of situational report.

The BRIDGE Information Intelligence comprises several components:

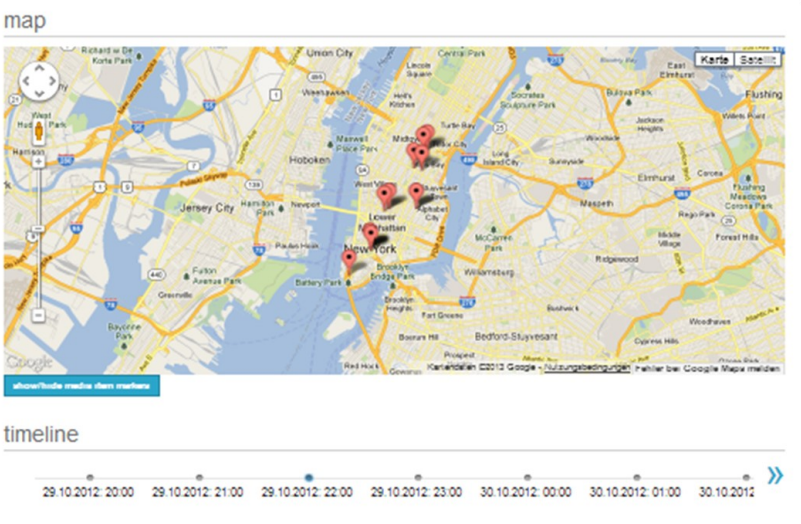
1. *Aggregation Component*: It performs the aggregation based on sub-events (= specific hotspots of a crisis) and shows the results to the user (see figures below).
2. *Data Simulation Component*: I allows the simulation of data during a running exercise. This tool can also be used for training purpose.
3. *Data Collection Component*: It is implemented as an Android-App and allows the collection of live data (from within the field).

The *Aggregation Component* performs the aggregation based on online clustering algorithms. It aggregates the data based on their textual and location content. The aggregation can be performed on social media data (e.g., Twitter) and on live data coming from within the field. The results are shown to the user via a web-based implementation reachable from any browser (e.g., Mozilla, Google Chrome etc.). The GUI contains a map-representation and a detail view for sub-events. In addition, it allows to filter the results based on geo-location and/or keywords.

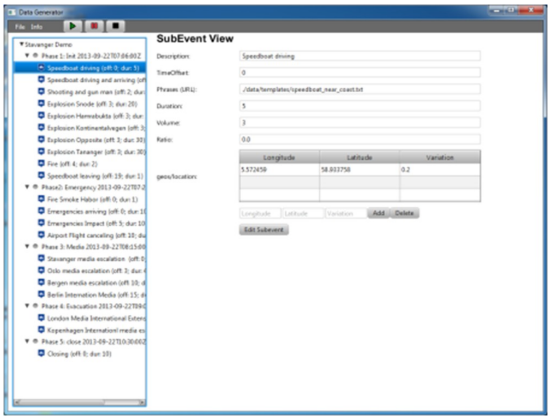
The *Data Simulation Component* allows the creation of data based on a given scenario description (XML). The description can be also administered by the tool. The creation of the dataset follows this scenario description. It comprises short text messages (i.e., simulated tweets), which are based on the effect the incident might have. For the generation process different sub-event attributes are needed, e.g., start of the sub-event (offset) during the exercise, description, some textual phrases for the generation mechanism, etc. The data simulation tool can be used, e.g., for training to integrate (simulated) "social media" into a running exercise.

The *Data Collection Component* allows the introduction of live data into the aggregation process. The Smartphone App was created in cooperation with Amro Al-Akkad (Fraunhofer FIT) and Christian Raffelsberger (Alpen-Adria University of Klagenfurt) within the framework of the *Local Cloud* concept. It allows the integration of text messages and pictures from persons in the field directly into the aggregation mechanism. The idea is to enrich the aggregation process with this live data.

The information aggregated by BRIDGE



Aggregation component GUI



Data simulation component

Information Intelligence can be passed to the *Master*. This is performed by selecting a specific sub-event which is of importance for the emergency agencies. In addition, it makes use of the general ideas of the *Local Cloud* concept.

Data collection component

The following components of the BRIDGE Information Intelligence were shown during Demo 3:

- *Aggregation Component*: The component used to aggregate and visualize the information.
- *Data Simulation Component*: This component is used to create sufficient amount of data to aggregate. The simulation is based on a description following the Risavika exercise process.
- *Data Collection Component*: Students collected pictures and sent text messages during the exercise.

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Robust and Resilient Communication

The main goal of *Robust and Resilient Communication* is to create an ad-hoc networking infrastructure that provides networking services on an incident site. The following components comprise this system:

1. Wireless *Mesh* routers that form an ad-hoc network (called the BRIDGE *Mesh*) to provide a networking infrastructure for other systems on the scene.
2. The *HelpBeacons* application that allows people to call for help using an Android smart phone.
3. The *HelpBeacons Seeker* application that is used by first responders to collect SOS messages.

The wireless mesh routers form an ad-hoc networking infrastructure that can be used by other concept cases to exchange data. All routers provide wireless access points to allow other devices (such as smart phones, notebooks or the *eTriage* bracelets) to join the network. Some routers provide gateways to other networks such as the Internet and bridge different wireless technologies.

The *HelpBeacons System* provides a way for people to call for help using their Android smart phones. The *HelpBeacons system* uses the Wi-Fi wireless technology to place short help messages. First responders that use a *HelpBeacons Seeker* application can collect beacons in their vicinity and locate victims. Technically, the idea is implemented by encoding short messages inside the name of the Wi-Fi access point created by the victim's smart phone. Any device in range can see these messages using its Wi-Fi interface.

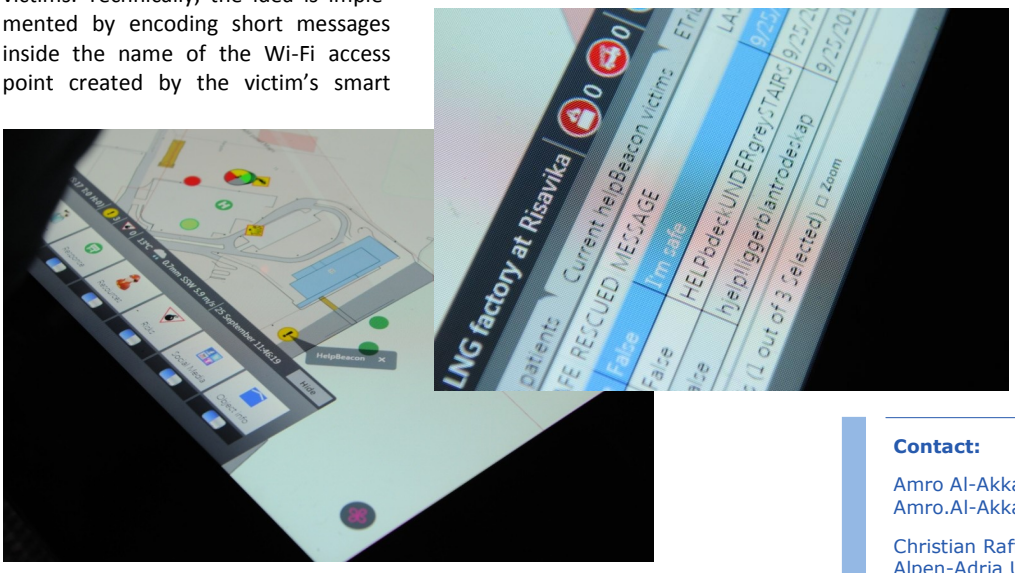
MESH devices deployed on a lamp post and inside the terminal building

The *HelpBeacons Seeker* application has been designed in a way that is does not need any user intervention to collect *HelpBeacons* and send them to the BRIDGE *Mesh*. This allows first responders to fully focus on their tasks. Optionally, first responders can be notified via acoustic signals or vibration when a new *HelpBeacon* has been found.

The information that is collected by the *HelpBeacons Seeker* application is sent to the BRIDGE *Mesh* network where a dedicated service first stores the received data locally. The data is then transferred via the BRIDGE middleware to other interested parties. Thus, the *Master* can visualize information about *HelpBeacons*, such as the help message itself or the time the help message was received by the seeker. If the GPS position of the victim and/or the seeker is available, the *Master* can visualize the location of *HelpBeacons* on a map.

During the Risavika exercise, the BRIDGE *MESH* provided wireless access across the exercise area and was operational throughout the exercise. It provided a communication infrastructure for several other BRIDGE systems, such as the BRIDGE *eTriage* or *Help Beacons*. Although, the BRIDGE *MESH* performed well during the exercise, the deployment of the mesh network required technical insights into networking in order to pick good places for the devices. Thus, an important topic for future work is to develop tools that monitor and visualize the network state in order to support the deployment process.

The *HelpBeacons* concept was used to locate victims on the ferry. A group of students staying on the ship played the role of the victims. These victims used the *Help Beacons* application to broadcast a distress signal, a help message placed inside the name of a wireless network. Additionally, one smartphone was used to track the victims behind the distress signals. After leaving the ship, the collected help messages were sent to the BRIDGE *Master Table* that displayed them on the map. A critique that the *HelpBeacons* system received after the exercise was that in terror attacks the system may expose the location of victims to the terrorists, thus potentially endangering them. This challenge will need to be addressed in the future to find ways to prevent the misuse of the system.



Help Beacons visualisation on the Master Table

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Master

BRIDGE *Master* assists in keeping a common operational picture among central actors during an incident.

The *Master* provides functionality to present and act on three types of information, which are accessible through the BRIDGE system:

- Information about the incident, e.g., incident location and number and triage status of victims;
- Information about the response, e.g., number and position of police, fire and health vehicles;
- Information from external services, e.g., weather.

The BRIDGE system is available on three different devices:

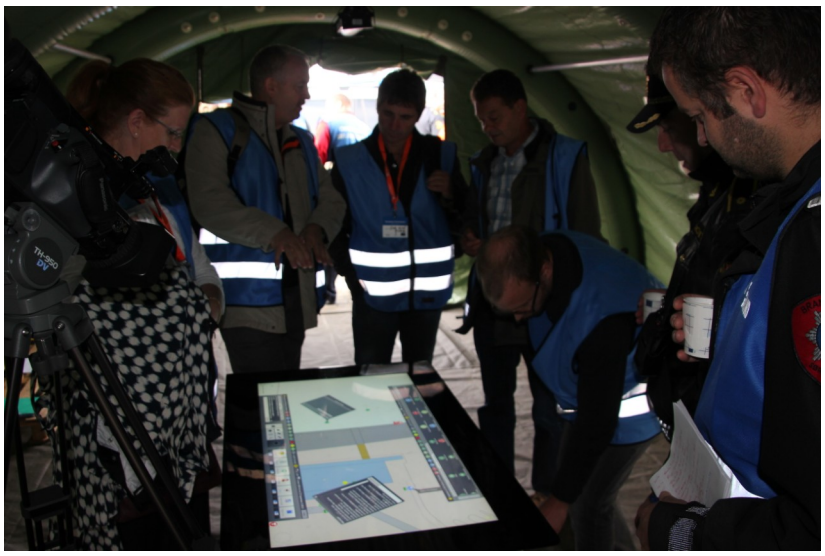
- Tablet for use by individual leaders;
- Touch sensitive table for use by the incident command team;
- Ordinary PC for use by operational centers.

During the 3rd Demonstration in Stavanger, the *Master* displayed information from the following BRIDGE parts:

- Incident information added by incident response teams using the *Master* system;
- Triage and status of patients;
- Resources Managing (e.g., outdoor location of emergency personnel, task assignment to first responders—individual and teams);
- Input from external sources (e.g., weather).

Tablet version of Master

BRIDGE End-User Advisory Board members testing Master



Master in the Incident Command tent during Risavika exercise

SWARM resources displayed on the Master table

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Situation aWAre Resource Management (SWARM)

The *SWARM (Situation AWare Resource Management)* application is an integral part of BRIDGE resource management. Through the collection of context information (location, activity, etc.) of, and interaction with, emergency personnel and first responders, it enables advanced support activities during large-scale multi-agency emergency responses. Its objective is to provide drastically improved support for resource management during emergency response operations.

The application has been demonstrated during the large-scale Risavika harbor exercise in Stavanger. Twenty-eight smartphones were provided to key personnel from the fire brigade, police department and the civil service medical teams. During the exercise these people could be tracked, and their location information was published in real-time to our BRIDGE partners, for display on the *MASTER* system and logged for training purposes by the University of Klagenfurt team.

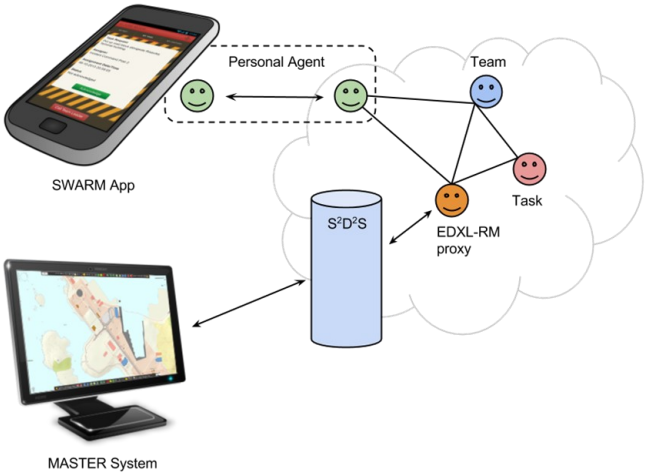
SWARM agents provide outdoor location tracking of the emergency personnel

SWARM App, these end-users can be given tasks. When a new task is created, the mobile application notifies the person using the smartphone. The software agents track the task status and provide the users with location information from the tasks.

Almende's Eve agent platform is used was done using Android-based smartphones.

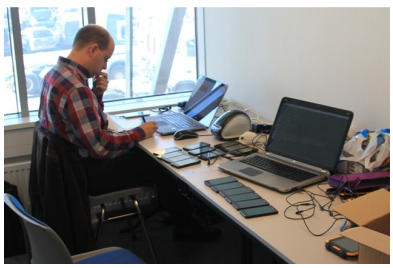
The *SWARM* agents provide the following features:

- Outdoor location tracking of the emergency personnel;
- EDXL-RM based dissemination of this data to the *MASTER* system;
- Task assignment to individual personnel and to teams of first responders;
- Availability monitoring of first responders;
- Context awareness dissemination to the end-users through a smartphone app;
- Dynamic team formation, based on requested tasks (not demonstrated in Demo 3).



SWARM-MASTER interaction

In the *SWARM* App each participant is represented by a software agent. This software agent runs partially on the personal electronic devices, e.g., smartphone, and partially on a cloud server. By running physically close to the end-user, the software agent can form an awareness of the current context of the user, by fusing and filtering sensor information. Examples of such context data are location, activity, mood, etc. From the *MASTER* system, through the as the execution environment, providing seamless integration between smart devices and cloud, and providing a scalable, cloud environment. The communication between this cloud environment and external parties is done through the EDXL-RM protocol, using Thales's S^2D^2S as a publish-subscribe service. In the current implementation the obtained context information is limited to location and task status, and the third demonstration



Andries Stam (Almende) preparing for the demonstration

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BRIDGE Scientific Results

ICMLA 2013
4-7 December 2013

BRIDGEr Daniela Pohl (University of Klagenfurt) presented a paper at the 12th International Conference on Machine Learning and Applications (ICMLA 2013) held in Miami, Florida, USA. The paper, entitled *Online Processing of Social Media Data for Emergency Management*, discussed how the analysis of social media (i.e., Twitter, Flickr and YouTube) can support emergency management by identifying sub-events. It was co-authored with with Abdelhamid Bouchachia (Bournemouth University, UK) and Hermann Hellwagner (University of Klagenfurt).

OzCHI 2013
25-29 November 2013

Amro Al-Akkad (Fraunhofer FIT) presented a BRIDGE paper at OzCHI'13 conference, held at Flinders University, Adelaide, Australia. OzCHI is the annual non-profit conference of CHISIG, the Computer-Human Interaction Special Interest Group of the Human Factors and Ergonomics Society of Australia inc, and is Australia's leading forum for work in all areas of Human-Computer Interaction. The paper—*"Reconstructing normality": The use of infrastructure leftovers in crisis situations as inspiration for the design of resilient technology*—examined challenges frequently faced in situations of disrupted network infrastructures and how surviving portions of technology could be used to cope with these challenges. It was co-authored by Leonardo Ramirez, Sebastian Denef (Fraunhofer Society—Headquarters), Alexander Boden, Andreas Zimmermann (Fraunhofer FIT), Lisa Wood, and Monika Büscher (Lancaster University).

MobileHCI 2013
27-30 August 2013

Marc Jentsch (Fraunhofer FIT) presented a BRIDGE paper at MobileHCI 2013—the 15th International Conference on Human-Computer Interaction with Mobile Devices and Services, held in Munich, Germany, 27-30 August 2013. The paper, entitled *The Reconfiguration of Triage by Introduction of Technology* and co-authored with Leonardo Ramirez, Erion Elmasllari (Fraunhofer FIT) and Lisa Wood (Lancaster University), discussed the drawbacks of introducing technology to the process of triage revealed in an extensive set of expert workshops and ways to mitigate unwanted reconfiguration of this process.

EuroPLoP 2013
10-14 July 2013

René Reiners (Fraunhofer FIT) presented another BRIDGE paper was at the annual EuroPLoP conference, which took place in Kloster Irsee, Germany, in the summer 2013. The paper, co-authored with Michael Falkenthal, Dierk Jugel, and Alfred Zimmermann (Reutlingen University), is entitled *Requirements for a Collaborative Formulation Process of Evolutionary Patterns to Support Knowledge Management*. It describes the approach of using design patterns as interdisciplinary communication medium.

ISCRAM 2013
12-15 May 2013

BRIDGE consortium partners were active participants of the 10th International Conference on Information Systems for Crisis Response and Management (ISCRAM 2013) held in Baden-Baden, Germany, 12-15 May 2013. BRIDGErs Monika Büscher and Michael Liegl (Lancaster University) organised a special track and panel on *Ethical, Legal and Social Issues (ELSI) of IT Supported Emergency Response*, together with Hayley Watson from Trilateral, Zeno Franco from Wisconsin Medical School, and Caroline Rizza, Paris Telecom University. Monika and Michael discussed BRIDGE innovation and issues of privacy and security and explored methodological challenges in the following BRIDGE papers:

- *Privacy, Security, Liberty: Informing the Design of EMIS* co-authored by Monika Buscher, Lisa Wood, and Sung-Yueh Perng (Lancaster University);
- *A New Manhattan Project? Interoperability and Ethics in Emergency Response Systems of Systems* co-authored by Monika Büscher, Lisa Wood (Lancaster University), Markus Bylund and Pedro Sanches (Swedish Institute of Computer Science) and Leonardo Ramirez (Fraunhofer FIT)

Aslak Wegner Eide (SINTEF) presented a third BRIDGE paper at ISCRAM 2013:

- *Inter-organizational Collaboration Structures during Emergency Response: A Case Study*, co-authored by Aslak Wegner Eide, Ida Maria Haugstveit, Ragnhild Halvorsrud, and Maria Borén (SINTEF), examined the problem of achieving efficient inter-organizational collaboration during emergency response.

PerNEM 2013 Workshop
22 March 2013

Christian Raffelsberger (University of Klagenfurt) presented a paper at the Third International Workshop on Pervasive Networks for Emergency Management (PerNEM) held in conjunction with the IEEE International Conference on Pervasive Computing and Communications (PerCOM) 2013 in San Diego, California, USA. The paper—*A Hybrid MANET-DTN Routing Scheme for Emergency Response Scenarios*—co-authored with Hermann Hellwagner (University of Klagenfurt) evaluates a store-and-forward mechanism for proactive routing protocols to mitigate the effects of network disruptions.

SoCoDiS 2013 Workshop
15 March 2013

Christian Raffelsberger (University of Klagenfurt) presented a paper at the Workshop on Self-Organized Communication in Disaster Scenarios (SoCoDiS 2013) organized by the University of Stuttgart in Stuttgart, Germany, in conjunction with the Conference on Networked Systems (NetSys) 2013, 11-15 March 2013. The paper, entitled *Overview of Hybrid MANET-DTN Networking and Its Potential for Emergency Relief Operations,* was co-authored with Hermann Hellwagner. This paper demonstrates that MANET-DTN routing schemes have the potential to improve network performance as the resulting network is diverse in terms of connectivity.

IJISCRM—2013, Vol. 5, No. 1

A BRIDGE paper, entitled *Peripheral Response: Micro-blogging During the 22/7/2011 Norway Attacks* and co-authored by Sung-Yueh Perng, Monika Buscher, Lisa Wood (Lancaster University), Ragnhild Halvorsrud, Michael Stiso (SINTEF), Leonardo Ramirez and Amro Al-Akkad (Fraunhofer FIT), appeared in the *International Journal of Information Systems for Crisis Response and Management.*

IJEM—2013, Vol. 9, No. 2

Gyrd Braendeland and Atle Refsdal (SINTEF) published a paper in the *International Journal of Emergency Management*. The paper—*Risk Factors in Emergency Response: A Review of Investigations of Emergency Response in Norway*—explored the factors affecting the risk level during emergency response and concluded that the most critical mistakes are made during the early stages of response, before the arrival of the external experts on scene.

You can find more on these and other project results at: http://www.bridgeproject.eu/en/bridge-results/

BRIDGE at a Glance

BRIDGE will build a system to support interoperability — both technical and social — in large-scale emergency management. The system will serve as a bridge between multiple First Responder organisations in Europe, contributing to an effective and efficient response to natural catastrophes, technological disasters, and large-scale terrorist attacks.

"The project will look in particular at how cooperation among different agencies and organisations can be made more efficient at national and transnational level."

EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

The vision of the BRIDGE project is to:

- Facilitate cross-border and cross-agency collaboration
- Allow the creation of a common, comprehensive, and reliable operational picture of the incident site
- Enable integration of resources and technologies into workflow management
- Enable active ad-hoc participation of third parties

CONSORTIUM

The BRIDGE consortium consists of a well-balanced mix of cross-disciplinary academics, technology developers, domain experts and end-user representatives:

- Stiftelsen SINTEF, Norway
- Almende B.V., The Netherlands
- CNet Svenska AB, Sweden
- The Fraunhofer Institute for Applied Information Technology FIT, Germany
- Lancaster University, UK
- Crisis Training AS, Norway
- SAAB Training Systems, Sweden
- Thales Nederland B.V., The Netherlands
- Alpen-Adria University of Klagenfurt, Austria
- Paris-Lodron University of Salzburg, Austria
- VSH Hagerbach Test Gallery LTD, Switzerland
- Technical University of Delft, The Netherlands
- Stockholm University, Sweden
- Helse Stavanger HF, Norway

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Newsletter designed by Lyudmila Zaitseva

BRIDGE Newsletter

ISSUE 3 — DECEMBER 2012

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Editorial

Dear Reader!

The proof of the pudding is in the eating, they say. I am happy to say that the chefs of the BRIDGE project have been busy cooking since our last newsletter, and that the fire fighters and end-users participating to our first demonstration were quite happy with consuming the results. However, before going into the details, let me recapitulate the past: in the first newsletter we introduced the conceptually simple concept of interoperability, but yet so hard to achieve. In the second newsletter we introduced the concepts we developed to show the value of interoperability in real life scenarios. Only one thing remained: the demonstration. Would our technology work?

End of September 2012 we gathered for a week deep inside a Swiss mountain to find out. During that week we staged an exercise for the local fire fighters simulating a car explosion in a tunnel setting ablaze a set of other cars and a truck with toxic chemicals at the tunnel entrance. People were trapped in the cars, and a plume of potentially toxic gas filled the valley below threatening the local villages of Heidiland, and possibly drifting off to Zürich.

Would the BRIDGE ad-hoc network be able to relay information from the chaotic scene inside a mountain with no telecom infrastructure to the master table of the commanders? Would our resource manager know where the tagged people and resources were? Would our bracelets used to tag the victims be able to transmit vital information about the victims' condition to the health services right from the moment a victim was discovered until she could be safely evacuated? Would our blast simulator be able to predict the damages on the exploded car, and would the risk analyser be able to combine chemical and meteorological information to advise to site commanders about evacuation? And could our training tools log information that would be valuable for the future training of the fire brigade?

Tunnel fire exercise at VSH, Flums, Switzerland, 20 Sept. 2012.
Photo courtesy: Max Wietek, VSH.

This newsletter covers the first BRIDGE demonstration and the experiences gathered. In addition it provides links to our animation video showing the overall scenario BRIDGE addresses with a special emphasis on the simulation of critical infrastructure. Finally, we are very proud of our research results, and summaries of the most recent ones can be found towards the end of this newsletter. The full BRIDGE team remains at your disposal should you have any comments, questions and suggestions on any of the material presented in this newsletter. In the meantime we have started planning for our next demonstrations to be covered in depth in our next newsletters, so stay tuned to BRIDGE!

Geir Horn, SINTEF
Project Coordinator

In this issue:

First BRIDGE Demonstration: Interoperability

The goal of BRIDGE is to increase safety of citizens by developing technical and organisational solutions that significantly improve crisis and emergency management. The key to this is to ensure interoperability, harmonization and cooperation among stakeholders on the technical and organisational level.

Demo team, headed by Thomas Kulbe, VSH (left), awaiting the start of the exercise. Photo courtesy: Max Wietek.

BRIDGE is aiming to demonstrate tangible results created during the different project phases and the demonstration work will show the integration of all parts of the solutions. A demonstration is also seen as a marketing tool in order to bring innovation closer to the market, which is very important for the developer as well as for the end-user. This research community – end-user interaction is part of the demonstration work, leading to a high degree of impact of the created solutions.

BRIDGE will perform a total of four demonstrators that are based on specific scenarios. Each demonstrator has a different focus, but all four are of consecutively increasing complexity. Demonstrator 1 deals with single components that have to show interoperability under harsh conditions. Demonstrator 2 is a table-top demonstration of a large-scale emergency addressing visualization and interaction. Demonstrator 3 focuses on multi-agency collaboration (technology) that will be shown in a real world setting. Finally, Demonstrator 4 is based on a large-scale emergency scenario involving a chemical disaster at a virtual facility called "ExploChemco". This will be an integrated exercise presenting the final results of the BRIDGE project.

The first BRIDGE demonstration was conducted in the controlled tunnel environment of the VSH Hagerbach Test Gallery in Flums, Switzerland, on 20 September 2012. The objective was to demonstrate network infrastructure and interoperability among various BRIDGE concept cases developed during the first 18 months of the project. The demonstration was embedded in a firefighting exercise involving a car explosion in a two way road tunnel, which triggered accidents, fire and smoke, damaged and burned cars, trapped and injured persons, failed communication, as well as a damaged chemical lorry leaking a toxic substance outside the tunnel. The practical demonstration intended to show how fire fighters could potentially include the following BRIDGE concept cases in their work under realistic conditions of an emergency in a busy road tunnel:

- MESH;
- HelpBeacons;
- eTriage;
- Resource Manager;
- Master;
- Risk Analyser;
- LocalCloud;
- Information Aggregator;
- Training System.

These concept cases were developed in the first phase of the project based on the domain analysis and user needs formulated in participatory design workshops, field observations, End-User Advisory Board meetings and other internal workshops.

The demonstration was divided into the so-called cold run and hot run. The main purpose of the cold run was to show in detail how the BRIDGE concept

Local fire engines at the entrance to the VSH Hagerbach Test Gallery. Photo courtesy: Max Wietek.

cases were integrated as a system of systems with the aim to optimize the emergency management. The reviewers and the end-users were guided through how the different concept cases were collaborating and how the information was flowing through the network infrastructure. The hot run demonstrated how BRIDGE could operate in a "real" emergency. It provided a glimpse on how the BRIDGE system could be included in the practices, how new practices could emerge around these artifacts and how ordinary processes would be influenced by using the BRIDGE technology.

Firefighters rescue trapped people from the damaged vehicles.
Photo courtesy: Max Wietek.

Exercise

The exercise begins with the notification of St. Gallen's emergency center by an eyewitness, who has stopped due to a traffic jam outside the tunnel. The eyewitness reports of an explosion he has heard inside the tunnel and the smoke coming out. The emergency center alarms the Fire Brigade Flums. Based on the received information, the local appointed Incident Commander decides to go with three fire trucks to the incident site. He also notifies a nearby hospital and orders an ambulance service. On the way to the incident site, the Incident Commander receives further information about the accident on his portable BRIDGE Master System.

Front officer approaching the accident scene.
Photo courtesy: Leonardo Ramírez Zúñiga, Fraunhofer FIT.

About 20 minutes later, the fire fighters arrive on scene. The Incident Commander gives a short brief of the situation using his transportable Master table (presented on a laptop during the demo) and the fire brigade splits up into teams that prepare for their operations based on specific roles and responsibilities.

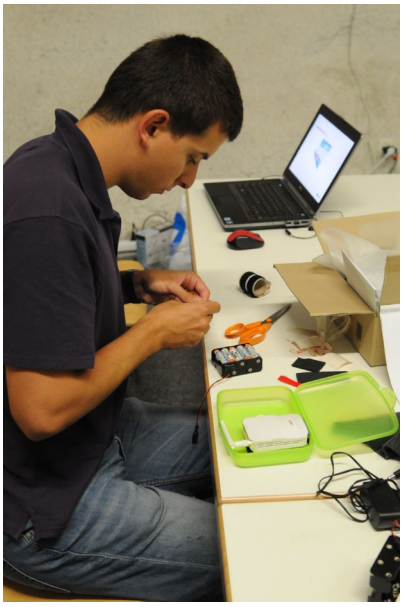
While the front officer walks through the tunnel, he deploys in an ad-hoc fashion nodes that form the overall BRIDGE MESH network. The front officer is also equipped with a smartphone that discovers and associates to a set of BRIDGE HelpBeacons – Wi-Fi hotspots conveying emergency needs through their network SSID. Discovered HelpBeacons are published over the BRIDGE MESH to a shared data space triggering the BRIDGE Master to visualize information about casualties. When the front officer arrives close to the hot zone, he assesses the number of cars involved in the accident and discovers a number of injured and trapped people in the hot zone. He locates a truck loaded with chemicals at the tunnel entrance, which he judges to be a potential danger due to a leakage. The Incident Commander informs the emergency center about the situation, mentioning the potential danger of a chemical release. The Emergency Centre initiates a risk assessment analysing the consequences of a potential leakage of chlorine from the truck.

Close to the hot zone the rescue and fire fighting units are introduced to the situation by the front officer. The paramedics start to triage the injured persons using the BRIDGE eTriage System. The persons trapped inside the cars are rescued with the help of a hydraulic cutter and transported to the ambulance vehicle waiting alongside the fire trucks. The triage information collected by the eTriage nodes will be presented on the BRIDGE Master table.

The Incident Commander receives the risk analysis related to the truck with chlorine and uses the Master table interface to invoke the BRIDGE Resource Manager for requesting extra fire fighters and a fire engine needed to handle the problems with the chemical truck. The demonstration of the BRIDGE system ends with the arrival of the requested resources, which the Incident Commander observes on the Master table. A total of about 40 Swiss fire fighters and paramedics from different rescue services of the Flums region participated in the exercise.

MESH

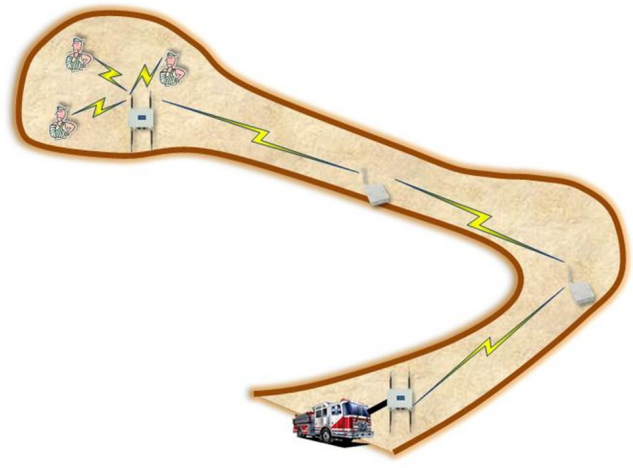
The BRIDGE MESH has the purpose of creating network coverage in unreachable areas and provide network services to those operating or captured in this area. During the first exploration of the area, emergency personnel deploys MESH bridges, which are ad-hoc



Final preparations before the demo.
Photo courtesy: Leo Ramirez.

routers equipped with multiple network interfaces. Depending on the devices in the area and the network interfaces of the closest MESH bridge, local network clouds are formed. Information is created in these local clouds and forwarded over the MESH backbone to the Incident Command.

During the Flums demonstration the MESH consisted of two Meshliums connected to power sockets and two mobile OM2P routers as illustrated in the figure below. The OM2P routers were equipped with batteries and enclosed in prototypic water-proof carriers. The deployed routers used the standard OLSR routing protocol to create an ad-hoc route without pre-configuration.



Demonstration set-up of BRIDGE MESH.

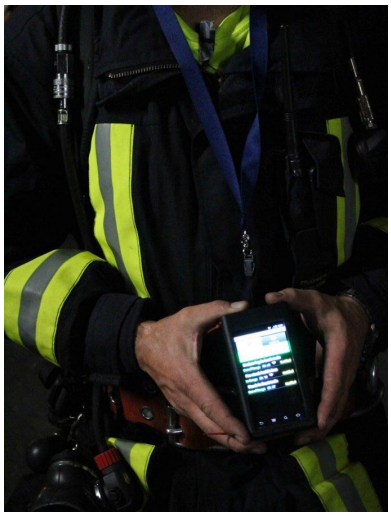
The gateway Meshlium was connected to the local network and thus was able to reach the Master table via the S2D2S. The HelpBeacons from the smart phones and the eTriage tags connected to the Meshlium deployed next to the fire. In the Meshlium ran a deamon that wrapped the received data into the standard xml scheme and posted it to the S2D2S. The demonstration and the feedback from the end-users justified the BRIDGE MESH concept case. The main lesson learned was that the robustness and reliability of the MESH have to be improved. It became one of the topics of the new Robust and Resilient Communication concept case.

Testing technical feasibility of the prototype
before the exercise. Photo courtesy: Leo Ramirez.

HelpBeacons

The HelpBeacons concept case explores the feasibility to use the SSID placeholder of Wi-Fi technology to convey emergency needs. Since an SSID signal is visible in a certain range and, moreover, the first thing people normally become aware of in terms of networks, we play with the idea of using it as a beacon to ask for help, to offer resources, or to disclose a location during a disaster.

We built a prototype and tested it several times inside the VSH underground test gallery before the exercise to make our implementation more robust. We placed several mobile phones in train wagons and other vehicles available in the facility. The large amount of steel inside the test gallery weakened the signals, but nonetheless, a fire fighter walking across the facility was able to quickly collect the help calls and have an idea



Front officer with a smartphone
in search for HelpBeacons.
Photo courtesy: Reinier Timmer, Thales.

of how many trapped people were located in the wagons. As soon as the fire fighter can connect to the BRIDGE MESH, a list of discovered beacons is published to the BRIDGE Master. The intriguing experience we made shows a great potential in using the technology available today to improve collaboration between first responders and members of the public.

eTriage

The focus of the eTriage concept case for the Flums demonstration was to put the prototypes through a realistic use and to test the inter-operation with the MESH and the Master table. We aimed to uncover problems and elicit suggestions from the fire fighters, paramedics, and other emergency responders in the exercise.

eTriage bracelets.
Photo courtesy: Leo Ramirez.

ETriage was used during the fire fighting exercise, when a fire fighter triaged victims just after eliminating the fire risk. The data were successfully transmitted over the MESH to the Master table and were also accessible via the triager's tablet devices. Sensor values were updated live; we could see how the ambient temperature increased due to the fire and then decreased when the victims were transported to the assembly point.

Paramedics during the exercise.
Photo courtesy: Max Wietek.

Since there is no GPS reception in the tunnels, we also tested our concept of "scan-and-locate", in which the triager scans the victim's bracelet via RFID and taps the victim's position on a map on the triage tablet.

The eTriage concept was deemed to be successful. We did uncover possible problems due to interference of the signals and are working to solve them for the next iteration, where we will be extending the concept to include tagging and sensing of the environment as well as the victims.

Resource Manager

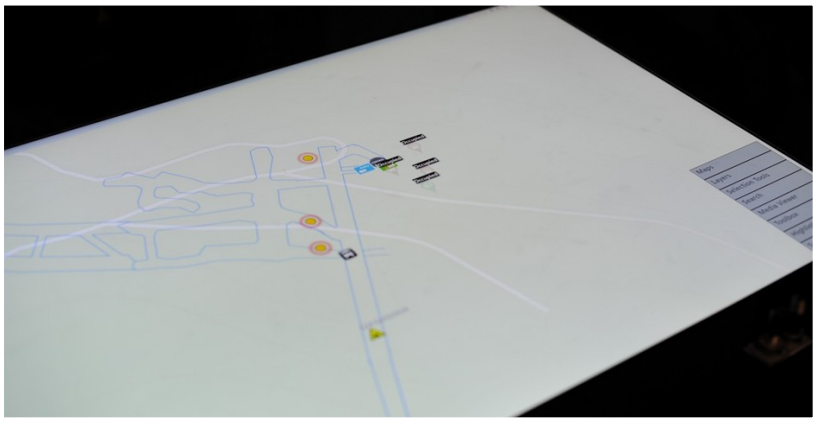
The BRIDGE Resource Manager supports the identification and discovery of various types of resources, the exchange of status information about resources and the communication between (human) resources during crisis management. It runs as a distributed agent-based system on smartphones, tablets, laptops and in the cloud. Next to this, the Resource Manager is able to perform various additional tasks aimed at helping incident commanders to do their job. For example, in case there is a demand for additional certified first responders at a certain incident location, the Resource Manager is able to identify automatically those first responders which are available to do the job, have the required skills for it and are near to the incident site.

For this concept case, the focus of the first BRIDGE demonstration in Flums was on technical interoperability with the Master table and the exposition of its main functionalities. The concept case was used at the end of the demonstration scenario, where an Incident Commander at the Master table asked the Resource Manager for three additional fire fighters to come as quickly as possible to the incident site. A special software agent inside the Resource Manager fulfilled this request. Five smartphones of various types were used to demonstrate the way in which end-users of the system (in this case, fire-fighters) are able to use the Resource Manager. The actual location and movement of these end-users was simulated, since this part of the demonstration in Flums had to take place inside the Steigersaal meeting room, rather than at the actual incident site in one of the VSH tunnels. Nevertheless, all involved resources were visible as clickable icons on the interactive map of the Master table: it was possible to follow exactly the movements of the fire fighters towards the incident scene and their collaboration in order to do this as quickly as possible. Flexible resource management is a very important aspect of emergency response in general. This makes the existence of a Resource Manager a clear necessity in the service landscape offered by BRIDGE. Next demonstrations need to show its value in a non-simulated setting, with a tighter integration into the demonstration scenario and with a more dynamic set of involved resources.

Five smartphones of various types were used in the demonstration.
Photo courtesy: Max Wietek.

Master

The objective of the Master concept case is to show how to support decision-making for leaders in a large-scale emergency response involving different organizations.



Master table with live data from other concept cases.
Photo courtesy: Leo Ramirez.

The Master provides functionality to present and act on three types of information:

- *Information about the incident*, e.g., incident location, number and triage status of victims;
- *Information about the response*, e.g., number and position of police, fire and health vehicles;
- *Information from external services*, e.g., weather conditions.

Master table with a multi-touch screen.
Photo courtesy: Leo Ramirez.

During the demonstration the Master concept case exploited the Microsoft PixelSense, which is a large shared multiuser table PC, in which leaders can cooperate on information exchange and decision-making. The interaction is based on direct manipulation exploiting multi-touch, as well as using physical objects as part of the interaction.

The Master concept case showed in Flums how to establish a common operational picture using services offered through LinkSmart from three different concept cases—HelpBeacons, eTriage, and Resource Manager .

HelpBeacons offered position and information from persons using the HelpBeacons application on their mobile phones. The eTriage offered triaging status and position of all victims. The Resource Manager offered the possibility to send tasking orders and get back updated status of tasks and positions from fire personnel and vehicles. All this information was collected and presented using the Master concept case.

Risk Analyser

The BRIDGE Risk Analyser is a collaborative tool intended to support risk analysis in crisis situations. The basic idea is that graphical risk models for various types of facilities and scenarios are prepared in advance and stored in a library. The risk modelling language is designed to be easy to understand and well suited for use with an interactive touch interface. When an emergency occurs, the suitable risk model is selected from the library to serve a starting point to be tailored to the actual situation. This tailoring can be done, for example, by personnel located at a command centre away from the incident site, thereby supporting incident commanders and other responders.

Toxic plume estimation.
Photo courtesy: Leo Ramirez.

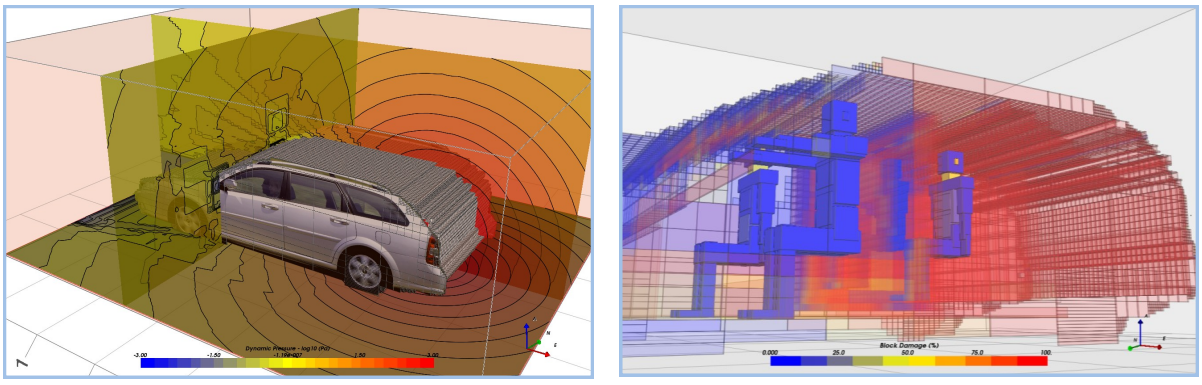
As time is crucial in emergency situations, the ability to easily update the risk model is essential. In Flums, we demonstrated basic editing functionality of the Risk Analyser deployed on a Samsung SUR40 interactive multi-touch table — BRIDGE Master. This functionality included adding and deleting risks, as well as inserting risk level assessments. Moreover, we demonstrated how the Risk Analyser can be utilised to obtain support from external experts via the Dynamic Expertise Integration Network (DEIN). In this case, the requests concerned estimations of the flow of a toxic plume that could potentially endanger a city.

Photos above: Actual vehicle before and after the explosion. Photo courtesy: Max Wietek.
Images below: Simulated vehicle before and after the explosion in 3ds-MAX.

The Risk Analyser also facilitates participation of external 3D modelling experts. 3D models can be used both for training of first responders and for on scene application. The main objective of the training is to simulate the type of scenarios that are too expensive or even impossible to practice in reality (e.g., large industrial accident with a chemical release). The on scene application of 3D models can help emergency personnel improve the risk assessment capability and situational awareness and support decision making process by providing preliminary information on (a) areas of increased risks for first responders (e.g., buildings and structures with a high probability of collapse), and (b) estimated number of casualties to be expected, as well as the type of injuries. Both sets of data assist in selecting the optimal protective equipment and prioritizing search and rescue operations.

In order to validate computer-assisted modelling, a test explosion of a passenger car was carried out in the VSH test gallery at the start of the demonstration. The resultant damage was then compared with the damage estimations by different modelling software. The HEXDAM model (see below) was completed within 15 minutes after the explosion. The 3ds-MAX model (see above) required about 45 minutes.

The demonstration showed that the Risk Analyser has large potential for facilitating better risk analysis and more proactive thinking during a crisis. However, the quality and relevance of the risk models in the library are essential to fulfil this potential. It is also very important to keep the solution simple.



Right: HEXDAM model of the vehicle during the explosion.
Left: HEXDAM model of the damaged vehicle and injuries incurred by four passengers.

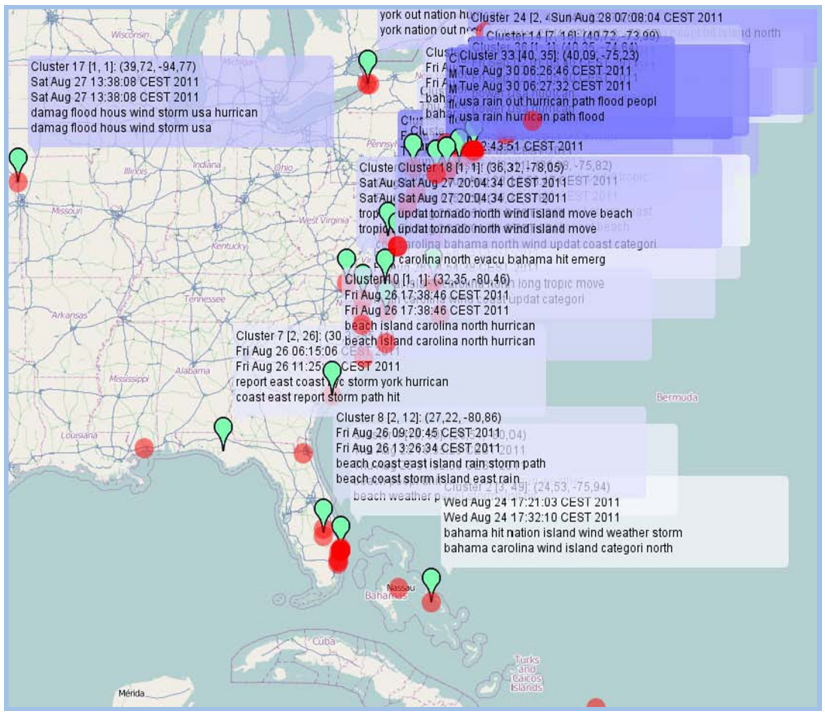
LocalCloud

The LocalCloud concept case enables spontaneous communication between proximate devices in P2P fashion. Via a story-carry-forward mechanism text or media can be relayed to social networks as Twitter or Facebook.

We tested an early prototype version during the first demo, using Wi-Fi technology interconnect mobile phones. Users were able to share content by the use of a Twitter client. Eventually, one phone relayed via 3G text messages to a dedicated Twitter account. Informal citizen response supported by information and communication technology is an emerging area, which definitely will be considered in the future efforts of the BRIDGE project.

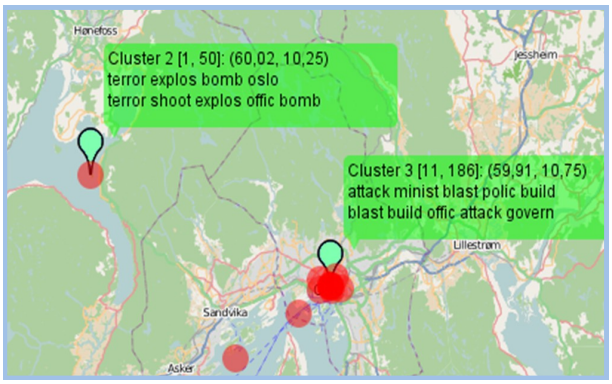
Information Aggregator

The BRIDGE Information Aggregator (IA) aggregates and processes data collected during an ongoing crisis situation. Currently, we focus on the processing of social media data gained during a crisis to support emergency management. Social media offers the possibility to include the public (opinion) from the very beginning into crisis management tasks. There are already intentions to use social media, especially by the police to gain a better situational awareness. Therefore, the Information Aggregator introduces the concept of "sub-event detection" as an aggregation technique. Sub-events are specific hotspots of a crisis that take place in the context of an event (or disaster). For example, the event could be the "Riots in London" where the sub-events are specific incidents/hotspots, e.g., the looting in London. The detected sub-events give some insights into the situation at hand and hints where emergency management has to focus on next.

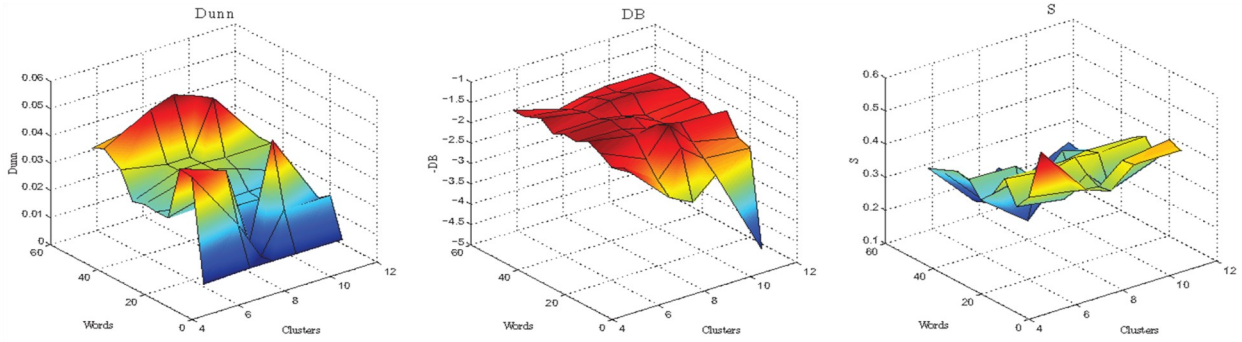


Results of the aggregation from Hurricane Irene.

We demonstrated the Information Aggregator during the poster presentation in Flums. The poster summarized our findings related to the sub-event detection techniques applied to data from emergencies in the year 2011 (e.g., Oslo bombing and shooting, Hurricane Irene). The discussions during the poster presentation emphasized the importance of such an aggregation tool, due to the high information load caused by intense activities in social media. Social media is becoming an important communication tool that must be included in emergency management to make the commanders aware of what is going on. In the future, we want to strengthen our efforts in developing a solution for an on-the-fly data analysis with an appealing user interface.



Results of the aggregation from the Oslo data 2011.



Indices for the 2PG (2Phase Geo-based Clustering Algorithm) and UK Riot data set.

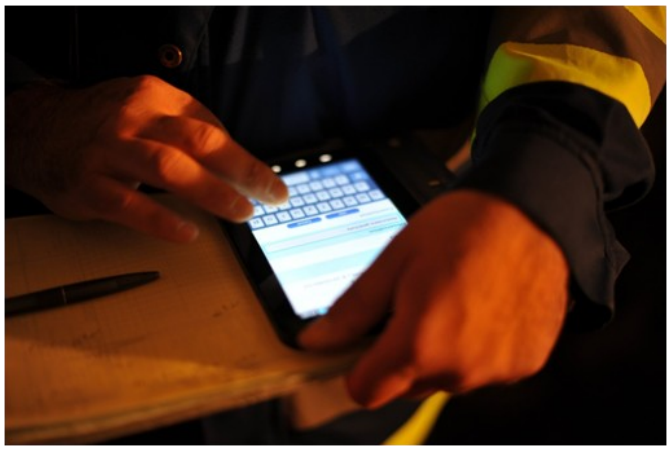
Training System

The BRIDGE Training System FRITS (**F**irst **R**esponders **I**ntegrated **T**raining **S**ystem) will prepare individuals and organisations to be able to cope with changing expectations, change of supporting tools, as well as change of procedures. The essence is to develop a training concept that can adapt to these rapid changes to ensure an optimal preparedness. The final version of FRITS will offer a toolbox allowing scenario-based training in a fully controlled training environment, which also includes the use of operational equipment to enhance the realism in the training.

A step by step implementation of a learning and training methodology will result in an optimized baseline for the exercise. Based on the training objectives, a number of criteria will be defined assuring a structured retrieval of observations. This will give an optimal prerequisite for the evaluation and learning process.

Last-minute checking before the demonstration.
Photo courtesy: Leo Ramirez.

The exercise can also be enhanced with simulated environment to make it more realistic. It is, for instance, possible to exercise nuclear, biological or chemical accidents. It can also be used to provide operational systems with simulated exercise information. The exercise can be analysed in real time, thus giving the exercise management situational awareness of the exercise and the power to control the exercise to achieve the set objectives. After the exercise, all collected data is analysed and thematic reports can be generated.



Swiss first responders trying FRITS Training System during the demo. Photo courtesy: Max Wietek.

The first demonstration in Flums focused on demonstrating the effect of using a well documented learning and training methodology and the use of the evaluation database. The evaluation database received data from different sources. A number of first responders and "injured" actors were followed using android mobile phones with a training app, giving live information of each actor´s unique status and position. Based on the defined training objectives, the voice communication of the Main Training Audience, in this exercise – the incident command team, was recorded to be used as input for optimal evaluation.

A number of appointed observers documented the training objectives using tablets with a predefined app assuring a structured retrieval of observations giving an optimal prerequisite for the evaluation and learning process.

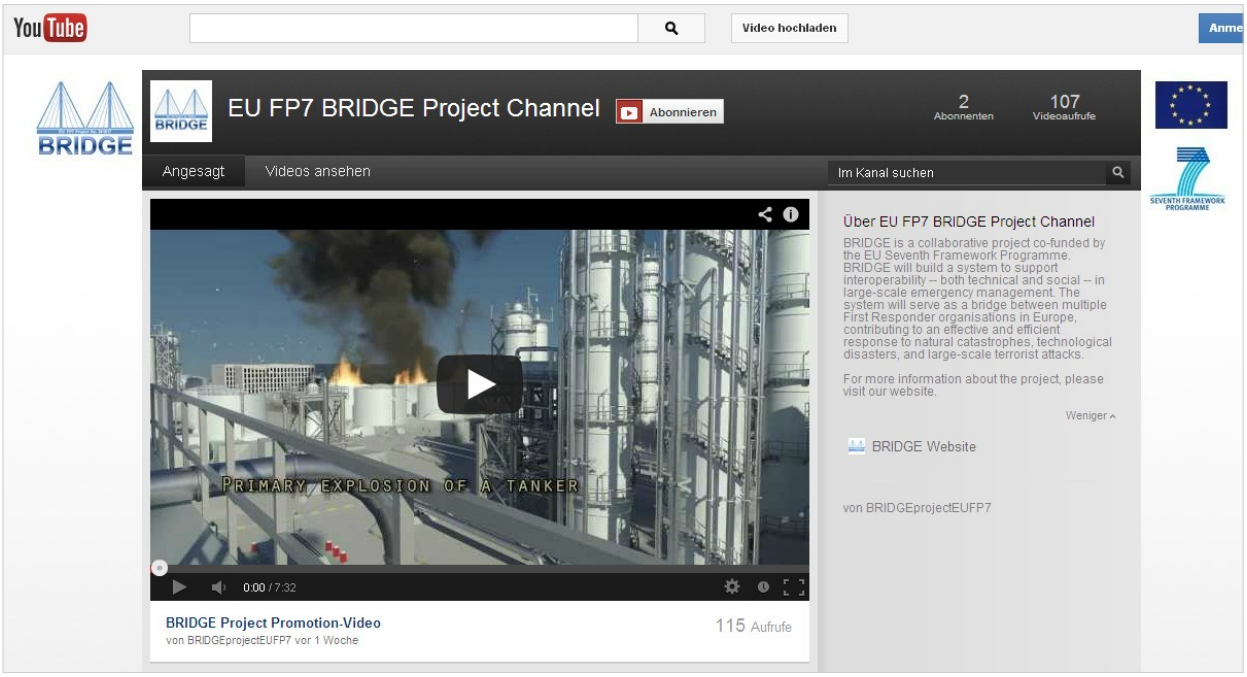
Each observation collected position, video, footage, voice and text information from the exercise and was forwarded directly to the exercise Management Team, which could follow the status of the exercise in real time. Video cameras recorded the exercise to support the evaluation process with an overview picture of the exercise. Helmet-mounted video cameras were also tested during the exercise, to evaluate the potential effect one could have in the future evaluation processes.

The structured information gathering process resulted in a well documented footprint of the result of the exercise to be used in the first responder´s evaluation process.

The response from the observers and appointed end-users was that the demonstrated features could optimize the process of assuring an optimal learning and training process. The user-friendliness was also assessed as a good feature of the demonstrated FRITS components.

BRIDGE Promotional Video Available on YouTube

We are pleased to announce the release of the BRIDGE promotional video! The video is based on a 3ds-MAX simulation of a major industrial accident at the virtual ExploChemco facility. This scenario was chosen by the BRIDGE consortium as a basis for the development of the BRIDGE platform that will provide technical support for multi-agency collaboration in large-scale emergencies by ensuring interoperability, harmonization and cooperation among stakeholders on the technical and organisational levels. The video demonstrates some of the components of the BRIDGE platform – BRIDGE Concept Cases. Please go to the BRIDGE YouTube Channel at http://www.youtube.com/user/BRIDGEprojectEUFP7?feature=watch to watch the video.



BRIDGE Partners Will Co-chair ELSI Track at ISCRAM 2013

We are pleased to announce that the track *Ethical, Legal and Social Issues (ELSI) of IT Supported Emergency Response*, proposed by BRIDGE consortium member Lancaster University, has been accepted for ISCRAM 2013 under the theme *Emergency Management Information Systems*.

Emergency Management Information Systems (EMIS) support novel forms of collaboration between diverse parties – from statutory emergency agencies through local authorities, humanitarian organizations and volunteers, to members of the public. The ELSI track will explore critical ethical, legal and social issues and innovative responses in policy, practice and IT design.

The track will be co-chaired by BRIDGErs Monika Büscher and Lisa Wood (Lancaster University). More information about the track and its topics can be found on the conference website: http://iscram2013.org/sites/default/files/ISCRAM2013_ELSI.pdf.

The Panel on 'Ethical, Legal and Social Issues of IT Supported Emergency Response' — run as part of the ELSI track — brings together a group of experts who will discuss issues raised as part of the special track. Topics will include privacy, technology usability and cost, transformations of professional accountability, issues of social justice, and societal challenges such as surveillance and a militarization of everyday life. Confirmed participants include Hayley Watson, Trilateral, UK, Heiko Werner, Federal Agency for Technical Relief (THW), Germany, Monika Buscher, mobilities.lab, Lancaster University (Chair).

Lisa Wood and Monika Büscher. Photo courtesy: Max Wietek.

BRIDGE Scientific Results

ICMLA 2012
12-15 December 2012

Daniela Pohl (University of Klagenfurt, Austria) presented a paper at the 11th International Conference on Machine Learning and Applications (ICMLA 2012) held in Boca Raton, Florida, USA. The paper, co-authored with with Abdelhamid Bouchachia (Bournemouth University, UK) and Hermann Hellwagner (University of Klagenfurt, Austria), described their research on automatic identification of crisis-related sub-events using clustering.

AmI for Crisis Management Workshop
13 November 2012

BRIDGErs Ragnhild Halvorsrud and Michael Stiso (SINTEF) co-organised a workshop in conjunction with the International Joint Conference on Ambient Intelligence (AMI2012) held in Pisa, Italy, 13-15 November 2012. The workshop entitled *Applying AMI Technologies to Crisis Management* brought together researchers and practitioners working on the application of *Ambient Intelligence* to crisis and disaster management and promoted better understanding of the strengths of the AmI paradigm, challenges to its application, and its potential in the development of innovative solutions. Three BRIDGE papers were presented at the workshop:

- *Response to Emergence in Emergency Response* co-authored by Lisa A. Wood, Monika Buscher (Lancaster University) and Leonardo Ramirez (Fraunhofer FIT);
- *Key Challenges in Multi-agency Collaboration During Large-scale Emergency Management,* co-authored by Aslak Wegner Eide, Ida Maria Haugstveit, Ragnhild Halvorsrud, Jan Håvard Skjetne and Michael Stiso (SINTEF); and
- *BRIDGE Risk Analyzer: A Collaborative Tool for Enhanced Risk Analysis in Crisis Situation,* co-authored by Mass Soldal Lund and Atle Refsdal (SINTEF).

The workshop was jointly organized by three ongoing FP7 projects - *MIRROR*, *Societies* and *BRIDGE* - that investigate ICT support for crisis management from different perspectives.

PLoP 2012
19-21 October 2012

René Reiners (Fraunhofer FIT) presented a paper at the 19th Conference on Pattern Languages of Programs (PLoP 2012), which took place in Tuscon, Arizona, USA. The paper, entitled *An Approach to Evolutionary Design Pattern Engineering* and co-authored with Ragnhild Halvorsrud, Aslak Wegner Eide (SINTEF) and Daniela Pohl (University of Klagenfurt), will be published during the first quarter of 2013 within the ACM Digital Library.

45th Session of Int'l Seminars on Planetary Emergencies, 19-25 August 2012

Friedrich Steinhäusler (University of Salzburg) presented a paper at the 45th Session of the International Seminars on Nuclear War and Planetary Emergencies organized by the World Federation of Scientists (WFS) in Erice, Sicily, Italy. The paper analyzed the gap in security and counterterrorism research initiatives of the European Union and will be published in the Science and Culture Series: *Nuclear Strategy and Peace Technology* (Series Editor and Chairman: Antonio Zichichi), World Scientific.

Participatory Design Conference
12-16 August 2012

Lisa Wood (Lancaster University) presented a paper at the 12th Participatory Design Conference, held in Roskilde, Denmark, 12-16 August 2012. The title of the paper, co-authored with Monika Büscher (Lancaster University), was *Reconfiguring Possibilities in Crisis Situations: an Agential Realist Approach to Participatory Design.*

PATTERNS 2012
22-27 July 2012

A BRIDGE paper co-authored by Alfred Zimmermann and René Reiners (Fraunhofer FIT) was presented at PATTERNS 2012, the Fourth International Conference on Pervasive Patterns and Applications, which took place in Nice, France. The full title of the paper is *Pattern Innovation for Architecture Diagnostics in Services Computing*.

WISES 2012 Workshop
5-6 July 2012

Christian Raffelsberger (University of Klagenfurt) presented a paper at the Workshop on Intelligent Solutions in Embedded Systems (WISES 2012) organized by Lakeside Labs in Klagenfurt, Austria. The paper, entitled *Evaluation of MANET Routing Protocols in a Realistic Emergency Response Scenario,* was co-authored with Hermann Hellwagner.

Workshop & International Conference on Video Analysis, 5 July 2012

Lisa Wood (Lancaster University) presented a paper entitled *On Missed Beginnings* at the Workshop and International Conference on Video Analysis, which was held in Bayreuth, Germany. Monika Büscher was a co-author of the paper.

21st IEEE International Conference
25-27 June 2012

Two BRIDGE papers were presented at the Collaborative Technology for Coordinating Crisis Management (CT2CM) track of the 21th IEEE International Conference *Collaboration Technologies and Infrastructures* held in Toulouse, France:

- *Supporting Crisis Management via Sub-Event Detection in Social Networks* co-authored by Daniela Pohl, Abdelhamid Bouchachia and Hermann Hellwagner (University of Klagenfurt) and
- *Agile Response and Collaborative Agile Workflows* co-authored by Lisa Wood, Monika Büscher (Lancaster University), Bernard Van Veelen (Thales), and Sander Van Splunter (Technical University of Delft).

You can find more on these project results at: http://www.bridgeproject.eu/en/bridge-results/publications.

BRIDGE at a Glance

BRIDGE will build a system to support interoperability — both technical and social — in large-scale emergency management. The system will serve as a bridge between multiple First Responder organisations in Europe, contributing to an effective and efficient response to natural catastrophes, technological disasters, and large-scale terrorist attacks.

"The project will look in particular at how cooperation among different agencies and organisations can be made more efficient at national and transnational level."

EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

The vision of the BRIDGE project is to:

- Facilitate cross-border and cross-agency collaboration
- Allow the creation of a common, comprehensive, and reliable operational picture of the incident site
- Enable integration of resources and technologies into workflow management
- Enable active ad-hoc participation of third parties

CONSORTIUM

The BRIDGE consortium consists of a well-balanced mix of cross-disciplinary academics, technology developers, domain experts and end-user representatives:

- Stiftelsen SINTEF, Norway
- Almende B.V., The Netherlands
- CNet Svenska AB, Sweden
- The Fraunhofer Institute for Applied Information Technology FIT, Germany
- Lancaster University, UK
- Crisis Training AS, Norway
- SAAB Training Systems, Sweden
- Thales Nederland B.V., The Netherlands
- Alpen-Adria University of Klagenfurt, Austria
- Paris-Lodron University of Salzburg, Austria
- VSH Hagerbach Test Gallery LTD, Switzerland
- Technical University of Delft, The Netherlands
- Stockholm University, Sweden
- Helse Stavanger HF, Norway

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For more information, please visit the project website: http://www.bridgeproject.eu.

Newsletter designed by Lyudmila Zaitseva

BRIDGE Newsletter

ISSUE 2 — JUNE 2012

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Editorial

Dear Reader!

Thank you for showing interest in the BRIDGE research project by reading this newsletter. In the previous edition we proudly introduced the project and our overall technical vision. Hopefully, we managed to give you the understanding that interoperability in emergency operations is a life-saving necessity, albeit achieving this in practice is rather complex and not straightforward. Interoperability requires that individual systems can communicate and exchange information with other systems, and make good use of the received information. Furthermore, innovative technical solutions should be compatible with the operational procedures, or be good arguments for improving the procedures.

This newsletter presents a first set of concepts developed in BRIDGE. Some of these deal with support for the incident command, ranging from new ways to visualise the information to have a common operational picture of the crisis scene and an overview of the available resources and the risks involved with various decisions. Making the right choices requires the right information from the right people, and is it is a challenge to extract the important data while suppressing the noise, especially in potentially voluminous multimedia sources.

At the individual level we propose two concepts: One application tries to involve the victims and to have them provide important on-scene information about what has happened and where; the other aims to inform the incident commander and the rescue workers about where victims have been found and the severity of their conditions. This may help assuring conscious victims that help is coming, and facilitate the evacuation of the casualties in the right order.

All of these concepts are example of applications and systems that need a network to communicate, and therefore may not work if the existing infrastructure has been severely damaged by the event or if there is no pre-existing communication infrastructure, as is unfortunately often the case in remote areas or tunnels. BRIDGE is therefore researching into how the infrastructure can be provided on-demand.

The above concepts are not the products of the project team's imagination, but responding to real needs of real emergency workers whose input we have obtained in a series of co-design workshops. We hope that you may understand this research methodology better through the few glimpses we provide in this newsletter.

In September we will demonstrate the presented concepts in a live demonstration focused on fire in a tunnel. I do hope this will confirm that we are on the right track, and I hope that you will pick up our next newsletter to read more about how that exercise went!

Geir Horn, SINTEF
Project Coordinator

In this issue:

BRIDGE will demonstrate its concepts in a tunnel fire exercise in September 2012.

BRIDGE Master

Supporting Coordinated Response to Large-Scale Emergencies

For emergency managers responding to large-scale incidents it is a big challenge to take the most appropriate and coordinated actions necessary to save lives and assets. The BRIDGE system will provide the incident commanders and their teams with the tools, which will help them to make coordinated assessments of the situations, coordinated planning, coordinated decision making and coordinated information gathering and sharing. The main component, which enables this coordinated view for the different leaders, is the *BRIDGE Master*. The BRIDGE Master is a component that provides basic functionality for visualization and management of all collected information and available resources during an incident and assists the leaders in making appropriate decisions using the BRIDGE system.

One of the main functions of the BRIDGE Master is an interactive map of the incident site. It is likely to be predominantly used on-site and in incident command centres, but also local leaders with mobile devices like a tablet will be provided with the map functionality. The map has several layers of geo-referenced information, such as:

- Location of severely injured or persons buried in the rubble;
- Location of fire hydrants;
- Location of vehicles;
- Location and status of first responders;
- Current weather forecast;
- Toxic plume.

Mockup of the common operational view.

By making decisions visible in the movement of resources, the BRIDGE Master supports – amongst other things – the principle that decisions should be taken at the lowest appropriate level, while co-ordination should be facilitated from the highest necessary level.

Normally, in large emergency response efforts, tracking and allocation of resources must occur in close cooperation with a central staff responsible for managing the logistics of the response. The BRIDGE Master will improve on that by making use of sensors and other geo-localised devices that are integrated into the BRIDGE system to visually track these resources. For each resource, the users of BRIDGE Master will be able to determine its (current) owner/commander, its status (availability, scarcity), whether others request it.

The BRIDGE Master will be developed to support cross-organisational teams both co-located and separated. The system will also provide tailoring based on roles, so it will also support an adapted but common view on different levels from tactical to strategic.

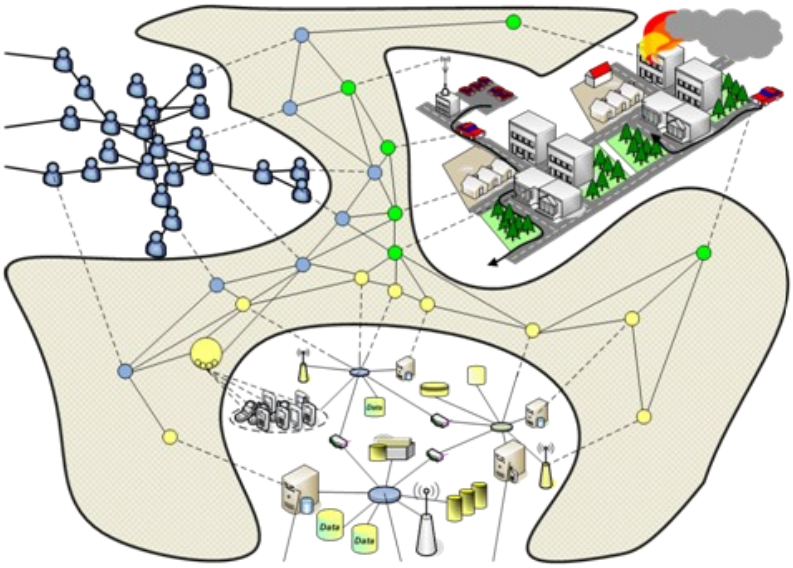
To enable this flexibility, the BRIDGE Master will be developed to support different end-user equipment from Android based tablets to larger Windows based tables or screens.

Microsoft Surface table supporting team work.

BRIDGE Resource Manager

Improved Support for Resource Management During Emergency Response

The objective of the *Resource Manager* is to provide drastically improved support for resource management during emergency response operations. It enables its users to identify and announce resources, to view information about resources from different agencies in real-time, and to allocate resources to specific tasks and locations.



Resources as clickable items on an interactive map.

The Resource Manager is an agent-based distributed system running on mobile devices (smartphones, laptops, tablets, MDTs) in combination with cloud-based services. Via these latter services, a tight integration with the *Master* concept is to be expected: resources and their status will be visible as clickable icons on an interactive map. Also, the assignment of resources to tasks and usage of the related decision support system can be done directly from the interactive map.

Various different communication media and protocols can be used by the Resource Manager in order to provide a robust and fully functional application even in circumstances with limited connectivity. For example, the Resource Manager will be able to make use of the *BRIDGE MESH* concept for communication between end user devices and with the cloud services, but will also be able to exploit HTTP connections over Wifi/GPRS/UMTS, if available.

Intended Users

The discovery and notification functionality is to be used by everybody involved in a crisis situation, both institutionalized first responders and citizens providing opportunistic support.

The allocation functionality of the Resource Manager is also intended to be used by personnel working at centralized command centers (e.g., operative centrals, call centers), and by command personnel working at incident control posts.

Intended users - emergency response personnel.

The real-time information visualization functionality is intended to be used by all actors from the agencies involved in the emergency response effort, including not only commanders, but also field workers and others.

Functionality

The Resource Manager typically provides the following functionality:

- Register / identify resources;
- Register / identify tasks;
- Assign tasks to resources either centrally or locally;
- Provide both local and centralized decision support for resource allocation;
- Monitor the location, state, availability and capabilities of resources;
- Propagate local decisions to upper echelons;
- Low-level (sub)task planning (typically local);
- Distributed analysis of data about earlier events and training-relevant events;
- Distributed prediction and forecasting functionality of resource location and status .

Technology

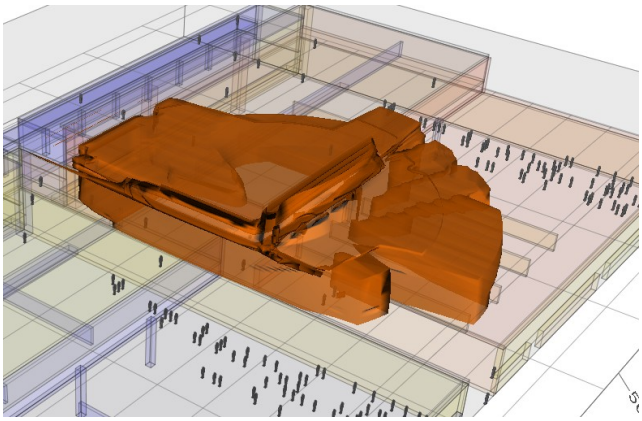
The Resource Manager is directly linked to resources by means of devices such as smartphones and MDTs. It uses an offline local data store, which can be synchronized periodically with other devices and/or with a data store in the cloud.

The Resource Manager will most likely make use of the Emergency Data Exchange Language (EDXL) to facilitate sharing of resource information and allocation requests. EDXL is a XML-based messaging standard for emergency-related organizations. Furthermore, compatibility with lightweight data exchange and integration protocols (e.g., JSON, RPC), architectural styles (e.g., REST), and open standards for data persistence (JDO, JPA, JTA) is envisaged.

BRIDGE Risk Analyzer

Supporting Emergency Risk Analysis and Communication

When an emergency or crisis occurs, big decisions need to be made on the basis of risk analysis, such as: Is it safe enough for rescue workers to enter the area? Do we need to evacuate the public from the surrounding area? Making the right decisions depends on a good understanding of the current risk picture:



3d model of a blast wave from a suitcase bomb at an airport departure hall blocked by a massive side wall.

- What are the assets, i.e., the things we need to protect, and what potential incidents may cause harm? Assets typically include the health and safety of the public and the responders, the environment, buildings and infrastructure, and so on.
- How likely are the incidents to occur, and what will be the consequence (impact) with respect to the identified assets?
- What are the available options to reduce the likelihood or consequence?

The nature of emergency and crisis situations makes these tasks very challenging. As the situation may quickly change, there is little time to collect and process the information needed to perform the analysis. Moreover, the analysis often requires participation from a number of different people, including external experts on specific domains, who may not be located together on the incident site.

The purpose of the *BRIDGE Risk Analyzer* is to support risk analysis during emergency and crisis situations where the decision time frame is longer than a few minutes.

The BRIDGE Risk Analyzer can be deployed on interactive multi-user tables aimed at incident command and command central, as well as on smaller tablet computers carried by selected individuals. It is based on graphical risk models represented in a slightly simplified version of the CORAS risk modeling language. For foreseen types of emergency scenarios, a library of predefined risk models will provide starting points for the analysis, to be filled in and tailored to the specific scenario when it occurs.

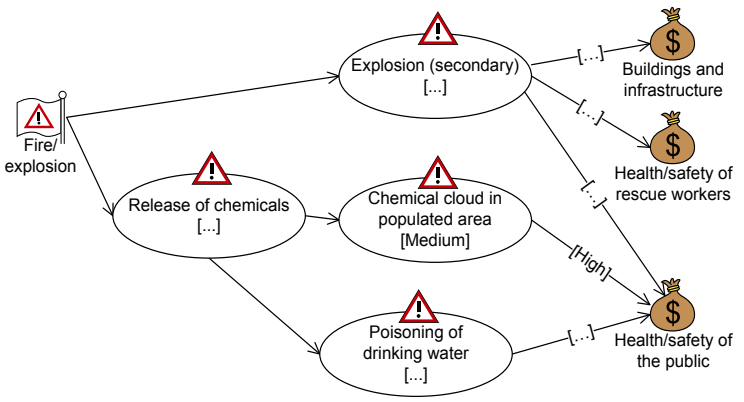
The graphical modeling language is very simple in order to ensure that the models can be intuitively understood by involved actors with different background and training, such as police, fire fighters, medical personnel, NGO representatives and external domain experts. By pointing to an unwanted incident (illustrated by a warning triangle), a new menu will appear that allows the user to:

- View a checklist of issues and information that should typically be considered when assessing this type of risk;
- Insert new entries and information to this checklist as it becomes available;
- Obtain support from external experts through dedicated collaboration tools (Dynamic Expertise Integration Network, Scenario-Based Multi-Criteria Decision Analysis);
- View 3d models, object plans or other visual information related to the incident;
- Locate the risk on a map;
- View mitigation options.

Likelihood and consequence assessments can be inserted in the brackets on an incident and the relation from an incident to an asset, respectively. If the combination of the likelihood and the consequence represents a high risk, a warning is trigged. This may result in a message to relevant actors based on roles or location.

The risk model can be viewed and edited from different devices located at different places, thereby supporting information sharing and distributed analysis, and contributing towards a common operational picture.

After developing the Risk Analyzer as a paper prototype and obtaining feedback from end users, work has now started on the technical development of the tool.



A simple risk model. Note that this model is only meant to illustrate the approach, and is not the result of a realistic analysis.

BRIDGE Information Aggregator

Facilitating Aggregation of Data Collected During an Emergency

The *Information Aggregator* – a specific BRIDGE component developed at Klagenfurt University – facilitates the aggregation of data collected during an emergency. Currently, we focus on the aggregation and analysis of social media data (e.g., from Flickr or YouTube) to support emergency management. Studies show that social media data is an important instrument during a disaster, due to the fact that people report and describe any kind of situation they are involved in. Hence, the increasing usage of social media platforms delivers valuable insight into crisis-related issues.

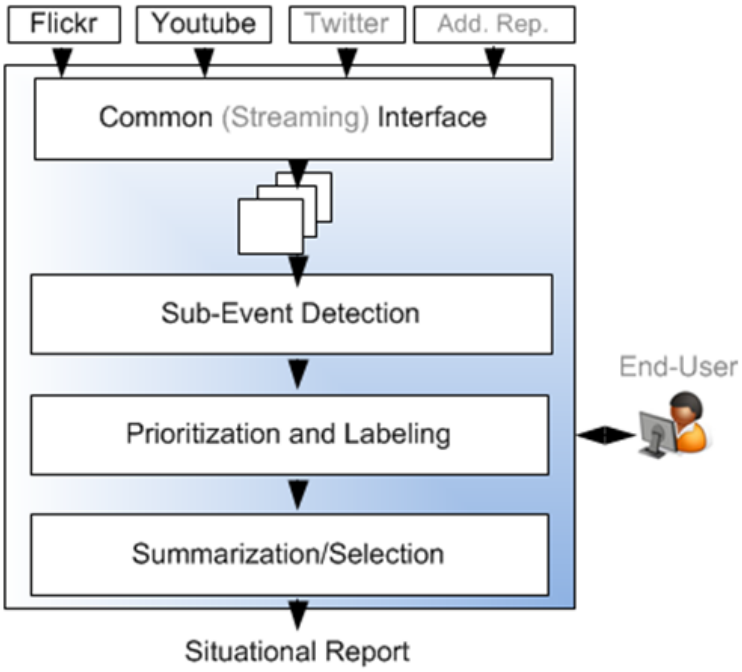
In case of large-scale emergencies, it is obvious that a huge amount of data is gathered and shared. Manual browsing through this amount of data in stressful situations is a time-consuming and cumbersome task. Therefore, the Information Aggregator can be seen as a Media Exploration Framework that relieves the user from this manual activity.

The framework supports an after-the-fact analysis of data related to a crisis. At the moment, it facilitates the identification of sub-events (specific hotspots of a crisis). Sub-events describe dominant threats in a crisis that need immediate emergency response to stabilize the situation.

Tsunami crisis in Japan, March 2011.

Events are often seen as a whole not recognizing the different facets, namely the sub-events. For example, also a soccer game, seen as a famous sport event, contains sub-events. Hence, goals recognized as specific sub-events have particular influence on the game. This is also true for crises, where specific hotspots (e.g., collapse of buildings, impact of an earthquake or tsunami on critical infrastructure) have an influence on the situation at hand.

We studied clustering techniques as an unsupervised learning approach to identify such sub-events based on crisis-related data from Flickr and YouTube. Each identified cluster represents a specific sub-event. To detect sub-events, the Information Aggregator performs several processing steps. First, a keyword-based query (e.g., "UK riots 2011") is set up that delivers the most important images and videos related to the keywords, from Flickr and YouTube. The resulting metadata fields of each item (image or video) are used to create a representation suitable as input to the clustering algorithm. Especially, we used metadata fields like title, description and tags associated with each item. Through natural language processing, a so called word vector (word-value pairs) for each item is created. This representation acts as input to the clustering-based sub-event detection.



Information Aggregator as media exploration framework.

We studied two clustering techniques: self-organizing maps and agglomerative clustering, which show suitable characteristics for the identification of sub-events. Based on the identified clusters, a prioritization/labeling mechanism is performed, which ranks the clusters based on their importance and creates for each cluster composite labels. This results in a suitable, user-readable overview of the extracted information.

In future work, we want to extend this framework to stream processing analysis that identifies sub-events in real-time. We also plan to further refine the static analyses (especially for an after-the-fact crisis analysis). Another future direction is the inclusion of additional sources (e.g., data collected directly in the BRIDGE project, Twitter or news media). We also intend to develop a user-friendly representation of the cluster results.

BRIDGE MESH

Supporting Communication Over Different Exploitable Channels

In an emergency situation the first network to become unavailable are cellular networks. Although emergency forces have priority to use this form of communication, the access may still be limited and victims at the emergency area have no possibility to send their help requests. *BRIDGE MESH* will provide the possibility to communicate with devices in an emergency area over different exploitable channels.

Network Triangle

When talking about exploitable channels we have to distinguish between different kinds of network:

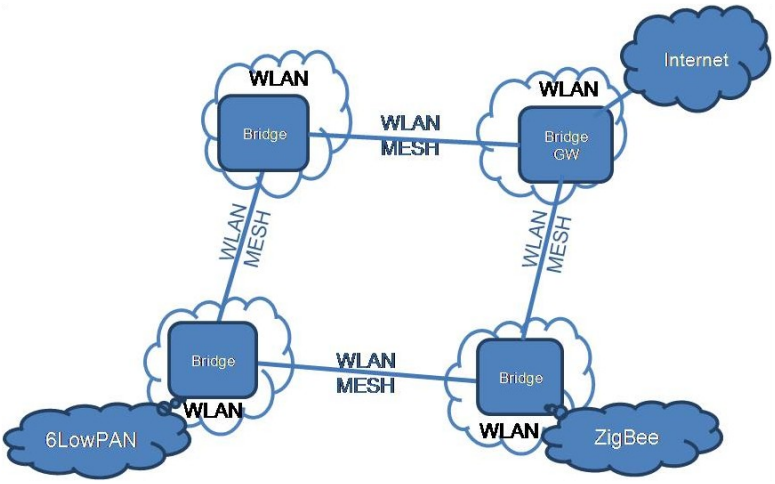
- There are networks, which are pre-installed for an area. We call this kind of networks *infrastructure*. It obviously includes the cellular network but also there are networks installed for special environments.
- At a disaster site arriving forces may deploy *ad-hoc* devices. These devices are designed to adapt to the dynamic nature of the network and to support emergency forces and victims. Example of such systems is a WiFi access points installed on top of fire trucks.
- In today's digital world devices with wireless interfaces are found everywhere. These resources can be used *opportunistically* to extend the services of the network. For example smart phones can be used as repeaters of packets or building control systems' sensors can be queried for context information.

BRIDGE MESH Architecture

MESH is an ad-hoc network, which will be based on deployed MESH Bridges, which have multiple network interfaces beside a 802.11s interface. As first responders arrive at the incident site and explore the region they carry the MESH Bridges with them and place them at given distances. The MESH Bridges create an ad-hoc WiFi network, where data is forwarded over multiple hops. Through this deployment the area gains network coverage.

Hardware

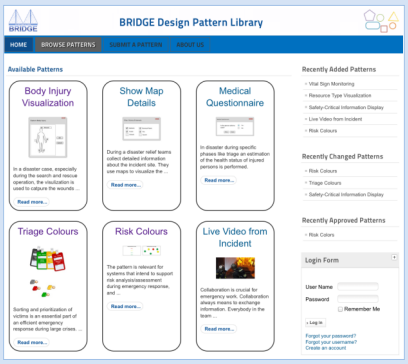
The hardware used as MESH Bridges are Libelium's Meshliums. These waterproof housed routers provide interfaces for 802.11g, ZigBee, 802.15.4, GPRS and GPS location information. They run full functional Linux Debian distributions and provide an easy to use web configuration page. They implement OLSR routing protocol for mesh construction and provide common access point functionality in their proximity.



BRIDGE MESH Architecture.

This network can from now on be used by different emergency forces, as a shared medium, over which communication or other data can flow. Additionally MESH Bridges accept local networks to attach to them (like ZigBee networks, Bluetooth piconets, etc.). These local systems can from now on be reached over the Bridge MESH and data can be forwarded between them and the Incident Command Centre.

This hardware is a very good starting point for all the development planned for Bridge MESH. The provided tools make a quick learning cycle possible and the powerful platform makes us able to run all the foreseen applications. The integration of "landmark" and eTriage has been initiated and we are collecting experience for developing applications on Bridge MESH.



BRIDGE Design Pattern Library

The BRIDGE Design Pattern Library (DPL) accompanies the engineering efforts undertaken within interface and prototype design and domain analysis by incorporating findings and early concepts right from the beginning of the exploratory research work. All stakeholders that are involved in the design, analysis and validation process contribute to the library from the very first minute. An evolutionary community process is applied to contribute, comment and refine the design pattern library. The more research is performed on a certain topic, the more mature a pattern idea becomes. From ideas to patterns - the concept of the BRIDGE DPL (pattern-library.sec-bridge.eu).

BRIDGE RescueMe App

Supporting Victim Notification in Case of Emergency

Public participation is one of the most underutilized resources during crisis response. Due to the increasing ubiquity of smartphones (and further portable devices as tablets) members of the public have the possibility to access the Internet over various forms of network technologies as 3G or Wi-Fi. Driven by the strong emergence of social media services citizens can express their status or needs when being at various locations and times, in daily life and in crisis situations.

Though, in crisis incidents public participation is often blocked due to infrastructural damage, e.g., parts of the cellphone network have been destroyed or are jammed due to usage over its capacity. At this, the *BRIDGE RescueMe* concept aims at the design and development of viable solutions that facilitate members of the public to still communicate their emergency needs in crisis situations in spite of critical infrastructure disruptions. In the following, we outline one design sketch that aims at supporting victims who are stuck due to a disaster as an earthquake or crisis incident as a gun rampage.

RescueMe App

The main goal of the application is to provide victims with the means to inform rescue agencies about being in emergency and receive the confirmation that their notification was registered at the dispatch center. To do this, when starting the application the user needs to indicate if he or she is facing an emergency, upon which an emergency beacon is sent to the dispatch center. Then, the victim briefly answers four W-questions (Who? What? When? Where?) resulting in an emergency ticket that is also sent to the dispatch center. As soon as the received information is registered in the BRIDGE system the victim receives a confirmation message that personnel at command center are aware of his or her critical status.

RescueMe App.

For the very first designs we investigated findings from past incidents and organized brainstorming sessions with members of the public. In participatory design workshops with crisis response practitioners and past victims we continuously evaluated our design ideas and gained inspirations for new ideas. For this we utilized paper prototypes and high-fidelity software prototypes.

The application is intended to scale from being used in a small emergency (e.g., car accident) to a large-scale crisis (e..g., heavy earthquake). Hence, depending on the aftermath of the disaster on the network infrastructure features as calling the local dispatch center, sending multimedia files, receiving status updates on the progress of the response operation or how to get to collection point where medical assistant is provided, might or might not be possible. In case of critical infrastructure disruptions the relaying of data is accomplished through *BRIDGE Mesh*.

Hardware

Currently, development takes place primarily on the Android operating system. However, porting the design sketches to Windows Phone or iOS devices is also possible.

BRIDGE Participatory Design Workshop.

BRIDGE eTriage

Unobtrusive Augmentation of Triage Process

Triage professionals told us that, by putting a variety of sensors on the victims and having them report live to the command post, the commanders' situation awareness would be improved and the incident better managed. GPS, heart rate, breathing rate, and blood pressure were the crucial values to measure and report. However, development should not come at the price of complicating the triage process.

Fraunhofer FIT's key observation was that not all patients need all sensors. Those with minor wounds may need only a GPS sensor, while the critically injured may need many others. We designed a triage concept—*eTriage*—that combines presently-available technologies in new ways to unobtrusively augment the triage process.

The triage concept from Fraunhofer FIT puts a "triage bracelet" at its center. The bracelet connects to the MESH network and serves as network access point for all other sensors on the victim. The sensors are tagged by RFID and the RFID reader in the bracelet is used to "pair" the sensor and the bracelet by touching them for a split second. In countries where ID cards have an RFID/NFC chip, the triager can simply touch the victim's ID to the bracelet to identify the victim.

The GPS sensor in the bracelet detects position. All sensor measurements are logged to flash. The bracelet's color can be changed electronically for retriage. The bracelet is barcoded and its back has peelable barcodes or RFID tags for tagging personal belongings, to interoperate with current hospital procedures. The flex sensor detects when the bracelet is opened or closed, i.e. when a victim attempts to exchange the bracelet for a higher priority one. To minimize network traffic, sensor values are reported only when they change.

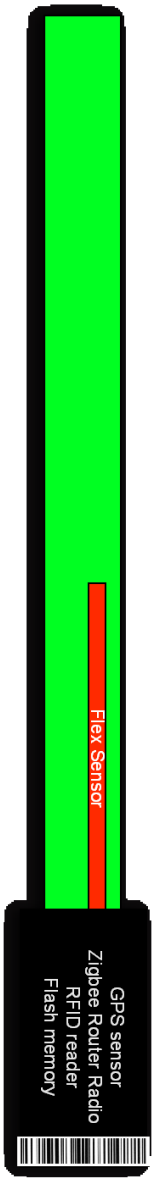
Data provided by the bracelets is visualized for incident commanders or ambulance staff via an app on the Triage Tablet device (a smartphone). The app shows live vital parameters and an overview of the emergency site.

In the *Map View*, the app shows the location and severity of triaged patients on a map relative to the medic's own location. The map rotates automatically to align to the medic's line of sight. It is available in satellite view, which helps orientation by landmarks, and in map view, which shows only streets and prevents distracting detail.

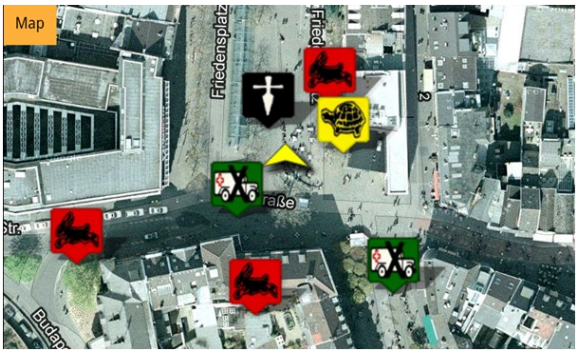
The *Augmented Reality* view allows the medic to "see through barriers" the location and category of the triaged patient, as an overlay over the device's camera image. In all views a tap on the screen brings up the ID and vital parameters of the victim, allowing a medic to remotely get a quick overview of the patient data.

When a victim is first triaged, the bracelet's GPS and clock are automatically initialized with values from the Triage Tablet GPS and clock. This shortens the initialization time of the bracelet's own GPS and allows the bracelet to timestamp events correctly from the beginning.

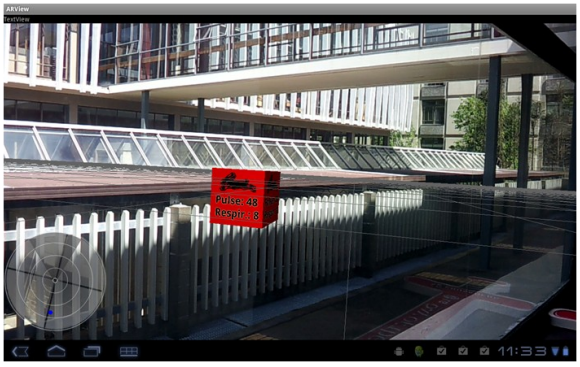
The current prototype reports the victim's ID number and triage category, GPS coordinates, and pulse values. It can detect removal of pulse sensor and opening/closing of bracelet (to detect exchanges of bracelets by victims themselves).



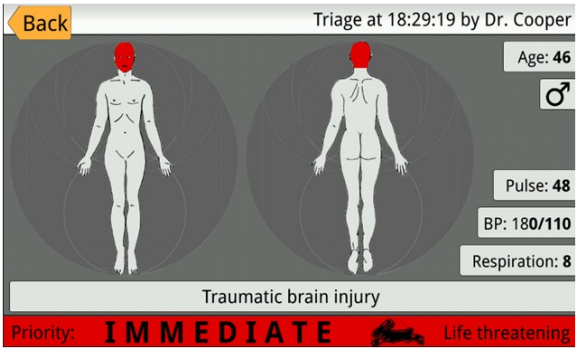
Triage Bracelet.



Map View.



Augmented Reality View.



Patient Data.

BRIDGE Co-Design User Workshops

The goal of the human-centred design approach is to ensure that the development, acquisition, and operation of an interactive system take the needs of the user into account. Complementary to the End-User Advisory Board, workshops with first responders provide a bottom-up perspective and practitioner's view to the BRIDGE project, in which their needs, desires, and current challenges are given extensive attention during the design process.

The overall goal of WP2 is to develop, facilitate, and document a user-driven innovation approach that folds ongoing domain analysis into the design and innovation process across the project. The workshops with domain experts are thus central in BRIDGE both for acquiring a deep understanding of the emergency response domain, and for involving those experts directly in the design process.

First Co-Design Workshop Oslo, Norway

The first in a series of three such workshops took place in SINTEF's premises

in Oslo, Norway, on the 29th of September 2011. The main focus was to explore and understand the complex practices of intra- and interagency collaboration during large-scale emergency response. Headed by Jan Håvard Skjetne, SINTEF, the workshop was planned and organized by participants from WP02 (domain analysis) and WP06 (interaction design), gathering 10 practitioners from Norwegian emergency response organizations: Fire and Rescue Services (Oslo and Bergen), Oslo Police district, Norwegian Police University College, the Western Norway Regional Health Authority, Stavanger University Hospital, Oslo University Hospital, Trondheim University Hospital, and Trondheim Municipality. The workshop covered several topics, including interagency collaboration, distributed situation awareness and decision making practices, risk assessment and engagement of experts, and media and the public.

Group work was the default method of information gathering. The experts were divided into three groups, each of which included representatives from each agency. Each group also had a facilitator, whose main responsibility was to assign the exercises, clarify any methodological issue, and keep track of time. Audio and video recordings were done by a technician, and a secretary supported the data collection process by taking notes and pictures.

Each group then participated in three consecutive workshop sessions (described in more detail below): (1) a domain analysis session focusing on current intra- and interagency work practices and challenges during large-scale emergencies; (2) a bluesky session in which the end users imagined and described future tools for tackling today's challenges – which, through comparison with those imagined tools, would also provide a test of the perceived usefulness of the BRIDGE concepts and prototypes; (3) a co-design session involving end users in an early phase of BRIDGE design, carried out using paper prototypes and basic artefacts. Short plenary sessions introduced and summarized each session.

Domain Analysis Session

This session was conducted by posing trigger questions about current work practices during large-scale emergencies. Of the list of questions that was generated before the workshop, the most important ones were posed to all of the groups, while the rest were distributed among them. The goal was to gather a broad range of information in a limited time, but still delve in depth into the main issues.

Four trigger questions were considered to be of major importance, and so they were the first questions posed to each of the three groups:

- How do you set up the emergency organisations on-site?
- Which roles and responsibilities can be identified?
- How do you obtain an understanding of the unfolding emergency situation?
- How do you maintain such an understanding?

The remaining questions on the list were distributed among the groups. They addressed communication issues, the decision making process, resource management, risk analysis, and interaction with bystanders, media, and experts.

Bluesky Session

This session was used to elicit thoughts and ideas about future tools. In our experience, experts sometimes constrain themselves during brainstorming, limiting their imagined solutions to what they consider to be realistic in today's world. For example, they tend to consider future solutions only in terms of their current workflow, and when asked to describe what they need and what could help them in their work, they tend to think only in terms of what is technologically familiar or currently possible, or within a given budget. So, a plenary warm-up session was held to get people "in the mood", encouraging them to think beyond current practices, technological constraints, and budgets – e.g., "Imagine that anything is possible. What would be useful in your work?"

Thinking beyond current practices: "Imagine that anything is possible!"

Co-Design Session

Getting proper input and feedback from domain experts during a design process is challenging. In BRIDGE, several ideas, concepts, and early prototypes were available at the time the user workshop was arranged. The following subset of early prototypes was chosen for the co-design session:

Master – a map-based tool for the incident command post, providing a detailed map and support for indicating scene of incident, overview of resources, etc;

RescueMe – a mobile phone app for victims trapped during an emergency, utilizing ad-hoc network connectivity to communicate with first responders during rescue;

Resource Manager – functionality embedded in the Master to manage resources and tasks during incident command;

Information Aggregator – a filtered view of rich material (pictures, video, etc.) collected from bystanders, including social media that could contribute to situation awareness needed in the incident command post or the command central;

eTriage – a tool for paramedics to support the triage process (sorting and prioritization of victims according to their injuries);

Risk Analyzer – functionality embedded in the Master for supporting risk analysis during incident command.

Paper-based prototypes are advantageous in a co-design session because they are quick to make, they show UI structure without distracting details, and most importantly – they invite *change*. In other words, they support exploration rather than demonstration, helping experts to make their unarticulated knowledge explicit.

From Domain Knowledge to System Design

A key task running parallel to the end user workshops is the translation of the information gathered into design and relevant requirements and specifications for BRIDGE. Work is in progress to analyse and categorise domain data, and to disseminate the results from the user workshops.

Second Co-Design Workshop Delft, The Netherlands

The workshop in Delft, held on December 6, 2011, replicated the structure of the Oslo workshop, working intensively with experts from RESPOND BV (leading provider of incident information management solutions in The Netherlands) and RIVM (RijksInstituut voor Volksgezondheid en Milieu, National Insititute for Health).

Themes and questions that were discussed included the current innovations in the emergency management domain and how they come (or do not come) to markets, networks and processes of collaboration, social and economic barriers to innovation, emergency planning and the processes of writing these plans, information flows, communication errors, information overload, practices of filtering information, the complexity of crises.

As in the Oslo workshop, discussions resonated with and challenged BRIDGE visions and prototypes. On citizen participation, for example, one of the participants expressed his support of Public Initiative and noted with regret that in western countries too much is left to specialists, whereas in some other parts of the world people help each other more.

> "IN WESTERN COUNTRIES CITIZENS LEAVE TOO MUCH TO THE SPECIALISTS. I WOULD LIKE TO SUPPORT PUBLIC INIITIATIVE. IN OTHER COUNTRIES PEOPLE HELP EACH OTHER."
>
> JAN OTTEN, RESPOND BV

This was followed by detailed discussions focused around the BRIDGE system components – *Master*, *Risk Analyzer*, *e-Triage*, *RescueMe App*, and *Resource Manager*. Given the background of the workshop participants, particularly useful insights were gained into competing, complementary and related technologies.

Third Co-Design Workshop Lancaster, UK

The third BRIDGE co-design user workshop was held in Lancaster University's *Imagination Lab* on April 16, 2012. Organized by Lisa Wood (Lancaster University) together with WP02, WP12 and the concept case owners, the workshop attracted 13 professionals from UK emergency response organisations, including Hertfordshire Police, Cumbria Police, Lancaster City Council, Cumbria Fire and Rescue Service, Lancashire Fire and Rescue Service, Cork City Fire Brigade, North West Ambulance Service, Langdale and Ambleside Mountain Rescue, and Emergency Planning College.

The workshop was split into two parts, starting with a 'sandbox' exercise where professionals described their role in past incident response efforts such as a Nuclear Power Plant incident exercise (Heysham Reactors), the Greyrigg train crash (Cumbria), a rapid river rescue during heavy flooding, the threat of a burst damn, and a factory fire. During the second half of the day, the professionals enacted and discussed multi-agency response work using prototypes of the BRIDGE *Master, Risk Analyzer, Resource Manager, RescueMe App, 3D Modelling, the Training Concept Case*, in collaboration with BRIDGE designers and domain analysts. A plenary session concluded the workshop, although discussions are continued in the BRIDGE Social Media Network. A host of insights were gained, which will be reflected in the future work of the project consortium.

BRIDGE Scientific Results

Security Management and Society
16-17 May 2012

Friedrich Steinhäusler (University of Salzburg) presented a paper at the Security Management and Society Conference held in Brno, Czech Republic. Talking about modern crisis management tools, he described several EU and US concepts, including those under development in the BRIDGE project.

4th iNTeg-Risk Conference
6-8 May 2012

Maximilian Wietek (VSH Hagerbach Test Gallery) presented BRIDGE at the 4th iNTeg-Risk Conference, which took place in Stuttgart, Germany. In his presentation, Max described the preliminary results of the first underground car test explosions conducted in the VSH tunnel complex and their corroboration with the 3D computer simulations by the University of Salzburg.

ISCRAM 2012
22-25 April 2012

Monika Büscher (Lancaster University) and Amro Al-Akkad (Fraunhofer FIT) attended the 9th International Conference on Information Systems for Crisis Response and Management (ISCRAM) in Vancouver, Canada. Monika presented a paper on microblogging during the 2011 terror attacks in Norway, starting a discussion around the design concept of *agile response*. Amro presented a short paper regarding a survey towards ICT-supported public participation in crisis situations. He also participated in the PhD colloquium and presented a poster describing the design process behind the RescueMe concept

SWDM 2012
17 April 2012

Daniela Pohl (Klagenfurt University) presented a paper at the First International Workshop on Social Web for Disaster Management (SWDM), which was held in Lyon, France, within the annual international World Wide Web Conference (WWW 2012). Daniela's paper investigated the application of multimedia metadata in identifying the set of sub-events related to an emergency situation.

ISCM 2012
29 March 2012

Friedrich Steinhäusler (University of Salzburg) presented the BRIDGE project and its developments at the 2nd International Symposium on Crisis Management (ISCM) held in London, UK. Organised by the University of Greenwich, the symposium was linked to the final review of the EU FP7 Pandora project.

ISTSS 2012
14-16 March 2012

Maximilian Wietek (VSH Hagerbach Test Gallery) discussed the validation aspect of the BRIDGE project at the 5th International Symposium on Tunnel Safety and Security (ISTSS), which was held in New York, USA. In his presentation, Max talked about the power of simulation and the need for experimental validation.

Dealing with the Disasters of Others
26-28 January 2012

The Center for Interdisciplinary Research (ZiF) at Bielefeld University, Germany, organized a closing conference *Dealing with the Disasters of Others*. Within the context of this conference, BRIDGErs Monika Büscher, Lisa Wood and Sung-Yueh Perng (Lancaster University) presented a paper entitled *Altruistic, Augmented, Agile: Public Crisis Response*. The paper discussed how those in the periphery of a disaster – watching it unfold via social and traditional media – can help mobilise resources, using the example of the bombing and shooting in Norway on 22 July 2011.

18th ACM Conference
17-21 October 2011

Atle Refsdal (SINTEF) attended the 18th ACM Conference on Computer and Communications Security in Chicago, USA, and gave a three-hour tutorial on risk analysis. One hour was dedicated to presenting the BRIDGE project and the emergency risk analysis support envisioned for BRIDGE.

Informatik 2011
4-7 October 2011

René Reiners (Fraunhofer FIT) presented a paper at Informatik 2011 — Workshop on Enterprise Services Computing and Communities, held in Berlin, Germany. The paper described new pattern language concepts for designing UbiComp applications connecting to cloud services.

PATTERNS 2011
25-30 September 2011

René Reiners (Fraunhofer FIT), presented a paper on new pattern language concepts in Rome, Italy, at PATTERNS 2011 — the Third International Conference on Pervasive Patterns and Applications. The full title of the paper, co-authored with Irina Astrova and Alfred Zimmermann, is *Introducing New Pattern Language Concepts and an Extended Pattern Structure for Ubiquitous Computing Application Design Support*.

Save the date!

BRIDGE is co-organizing AMI for Crisis Management workshop, which will be held in conjunction with the International Joint Conference on Ambient Intelligence (AMI2012) in Pisa, Italy, on 13 November 2012. The workshop will bring together researchers and practitioners working on the application of AmI for crisis management.

You can find more on these project results at: http://www.bridgeproject.eu/en/bridge-results/publications.

BRIDGE at a Glance

BRIDGE will build a system to support interoperability — both technical and social — in large-scale emergency management. The system will serve as a bridge between multiple First Responder organisations in Europe, contributing to an effective and efficient response to natural catastrophes, technological disasters, and large-scale terrorist attacks.

"The project will look in particular at how cooperation among different agencies and organisations can be made more efficient at national and transnational level."

EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

The vision of the BRIDGE project is to:

- Facilitate cross-border and cross-agency collaboration
- Allow the creation of a common, comprehensive, and reliable operational picture of the incident site
- Enable integration of resources and technologies into workflow management
- Enable active ad-hoc participation of third parties

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The BRIDGE consortium consists of a well-balanced mix of cross-disciplinary academics, technology developers, domain experts and end-user representatives:

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- Almende B.V., The Netherlands
- CNet Svenska AB, Sweden
- The Fraunhofer Institute for Applied Information Technology FIT, Germany
- Lancaster University, UK
- Crisis Training AS, Norway
- SAAB Training Systems, Sweden
- Thales Nederland B.V., The Netherlands
- Alpen-Adria University of Klagenfurt, Austria
- Paris-Lodron University of Salzburg, Austria
- VSH Hagerbach Test Gallery LTD, Switzerland
- Technical University of Delft, The Netherlands
- Stockholm University, Sweden
- Helse Stavanger HF, Norway

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Newsletter designed by Lyudmila Zaitseva

BRIDGE Newsletter

ISSUE 1 — DECEMBER 2011

BRIDGE is a collaborative project funded by the European Commission within the 7th Framework Programme (Call FP7-SEC-2010-1, Work Programme Topic 4.2-1: Interoperability of data systems, tools and equipment, Grant Agreement no. 261817)

In this issue:

Editorial

Dear Reader!

I am proud to welcome you to the BRIDGE research project, which is a major effort in *interoperability*. The main goal of BRIDGE is to increase safety of European citizens by developing technical and organisational solutions that significantly improve crisis and emergency management.

To understand why BRIDGE is important, it suffice to consider the potential nightmare scenario caused by an accident or an assault on a chemical facility located close to the Franco-German border. This is a densely populated area with major communication infrastructure, so the potential impact can be severe. It will be an immense challenge for the first responders, i.e., the industrial safety brigade, the fire fighters, the police, and the ambulance personnel from both sides of the border. Furthermore, various government levels are involved with deciding and organising potential evacuation of the people living in the area, including hospitals, schools, kindergartens and retirement homes. The challenge is worsened by the fact that the first responders work with different equipment, operate under different procedures, speak different languages, and come from different cultures. Still, in a split second critical decisions about life and death must be made.

> ***"Research and development projects concerning emergency services are urgently needed, and the EU has met this challenge by financing BRIDGE (Bridging resources and agencies in large-scale emergency management)."***
>
> EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

In this first issue of the newsletter you will get a glimpse into the work we have done in the first eight months of the project. We will regularly issue newsletters like this over the four years of the project, and hope that by following our progress you will be able to better understand how complex emergency responses, like the one in the scenario above, can be handled in the future.

Geir Horn, SINTEF
Project Coordinator

BRIDGE Kick-off Meeting, Finse, Norway, 14-15 April 2011.

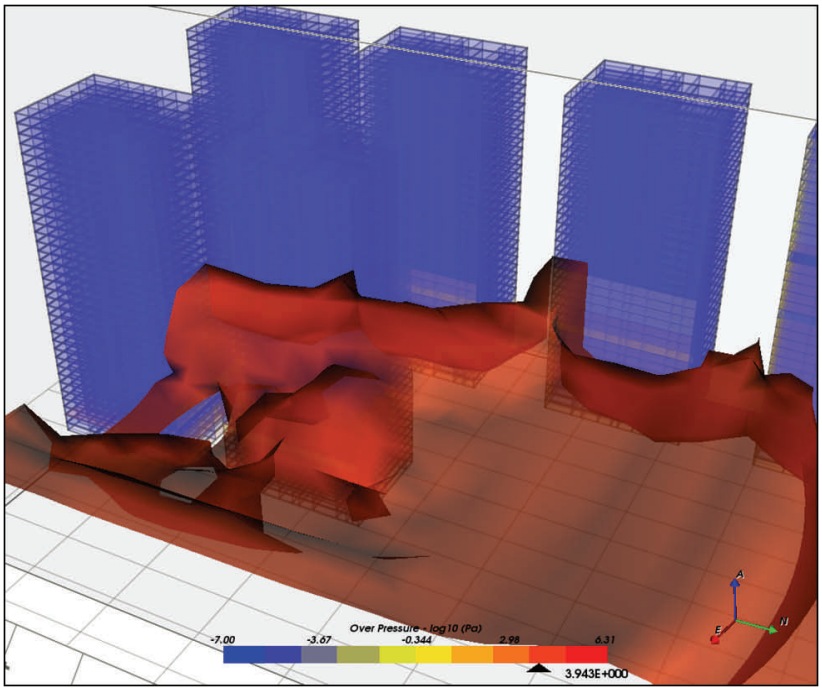
Reality-Based Modelling of Catastrophes

Our daily news show clearly that catastrophes can occur anywhere at any given time, be it an industrial accident, a natural disaster, or an intentional act of crime or terror. Any such high-consequence event exceeds, or threatens to exceed, the response capability of the local emergency services: (a) Number of victims is too high to be assisted in a timely manner; (b) Critical infrastructure is damaged to such an extent that emergency services can no longer provide sufficient protection of the system still functioning; (c) Societal infrastructure seizes to exist and results in wide spread social unrest and lawlessness.

BRIDGE Work Package 3 uses reality-based modelling to help first responders prepare for such catastrophes by developing:

- Tools for generation of a computer-based 3D graphics model, based on the available information about targeted critical infrastructure;
- Tools for generation of 3D simulations based on threat scenarios developed by BRIDGE, using models of critical infrastructure;
- Software components for running 3D simulations in real time during training and in case of an actual emergency;
- Software components for deploying 3D simulations to relevant parties using ad-hoc network and technology.

Different views of the virtual chemical facility CHEMCO.



Truck bomb attack in a hypothetical financial district resulting in the complete destruction of the tower above and hundreds of additional victims in the surrounding buildings and on the streets.

3D-modelling of *generic* critical infrastructure (CI) components is essential in crisis management, since the destruction or disruption of infrastructures providing key services could entail the loss of lives, the loss of property, and a collapse of public confidence and moral in the EU (figure left).

BRIDGE foresees: (a) Provision of *generic* 3D-model of a virtual chemical facility; (b) Development of a detailed threat scenario, assuming uncontrolled release of hazardous material (accidental and malicious); (c) Modelling of threat impact on selected reality -based CI facilities; (d) Modelling of the impact on staff and public for selected CI facilities; (e) Modelling of the catastrophic impact on environment for selected CI facilities. Subsequently, the results of the 3D-modelling are imported and rendered using COLLADA software. The figures above show an example of reality-based 3D-modelling of a virtual chemical facility.

BRIDGE System

The BRIDGE system consists of individual modular components, which are used to support coordinated multi-agency response efforts. The vision of the possible technical outcomes of the project is reflected in prototypes described below, which will be developed during the project implementation.

The BRIDGE system aims for practically applicable, optimal solutions for first responders beyond the state-of-the-art and is designed upon the following principles for effective response and recovery in emergency response: *Anticipation, Preparedness, Subsidiarity, Direction, Information, Integration, Cooperation, Continuity, Transparency, Flexibility, Correctness, Security, Traceability, Mixed Intelligence, Coherence, Graceful Augmentation* and *Degradation, Versatility and Scalability.*

The BRIDGE System has different components, arranged in categories according to their role: front ends or applications; back-office and configuration tools; and networking tools. This logical architecture, describing a service or unit of logical functionality of the system, identifies the elements of the system that have contact with the users and the elements of the system that support its functionality, such as information repositories and configuration tools. The logical structure is organized in components.

> *"BRIDGE will examine how we can obtain and use information as disasters develop, in order to give us a better joint understanding of the situation and thus enable us to make better decisions more rapidly."*
>
> EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

BRIDGE Tools

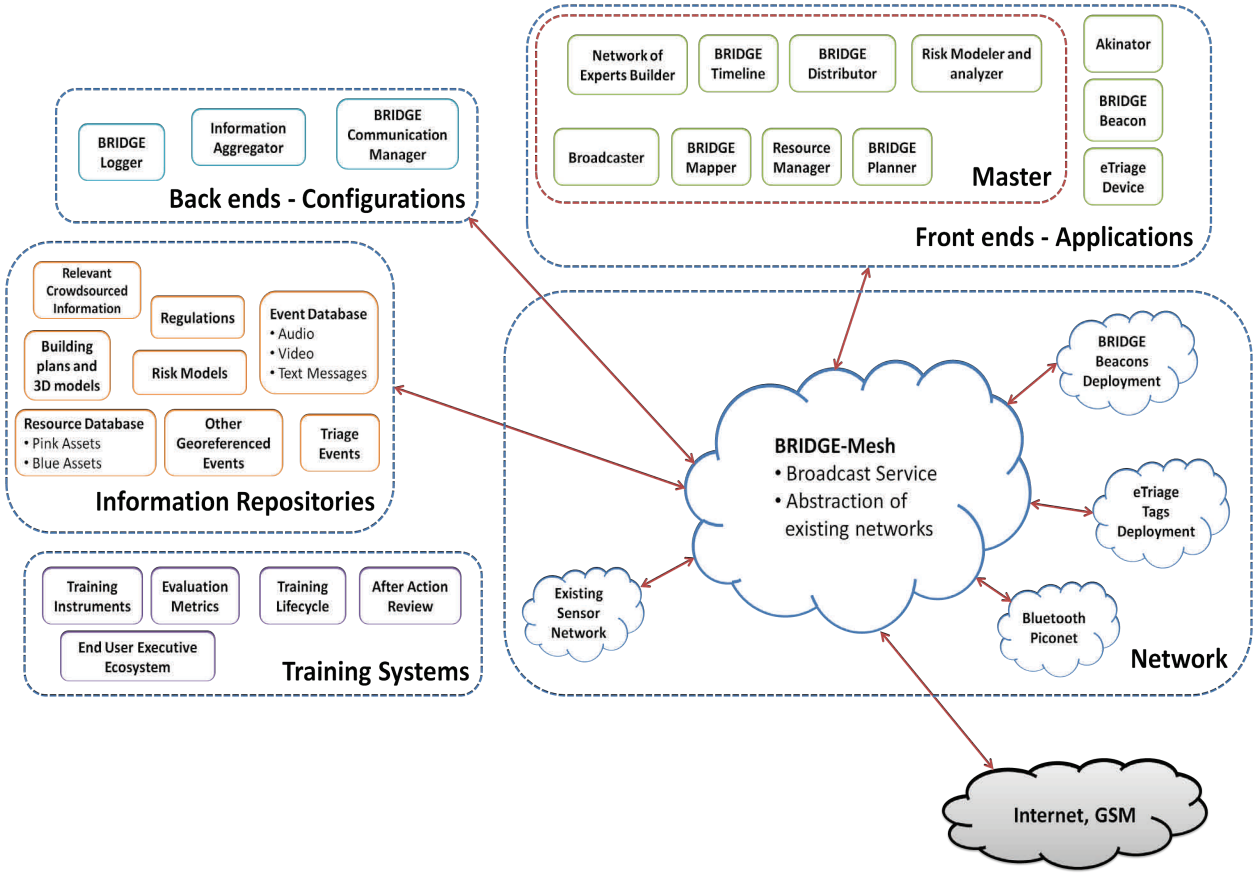
BRIDGE Mesh is a dynamically adaptable, mobile, interoperable network. It does not require the need of an infrastructure, i.e., users themselves may extend the area of coverage.

BRIDGE Master: is an application that allows the composition of several services or functionalities of the system, based on the role of the user. The following modules can be used as part of the Master System:

BRIDGE Mapper displays all data being logged and offering responders an interactive map of the incident site.

BRIDGE Resource Manager enables efficient, collaborative location and allocation of available assets in multi-agency emergency responses.

BRIDGE Planner is a command tool for planning and coordinating per-



BRIDGE System.

sonnel tasks and responsibilities within and between response agencies.

BRIDGE Broadcaster connects to any available output medium within a defined area and displays the message of the media officer.

BRIDGE Distributor lets command post personnel distribute relevant information to specified mobile units. It will not be a standalone tool, but rather will integrate with other modules, such as the Locator, Timeline, and Plan and Execute.

*BRIDGE Expert Network Buil*der enables the team members to dynamically establish networks of experts that are centered on specific topics and relevant to the management of the emergency situation.

BRIDGE Risk Modeller is a computerized tool that provides support for risk analysis concerning potential follow-on risks. It supports identification and anticipation of relevant risks, projection of their unfolding and cascading consequences, as well as assessment of risk levels in terms of likelihood and consequence.

BRIDGE Timeline helps users build and maintain the temporal aspects of their situation awareness. Just as interactive graphical map displays support spatial understanding of an unfolding situation, an interactive graphical timeline display will support temporal understanding.

BRIDGE foresees additional collaborating systems, such as: *BRIDGE Akinator* (mobile application to allow communication among command post, staff on site, victims and bystanders to provide information based on bandwidth; *BRIDGE eTriage System* (tagging victims and environmental features with RFID tags that store timestamps for direct use in the command post); *BRIDGE Beacons* (markers that emergency responders deploy in the environment during an intervention).

BRIDGE also addresses Back-Office and configuration, i.e., *BRIDGE Logger* (records every event registered along the whole the system); *BRIDGE Information Aggregator* (combines incoming text/audio/image/video situation reports from the field and prepares them to be displayed in the BRIDGE Mapper); *Bridge Communication Manager* (allows managing the network and supporting the construction of communication infrastructure).

> ***"The subject of the EU's BRIDGE project is transnational and interagency cooperation in the event of terror attacks, natural disasters and industrial accidents. ... Climate change and developments in society mean that we must be prepared for major disasters in Norway and elsewhere in the world. The recent terror attacks in Oslo and on the island of Utøya have shown that both individuals and society and a whole must be prepared for the unthinkable."***
>
> EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

Domain Analysis

The work in WP2—Domain Analysis—in the first phase of the project has focused on several aspects. One of these aspects is the establishing of the required collaboration infrastructure. This work will result in the production of several collaboration tools such as a multimedia server, a requirement management system and others, together with documentation containing methods, strategies and workflows to support collaborative design efforts in the whole project.

The second aspect in WP2 is fieldwork. In collaboration with WP12, several accounts of crisis management in action were collected and made available to the project. Interviews with relevant stakeholders in Norway and England were conducted. A video analysis workshop centered on a large emergency response exercise conducted in Norway was organized by WP2. All this work is oriented towards the production of a corpus of data that will inform the production of domain analysis deliverables.

Finally, an important aspect in the work of WP2 has been to catalyze the combination of empirical studies and technical design. The work package has collected technical visions from all the other WPs to create a unified vision of a BRIDGE system, accompanied with a scenario that provides a context to understand the system. This vision will help technical partners in defining the architecture of the different elements and the requirements of the platform along the whole duration of the project.

BRIDGE Domain Analysis experts at work.

BRIDGE Mesh Network

The network communication backbone of BRIDGE is developed by Work Package 5. The primary output of this work package is the BRIDGE Mesh, which lays the foundations for the technical work in the other work packages. Its purpose is to provide a stable network infrastructure and interoperability platform for various network nodes.

Due to the extreme conditions of crisis and catastrophe situations, the BRIDGE Mesh is supposed to operate in harsh, and highly dynamic unreliable scenarios. The breakdown of single network nodes and whole sub-networks cannot only not be precluded but is to be expected. One objective of this WP is to develop network infrastructures that can deal with these issues and adapt to dramatically changing environmental conditions. Furthermore, these conditions lead to the requirement of seamless integration of various heterogeneous devices. This is the second purpose the BRIDGE Mesh has to fulfill.

A typical scenario for the BRIDGE Mesh is: in a disaster site, a node (a trapped victim's cell phone device) could be able to discover via WiFi an access point equipped in a first responders' vehicle and transmit the whole data collected inside the BRIDE Mesh network. In turn, the first responder acts as a gateway to the outside world forwarding via 3G/GSM all the received data inside the overall BRIDGE system.

The BRIDGE Mesh is a dynamically adaptable, mobile network being interoperable. The Mesh network does not require the need of an infrastructure, i.e., users themselves may extend the area of coverage. The BRIDGE Mesh architecture is robust in the sense that it is able to deal with various technologies. Additionally, the mesh architecture is resilient to temporarily unavailable nodes by following alternate paths. Some of the nodes inside the mesh will act as gateway nodes that have additional, external network connections, e.g., to the Internet, or GSM network.

The BRIDGE Mesh will provide the infrastructure to broadcast information to any node or group of nodes inside of the network. The mesh will be able to handle several incidents simultaneously and will provide the ability to handle heterogeneous environments with minimum interdependencies.

> ***"BRIDGE aims to develop technology for improving communication and coordinated actions so that emergency leaders and agencies (police, fire and health services) will be better able to save lives and limit the extent of damage by means of the appropriate tools and equipment."***
>
> EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

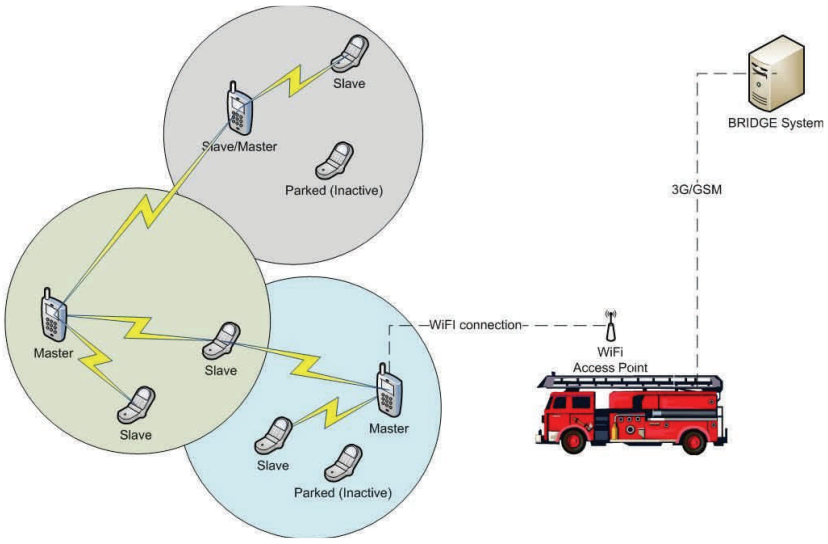
Several middlewares that different partners of the BRIDGE consortium bring into the project will be integrated to form the BRIDGE Mesh:

LinkSmart – the distinguished open source middleware for networking heterogeneous embedded devices that resulted from the Hydra EU project of the Sixth Framework Programme. It enables different kinds of devices to communicate over various networks.

AgentScape – a well-known Java-based open source middleware for agents, i.e., autonomous computer programs which observe and act upon an environment and direct their activity towards achieving goals. Aimed at providing low-level support for distributed agent applications, agents can move between physical and virtual locations.

CHAP – an agent development platform that provides a conceptual framework for multi-agent systems, based on the agent design pattern LiNeMeMo (Links - Nets – Memo – Motor). CHAP includes a software development kit for multi-agent systems, a library of for agent-based algorithms, and a middleware platform targeting various multi-agent problems.

WISE – a framework originating from the military domain that provides information-centric connectivity regardless of protocols, standards and architectures. It allows digital signing of drives to assure information security.



BRIDGE Mesh Network.

BRIDGE Social, Legal and Ethical Issues

BRIDGE pays particular attention to social, legal and ethical issues. This entails the analysis of fundamental aspects of the work of emergency response professionals, resulting in a "Manifesto" called *Towards a System Architecture Use Case*. Key insights from this manifesto are entered into an *architectural qualities* database and then, at least in part, folded into the *BRIDGE System* scenario. BRIDGE social, ethical and legal experts of WP12 also address *Privacy Protection and Legal Risk Analysis*. Furthermore, they analyse twitter communication associated with the urban riots (e.g., London 2011) and terror attacks (e.g., Oslo 2011) and organise collaborative design user workshops. This group of experts also collects and analyses international disaster reports, including over 50 publications that discuss privacy issues. Besides, they have created bibliographies on specific social, legal and ethical issues on Mendeley.

> ***"In addition to technological research and development, the project will examine European laws and regulations and how these affect cooperation and the management of major disasters across agencies and antional boundaries. Ethical and social aspects of the use of technology will also be central topics of the project."***
>
> EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

First End-User Advisory Board Meeting

Salzburg, Austria, 26-27 June 2011

In order to guarantee active end-user participation during the whole project, BRIDGE established an advisory board of end-users from national and regional emergency management organizations and industry representatives.

> **"EXTREME SITUATIONS REQUIRE INNOVATIVE SOLUTIONS, PAIRED WITH EXTENSIVE STANDARDIZED TRAINING ON THESE NEW METHODS."**
> **J. SCHADWASSER AUSTRIAN FEDERAL POLICE**

The first meeting of the End-User Advisory Board (EUAB), held in Salzburg, Austria, 26-27 June 2011, brought together several European experts from first responder and civil defence organizations: Barbara Campbell (UK), Sindre Mellesmo (Norway), Svein Arne Hapnes (Norway), Johann Schadwasser (Austria), Christian Van De Voorde (Belgium), Heiko Werner (Germany) and Thomas Larsson (Sweden). The members of the Advisory Board, representing both emergency services and industry, were introduced to BRIDGE goals, objectives, and methodology and briefed about their expected role in the project. They shared their personal expectations for the project and provided feedback with regard to the main BRIDGE scenario (technological disaster at a chemical facility).

EUAB Meetings are held every six months. The next meeting is scheduled to take place at VSH, Flums, Switzerland.

> ***"In order to ensure that appropriate solutions emerge from the project, the emergency services will be involved in the development and evaluation of the solutions."***
>
> EU finances BRIDGE project to tackle major disasters, *News Medical*, 26 August 2011

First BRIDGE User Workshop

Oslo, Norway, 28-30 September 2011

Complementary to the EUAB meetings, BRIDGE User Workshops provide opportunities for collaboration and co-design with practitioners. Professional specialists dealing with operational issues of crisis management at different levels are invited to explore and explain key aspects of their work with BRIDGE analysts and designers. They identify problems and opportunities and evaluate BRIDGE prototypes in the context of real world work experience. The first in a series of such BRIDGE User Workshops took place in Oslo, Norway, 28-30 September 2011. It focused on inter-agency collaboration, ongoing situation awareness and decision making practices, risk assessment and engagement of experts, media and members of the public.

BRIDGE Dissemination Activities

Conferences and Symposia

BRIDGE at ISCM 2011
9-10 June 2011

The first official presentation of BRIDGE to an international audience took place at the Intenational Symposium on Crisis Management (ISCM) 2011, which was held at Vouliagmeni of Athens, Greece, on 9-10 June 2011. The leader of the dissemination work package, Fritz Steinhäusler (University of Salzburg), presented the aims, methodology, and expected results of the BRIDGE project to a large group of European experts in crisis management. The meeting was organised by a multidisciplinary research consortium of EU FP-7 Project "Learning for Security - L4S".

BRIDGE at CBRNEmap
8 September 2011

Project Coordinator Geir Horn (SINTEF) presented BRIDGE at the CBRNEmap Final Conference on 8 September 2011 in Brussels, Belgium. The main purpose of the conference was to provide its audience with the overview on the work implemented within the framework of the EU-FP7 project CBRNEmap and its main contribution to the next step of the European Commission Security Research Programme.

BRIDGE at SRC 2011
19-21 September 2011

BRIDGE was one of the few projects selected for a poster presentation at the Security Research Conference (SRC) 2011 — the largest European conference on research for security, which was held on 19-21 September 2011 in Warsaw, Poland. The BRIDGE poster — displayed in the conference hall — raised a lot of attention among the conference participants.

BRIDGE at ECSCW 2011
24-28 September 2011

A one-day specialized workshop *Collective Intelligence in Crisis Situations* was conducted within the framework of the European Computer Supported Collaborative Work (ECSCW) Conference, which took place in Aarhus, Denmark, 24-28 September 2011. Organised by Monika Büscher (Lancaster University) and supported by BRIDGE, this workshop discussed how members of the public and professionals in emergency response currently use social media to collaborate in crises. The workshop participants took examples of collaborative work and collective intelligence in disasters and 'creeping' crises such as climate change to explore opportunities and challenges for innovation. Two BRIDGE-related contributions were made at this workshop by the project consortium partners.

Workshops

New Social Media and Crisis Workshop
27 April 2011

New Social Media and Crisis workshop, organised by Center for Interdisciplinary Research (ZiF, Bielefeld University, Germany) in April 2011, discussed how members of the public and professionals in emergency response currently use social media (Facebook, Twitter) in crises. This one day workshop focuses on one particular phenomenon of social media use in crises: 'collective intelligence'. The workshop was built on work undertaken in the BRIDGE project by Monika Büscher (Lancaster University), who was also a co-organiser of the event.

Exercises

Major Sea Disaster Exercise SkagEx11
6-8 September 2011

A large exercise — SkagEx11 — was conducted on 6-8 September 2011 in the Skagerrak basin, Norway. The main goal of the exercise was to test the ability of the neighbouring Norway, Sweden, Denmark and Finland to handle major disasters at sea. Morten Wenstad of Crisis Training (CTAS)— one

of the BRIDGE partners — observed the exercise to gain a better understanding on how the different organizations in the participating countries would collaborate in a major disaster and how they would organize their National Emergency Management.

Oil Spill Exercise BOILEX
27-29 September 2011

Two members of the BRIDGE consortium — Stiftelsen SINTEF and Crisis Training AS — were among the observers of another exercise, BOILEX, focusing on collaboration, coordination and communication mechanisms at the tactical level. This oil spill exercise conducted by the Swedish rescue services between 27 and 29 September 2011 in Nynäshamn, Sweden, was part of the EnSaCo project — Environmental and Safety Management on Shoreline Oil Spill Response.

BRIDGE in the Press

From the very start, BRIDGE has enjoyed a good press coverage in many of the participating countries. Many articles in English, German, Norwegian, Swedish, and Dutch can be found in the Press Room of the BRIDGE website .

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- Almende B.V. (ALMENDE), NL
- CNet Svenska AB (CNET), SE
- The Fraunhofer Institute for Applied Information Technology FIT (Fraunhofer FIT), DE (**Technical Coordinator**)
- Lancaster University (ULANCS), UK
- Crisis Training AS (CTAS), NO
- SAAB Training Systems (SAAB), SE
- Thales Nederland B.V. (THALES NL), NL
- Alpen-Adria University of Klagenfurt (UNIKLU), AT
- Paris-Lodron University of Salzburg (PLUS), AT
- VSH Hagerbach Test Gallery LTD (VSH), CH
- Technical University of Delft (TUDelft), NL
- Stockholm University (SU), SE
- Helse Stavanger HF (RAKOS), NO

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You can find more information about the project and subscribe to the newsletter at www.sec-bridge.eu

Newsletter designed by Lyudmila Zaitseva