



Resilience and Survivability for future networking: framework, mechanisms, and experimental evaluation



1st BIENNIAL PROJECT PERIODIC REPORT (SEPTEMBER 2008-FEBRUARY 2009)

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Editor:	M. Karaliopoulos, S. Hodel (ETHZ)
Contributors:	A. Fessi (TUM), M. Karaliopoulos (ETHZ), C. Lac (FT), M. Schöller (NEC), P. Smith (ULANC)
Reviewer:	M. Schöller (NEC)

Publishable summary

The work in the context of the ResumeNet project proposes a fundamentally new architectural approach to Internet resilience that is multilevel, systemic, and systematic. At the same time, we aim to maximize interoperability with legacy network components.

We define **resilience as the ability of the network to provide and maintain an acceptable level of service in the face of various faults and challenges to normal operation**. This service includes the ability for users and applications to access information when needed (e.g., Web browsing and sensor monitoring), the maintenance of end-to-end communication association (e.g., tele- and video conferences), and the operation of distributed processing and networked storage. Our definition of resilience is therefore a superset of commonly used definitions for survivability, dependability, and fault tolerance. The challenges that may impact normal operation include unintentional hardware/software misconfiguration or operational mistakes, large-scale natural disasters (e.g., hurricanes, earthquakes, ice storms, tsunamis, floods), malicious attacks from intelligent adversaries against the network hardware, software, or protocol infrastructure including DDoS (distributed denial of service) attacks, environmental challenges of mobility, weak channels, and unpredictably long delay, unusual but legitimate traffic load such as a flash crowds

We summarize our architectural approach as follows:

First, we develop a set of architectural principles on which resilient systems in general, and the Internet in particular, should be based. Examples of such principles are self-protection, redundancy, diversity, and resource tradeoffs.

Secondly, we characterize the challenges for the network operation to understand the threats against which the network must be resilient. The resilience aim can be generally achieved via a six-step strategy, which could be neatly described with the help of the castle analogy:

- Defense, according to which the Internet is made robust to challenges and attacks (analogy: strong castle wall);
- Detection of an adverse event or challenge that has impaired normal operation of the Internet and degraded services (analogy: guards on the castle wall);
- Remediation in which action is autonomously taken to continue operations as much as possible and to mitigate the damage (analogy: boiling oil and fortification of internal walls when the castle wall is breached by a trebuchet);
- Recovery to original normal operations once the adverse event has ended or the attacker has been repelled (analogy: cleaning up the oil and repairing the hole in the castle wall);
- Diagnosis of the root cause of the challenge that impaired normal operation. This could be used to improve the system design and effect the recovery to a better state (analogy: determine the way in which enemy soldiers entered the inner walls of the castle); and
- Refinement of future behavior based on reflections of the previous cycle (analogy: construction of a thicker wall that will defend against current and predicted trebuchet technology).

In ResumeNet, besides detailing and quantifying the aforementioned framework, the aim is to also look into particular mechanisms that can be viewed as its building blocks (monitoring, learning processes, decision engines). It is, in fact, the synthesis of these blocks that will enforce resilience to the various network layers and one of the questions pursued in the project is to what extent could their systematic definitions ease their reuse and result in scalable solutions.

Last, but not least, the project picks particular network-level and service provision scenarios for deepening into the mechanism-level analysis and carrying out their experimental evaluation. The

scenarios to be implemented on top of existing to-be-enhanced test beds are a well balanced mix of networking scenarios with both short-term and longer-term potential for commercial exploitation.

ResumeNet aims at having a broader socio-economic impact by contributing, though not to the same extent, to the following four points, as quoted from the FP7 ICT Work program for 2007-08 for the strategic objective ICT-2007.1.6:

- Strengthened European position in the development of the Future Internet.
- Wider take-up of technological developments in networks and service infrastructure facilitated by a comprehensive validation of the technological and service choices.
- Global consensus towards standards and strengthened international cooperation through interconnected test beds and interconnection capabilities offered to third countries.
- Higher confidence in the secure use of the Internet through test beds enabling trusted access to e-Services.

The emphasis on these first six months of the project has been on the development of the framework for embedding resilience in the future networks. In particular, the project work addressed the characterization of the challenges to the network operation and their impact (Task 1.2) as well as the development of metrics for assessing the resilience of network and services (Task 1.3). Both threads of work evolve in WP1, the first one having resulted in the deliverable 1.1, one of the first ones of the project.

Task 1.2 has been investigating how information security risk management approaches, such as OCTAVE [ResD1.1] can be applied in a resilience context to better understand the most probable challenges that will have the highest impact on the network. It is essential to understand these high-impact challenges, as the resources that are available for building resilience mechanisms are likely to be constrained, e.g., monetarily and computationally. Task 1.3, on the other hand, has been investigating metrics for resilience. TU Delft have been developing a framework for resilience that aims to derive metrics that can be used to evaluate the resilience of a network topology in relation to service requirements. This has resulted in three releases of a project-internal white paper that has fielded constructive comments from partners, which have influenced the research. Next steps will include determining how the work of TU Delft overlaps with other work in the resilience metrics task, for example, on the resilience state space work that is being carried out jointly by ULANC and KU.

Tasks 1.4 (on policies for resilience) and Task 1.5 (on cross-layering and multi-level approaches for resilience) were due to start at M6 of the project. There has been some preparatory work carried out on these tasks; research from the EU FP7 ANA project has been explored to determine its suitability for use in the project in relation to Task 1.5. Further discussions were made amongst the WP1 project partners regarding the output of Task 1.5. Further clarification of the outcome of these tasks and their relation to other WPs (WP2 and WP3) is a matter of on-going work.

While officially the work in WPs 2 and 3 starts only in M9 (May 2009), there has been significant effort to detail and adapt the work in these two WPs inline with the new inputs coming from the progress in WP1. A meeting dedicated to WP2 has been planned (and, by the time of writing this report, has actually taken place) for 18th March in Heidelberg with the aim to better detail the work in WP2 and the inputs/outputs of each task/subtask, given the progress of work so far in WP1. Outcome of the meeting will be the planning of work throughout the three month period till the next project PCC meeting, to take place in Lancaster, UK, 10-12 June.

Likewise, A WP3 kickoff meeting at the beginning of May 2009 is planned in order to clarify remaining open questions. Outcome of the meeting will be to better consolidate the research questions that will be addressed in WP3. WP leader from other WPs will be also present and contribute to the discussion.

Similar effort has been made in WP4 to specify the four envisaged experimentation case studies. This effort was partly motivated by the commitment of the project to support the activities of the FIREWorks project, which included the compilation of two light deliverables on the experimentation facilities and the links between research and experimentation in ResumeNet.

ResumeNet has early stated its intentions to devote significant resources to the dissemination of its results. For this first phase of activities (covering effectively the 1/6 of the project lifetime), we have focused our dissemination efforts in the following directions:

- The project's Web site and Wiki pages, initially due for M2, are operational since November 2008 (<http://www.resumenet.eu/>).
- ResumeNet has been presented, with the use of abstract, flyer, poster¹, or slides, in various venues such as the SAC/FIRE Workshop (Turin, Italy) on 05 March 2008, the Future of the Internet Event (Bled, Slovenia) on 02 April 2008, the IWQoS 2008 Conference (Twente, Netherlands) on 03 June 2008, the FIRE Launch Event (Paris, France) on 10 September 2008, the ICT 2008 event (Lyon, France) on 25-27 November 2008, and the IWSOS 2008 Workshop (Vienna, Austria) on 10-12 December 2008.
- A Dagstuhl Seminar on "Architecture and Design of the Future Internet" will be organized by Georg Carle, David Hutchison, Bernhard Plattner, and James P.G. Sterbenz on 14-17 April 2009, all partners of the ResumeNet project. This perspective workshop will gather researchers and practitioners whose interests are in the future direction of Internetworking, where resilience is an important aspect.
- Exchanges have also taken place with EU projects in the field of resilience, both in FP6's programme such as ReSIST NoE (<http://www.resist-noe.org/>), where contacts have started to ensure that ResumeNet actors and results will be included in the Resilience Knowledge Base, one of ReSIST's legacy, and Amber (<http://amber.dei.uc.pt/>), an FP7 CA coordinating the study of resilience measuring and benchmarking, where a ResumeNet member (Dr. Chidung Lac) is part of the Advisory Board. Similar interactions, less formal this time, are enabled with the FP6 IP ANA and the FP7 STREP ECODE thanks to common partners in those Consortia. With ANA, in particular, there will be a common workshop day on June 12th in Lancaster, UK, before the 2nd plenary meeting of the project, with the aim to identify what out of the ANA outcomes could be reused and benefit the work in ResumeNet.

Moreover, ResumeNet has been closely monitoring the activities of the Future Internet Assembly, FIREWorks and participating in the meetings of the FIRE Expert Group, been always keen to support standardization actions originating from these bodies federating the European industry sector.

Finally, considerable effort over these six months has been devoted to the set-up of adequate management tools and processes. "Well begun is half done"; therefore, the concern of the management team has been to put in place all those tools and processes that can ensure a smooth collaboration amongst partners but also their commitment to the project research plan. In this direction, the management has, on the one hand, applied best practices and, on the other hand, experimented with tools and processes that appear to help the project every day running.

¹ A second, and detailed, version of ResumeNet's poster is in preparation.



<http://www.resumenet.eu>

Contact details:

Prof. Dr. Bernhard Plattner

Project Coordinator

ETH Zurich

Computer Engineering and Networks Laboratory

Address: Gloriastrasse 35

CH-8092 Zurich

Switzerland Telephone: +41 44 632 7000

Fax: +41 44 632 1035

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1. Project objectives for the period

This is the first biannual project progress report covering the first six months of the project lifetime, namely the time period from 1 September 2008 until 28 February 2009. The document summarizes the progress of research work in the project, addresses project management issues, and reports on the use of project resources at partner level over these six months.

There were two main objectives during these first six months of the project lifetime:

- Research-related: the intention has been to develop as much as possible the different components of the resilience framework. Challenges and their impact assessment, metrics, policies, and cross-layer techniques, including monitoring, are the four main components of the proposed framework. Each one poses its own requirements to the network and service architecture and the mechanisms to be defined and studied in WP2 and WP3, and later to be evaluated in WP4, have to make sure that they serve them. Work on challenges and metrics is ongoing, whereas the treatment of policies and cross-layer has started in M7. Work has been carried out also in WP4 in response to the request of inputs from FIREworks.
- Management-related: “the beginning is half of the whole” if we believe Pythagoras, or, in its English version “Well begun is half done”. Therefore, the concern of the management team has been to put in place all those tools and processes that can ensure a smooth collaboration amongst partners but also their commitment to the project research plan. In this direction, the management has, on the one hand, applied best practices and, on the other hand, experimented with tools and processes that appear to help the project every day running.

In the following sections, we summarize the steps made in both directions during the reporting period.

2. Work progress and achievements during the period

2.1. WP1: Framework for resilient networking

Work in WP1 over these first six months of the project has proceeded mainly in the context of tasks 1.1, 1.2, and 1.3.

Task 1.1 is intended to guide the activities in the project regarding the resilience strategy, coordinating the interaction and exchange of information amongst its various activities. To this end, a brief document was disseminated to project partners in M4 that describes some of the learning outcomes from the currently running tasks in the project (specifically, Tasks 1.2 and 1.3). In this document, for example, we acknowledge the need to understand the *impact* of challenges and its associated *symptoms* so that appropriate remedies can be invoked. We suggest that some form of *instinctive* remediation can be invoked based upon the symptoms of a challenge occurrence, and that this can be done without understanding the root cause of a challenge. These findings and others will be compiled into D1.5a, which is due in M12. Furthermore, existing resources that are available from the ResiliNets project regarding the resilience framework have been used by partners to influence their research, for example on metrics.

Task 1.2 has been investigating how information security risk management approaches, such as OCTAVE [ResD1.1] can be applied in a resilience context to better understand the most probable challenges that will have the highest impact on the network. It is essential to understand these high-impact challenges, as the resources that are available for building resilience mechanisms are likely to be constrained, e.g., monetarily and computationally. Furthermore, understanding challenges in this way has some additional benefits: it should prove useful when considering which facets of a system to monitor in relation to its normal behaviour, which, as we argue, is necessary to understand when a system is challenged. Moreover, the selection of defensive and remediation mechanisms can be guided by this understanding and provides a sound basis for prioritizing remediation strategies for the assets of the system. There has been a meeting at the University of Passau to kick-start this task, in addition to discussions at the two PCC meetings, and a number of remote meetings (Phone Conferences). The outcome of this task is contained in deliverable D1.1, entitled "Understanding challenges and their impact on network resilience", which has been submitted to EC (ref. Table 1).

There has been strong progress on Task 1.3, which is investigating metrics for resilience. TU Delft has been developing a framework for resilience that aims to derive metrics that can be used to evaluate the resilience of a network topology in relation to service requirements. This has resulted in three releases of a project-internal white paper that has fielded constructive comments from partners, which have influenced the research. Work on the resilience framework in Task 1.3 is ongoing. Next steps will include determining how the work of TU Delft overlaps with other work in the resilience metrics task, for example, on the resilience state space work that is being carried out jointly by ULANC and KU.

Tasks 1.4 (on policies for resilience) and Task 1.5 (on cross-layering and multi-level approaches for resilience) were due to start at M6 of the project. There has been some preparatory work carried out on these tasks; research from the EU FP7 ANA project has been explored to determine its suitability for use in the project in relation to Task 1.5. Further discussions were made amongst the WP1 project partners regarding the output of Task 1.5. Further clarification of the outcome of these tasks and their relation to other WPs (WP2 and WP3) is a matter of ongoing work.

2.2. WP2: Network-level resilience

This Work Package officially starts in M9 (May 2009) only. Therefore, there is no progress to be reported from the tasks themselves yet. Partners have presented their ideas on how to approach the research challenges in the kick-off meeting in Zurich. At the Heidelberg PCC meeting partners presented objectives and results from other research projects to keep the project up to date to the state of the art of network resilience.

A meeting dedicated to WP2 has been planned (and, by the time of writing this report, has actually taken place) for 18th March in Heidelberg with the aim to better detail the work in WP2 and the inputs/outputs of each task/subtask, given the progress of work so far in WP1. Outcome of the meeting will be the planning of work throughout the three month period till the next project PCC meeting, to take place in Lancaster, UK, 10-12 June.

2.3. WP3: Service-level resilience

WP3 will officially start in M9 (May 2009) according to the project timeplan. Nevertheless, there has been a considerable preparatory effort spent in this WP3 in order to have a clearer picture of potential valuable research activities that should be addressed in this WP. There has been also some interaction with other WPs, in particular with WP1, in order to keep WP3 aligned with the whole resilience framework, and with WP4 in order to be able to evaluate the concepts developed in WP3.

The main ingredients for resilience at the service-level are, as described in the DoW, overlay/peer-to-peer networking and virtualization. TUM has been carrying its activities on providing resilience with P2P signalling for lookup services [Fessi07], and performed some initial investigation on resilient service discovery based on P2P networks. Moreover, TUM has been investigating routing optimization algorithms in the overlay based on previous work carried at TUM, which concerned routing in the underlay so far [Fisch06].

The work on virtualization will be carried by the UP. A potential interface between the activities of TUM and UP has been identified. Services which are hosted on virtual hosts will need to be found after they have been migrated. Migration will be triggered, for example, as a remediation mechanism, due to a detected challenge. The resilient service discovery mechanisms that will be provided by TUM will allow for the servers to be available after migration.

Moreover, there have been discussions between TUM (WP leader) and FT about FT's Chronicle Recognition System (CRS), which is intended to be used for the detection of challenges. There have been also short discussions between TUM and NEC about overlay-assisted transport, i.e., how to provide resilient connectivity in the overlay, if the underlay fails to provide it.

A half-day meeting between TUM and Passau, the main contributors in this WP, was held in Munich on October 24th 2008; WP3 sessions were also held during the kickoff meeting in Zurich in September 2008 as well as in the PCC meeting in Heidelberg in January 2009. The WP3 kickoff meeting is planned to take place during the first week of May 2009 in order to better consolidate the research questions that will be addressed in WP3; finally, full day sessions are envisaged for WP3 in the context of future project plenary meetings, the first one being about to take place in Lancaster, UK, 10-12 June.

2.4. WP4: Experimental evaluation of resilient networking

The main experimentation tasks in WP4 are scheduled for the second half of the project lifetime. The only WP4 task that has been officially kicked off is task 4.5, which is responsible for feeding information to the FIREworks coordination action. In the context of this task, the experimentation

scenarios, the facilities envisaged in the project, and implications with respect to federation have been described in the deliverable D4.1a submitted to EC (ref. Table 1). Note that this deliverable reflects the current understanding within the project and should be viewed as working document.

Partly motivated by the scope of task 4.1 and partly due to the ongoing effort in WP2 to further focus work and align it with WP1, there has been further work in WP4. More specifically, WP4 partners gave inputs on challenges for the WP1 meeting in University Passau, and have been participating in the discussions with WP2 partners to align the experimentation scenarios with the work to be carried out there.

2.5. WP5: Dissemination and exploitation of projects results, and standardization activities

Dissemination of project results

ResumeNet has early stated its intentions to devote significant resources to the dissemination of its results. For this first phase of activities (covering effectively the 1/6 of the project lifetime), we have focused our dissemination efforts in the following directions:

- The project's Web site and Wiki pages, initially due for M2, are operational since November 2008 (<http://www.resumenet.eu/>). While the Web site represents the major, and permanent, dissemination channel for ResumeNet's activities, the Wiki is the internal tool used daily by all partners to drop/retrieve working documents and data; it is exploited, e.g., for organizational purposes, before and after any meeting, should its scope be restricted (dedicated to one single WP, e.g., WP2 meeting in Heidelberg on 18 March 2009), or a whole project meeting, e.g., plenary project meeting in Heidelberg on 15-16 January 2009.
- ResumeNet has been presented, with the use of abstract, flyer, poster², or slides, in various venues:
 - - SAC/FIRE Workshop (Turin, Italy) on 05 March 2008, by Bernhard Plattner
 - - The Future of the Internet Event (Bled, Slovenia) on 02 April 2008, by Bernhard Plattner
 - - IWQoS 2008 (Twente, Netherlands) on 03 June 2008, by Christopher Edwards in the framework of an invited talk of David Hutchison on QoS³
 - - FIRE Launch Event (Paris, France) on 10 September 2008, by Merkouris Karaliopoulos
 - - ICT 2008 (Lyon, France) on 25-27 November 2008 by Marcus Schöller
 - - IWSOS 2008 (Vienna, Austria) on 10-12 December 2008 by Bernhard Plattner, David Hutchison, Paul Smith, and James Sterbenz
- A Dagstuhl Seminar on "Architecture and Design of the Future Internet" will be organized by Georg Carle, David Hutchison, Bernhard Plattner, and James P.G. Sterbenz on 14-17 April 2009, all partners of the ResumeNet project. This perspective workshop will gather researchers and practitioners whose interests are in the building of future directions for secure, resilient, and survivable networks.
- Exchanges have also taken place with EU projects in the field of resilience, both in FP6's programme such as ReSIST NoE (<http://www.resist-noe.org/>), where contacts have started to ensure that ResumeNet actors and results will be included in the Resilience Knowledge Base, one of ReSIST's legacy, and Amber (<http://amber.dei.uc.pt/>), an FP7 CA coordinating

² A second, and detailed, version of ResumeNet's poster is in preparation.

³ Note that project dissemination actions have been carried out before the official start of the project, in September 2008

the study of resilience measuring and benchmarking, where a ResumeNet member (Dr. Chidung Lac) is part of the Advisory Board. Similar interactions, less formal this time, are enabled with the FP6 IP ANA and the FP7 STREP ECODE thanks to common partners in those Consortia. With ANA, in particular, there will be a common workshop day on June 12th in Lancaster, UK, before the 2nd plenary meeting of the project, with the aim to identify what out of the ANA outcomes could be reused and benefit the work in ResumeNet.

Exploitation and standardization activities

The first part of these activities has not started yet, as it is premature to study knowledge transfer so early in the course of the project. As for standardization, the ResumeNet Consortium has, from the beginning, set modest objectives for this subject, channelling all its efforts in this respect mainly through coordination actions within the FIRE and the broader European R&D CAs.

Therefore, ResumeNet has been closely monitoring the activities of the Future Internet Assembly, FIREworks and participating in the meetings of the FIRE Expert Group, been always keen to support standardization actions originating from these bodies federating the European industry sector. More specifically:

- ResumeNet has been represented in the FIA conference in Bled, Slovenia, by Prof. Plattner and Dr. Karaliopoulos. There was a presentation from Prof. Plattner during the session on experimentation facilities. Likewise, the same two people represented ResumeNet in the FIA Conference in Madrid, in December 2008. In both cases, the activities of the conference were tracked to identify where the project inputs could be channelled.
- The project has established and maintains a link to FIREworks, the de-facto FIRE coordination action, replying positively to all its requests for information. It has released two "light" deliverables, D4.1a and D6.2a, as inputs to a consolidated FIREworks document aggregating information from all projects running under the FIRE initiative.
- The project participates in the activities of the FIRE Expert Group, represented so far by Prof. Plattner.

The project has signed the Bled declaration and intends to continue participating in the activities of the FIA, the next relative event being the FIA Conference in Prague, on 11-13 May. Individual project actions, at least at this early stage of the project, are not envisaged

3. Deliverables and milestones tables

3.1. Deliverables (excluding the periodic report)

Table 1. Deliverables									
Del. no.	Deliverable name	WP no.	Lead beneficiary	Nature	Dissemination level	Delivery date from Annex I	Delivered	Actual / Forecast delivery date	Comments
1.1	Understanding of challenges and their impact on network resilience	1	NEC	R	PU	M6	✓		Delivered before end of M7 to allow inclusion of risk-assessment approach in the document. A revision of the deliverable is proposed for M12, to accommodate continuing research on challenges.
4.1a	Federation Requirements (Interim)	4	ETHZ	R	PU	M6	✓		Light deliverable in response to the delayed request for inputs from FIREworks
5.1	ResumeNet website and Wiki pages	5	ETHZ	O	PU	M2	✓		Delivered in time
6.1	Project Management Guidelines	6	ETHZ	R	PP	M2	✓		Delivered in time
6.2a	Links between research and experimentation	6	ULANC	R	PU	M6	✓		Light deliverable in response to the delayed request for inputs from FIREworks

Note that an update to deliverable D1.1, potentially D1.1b, is proposed to accommodate ongoing research on challenges and the assessment of their impact. This need arose out of the risk management oriented asset-based approach explored in task 1.2 and reported in D1.1.

3.2. Milestones

Table 2. Milestones							
Milestone no.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments
M5.1	Website and Wiki pages set up and operational	WP5	ETHZ	M2	Yes	M2	

4. Project management

The management structure in ResumeNet involves two Committees, the Project Coordination Committee (PCC) with representation of all partners and the Project Technical Management Committee (TPC) with participation of WP leaders. This way management tasks are distributed amongst a number of partners rather than been concentrated on a single partner; of course, increased responsibilities and activities correspond to the people leading the two committees, Prof. Plattner and Dr. Karaliopoulos, and Prof. Hutchison, respectively. On top of this, the responsibility for certain administrative tasks of the project (finance data collection, documentation) lies with the EUresearch team in ETH Zurich, and more specifically, with Mrs. Sibylle Hodel.

Over these first six months of the project lifetime, significant resources were devoted to the set-up of proper management tools and processes to accompany the project along its full duration. More specifically, management effort was directed in the following directions:

- **Setting up the required information infrastructure** to allow dissemination/exchange of information and the interaction of partners. This includes:
 - Project website: the project website (<http://www.resumenet.eu>) was set up already by early November to allow dissemination of project information
 - Wiki pages: the main tool for every day interaction of partners (<http://wiki.resumenet.eu>). It was made available together with the public website and has been heavily used for running the project, being by far the most valuable tool for progressing the project work. Both the public website and the Wiki pages are hosted by ETH Zurich.
 - Emailing lists: two emailing lists are hosted by the information services section of ETH Zurich for the ResumeNet project, one for the project assembly and one for the Technical Management Committee.
 - Subversion repository tool (svn): documents (deliverables, reports, presentations, and publications) are prepared using the svn tool made available by ETH Zurich (<svn://svn.ee.ethz.ch/eu-fp7-resumenet>)
- **Maintaining synchronization of the whole Consortium on the project activities.** This is served by two main processes:
 - The bimonthly Phone Conferences organized every second Thursday at 1pm amongst the member of the TPC. These are used for reporting on the status and progress of all WPs and planning both WP-level and project-level actions. The first Phone Conference was run on Oct 2nd and till end of M6 (February) there have been 10PhCs.
 - The preparation and distribution to all Consortium partners of a weekly internal newsletter summarizing the main facts and news about the project. This process was only recently launched when it was found out that the synchronization of partners outside the TPC is not adequate
- **Project monitoring.** A lightweight process is introduced with the purpose of enforcing respect of deadlines in the preparation of project deliverables and milestones. This involves the identification of important stages and dates in the progress of deliverables/milestones and the scoring of partners who have a role in those stages.

- **Organization of physical meetings** to set up the overall project work but also within individual WPs. Besides the kickoff meeting in Zurich, 17-18 September 2008 and the first plenary meeting in Heidelberg, Germany, 15-16 January 2009, an additional meeting was organized in Passau, Germany, on November 7th to structure work with respect to challenges (task 1.2 and deliverable D1.1). Further special meetings are scheduled for March 18th to focus work in WP2 and align it with the current directions in WP1, and for May 7th to detail the work in WP3.

The list of meetings scheduled for the interval March-August 2009 is given below:

Table 4.1: Physical meetings envisaged over the next 3 months of the project

Meeting	Context (scope)	Date	Location/ Host
WP2 meeting	Focus work in WP2	18 March 2009	Heidelberg, Germany (NEC)
WP3 meeting	Kick off work in WP3 and detail it in light of work in WP1 and WP2	7 May 2009	Munich, Germany (TUM)
2 nd Project plenary meeting	The tri-annual plenary project meeting	10-12 June 2009	Lancaster, UK (ULANC) –with a parallel workshop with a reduced set of ANA Consortium

Moreover, the 3rd project plenary meeting is scheduled for October 2009, in Munich, Germany

So far the management of the project runs smoothly. No particular problems have emerged. There are changes neither in the Consortium nor in the status of beneficiaries.

5. Explanation of the use of the resources

Information omitted.

All finance data appear in the original version submitted to EC.

References

[ResD1.1]	Understanding challenges and their impact on network resilience. ResumeNet Deliverable D1.1, March 2009
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