RESCUE: Compte-rendu de fin de projet

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ANR AGENCE NATIONALE DE LA RECHERCHE	**Compte-rendu de fin de projet**	

Projet ANR- 10-VERS-003

RESCUE

Programme VERSO 2010

Ce document est à remplir par le coordinateur en collaboration avec les partenaires du projet. L'ensemble des partenaires doit avoir une copie de la version transmise à l'ANR.

Ce modèle doit être utilisé uniquement pour le compte-rendu de fin de projet.

A IDENTIFICATION

Acronyme du projet	RESCUE
Titre du projet	Réseaux Coordonnés de Substitution Mobiles
Coordinateur du projet (société/organisme)	Tahiry Razafindralambo Inria
Période du projet (date de début – date de fin)	1er Decembre 2010 31 Mars 2014
Site web du projet, le cas échéant	http://rescue.lille.inria.fr

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Date de rédaction	Mars 2014

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Téléphone	
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Liste des partenaires présents à la fin du projet (société/organisme et responsable scientifique)	Inria, Orange, UPMC, LAAS, ENS Lyon

B RÉSUMÉ CONSOLIDÉ PUBLIC

B.1 RÉSUMÉ CONSOLIDÉ PUBLIC EN FRANÇAIS

La mobilité contrôllée dans les réseaux : Le Réseau de Substitution

Un réseau mouvant, la mobilité comme caratéristique du réseau.

Nous définissons un réseau de substitution comme un réseau sans fil pouvant être déployé rapidement comme solution d'appui ou de soutien venant en aide à un réseau déjà en place (ou réseau de base) qui connaîtrait un problème de performance. Dans ce projet, nous étudions des scénarios dans lesquels les entités d'un réseau existant, comme les routeurs, sont subitement déconnectés ou rencontrent des pannes. Les problèmes rencontrés par ce réseau de base doivent être résolus en restaurant les services comme la connexité et ce en utilisant la capacité des routeurs composant le réseau de substitution à se mouvoir de manière autonome. Dans cette optique, il est crucial de concevoir des algorithmes pouvant fonctionner dans cet environnement et pouvant faire fonctionner les entités de cet environnement.

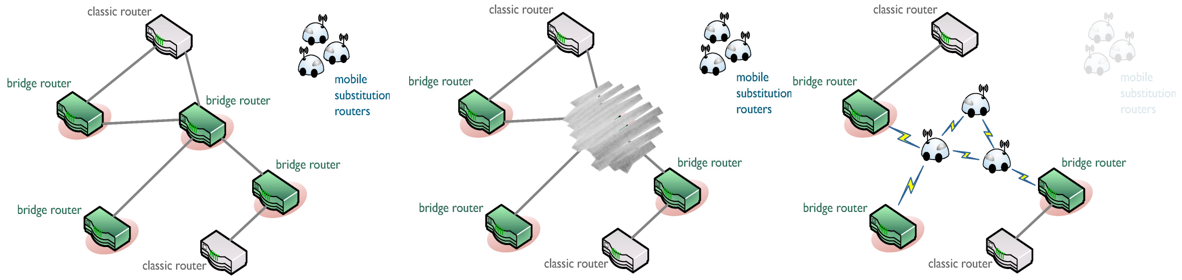
Questions fondamentales

L'utilisation de la mobilité contrôlée soulève un aspect spatial et temporel. Ainsi les questions basiques pour lesquelles il nous faut des réponses et autours desquelles s'articule le projet RESCUE sont les suivantes. Si le réseau possède la

capacité de se mouvoir il faut savoir : Pourquoi ? Quand ? Où ? Comment ? Le pourquoi nous permet d'identifier l'objectif lié au mouvement perte de performance ou déconnexion du réseau. Le quand permet de décider du moment opportun pour profiter de la capacité du réseau à se mouvoir en anticipant au mieux l'évolution du réseau dans le temps et l'espace. Le où permet de savoir au delà du fait qu'il faille se mouvoir la direction vers laquelle il faut aller pour satisfaire le 'pourquoi'. Le comment prend en compte toutes les contraintes du mouvement en y impliquant toutes les entités du réseau.

Résultats majeurs.
Le résultat principal du projet RESCUE est la preuve de concept résultant de l'approche abordée dans tout au long du projet. En partant de la définition des problèmes les partenaires du projet ont développé selon leur compétence et en synergie avec les autres partenaires, des solutions théoriques aux problèmes soulevés pour enfin arrivé à une implémentation réelle des ces solutions.

Cette approche fondamentale de la recherche mené dans le projet RESCUE a permis aux partenaires de produire des publications de haut niveau impliquant plusieurs partenaires du projet. Les figures ci-dessous montrent le scénario implémenté dans la preuve de concept developpé dans le projet RESCUE autour des réseaux de substitution.



Le projet RESCUE est un projet de recherche fondamentale coordonné par Inria. Il associe Orange ainsi que des laboratoires de recherches tel que le LIP (ENS Lyon), le LAAS (Toulouse), et le LIP6 (Paris). Le projet a commencé en Décembre 2010 et a duré 36 mois. Il a bénéficié d'une aide ANR de 796.605 euros pour un coût global de l'ordre de 2.535.130 euros.

B.2 Résumé consolidé public en anglais

Controlled mobility inside the networks : The Substitution Network

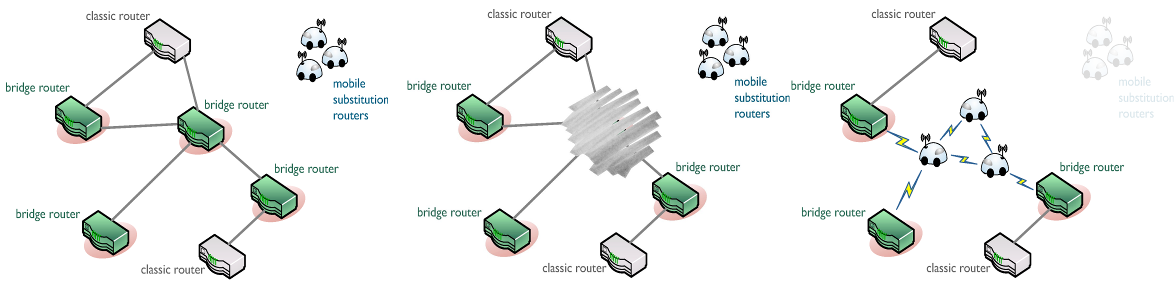
A moving network, mobility as a network characteristic.
We define a substitution network as wireless network backup solution that can be rapidly deployed. The substitution network supports an already established network (base network) which is experiencing performance or topology issues. In this project, we study scenarios in which entities of an existing network, such as routers, are suddenly disconnected or experience blackouts. The issues encountered by the base network must be solved by

restoring services such as connectivity and using the capacity of the substitution network routers to move autonomously. In this context, it is crucial to design algorithms capable of operating in this environment and mobile entities.

Fundamenal questions.
The use of controlled mobility raises a spatial and temporal aspect. The basic questions for which we need answers and which are tackled in the RESCUE project are as follows. If the network has the ability to move we need to know: Why? When? Where? How? “Why” identifies the objective related to performance loss or network disconnection and linked to the movment. “When” is important to decide when to take advantage of the network's capacity to move anticipating the network time and space evolutions. “Where” allows us to decide (beyond the fact that we should move) the direction we must go to meet the 'why' requirements. “How” takes into account all the constraints of movement by involving all network entities.

Key facts.
The main result of the RESCUE project is the proof of concept resulting from the approach followed throughout the project. Starting from the definition of the problems, the project partners have developed, according to their competence and synergy with other partners, theoretical solutions and implementations of these solutions.

The fundamental approach conducted in the RESCUE project has enabled the partners to produce high level publications involving several project partners. The figures below show the implemented proof of concept related to substitution networks developed in the RESCUE project .



The RESCUE project was a fundamental research project led Inria. This project involved Orange and research laboratory such as LIP (ENS Lyon), LAAS (Toulouse) and the LIP6 (Paris). The project started in December 2010 with a 36 months duration. It received an ANR funding of 796.605 euros for a global cost of 2.535.130 euros.

C Mémoire scientifique

Mémoire scientifique confidentiel : non

C.1 Résumé du mémoire

Ce résumé peut être repris du résumé consolidé public.

Emerging pervasive communication systems will face a number of challenges including the need to operate in "extreme" and "moving" environments and thus they will withstand frequent connectivity quality variations. These quality variations in connectivity may be caused by a number of factors including limitations of sparse deployment, wireless channel impairments, capability of the devices, etc. Examples of applications likely to operate in these extreme environments include emergency response and disaster recovery, environmental and habitat monitoring, vehicular networks, etc. In the literature, these networks have been referred to as Rapidly Deployable Networks or Substitution Networks. The goal of a substitution network is therefore to deploy a set of wireless mobile devices between classical network routers to restore, without prior knowledge of the optimal wireless mobile router locations, the connectivity, to improve the network performance, and, if possible, to satisfy applications' requirements, such as, for instance, delay, throughput or Mean Opinion Score. Substitution networks use controlled mobility, provided to wireless mobile routers, to improve network performance at all the layers of the protocol stack. Previous works have been done on deployment and placement of mobile devices (e.g., robots) for area coverage. But, in these works, the controlled mobility is exploited at the application layer to provide new services. In this project, controlled mobility is introduced at all layers of the protocol stack that can exploit this controlled mobility to enhance their own performance. In the RESCUE projet, we specifically aim at introducing mobility as a primitive of the protocol stack.

C.2 Enjeux et problématique, état de l'art

Access and metropolitan networks are much more limited in capacity than core networks. While the latter operate in over-provisioning mode, access and metropolitan networks may experience high overload due to evolution of the traffic or failures. In wired networks, some failures (but not all) are handled by rerouting the traffic through a backup network already in place. In developed countries, backup networks are adopted wherever possible (note that this is generally not the case for the links between end users and their local DSLAM). Such a redundant strategy may not be possible in emerging countries because of cost issues. When dedicated backup networks are not available, some operators use their 3G infrastructure to recover some specific failures; although such an alternative helps avoid full network outage, it is a costly solution. Furthermore, availability of 3G coverage is still mainly concentrated in metropolitan zones. When no backup networks are available, it would be interesting to deploy, for a limited time corresponding to the period of the problem (i.e., failure or traffic overload), a substitution network to help the base network keep providing services to users. In the RESCUE project, we investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure. The advantages of an on-the-fly substitution network are manifold: 1) Reusability and cost reduction. Substitution resources are only used when needed compared to a permanent backup network which may be not used very often. Furthermore, substitution nodes can be redeployed at different parts on the network at different times. 2) Deployability. Substitution network may help some parts of the base network where there is no redundancy. It is important to underline that deploying substitution networks is not orthogonal to having traditional backup networks. Instead, it should be seen as complementary. 3) Adaptability. The topology of the substitution network may be adapted to the context, i.e. to the environment as to the on-going traffic so that an efficient delivery service may be provided.

C.3 Approche scientifique et technique

Note that a fundamental aspect of the project is the decision strategy, as deploying a substitution network has some counterpart cost. By decision, we mean the judgment concerning the right time and the right place a substitution should be deployed (or undeployed when the system estimates that the substitution network is no further needed). To this end, the RESCUE project addresses both the theoretical and the practical aspects of the deployment of a substitution network. From a theoretical point of view, we propose a two-tiered architecture including the base network and the substitution network. This architecture describes the deployment procedures of the mobile routing devices, the communication stack, the protocols, and the services. The design of this architecture takes into account some constraints such as quality of service and energy consumption (since mobile devices are autonomous), as we want the substitution network to provide more than a best effort service. From a practical point of view, we provide a proof of concept, the architecture linked to this concept, and the necessary tools (e.g., traffic monitoring, protocols) to validate the concept and mechanisms of on-the-fly substitution networks. At last but not least, we validate the proposed system both in laboratory testbeds on a real-case scenario.

C.4 Résultats obtenus

Scenario definition and global architectures. The consortium has defined the framework of the project regarding the scenario definition and the architecture. We agreed about a scenario that is developed and described in the D3.1 deliverable. Moreover upon the recommendation of the ANR reviewer we are still discussing about the in-vivo experimentation and we expect a formal definition of the this experimental scenario as soon as possible.

Mobility control. As the mobile routers can be deployed independently and dynamically, the substitution network topology can vary. It can be interesting for a router to know in which topology it is located as the network's usage. To this end, we work on the characterization of idle periods. We have shown that these distributions can be different from one node to another and that they could be multi-modal, as opposed to what is considered in some works. The goal is to exploit this characterization and show in which extent it can be useful to a mobile router to infer the kind of network that surrounds it.

Protocols. A multi-path routing protocol that will be used in the substitution network has been developed. As the capacity of substitution networks is limited, it is very important to optimize the network resources usage. To this end, it can be interesting to use multi-path routing. We have worked on MP-OLSR that is a proactive multi-path routing based on source routing. We have improved the performance of MP-OLSR by proposing new recovery schemes and a dynamic load-balancing technique based on packet loss rate.

Substitution networks must provide QoS guarantees to some traffic classes. A bandwidth reservation scheme was also devised to provide per flow end-to-end bandwidth guarantees in multi-radio multi-channel 802.11 wireless multi-hop networks. A graph based model that captures the interference that links are subject to is used to assess the available bandwidth on each link. Bandwidth aware route discovery and admission control are used to find a route with the required bandwidth. Link diversity (with load balancing) is exploited to improve flow admissibility.

Wireless network metrology. A monitoring platform has been set up and some experiments have been performed to study the impact of channel state and interference on the router mobile router. Moreover, a cross layer monitoring architecture has been defined, implemented and tested. Traces have been generated and gathered using the architecture and we have started analyzing the results. The traces are stored on a private FTP site and are available for the consortium. The analysis of these traces have been used to calibrate the monitoring system and architecture. Some machine learning techniques, as SVM, have been used to help predicting on a short time period the evolution of the performance and QoS provided by the network. It permits the selection of the most significant parameters to characterize the wireless network and its performance.

Wireless network performance evaluation. We have worked on the modeling of multihop wireless networks based on IEEE 802.11. The goal is to have a theoretical and simple model that would give indications on the flow performance and that would help the mobile routers positioning. Most of the current analysis consider cell networks where sources have independent traffic to transmit under an ideal physical layer. Our goal is to design a more general model where the physical layer is not ideal and is not the same between sources and where the packet arrivals on the nodes are not independent. To this aim, we have already developed a hierarchical model based on a network of single-server queues whose parameters can be derived from the physical topology of the IEEE 802.11 multi-hop network. We validated this approach for 3 nodes. Some work has been achieved on the estimation of the global QoS on a full wireless dynamic network. It relies on the introduction of a satisfaction index that helps to estimate the level of performance of any network configuration, then helping to select the most appropriate one, and the related routing. This estimation relies on the monitoring of the wireless links.

Implementation. Some experiments have already been run and implemented. Especially, a preliminary algorithm for rescue mobile router deployment has already been developed and some preliminary tests have been performed using real experiments and simulations. This is the most important results during the last couple of months of the project since the consortium spent most of its man.month on this part of the project namely WP3.

C.5 Exploitation des résultats

Over the RESCUE project duration, the consortium has notably investigated the applicability, into real-world environments, of the use of a potential RESCUE-based networks, and in particular of the probable effects of controlled mobility for aerial platforms. The contexts studied for the different use cases (described in delivrable D3.1) included Public Protection and Disaster Relief (PPDR) communications, as well as the cost of deploying a mobile collection of substitution routers in rural areas. For the latter case, a profitability study was conducted. These activities were reported in deliverable D3.1, and to a lesser extent into D1.2 and D3.3. Further, the work led to a published profitability study of the economic impact of deploying altitude-based substitution networks in large scale, low user density areas.

Furthermore, the dissemination (see annex D) and exploitation of the RESCUE project results is a significant part of the overall project results. As the industrial partner of the consortium, Orange offered support to assess the relevance of developments of substitution networks and controlled mobility towards industrial requirements and also ensures the exploitation of results is targeted toward the French and European community. To this end, Orange evaluated early implementations of controlled mobility deployed on aerial networks during dedicated experimentations, reported into D3.3. This practical experience, as well as the other experimentation results performed by the consortium (e.g. WiFibots) led to a sustained dissemination effort of the project results, not only in direction of the scientific community, but as well towards industrial actors. As an example, the RESCUE concepts and mechanisms were disseminated through national exhibitions (e.g. Salons de la Recherche 2014, held in Orange premises in Paris) with the intention to focus the attention and initiate exploitation-related discussions with SMEs. Likewise, the exploitation of RESCUE results was carefully discussed during several Orange workshops with Japanese partners deeply involved in PPDR real-world scenarios (in the wake of the Tohoku disaster in 2011) where substitution networks offers valuable features in terms of network robustness, dynamicity and scalability. Those close discussions were held in 2013-2014 and are still active at the time of writing this report. Finally, it is worth mentioning that the principles researched in the context of the RESCUE project were instrumental in proposing new, closely related, research projects. That’s the case of the European ICT FP7 ABSOLUTE project, started in October 2012, which was partially built on concepts close to substitution networks and also focused on emergency communications and temporary services. At the time of the project acceptation, the early results of RESCUE have been crucial to illustrate and embody the substitution network principles.

At the time of writing this report, the further exploitation of controlled mobility as studied in RESCUE is still under scrutiny, in particular at Orange, were substitution networks is seen as a promising cost-efficient technology to cover in particular remote areas (notably of emerging countries, where network expenditure is a critical aspect), and is therefore studied in a dedicated research program over the course of several years.

C.6 Discussion

The schedule of the project hasderived from the initial description of the RESCUE project on different aspects. The most important issues encountered by the project is related the the experimentations. For these issues, we have requested to the ANR an extension of 4 months for the project. Since we wanted to demonstrate that the concept of substitution network is viable, some assumptions related to the size of the scenario have been reduced. Moreover, we mainly focus or implementation work on specific technology such as 802.11 and on specific plateforms such as the WiFibots. It is important to notice that these choices do not restrict the use of substitution network to some specific cases but help the consortium to work on the same hardware and software basis.

C.7 Conclusions

In the RESCUE project, we introduce the concept of substitution network. A substitution network is a rapidly deployable backup wireless solution to quickly react to issues of existing networks, called base networks. The substitution network is not directly deployed for customers or end users but only to help a base network that experiences issues. The substitution network is, therefore, not a stand-alone network and can rely on mechanisms implemented inside the base network or at the edge routers which serve as bridges between the base network and the substitution network.

The main challenges regarding the implementation of substitution networks are related to some simple questions: 1) ``When'' to deploy the substitution network and when to stop the deployment? 2) ``Where'' to place the mobile substitution routers and where to place the network services that must be implemented? 3) ``How'' to implement the network mechanism and protocols in order to fit the base network and substitution network needs?

The RESCUE project covered the main scientific, technical and implementation challenges raised by the usage of substitution network. It also describes possible use cases and provides recommendations for the mechanisms' implementation and for the hardwares that could be used.

C.8 Références

D Liste des livrables

Date de livraison	N°	Titre	Nature (rapport, logiciel, prototype, données, ...)	Partenaires (souligner le responsable)	Commentaires
T3	D0.1	Promotion Material	web	Inria	
T12	D1.1	Protocols for substitution networks: State of the art	doc	Inria	
T18	D2.1	Traces and materials	doc	LAAS	
T26	D1.2	Controlled mobility, algorithms and protocols	doc	UPMC	
T26	D2.2	Concepts and methods for monitoring in RESCUE	doc	LAAS	
T18	D3.1	Scenario description, and experiment sizing	doc	Orange	
T24	D0.2	Intermediate report on publications and events	doc	LAAS	
T30	D3.2	Architecture implementation and integration	doc	Inria	
T36	D0.3	Report on publications, events and exploitation plans	doc	Inria	
T36	D1.3	RESCUE: Final architecture, algorithms, and protocols	doc	ENSL	
T36	D2.3	Integration of monitoring and metrology tools in RESCUE	doc	LAAS	
T36	D3.3	Architecture evaluation and recommendations	doc	Orange	

E IMPACT DU PROJET

E.1 INDICATEURS D'IMPACT

Nombre de publications et de communications (à détailler en E.2)

		Publications multipartenaires	Publications monopartenaires
International	Revues à comité de lecture		6
	Ouvrages ou chapitres d'ouvrage	1	
	Communications (conférence)	5	18
France	Revues à comité de lecture		
	Ouvrages ou chapitres d'ouvrage		
	Communications (conférence)	1	1
Actions de diffusion	Articles vulgarisation		
	Conférences vulgarisation		
	Autres		

Autres valorisations scientifiques (à détailler en E.3)

	Nombre, années et commentaires (valorisations avérées ou probables)
Brevets internationaux obtenus	
Brevet internationaux en cours d'obtention	
Brevets nationaux obtenus	
Brevet nationaux en cours d'obtention	
Licences d'exploitation (obtention / cession)	
Créations d'entreprises ou essaimage	
Nouveaux projets collaboratifs	
Colloques scientifiques	
Autres (préciser)	

E.2 LISTE DES PUBLICATIONS ET COMMUNICATIONS

International book chapters (multi-partners)

1. T. Razafindralambo ; I. Guérin-Lassous. Substitution Network: Controlled Mobility for Network Rescue. World Scientific (to appear)

International Conference Publications (multi-partners)

1. T. Razafindralambo; T. Begin; M. Dias De Amorim; I. Guérin-Lassous; N. Mitton; D. Simplot-Ryl. Promoting Quality of Service in Substitution Networks with Controlled Mobility. 10th International Conference on Ad Hoc Networks and Wireless (AdHocNow), Jul 2011, Padderborn, Germany. pp. 248-261. http://hal.inria.fr/inria-00599124
2. I. Doghri, L. Reynaud and I. Guérin Lassous. On The Recovery Performance of Single- and Multipath OLSR in Wireless Multi-Hop Networks, Third International ICST Conference on Ad Hoc Networks (ADHOCNETS), Paris, France, September 21-23, 2011. http://hal.archives-ouvertes.fr/hal-00708684
3. T. Abreu, N. Nguyen, T. Begin, I. Gu´erin Lassous, and B. Baynat. Substitution networks: Performance collapse due to overhead in communication times. In Proceedings of the 4th International Conference on Ad Hoc Networks (AdHocNets), Paris, France, Sep 2012.
4. Nam Van Nguyen, Isabelle Guerin-Lassous, Victor Moraru, and Tahiry Razafindralambo. Characterisation and application of idle period durations in ieee 802.11 dcf-based multihop wireless networks. In Proceedings of the 15th ACM international conference on Modeling, analysis and simulation of wireless and mobile systems (MSWiM) , pages 277–284, Paphos, Cyprus, 2012.
5. T. Abreu, B. Baynat, T. Begin and I.Guérin Lassous, Hierarchical Modeling of IEEE 802.11 Multi-hop Wireless Networks, accepted to the 16th ACM International Conference on Modeling, Analysis, Simulation of Wireless and Mobile Systems (MSWiM), Barcelona, Spain, November 2013.

National Conference Publications (multi-partners)

1. V. N. Nguyen; I. Guerin Lassous; T. Razafindralambo; V. Moraru. Caractérisation des Périodes Libres dans les Réseaux 802.11 Multisauts. 14èmes Rencontres Francophones sur les Aspects Algorithmiques des Télécommunications (AlgoTel), 2012, La Grande Motte, France. pp. 1-4. http://hal.archives-ouvertes.fr/hal-00690957

International journals (mono-partners)

1. A. Gluhak; S. Krco; M. Nati; D. Pfisterer; N. Mitton; T. Razafindralambo. A Survey on Facilities for Experimental Internet of Things Research. *IEEE Communications Magazine*, IEEE, 2011, 49 (11). http://hal.inria.fr/inria-00630092
2. Usman Ashraf, Slim Abdellatif, and Guy Juanole. Interference-aware bandwidth reservation in multi-radio multi-channel mesh networks. Computer Communications, 35(17):2138 – 2149, 2012.
3. Milan Erdelj, Tahiry Razafindralambo, and David Simplot-Ryl. Covering points of interest with mobile sensors. IEEE Transactions on Parallel and Distributed Systems , 24(1):32 –43, 2013.
4. Karen Miranda, Enrico Natalizio, and Tahiry Razafindralambo. Adaptive deployment scheme for mobile relays in substitution networks. International Journal of Distributed Sensor Networks, 2012, 2012.
5. Milan Erdelj, Valeria Loscri, Enrico Natalizio, Tahiry Razafindralambo. Multiple Point of Interest Discovery and Coverage with Mobile Wireless Sensors. *Ad Hoc Networks*, Elsevier, 2013, 11 (8), pp. 2288-2300
6. Dimitrios Zorbas, Tahiry Razafindralambo. Prolonging network lifetime under probabilistic target coverage in wireless mobile sensor networks. *Computer Communications*, Elsevier, 2013, 36 (9), pp. 1039-1053.

International conferences (mono-partners)

1. L. Reynaud, T. Rasheed, S. Kandeepan, An Integrated Aerial Telecommunications Network that Supports Emergency Traffic, In Proceedings of the International Workshop on Emergency Telecommunications (EMT'11), Brest, 2011.
2. L. Reynaud, S. Zaïmi and Y. Gourhant, Competitive Assessments for HAP Delivery of Mobile Services in Emerging Countries, In Proceedings of The 3rd International Workshop on Business Models for Mobile Platforms (BMMP'11), Berlin, 2011.
3. P. Owezarski, R. Hasan, G. Kremer, P. Berthou, "First step in cross-layers measurement in wireless networks – How to adapt to resource constraints for optimizing end-to-end services?", Invited paper, 9th International Conference on Wired and Wireless Network Internet Communications (WWIC'2011), Vilanova i la Geltrú, Barcelona, Spain, June 15-17, 2011
4. P. Pace; V. Loscri; E. Natalizio; T. Razafindralambo. Nodes Placement for reducing Energy Consumption in Multimedia Transmissions. *22nd IEEE Symposium on Personal, Indoor, Mobile and Radio Communications (PIMRC)*, Sep 2011, Toronto, Canada.
5. K. Miranda; E. Natalizio; T. Razafindralambo. On the impact of router's mobility on substitution networks. *Twelfth ACM International Symposium on Mobile Ad Hoc Networking and Computing*, May 2011, Paris, France. http://hal.inria.fr/inria-00589807
6. Denis Carvin, Philippe Owezarski, and Pascal Berthou. Managing The Upcoming Ubiquitous Computing. In Proceedings of the 1st Conference on Network and Service Management (CNSM), Las Vegas, USA, October 2012.
7. K. Miranda, E. Natalizio, T. Razafindralambo, and A. Molinaro. Adaptive router deployment for multimedia services in mobile pervasive environments. In Pervasive Computing and Communications Workshops

(PERCOM Workshops), 2012 IEEE International Conference on (Percom), pages 471 –474, Lugano, Switzerland, march 2012.
8. L. Reynaud, S. Zaimi, and Y. Gourhant. Competitive assessments for hap delivery of mobile services in emerging countries. In Proceedings of The 3rd International Workshop on Business Models for Mobile Platforms (BMMP) , Berlin, Germany, 2012.
9. Laurent Reynaud and Tinku Rasheed. Deployable aerial communication networks: challenges for futuristic applications. In Proceedings of the 9th ACM symposium on Performance evaluation of wireless ad hoc, sensor, and ubiquitous networks (PE-WASUN) , pages 9–16, Paphos, Cyprus, Oct 2012.
10. Laurent Reynaud, Tinku Rasheed, and Kandeepan Sithamparanathan. An integrated aerial telecommunications network that supports emergency traffic. In Proceedings of the International Workshop on Emergency Telecommunications (EMT) , Brest, France, 2012.
11. D.P. Venmani, Y. Gourhant, L. Reynaud, P. Chemouil, and D. Zeghlache. Substitution networks based on software defined networking. In Proceedings of the 4th EAI International Conference on Ad Hoc Networks (AdHocNets) , Paris, France, Sep 2012.
12. D. Carvin, G. Kremer, P. Owezarski, P. Berthou, Event based performance evaluation and analysis of dynamic wireless networks, International conference on Network and System Management (CNSM'2013), Zurich, Switzerland, 14-18 October 2013
13. Karen Miranda, Victor Ramos, Tahiry Razafindralambo. Using efficiently autoregressive estimation in Wireless Sensor Networks. *International Conference on Computer, Information, and Telecommunication Systems (CITS) - 2013*, May 2013, Piraeus-Athens, Greece.
14. Jean Razafimandimby, Karen Miranda, Dimitrios Zorbas, Tahiry Razafindralambo. Fast and reliable robot deployment for substitution networks. *PE-WASUN - Tenth ACM International Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Networks - 2013*, Nov 2013, Barcelona, Spain. pp. 17-24.
15. Milan Erdelj, Tahiry Razafindralambo. Design and implementation of architecture for multi-robot cooperation in the context of WSN. *Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Network*, Nov 2013, Barcelona, Spain.
16. Valeria Loscri, Enrico Natalizio, Tahiry Razafindralambo, Nathalie Mitton. Distributed Algorithm to Improve Coverage for Mobile Swarms of Sensors. May. 2013. Poster in IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS)
17. G. Kremer, *P. Owezarski*, P. Berthou, G. Capdehourat, "Predictive Estimation of Wireless Link Performance from Medium Physical Parameters Using Support Vector Regression and k-Nearest Neighbors", 6^th international workshop on Traffic Monitoring and Analysis (TMA'2014), London, UK, April 14, 2014
18. D. Carvin, P. Owezarski, P. Berthou, "A generalized distributed consensus algorithm for monitoring and decision making in the IoT", 5th international conference on smart communications in network technologies (SaCoNet'2014), Vilanova i la Geltrú, Barcelona, Spain, June 18-20, 2014 (Article invité)

National Conference Publications (mono-partners)

1. G. Rémy, S.M. Senouci, F. Jan and Y. Gourhant, "SAR.Drones: Drones for Advanced Search and Rescue Missions," in Journées Nationales des Communications dans les Transports (JNCT), Nevers, France, 2013.

E.3 Liste des éléments de valorisation

E.4 Bilan et suivi des personnels recrutés en CDD (hors stagiaires)

Identification				Avant le recrutement sur le projet			Recrutement sur le projet				Après le projet				
Nom et prénom	Sexe H/F	Adresse email (1)	Date des dernières nouvelles	Dernier diplôme obtenu au moment du recrutement	Lieu d'études (France, UE, hors UE)	Expérience prof. Antérieure, y compris post-docs (ans)	Partenaire ayant embauché la personne	Poste dans le projet (2)	Durée missions (mois) (3)	Date de fin de mission sur le projet	Devenir professionnel (4)	Type d'employeur (5)	Type d'emploi (6)	Lien au projet ANR (7)	Valorisation expérience (8)
Kremer Guillaume	H	gkremer@laas.fr	Mars 2014	Master 2	France	-	LAAS	PhD	39	Mar 2014					
Miranda, Karen	F	Karen.Miranda@inria.fr	Mar 2014	Master 2	Mexique	-	Inria	PhD	38	Mar 2014					
Nguyen Nghi	H	donnghi8985@gmail.com		Master 2	Vietnam	-	UPMC	Engineer	12	Apr 2013					
ABREU Thiago	H	thiago.wanderley@ens-lyon.fr	Jan 2014	Master 2	Bresil	-	ENSL	PhD	36	Jan 2014					
Magkalra, Kalypso	F	Kalypso.magklara@inria.fr	Nov 2013	Master 2	Greece	-	Inria	Engineer	12	Nov 2013					

Aide pour le remplissage

(1) Adresse email : indiquer une adresse email la plus pérenne possible
(2) Poste dans le projet : post-doc, doctorant, ingénieur ou niveau ingénieur, technicien, vacataire, autre (préciser)
(3) Durée missions : indiquer en mois la durée totale des missions (y compris celles non financées par l'ANR) effectuées sur le projet
(4) Devenir professionnel : CDI, CDD, chef d'entreprise, encore sur le projet, post-doc France, post-doc étranger, étudiant, recherche d'emploi, sans nouvelles
(5) Type d'employeur : enseignement et recherche publique, EPIC de recherche, grande entreprise, PME/TPE, création d'entreprise, autre public, autre privé, libéral, autre (préciser)
(6) Type d'emploi : ingénieur, chercheur, enseignant-chercheur, cadre, technicien, autre (préciser)
(7) Lien au projet ANR : préciser si l'employeur est ou non un partenaire du projet
(8) Valorisation expérience : préciser si le poste occupé valorise l'expérience acquise pendant le projet.