



Activity Report 2011

Project-Team POPS

System and Networking for Portable Objects
Proved to be Safe

RESEARCH CENTER
Lille - Nord Europe

THEME
Distributed Systems and Services

Table of contents

1. Members	1
2. Overall Objectives	1
3. Scientific Foundations	3
3.1. Embedded Operating Systems	3
3.2. Mobile Networking	3
4. Software	4
4.1. ASPIRE TDT	4
4.2. ASPIRE ALECC	5
4.3. EPC TAG CONVERTER	5
4.4. EPC TAG GENERATOR	5
4.5. EVe - TCF	5
4.6. GOLIATH 1.0	5
4.7. JITS	5
4.8. Light ALE	6
4.9. Light RP	6
4.10. NFC Light ALE	6
4.11. RFID Tag Searcher	7
4.12. SINGLE	7
5. New Results	7
5.1. RFID and Internet of Things	7
5.1.1. Reader anti-collision protocol	7
5.1.2. Distributed ALE	8
5.1.3. Advance Internet of Things	8
5.2. Topology control and neighbor discovery	8
5.2.1. Topology control	8
5.2.2. Neighbor discovery	9
5.2.3. Address allocation	9
5.3. Routing	9
5.4. Self-deployment, localization and area coverage	10
5.4.1. Deployment	10
5.4.2. Coverage	11
5.4.3. Localization	11
5.5. Platforms and Substitution Networks	12
5.5.1. Platforms	12
5.5.2. Emulation	12
5.5.3. Substitution network	12
5.6. Data collection and management	13
5.6.1. Data collection	13
5.6.2. Data management	14
5.6.3. Data security	14
6. Contracts and Grants with Industry	14
6.1. Gemalto partnership	14
6.2. France Telecom partnership	15
6.3. Etineo Partnership	15
6.4. Noolitic partnership	15
7. Partnerships and Cooperations	15
7.1. Regional Initiatives	15
7.1.1. DECARTE	15
7.1.2. IDC	16

7.2. National Initiatives	16
7.2.1. ANR	16
7.2.1.1. SensLAB	16
7.2.1.2. RESCUE	16
7.2.1.3. WINGS	17
7.2.1.4. F-Lab	17
7.2.1.5. BinThatThinks	17
7.2.2. ARC	18
7.2.3. ADT	18
7.2.3.1. SenSas	18
7.2.3.2. SensLille	18
7.2.4. Equipements d'Excellence	18
7.3. European Initiatives	19
7.3.1. FP7 Projet	19
7.3.1.1. SECURE CHANGE	19
7.3.1.2. ASPIRE	19
7.3.2. Collaborations in European Programs, except FP7	20
8. Dissemination	21
8.1. Animation of the scientific community	21
8.1.1. Conference organization	21
8.1.2. Invited talks	21
8.1.3. Editorial activity	21
8.1.4. Misc	22
8.2. Teaching	22
9. Bibliography	24

Project-Team POPS

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2. Overall Objectives

2.1. Overall Objectives

The POPS research group studies solutions to improve programmability, adaptability and reachability of “POPS” (Portable Objects Proved to be Safe). The POPS family contains small and limited devices like smart cards, RFID tags (see Fig. 1) [50], wireless sensors (see Fig. 3) [48] or personal digital assistants. Such small devices are characterized by limited resources, high mobility, frequent disconnections, low-bandwidth communications, passive (no battery) or limited battery life and reduced storage capacity. Moreover, in spite of these constraints and because of the use in an untrusted environment, users and applications require high security level for POPS. The development of applications integrating POPS suffers from lack of “reachability” of such platforms. For instance, software development is penalized by exotic and limited operating systems. Indeed, POPS, such as smart cards, are difficult to program and high level of expertise is needed to produce software. Some efforts were taken recently with the advent of Java Cards [45], PalmOS or Windows CE. But Java Card offers a very small part of Java API and a typical application written in Java cannot be directly translated to Java Card. POPS mobility induces sudden and frequent disconnections, long round trip times, high bit error rates and small bandwidth. Hence, POPS systems have to adapt themselves to application requirements or modification of the environment.



Figure 1. Example of RFID tags.

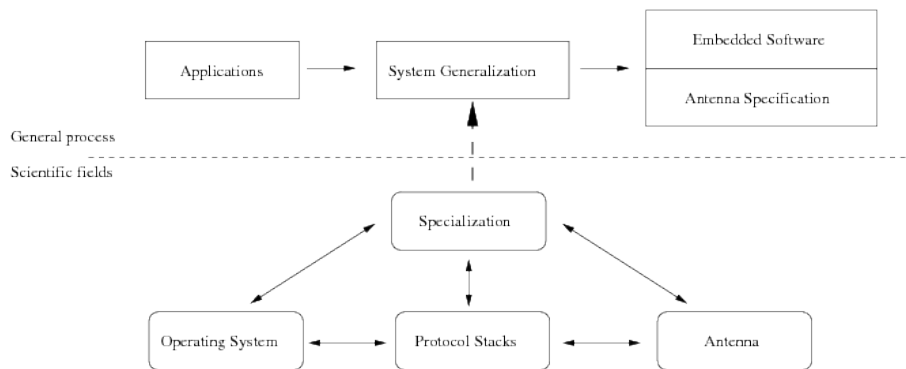


Figure 2. POPS' thematics and objectives.

Indeed, the application should guide the system. Therefore, the POPS research group aims to propose a generic approach allowing any application to specialize the system according to its own needs and characteristics (See Fig. 2). Since POPS are limited in capacity, specializing the system for the application will allow to embed much less code and functionalities.

POPS research action takes advantage of its strong partnership with Gemplus/Gemalto since more than 19 years. This collaboration brings both partners (the POPS research group of INRIA and Gemplus/Gemalto) to

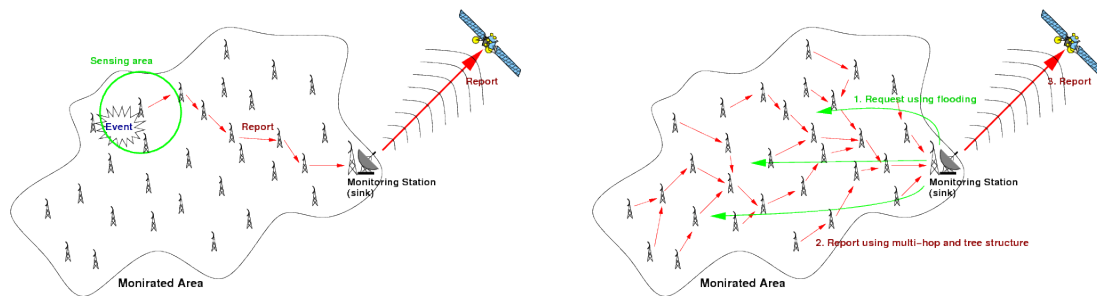


Figure 3. Example of a sensor network with event-driven (left) and on-demand (right) models.

high level of expertise in embedded operating system design and mobile networking which are our two main research activities.

3. Scientific Foundations

3.1. Embedded Operating Systems

We focus our activities on “adaptability” and on “connectivity” of embedded platforms dedicated to POPS. From then on, our researches have evolved around the smart card. In fact, in the nineties (birth date of POPS research group) smart card was the only valuable and industrially deployed POPS. Smart card integration in database management systems, smart card integration in Corba (using the Card Object Adapter), open platform for smart card (the first smart card virtual machine), have been milestones of the POPS research. More recently, we have focused our attention (according to our industrial inputs) on embedded operating system techniques, enabling “on-card” type checking and bytecode compression. Today, smart card manufacturers and other emerging POPS manufacturers have to deal with new technological ‘lock-in’ inside and outside the mobile object. Dedicated operating systems are now powerful enough to run dynamically downloaded applications in a safe way. Typically, Java Card loads and runs a Java-like bytecode. Nevertheless, “Java-like” means “non-Java”. Embedded virtual machines do not support standard abstractions. And so, Java applications cannot be deployed in a limited embedded system. On the other hand, embedded applications do not limit their needs to the Java APIs. To overcome these limitations, we will focus on two complementary studies:

1. Firstly we study a new architectural way to embed a Java virtual machine. Conventional virtual machines are not operating systems but they overlap the abstractions proposed by the system. We plan to define a Java virtual machine designed to be the operating system (the virtual machine will manage the hardware itself).
2. Java is one of the possible hardware abstractions. However different applications require different abstractions: file-system, database systems, and so on. Camille OS is a smart card Exo-kernel enabling the download of different hardware abstractions in a safe way. In this way Camille ensures POPS “adaptability” to the applications requirements. Nevertheless some critical system extensions (enhanced IO protocols for example) need additional guaranties: real-time properties and hardware resources control.

3.2. Mobile Networking

POPS also have a non-conventional communication interface. Due to their mobility, they have transient and unpredictable communications with other entities. This fact motivates our focusing on the ad hoc network communication model which is the most flexible model.

Indeed wireless ad hoc networks [51], [46], [47], [44] encompass a wide range of self-organized network types, including sensor, mobile ad hoc, personal area, and rooftop/mesh networks. The design of data communication techniques in multi-hop ad hoc networks comprises challenges at all layers of communication: physical, medium access control (MAC), network, transport and application layers. This research project concentrates on the network layer. The network layer problems can be divided into three groups: data communication, service access, and topology control problems. Data communication problems include routing, quality-of-service routing, geocasting, multicasting, and broadcasting. The protocols need to minimize the communication overhead (since bandwidth in wireless communication is typically limited) and the power consumption of battery operated POPS. In service access problems, such as multi-hop wireless Internet (hybrid network, see Fig. 4), the goal is to provide or receive services from a fixed infrastructure with other hosts serving as relays if necessary. Topology control problems include neighbor discovery problems (detecting neighboring nodes located within transmission radius) and network organization problems (deciding what communication links to establish with neighboring nodes, operating sleeping period and adjusting transmission radii). Secure routing faces the following challenges: node selfishness, threats using modification of routing information, misrepresenting identity, fabrication of routing messages by one node, or between two malicious nodes (wormhole attack), and self-organized public-key management and authentication services. The main paradigm shift is to apply localized (or greedy) schemes as opposed to existing protocols requiring global information. Localized algorithms are distributed algorithms where simple local node behavior achieves a desired global objective. Localized protocols provide scalable solutions, that is, solutions for wireless networks with an arbitrary number of nodes, which is one of the main goals of this research project.

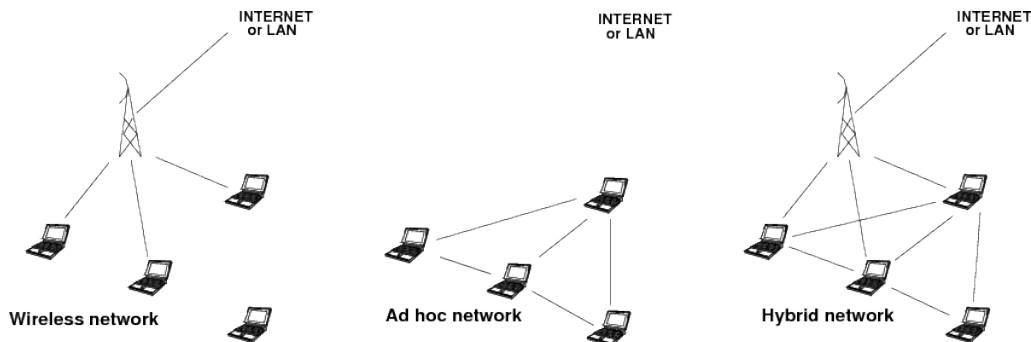


Figure 4. From wireless network to hybrid networks.

4. Software

4.1. ASPIRE TDT

Participants: Nathalie MITTON, Loic Schmidt [correspondant], David Simplot-Ryl.

Tag Data Translation (TDT) is an EPCglobal Inc. standard allowing the translation of identifiers EPC in different representation standard. EPCglobal standards deal only EPC identifiers. We have extended it to other RFID GS1 and smartcard standards (as ISO 14443 or 15693 and EAN/UPC).

See also the web page <http://wiki.aspire.ow2.org/xwiki/bin/view/Main.Documentation/TDT>.

- Version: version 0.5

4.2. ASPIRE ALECC

Participants: Nathalie MITTON [correspondant], David Simplot-Ryl, Lei Zhang.

According to the feedback of several RFID application SMEs. They are more likely to accept a light and efficient ALE scheme which only includes the most-used basic modules defined by EPC standard. They desire that such light scheme can be encapsulated and be flexibly used to establish their own RFID application.

The AspireALECC scheme is encapsulated in jar and aims to supply an easy and efficient framework for developers to realize the most used basic operations defined by the EPC ALECC standard.

- Version: 1.0

4.3. EPC TAG CONVERTER

Participants: Roudy Dagher [correspondant], Nathalie MITTON, Loic Schmidt, David Simplot-Ryl.

This module is an EPC-compliant module that aims to convert any tag format into an EPC tag understandable by the middleware.

- Version: 1.0

4.4. EPC TAG GENERATOR

Participants: Roudy Dagher [correspondant], Nathalie MITTON, Loic Schmidt, David Simplot-Ryl.

This module aims to generate tag ids in hexadecimal format in order to validate the EPC grouping and filtering engines of the ALE.

See also the web page <http://wiki.aspire.ow2.org/xwiki/bin/view/Main.Documentation.EmbeddedTools/TagGenerator>.

- Version: 1.0

4.5. EVe - TCF

Participants: Arnaud Fontaine, Isabelle Simplot-Ryl [correspondant].

Verification of transitive control flow policies on JavaCard 2.x bytecode. Control flow policies expressed using a DSL language are embedded in JavaCard packages (CAP files) using EVe-TCF convert tool. Control flow policies are then statically verified on-device at loading-time thanks to an embedded verifier (designed for smart cards in EVe-TCF). EVe-TCF (Embedded Verifier for Transitive Control Flow) also contains an off-device (i.e. PC tool) to simulate on-device loading process of JavaCard 2.x platforms with GlobalPlatform 2.x installed.

- Version: v2.0 - 07/09/2011

4.6. GOLIATH 1.0

Participants: Tony Ducrocq, Nathalie MITTON, David Simplot-Ryl [correspondant], Julien Vandaele.

GOLIATH (Generic Optimized LIghtweight communication stack for Ambient TecHnologies) is a full protocol stack for wireless sensor networks.

4.7. JITS

Participants: Geoffroy Cogniaux, Gilles GRIMAUD [correspondant].

Initial goal of Java was to allow high level software development on small devices. Eventually it founds success and promotion with software deployment on the Web, and more recently as a solution for huge enterprise servers and massive parallel computing. Today small targets are still supported, but with dedicated (Java-like) APIs and VMs. These specific technologies dramatically restrain the context in which Java applications can be deployed.

JITS focuses on these technologies and on enhancements to allow the use of a real Java Runtime Environment and a Java Virtual Machine everywhere by targeting tiny devices such as SmartCards. These devices usually don't use a Virtual Machine layer over an OS, but expect the Virtual Machine to be the OS. This is possible thanks to the JVM features which can be presented as a specific hardware abstraction for most of them.

See also the web page <http://jits.gforge.inria.fr/>

- Version: 1

4.8. Light ALE

Participants: Roudy Dagher [correspondant], Nathalie Mitton, Loic Schmidt, David Simplot-Ryl.

In order to provide minimal inventory services, at interface level, subsets of the Reading and the Logical Reader APIs are implemented : (1) Immediate mode : sufficient for user-triggered inventory. (2) Fixed readers configuration : only some properties (Power, Session and InitialQ) can be updated.

The ALE engine manages tag grouping and filtering according to EPC standard patterns in input ECSpec objects. A lightweight custom CODEC was developed as well, in order to decode tag IDs using binary format (array of bytes) and in a garbage-free fashion. A filter engine is also made available for software filtering of tags. This leaves the choice for Reader Connectors to choose the best tradeoff between software and hardware filtering. Note that, because of the Java CDC constraint, the ECSpec and ECReports classes and subclasses were written manually despite of automatic generation from XSD files.

See also the web page <http://wiki.aspire.ow2.org/xwiki/bin/view/Main.Documentation.Filtering%26Collection/EmbeddedALE>.

- Version: 1.0

4.9. Light RP

Participants: Roudy Dagher [correspondant], Nathalie Mitton, Loic Schmidt, David Simplot-Ryl.

This wrapper defines the Reader Protocol interface classes that are used to dialog with an RP-compliant reader device. Based on each vendor-specific driver, two implementations were developed in order to provide minimal required services (inventory). Note that the communication with the Reader Device is done locally and directly via method calls. This avoids overhead when using MTB layers for message bindings.

See also the web page <http://wiki.aspire.ow2.org/xwiki/bin/view/Main.Documentation/LightRP>.

- Version: 1.0

4.10. NFC Light ALE

Participants: Nathalie Mitton [correspondant], Loic Schmidt, David Simplot-Ryl, Lei Zhang.

In order to provide minimal inventory services, at interface level, subsets of the Reading and the Logical Reader APIs are implemented : (1) Immediate mode : sufficient for user-triggered inventory. (2) Fixed readers configuration : only some properties (Power, Session and InitialQ) can be updated.

The ALE engine manages tag grouping and filtering according to EPC standard patterns in input ECSpec objects. A lightweight custom CODEC was developed as well, in order to decode tag IDs using binary format (array of bytes) and in a garbage-free fashion. A filter engine is also made available for software filtering of tags. This leaves the choice for Reader Connectors to choose the best tradeoff between software and hardware filtering. Note that, because of the Java CDC constraint, the ECSpec and ECReports classes and subclasses were written manually despite of automatic generation from XSD files. This package has been developed for NFC connection on a mobile phone.

- Version: 1.0

4.11. RFID Tag Searcher

Participants: Roudy Dagher [correspondant], Nathalie Mitton, Loic Schmidt, David Simplot-Ryl.

The objective is to use the PDA to look for an item in a given neighborhood. The user would be notified of item proximity via the change of the beep frequency.

Tag Searcher is composed of three main modules:

- The Reader interface is an abstraction of the required services for searching for a tag at a given RF power. The wrappers for CAEN and Intermec readers are straightforward.
- The Ticker class represents a periodic thread that beeps periodically using the standard java call `java.awt.Toolkit.getDefaultToolkit.beep()`. The ticker's period is synchronized inside the `PeriodSemaphore` class.
- The Scanner class is able to scan for a tag ID and update the Ticker period according to the RF power at which the tag was observed : observation at a small RF power leads to a small tick period, and vice versa.

After testing on both PDAs (i.e. Psion, Intermec), a standalone application with an IHM was developed. It is able to retrieve a list (from a local file or an URL) so that the user choose the item to search for. See also the web page <http://wiki.aspire.ow2.org/xwiki/bin/view/Main.Documentation.EmbeddedTools/TagSearcher>.

- Version: 1.0

4.12. SINGLE

Participants: Tony Ducrocq, Nathalie Mitton, David Simplot-Ryl [correspondant].

SINGLE pour Simple IN-door Geo-Localization systEm est une application pour réseaux de capteurs permettant la localisation géographique de capteurs sans fils dans un environnement intérieur.

See also the web page <http://www.senslab.info/>.

- Version: 1.0

5. New Results

5.1. RFID and Internet of Things

Participants: Roudy Dagher, Nathalie Mitton, Roberto Quilez, Loic Schmidt, David Simplot-Ryl, Lei Zhang.

5.1.1. Reader anti-collision protocol

In a Radio-Frequency IDentification network, while several readers are placed close together to improve coverage and consequently read rate, reader-reader collision problems happen frequently and inevitably. High probability of collision not only impairs the benefit of multi-reader deployment, but also results in misreadings in moving RFID tags. In order to eliminate or reduce reader collisions, we propose in [28] an Adaptive Color based Reader Anti-collision Scheduling algorithm (ACoRAS) for 13.56 MHz RFID technology where every reader is assigned a set of colors that allows it to read tags during a specific time slot within a time frame. Only the reader holding a color (token) can read at a time. Due to application constraints, the number of available colors should be limited, a perfect coloring scheme is not always feasible. ACoRAS tries to assign colors in such a way that overlapping areas at a given time are reduced. To the best of our knowledge ACoRAS is the first reader anti-collision algorithm which considers, within its design, both application and hardware requirements in reading tags. We show, through extensive simulations, that ACoRAS outperforms several anticollision methods and detects more than 99% of mobile tags while fitting application requirements.

5.1.2. Distributed ALE

Following the Internet of Things concept [14], each object is associated with a unique identifier which will allow to retrieve information about it in large databases. In the process of managing a large amount of objects, and consequently a large amount of events from readers, without overloading the network, these events have to be filtered and aggregated. This is the aim of the Application Level Events (ALE) standard from EPCglobal, which receives events from readers and sends a useful and well constructed report to the business application. The ALE may be connected to several hundreds of readers. As the number of readers may increase with the increase of the company, a bottleneck may appear with all readers events sent to the ALE. A solution for scalability is to distribute the ALE. In [37], we propose an efficient way to solve this problem based on a Distributed Hash table (DHT). One role of the ALE is to insulate business application from technical concern so in our solution, we present a mechanism to distribute the ALE using Chord, a well-known peer-to-peer lookup system, and being transparent for business applications. This solution is compliant with the EPCglobal existing standard, scalable, robust and transparent for other layers of the middleware. We show that our solution generates only 10% overhead than in a nominal case while offering a better robustness and scalability when numbers of tags and readers increase significantly.

5.1.3. Advance Internet of Things

The Internet of Things (IoT) is a network of Internet-enabled objects, whose original purpose would be to interconnect all things in our daily life to build an always connected world. However, most of studies in the current IoT scientific community only focus on the radio-frequency identification (RFID) and wireless sensor network (WSN) based objects and lose the generality features endowed by the original definition of IoT. Furthermore, the emergence and proliferation of smart objects have been significantly changing our daily lives. It has been becoming evident that the objects should far beyond only "be identified and interconnected", but can also be controlled in an intelligent and transparent way independent of third party object (user) profiles and space and time span. In [39], we proposes a standardization scheme for a new paradigm: Advanced Internet of Things (AIoT), which is based on our proposed Unified Object Description Language (UODL) and allows to identify and interconnect every object and event with a standard format, and makes it easier and flexible for the third party control and management by integrating multiple services issued from cloud computing. The purpose of our proposed AIoT scheme is to build a smart world of always on, always-awareness, always-connected, always-controllable, and establish an "intelligent networking" based relationship among the objects, service suppliers and the third party users. In the scope of AIoT, all the objects are transparent across the networks and can be identified and controlled (with security guarantees) via a standard prototype anytime and anywhere.

5.2. Topology control and neighbor discovery

Participants: Xu Li, Nathalie Mitton, Jovan Radak, David Simplot-Ryl, Isabelle Simplot-Ryl.

5.2.1. Topology control

Topology control is a tool for self-organizing wireless networks locally. It allows a node to consider only a subset of links/neighbors in order to later reduce computing and memory complexity. Topology control in wireless sensor networks is an important issue for scalability and energy efficiency. It is often based on graph reduction performed through the use of Gabriel Graph or Relative Neighborhood Graph. This graph reduction is usually based on geometric values.

In [35] we tackle the problem of possible connectivity loss in the reduced graph by applying a battery level based reduction graph. Experiments are conducted to evaluate our proposition. Results are compared with RNG [52] reduction which takes into account only the strength of the received signal (RSSI). Results show that our algorithm maintains network connectivity longer than solutions from the literature and balances the energy consumption over nodes.

In [31], we propose a radically new family of geometric graphs, i.e., Hypocomb, Reduced Hypocomb and Local Hypocomb for topology control. The first two are extracted from a complete graph; the last is extracted from a Unit Disk Graph (UDG). We analytically study their properties including connectivity, planarity and degree bound. All these graphs are connected (provided the original graph is connected) planar. Hypocomb has unbounded degree while Reduced Hypocomb and Local Hypocomb have maximum degree 6 and 8, respectively. To our knowledge, Local Hypocomb is the first strictly-localized, degree-bounded planar graph computed using merely 1-hop neighbor position information. We present a construction algorithm for these graphs and analyze its time complexity. Hypocomb family graphs are promising for wireless ad hoc networking. We report our numerical results on their average degree and their impact on FACE [49] routing. We discuss their potential applications and some open problems.

5.2.2. Neighbor discovery

To perform topology control, a node needs to discover its neighbors. Hello protocol is the basic technique for neighborhood discovery in wireless ad hoc networks. It requires nodes to claim their existence/aliveness by periodic "hello" messages. Central to a hello protocol is the determination of hello message transmission rate. No fixed optimal rate exists in the presence of node mobility. The rate should in fact adapt to it, high for high mobility and low for low mobility. In [30], we propose a novel mobility prediction based hello protocol, named ARH (Autoregressive Hello protocol). Each node predicts its own position by an ever-updated autoregression-based mobility model, and neighboring nodes predict its position by the same model. The node transmits "hello" message (for location update) only when the predicted location is too different from the true location (causing topology distortion), triggering mobility model correction on both itself and each of its neighbors. ARH evolves along with network dynamics, and seamlessly tunes itself to the optimal configuration on the fly using local knowledge only. Through simulation, we demonstrate the effectiveness and efficiency of ARH, in comparison with the only competitive protocol TAP (Turnover based Adaptive hello Protocol). With a small model order, ARH achieves the same high neighborhood discovery performance as TAP, with dramatically reduced message overhead (about 50% lower hello rate).

5.2.3. Address allocation

In [9], we propose a localized address autoconfiguration (LaConf) scheme for wireless ad hoc networks. Address allocation information is maintained on the network border nodes, called addressing agents (AAs), which are locally identified by a geographic routing protocol GFG (Greedy-FACE-Greedy). When a node joins the network, it acquires an address from a neighboring AA (if any exists) by local communication or from the head AA (a geographic extreme AA) by GFG-based multi-hop communication. A Geographic Hash Table (GHT) is adopted for duplicate address detection. Each address is hashed to a unique location in the network field, and the associated assignment information is stored along the face perimeter enclosing that location (in the planar graph). When a node receives an address assignment, it consults with the perimeter nodes around the hash location of the assigned address about any conflicts. AAs detect network partitions and mergers locally according to neighborhood change and triggers AA re-selection and network re-configuration (if necessary). We propose to apply a Connected Dominating Set (CDS) to improve the performance. We also evaluate LaConf through simulation using different planar graphs.

5.3. Routing

Participants: Nicolas Gouvy, Xu Li, Nathalie Mitton, David Simplot-Ryl.

In mobile wireless sensor networks, flows sent from data collecting sensors to a sink could traverse inefficient resource expensive paths. Such paths may have several negative effects such as devices battery depletion that may cause the network to be disconnected and packets to experience arbitrary delays. This is particularly problematic in event-based sensor networks (deployed in disaster recovery missions) where flows are of great importance. In [27], we use node mobility to improve energy consumption of computed paths. Mobility is a two-sword edge, however. Moving a node may render the network disconnected and useless. We propose CoMNet (Connectivity preservation Mobile routing protocol for actuator and sensor NETWORKS), a localized mechanism that modifies the network topology to support resource efficient transmissions. To the best of

our knowledge, CoMNet is the first georouting algorithm which considers controlled mobility to improve routing energy consumption while ensuring network connectivity. CoMNet is based on (i) a cost to progress metric which optimizes both sending and moving costs, (ii) the use of a connected dominating set to maintain network connectivity. CoMNet is general enough to be applied to various networks (actuator, sensor). Our simulations show that CoMNet guarantees network connectivity and is effective in achieving high delivery rates and substantial energy savings compared to traditional approaches. CoMNET has then been extended in [26] to multi-hop movement.

In [12] we propose a novel localized Integrated Location Service and Routing (ILSR) scheme, based on the geographic routing protocol GFG, for data communications from sensors to a mobile sink in wireless sensor networks. The objective is to enable each sensor to maintain a slow-varying routing next hop to the sink rather than the precise knowledge of quick-varying sink position. In ILSR, sink updates location to neighboring sensors after or before a link breaks and whenever a link creation is observed. Location update relies on flooding, restricted within necessary area, where sensors experience (next hop) change in GFG routing to the sink. Dedicated location update message is additionally routed to selected nodes for prevention of routing failure. Considering both unpredictable and predictable (controllable) sink mobility, we present two versions. We prove that both of them guarantee delivery in a connected network modeled as unit disk graph. ILSR is the first localized protocol that has this property. We further propose to reduce message cost, without jeopardizing this property, by dynamically controlling the level of location update. A few add-on techniques are as well suggested to enhance the algorithm performance. We compare ILSR with an existing competing algorithm through simulation. It is observed that ILSR generates routes close to shortest paths at dramatically lower (90% lower) message cost.

In [29], we propose a novel trust management scheme for improving routing reliability in wireless ad hoc networks. It is grounded on two classic autoregression models, namely Autoregressive (AR) model and Autoregressive with exogenous inputs (ARX) model. According to this scheme, a node periodically measures the packet forwarding ratio of its every neighbor as the trust observation about that neighbor. These measurements constitute a time series of data. The node has such a time series for each neighbor. By applying an autoregression model to these time series, it predicts the neighbors future packet forwarding ratios as their trust estimates, which in turn facilitate it to make intelligent routing decisions. With an AR model being applied, the node only uses its own observations for prediction; with an ARX model, it will also take into account recommendations from other neighbors. We evaluate the performance of the scheme when AR, ARX or a previously proposed Bayesian model is used. Simulation results indicate that the ARX model is the best choice in terms of accuracy.

5.4. Self-deployment, localization and area coverage

Participants: Milan Erdelj, Xu Li, Enrico Natalizio, Nathalie Mitton, Tahiry Razafindralambo, David Simplot-Ryl, Isabelle Simplot-Ryl.

5.4.1. Deployment

First steps in order to perform any task, a network needs to be deployed and nodes need to discover each others. To the best of our knowledge, very few scenarios when robots self-deploy to afterwards themselves constitute the network nodes or drop off sensor nodes have been investigated so far and none of them ensure the network connectivity at every step. In [15], we consider the self-deployment of wireless sensor networks. We present a mechanism which allows to preserve network connectivity during the deployment of mobile wireless sensors. Our algorithm is localized and is based on a subset of neighbors for motion decision. Our algorithm maintains a connected topology regardless of the direction chosen by each sensor. To preserve connectivity, the distance covered by the mobile nodes is constrained by the connectivity of the node to its neighbors in a connected subgraph like the relative neighborhood graph. We show the connectivity preservation property of our algorithm through analysis and present some simulation results on different deployment schemes such as full coverage, point of interest coverage or barrier coverage.

Another approach is the one proposed in [34] in which node placement is performed off-line with objective to optimize a criterion. Based on the specific application, different objectives can be taken into account such as energy consumption, throughput, delay, coverage, etc. Also many schemes have been proposed in order to optimize a specific quality of service (QoS) parameter. Power consumption is an essential issue in wireless multimedia sensor networks (WMSNs) due to the elevated processing capabilities requested by the video acquisition hardware installed on the generic sensor node. Hence, node placement scheme in WMSNs greatly impacts the overall network lifetime. [34] first proposes a suitable hardware architecture to implement a feasible WMS node based on off-the-shelf technology, then it evaluates the energy consumption obtained throughout a wise "energy-spaced" placement of the wireless nodes without affecting the video quality of multimedia traffic. In [4], we propose to use a neural network as a controller for nodes mobility and a genetic algorithm for the training of the neural network through reinforcement learning. This kind of scheme is extremely adaptive, since it can be easily modified in order to consider different objectives and QoS parameters. In fact, it is sufficient to consider a different kind of input for the neural network to aim for a different objective. All things considered, we propose a new method for programming a WSRN and we show practically how the technique works, when the coverage of the network is the QoS parameter to optimize. Simulation results show the flexibility and effectiveness of this approach even when the application scenario changes (e.g., by introducing physical obstacles).

5.4.2. Coverage

The coverage of Points of Interest (PoI) is a classical requirement in mobile wireless sensor applications. Optimizing the sensors self-deployment over a PoI while maintaining the connectivity between the sensors and the sink is thus a fundamental issue. [22] addresses the problem of autonomous deployment of mobile sensors that need to cover a predefined PoI with a connectivity constraints and provides the solution to it using Relative Neighborhood Graphs (RNG) [52]. Our deployment scheme minimizes the number of sensors used for connectivity thus increasing the number of monitoring sensors. Analytical results, simulation results and real implementation are provided to show the efficiency of our algorithm. To the best of our knowledge, only [21] both preserves the network connectivity and validates its proposition through experimentations with real wireless robots. This work has been extended to discovery and coverage of multi-point of interested in [21]. Indeed, the problems of multiple PoI coverage, environment exploration and data report are still solved separately and there are no works that combine the aforementioned problems into a single deployment scheme. In [21], we present a novel approach for mobile sensor deployment, where we combine multiple PoI coverage with network connectivity preservation and environment exploration in order to capture the dynamics of the monitored area. We examine the performance of our scheme through extensive simulation campaigns.

As sensors are energy constrained devices, one challenge in wireless sensor networks (WSNs) is to guarantee coverage and meanwhile maximize network lifetime. In [7], we leverage prediction to solve this challenging problem, by exploiting temporal-spatial correlations among sensory data. The basic idea lies in that a sensor node can be turned off safely when its sensory information can be inferred through some prediction methods, like Bayesian inference. We adopt the concept of entropy in information theory to evaluate the information uncertainty about the region of interest (RoI). We formulate the problem as a minimum weight submodular set cover problem, which is known to be NP hard. To address this problem, an efficient centralized truncated greedy algorithm (TGA) is proposed. We prove the performance guarantee of TGA in terms of the ratio of aggregate weight obtained by TGA to that by the optimal algorithm. Considering the decentralization nature of WSNs, we further present a distributed version of TGA, denoted as DTGA, which can obtain the same solution as TGA. The implementation issues such as network connectivity and communication cost are extensively discussed. We perform real data experiments as well as simulations to demonstrate the advantage of DTGA over the only existing competing algorithm and the impacts of different parameters associated with data correlations on the network lifetime.

5.4.3. Localization

In mobile-beacon assisted sensor localization, beacon mobility scheduling aims to determine the best beacon trajectory so that each sensor receives sufficient beacon signals with minimum delay. We propose a novel

Deterministic beacon Mobility Scheduling (DREAMS) algorithm [32], [10], without requiring any prior knowledge of the sensory field. In this algorithm, beacon trajectory is defined as the track of depth-first traversal (DFT) of the network graph, thus deterministic. The mobile beacon performs DFT under the instruction of nearby sensors on the fly. It moves from sensor to sensor in an intelligent heuristic manner according to RSS (Received Signal Strength)-based distance measurements. We prove that DREAMS guarantees full localization (every sensor is localized) when the measurements are noise-free. Then we suggest to apply node elimination and topology control (Local Minimum Spanning Tree) to shorten beacon tour and reduce delay. Through simulation we show that DREAMS guarantees full localization even with noisy distance measurements. We evaluate its performance on localization delay and communication overhead in comparison with a previously proposed static path based scheduling method.

5.5. Platforms and Substitution Networks

Participants: Tony Ducrocq, Lucie Jacquelin, Milan Erdelj, Karen Miranda, Nathalie Mitton, Enrico Natalizio, Jovan Radak, Priyanka Rawat, Tahiry Razafindralambo, Loic Schmidt, David Simplot-Ryl, Julien Vandaele.

5.5.1. Platforms

In the framework of the ANR SensLAB project, a wireless sensor testbed has been set up in Lille in order to allow the evaluation through experimentations of scalable wireless sensor network protocols and applications. All functionalities offered by the platform have then been presented in [17], [16], [42]. SensLAB's main and most important goal is to offer an accurate open access multiusers scientific tool to support the design, the development tuning, and the experimentation of real large-scale sensor network applications. The SensLAB testbed is composed of 1024 nodes over 4 sites. Each site hosts 256 sensor nodes with specific characteristics in order to offer a wide spectrum of possibilities and heterogeneity. Within a given site, each one of the 256 nodes is able both to communicate via its radio interface to its neighbors and to be configured as a sink node to exchange data with any other "sink node". The hardware and software architectures that allow to reserve, configure, deploy firmwares and gather experimental data and monitoring information are described. We also present demonstration examples to illustrate the use of the SensLAB testbed and encourage researchers to test and benchmark their applications/protocols on a large scale WSN testbed. A survey of platforms similar to SensLAB can be found in [6].

5.5.2. Emulation

Although some platforms like SensLAB are very convenient, they do not always fit the application requirements and setting up experimental testbed of large scale wireless sensor networks requires huge cost, space and human resources. A more affordable approach is needed to provide preliminary insights on network protocols performance. To overcome the need for significant number of sensors required to perform a realistic experiment, and/or to experiments with high density networks, we introduce in [43] a novel approach: emulation by using all available sensors as candidate forwarding neighbors of the node S currently holding the packet. Destination position is virtual. After successfully sending message to forwarding node B over realistic wireless channel, the position of virtual destination is adjusted by translating it for vector BS and possibly rotating it to change the neighborhood configuration. The same node S then again selects new forwarding neighbor. Such selection of best forwarding neighbor continues until virtual destination appears close to a real node, and the later then becomes final destination node. Compared to real testbeds, our emulation has advantages of testing networks with very large densities (which may not be possible in small scale implementations), and in unlimited scalability of our physical implementations (e.g. we can emulate network with a million nodes).

5.5.3. Substitution network

A substitution network is a rapidly deployable backup wireless solution to quickly react to network topology changes due to failures or to flash crowd effects on the base network. Unlike other ad hoc and mesh solutions, a substitution network does not attempt to provide new services to customers but rather to restore and maintain at least some of the services available before the failure. Furthermore, a substitution network is not deployed

directly for customers but to help the base network to provide services to customers. Therefore, a substitution network is not, by definition, a stand-alone network. [36] describes the quality of service architecture for substitution networks and discuss provisioning, maintenance, and adaptation of QoS inside and between the base network and the substitution network. In the same context, [33] shows the impact of the router mobility on the QoS of such networks.

5.6. Data collection and management

Participants: Thierry Delot, Geoffroy Cogniaux, Arnaud Fontaine, Alia Ghaddar, Michael Hauspie, Samuel Hym, Xu Li, Nathalie Mitton, Tahiry Razafindralambo, David Simplot-Ryl, Isabelle Simplot-Ryl.

5.6.1. Data collection

Wireless sensors networks (WSNs) are deployed to collect huge amounts of data from the environment. This produced data has to be delivered through sensor's wireless interface using multi-hop communications toward a sink. The position of the sink impacts the performance of the wireless sensor network regarding delay and energy consumption especially for relaying sensors. Optimizing the data gathering process in multi-hop wireless sensor networks is, therefore, a key issue. [19] and [18] address the problem of data collection using mobile sinks in a WSN. We provide a framework that studies the trade-off between energy consumption and delay of data collection. This framework provides solutions that allow decision makers to optimally design the data collection plan in wireless sensor networks with mobile sinks.

In [20], [5], we focus on information gathering in vehicular ad hoc networks. Until now, only a few research works have addressed this problem. They have lead to solutions relying on push models, where potentially useful data are pushed towards vehicles. To the best of our knowledge, no work has tackled the use of pull models in VANETs. Such models would allow users to send queries to a set of cars in order to find the desired information. In order to propose such a query processing scheme, the main challenge to address is to route the different results towards their recipient in a highly dynamic network where the nodes move very quickly. To solve this issue, we propose GeoVanet, a DHT-based geographic routing protocol which ensures that the sender of a query can get a consistent answer. Our goal is not to compute the query result "instantaneously" but to ensure that the user will be able to retrieve it within a bounded time. To prove the effectiveness of GeoVanet, an experimental evaluation is provided in the paper. It shows that up to 80% of the available query results are delivered to the user.

Another way to optimize data collection is to send data only when necessary. Knowledge discovery and data analysis in resource constrained wireless sensor networks faces different challenges. One of the main challenges is to identify misbehaviors or anomalies with high accuracy while minimizing energy consumption in the network. In [25], we extend a previous work of us and we present an algorithm for temporal anomalies detection in wireless sensor networks. Our experiments results show that our algorithm can efficiently and accurately detect anomalies in sensor measurements. It also produces low false alarm rate for slow variation time series measurements without harvesting the source of energy.

In data aggregation, sensor measurements from the whole sensory field or a sub-field are collected as a single report at an actor using aggregate functions such as sum, average, maximum, minimum, count, deviation, etc. We propose a localized Delay-bounded and Energy-efficient Data Aggregation (DEDA) protocol [11], [38] for request-driven wireless sensor networks with IEEE 802.11 CSMA/CA MAC layer. This protocol uses a novel two-stage delay model, which measures end-to-end delay using either hop count or degree sum along a routing path depending on traffic intensity. It models the network as a unit disk graph (UDG) and constructs a localized minimal spanning tree (LMST) sub-graph. Using only edges from LMST, it builds a shortest path (thus energy-efficient) tree rooted at the actor for data aggregation. The tree is used without modification if it generates acceptable delay, compared with a given delay bound. Otherwise, it is adjusted by replacing LMST sub-paths with UDG edges. The adjustment is done locally on the fly, according to the DEsired Progress (DEP) value computed at each node. We further propose to integrate DEDA with a localized sensor activity scheduling algorithm and a localized connected dominating set algorithm, yielding two DEDA variants, to improve its energy efficiency and delay reliability. Through an extensive set of simulation, we evaluate the performance of

DEDA with various network parameters. Our simulation results indicate that DEDA far outperforms the only existing competing protocol.

5.6.2. Data management

The use of reliable high-level languages based on virtual machines, such as java, is now possible on systems as small as smart cards or sensors. However, the potential of these languages is widely limited by hardware constraints as memory storage capacity etc. We claim that is lock may be leveraged by coupling cache mechanisms with external memory storages. [40] is a preliminary study of the set up of such an approach. Thanks to simulation based results, we identify three main factors which tend to decrease the performances of cache setting code in Java.

5.6.3. Data security

[41], [24] presents the enforcement of control flow policies for Java bytecode devoted to open and constrained devices. On-device enforcement of security policies mostly relies on run-time monitoring or inline checking code, which is not appropriate for strongly constrained devices such as mobile phones and smart-cards. We present a proof-carrying code approach with on-device lightweight verification of control flow policies statically at loading time. Policies are expressed by finite automata, the technique is in-between security automata and control flow security policies of Jensen et al. Our approach is suitable for evolving, open and constrained Java-based systems as it is compositional, to avoid re-verification of already verified bytecode upon loading of new bytecode, and it is regressive, to cleanly support bytecode unloading.

While mobile devices have become ubiquitous and generally multi-application capable, their operating systems provide few high level mechanisms to protect services offered by application vendors against potentially hostile applications coexisting on the device. In [23], we tackle the issue of controlling application interactions including collusion in Java-based systems running on open, constrained devices such as smart cards or mobile phones. We present a model specially designed to be embedded in constrained devices to verify at install-time that interactions between applications abide by the security policies of each involved application without resulting in run-time computation overheads; this models deals with application (un)installations and policy changes in an incremental fashion. We show the feasibility of our approach and its security enhancements on a multi-application use case for GlobalPlatform/Java Card smart cards. This approach is developed in EVE - TCF.

Telecommunication software systems, containing security vulnerabilities, continue to be created and released to consumers. We need to adopt improved software engineering practices to reduce the security vulnerabilities in modern systems. Contracts can provide a useful mechanism for the identification, tracking, and validation of security vulnerabilities. In [8], we propose a new contract-based security assertion monitoring framework (CB SAMF) that is intended to reduce the number of security vulnerabilities that are exploitable across multiple software layers, and to be used in an enhanced systems development life cycle (SDLC). We show how contract-based security assertion monitoring can be achieved in a live environment on Linux. Through security activities integrated into the SDLC we can identify potential security vulnerabilities in telecommunication systems, which in turn are used for the creation of contracts defining security assertions. Our contract model is then exercised, as runtime probes, against two common security related vulnerabilities in the form of a buffer overflow and a denial of service.

6. Contracts and Grants with Industry

6.1. Gemalto partnership

Participants: Gilles Grimaud [correspondant], Michael Hauspie, Geoffroy Cogniaux.

Since its creation, POPS has been supported by Gemplus/Gemalto within the framework of a partnership agreement that lasts for 19 years. Gemplus/Gemalto has been continuously supported the POPS research activities though fundings and the sharing of experiences and problems between POPS and Gemplus/Gemalto Labs researchers.

POPS has been a provider of innovative technologies for Gemplus/Gemalto thanks to several major patents (including those for a secure interpreter, a database card, a loader-linker of code, or communication protocols for tags), and thanks to thesis and projects such as: the card interpreter CAVIMA (1991), the "blank card" model (1991 and 1995), the CQL card and its integration in ODBC (from 1991 to 1994), a 32-bit RISC architecture for smart cards (1996), a programmable open card and its integration in object-oriented systems (1996), the language for the GemXplore 98 cards (1997), the integration of smart cards in transactional systems (1999), optimized communication protocols for tags (from 1999 to 2001 with Gemplus/Gemalto Tags), the card system CAMILLE (2000), or the card with multiple execution contexts.

Gemplus/Gemalto and POPS have also gained benefits from this partnership through National or European projects in which they participate altogether: CASCADE (IST 4th framework), CESURE (RNRT), COMPiTV (RNTL), RESET (IST 5th framework), and INSPIRED (IST 6th framework).

At that present time, their partnership is mainly focused on embedded operating system research activities (JITS, Camille, and OS customization).

6.2. France Telecom partnership

Participants: Tahiry Razafindralambo [correspondant], Enrico Natalizio.

In this project, we will propose a new energy efficient and QoS aware architecture for wireless rural networks or emerging country networks. Energy efficiency and QoS aware will be included inside the network as primitives and not only optimization criteria.

This project will tackle the raised issue jointly based on the assumption related to the actual architecture and constraints of wireless rural networks.

6.3. Etineo Partnership

Participants: Roudy Dagher, Xu Li, Fadila Khadar, Nathalie Mitton [correspondant].

EtiPOPS will focus on portability and flexibility of GOLIATH on several hardwares and in different environments (indoor and outdoor) through the deployment of different applications such as geolocalization. In order to favor the portability, designed solutions in EtiPOPS will respect on-going communication standards which will allow a greater interoperability between heterogeneous hardwares.

6.4. Noolitic partnership

Participants: Roudy Dagher, Nathalie Mitton [correspondant], Roberto Quilez.

This collaboration aims to set up a localization trial for localization of mobile object in a building based on wireless sensor networks. The idea is to deploy some landmarks (fix sensors) in places to be defined and to equip the mobile objects to other sensors. These sensors must be zigbee compliant for portability purposes.

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. DECARTE

Participants: Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: Developpement de Carton électronique

Type: FUI

Duration: November 2008 - June 2012

Coordinator: Cartonneries de Gondardennes

Others partners: ___Inria POPS___ ___IEMN___ ___CTP___ ___Cascades___ ___IER___
___TagSys___

Abstract: ___DECARTE studies the printing of an UHF RFID tag on packaging in order to reduce manufacturing costs.___

7.1.2. IDC

Participants: Roudy Dagher, Michael Hauspie [correspondant], Nathalie Mitton, David Simplot-Ryl.

Title: Intelligent Data Center

Type: IPER

Duration: November 2010 - June 2012

Coordinator: NooliTic

Others partners: ___Inria POPS___ ___CIV___

Abstract: ___IDC studies wireless sensor network based solution to optimize the server monitoring in data centers. ___

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. SensLAB

Participants: Nathalie Mitton [correspondant], Loic Schmidt, David Simplot-Ryl, Julien Vandaele.

Title: Project Very large scale open wireless sensor network testbed

Type: TLCOM

Duration: December 2007 - December 2011

Coordinator: Inria DNET (Lyon)

Others partners: ___Inria POPS and ASAP___ ___Thales___ ___UPMC___ ___Université de Strasbourg___

See also: ___<http://www.senslab.info/>___

Abstract: ___SensLAB is a group of 1K sensor nodes available as a testbed for distributed embedding sensor network application and distributed systems research. Distributed systems based on networked sensors and actuators with embedded computation capabilities allow for an instrumentation of the physical world at an unprecedented scale and density, thus enabling a new generation of monitoring and control applications. The SensLAB project was started in 2008. As of June 2009, SensLAB was composed of 1024 nodes at 4 sites. Accounts are available to persons affiliated with corporations and universities that host SensLAB nodes but also to any researchers for R&D purpose on request. SensLAB members actively participate in developing tools for the greater good of the community, and as a result each user has a wide choice of tools to use in order to design, compile, simulate, emulate, debug his/her embedded sensor application. There are a number of free, public services / tools / package have been deployed on SensLAB, including drivers, OS portage, network simulator (WSNET) and a software-driven simulator for full platform estimations and debu (WSIM). SensLAB forms the core of the an emerging testbed for the future internet of things technologies. ___

7.2.1.2. RESCUE

Participants: Milan Erdelj, Nathalie Mitton, Karen Miranda, Tahiry Razafindralambo [correspondant], David Simplot-Ryl.

Title: Reseau Coordonne de substitution mobile

Type: VERSO

Duration: December 2010 - December 2013

Coordinator: Inria POPS

Others partners: ___LAAS___ ___UPMC___ ___France Telecom___ ___ENS Lyon___

See also: ___<http://rescue.lille.inria.fr/>___

Abstract: ___In RESCUE, we propose to exploit the controlled mobility of mobile routers to help a base network in trouble provide a better service. The base network may be any access network or metropolitan network (including wired and wireless technologies). Troubles may come from an increase of unplanned traffic, a failure of an equipment, or a power outage.

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 will 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. ____

7.2.1.3. WINGS

Participants: Nathalie Mitton [correspondant], Roberto Quilez, David Simplot-Ryl.

Title: Widening Interoperability for Networking Global Supply Chains

Type: VERSO

Duration: November 2009 - March 2012

Coordinator: GS1

Others partners: ____ Inria POPS ____ UPMC ____ France Telecom ____ AFNIC ____ GR-EYC ____

See also: ____ <http://www.wings-project.fr/> ____

Abstract: ____ This 2-year project focus on a proof-of-concept platform demonstrating the federated ONS model and the interaction with a prototype of Discovery Service. ____

7.2.1.4. F-Lab

Participants: Nathalie Mitton [correspondant], Priyanka Rawat, Tahiry Razafindralambo, David Simplot-Ryl.

Title: Federating Computing Resources

Type: VERSO

Duration: November 2010 - November 2013

Coordinator: UPMC

Others partners: ____ Inria DNet, Planete, POPS ____ Thales ____ ALU ____

See also: ____ <http://f-lab.fr/> ____

Abstract: ____ The F-Lab project works towards enabling an open, general-purpose and sustainable large-scale shared experimental facility that fosters the emergence of the Future Internet. F-Lab builds on a leading prototype for such a facility: the OneLab federation of testbeds. F-Lab will enhance the OneLab federation model with the addition of SensLAB's unique sensor network and LTE-based cellular systems, and develop tools to conduct experiments on these enriched facilities. Project partners include some of France's top academic and industrial research institutions, working together to develop experimental facilities on the Future Internet. F-Lab presents an unique opportunity for the French community to play a stronger role in the design of federation systems; for the SensLAB testbed to reach an international visibility and use; and for the pioneering of testbeds based on LTE technology. ____

7.2.1.5. BinThatThinks

Participants: Tony Ducrocq, Michael Hauspie, Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: BinThatThinks

Type: ECOTECH

Duration: November 2010 - November 2013

Coordinator: Inria ACES (Rennes)

Others partners: ____ Etineo ____ Veolia ____

See also: ____ <http://binthatthink.inria.fr/> ____

Abstract: ____ Efficient dust sorting is a main challenge for the current society. BinThatThinks is a research project that aims to propose a system that makes the collect and sorting easier through the use of RFID and sensors. ____

7.2.2. ARC

7.2.2.1. MISSION

Participants: Milan Erdelj, Nathalie Mitton, Enrico Natalizio, Tahiry Razafindralambo [correspondant], David Simplot-Ryl.

Title: Mobile Substitution Networks

Type: ARC

Duration: January 2010 - December 2011

Coordinator: Inria POPS

Others partners: ___Inria Reso___ ___UPMC___

See also: ___<http://arcmission.lille.inria.fr/>___

Abstract: ___ In MISSION, we study the feasibility of the set up of a substitution network by using mobile robots equipped with one or several wireless technologies. More precisely, the focus is be put on the deployment and re-deployment of robots based on QoS constraints. ___

7.2.3. ADT

7.2.3.1. SenSas

Participants: Nathalie Mitton [correspondant], Lucie Jacquelin, Tahiry Razafindralambo, Julien Vandaele.

Title: Sensor Network Applications

Type: ADT

Duration: November 2010 - November 2014

Coordinator: Inria POPS

Others partners: ___Inria Non-A___ ___Inria D-NET___ ___Inria Planete___ ___Inria NECS___
___Inria DEMAR___ ___Inria MADYNES___ ___Inria AMAZONE___ ___Inria SED___

See also: ___<http://sensas.gforge.inria.fr/>___

Abstract: ___Sensas aims to propose mainly control science application based on wireless sensor and actuator network nodes provided from the work done around senslab and senstools projects. ___

7.2.3.2. SensLille

Participants: Victor Corblin, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: SensLille

Type: ADT

Duration: November 2011 - November 2013

Coordinator: Inria POPS

Abstract: ___SensLille is an ADT that aims to improve SensLab Lille platform by offering new functionalities as the use of electric trains to experiment mobile nodes. ___

7.2.4. Equipements d'Excellence

7.2.4.1. FIT

Participants: Nathalie Mitton [correspondant], Tahiry Razafindralambo, Loic Schmidt, Julien Vandaele.

Title: Future Internet of Things

Type: EquipEx

Duration: March 2010 - December 2019

Coordinator: UPMC

See also: ___<http://fit-equipex.fr/>___

Abstract: ___FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet. ___

FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Equipements d'Excellence" (Equipex) research grant program. Coordinated by Professor Serge Fdida of UPMC Sorbonne Universités and running over a nine-year period, the project will benefit from a 5.8 million euro grant from the French government.____

7.3. European Initiatives

7.3.1. FP7 Projet

7.3.1.1. SECURE CHANGE

Participants: Arnaud Fontaine, Isabelle Simplot-Ryl [correspondant].

Title: Security Engineering for lifelong Evolvable Systems (SecureChange)

Type: COOPERATION (ICT)

Defi: ICT forever yours

Instrument: Integrated Project (IP)

Duration: February 2009 - February 2012

Coordinator: Università degli Studi di Trento (Italy)

Others partners: ___Budapest University of Technology and Economics___ Hungary___
___Gemalto___ France___ ___Katholieke Universiteit Leuven___ Belgium___ ___Smartest-
ing___ France___ ___Open University___ UK___ ___Stiftelsen for industriell og teknisk
forskning ved Norges Tekniske Hogskole___ Norway___ ___Thales___ France___ ___Tele-
fonica Investigacion y Desarrollo Sociedad Anonima Unipersonal___ Spain___ ___Univer-
sity of Innsbruck___ Austrich___ ___Deep Blue___ Italy___ ___Technische Universität Dort-
mund___ Germany___

See also: ___<http://www.securechange.eu/>___

Abstract: ___Software-based systems are becoming increasingly long-living. This was demonstrated strikingly with the occurrence of the year 2000 bug, which occurred because software had been in use for far longer than its expected lifespan. At the same time, software-based systems are getting increasingly security-critical since software now pervades the whole critical infrastructures dealing with critical data of both nations and also private individuals. There is therefore a growing demand for more assurance and more verified security properties of IT systems both during development and at deployment time, in particular also for long living systems. Yet a long lived system also needs to be flexible, to adapt to changes and adjust to evolving requirements, usage and attack models. However, using today's system engineering techniques we are forced to trade flexibility for assurance or vice versa.____

7.3.1.2. ASPIRE

Participants: Nathalie Mitton [correspondant], Loic Schmidt, Lei Zhang, David Simplot-Ryl.

Title: Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications (Aspire)

Type: COOPERATION (ICT)

Instrument: Integrated Project (IP)

Duration: January 2008 - June 2011

Coordinator: Aalborg University (Denmark) (Italy)

Others partners: ___Université Joseph Fourier - Grenoble University - LIG Laboratory___
France___ ___Athens Information Technology___ Greece___ ___Melexis technologies
SA___ Switzerland___ ___Open Source Innovation Ltd___ UK___ ___UEAPME European
Office of Crafts, Trades and SMEs for Standardisation___ Belgium___ ___SENS@P___ Greece___
___Pole Traceability Valence___ France___ ___Instituto Telecomunicacões___ Portugal___

See also: ___ <http://www.fp7-aspire.eu/> ___

Abstract: ___ASPIRE Project (Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications) will change the current RFID deployment paradigm, through introducing and boosting a shift towards royalty-free RFID middleware, while also placing the middleware at the heart of RFID infrastructures. In this paradigm a great deal of an RFID's solution intelligence is place on the middleware, which is freely offered to end-users (particularly SMEs). Accordingly, the RFID middleware can integrate with low-cost hardware, as well as with legacy IT and networking infrastructures of the networked enterprise. To support this paradigm ASPIRE will develop and deliver a lightweight, royalty-free, programmable, privacy friendly, standards-compliant, scalable, integrated and intelligent middleware platform that will facilitate low-cost development and deployment of innovative fully automatic RFID solutions. The above attributes of this middleware platform can be analyzed as follows: (i) Lightweight, (ii) Programmable, (iii) Intelligent, (iv) Standards-Compliant, (v) Scalable, (vi) Privacy-Friendly, (vii) Integrated. ASPIRE will research and provide a radical change in the current RFID deployment paradigm through innovative, programmable, royalty-free, lightweight and privacy friendly middleware. This new middleware paradigm will be particular beneficial to European SME, which are nowadays experiencing significant cost-barriers to RFID deployment ___

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. EGO

Participants: Gilles Grimaud [correspondant], Michael Hauspie, Francois Serman.

Program: EUREKA CATRENE

Project acronym: EGO

Project title: EGO

Duration: 2010 - 2013

Coordinator: Gemalto (France)

Other partners: Atos Worldline (France), Cork Institute of Technologie (Ireland), Continental Automotive (France), IDEX (Norway), Decawave (Ireland), Precise Biometrics (Sweden), STMicroelectronics (France), Tyndall (Ireland)

Abstract: The eGo project offers an innovative way to establish wireless bidirectional channels of communication between objects and users. Using signal transmission via the user's body, every eGo-compliant object you touch is "paired" with the eGo device you carry on you, close to your skin. The objective is to enable very intuitive, very simple applications where touching a device turns into a personalization of such a device to install, for example, the user's rights and credentials. "what you touch is yours". eGo offers a vast horizon of new intuitive applications, making user interfaces as simple as possible. eGo will be prototyped, integrated in several form factors in miniaturized system (System In Package) for new sensors, new batteries, ultra low-power transmitters for intrabody communication (via a natural connector: human skin), a highly secure micro controller comparable to those embedded in smart cards, a large data storage capacity and a high performance, high-speed wireless (Ultra Wide Band) transmitters. Embedded software, including JavaCard technology and secure remote management (Trusted Service Management) for managing services will also be integrated. This web site presents multiple use cases where eGo can add value.

See also: ___ <http://www.ego-project.eu/> ___

8. Dissemination

8.1. Animation of the scientific community

8.1.1. Conference organization

Program (co-)chairs

- Nathalie Mitton is/was program chair or co-program chair for WiSARN-Fall 2011 and IThings 2012.
- Xu Li is/was chair or co-chair for IoT-ET 2012, AdHoc-NOW 2011, WiSARN 2011-Spring, SCNC 2011.

Program committee members (TPC)

- Jean Carle is/was TPC member of AdHoc-Now 2011, PIMRC 2011, ANT 2011, IUTP 2011, IUPT 2012.
- Michael Hauspie is/was in a TPC member for MCCIS 2011.
- Xu Li is/was a TPC member for IPCCC 2011, LCN 2011, MASS 2011, ICNS 2011, FutureTech 2011, IWCMC 2011, PIMRC 2011, IST-AWSN 2011.
- Nathalie Mitton is/was a TPC member for SSS 2011, SensorComm 2011, WWANS 2011, AdHoc-Nets 2011, SETIT 2011, AlgoTel 2011, WiSARN 2011, CMC 2011, CMC 2012, WWASN2012.
- Tahiry Razafindralambo is/was a TPC member for MASS 2011, MSWIM 2011, PE-WASUN 2011.
- Isabelle Simplot-Ryl is/was a TPC member of ICC-AHSN 2012, ICC-WSN 2012, LCN 2011, ICC2011.

Publicity chair

- Nathalie Mitton was/is publicity chair of MASS 2011, AdHocNow 2011, SPECTS 2011 & 2012.
- Tahiry Razafindralambo was publicity chair of AdHocNets 2011.
- Xu Li is/was publicity chair for TPDS Special Issue on Cyber-Physical Systems (2012), DCOSS 2011, iThings 2011, HPCC 2011, UIC 2011, ATC 2011, LOCALGOS 2011.

Misc

- Nathalie Mitton was poster chair of MobiHoc 2011.
- Tahiry Razafindralambo was web chair of AdHocNow 2011.
- Xu Li was/is submission chair for MASS 2011.

8.1.2. Invited talks

- Tahiry Razafindralambo was invited speaker at AdHocNow 2011 and gave a tutorial at WPMC 2011.
- Nathalie Mitton was invited speaker at "RESCOM school", "Les mercredis de la RFID2011", Rencontres Inria Industries, "Les assises de l'embarqué" 2011.
- Xu Li was invited speaker at University of Paderborn, Germany, Chinese Academy of Sciences, Beijing, China and Shanghai Jiaotong University, Shanghai, China.
- David Simplot-Ryl was invited speaker at WiSARN-Fall 2011.

8.1.3. Editorial activity

- Nathalie Mitton and Xu Li are editorial board members of AHSWN since 2011.
- Xu Li is editorial board member of Parallel and Distributed Computing and Networks since 2010.
- Xu Li is associate editor, European Transactions on Telecommunications since 2011

- Nathalie Mitton is guest editor for special issues in Eurasip journal (2011).
- Nathalie Mitton and Xu Li are guest editors of special issue in Springer PPNA (2011)
- Xu Li is guest editor of special issues in Elsevier's COMCOM, JCM and AHSWN (2011)
- Jean Carle is/was reviewer for IJPEDES, IPL, TPDS.
- David Simplot-Ryl is involved in numerous international conferences and workshops (e.g.recently AdHocNets 2011, IEEE MASS 2011, IEEE INFOCOM 2011-2012) and in editorial activities (e.g. special issue in IEEE Network Magazine on the "Internet of Things" or member of associate editor of IEEE Transactions Parallel and Distributed Systems).

8.1.4. Misc

- + Nathalie Mitton was/is member of the ANR programme blanc SIMI3 and expert for ANR ARPEGE program.
- + Nathalie Mitton is a member of the Inria COST-GTAI.

8.2. Teaching

- Jean Carle
 - DUT Informatique : Réseau, 74 h, L1, Université Lille 1, France
 - Informatique : Structure de données, 32 h, L1, Université Lille 1, France
 - Informatique : Réseau avancé, 86 h, L2, Université Lille 1, France
- Gilles Grimaud
 - Licence Informatique : Réseaux, Niveau L3, 54h, Université de Lille 1
 - Master Informatique : Architecture des Systèmes, Niveau M1, 64h, Université de Lille 1
 - Master Informatique : Architecture des réseaux, Niveau M2, 20h, Université de Lille 1
 - Master Informatique : Cryptographie Appliquée, Niveau M2, 12h, Université de Lille 1
 - Master Informatique : Innovation et Initiation à la Recherche, Niveau M2, 12h, Université de Lille 1
 - Master Informatique Enseignement a Distance : Cryptographie Appliquée, Niveau M2, 12h, Université de Lille 1
 - Master Informatique Enseignement a Distance : Innovation et Initiation a la Recherche, Niveau M2, 12h, Université de Lille 1
- Michael Hauspie
 - DUT Informatique : Programmation Système. Niveau L2, 72h. IUT A, Université Lille 1
 - DUT Informatique : Introduction à l'OpenGL. Niveau L2, 3x24h. IUT A, Université Lille 1
 - DUT Informatique : Projet tuteuré. Niveau L2, 16h. IUT A, Université Lille 1
 - Licence Pro. RT-CGIR : Services Réseau. Niveau L3, 60h. IUT A, Université Lille 1
 - Licence Pro. SIL-DA2I : Administration Système. Niveau L3, 35h. IUT A, Université Lille 1
- Samuel Hym
 - Licence : Initiation à la programmation impérative, 54h eqTD, L1, Université Lille 1, France
 - Licence : Automates et logiques, 28h eqTD, L2, Université Lille 1, France
 - Licence : Programmation système, 37,5h eqTD, L3, Université Lille 1, France

Licence : Programmation des systèmes, 38,5h eqTD, L3, Université Lille 1, France
 Licence : Tutorat de stage en entreprise, 4h eqTD, L3, Université Lille 1, France
 Licence : Tutorat d'alternance, 8h eqTD, L3, Université Lille 1, France
 Master : Algorithmique Avancée, Complexité, Calculabilité, 30h eqTD, M1, Université Lille 1, France
 Master : Administration système, 8h eqTD, M2, Université Lille 1, France

- Nathalie Mitton

Licence : Transmission et protocoles 34H EqTD, L3, Université Lille 1, France
 Master : RFID Systems, 8H EqTD, M2, Université Lille 1, France
 Master : RFID and sensor networks, 8H EqTD, M2, Telecom Lille 1, France

- Tahiry Razafindralambo

Licence : Introduction to Networking, 20h, L2, IUT A, Université Lille 1 - GEII, France.
 Master : Network architecture and technology, 12h, M2, Université Lille 1, France.
 Master : Networked Objects, 9h, M2, telecom Lille 1, France.
 Master : Networking, 20h, M2, Université Lille 1 - Master TIIR/Distance, France.

- Marie-Emilie Vogé

Licence : Responsabilité Pédagogique, 18 hEqTD, L2, université Lille 1, France
 Licence : Stage Unix, 6 hEqTD, L2, université Lille 1, France
 Licence : Algorithmes et Structures de Données, 36 hEqTD, L2, université Lille 1, France
 Licence : Algorithmique, 108 hEqTD, L2, université Lille 1, France
 Licence : Algorithmique, 69 hEqTD, L3, université Lille 1, France
 Master : Algorithmique Avancée et Complexité, 28 hEqTD, M1, université Lille 1, France

PhD & HdR :

HdR : Nathalie Mitton, INTERNET DES OBJETS, AUTO-ORGANISATION ET PASSAGE A L'ECHELLE, Université Lille 1, May 26th 2011

PhD : Alia Ghaddar, IMPROVING THE QUALITY OF AGGREGATION USING DATA ANALYSIS IN WSNS, Université Lille 1, December 2nd 2011, Tahiry Razafindralambo and Isabelle Simplot-Ryl

PhD : Jovan Radak, Algorithms for Realistic Wireless Sensor Networks, Université Lille 1, December 15th 2011, Nathalie Mitton

PhD in progress : Tony Ducrocq, Toward an unified RFID and wireless sensor network, December 1st 2010, Nathalie Mitton and Michael Hauspie

PhD in progress : Nicolas Gouvy, Geographical routing protocols for wireless sensor and actuator networks, September 1st 2010, Nathalie Mitton and David Simplot-Ryl

PhD in progress : Karen Miranda, Self deployment algorithms for mobile routers, January 1st 2011, Tahiry Razafindralambo and David Simplot-Ryl

PhD in progress : Milan Erdelj, Algorithm for Mobile Sensor Deployment, September 1st 2010, Tahiry Razafindralambo and David Simplot-Ryl

PhD in progress : Geoffroy Cogniaux, In place eXecution from serial memories, January 1st 2010, Gilles Grimaud and Michael Hauspie

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- [1] A. GHADDAR. *Improving the quality of aggregation using data analysis in WSNS*, Université Lille 1, December 2011.
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- [3] J. RADAK. *Algorithms for Realistic Wireless Sensor Networks*, Université Lille 1, December 2011.

Articles in International Peer-Reviewed Journal

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- [12] X. LI, J. YANG, A. NAYAK, I. STOJMENOVIC. *Localized Geographic Routing to a Mobile Sink with Guaranteed Delivery in Sensor Networks*, in "IEEE Journal on Selected Areas in Communications", 2012.

- [13] N. MITTON, B. SERICOLA, S. TIXEUIL, E. FLEURY, I. GUÉRIN-LASSOUS. *Self-stabilization in self-organized multi-hop wireless Networks.*, in "Ad Hoc and Sensor Wireless networks (AHSWN)", June 2011, vol. 11, n^o 1-2, p. 1-34, <http://hal.inria.fr/inria-00599550/en>.
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