INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Project-Team POPS

System & Networking for Portable Objects Proved to be Safe

Lille - Nord Europe

Theme : Distributed Systems and Services

Table of contents

Joint team with LIFL (CNRS and UniversitÃ© Lille 1), located in Lille, created on September 2nd, 2004.

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2. Overall Objectives

2.1. Introduction

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) [31], wireless sensors (see Fig. 3) [30] 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 [27], 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.

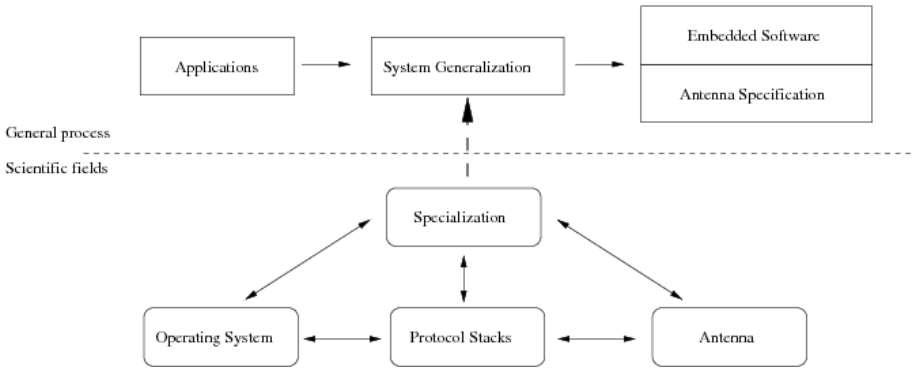

Figure 2. POPS' thematics and objectives.

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.

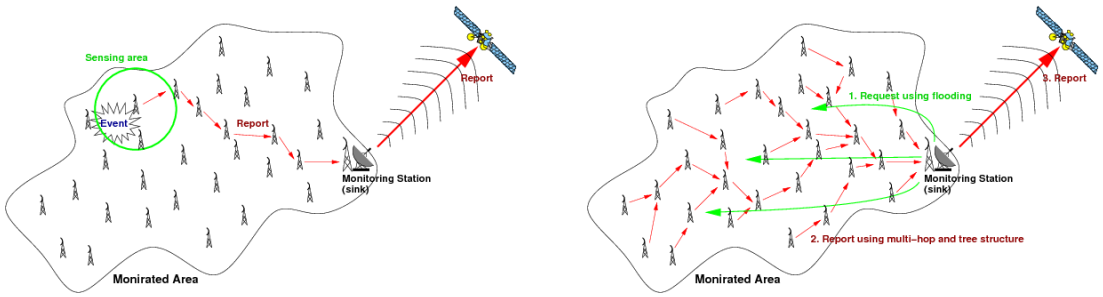

Figure 3. Example of a sensor network with event-driven (left) and on-demand (right) models.

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

2.1.1. 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.

2.1.2. 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 [33], [28], [29], [26] 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.

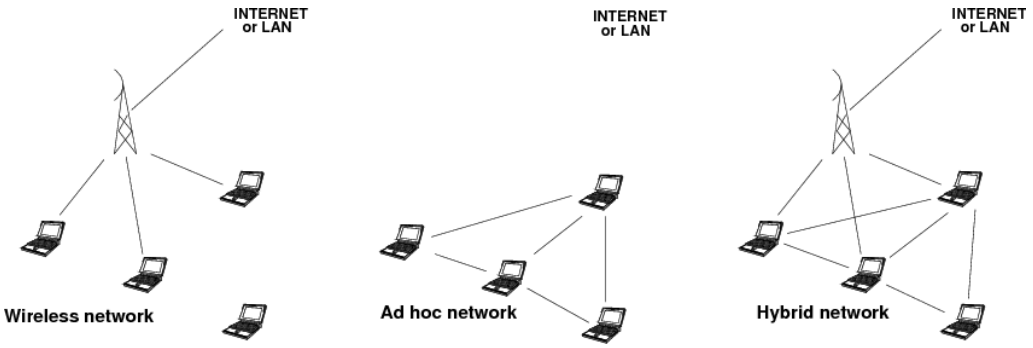

Figure 4. From wireless network to hybrid networks.

2.2. Highlights of the year

The Senslab platform is currently deployed in the framework of the ANR Senslab (See Section 7.6). The Lille platform has been deployed in November 2009 at Euratechnologies. It is composed of 246 nodes, 32 of them being mobile.

3. Scientific Foundations

3.1. Scientific Foundations

The POPS research group investigates solutions to enhance programmability, adaptability and reachability of small objects designated as "POPS" (Portable Objects Proved to be Safe). The POPS set includes small devices like smart cards, RFID tags or personal digital assistant which are characterized by limited resources, high mobility and high security level in spite of untrusted environment. The development of applications integrating POPS suffers from lack of "*reachability*" of these platforms. Indeed, most POPS are not easy to program and high level of expertise is needed to produce software for such limited operating systems and devices. Moreover, POPS mobility induces sudden and frequent disconnections, long round trip times, high bit error rates and small bandwidth.

We believe that the "system and networking" approach makes sense in the context of portable objects proved to be safe. We have demonstrated that the application-driven approach can be very efficient for customization of embedded software. We propose to focus on the following objectives where sensors are privileged platforms:

3.1.1. Customization of evolving and communicating systems

We propose to address the two following problems based on our work on customization of Java-stems:

1.1 Dynamical customization: It corresponds to what we proposed in the previous proposal: "The ability to adapt a POPS system while it is running (after it has been issued) can be an important differentiation factor to ensure the durability of the system, the update of the applications it can run, and its capacity to adapt to new usages and environments. The more POPS are complex (and expensive) and general purpose, the more these requirements are important. Dynamic configuration is clearly in the objectives of the Camille action since the system is designed to support dynamic extensions of the operating system kernel via techniques such as dynamic linking, on-the-fly compilation, and verifiable typed intermediate language." In means that we have to study how we can design a specialized system – where functionalities could be removed – which is able to evolve in order to get new functionalities while preserving safety of already installed applications.

Our goal is also to promote the JITS platform for POPS.

1.2 Optimization of the communication stack: The goal is to study the architecture of the communication stack in sophisticated cases (*i.e.* not limited to serial link) and in particular for objects with wireless capabilities. This is illustrated by the Figures 2 and 5. In the latter, we illustrate the case of a sensor network application. The "selection engine" takes a "model of the application" (including model of the network) and the "specification of the hardware". A set of protocols of each layer are evaluated according to "cost function" and the "selection engine" generates the combination of protocols which is optimal for the application and the hardware.

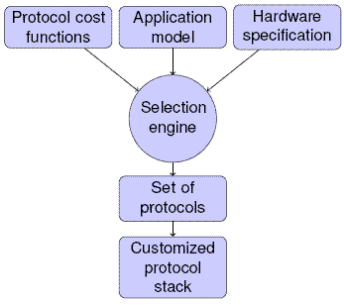

Figure 5. Complete scheme of the generation of the communication stack.

From our interaction with industrial partners, we see that it is also important to consider application layers and in particular http.

3.1.2. Realistic wireless networking

We show that the unit-disk graph model is not realistic and that an excellent and sophisticated algorithm can be jeopardized in the real world. Our approach is to consider realistic physical layer (*e.g.* Log-normal shadowing model). Moreover, it is necessary to validate results analytically, with simulators, but also with real experimentations.

We propose to investigate the two following objectives:

2.1 Position-based algorithms: The main advantage of this family of protocol is that they are both localized and memoryless. It means that these protocols are robust since they do not need a huge quantity of information (1-hop or 2-hop knowledge in most of cases) and that it can support an arbitrary number of simultaneous flows since intermediate nodes do not need to store information. We will investigate (i) protocols based on geographical coordinates (*e.g.* GPS coordinates) and (ii) protocols based on virtual coordinates when geographical coordinates. Our goal is to propose energy-efficient protocols with guaranteed delivery for the different kind of protocols: unicast, multicast, data collection (for sensors), topology control, etc.

In particular, we are interested in data collection with data fusion and we think that such techniques can be applied in RFID applications where RFID readers can be assimilated to sensors. Depending on the application, the network can apply different filters in order to limit the amount of data which is sent to the sink.

2.2 Hardware-software optimizations: We will focus on low consumption radio interface for wireless sensors. More precisely, we believe that energy constrained objects can take advantage of smart antenna technologies. This area seems very promising on paper but it raises a lot of implementation problems. In the context of a partnership with IEMN (Institut d'Electronique, de Microélectronique et de Nanotechnologie), we want to experiment the implementation of a full communication stack dedicated to smart antennas (physical layer, MAC layer, etc.).

4. Application Domains

4.1. Application Domains

We believe that it is necessary to validate proposition with analysis, simulations and real experimentations. In order to achieve this, we will focus on three specific targets which are:

- **Smartcards** which are the core of our 19-years partnership with Gemalto.
- **Sensors motes**. In the SensLab project, we will have a real experimental platform.
- **COM platform** which is developed in the hard-soft project with IEMN and which allows the experimentation of smart antenna implementation.

The relationship between objectives and platforms are underlined in Figure 6. It is clear that JITS platform is the ideal platform to support our experimentations.

We will also explore these problems in two new application domains which are (i) sensor and actuator networks – also called SANET – and (ii) wireless mesh networks.

	Smartcards	Sensor motes	COM platform
1.1 Dynamical customization	X	X	-
1.2 Communication stack optimization	X	X	X
2.1 Position-based algorithms	-	X	X
2.2 Hardware-software optimizations	-	-	X

Figure 6. Objectives vs Platforms.

In SANET, we consider active nodes in a sensor network denoted as actuators and the whole network will support the breakthrough functionality, which is necessary for massively deployed heterogeneous sensor networks pervading our everyday life. We envision actuators as independent participants in the network, *e.g.*, autonomous robots or other devices capable of acting upon their environment. They are resource rich nodes that can autonomously move and affect the sensor network operations, either by being a mobile data sink or actively inserting, removing, and relocating sensor nodes. Moreover, actuator nodes can perform actions on the environment, based on the sensed environment and some intelligent decision logic. For example, they can turn on water sprinklers to stop assumed fire when high temperature reports are received from nearby sensors.

The second application domain is wireless mesh networks which are similar to wireless LAN (typically WIFI) where access points are connected with wireless link. Some access point in the network are connected to internet – these nodes are called gateway. The network works like an ad hoc network or a hybrid wireless network where nodes are fixed and where traffic is massively directed to the gateways (like in wireless sensor networks).

5. Software

5.1. Java In The Small

Participants: Gilles Grimaud [Contact], Kevin Marquet, David Simplot-Ryl.

Initial goal of Java was to allow high level software development on small devices. Eventually it found 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.

JITS platform can be found at the URI http://jits.gforge.inria.fr/.

5.2. STatic Alias aNalyser

Participants: Arnaud Fontaine, Samuel Hym, Gilles Grimaud, Isabelle Simplot-Ryl [Contact].

STAN is a Java abstract analyser that allows static alias analysis and checking of information flow. Moreover, STAN targets small systems, like embedded systems. The STAN tool statically checks already compiled source code and annotates the .class files with verifiable signatures at loading time. STAN is dedicated to embedded systems and adapted to their constraints, supports mobile code, easy to use.

STAN can be found at the URI http://stan-project.gforge.inria.fr.

5.3. Smart and Mobile Embedded Web Server

Participants: Simon Duquennoy, Gilles Grimaud, Jean-Jacques Vandewalle.

Smews is a Smart and Mobile Embedded Web Server designed for hardware-constrained devices like smart cards, sensor boards and other small targets. Smews provides high performances thanks to several points:

- Single process event-driven architecture,
- TCP-IP stack dedicated to HTTP, allowing cross-layer optimizations,
- On-line pre-calculations done on Web contents (protocol headers, checksums, parsing automatons).

Smews is able to serve rich Web applications:

- Able to send static and dynamic contents,
- Comet support (server pushed data),
- Advanced typing of dynamic Web contents (persistent, idempotent and volatile contents).

Smews is currently available for MicaZ sensor and Funcard 7 smart card (AVR 8 bits), WSN430 sensor (MSP430 16 bits), Game Boy Advance (ARM 32 bit) and as a single UNIX/win32 process (x86 32bits).

6. New Results

6.1. Embedded Web Server

Participants: Simon Duquennoy, Gilles Grimaud, Jean-Jacques Vandewalle.

We consider in this work the integration of a dedicated web server in small embedded devices. In [8], we motivate the deployement of dedicated web server in various POPS. In [9], we demonstrated the weakness of existing approch to embed TCP/IP stack. and we show a new set of algorithms allowing to manage TCP/IP protocols in an optimal way for static contents distributed by small devices through HTTP. In [7] (based on a previsous work published in [19]) we proposed a complete taxonomy of the kind of contents distributed by web services. According to this taxonomy we propose serveral innovative ways to produce web content and to manage efficiently HTTP/TCP/IP stack in a POPS. Finally, in [6] we focus our attention on an emerging approach used to distribute dynamic contents on the web. We propose dedicated algorithms, embedded on small devices, and used to manage the very efficient comet paradigm.

6.2. RFID

Participants: Roudy Dagher, Grégory Guche, Nathalie Mitton, Loïc Schmidt, David Simplot-Ryl.

Following the 'Internet of Things' concept, each object will be associated with a unique identifier which will allow to retrieve information about it in large databases. EPC Global[1]. In this framework and in the one of ICOM, ASPIRE and DECARTE projects, the POPS has investigated several aspects linked to the RFID EPC-compliant middleware [24].

In the process of retrieving information, the identifier (ID) may have to be translated into different formats (e.g. domain name style format for object name service query, binary, legacy,...). The Tag Data Translation (TDT) is responsible for the translation of IDs into these different formats. In [18], we have proposed a general TDT system which extends the standards of EPCGlobal which only targets Electronic Product Code (EPC). We have integrated other RFID and smart cards standards (such as ISO 14443 and 15693) and GS1 standards which are more general as they also deal with bar code (EAN/UPC).

[1] http://www.epcglobalinc.org

Another important module in the EPC architecture is the Object Naming Service (ONS). The ONS is a central lookup service used in the EPCglobal network for retrieving the location of information about a specific EPC. This centralized solution lacks scalability and fault tolerance. In [25], we present the design principles of a distributed solution for ONS lookup service. In distributed systems, the problem of providing a scalable location service requires a dynamic mechanism to associate identification and location. We show that the use of Distributed Hash Tables (DHT) is a good candidate for distributing as it provides such a mechanism. We then outline how to adapt the DHT principles (operations on objects or nodes) to the ONS distribution problem.

6.3. Energy-aware Geographical Routing in Wireless Networks

Participants: Essia Hamouda, Nathalie Mitton, David Simplot-Ryl.

Routing in wireless sensor networks is a challenging task. A promising approach is position-based (or geographical) routing approaches. Indeed, such an approaches assume that a node only needs local information (its position, the ones of its neighbors and of the destination) to perform a routing decision). These approaches are memory-less, distributed and scalable, which makes this kind of routing very suitable for wireless sensor networks. Then, several communication primitives may be designed based on these principles. To date, several georouting algorithms have been proposed in the literature but the POPS team has proposed the first protocols for unicast and anycast routing which are both energy-aware and guaranteed delivery.

In [1], we propose EtE an end-to-end energy-aware routing protocol for wireless sensor networks. EtE is localized and guarantees delivery. To forward a packet, a node s in graph G computes the cost of the energy weighted shortest path between s and each of its neighbors in the forward direction towards the destination which minimizes the ratio of the cost of the shortest path to the progress (reduction in distance towards the destination). It then sends the message to the first node on the shortest path from s to x: say node x'. Node x' restarts the same greedy routing process until the destination is reached or an obstacle is encountered and the routing fails. To recover from the latter scenario, local minima trap, our algorithm invokes an energy-aware Face routing that guarantees delivery. Our work is the first to optimize energy consumption of Face routing. It works as follows. First, it builds a connected dominating set from graph G, second it computes its Gabriel graph to obtain the planar graph G'. Face routing is invoked and applied to G' only to determine which edges to follow in the recovery process. On each edge, greedy routing is applied. This two-phase (greedy-Face) End-to-End routing process (EtE) reiterates until the final destination is reached. Simulation results show that EtE outperforms several existing geographical routing on energy consumption metric and delivery rate. Moreover, we prove that the computed path length and the total energy of the path are constant factors of the optimal for dense networks.

In the anycasting problem, a sensor wants to report event information to one of sinks or actors. In mitton-infocom-09, we describe the first localized anycasting algorithms that guarantee delivery for connected multi-sink sensor-actor networks. Let $S(x)$ be the closest actor/sink to sensor x, and $|xS(x)|$ be distance between them. In greedy phase, a node s forwards the packet to its neighbor v that minimizes the ratio of cost $cost(|sv|)$ of sending packet to v (here we specifically apply hop-count and power consumption metrics) over the reduction in distance $(|sS(s)| - |vS(v)|)$ to the closest actor/sink. A variant is to forward to the first neighbor on the shortest weighted path toward v. If none of neighbors reduces that distance then recovery mode is invoked. It is done by face traversal toward the nearest connected actor/sink, where edges are replaced by paths optimizing given cost. A hop count based and two variants of localized power aware anycasting algorithms are described. We prove guaranteed delivery property analytically and experimentally.

Nevertheless, despite all the results we have achieved so far in geographical routing, existing theoretical and simulation studies on georouting appear detached from experimental studies in real environments. Therefore, in [14], we set up our test environment by using WSN430 wireless sensor nodes. To overcome the need for significant number of wireless nodes required to perform a realistic experiment in high density network, we introduce a novel approach - emulation by using relatively small number of nodes in 1-hop experimental setup. Source node is a fixed sensor, all available sensors are candidate forwarding neighbors with virtual destination. Source node makes one forwarding step, destination position is adjusted, and the same source again searches for best forwarder. We compare three georouting algorithms. We introduce here Greedy geographical routing

Algorithms in a REal environment (GARE) which builds a RNG by using $\frac{ETX(uv)}{|uv|}$ as edge weight ($ETX(uv)$ counts all transmissions and possibly acknowledgments between two nodes until message is received), and selects RNG neighbor with greatest progress toward destination (if none of RNG neighbors has progress, all neighbors are considered). Our experiments show that GARE is significantly more efficient than existing XTC algorithm (applying RNG on ETX(uv)) in energy consumption. COP GARE selects neighbor with progress that minimizes $\frac{ETX(uv)}{|uv|}$, and outperforms both algorithms.

6.4. Wireless Sensor Networks with Mobile Nodes

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

We consider in this work sensor networks with mobile nodes. In [21], we propose a localized sensor localization scheme making full use of controlled mobility of a location-aware actor and the connectivity of the sensor network. It contains two new algorithms: a unscented particle filter (UPF) based localiza- tion algorithm and an actor mobility scheduling algorithm. In [13], we address the focused coverage problem, where sensors are required to be deployed around a given point of interest (POI) with respect to a priority requirement: an area close to POI has higher priority to be covered than a distant one. We improve the Greedy-Rotation-Greedy (GRG) that assumes an obstacle-free environment by adding a novel obstacle "penetration" technique and that gives the important obstacle avoidance capability. The new version of GRG is referred to as GRG/OP.

In focused coverage problem, sensors are required to be deployed around a given point of interest (POI) with respect to a priority requirement: an area close to POI has higher priority to be covered than a distant one. A localized sensor self-deployment algorithm, named Greedy-Rotation-Greedy (GRG) [32], has recently been proposed for constructing optimal focused coverage. The previous work assumed obstacle-free environment and focused on theoretical aspects. In [13], we remove this strong assumption and extend GRG to practical settings. We equip with a novel obstacle "penetration" technique and give it the important obstacle avoidance capability. The new version of GRG is referred to as GRG/OP. Through simulation, we evaluate its performance in comparison with plain GRG.

In [21], we propose a localized sensor localization scheme making full use of controlled mobility of a location-aware actor and the connectivity of the sensor network. It contains two new algorithms: an unscented particle filter (UPF) based localization algorithm and an actor mobility scheduling algorithm. The former is an application of UPF. It enables sensor self-localization using received signal strength indicator and actor position. The latter models actor mobility scheduling as traveling salesman problem and aims for fully localized network and minimized time delay. Navigated by sensors, the actor depth-first traverses a local minimum spanning tree of a connected 3-dominating set of the network.

6.5. Performance Evaluation in Wireless Nertworks

Participants: Fadila Khadar, Tahiry Razafindralambo, Marie-Emilie Voge.

Since the emergence of ubiquitous computing, evaluating wireless network performances has become one of the major economic issues. Among the existing performance indicators, the network *capacity*, defined as the maximal amount of flow carried by a topology during a fixed time period, is essential. Some cross-layer characteristics have to be taken into account in order to optimally allocate the common resources. In [16], a comparative study is done between interference consequences in the two following models: (i) usual IEEE 802.11 MAC layer with acknowledgments at each hop, and (ii) block acknowledgments reported at the transport layer that can be included in the IEEE 802.16 standard. Cross-layer properties are modeled in a linear programming formulation that is solved using the column generation process. We quantify the gain in capacity induced by the move of the MAC acknowledgments into the transport layer, and show the better load distribution obtained in the network with the second model.

The performance of ad hoc networks based on IEEE 802.11 DCF degrade when congestion increases. The issues concern efficiency and fairness. Many solutions can be found at the MAC layer in the literature, but very few solutions improve fairness and efficiency at the same time. In this In [17], we design a new backoff solution, called SBA. SBA uses only local information and two contention window sizes. By simulations, we compare SBA with IEEE 802.11 and several alternatives to 802.11 in ad hoc networks. The results presented in this paper show that SBA is fairer than 802.11. Of course, the fairness induced by SBA reduces the global throughput (compared to 802.11), but this decrease is often lower than the one achieved by some other fair MAC protocols. Given the first obtained results, we think that SBA is a good candidate in terms of trade-off between fairness, simplicity and efficiency.

In [12], we consider Wireless Sensor Networks (WSN) applications in which sensors have to send data to a unique sink in a multi-hop fashion. The routing problem in WSN has been the subject of intense studies. One important difference between wired and wireless networks is the use of location for routing purposes. Position awareness improves the efficiency and scalability of routing protocols as it helps reducing the number of messages used for route discovery. Gradient routing protocol uses virtual coordinates, i.e., a coordinate system set up for routing purposes only. They create a one-dimensional virtual coordinate system where the position of a node corresponds to its hop distance to the sink. This information is then used to efficiently route packets to the sink in a multi-hop fashion. Many gradient routing protocols exist, they mainly differ in their performances (delay, delivery ratio, etc.). In this paper, we propose an extensive performance evaluation study of some gradient routing protocols and show that the choice of the algorithm must be based on what is expected from the network (reliability, energy consumption, ...). .

6.6. Data Agregation, and address allocation in Wireless Networks

Participants: Alia Ghaddar, Tahiry Razafindralambo, Isabelle Simplot-Ryl, David Simplot-Ryl.

A primary purpose of sensing in a sensor network is to collect and aggregate information about a phenomenon of interest. The batteries on today's wireless sensor barely last a few days, and nodes typically expend a lot of energy in computation and wireless communication. Hence, the energy efficiency of the system is a major issue. Aggregation techniques were used to reduce the amount of data communication generated by sensors. Depending on the data type, ARMA series and forecasting are possible ways to reduce data transmission. In [20], we propose different data aggregation algorithms based on the AutoRegressive model built at each sensor to predict local readings. The experiments show that it is possible not only to reduce the frequency of the AR re-parametrization but also to decrease the number of computational operations and hence increasing the node's lifetime which of course affects on the longevity of the network.

In [5], we present for mobile ad hoc networks an efficient distributed address allocation protocol which is immune to topology changes caused by node's mobility. Contrary to the common belief that mobility makes protocol design more difficult, we show that node's mobility can, in fact, be useful to provide efficient address allocation in ad hoc networks. In our protocol, each node that has been assigned an address manages a disjoint subset of free addresses independently. By taking advantage of node mobility, we can achieve roughly even distribution of free addresses amongst nodes in the system, which enables a new joining node to be configured by its neighbors via only local communication. Theoretical analysis and extensive simulation results are presented. We show that most of the address allocation requests can be processed in a timely fashion via local communication in the requester's neighborhood with time and message complexity in the order of node's degree, regardless of the network size.

6.7. Electronic cash

Participant: Isabelle Simplot-Ryl.

The volume of E-commerce transactions has considerably increased in the last several years. One of the most important aspects of such progress is the efforts made to develop and deploy dependable and secure payment infrastructures. Among these infrastructures is electronic cash, which is an attempt to reproduce the characteristics of paper cash in online transactions. Electronic cash schemes have so far been the purpose of a significant amount of research work. Although real-life deployments of such schemes are expected to take place in highly distributed environments, limited attention has been paid in the literature on underlying architectural issues. So far the focus has mostly been on addressing only security issues. However, for real-life deployment, distributed processing criteria such as performance, scalability and availability are of prime importance. In [4], through a survey of the literature, we identify and analyse the different distributed architectural styles underlying existing e-cash schemes. We discuss the strengths and limitations of these architectures with respect to fundamental system distribution criteria. In light of such discussion, we make some recommendations for designing effective distributed e-cash systems from an architectural perspective.

6.8. Sound Information Flow

Participants: Arnaud Fontaine, Dorina Ghindici, Samuel Hym, Isabelle Simplot-Ryl.

We have continued our work in the field on information flow analysis that has given the STAN tool, trying to formalize the analysis. This has lead to a first work [10], in which we present a flow-sensitive analysis for secure information flow for Java bytecode. Our approach consists of computing, at all program points, an abstract memory graph (AMG) which tracks how input values of a method may influence its outputs. This computation subsumes a points-to analysis (reflecting how objects depend on each other) by addressing dependencies arising from data of primitive types and from the control flow of the program. Our graph construction is proved to be sound for both intra-procedural and inter- procedural analysis by establishing a non-interference theorem stating that if an output value is unrelated to an input one in the AMG then the output remains unchanged when the input is modified. In contrast with many type-based information flow techniques, our approach does not require security levels to be known during the computation of the graph: security aspects of information flow are checked by labeling “a posteriori” the AMG with security levels.

7. Contracts and Grants with Industry

7.1. Gemplus/Gemalto partnership

Participants: Gilles Grimaud [Scientific responsible], Simon Duquennoy, David Simplot-Ryl.

Since its creation, POPS has been supported by Gemplus/Gemalto within the framework of a partnership agreement that lasts since 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 4^{th} framework), CESURE (RNRT), COMPiTV (RNTL), RESET (IST 5^{th} framework), and INSPIRED (IST 6^{th} framework).

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

7.2. European FP6 IST IP "Wirelessly Accessible Sensor Populations" (WASP) 2006-2009

Participants: Jean Carle [contact], Gilles Grimaud, Michael Hauspie, Fadila Khadar, David Simplot-Ryl [contact].

An important class of collaborating objects is represented by the myriad of wireless sensors, which will constitute the infrastructure for the ambient intelligence vision. The academic world actively investigates the technology for Wireless Sensor Networks (WSN). Industry is reluctant to use these results coming from academic research. A major cause is the magnitude of the mismatch between research at the application level and the node and network level.

The WASP project aims at narrowing this mismatch by covering the whole range from basic hardware, sensors, processor, communication, over the packaging of the nodes, the organization of the nodes, towards the information distribution and a selection of applications. The emphasis in the project lays in the self-organization and the services, which link the application to the sensor network. Research into the nodes themselves is needed because a strong link lies between the required flexibility and the hardware design. Research into the applications is necessary because the properties of the required service will influence the configuration of both sensor network and application for optimum efficiency and functionality. All inherent design decisions cannot be handled in isolation as they depend on the hardware costs involved in making a sensor and the market size for sensors of a given type. Three business areas, road transport, elderly care, and herd control, are selected for their societal significance and large range of requirements, to validate the WASP results. The general goal of the project is the provision of a complete system view for building large populations of collaborating objects. The system incorporates networking protocols for wireless sensor nodes to hide the individual nodes from the application.

The tangible results of the project are:

- A consistent chain of energy-sensitive software components.
- Sets of cross optimized software stacks.
- Benchmarks and a set of measurements on energy- and code- efficiency.
- Rules for the design of configurable sensor nodes.
- A prototype implementation in one of the three chosen business areas.

List of participants: Philips Research Eindhoven, Philips Forschung Laboratorium, IMEC, CSEM, TU/e, Microsoft Aachen, Health Telematic Network, Fraunhofer IIS, Fokus, IGD, Wageningen UR, Imperial College London, STMicroelectronics, INRIA, Univ of Lille, Ecole Polytechnique Federale Lausanne, Cefriel, Centro Ricerce Fiat, Malaerdalen University, RWTH Aachen, SAP, Univ of Paderborn

http://www.wasp-project.org/.

7.3. European FP7 ICT IP "Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications" (ASPIRE) 2008-2010

Participants: Nathalie Mitton [contact], Loïc Schmidt, David Simplot-Ryl.

ASPIRE will research and provide a radical change in the current RFID deployment paradigm through innovative, programmable, royalty-free 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.

European networked enterprises in general and SME in particular are still reluctant to adopt RFID, since they perceive RFID as unprofitable or too risky. This is largely due to the fact that the adoption of RFID technology incurs a significant Total Cost of Ownership (TCO). ASPIRE will significantly lower SME entry costs for RFID technology, through developing and providing a lightweight, royalty-free, innovative, programmable, privacy friendly, middleware platform that will facilitate low-cost development and deployment of innovative RFID solutions. This platform will act as a main vehicle for realizing the proposed swift in the current RFID deployment paradigm. The ASPIRE middleware platform will take into account innovative European developments in the area of ubiquitous RFID-based sensing (i.e., physical quantities sensing (temperature, humidity, pressure, acceleration), mobile sensing) towards enabling novel business cases that ensure high ROI (Return on Investment). The ASPIRE RFID middleware paradigm, as well as the unique and novel characteristics of the ASPIRE middleware platforms are thoroughly described in this proposal.

List of participants: Aalborg University - CTiF (Danemark), INRIA-ObjectWeb (France); INRIA-POPS (France), Université Joseph Fourrier - Grenoble University - LIG Laboratory (France), Research and Education Laboratory in Information Technologies - Athens Information Technology (Greece), Melexis technologies SA (Switzerland), Open Source Innovation Ltd (United Kingdom), NORMAPME European Office of Crafts, Trades and SMEs for Standardisation (Belgium), Dimitropoulos - VICOP LTD (Greece), Pole Traceability Valence PV (France), Instituto Telecomunicaoes (Italy).

http://www.aspire-project.eu/.

7.4. ANR RNRT “Réseaux hétérogènes Intelligents pour Situations de Risques” (RISC) 2007-2010

Participants: Jean Carle [contact], David Simplot-Ryl, Michael Hauspie, Nathalie Mitton.

This project is a RNRT project (Réseau National de la Recherche en Télécommunications http://www.telecom.gouv.fr/rnrt/).

The RISC project (Réseaux hétérogènes Intelligents pour Situations de Risques) focuses on heterogeneous networks in the context of civil safety. The goal is to study and define the communication from physical to network layer process in a crosslayer optimization. This network is heterogeneous since it contains mobile and static nodes, with variable bandwidth. Furthermore, some nodes have the ability to monitor the environment. This heterogeneity comes from realistic deployment where different kind of nodes must operate in the same global network. For example, in safety operation context, mobile nodes are human with portable radio in the field of operations, fixed nodes correspond to radios infrastructure link to external world (i.e. headquarters). Sensors are also used to support current action: Static sensors are used to monitor the environment. Mobile sensors could be placed on human to monitor either environmental constants or human biological constants during operation.

The project is organized around two axes:

- Research and implementation of innovative technical methods taking into account heterogeneity of the network and in-use constraints.
- Crosslayer optimization which guaranty significant improvement for the performances. In the context of mobile ad hoc wireless environment, heterogeneity tighten up the need of crosslayering methods.

List of participants: CRESTIC, ENST Paris, ETIS, LIFL, RTS Electronics, Thales Communication.

http://risc.univ-reims.fr/.

7.5. “Infrastructure pour le COMmerce du futur” (ICOM) 2007-2009

Participants: Roudy Dagher, Grégory Guche, Nathalie Mitton [contact], Loïc Schmidt, David Simplot-Ryl.

This project is lead in the framework of the competitiveness cluster of trade industry of Nord-Pas de Calais PICOM (Pôle des Industries du COMmerce). Trade industry are being in constant evolution. The massive apparition of the Internet, the increasing exigence of quality of service, the ubiquitous and pervasive informatics shatter the traditional trade practices, their economical and organizational models.

ICOM (Infrastructure pour le COMmerce du futur) aims at helping enterprises regarding a fast and easy deployment of new applications using new technologies and infrastructures from ubiquitous informatics. It will provide a smart infrastructure which hides the heterogeneity of identifiers (RFID, NFC, bar code) and manages data storage and request routing to provide scalability.

List of participants: Atos Origin (H. Jost), Auchan (B. Courouble), Décathlon (E. Lecointe), La Poste (J. Estienne), La Redoute (F. Gitton), INRIA-ASAP (A. Viana), INRIA-ADAM (L. Duchien), INRIA-POPS (N. Mitton), GS1 (N. Pauvre), ORANGE France (D. Dufresne).

7.6. ANR TLCOM “Very large open wireless sensor networks” (SensLab) 2008-2010

Participants: Nathalie Mitton [contact], David Simplot-Ryl, Julien Vandaële.

The purpose of the SensLab project is to deploy a very large scale open wireless sensor network platform. SensLab’s main and most important goal is to offer **an accurate and efficient scientific tool** to help in the design, development, tuning, and experimentation of real large-scale sensor network applications. Ambient and sensor networks have recently emerged as a premier research topic. Sensor networks are a promising approach and a multi-disciplinary venture that combines computer networks, signal processing, software engineering, embedded systems, and statistics on the technology side. On the scientific applications side, it covers a large spectrum: safety and security of buildings or spaces, measuring traffic flows, environmental engineering, and ecology, to cite a few. Sensor networks will also play an essential role in the upcoming age of pervasive computing as our personal mobile devices will interact with sensor networks dispatched in the environment.

The SensLab platform will be distributed among 4 sites and will be composed of 1,024 nodes. Each location will host 256 sensor nodes with specific characteristics in order to offer a wide spectrum of possibilities and heterogeneity. The four test beds will however be part of a **common global test bed** as several nodes will have global connectivity such that it will be possible to experiment a given application on all 1K sensors at the same time.

When deployed, SensLab would be a unique scientific tool for the research on wireless sensor networks.

List of participants: INRIA-ARES, INRIA-ASAP, INRIA-POPS, Thales Communication S.A. (V. Conan), UPMC-LIP6, ULP-LSIIT. http://www.senslab.info/.

7.7. INRIA ADT "Software and Hardware Toolbox for the Wireless Sensor Network Testbed" (SensTools) 2008-2009

Participants: Nathalie Mitton [contact], David Simplot-Ryl, Julien Vandaële.

The main and most important goal of the SensTOOLS ADT project is to foster the design, development, tuning, and experimentation of real large scale sensor network applications. Sensor networks have recently emerged as a premier research topic. However, due to their massively distributed nature, the design, implementation, and evaluation of sensor network applications, middleware, and communication protocols are difficult and time-consuming tasks. The purpose of the SensTOOLS is to provide both software and hardware toolboxes in order to offer to the developer appropriate tools and methods for designing, testing and managing his/her large scale large scale wireless sensor network applications.

List of participants: INRIA-ARES, INRIA-ASAP, INRIA-POPS.

7.8. FUI "DEveloppement de CARTon Electronique" (DECARTE) 2008-2010

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

The DECARTE project, labelized by the competitiveness clusters MAUD (Matériaux Utilisations et Développement Durable), of the Trade Industry PICOM (Pôle de compétitivité de l'Industrie et du COMmerce), PFA (Pôle de compétitivité Filiaire Aquatique) and Textil (Uptex Pôle de compétitivité textile innovant) consists in demonstrating the technical feasibility and economic integration of a RFID system printed on packaging during their manufacturing process in mass production. So with a new feature of a non-visual low unit cost, these new electronic packages will offer the opportunity to develop communicating solutions all along the distribution chain.

List of participants: Cartonneries de Gondardennes (Bertrand Helle), Cascades Blendecques, Etik Ouest, Gic, Cartonneries de Gondardennes, CTP, INRIA POPS, IEMN and IFTH.

7.9. CNRS national platform "Sensor and Self-Organized Networks" (RECAP)

Participants: Jean Carle [contact], Antoine Gallais, Michael Hauspie, Fadila Khadar, Nathalie Mitton, David Simplot-Ryl [contact].

Miniaturization in micro-electro-mechanical systems (MEMS) has enabled the development of a new kind of networks: Sensor Networks. Sensor networks use small objects able to monitor their close environment such as obtaining a temperature, an air or water pollution level, to detect movements or vibrations, etc. These networks also use one or more monitoring stations (also called sink stations) responsible to collect information from sensors. Using a large number of small inexpensive sensors increases the dependability of surveillance and reconnaissance systems and also decreases the vulnerability of the system to failure. To forward their data (monitoring information, request, etc.), all these nodes use multi-hop wireless communication.

Self-adaptive and self-organized are questions of active research in a number of different research communities, ranging from hardware to applications. Many topics must be study such as topology control (addressing, localization, etc.), data communication (broadcasting, routing, gathering, etc.), architecture (hardware, system -OS-, network -communication stacks-, etc.), applications (service lookup, distributed database, etc.). The RECAP project is a CNRS national platform which aims to support research activities in this area. RECAP is organized in four sub-projects: Applications, Data Communication, Topology Control, and System Architecture.

List of participants: CITI INSA Lyon (E. Fleury), LAAS (M. Diaz), LIFL (J. Carle), LIP6 (M. Dias de Amorim), IRISA (P. Quinton), LSIIT (T. Noël), LSR (A. Duda). http://www2.lifl.fr/sensor/.

7.10. ANR SESUR 2007 "Securing Flow of INformation for Computing pervasive Systems" (SFINCS) (2008-2010)

Participants: Arnaud Fontaine, Dorina Ghindici, Gilles Grimaud, Samuel Hym, Isabelle Simplot-Ryl [project leader].

The upsurge of a globally interconnected network of devices have had a deep impact on the environment, habits and even typology of computing devices end-users. These advances changed our behaviour in a lot of beneficial ways but also gave way to new threats that feed decades-old fears about liberty. Preserving privacy and security are thus more than ever at the heart of service users and providers concerns.

In an open, heterogeneous and highly concurrent context, enforcing private and business data confidentiality requires, beyond basic access control, fine-grained control over data usage by the various actors. This problem is known from the literature as information flow control. Information flow analysis has been actively investigated for several years, leading to a rich theory. This problem has usually been tackled from a type-checking or static analysis viewpoint. However, it appears that this rich theory has been scarcely applied in the industry.

The SFINCS project aims at studying application of this theory on practical use-cases to identify bottlenecks that prevent wider industrial adoption of information flow control techniques. To this end, project SFINCS brings together complementary partners: From case studies provided by industrial partners, academic partners shall enrich information flow theory to take into account practical issues preventing thorough analysis of ubiquitous software systems. Provided case studies come from distance selling services and mobile telephony and thus will provide a wide array of the diverse problems encountered in the enforcement of needed security and privacy properties.

This project addresses varied problems:

- Software engineering and programming problems, like analysis of programs using shared libraries through public APIs or external streams (eg. XML),
- Theoretical problems about information analysis, like tracking information in arrays or collections,
- Security engineering problems, like expressing of security rules or selective authorization of information leaking through safe channels (eg. using cryptography).

List of participants: LIFL (G. Grimaud, S. Hym, I. Simplot-Ryl), LIF, Univ. of Provence (J.-M. Talbot), VERIMAG (Laurent Mounier, Michael Périn, Yassine Lakhnech, Pascal Lafoucarde), NORSYS/SI3SI (Pascal Flamant, Arnaud Bailly), Trusted Labs (Anthony Ferrari, Erci Vétillard).

http://sfincs.gforge.inria.fr/.

7.11. ANR VERSO 2009 “Widening Interoperability for Networking Global Supply Chains” (WINGS) (2009-2011)

Participants: Nathalie Mitton [contact], Loïc Schmidt, David Simplot-Ryl.

As we move forward towards ambient intelligence environments where most devices are connected to seamless, ubiquitous networks, inter-enterprise interoperability becomes an essential condition. The next phase of the supply chain development will improve robustness and increase reach. Such a shift of focus from small localized activities to large cross-company and cross-country networks will require both more complete and more comprehensive data sets. This implies efficient data synchronization, guaranteed data availability and improved data security. The exciting opportunities come from the fact that this scenario will integrate complex networks composed of a huge amount of different types of objects - forming the so-called Internet of things or rather Intranet of Goods as it can be designed in a networked business-to-business world. This increase in scale for the network also demands the development of an architecture framework that will allow an open governance model. The WINGS project focuses on the large scale EPCGlobal network as being part of the Internet of Things and in which, as designed, a single ONS (Object Naming Service) root is in existence today. What’s more, the operation of this root has been entrusted to an US-based company by EPCGlobal Inc. Given the importance of ONS systems in a near future, it is becoming urgent to develop alternative solutions to break the current centralized architecture and the monopoly of a single company. For ensuring the further interconnection and the interoperability of these roots, the project partners propose to design and evaluate a multi-root ONS system that will take into consideration security, stability, performance as well as interaction with DS (Discovery Services). The aim is to show that several ONS roots can work together and safely share the management and the governance of the network.

List of participants: GS1 France (Nicolas Pauvre), INRIA POPS, PMC (Marcelo Dias de Amorim), AFNIC (Mohsen Souissi), Orange Labs (Dominique Le Hello), GREYC (Jacques Madelaine). http://sfincs.gforge.inria.fr/.

7.12. FP7-ICT “Security Engineering for lifelong Evolvable Systems” (SecureChange) (2009-2011)

Participants: Donia El Kateb, Samuel hym, Isabelle Simplot-Ryl [contact].

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.

The objective of the project is thus to develop techniques and tools that ensure "lifelong" compliance to evolving security, privacy and dependability requirements for a long-running evolving software system. This is challenging because these requirements are not necessarily preserved by system evolution.

The project will develop techniques, tools, and processes that support design techniques for evolution, testing, verification, re-configuration and local analysis of evolving software. The project results will be applied and evaluated in particular in the industrial application domains of mobile devices, digital homes, and large scale air traffic management which all offer both great research challenges and long-term business opportunities.

List of participants: Università degli Studi di Trento (Italia), Budapest University of Technology and Economics (Hungary), Gemalto (France), INRIA (France), Katholieke Universiteit Leuven (belgium), Smartesting (France), Open University (United Kingdom), Stiftelsen for industiell og teknisk forskning ved Norges Tekniske Hogskole (Norway), Thales (France), Telefonica Investigacion y Desarrollo Sociedad Anonima Unipersonal (Spain), University of Innsbruck (Austria), Deep Blue (Italia), Technische Universität Dortmund (Germany)

7.13. International Relationship

We have research activities with international partners as:

- Edgar Chavez, Univ. Morelia, Mexico,
- Essia Hamouda, Riverside University, Los Angeles, USA,
- Ivan Stojmenović, Univ. Ottawa, Canada.
- Issa Traoré, Univ. of Victoria, Canada.

Isabelle Simplot-Ryl is guest scientist of the EMERGENCY project (Mobile decision support in emergency situations) funded by the Research Council of Norway under the VERDIKT research program (2008–2012)

7.14. Visits and Invitations of Researchers

- Associate Professor Issa Traoré from the University of Victoria, Canada was invited for 6 monthes in 2008.
- Prof. David Simplot-Ryl was visiting professors at the University of Ottawa in August 2008.

8. Dissemination

8.1. Editorial Activities

- **David Simplot-Ryl** is managing editor of *Ad Hoc & Sensor Wireless Networks: An International Journal (AHSWN)* (Old City Publishing), associate editor of *International Journal of Computers and Applications (IJCA)* (ACTA Press), member of editorial board of *International Journal of Wireless and Mobile Computing (IJWMC)* (Inderscience) and of editorial board of *International Journal of Parallel, Emergent and Distributed Systems (IJPEDS)* (Taylor & Francis). He is guest-editor of a special issue of *Journal of Computer Communications* (Elsevier) on "Sensor-Actuator Networks (SANETs)" in 2007.

- **Nathalie Mitton** and **David Simplot-Ryl** are guest editors of "Supervision et sÃ©curitÃ© dans les grands rÃ©seaux", TSI, Hermes, Lavoisier, volume 28, nÂ°4, 2009

8.2. Organization Committees and Program Committees (Conferences, Workshops, Schools)

- **Jean Carle** is program committee member of :
  - *10^{th} ACIS International Conference on Software Engineering, Artificial Intelligence, Networking, and Parallel/Distributed Computing (SNPD 2009)*, (Daegu, Korea, May 27 - 29, 2009).
  - *3^{e} workshop sur la cohérence des données en univers réparti (cdur'09)*, (Toulouse, France, September 11-13, 2009).
  - *8^{th} International Conference on Ad hoc Networks and Wireless (Ad-Hoc Now 2009)*, (Murcia, Spain, September 23 - 25, 2009).
- **Gilles Grimaud** is general co-chair of:
  - *Eighth Smart Card Research and Advanced Application IFIP Conference (CARDIS 2008)*, (Ehgam, UK, September 2008), program co-chair,
- He is involved in the program committee of international events:
  - *The 8th WG 8.8/11.2 International Conference CARDIS 2008 (Program co-chair), Royal-Holloway, University of London, UK, September*,
  - *ACM SigOps/ASF CFSE'08, Fribourg, Switzerland, February*,
  - *ACM SIGAPP & ACP SIGPLAN, Pinciples and Practice of Programming in Java 2007, Lisbon, Portugal, September*.
- **Michael Hauspie** is a program committee member of:
  - *The 8th ACS/IEEE International Conference on Computer Systems and Applications 2010*
  - *International Conference on Mobile Communications and Pervasive Computing (MCPC 2010)*
- **Nathalie Mitton** is program co-chair of
  - *Fifth International Workshop on Localized Communication and Topology Protocols for Ad hoc Networks (LOCAN 2009)*, December 14, 2009 - Wu Yi Mountains, China

  She is a program committee member of:
  - *First International Workshop on Wireless Sensor, Actuator and Robot Networks (WiSARN 2010)*, 17 June 2010, Montreal, Canada.
  - *Fifth International Conference on Mobile Ad-hoc and Sensor Networks (MSN 2009)*, 16-18 December 2009, Wu Yi Mountain, China.
  - *1st International Workshop on Middleware for Sensing and Actuation Augmented Pervasive Systems (MSAPS'09)*, Barcelona, Spain, July 19, 2009.
  - *6th conférence international on Mobile Technology, Applications and Systems (Mobility'09)*, Nice, France, September 2-4, 2009.
  - *8th Int'l Conference on on AD-HOC Networks and Wireless (AdHoc-Now 2009)*, Murcia, Spain, September 16-19, 2009.
  - *11^{es} Rencontres Francophones sur les Aspects Algorithmiques de Télécommunications (Algotel-2009)*, Carry le Rouet, France, June 16-19, 2009.

- *Sixth Workshop on Wireless Ad hoc and Sensor Networks (WWASN2009)*, Montreal, Canada, June 2009.
- *10^{es} Journées doctorales en Informatique et Réseaux (JDIR 2009)*, Belfort, France, Feb. 2-4, 2009.

She is publicity chair of:

- *First International Workshop on Wireless Sensor, Actuator and Robot Networks (WiSARN 2010)*, 17 June 2010, Montreal, Canada.
- *International Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECTS 2010)*, Ottawa, Canada, July 11-14
- *7^{th} ACS/IEEE International Conference on Computer Systems and Applications (AICCSA-2009)*, Rabat, Morocco, May 10-13, 2009.

She is a member of the steering and organizing committee of ICTF (International Contactless Technologies Forum) hold on June 2008 in Lille and in June 2009 in Marseille.

- **Tahiry Razafindralambo** is program co-chair of
  - *International workshop on Mobility, Algorithms, Graph theory in dynamic NEtworks*, May 25-27, 2009 - Piran - Slovenia

  He is a program committee member of:
  - *Fifth International Workshop on Localized Communication and Topology Protocols for Ad hoc Networks (LOCAN 2009)*, December 16-18, 2009 - Wu Yi Mountain, China.
  - *Sixth ACM International Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Networks (PE-WASUN 2009)*, October 29-30, 2009 - Tenerife, Canary Islands, Spain.
  - *12-th ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (MSWIM 2009)*, October 26-30, 2009 - Tenerife, Canary Islands, Spain.
  - *IEEE International Conference on Communications (ICC 2010)*, May 23-27, 2010 - Cape Town, South Africa.

  He is publicity chair:
  - *Sixth ACM International Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Networks (PE-WASUN 2009)*, October 29-30, 2009 - in Tenerife, Canary Islands, Spain.

- **David Simplot-Ryl** is general co-chair of:
  - *5th International Workshop on Localized Communication and Topology Protocols for Ad hoc Networks (LOCAN 2009)*, (Wu Yi Mountain, China, 2009, 14-16, December, 2009), organized in conjunction with the *5th International Conference on Mobile Ad-Hoc and Sensor Networks (MSN 2009)*,
  - *6th Workshop on Wireless Ad hoc and Sensor Networks (WWASN2009)*, (Montreal, Canada, June 22-26, 2009) organized in conjunction with the *The International Conference on Distributed Computing Systems (ICDCS 2009)*,
  - first International School on Cyber-Physical and Sensor Networks (SensorNets 2009) (Monastir, Tunisia, dec. 17-21, 2009).

  He is program chair, vice-chair or co-chair of:
  - *Computer & Electronics Security Applications Rendez-vous (C&ESAR 2009)* (Rennes, France, nov. 24-26, 2009).

He is member of several program committees:

- *2nd Joint IFIP Wireless and Mobile Networking Conference (WMNC'09)*, (September 9-11, 2009 Gdansk, Poland),
- *34th IEEE Conference on Local Computer Networks (LCN 2009)* (ZÃ¼rich, Switzerland, oct. 20-23, 2009).

- **Isabelle Simplot-Ryl** is a program committee member of several international events:
  - 2^{nd} *International Conference on Computer Science and its Applications (CSA 2009)*, (Jeju, Korea, December 10-12, 2009).
  - 2^{nd} *International Workshop on Multimedia, Information Privacy and Intelligent Computing Systems (MPIS'09)*, (Jeju, Korea, December 10-12, 2009).
  - 4^{th} *International Symposium on Smart Home (SH'08)*, (Toronto, Canada, July 13-16, 2009).
  - 34^{rd} *IEEE Conference on Local Computer Networks (LCN 2008)*, (Zürich, Switzerland, October 20–23, 2009).
  - 6^{th} *International Conference on Ubiquitous Computing and Intelligence (UIC-09)*, (Brisbane, Australia, July 7–10, 2009).
  - 4^{e} *Conférence sur la Sécurité des Architectures Réseaux et des Systèmes d'Information (SARSSI 2009)*, (Luchon, France, June 22–26, 2009).
  - 2^{nd} *International Conference on Dependability (DEPEND 2009)*, (Athens, Greece, June 14–19, 2009).
  - *The Ad-Hoc and Sensor Networking Symposium (ICC'2009-AHSNET)*, (Dresden, Germany, June 14-18, 2009), in conjunction with IEEE ICC'2009.
  - 3^{rd} *International Conference on Multimedia and Ubiquitous Engineering (MUE'09)*, (Qingdao, China, June 4-6 2009).
  - 3^{rd} *International Workshop on Intelligent, Mobile and Internet Services in Ubiquitous Computing (IMIS 2009)*, (Fukuoka, Japan, March 16-19, 2009), in conjunction with CISIS 2009.
  - 10^{es} *Journées Doctorales en Informatique et Réseaux (JDIR'09)*, (Belfort-Montbéliard).

8.3. Invited Talks and Seminars

- **Nathalie Mitton** gave a number of invited talks:
  - RFID middlewares and Aspire project, *Les Assises de la Traçabilité*, April 1st 2009, Valence, France.
  - Routing and energy saving in wireless sensor networks, *journées thématiques du GDR SoC/SiP*, July 9th 2009, Paris, France.
  - RFID middlewares, *WMNC, Special session Internet of Things*, September 11th 2009, Gdansk, Poland.
  - Routing in wireless multihop networks, *PucesCom Atelier réseau de capteurs*, October 15th 2009, Vannes, France.
  - RFID middlewares, *Internet of Things*, October 30th 2009, Lille, France.

8.4. Teaching

- **Jean Carle** is director of a vocational degree in computer sciences (licence professionnelle). He is also in charge of lecture in Mobile Networking for master degree in computer science, of lectures in *Networking and Data Communication* to under degree in computer science (IUT 1st and 2nd year) and in *Algorithm* to under degree in computer science (IUT 1st year).
- **Gilles Grimaud** is in charge of lectures in *Embedded Systems* for research master (Master Recherche), of lecture in *Security of Networks and Systems* for professional master (Master TIIR), of lecture in *Operating Systems Architecture* for master of computer science (maîtrise), and of lecture in *Networking* in computer science degree (licence).
- **Michael Hauspie** is in charge of lectures in *Software engineering*, *Networking*, *Operating Systems* and *Network services administration* in under degree in computer science and vocational degree in computer science (IUT 1st and 2nd year/licence professionnelle).
- **Samuel Hym** is in charge of lectures in *Introduction to Programming* to first-year students and *Operating systems* to continuing education students.
- **Nathalie Mitton** is in charge of lectures in *Mobile Networking* for research master (DEA), in *Networking for Autonomous Systems* for professional master (DESS) and in *Transmission and Protocols* for vocational degree in computer science (licence professionnelle).
- **Tahiry Razafindralambo** is in charge of lecture in *Networking for Autonomous Systems* for professional master (DESS) and an Introduction to Computer Networks for (IUT 2nd).
- **Isabelle Simplot-Ryl** is in charge of lectures in systems programming to vocational degree in computer science (licence professionnelle), and of Lectures in Security in master.
- **Marie-Emilie Voge** is in charge of lectures in *Algorithms and simulations for wireless networks* to research master students (master TAC), in *Algorithmics* in computer science applied to enterprise management degree (licence MIAGE) and in *Algorithmics* to second-year students.

8.5. Miscellaneous Scientific Animation

- **David Simplot-Ryl** was referee or examiner for several PhD thesis and Habilitation thesis:
  - Jia Liang Lu (CITI, INSA Lyon, directed by Fabrice Valois, referee),
  - Thomas Watteyne (CITI, INSA Lyon, directed by Stéphane Ubéda and Isabelle Augé-Blum, chair),
  - Emil Ivov (LSIIT, Univ. Strasbourg I, directed by Thomas Noël, chair),
  - Vincent Borrel (LIP6, UPMC, directed by Marcelo Dias di Amorim and Serge Fdida, referee),
  - Fabrice Peyrard (LATTIS, Univ. Toulouse II, habilitation, referee),
  - Mohammad Nassiri (LIG, Univ. Grenoble, directed by Andrzej Duda, referee),
  - Ghazi Al Sukkar (INT Evry, directed by Hossam Afifi, referee).
- **Gilles Grimaud** is a member of the steering committee of French Chapter of ACM SigOps. He is also is a member of the IFIP Working group 8.8 (SmartCards) and a member of the CSE of Lille university and Valenciennes University.
- **David Simplot-Ryl** is a member of the working group of OFTA (Observatoire Français des Technologies Avancées) on Ambient Computing directed by Valérie Issarny. He is member of the scientific committee of GDR ASR of CNRS.
- **Nathalie Mitton** is member of the technology development committee (CDT).

9. Bibliography

Year Publications

Articles in International Peer-Reviewed Journal

[1] E. ELHAFSI, N. MITTON, B. PAVKOVIC, D. SIMPLOT-RYL. *Energy-aware Georouting with Guaranteed Delivery in Wireless Sensor Networks with Obstacles.*, in "International Journal of Wireless Information", 2009, to appear.

[2] S. HYM. *Mobility control via passports*, in "IC", vol. 207, n^{o} 2, 01 2009, p. 171-193, http://dx.doi.org/10.1016/j.ic.2007.11.011.

[3] N. MITTON, B. SERICOLA, S. TIXEUIL, E. FLEURY, I. GUÉRIN LASSOUS. *Self-stabilization in Self-organized Multihop Wireless Networks.*, in "Ad hoc and Sensor wireless networks (AHSWN)", 2010, (to appear).

[4] I. SIMPLOT-RYL, I. TRAORÉ, P. EVERAERE. *Distributed Architectures for Electronic Cash Schemes: A Survey*, in "International Journal of Parallel, Emergent and Distributed Systems (IJPEDS)", vol. 24, n^{o} 3, 2009, p. 243–271 CA .

International Peer-Reviewed Conference/Proceedings

[5] Y. CHEN, E. FLEURY, T. RAZAFINDRALAMBO. *Scalable Address Allocation Protocol for Mobile Ad Hoc Networks*, in "Proc. Int. Conf. on Mobile Ad-hoc and Sensor Networks (MSN 2009), Wu Yi Mountain, China", December 2009, (to appear).

[6] S. DUQUENNOY, G. GRIMAUD, J.-J. VANDEWALLE. *Consistency and scalability in event notification for embedded Web applications*, in "11th IEEE International Symposium on Web Systems Evolution (WSE'09), Edmonton, Canada", 2009.

[7] S. DUQUENNOY, G. GRIMAUD, J.-J. VANDEWALLE. *Serving embedded content via Web applications: model, design and experimentation*, in "ACM International Conference on Embedded Software (EMSOFT'09), Grenoble, France", 2009.

[8] S. DUQUENNOY, G. GRIMAUD, J.-J. VANDEWALLE. *Smews: Smart and Mobile Embedded Web Server*, in "3rd International Workshop on Intelligent, Mobile and Internet Services in Ubiquitous Computing (IMIS'09), Fukuoka, Japan", 2009.

[9] S. DUQUENNOY, G. GRIMAUD, J.-J. VANDEWALLE. *The Web of Things: interconnecting devices with high usability and performance*, in "6th International Conference on Embedded Software and Systems (ICESS'09), HangZhou, Zhejiang, China", 2009.

[10] D. GHINDICI, I. SIMPLOT-RYL, J.-M. TALBOT. *A sound analysis for secure information flow using abstract memory graph*, in "Proc. 3rd International Conference on Fundamentals of Software Engineering (FSEN'09), Kish Island, Persian Gulf, Iran", LNCS, SPRINGER, 2009, to appear.

[11] D. HIRSCHKOFF, A. PARDON, T. HIRSCHOWITZ, S. HYM, D. POUS. *Encapsulation and Dynamic Modularity in the Pi-Calculus*, in "Proceedings of the First Workshop on Programming Language Approaches to

Concurrency and Communication-cEntric Software (PLACES 2008) PLACES 2008, Oslo Norvège", Electronic Notes in Theoretical Computer Science, vol. 241, Elsevier, 2009, p. 85 - 100, http://dx.doi.org/10.1016/j.entcs.2009.06.005.

[12] F. KHADAR, T. RAZAFINDRALAMBO. *Performance Evaluation of Gradient Routing Strategies for Wireless Sensor Networks*, in "Proc. IFIP Networking 2009, Aachen, Germany", 2009.

[13] X. LI, N. MITTON, I. SIMPLOT-RYL, D. SIMPLOT. *Localized Sensor Self-Deployment with Coverage Guarantee in Complex Environment*, in "Proc. 8th Int. Conf. on AD-HOC Networks & Wireless (Ad Hoc Now'09)", LNCS, vol. 5793, 2009, p. 138–151 CA .

[14] M. LUKIC, B. PAVKOVIC, N. MITTON, I. STOJMENOVIC. *Greedy geographic routing algorithms in real environment*, in "Proc. Int. Conf. on Mobile Ad-hoc and Sensor Networks (MSN 2009), Wu Yi Mountain, China", December 2009, (to appear).

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[16] C. MOLLE, M.-E. VOGE. *Effects of the Acknowledgment Traffic on the Capacity of Wireless Mesh Networks*, in "69th IEEE Vehicular Technology Conference (VTC2009-Spring), Barcelona, Spain", April 2009.

[17] T. RAZAFINDRALAMBO, I. GUÉRIN LASSOUS. *SBA: A Simple Backoff Algorithm for Wireless Ad Hoc Networks*, in "Proc. IFIP Networking 2009, Aachen, Germany", 2009.

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[19] S. DUQUENNOY, G. GRIMAUD, J.-J. VANDEWALLE. *Servir du contenu embarqué via des applications Web : modèle, conception et expérimentation*, in "7ème Conférence Française en Systèmes d'Exploitation (CFSE'7), Toulouse, France", 2009.

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[22] F. INGELREST, N. MITTON, D. SIMPLOT-RYL. *9*, in "Réseaux de capteurs : théorie et modélisation (Collection Architecture, Applications, Service)", vol. IX, Lavoisier, 2009.

[23] N. MITTON, F. INGELREST, D. SIMPLOT-RYL. *8*, in "Réseaux de capteurs : théorie et modélisation (Collection Architecture, Applications, Service)", vol. VIII, Lavoisier, 2009.

[24] N. MITTON, L. SCHMIDT, D. SIMPLOT-RYL. */RFID Systems : Research Trends and Challenges/*, in "RFID Middleware : Concepts and Architecture", Wiley, 2009, to appear.

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[25] M. DIAS DE AMORIM, S. FDIDA, N. MITTON, L. SCHMIDT, D. SIMPLOT-RYL. *Distributed Planetary Object Name Service: Issues and Design Principles*, n^{o} 7042, INRIA, 09 2009, Research Report.

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