Networking for Communications Challenged Communities:
Architecture, Test Beds and Innovative Alliances
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D7.1 N4C System integration Workshop

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ABSTRACT

Starting in May 2008, N4C is a 36 month research project funded by the Seventh Framework Programme (www.cordis.lu/fp7). This is a cooperation project between end-users, in Swedish Lapland and Kočevje region in Slovenian mountain, and technological partners (RTD performers and companies). Under the scope of the project we will design and experiment with an architecture infrastructure and applications in field trials and build two test beds.

This document is a brief description of the System Integration workshop and the N4C technical internal meeting.

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1. INTRODUCTION

The objective of the Integration Workshop was to contribute to a shared perspective of the work that has to be carried out, under the scope of the N4C project, and raise partners' awareness towards potential difficulties that are commonly encountered in this type of projects. Thus, the work sessions/presentations were mainly focused on: system requirements, partners' involvement in the implementation of the different modules, architecture discussion, Lab tests and real life testing (field tests). By using practical case studies and a very heterogeneous speaker panel, with academic and multinational corporation backgrounds, we were able to give the audience a broader view of the topic and disclose some of its secrets.

The event that took place in Coimbra city on the 10th of December was organized by the Instituto Pedro Nunes (IPN) in cooperation with the University of Coimbra. This 3 days initiative also included the workshop 'African and other 3rd Countries' and internal meetings of the FP7 project N4C (for more details, please refer to the official agenda in Annex B). The staff involved comprised three IPN employees and seven students that are currently pursuing their Masters degree in the Coimbra University. António Cunha, André Pardal and Hugo Freitas were responsible for the event work plan and for the coordination of the students' activities. The students involved in the event are senior students of the Informatics Engineering course and their names are: João Correia, Francisco Ventura, Filipe Amaral, João Pedro Almeida, José Brandão, Teresa Frazão and José Nuno Monsanto. They participated in the dissemination activities (posters, flyers, blogs information), the workshop agenda content, dinner preparations, event recording (photos, videos), among others. These young engineers have been involved on the workshop because it is part of the IPN's strategic cooperation police to collaborate with teaching institutions and also because we feel that these type of experiences and working environments can be quite relevant for the students' learning process and curriculum.

The N4C partners who attended the event were the following: Samo Grasic, Maria Udén, John Näslund from LTU; Susanne Spik and Karin Kuoljok from TANNAK; Krzysztof Romanowski and Piotr Remlein from ITTI; Barbro Fransson from PLAB; Shane Brodie and Michael Cummins from Intel; Elwyn Davies from FOLLY; Santiago Zazo, Carlos Gonzalez and Xavier Ycaza from UPM; and Javier Guillen for ALBENTIA. Other participants that could not be present contributed to the discussion through videoconference. For that purpose it was used the videoconference software Marratech. The event was broadcasted in N4C channel in Marratech to allow for the other partners to be involved in the discussion sessions that took place in the conference room at IPN. Through the remote call platform, our colleagues: Avri Doria from LTU, Marija Z. Božnar and Boštjan Grašič from MEIS, were able to participate. Considering all of these aspects, we were able to gather, during the 3 days of the event, an average assistance of forty people.

The workshop objective was to present the best practices in system integration and disseminate the N4C work. The agenda included a sequence of four presentations in the morning and a technical internal meeting between N4C partners in the afternoon of the workshop day, which were totally filmed for possible reviews. The presentations were organized according to the road map layout in order to cover the main subjects related to systems integration. For more information please visit the wiki page: http://wiki.n4c.eu/wiki/index.php/Current_events.

In the first presentation the speaker Paulo Marques, Professor in the University of Coimbra, elaborated on the potential issues involving systems' integration. The idea was to forward the importance of having Enterprise Application Integration with Service-Oriented Architecture and its implementation problems.

The following speaker, Rui Melo Biscaia, from Critical Software, presented Critical, a successful company with good practices for software development. It was focused the EdgeBox system, one of Critical's main products, which represents a good example of successful system integration procedures.

In the following presentation, Michael Cummins explained some aspects of system integration such as change control and how software distribution is made. The idea was to understand how systems integrations work in a large scale company like Intel.

The last speaker, Marília Curado (Professor of the University of Coimbra), presented the WEIRD project. This presentation was particularly interesting to the N4C project members because, in the past, Prof. Curado worked in a project with similar characteristics. Prof. Curado shared her valuable experience, regarding System's Integration associated with the project WEIRD. Prof. Curado addressed the main difficulties she faced, at the time, and gave some practical advises useful to this project.

In the afternoon, the N4C partners got together for an internal technical meeting (closed session). The goal was to share the work already done by each partner, discuss alternative inputs and incorporate suggestions.

In the next day, there were closed sessions about the project work, where partners discussed about the system's integration model and requirements for the application, as detailed in section 4.2.

2. Agenda

The event's official agenda:

08:45-09:00	**Coffee and Tea**
09:00-09:45	**Systems' integration Methodologies**
	Professor Paulo Marques, FCTUC
09:45-10:30	**Systems' Integration in Technology based companies**
	Mr. Ricardo Patrício, Active Space Technologies
10:30-10:45	**Coffee break**
10:45-11:30	**Systems' integration and tests in critical systems**
	Critical Software
11:30-12:15	**Systems' integration in multinational corporations**
	Michael T. Cummins, Intel
12:15-12:45	**Debate Sessions**
	Moderator: Professor Marília Curado, Coimbra University

About the participants

FCTUC Faculty of Sciences and Technology is the major faculty within the University of Coimbra, an indisputable reference in higher education and research in Portugal, due to the quality of the courses taught and to the advances achieved in pure and applied research in various areas of knowledge. The Faculty draws on its involvement in cutting-edge research to provide students the best education possible. Fourteen departments offer programs leading to the Bachelor, Master and Doctoral degree programs. Some of the R&D units that have close cooperation ties with the University are: IPN (Instituto Pedro Nunes de Coimbra), ISR (Instituto de Sistemas e Robótica), IT (Instituto de Telecomunicações, Inesc Coimbra (Instituto de Engenharia de Sistemas e Computadores de Coimbra)

Active Space Technologies is a European based company positioning its services in the global markets of aerospace, defense, automotive, nuclear fusion, and scientific sectors. The company aims at providing services and products across the whole supply chain through synergies and integrated competences of an ever-growing network of partnerships. A continuous and sustained investment in innovation and R&D is a critical part of a long-term vision, ensuring permanent aptitude to exceed customers and partners' expectations. Active Space has cooperated in the past with the European Space Agency, Galileo Avionica, JET/UKAEA, ITER/EFDA, Critical Software, and EFACEC.

Critical Software SA is an international company established in Portugal (1998) that develops innovative and dependable information technologies for business and mission critical systems. The company operates a quality system certified to ISO 9001:2000 Tick-IT and follows rigorous software processes based in international norms such as ISO 15504 and ISO 12207. Critical Software's portfolio of customers comprises companies like Vodafone, PT, Infineon, Westland, Nasa or ESA. The company, with headquarters in Coimbra, has offices in Lisbon, and is represented in U.S.A. (San Jose, California) through the Critical Software Inc. subsidiary, and in UK (London), through Critical Software Technologies Ltd.

Intel, The company is focused on the convergence of computer and communications technologies and manufactures chips, boards systems, software and network and communications equipment. Intel currently has 15.3% of the world's semiconductor market. Intel's success stems from investment in R&D, its scale of operation and consistency of standards worldwide. Intel Irish operation employs 5,000 people directly and indirectly in engineering, technical and operational activities. Ireland's fostering of highly qualified professionals in technological disciplines is a key factor to Intel Ireland's success. Employing 3,800 full time employees and 1,200 long term contractors many of whom have a technological qualification, Intel has access to skills which are fundamental to the company's focus on new technology innovations.

3. Presentations

3.1 "Systems' integration Methodologies – Enterprise Application Integration"

In this presentation Professor Paulo Marques talked about system's integration methodologies in large scale. It is common to think that systems integration is only the development of a Three-Tier system, which consists in opening some networks connections to a different machine and do some operations. In reality there are many systems implicated, each one of them with its own specific complexity.

The speaker gave a few examples to expose his ideas to the audience: For instance, Software Engineering can seem perfect, but with the multiple point-to-point integrations one can end up with what is commonly called "*spaghetti code*". This situation occurs when the code, developed according to the initial user specifications, is integrated with other add-on functionalities or modules. This leads to a huge mess at the organizational level, because people, at a certain point, don't know which applications are running on which machines, and which surfaces are deployed.

Enterprise Application Integration is taught to prevent these problems. It's important to make a structured Enterprise Application Integration because the applications must be able to communicate with each other; systems are always changing and the majority of costs are in maintenance of software (companies sustainability). The conclusion is that ad-hoc integration is not an option.

In terms of technology, to build applications is used: databases, networks, Software Engineering and Programming Languages. To structure and integrate applications is used: Enterprise Application Integration, Service-Oriented Architecture and Enterprise Service Bus. In the Enterprise Application Integration implementation must address the following topics: data representation, localization of services, time and synchronization and fault tolerance. The way to do that is creating Service-Oriented Architecture, where systems are composed by autonomous entities which can act independently from each other. These entities must be able of executing independently and are usually designated as services.

The speaker elaborated on future approaches and methodologies. In his opinion scalability and evolution are the reasons to use Service-Oriented Architecture in systems integration. Future applications and people will require interfaces (communication) with the applications created today; ad-hoc integration is very expensive in terms of maintenance and costs and people will surely want to deploy new application and platforms.

It's important that Service-Oriented Architectures can be based on Open Standards. Sooner or later, the systems deployed in the enterprise will be replaced, but the Service-Oriented Architecture has to work very stably for many years. Another very important aspect is the representation of data; nowadays, XML is probably the best choice when compared with old approaches. To create Service-Oriented Architecture are used Web Services but there's other ways to do that. In the speaker's opinion, it is naive to think that Service-Oriented

Architecture is only Web Services and that it can't be approached by any other way, because Web Services, in some situations, aren't always the best technology to employ.

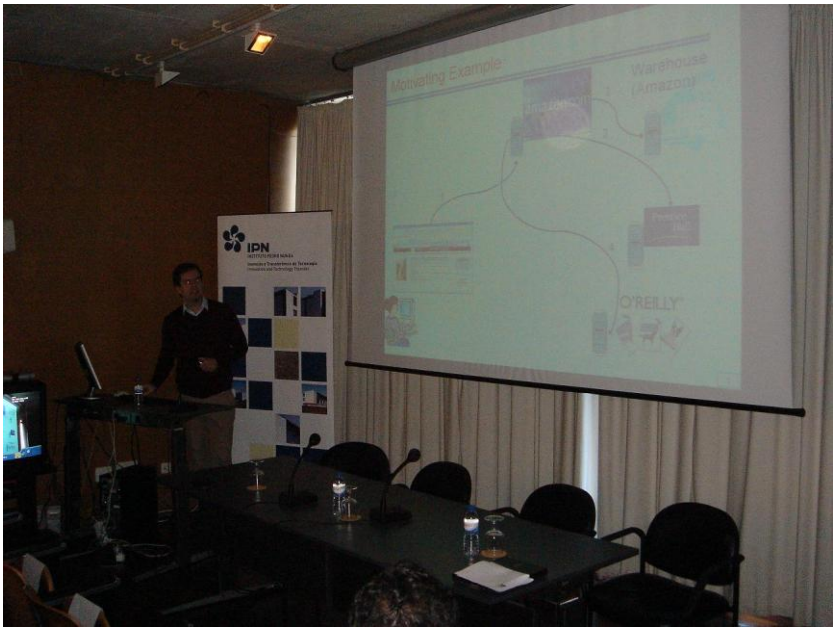


Figure 1

At last, Professor Paulo Marques mentioned that the problem of implementing Service-Oriented Architectures and enterprise application integration is that, typically, it is used synchronous models and Remote Invocation Models and, by doing this, the applications usually work in small and test systems but crash when they are applied to real enterprise scales.

Figure 2

3.2 "Systems' Integration in Technology based companies"

Mr. Ricardo Patrício from Active Space Technologies could not attend the event due to personal reasons. Mr. Patrício was replaced by Professor Marília Curado (the workshop moderator). Professor Curado made a presentation about the WEIRD project, which is described with more detail further ahead in this document.

3.3 "Systems' integration and tests in critical systems"

In this presentation Mr. Rui Melo Biscaia introduced Critical Software, which is a Portuguese software engineering based company with presence in the international market and customers in several sectors. It was created in 1998, in Coimbra, as the result of a spin-off business from Instituto Pedro Nunes.

After making a brief introduction to the company, the speaker presented a successful practical case of system's integration (communication services integration) materialized in a novel product designated "edgeBOX". The edgeBOX is a multi-function network appliance or "business gateway" developed by Critical Software Inc (CSW) and targeted at Small and Medium Enterprises (SME) and Enterprise Branch Offices (EBO). The edgeBOX provides converged services that include network (IP), collaboration (IT) and voice (VoIP) out of a single box, effectively replacing an average of 4 pieces of equipment required today in enterprises to deliver the same set of services.

Figure 3

This is the first fully Integrated IP solution that combines all Small Office Voice, Data and IT technology in a single remotely managed appliance for 1/3 the price of the competition and reduces operations and communications costs by 50%. EdgeBOX integrates different services that are the following: VoIP, router, Wi-Fi, security, network access, quality of service, storage & print and collaboration. The web-based and secure unified management interface makes the typically lengthy and error prone configuration of phone and data networks simple and easy.

As a result of a strategic alliance with Intel, Critical is: an Intel independent software vendor partner; a member of the Intel ClassmatePC initiative; certified for Intel x86 platforms; working with Intel's Emerging Markets Product Group (EMPG) and recognized by Intel as a successful case study.

Figure 4

3.4 "Systems' integration in multinational corporations – Software systems integration"

In this presentation, Mr. Michael Cummins presented the software system's integration from Intel's point of view. To Intel, the major challenge is delivering software to control products and processes. This leads to other challenges: the need to have real time capability (due to software's complexity, caused, in part, by multiple data sources), site processes (due to age, some sites had provided some locally grown) and remote locations and differing time zones. Site automation/I.T., manufacturing, process engineering, are some key groups or organizations that are affected by this challenges.

One goal to build factory software is Change Control. This is a technology approach which is design to allow Intel developers to work the requirements with the knowledge that every site will use in solutions and all sites have the same base build. If all sites are build the same way and everybody keeps the same software, there would be no maintenance costs (because there's no need to maintain all different systems) and the software distribution would then be much easier. Change control works because Intel developers produce software to meet most recent Intel technology.

In the final part of its presentation, the speaker mentioned a sample project deployment where some questions were addressed, such as: a) roles and responsibilities; b) the application, with projects examples, showing who were involved and the main stages in application proliferation progression (how we do it in terms of progression); c) the capability proliferation pacing expectation; d) schedule management process; e) representation of distributed applications transfer process.

Figure 5

Figure 6

3.5 "WEIRD – WiMAX Extension to Isolated Research Data networks"

Professor Marília Curado spoke about the project WEIRD (WiMAX Extension to Isolated Research Data networks) in which she was involved. There's a clear similarity between the problematic integration issues that will be encountered in the N4C and those that Professor Curado and her team faced when working on the WEIRD project, where partners with different backgrounds in industry and academic expertise interacted in order to achieve a common goal. Hence the pertinence of Prof. Curado's intervention in this workshop and its interest to our project.

The WEIRD project was an European integrated project, that started in June 2006, with 2 years of duration and 17 partners, and had as goal the application of the WiMAX technology to provide internet access to remote areas (facilitate environmental monitoring, telemedicine and fire prevention). Four testbeds were implemented (Portugal, Italy, Romania and Finland) and for each one of them it was developed software models which were compose by: a mobile station with WiMAX connection, the base station with connection to the outside and the Connectivity Service Network with connection to the internet.

Figure 7 – WEIRD project presentation

One test case of the WEIRD technology involved a fire prevention scenario that took place near Coimbra. It was used video surveillance cameras, meteorological sensors and the information was transferred to a central server for the fire prevention season. Applied in environmental monitoring, WEIRD can also be used to predict volcanic eruptions and because

the WiMAX technology is becoming cheaper, the video surveillance, which was used in fire prevention, is cheaper than human resources and avoids danger to people.

Many modules had to be developed and integrated and, according to the speaker, the interface definition was the main challenge. It was necessary to define an interface and the major problem was to guarantee that different software builders defined a common interface. It's very important to make sure that everybody follows the same methodology and other important definitions and that everybody agrees on what they are building on.

For example, the group acquired hardware from different vendors. Thus, researchers had to develop specific adapters for each module to allow the WEIRD system to interact with the hardware. The different operating systems problem was solved with an agreement between all partners that would be using all the same. They didn't use a common programming language and they chose to use state diagrams to specify the models and UML to specify how the components should interact. Depending on the type of model they would use a different approach.

Figure 8 – Professor Marília Curado

Throughout its presentation, Professor Curado continued to give advices and stressed a few other important aspects like for instance the importance of having a well delineated risk plan, a defined implementation methodology and an effective monitoring process.

4. N4C TECHNICAL INTERNAL MEETING

The Technical internal meeting was divided in two parts: The first part consisting of presentations which was intended for the partners to share their work progress and the other component involved a discussion session to elaborate on the Applications and Architecture approach of the N4C system.

4.1 Partners' Presentations

The partners were invited to make a brief presentation where they were asked to indicate: a) what they were doing and in which way they are contributing to the project; b) in which stage their work would fit in the global picture (system's architecture); c) which are the modules that interact with their application; d) which are the main interfaces between their modules and the global system.

The presentations were made according to the following sequence: FOLLY, TCD (Marratech), Intel, ALBENTIA, LTU, NORUT, MEIS (Marratech), UPM, ITTI and IPN. Some partners, that could not be present in the meeting, participated and made their presentations by videoconference with Marratech software.

4.1.1 FOLLY

The outcome applications of N4C's project are intended to be used in several platforms and to have a common software infrastructure which should be testable independently of applications. It was proposed some infrastructure test modules: configuration, Application Programming Interface (API), Bundle Protocol, encounter management and routing, storage management, remote node management and update, gateway functionality and clearing house interface. As testing tools it was proposed a DTN network emulator to emulate opportunistic encounters.

Testing management should be done to management applications, through remote configurations and upgrades, and to provide part of testing infrastructure during system integration and field tests. The system applications should include gateway and clearing house functionalities and the basic applications should include email and NSIM. In mobility scenarios is important to handle chameleon nodes moving from CCR to: main LI, enclaves and other CCR.

4.1.2 TCD (Marratech)

This presentation was canceled due to technical reasons.

4.1.3 Intel (Automation Department)

Intel started documenting use cases around e-mail, web usage both static and interactive to help identify issues and potential solutions to these use cases. This department is currently working on network management use cases to help understand how to manage the DTN network, made the first revision of application use cases and network management use cases. They also had acquired small form factor board from Intel to help with the next stage of testing Atom processor and potential architecture; completed initial testing on SFF board; put second Atom based system in place and part of test network; and completed Product Requirement.

Other work included, document and design for platform, both revision 1; identified a producer of a board that meet the requirements (Eurotech) and order three boards (Proteus); powered bench in place and initial power utilization tests were completed on SFF board; putted 3 boards on order for initial testing of summer design and completed Product Requirement Document in draft revision 1. The modules that interact with Intel's modules are: DTN and routing, file handling, resource and device management.

4.1.4 ALBENTIA

ALBENTIA is enhancing WiMAX technology, to be used in N4C, to: reduce costs, make it more rugged and put it in a small form. They are also preparing support for summer and winter tests II and planning radio network. Essentially, ALBENTIA's modules will interact with other physical modules. There is some equipment that can interface ALBENTIA's: DTN Routers; Wi-Fi Access Points and Internet Service Provider (ISP) Equipment.

4.1.5 LTU

LTU is studding PRoPHET Routing by reproducing the results from the RAPID paper (University of Massachusetts), adding the time scaling to main prophet parameters, self adapting parameters and building a DTN emulating lab. To do the integration and testing PRoPHET Routing has to take into account the inputs (traffic, density, mobility, encountering time), the outputs (gathered

traces) and the fail/pass criteria (optimal route at every "route decision step"). LTU is doing cold lab tests before winter test.
This is a cold lab room with the equipment that they already have. They test the different hardware platforms with cold and warm startups; the different batteries and the handling of the devices. LTU is also setting up public DTN node. This was an idea presented within the DTNRG. It consists in gathering a list of other public DTN running nodes; automated web page and set up DTN-Cam.

4.1.6 NORUT

NORUT is responsible for Hiker's Applications which should be composed by: e-mail, web-cache and NSIM; weather; map with GPS for own location and Geoblog (information-push; health services; governmental services and bank services). Hiker's Applications should have available information services based on location, such as: tour operators and guides, in-field weather services, geology and biology, point of interests, installations, land-owners, authorities, environment regulations, fishing and hunting permits and access information. NORUT is studding the best PDA, UMPC and MID candidates and working in tests in Sweden. GeoBlog have different information types: auto track messages, photos, observations, e-mail & NSIM, web-cache, map-cache and point of interests. It has some features, for example: ad-hoc networks, Peer-to-Peer, communication in the field, communication in the office and information spreading. On GeoBlog, NORUT has been working in: architectural sketches, ad-hoc WLAN and IPv6 experiments, information flooding strategies, discussing hardware and platform issues and thinking about some scenarios.

4.1.7 MEIS (Marratech)

MEIS is responsible for testing and validation on two remote test beds (WP8). The MEIS work has been focused in the following tasks: a) studies of the project overall tasks; b) familiarization with PRoPHET code, environment and executable; c) familiarization with DTN executable; d) preparation of summer test in Slovenia; e) organized the technical start up meeting. From this work MEIS is expecting to deliver the milestone reporting the summer test and the deliverable about tests preparation and technical start up. The main modules that interact with MEIS's modules are PRoPHET and DTN.

4.1.8 UPM

UPM is responsible for designing the hardware and software for animal tracking. They are developing a simulator; doing the first prototype of the secondary node; designing the primary node and will do real trials. The simulator is almost finished. The first design results are expected in March 2009 and it is being designed to solve some problems. The primary nodes (reindeer and base station nodes) will be finished in March 2009 and it will have a Linux/Windows library in order to communicate with the embedded computer. The first design of the secondary node is ready to be tested. This node will be tested outdoor, with a dog, to analyze the coverage. The first real tests will take place in Lapland, in February 2009, in order to evaluate the coverage of the system; check the suitability of the design of the kinetic generator regarding the movement of the animal; evaluate the effect of the temperature and study of the collar design.

4.1.9 ITTI

In this project there will be some individual applications with different usage domains, in different regions, time and so on. These applications are: hiker's PDA; reindeer tracking and Data Transfer from Meteorological Station, and will have common functionalities, essentially in the middle layers, such as: transport; routing and management. In middle layers we can find: DTN bundle layer; LTP transport protocol; PRoPHET routing protocol; caching; storage; communication opportunity management and security.

It has been proposed to adopt Enterprise System Bus as a technique to do the system integration. Enterprise System Bus has some interesting features such as: invocation, message routing, mediation, event processing, QoS, 'choreography', 'orchestration' and management. This brings useful functionalities: distributed, possibility of central management, extensible, standard-based, supports various communication patterns and 'transport' protocols. Use Enterprise System Bus only makes sense if there are services to be delivered over the bus. There are some issues that have to be considered like: if the service abstraction is appropriated and if there are common services. It was presented some examples of commercial and open source Enterprise System Bus.

4.1.10 IPN

IPN is responsible for N4C systems integration. IPN team has conceived a subsystem integration module and tests draft version 1 and, with the partner's contribution, made the draft version 2. There must be an integration team, composed by one responsible per partner, to deal with integration. This team must define an integration plan and with regularly meets establish the main diagram, define the main black boxes and define the owner of each black box. To get more information about each module, it's very important that each "black box owner" defines the inputs, the outputs and what it's needed to test the block.

For now, IPN is considering as the best integration option the Inter-Process Communication (IPC), namely the use of the D-Bus integration platform, which allows the division of the system into modules, made with the purpose to test the integration process, giving the whole system a new concept of modularity and flexibility.

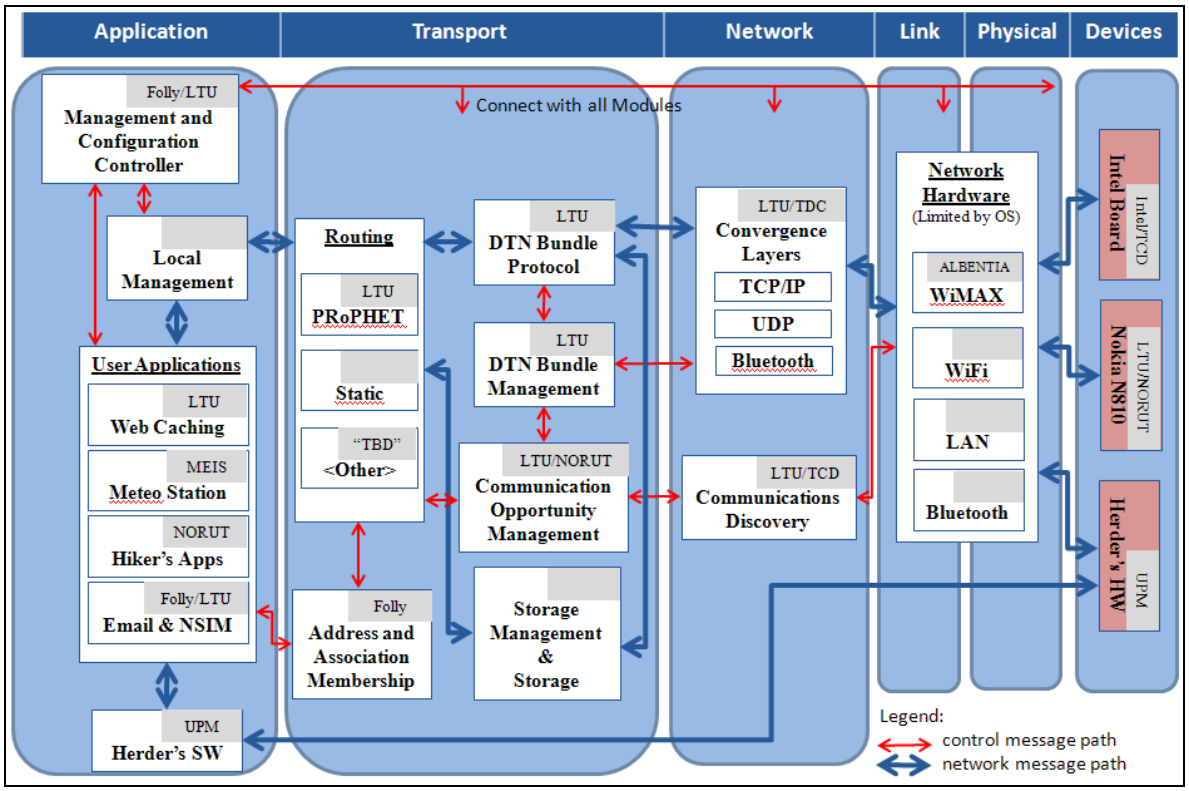


Figure 9- Partners position in the general Module Diagram

The previous general diagram was built by IPN with the cooperation of the partners in the technical meeting and subsequently. This will help the partners to located themselves in the general diagram and become acquainted with the partners that have modules that interact with their. The diagram is divided in six fractions – or swim lanes: the firsts five correspond to the

communication stack and last to others hardware devices with other function (not only network functions).

4.2 Partners Work Session

The objective of the partners' work session was to focus on two key issues: the Application Requirements and the discussion of the Architecture for the system. In order to do so, the participants were divided in two groups each one assigned to one of the topics. After the discussion that took place within the groups, each group's spokesman was invited to share ideas. The output of the debate is briefly described in the next sections.

4.2.1 Application Requirements

The outcomes of the closed sessions about the applications' requirements are listed below:

a) It should be possible to send and receive messages or information by: unicast; anycast; multicast and broadcast.

b) There must be receive confirmations at different levels: from first custodian and from destination node (network/transport layer, bundle layer; application end-to-end; human).

c) It should be possible to specify some attributes of the communication channel and messages (on registering and/or for each message): priority; emergency level; time-out; how often to send or receive messages and characteristics; specific tag for billing possibility; security information and the possibility to affect routing policy according to these tags.

d) The application should be provided with location awareness: of my own node; of other nodes on the CCR; of other nodes in the surrounding area (maybe who they are); in order to publish to others control of whether, my location and ID; user-level awareness of others (application in emergency) and encounter management (who is around, control syncing and message passing). The idea of establishing CCR membership was dropped.

e) It's important to equip the application with some type of time information in order to warn if the system is out-of-sync. This should use GPS when possible.

f) There are some requirements that should be delegated to separate subtasks. Taking in account security aspects, the register of the information profile or characteristic of a node should use: user and interest categories and the periodicity of updates (how often to receive information). There must be an information broker that would collect information of common interest and then distribute it according to registered profiles without the nodes needing to know specific service addresses (database and distribution tasks).

4.2.2 Discussion on System's Architecture

The review of the API led to discussion around D-Bus. Among others, D-Bus has the following features that may be relevant to the project: allows notification, removes X11 and allows the configuration of options. D-Bus has bindings for several programming languages, some of them multiplatform like Qt or Java, which is important to the use of different operating systems. The adoption of D-Bus, and the binding to be used with it, is a subject that still requires some discussion and that possibly needs a technical meeting or technical steering phone conference needed.

For the purposes of this project in the technical meeting was taken the following decisions:

i. the system should be Linux based;
ii. browsers need to be the end point;
iii. NSIM and Reindeer Tracking need to be server based.

Beyond the integration method, from the closed sessions also resulted a list of requirements for the DTN:

1. Discovery;
2. Send / Receive - Unicast and Broadcast;
3. Custody - confirmation that a bundle is sent and that the user knows that it has been sent from first point to next;
4. End to end - acknowledgement that end point has received a bundle;
5. Time-Out - User specifies relative time. Implemented in absolute time. (bundle is aware of its creation time);
6. Priority - application can set bits to decide priority (although it was not decided if this feature is going to be implemented, since this feature requires both responsible developers and users);
7. Emergency is not covered;

Together with these, a list of questions and possibilities arisen from the discussion:

1. Should there be a billing system for the DTN network?
2. How is security handled?
    a) Integrity;
    b) Authorization;
    c) Access;
    d) Accounting;
    e) Encryption - key distribution or pre-sharing.
3. Should we expose ProPHET data through the API?
4. Network time is an open question.
5. Clocks that are out of synchronism between any 2 nodes should be a warning?
6. Receiver needs to know when the bundle was originated - Encounter management need to exchange the clock times and warn.

7. Clocks can be synchronized through GPS signal.
8. How to distribute details of profiles and users?
    a. It needs a separate API.
    b. Configuration Database - who owns this?
    c. LTU or TCD - Part of it is routing and then the whole user registration - Steering Committee needs to decide.
    d. Security of the user information that might be distributed?
    e. Design the database and the distribution of the database.
9. End of January for a decision on who does what?

5. Conclusions

After the discussion sessions and having identified the general global diagram, there have been identified several modules that are not yet covered by the development activities. The partners realized that there still is a lot of aspects that are not fully covered by the functional specification of the system.

We believe the results of the workshop were quite encouraging, because for the first time the partners were able to actively contribute to the project as a group and not as mere individuals. By having a group perspective of the overall system, it becomes easier to produce usable inputs and also facilitates the group contribution to the big picture.

Regarding future work, we will carry on with the definition of the general diagram of the system, working always in close contact with the participants of the consortium.

6. DISSEMINATION IMPACT

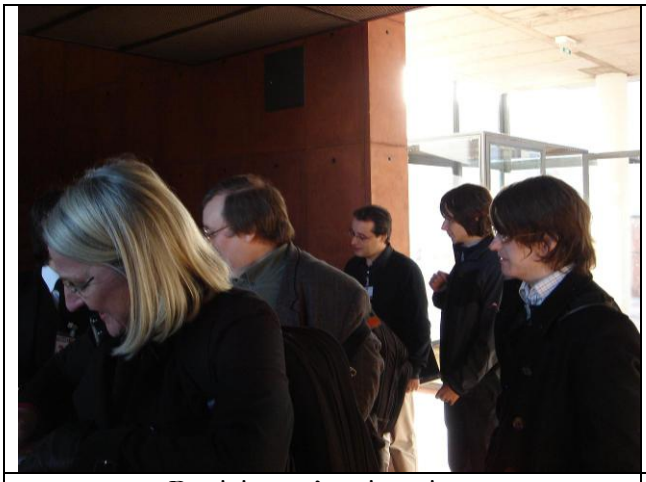
In order to maximize resources IPN adopted a common strategic to disseminate the 2 workshops that took place in Coimbra, namely the "Integration Workshop" and the "African and Other Third countries Workshop". This approach enabled IPN to collect the publicity benefits of the two events, using the same resources and dissemination channels.

This workshop had a big impact on the community due to the media coverage of the event. In the 11th of December 2008 if anyone inserted in the Google search engine the words "N4C Coimbra" it would have had 276 hits. News about this workshop were published in the main Portuguese newspapers and the initiative has also been reported on national TV (http://wiki.n4c.eu/wiki/index.php/Current_events), where António Cunha explained the main directives of the project N4C and the expected outcome and impact in challenged regions (Swedish Lapland, African communities).

Due to IPN's dissemination strategy, the Integration Workshop attracted quite a lot of attention from the general public. Among the participants were present members of Technological based Companies, academics and also Engineering students.

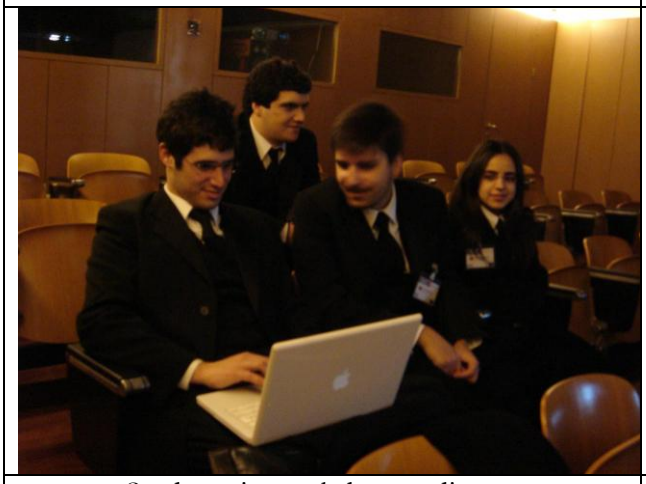
ANNEXES

ANNEX A: PHOTO REPORT

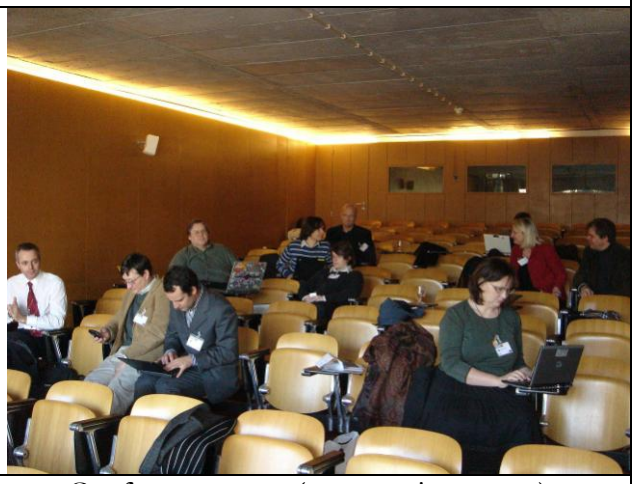
<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Participants' registration.</td><td>Participants' registration.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Coffee and tea before the workshop.</td><td>Students and participants at coffee break.</td></tr>
</table>

Coffee break.

The audience.

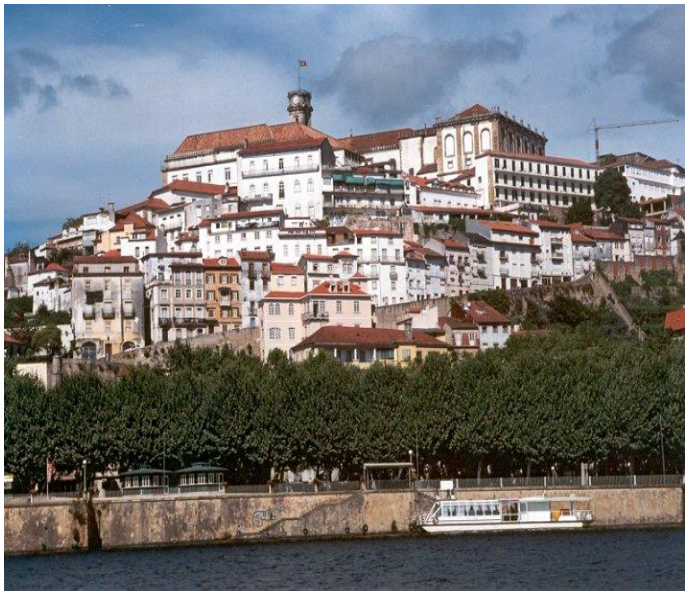


Students in workshop audience.



Conference room (presentation recess).

ANNEX B



Invitation to:

African and other 3rd Countries & Integration workshops

Hosted by the Pedro Nunes Institute (IPN) & Coimbra University (FCTUC)

From 9 to 11 of December of 2008, in Coimbra City, Portugal

ABOUT N4C

N4C ("Networking for Communications Challenged Communities: Architecture, Test Beds and Innovative Alliances") is a three year research project financed by the European Commission, Seventh Framework Programme, coordinated by the LTU. N4C objectives are to develop and test a broadband network with use of Delay and Disruption Tolerant Networking (DTN) access technology and to evolve a test bed for applications in communication-challenged areas in Swedish Lapland and in Slovenian mountain. In the network and the test bed, tests will be carried out on user-driven applications, animal tracking including reindeer and cattle, hiker PDA applications and on the collection of meteorological data.

PRACTICAL INFORMATION

9th to 11th of December 2008: Pedro Nunes Institute (IPN)

Fees: The workshop is open to invited guests and other interested parties. Participants will be assigned to participation on the "first come, first served" basis.

Travel and Accommodation: Participants are expected to make their own travel and accommodation arrangements.

Language of the workshop: The event will be held in English only.

Booking details and further information about this initiative please contact:

Mr. António Cunha Email: cunha@ipn.pt Phone:+351 239 700 934

Mr. Hugo Freitas Email: hfreitas@ipn.pt Phone:+351 239 700 935

The Seventh Framework Programme for research and technological development (FP7) is the European Union´s chief instrument for funding research over the period 2007-2013.

SEVENTH FRAMEWORK PROGRAMME

Agenda N4C

Wednesday 10th of December of 2008, Coimbra city		
Integration Workshop (Public conference, N4C Project closed session)		
08:45-09:00	**Coffee and Tea**	
09:00-09:45	**Systems' integration Methodologies**	*Professor Paulo Marques, FCTUC*
09:45-10:30	**Systems' Integration in Technology based companies**	*Mr. Ricardo Patrício, Active Space Technologies*
10:30-10:45	**Coffee break**	
10:45-11:30	**Systems' integration and tests in critical systems**	*Critical Software*
11:30-12:15	**Systems' integration in multinational corporations**	*Michael T. Cummins, Intel*
12:15-12:45	**Debate Sessions**	
	Moderator: Professor Marília Curado, Coimbra University	
13:00-14:30	**Lunch Buffet**	
	N4C Technical Internal meeting - Member Presentations I (closed session)	
	Guidelines for partner's presentations: - What am I doing? (Please use diagrams to illustrate your contribution to the project, e.g. use case diagram) - Where do I locate my work in the "big picture"? (location your work on the global diagram of the system) - Which are the modules that interact with my research modules? - What are the main interfaces between my modules and the global system?	
	Sequence of partners presentations:	
14:30-14:55	- FOLLY	
14:55-15:20	- TCD (Marratech)	
15:20-15:45	- Intel	
15:45-16:10	- ALBENTIA	
16:10-16:35	- LTU	
16:35-17:05	**Coffee Break**	

	N4C Technical Internal meeting - Member Presentations II (closed session)
	Sequence of partners presentations:
17:05-17:30	- NORUT
17:30-17:55	- MEIS (Marratech)
17:55-18:20	- UPM
18:20-18:45	- ITTI
18:45-19:30	- IPN
19:45-21:30	**Dinner**

Thursday 11th of December of 2008, Coimbra city	
N4C Internal Meeting (Closed session - Project work)	
08:45-09:00	Coffee and Tea
	N4C Technical Internal meeting: Subsystem Integration Model and Test (Global view). The group will be divided in two or three teams taking into account the specific area of expertise of each partner. Expected outputs: N4C global platform use case; Identification of the interfaces between modules; identification of the modules and parts not foreseen in the initial specification ("Do we have all the modules to build the common platform?") ; Main Tests identification; Work document: M7.1_N4C-WP7.-0.2 - Team Work - Presentation to the group
09:00-10:30	
10:30-10:50	
10:50-11:10	Coffee break
	N4C Technical Internal meeting: Subsystem Integration Model and Test (Winter Tests): Expected outputs: Winter tests use case; Identification of the modules that will be used in winter tests; tests identification; success criteria identification Work document: M7.1_N4C-WP7.-0.2 - Team Work - Presentation to the group
11:10-12:30	
12:30-12:45	
12:45-14:00	Lunch Buffet
14:00-15:00	N4C Technical Internal meeting – Ad Hoc Meeting

	N4C Technical Internal meeting – Presentation of Redmine Platform
15:00-15:15	- Exposition of Redmine Characteristics
15:15-15:30	- Discussion and decision about platform adoption
15:30-16:00	N4C Technical Internal meeting – Conclusions and next steps
16:30-17:00	Coffee Break
17:00-18:30	IPN Presentation Visit to IPN Labs and Business Incubator
	Note: all sessions will have Marratech and Skype available except the Nicolas Chevrollier intervention, because we will use the same equipment to establish the video conference between TNO and IPN.