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Your Connection to ICT Research

ANNUAL REPORT 2011

CENTRE OF EXCELLENCE IN INFORMATION AND COMMUNICATION TECHNOLOGIES

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ABOUT CETIC

CETIC at a Glance

The Centre of Excellence in Information and Communication Technologies (CETIC) is the Belgian centre for applied research serving ICT enterprises, founded in 2001 by the Catholic University of Louvain (UCL), the University of Namur (FUNDP) and the University of Mons (UMONS).

CETIC's mission is to support regional economic development by transferring the results of the most innovative applied research in ICT to Walloon companies, particularly SMEs. On a practical level, CETIC helps companies integrate these technological innovations into their products, processes and services. To achieve this objective, its researchers continually enhance their expertise through collaborative research projects involving regional and European actors in advanced technology.

CETIC's board is composed of industry representatives from the ICT sector and representatives from its founding universities.

As an independent actor and trusted third party, CETIC is well positioned between academia and the industry community.

Simon Alexandre,
General Manager

Introducing CETIC

ICT provides one of the most promising opportunities for addressing key societal challenges: sustainable health care linked to ageing well, and a reduced-carbon economy. In turn, these two challenges provide Walloon companies with an ideal opportunity to develop new and innovative solutions that can be exported worldwide. In this respect, CETIC continues to develop advanced expertise in technologies and approaches related to the field of eHealth and to the use of ICT to lower energy consumption.

Strengthening that regional expertise, through the research and innovation capacity available to citizens and industry, is neither a luxury nor an option, but rather a requirement for a region that needs to redeploy its economic initiative. This is the mission of the CETIC research centre, accredited by Wallonia.

The year 2011 has been a very special one for CETIC. The research centre celebrated 10 years of innovative research and development activities, and 10 years of dedication to the enhancement of key expertise to help the region's ICT industry by bootstrapping access to key research results.

In fulfilling this mission, CETIC provides expertise in software engineering, service-oriented technologies and embedded systems. This expertise is continuously increased through CETIC's active involvement in European and regional projects, and with European technological platforms. CETIC develops its expertise in key technologies, including: Cloud Computing, semantics, the Internet of Things, security and quality, as applied in domains of primary importance to society, such as eHealth, smart mobility, energy and the environment. This expertise is systematically developed through strategic and long-term partnerships with technological leaders and European industries, and speeds up technological transfer to local Belgian companies.

The work of CETIC experts stimulates research and provides IT support to local industries, enabling them to adopt advanced technologies, innovate faster, save time and money, and meet new needs, so as to strengthen the EU's competitiveness and leadership. eHealth and efficient energy management are two strategic domains for CETIC research.

The key achievements of CETIC in 2011 were many and varied. Among the most significant outcomes are the following:

- In February, CETIC actively participated in the successful closure of the FP7 RESERVOIR project. This consortium had developed reference Open Source Cloud middleware, which provides high value functionalities that enable the delivery of enhanced services by companies and eGovernment, in terms of energy efficiency and elasticity, by increasing or reducing computing capacity based on demand.
- In May, more than 200 representatives from regional ICT industries, universities and government attended a conference organised to celebrate CETIC's 10th anniversary. Participants had the opportunity to learn about CETIC expertise through several very innovative demos.
- In December, after several years of collaborative research and development, CETIC launched its first spinoff, CareSquare, dedicated on the development and deployment of a highly innovative digital companion for the elderly living at home, to provide them with interactive health and social services.

CETIC takes pride in cultivating excellence to provide innovative and effective solutions to Wallonia's ICT industry, and the entire team is committed to continually enhancing this expertise.

Again, we thank our industrial partners for their active interest and the trust they place in us, and all CETIC employees for their great creativity and expertise.

> **CETIC cultivates excellence in providing innovative and efficient expertise to industry. The entire team is committed to continuous innovation in order to help Wallonia's Information and Communication Technologies (ICT) industry.**

Members and Organisation

CETIC is a non-profit organisation (ASBL under Belgian law) established at B-6041 Charleroi, 29 rue des Frères Wright, and composed as follows:

FIVE CORPORATE BODIES:

- Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP)
- Université catholique de Louvain (UCL)
- Faculté Polytechnique at the Université de Mons (UMONS)
- IGRETEC
- Technology Industry Federation AGORIA

FOURTEEN PHYSICAL BODIES:

- Mr Bernard Bolle, ATOS
- Mr Patrick Donnay, Haulogy sa
- Mr Philippe Fortemps, Professor, UMONS
- Mr Naji Habra, Professor, FUNDP
- Mr Jean-Luc Hainaut, Professor, FUNDP
- Mr Benoît Hucq, Océ Software Laboratories Namur sa
- Mr Roland Keunings, Professor, UCL
- Mr Jean-Didier Legat, Professor, UCL
- Mr Benoît Macq, Professor, UCL
- Mr Roger Malchair, Evadix.Net sa
- Mr Pierre Manneback, Professor, UMONS
- Mrs Nicole Moguilevsky, Research Administration, FUNDP
- Mr Daniel Truyttens, Professor, UMONS
- Mr Christian Verdonck, BizzDev sa

Members of the association meet regularly in a statutory General Assembly, tasked with approving the CETIC budget, and appointing administrators and members.

Board of Administrators

CETIC's Board of Administrators is composed of the following members:

- Mr Bernard Bolle, ATOS
- Mr Giacomino Bonsignore, NRB
- Mr Serge Boucher, UMONS
- Mr Patrick Donnay, Haulogy sa
- **Mr Marc Durvaux, Thales Alenia Space – President**
- Mr Jean-Luc Hainaut, FUNDP
- **Mr Benoît Hucq, Océ Software Laboratories Namur sa – Vice-President**
- Mr Jean-Didier Legat, UCL
- Mr Benoît Macq, UCL
- Mr Roger Malchair, Evadix.Net sa
- **Mr Pierre Manneback, UMONS – Treasurer and Secretary**
- Mr Lucyan Papiernik, IGRETEC
- **Mr Yves Poullet, FUNDP – Vice-President**
- Mr Bruno Schroder, Microsoft
- Mr Olivier Verbeke, Idealy
- Mr Christian Verdonck, BizzDev sa

Mr Pierre Villers, DGO6, is the observing member appointed from Wallonia, who sits on the Board of Administrators and participates in the General Assembly.

Mr Simon Alexandre is the General Manager, appointed by the Board of Administrators.

Technical Committee

The research decree published on July 3, 2008, defines the conditions and modalities for Walloon Research Centre accreditation. It embodies the Research Centre's mission, which is to perform general industrial research that can be transferred to industry, according to expressed needs and specificities.

In particular, the decree mandates that the Research Centre conduct collaborative industrial research that is general enough to be of interest to companies with similar requirements.

The Centre's areas of research are determined by these needs, along with a typology of Wallonia created under the guidance of a technical committee composed of representatives of corporations and industries.

In order to align research activities with industry needs, the Research Centre has set up a permanent technical committee in charge of validating the R&D strategy

The mission and objectives of the Technical Committee are the following:

- Advise the Board of Administrators and the General Manager on the scientific and technological objectives to develop according to the sector's needs. The Committee works at the request of the General Manager, in particular with respect to developing or updating CETIC's strategic plan.
- Evaluate proposals for new research directions, at the request of the Board or the General Manager. If relevant, the Committee proposes new business opportunities or research projects, or both, consistent with CETIC's scientific and technological orientations.
- Support CETIC in its continuing effort to remain an independent and internationally recognised applied research centre in ICT.
- Advise CETIC management on research exploitation opportunities for CETIC projects that are on-going or likely to be initiated.
- Report annually to the CETIC Board of Administrators on its work and scientific achievements.

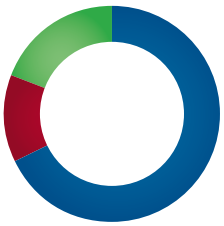
The CETIC Technical Committee is composed of the following members:

- Mr Simon Alexandre, General Manager, CETIC
- Mr Thierry Bingen, Haulogy
- Mr Jean-Louis Bolsée, Thales Alenia Space ETCA
- Mr Patrick Crasson
- Mr Michaël Demeyere, AGC
- Mr Jean-Christophe Deprez, Scientific Coordinator, CETIC
- Mr Pascal Devincenzo, Open Engineering
- Mr Denis Flandre, UCL – Dice
- Mr Naji Habra, FUNDP
- Mr Jean-Luc Hainaut, FUNDP
- Mr Patrick Heymans, FUNDP
- Mr Benoit Hucq, Océ Software Laboratories Namur sa
- Mr Christian Huvelle, Atos
- Mr Igor Klapka, FN Herstal
- Mr Pierre Leclercq, Microsoft Innovation Centre
- **Mr Jean-Didier Legat, UCL – President**
- Mr Alain Leroy, PENTACLE
- Mr Benoit Macq, UCL – Tele
- Mr Pierre Manneback, UMONS
- Mr Philippe Massonet, Scientific Coordinator, CETIC
- Mr Kim Mens, UCL – INGI
- Mr Yves Moulart, ST Microelectronics
- Mr Dominique Orban, Rever sa
- Mr Emmanuel Ottevaere, BizzDev
- Mr Frederic Peters, Thelis
- Mr Etienne Pourbaix, Thales Communications Belgium
- Mr Frédéric Robert, ULB
- Mr Bruno Schroder, Microsoft
- Mr Daniel Tuyttens, UMONS
- Mr Luc Vandendorpe, UCL
- Mr Christian Vanhuffel, Agoria ICT
- Mr Axel van Lamsweerde, UCL

Key Figures

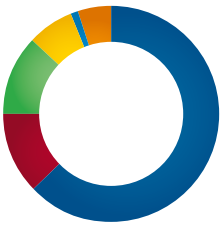
27% Service to industry
14% Walloon Region
11% EU
11% Federal
30% Convergence ERDF
7% Other

Sources of revenues



68% SME
13% Large companies
19% Non profit & public

R&D activities and services offered by CETIC to industry specifically target Walloon SMEs.



63% ICT
12% Industry
12% eGov
7% Health
1% Finance
5% Other

Distribution by sector of CETIC technology transfer activities.

Human Resources

General Management
Simon Alexandre

Business Development
Michel Van Der Straeten
Olivier van de Werve

Operations Management
Damien Hubaux

Scientific Management
Philippe Massonet
Jean-Christophe Deprez

Admin & Finances
Laurence Lepied
Pierre Romain
Corentine Biron

Communication
Bérengère Fally
Corentine Biron

Quality
Frédéric Fleurial Monfils
Nicolas Devos
Michaël Van de Borne

IT
Stéphane Mouton
Etienne Charlier
Dimitri Diakodimitris

Software & System Engineering
Christophe Ponsard
Gautier Dallons
Annick Majchrowski
Sanae Saadaoui
Nicolas Devos
Jacques Flamand
Arnaud Michot
Renaud De Landtsheer
Raphaël Michel
Ravi Ramdoyal

Software & Services Technologies
Frédéric Fleurial Monfils
Stéphane Mouton
Etienne Charlier
Orlando Cassano
Fabien Steels
Michaël Van de Borne
Robert Viseur
Syed Naqvi
Dimitri Diakodimitris
Joseph Roumier
Fabrice Estiévenart
Nikolaos Matskanis

Embedded & Communication Systems
Philippe Drugmand
Lofti Guedria
Valéry Ramon
Mathieu Ocaña
Sébastien Dawans
Gérard Florence
Jonas Simon
Jimmy Nsenga
Laurent Deru
Ronald Moncarey

Quality Policy

ISO 9001 CERTIFICATION

CETIC has been ISO 9001 certified since September 2010, receiving this recognition from a leading inspection, verification, testing and certification company, SGS, following implementation of its quality management system.

The certified activities cover business support for the realisation of technology transfer missions, as well as for the set-up, follow-up and management of R&D projects.

ISO 9001 is a standard recognised worldwide, which details the basic requirements with which a company's quality management system (QMS) must be compliant. These requirements, if they are fully met, ensure that the quality of the processes set up by that company is guaranteed, constituting a proof of trust.

CETIC QUALITY POLICY

CETIC's mission is to improve the efficiency and competitiveness of Walloon companies by helping them integrate Information and Communication Technologies (ICT) into their products and services quickly and effectively.

From this perspective, and to ensure the satisfaction of all its partners (companies, universities and government), CETIC aspires to practice "operational excellence".

CETIC is committed to:

- Developing cutting-edge expertise in ICT;
- Delivering innovative results with high added value for companies through continuous improvement of the technological innovation process;
- Ensuring objectivity and quality results, thanks to its independent position, its international recognition, and its strict adherence to ethical and scientific protocols;
- Ensuring the quality of its competencies and technical capabilities by conducting on-going training and appropriate recruitment;
- Promoting the development and fulfilment of its employees by promoting a healthy environment, conducive to creativity, professional achievement and teamwork.

This commitment applies to all the research projects that CETIC leads, both with and for companies, as well as the management of these research projects and the organisation of CETIC's development over the long term.

CETIC Values

CUSTOMER

CETIC is the trusted third party when partnering with companies, helping them to integrate the latest technologies to innovate, grow faster and remain competitive.

CETIC employees are approachable and forthright, and the way in which they interact with their partners is, for them, a point of honour. They take the time to understand the needs of their clients, and provide them with the solutions that best meet those needs.

EXCELLENCE

CETIC applies its expertise to achieving the highest level of software quality to yield maximum benefit for both companies and partners. Thanks to the close ties among its research teams, CETIC maintains control of all phases of a project.

TRANSFER

CETIC actively contributes to the development of Wallonia by supporting and stimulating innovation in the local economy, particularly in SMEs.

INNOVATION

CETIC teams demonstrate initiative, creativity and curiosity in the research topics they select, using their complementary skills to ensure an innovative, high-quality result. Strong links with industry (including those maintained by the Technical Committee) ensure the relevance of the research projects that CETIC chooses.

COLLABORATION

Thanks to its status as a private, non-profit SME, CETIC is able to collaborate with industry and the public sector in total independence, within a framework of trust and in a spirit of cooperation without competition.

> **CETIC's values match its commitment to operational excellence, and enable this Centre of Excellence to achieve a high level of partner and customer satisfaction.**

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Research

Industry
Innovation

Prototyping

Technology Transfer

eHealth

Software Industry

Aeronautics and Space

Transport

Logistics

Mechanical Engineering

Accessibility

Open Source

Development Life Cycle

Human-Computer Interaction

Methodologies

Standards

Complex and Optimising Algorithms

Design and Programming Languages

Electronic Design

FPGA

Ultra Low Power

Embedded Systems

Internet of Things

Networks

Wireless Technologies

Embedded & Communication Systems (ECS)

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Software & System Engineering (SSE)

Software Development Effort Estimation

Source Code Analysis

Requirements Engineering

Model Driven Engineering

Software Product Lines

Software and Processes

Software Certification

Software Process Quality

Computer Security and Trust

Safety

Model-based Testing

Formal Methods

Future Internet

Cloud Computing

Service Oriented Architecture

Private Cloud

Linked Data

Search Engine and Indexing

Semantic Technologies

Web Services

Big Data Management

Software & Services Technologies (SST)

EXPERTISE

CETIC develops expertise in the following areas:

• Software and System Engineering (SSE), focusing on methodological research, with a view to enhancing the quality, efficiency, security and safety of new ICT systems, which are becoming increasingly complex. By providing methodological, tooling and algorithmic design support, SSE helps IT companies to produce high quality software products and services. A specific focus is devoted to lightweight approaches adapted to SMEs and still compliant with international standards.

• Software and Services Technologies (SST), helping companies exploit to the utmost the newest distributed, dynamic and service-oriented architectures. The aim is to speed up the process of transformation from knowledge to semantic technologies, as well as to take advantage of the valuable opportunities offered by Open Source software and provide companies with advanced technological expertise. These technologies strongly impact the way software and data are assembled, deployed and managed.

• Embedded and Communication Systems (ECS), developing exceptional prototyping skills in the electronic component and wireless technologies to help industry build new and innovative products.

These various knowledge areas are available as advanced services for industry. With them, we can help companies in the following aspects of enterprise development: collaborative R&D, assistance to IT project owners, technical advice, design and prototyping, IT project quality improvement, and the certification process, among others. These services can be partially financed, e.g. by technology vouchers in Wallonia, or supported by other public funding.

SSE

Safety

Software Certification

Software Development Effort Estimation

Source Code Analysis

Requirements Engineering

Model Driven Engineering

Software and Processes

Computer Security and Trust

Model-based Testing

Formal Methods

Software product lines

Software Process Quality

CETIC expertise is based on its ability to select the right assessment tool for every development context, and its capacity to produce both lightweight and high-quality analysis that assists project managers in the decision-making process. As well, clear guidance is provided to the development team on reaching greater maturity through better practices, and specific training and coaching on their actual projects.

Software and System Engineering (SSE)

HELPING ENTERPRISES REACH HIGHER LEVELS OF QUALITY IN THEIR SOFTWARE DEVELOPMENT

As software becomes ever more pervasive and business-critical, the mission of the Software and System Engineering (SSE) department is to actively help enterprises master their software development activities and IT processes. The department's expertise covers the whole range of technical activities involved in the software development life cycle: requirements engineering, architectural design, model-driven development, design of complex algorithms, code quality, test design/coverage. It focuses on Walloon enterprises of all sizes – from SMEs to IT departments in large companies.

1. IT DEVELOPMENT PROCESS QUALITY

DEVELOPED EXPERTISE

The SSE has developed strong expertise in process quality and its related standards, such as CMMI and ISO/IEC 15504. However, because of their complexity and inherent costs, these standards cannot be adopted by small development structures. In response to this problem, the department developed a software improvement approach for use in very small structures, originally based on FUNDP's OWPL method. CETIC's approach ultimately contributed to an international standard for SMEs, called ISO 29110 Software Life Cycle Profiles and Guidelines for Very Small Entities), published in January, 2011. A specific assessment tool is also available.

ADDED VALUE FOR COMPANIES

SMEs, but also larger companies, must have fast assessment tools that can quickly spot which areas need to be improved as a matter of urgency, so that a higher level of software development maturity can be reached. The DiagnosTIC approach is designed based on progressive layers of analysis:

- First, a lightweight micro-assessment questionnaire is used to collect information about current software practices. This tool reliably spots the software quality aspects that require attention.

- Then, the ISO 29110 assessment process is applied to targeted areas to produce specific recommendations that will lead to quality improvement.

SUCCESS STORY

The DiagnosTIC assessment tool has been successfully applied to several organisations of various sizes, ranging from a VSE to the IT department of an international charitable organisation. It also proved efficient in keeping externalisation issues under control.

2. SOFTWARE PRODUCT QUALITY

DEVELOPED EXPERTISE

While the quality of the process is key to delivering quality products, the quality of the product itself must be measured as well. Drawing on its expertise in software metrics, CETIC has developed the ability to perform precise code level measurements of maintainability, security and reliability. This expertise is supported by state-of-the-art tools, maintained by the Software Engineering Lab (see page 54).

This CETIC expertise lies in its deep knowledge of the entire tool landscape and in its ability to select the right tool for every development context. CETIC interprets the outputs and produces a focused code analysis report that assists project managers in the decision-making process and developers in the code improvement process.

ADDED VALUE FOR COMPANIES

Knowing the quality of the code and keeping it under control is very important in many contexts, such as:

- Achieving continuous quality monitoring for internal quality control or in a client-provider relationship.
- Taking a strategic decision with respect to legacy code, or the inclusion of external (possibly Open Source) software, by evaluating its technical debt.
- Assessing the level of security or safety of a sensitive application and identifying the parts of the application that should be strengthened.

Whether code quality is monitored on either a punctual or a continuous basis, direct customer benefits are: reduced development time, reduced maintenance costs through strategically controlling bad components, improved confidence in the quality of the code, and a well supported decision-making process.

SUCCESS STORY

IT start-ups produce highly innovative software, but generally have limited experience in managing quality. Keeping quality under control and raising its maturity level is important to avoid increasing maintenance costs. These costs can result in a technical debt that is higher than the cost of the innovation itself. CETIC is actively helping various incubators (WSL, Louvain Technology Transfer Office) that host start-ups to learn about code maturity, and ensure that the prototypes created by the start-ups will evolve into successful commercial products.

3. REQUIREMENTS ENGINEERING AND SYSTEM MODELLING

DEVELOPED EXPERTISE

Requirements Engineering (RE) is the process of defining a software system's purpose by identifying stakeholders and their needs, and documenting these in a form that can be analysed, communicated and subsequently implemented.

CETIC's expertise in RE covers the whole spectrum of methods and application contexts, from lightweight methods combining structured templates and UML-based notations to rigorous models that enable early formal reasoning on the system. There is specific focus on model-based approaches to automating specific development steps, providing higher design assurance or managing specific aspects, such as optimisation and software product lines.

ADDED VALUE FOR COMPANIES

Poor requirements gathering and modelling practices are all too common in enterprises, and helping them change that will produce many benefits:

- Better requirements documents result in better estimates, smoother provider selection, fewer costly requirements-related bugs, and easier testing and acceptance.
- Process modelling and organisational audits provide a precise definition of current/expected behaviour, identify risks and enable better governance.

CETIC can recommend the best methods and tools to adopt in order to achieve the best return on investment in this process.

SUCCESS STORY

CETIC has performed an advanced business modelling exercise on the processes related to the health consultations involving young children (0-6 years old). Both existing and planned processes were modelled and refined into a use-case-based requirements document. The work was carried out within the scope of a projected organisation-wide model repository. CETIC also contributed to the selection, mastery and adaptation of the tooling environment.

4. DEVELOPMENT EFFORT ESTIMATION

DEVELOPED EXPERTISE

Accurately estimating software development effort is a challenge that has a substantial impact on a project's organisation and schedule. Currently, such estimates rely mainly on past experience. CETIC has developed expertise in this area, essentially based on COSMIC (ISO/IEC 19761), a widely used method for estimating software functional size. Objective criteria are used for estimation purposes, and are applicable to requirements documents early in the software life cycle. This functional size is then converted into development effort, based on the ISBSG project database.

ADDED VALUE FOR COMPANIES

Effort estimation techniques will greatly help the project manager optimally define the budget and schedule of a new project. In the context of a call to tender, they will provide a neutral comparison point for selecting the best offer.

SUCCESS STORY

CETIC is actively helping Atos Belgium SA to build up strong expertise in effort estimation using COSMIC. The initial objective is to comply with specific EU calls to tender and to estimate the size of internal developments for building measurement plans. CETIC also trained the company's international team.

5. CERTIFICATION AND STANDARDS

DEVELOPED EXPERTISE

Certification is required in a number of industrial domains as a condition for accessing a particular market or to comply with regulatory provisions. Security-critical products, like smart cards, may be subject to the Common Criteria (ISO/IEC 15408), and a number of safety standards – such as DO-178B (aeronautics), Cenelec 501268 (railways), ECSS (space), IEC 62304 (medical software) – are also required in safety-critical domains. Mastering the certification process is not trivial, and requires knowledge of the standard and how to implement it within the software life cycle. CETIC is actively developing expertise and experience in these areas, in conjunction with its mastery of a number of supporting tools.

ADDED VALUE FOR COMPANIES

Integrating certification constraints into a development process can result in very large overheads. CETIC expertise can help keep these costs under control by defining what compliance means in a specific context, aligning the certification process with a company's quality systems and deploying efficient tool support.

SUCCESS STORY

Since 2006, CETIC has been involved in the ISO ISO/IEC JTC1-SC7 to produce a standard referred to as Software Life Cycle Profiles and Guidelines for Very Small Entities. CETIC helped define this practical standard, which was officially adopted in 2011. It is becoming commonly used as reference and lightweight method for IT process assessment in Walloon SMEs, but also in many other countries, like Canada, Thailand and Mexico.

ECS

Internet of Things

Networks

Wireless Technologies

FPGA

Electronic Design

Ultra Low Power

Embedded Systems

As both humans and machines increasingly demand advanced services everywhere and at any time, embedded systems will improve their adaptation to mobility and connectivity. The ECS department studies innovative methodologies and technologies for embedded systems and wireless communication.

Embedded and Communication Systems (ECS)

INNOVATIVE TECHNOLOGIES ENABLING SMART DEVICES FOR THE INTERNET OF THINGS

The Internet of Things refers to an intelligent association of uniquely identified objects that are directly trackable on the Internet and which can be fully accessed by smart devices. The underlying technologies will enable these systems to seamlessly collaborate over the Internet, making overall Internet services much more dynamic, scalable and powerful. ECS is examining emerging technologies that will enable the Internet of Things, including methodologies, hardware and software design and prototyping, and wireless telecommunication.

1. IPV6 WIRELESS SENSOR NETWORKS (WSN)

DEVELOPED EXPERTISE

IPv6 is the cornerstone of communication in the Internet of Things (IoT), and is required for the global addressing of objects. 6LoWPAN, the emerging standard for IPv6 wireless communication, and the Contiki OS enabled WSN for IoT.

ADDED VALUE FOR COMPANIES

These new technologies, and some others, will soon transform the classical WSNs – home automation, eHealth, energy management, etc. – by turning the actual sensors into smart devices connected to the Internet. This will revolutionise the services offered by these systems.

SUCCESS STORY

The MIDFLEX project explores the capabilities of these technologies and experiments with advanced routing algorithms in large scale academic WSN, like SensLab of INRIA Lille and TWIST of TU Berlin. CETIC is collaborating in this area with SICS in Sweden, which is the originator of Contiki.

2. ADVANCED ARCHITECTURES FOR EMBEDDED SYSTEMS

DEVELOPED EXPERTISE

The increasing complexity of embedded systems can lead to performances that are not optimised, as well as unexpected drawbacks that appear in the final stages of development. It is mandatory that non-functional aspects, like power consumption, reliable upgrade processes and overall performances with advanced architectures (multi-core, rich OS, etc.), be mastered at the design stage.

ADDED VALUE FOR COMPANIES

The huge rise expected in the number of functionalities offered by embedded systems in the world of the Internet of Things will call for the use of advanced design techniques, to the point where the key differentiators for successful solutions will ultimately be autonomy, reliability and performance.

SUCCESS STORY

CETIC analysed the feasibility of a smart device for IL4P, a French start-up specialising in unified contactless solutions. It was actually possible to check the expected characteristics of this device.

3. MODELLING AND SIMULATION OF EMBEDDED SYSTEMS

DEVELOPED EXPERTISE

CETIC has integrated advanced tools for modelling and simulating embedded systems into its Software Engineering Lab and its Wireless Lab.

ADDED VALUE FOR COMPANIES

CETIC aims to support enterprises in their use of the methodologies and tools available to address these issues, and CETIC intends to support enterprises in their use. The Software Engineering Lab and the Wireless Lab are equipped with advanced tools for use in this area.

SUCCESS STORY

In 2011, CETIC collaborated with CISSOID to implement an automated tool chain for testing electronic components. CETIC studies approaches like Model Based Design applied to embedded systems via tools such as Matlab Simulink and LabView, among others.

4. METHODOLOGIES FOR EMBEDDED SYSTEMS

DEVELOPED EXPERTISE

When studying systems, it is very tempting to focus only on the result viewed from the perspective of the demonstrator. In order to systematically and efficiently achieve all the goals of these systems, their whole life cycle must be considered.

ADDED VALUE FOR COMPANIES

CETIC's purpose is to transfer technologies to enterprises in such a way that their use can be extended beyond the study or prototype stage. This presupposes the mastery of the methodologies involved and of the associated tools.

SUCCESS STORY

In an ICT project, CETIC studies the all-important teething phase (test) of the life cycle of an embedded system more closely. It is also broadening its expertise in code quality analysis to the specific case of embedded software.

5. HARDWARE DESCRIPTION LANGUAGE (HDL) AND THE FIELD PROGRAMMABLE GATE ARRAY (FPGA)

DEVELOPED EXPERTISE

An FPGA is a hardware programmable circuit that offers huge possibilities in terms of architectural configurability and flexibility. It can dramatically simplify the design of circuit boards and make them more generic. But the FPGA has one significant drawback, which limits its adoption: the level of expertise and the design time required to efficiently develop HDL systems.

ADDED VALUE FOR COMPANIES

ECS studies the tools and techniques, like porting C to HDL, that will make developing HDLs easier and facilitate the use of FPGAs.

SUCCESS STORY

In the PSOPP project, CETIC studies and prototypes FPGA-based accelerators, based on the use cases provided by industrial partners. These prototypes are intended to highlight not only the efficiency of the FPGAs themselves, but also their applicability vs. classical software architectures.

6. SMART GRIDS

DEVELOPED EXPERTISE

Research on Smart Grid is receiving strong impetus, which is driven by multiple factors: the need to use renewable energy more efficiently, the need for more effective energy management to lower its cost and the current state of electrical infrastructures, which cannot evolve significantly because of the huge costs involved.

ADDED VALUE FOR COMPANIES

ICT is, of course, key to the development of smart grids, and CETIC's interest in this area is twofold: intelligent application of ICT to optimise the energy production/consumption balance, and establishment of a telecommunications network to enable the metering and control of the related equipment.

SUCCESS STORY

In 2011, CETIC initiated a fruitful collaboration with Made In Power, start-up dedicated to Smart Grid development, by studying ICT architectures and constraints of telecommunication platform and industrial networks. This collaboration will be pursued in 2012 through a larger technical feasibility study on a Smart Grid simulator.

7. SECURITY FOR EMBEDDED SYSTEMS

DEVELOPED EXPERTISE

On the one hand, we have the Internet of Things, which is all about openness and interoperability; on the other, we have embedded systems, which are increasingly important in our lives – just think of eHealth and Smart Grids, and the correspondingly greater need to pay attention to security issues.

ADDED VALUE FOR COMPANIES

Security is still underestimated in the world of embedded systems, or often at best treated as a function to be added later. Our role is to highlight the need for security at an early stage of a project and to integrate it into the whole life cycle of the system from a global perspective.

SUCCESS STORY

In 2011, the primary focus of the ECS was to study and prototype security solutions for eHealth systems that encompass all aspects of security in this area (privacy, medical confidentiality, and safety).

SST

Future Internet

Cloud Computing

Service Oriented Architecture

Private Cloud

Linked Data

Search Engine and Indexing

Semantic Technologies

Big Data Management Web Services

The Software and Services Technologies (SST) department is developing incisive expertise in Cloud Computing and Web semantics aimed at exploiting the resources available today to the maximum extent possible, and at designing superior architectures and tools for tomorrow.

Software and Services Technologies (SST)

EXPLOITING DISTRIBUTED RESOURCES, GIVING MEANING TO DATA

The Software and Services Technologies (SST) department covers key areas relevant to the future of ICT: service-oriented architecture (SOA), Cloud Computing, semantic Web resources, and Open Source software technologies. SST helps companies master the expertise required to take advantage of the latest trends and technological advances in these fields, while respecting scalability and deployment constraints.

1. PROGRAMMABLE WEB

The Programmable Web provides composable web services, i.e. small pieces of software available through the Internet, for next-generation applications.

DEVELOPED EXPERTISE

CETIC has built up significant expertise in designing and adapting the architecture of applications that are consuming, or providing, Web services, in order to make them scalable. This expertise helps CETIC to identify and solve challenges in the Software as a Service (SaaS) process, i.e. adapting existing software for delivery as a service.

ADDED VALUE FOR COMPANIES

Mastering service-oriented architectures shortens the time-to-market of innovative solutions, thanks to the composition of Web services, and consequently reduces the development effort. Providing efficient and well-designed Web APIs that are in line with standards is a key factor in the adoption of those Web services.

SUCCESS STORY

CETIC has supported SMEs, like UNIWAN and ATHENA, in defining the optimal architecture for their service-oriented solutions, in line with their SaaS strategy. CETIC designed the Web API at the core of GREATCIRCLE's business model. CETIC defined key Web services in the FP7 PONTE project.

2. CLOUD-READY SOFTWARE ARCHITECTURE AND DEPLOYMENT

Realising the promise of Cloud Computing in terms of scalability and flexibility requires new software architectures. Existing applications also need redesigning or refactoring, in order to tap into the resources of Infrastructure as a Service (IaaS) platforms and to exploit the high-level services of Platform as a Service (PaaS) offerings. As well, deployment has to be taken into account from the inception of an application, when software is shared among countless servers.

DEVELOPED EXPERTISE

By keeping the state of the art on Cloud software development technologies, tools and platforms up to date, CETIC is able to design software architectures that capitalise on the features of Cloud Computing. The development of Cloud-ready software in research projects or for enterprises validates knowledge acquired by experiment, provides feedback on the true capabilities of technologies and serves as the experimental platform for software deployment strategies.

ADDED VALUE FOR COMPANIES

The ability to make the right choice concerning the architecture, the format or the provider of Cloud Computing technologies is an important skill for validating a proof-of-concept that takes advantage of these technologies and is vendor-independent.

SUCCESS STORY

CETIC prototyped cloud-shaped software architectures for ENERBAN and TAGEXPERT, and redesigned existing software for MARKET-IP, in order to meet scalability needs.

3. CLOUD ENABLED DISTRIBUTED SCALABLE STORAGE

The advent of commercial Cloud offerings has provided abundant and inexpensive storage resources, but they were scattered and unstructured. As a result, the database management system software had to be able to handle huge amounts of data, and required redundancy and load balancing capabilities. The new kinds of distributed file systems and the innovative NoSQL class of database management systems that emerged in response are able to handle all these data.

DEVELOPED EXPERTISE

Through constant monitoring of distributed storage solutions, CETIC was able to build a taxonomy of NoSQL databases, which made it possible to define a decision-making process for database selection. By testing storage solutions in research projects or in proofs-of-concept, CETIC also gained experience with distributed storage software.

ADDED VALUE FOR COMPANIES

The expertise CETIC gained in the distributed databases field made it possible to help companies find the right storage solution based on the kind of data to be managed and on the use to which those data would be put. Open Source distributed storage tools also provide data management solutions that are low-cost and scalable.

SUCCESS STORY

CETIC analysed the storage needs of BIOAWARE, and selected a NoSQL database (MongoDB) for this company. CETIC also designed a storage solution for the ENERBAN platform and implemented it as a proof-of-concept.

4. CLOUD INFRASTRUCTURE MANAGEMENT

IT hardware requires software management in order to form a Cloud infrastructure and deliver the promise of flexible resource provisioning and use. These Cloud managers can also aggregate local IT resources with those from external Cloud providers.

DEVELOPED EXPERTISE

CETIC conducts a technology watch on new technologies, emerging standards and technology providers at the IaaS level. CETIC also masters various Open Source Cloud infrastructure managers, as well as open standards for infrastructure definition and interoperability.

ADDED VALUE FOR COMPANIES

Enterprises willing to manage their own IT infrastructure as a private Cloud, or to seamlessly integrate external resources from Cloud providers into their existing infrastructure (creating a hybrid Cloud) using Open Source platforms, will find the help they need for the design and experimental deployment of such solutions at CETIC.

SUCCESS STORY

CETIC has gained valuable experience in the OpenNebula and OpenStack IaaS solutions, and their related open standards, in the RESERVOIR and ComodIT projects respectively. CETIC has also delivered OpenNebula training and deployed a proof-of-concept test bed to demonstrate these technologies to local SMEs.

5. SEMANTIC WEB RESOURCES

Exploiting semantic Web resources is about transforming the increasingly large amount of unstructured data available on the Internet or private networks, or in specific domains like eHealth into business information based on which companies can make decisions.

DEVELOPED EXPERTISE

CETIC masters semantic Web standards used to model, query and link data, as well as to create ontologies. CETIC also contributes to powerful and interoperable content management solutions serving end-users or other software components.

ADDED VALUE FOR COMPANIES

SMEs are able to model the data available in their field of expertise, but also to be connected to other available resources, in order to obtain relevant added value.

SUCCESS STORY

CETIC developed a prototype of an ontology-based system. In the PONTE research project, CETIC studied and modelled several health-related data sources as ontologies, and published them on a Web platform, which makes it possible for them to be consulted, either via semantic links in the user's browser or from software queries.

6. OPEN SOURCE SOFTWARE TECHNOLOGIES

The Open Source movement is gaining in popularity, but there are still questions to be answered; for example, about the availability of support, the quality of the software developed or the compatibility of licenses. Interest in open data and open hardware is also growing.

DEVELOPED EXPERTISE

CETIC supports SMEs in releasing software into the Open Source domain, in auditing existing source code, and in managing Open Source projects and communities. Finally, CETIC has mastered the license selection process and its impact on business models.

ADDED VALUE FOR COMPANIES

Releasing source code to an Open Source community requires preparation, in order to maximise the chances that the software will meet its target and will operate successfully. Finally, selecting the right license is key to business model alignment.

SUCCESS STORY

Open Source software is based on a set of licenses. These are numerous and involve a wide variety of rights and duties. An integrator of Open Source VoIP systems asked CETIC to study the source code of a product developed by a third party to ensure that this solution was operating within a legal framework. CETIC produced an inventory of the intellectual property items (mainly related to the source code) and produced a set of recommendations.

How to Work with CETIC

TRUSTED AND SKILLED PARTNER IN RESEARCH AND INNOVATION IN THE APPLICATION OF ICT IN VARIOUS FIELDS OF EXPERTISE

COLLABORATIVE R&D PROJECTS

CETIC's aim is to involve companies, especially SMEs, in collaborative R&D project programs funded by European and regional authorities, to strengthen their market position, improve their existing products or acquire new skills. We offer our comprehensive experience in writing proposals, and in creating and coordinating consortia, with a view to building projects, both large and small. We have an excellent track record of success in several kinds of competitive calls for proposals, such as FP7, ERANET, Interreg and Marshall Plan 2.Green, for example.

INNOVATION (R&D&I) ACTIVITIES

Whether a company wants to externalise a research, development and initiative (R&D&I) activity or needs support to integrate breakthrough technologies into their R&D&I process, we offer a full range of expertise, from feasibility study, through to design, engineering, concept proving, prototyping and testing.

SMEs conducting R&D&I activities are widely supported by several flexible funding instruments offered by local authorities:

- For SMEs established in the Walloon Region, the most popular instruments are the technology vouchers delivered by the Agence de Stimulation Technologique (AST) and the software feasibility studies from DG06, which both provide up to 75% of funding.
- Brussels-based SMEs have access to similar kinds of funding from INNOVIRIS, the Brussels Institute for Research and Innovation.
- CETIC is also certified by France's Ministry of Research to carry out R&D activities under the French research tax credit system.

KNOWLEDGE TRANSFER AND CONSULTING

CETIC has unique expertise in a few niche segments. This enables CETIC to provide specialised and non-ubiquitous support to partners and customers. Topics include:

- Wireless Sensor Networks (WSN), embedded system design methodology;
- Cloud Computing, Internet of Services, large-scale network-based applications;
- Advanced software engineering, model-based testing, software product lines (SPL);
- Intelligent information management and semantics;
- Combinatorial problem solving;
- Simulation and model-based design (Matlab/Simulink).

TRUSTED THIRD PARTY AUDITING AND ADVICE

As a research centre and non-profit organisation in close proximity to academia, CETIC is often asked by public and private organisations to provide neutral, unbiased support, such as:

- Helping with needs identification, choosing technologies and suppliers, contract follow-up, the escrow procedure, evaluation of software development costs, etc.
- Conducting technological and methodological audits of software product and development life cycle processes, and providing recommendations in the adoption of best practices, architectural change, code refactoring, etc.

Chèques Technologiques

FINANCING AN INNOVATION PROJECT WITH TECHNOLOGY VOUCHERS

An SME ready to innovate can quickly obtain simple, flexible financial support from Wallonia.

When working with an accredited research centre like CETIC, an SME is eligible for reimbursement by Wallonia of 75% of the total cost of R&D through the Chèques Technologiques programme. These technology vouchers are available to a maximum amount of €20,000 per SME annually.

Further information about these vouchers can be found on the CETIC website and at www.ct.innovons.be.

CETIC is also certified under the Crédit Impôt Recherche programme in France, which is a favourable tax credit scheme that enables any French company to enter into a contractual R&D agreement with CETIC. A significant tax credit is available (cfr. http://www.industrie.gouv.fr/enjeux/ innovation/cir.html). Brussels-based companies can also benefit from regional funding for their R&D activities.

For more information, contact CETIC (info@cetic.be).

> **Backed by the extensive expertise they have gained over many years in European and Walloon research projects, our team of expert researchers is ready to help companies to be more innovative and competitive.**

Focus on eHealth

IT FOR BETTER HEALTH

The health sector is facing challenges related to the ageing of the population and the increased incidence of chronic illnesses, both of which entail high costs for social security systems. These changes, and the decrease in the number of health specialists, underline the need for adequate solutions and innovative processes. Experts have demonstrated that ICT have an important role to play. Among the strategies that could help overcome the challenges are the following two: reducing the duration of hospital stays, and enabling patients to take an active part in the management of their health.

EXPERTISE DEVELOPED IN eHEALTH

CETIC is currently involved in several research projects in the eHealth area.

First, CETIC coordinates a regional project, **eHealth for Citizens** (see page 31), aimed at designing and implementing a technological service-oriented platform capable of devising and supporting innovative and customised eHealth services, such as patient monitoring. The project targets several health care issues, among them diabetes and epilepsy. CETIC is in charge of coordinating the project and the research items related to service composition and security, and to the design of the communications protocol.

CETIC is also involved in the **SPES European project** (see page 49), the aim of which is to transfer the approach and results achieved in the implementation of the older FP6 OLDES European project (www.oldes.eu) to support patients from four European locations through e-service solutions specially tailored to manage respiratory problems, dementia, disabilities and social exclusion. CETIC leads the technical development of the project.

In addition, CETIC is the coordinator of the **PONTE FP7 European project** (see page 47), which is aimed at providing a platform with a Service Oriented Architecture (SOA) and a semantic approach that will provide automatic intelligent identification of patients eligible to participate in well specified clinical trials for drug repositioning, with a specific focus on mitigating patient safety risks, reducing the cost of clinical trials and improving their efficacy.

CETIC is a key partner of the **European ERA-SME AMACS project** (see page 42), the goal of which is to develop and evaluate, in a real-life situation, an ICT-based system that can automatically monitor the activities of daily living (ADLs) (sleeping, cooking, bathing, dressing, etc.) of the elderly living alone at home. Specifically, the project targets the detection of incidents (like falls) and changes in the behaviour of individuals who suffer from cognitive decline or dementia.

Involved in the **DAPCARE project** with health care expert partners, CETIC is working on a DAPCARE software solution for collecting, archiving and optimising dosimetry data through a Patient Dosimetry eBook, which can be shared among health care facilities to monitor patients (see page 30).

CARESQUARE, A CETIC SPIN-OFF OFFERING eSERVICES FOR THE ELDERLY AT HOME

In 2011, CETIC created a spin-off called CareSquare, which exploits the results of OLDES, a European FP6 project to which CETIC contributed.

CareSquare specialises in the development and commercialisation of innovative technological solutions for the improvement of medical home care.

The objective is to help the elderly live longer at home, with the assistance of a home health telemonitoring platform using wireless medical devices and providing interactive online entertainment and social services.

More information: info@caresquare.com

> **For several years, CETIC has been developing strong expertise in eHealth through research projects and technology transfer to industry.**

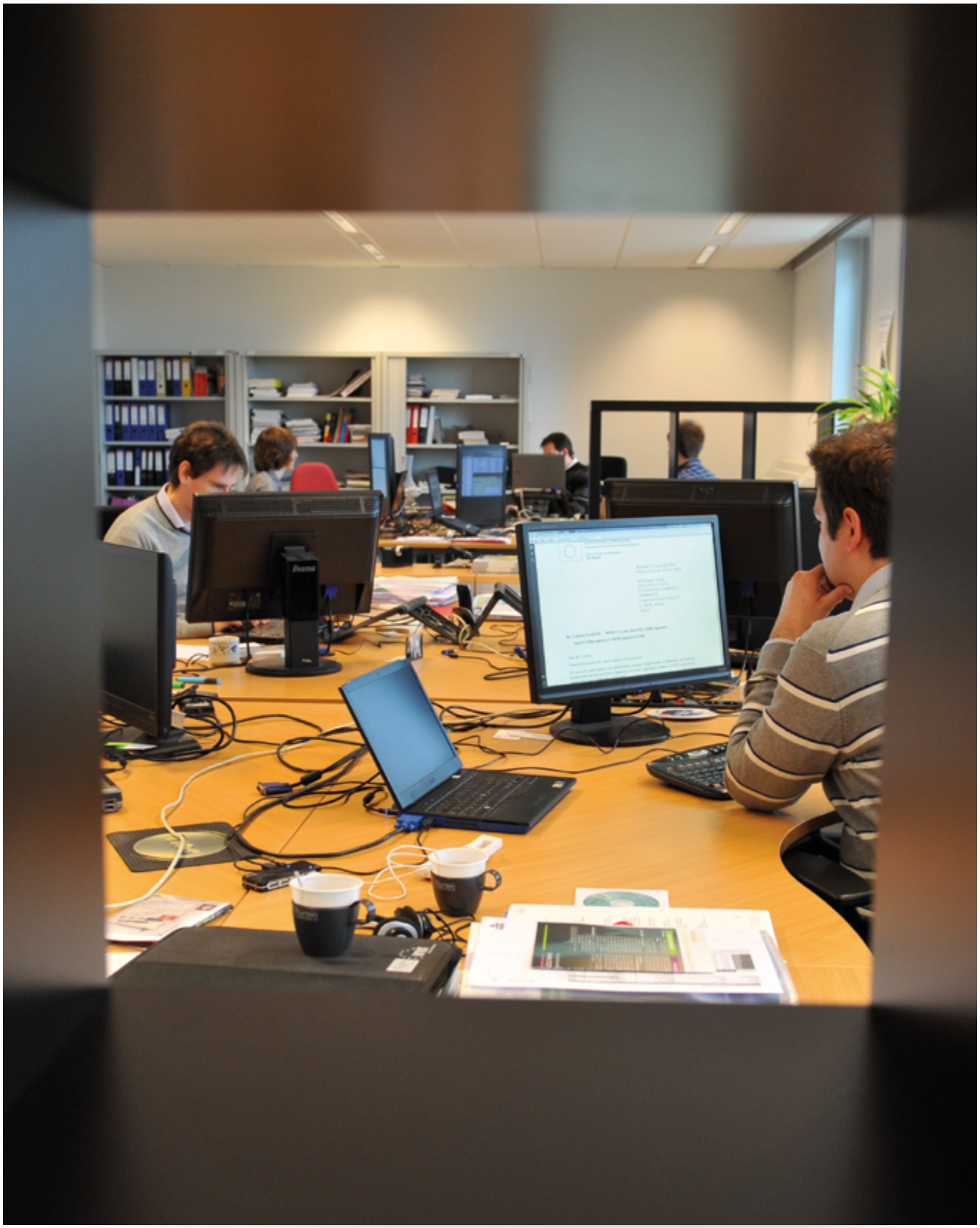
WALLOON RESEARCH PROJECTS

CETIC is active in several types of regional R&D projects funded by the Regional Ministry of Research and coordinated by the Walloon administration.

From 2001 to 2007, CETIC ran seven ambitious research projects funded under the Phasing Out provisions of the structural funds provided by the European Union and Wallonia.

Since 2008, CETIC has been working with several research partners (Cenaero, FUNDP, MULTITEL, UCL, ULB, UMONS) on a new wave of applied R&D projects funded under the Convergence objective (ERFD 2007-2013).

In addition to these large projects, CETIC is involved in regional collaborative projects (Marshall Plan, WIST projects, Technology Innovation Partnerships and Collaborative Research), designed by, and especially for, industry, and aimed at solving specific problems through the innovative use of ICT technologies.



BEM

Business Event Manager

Type of project: Wallonia – Marshall Plan
CETIC Budget: €274,850
Duration: 2010-2013

Department: Software and System Engineering
Contact: ravi.ramdoyal@cetic.be

TRANSPORT

The goal of the BEM project is to develop and validate a new IT approach to managing events in the transportation and distribution sectors, with a special focus on unexpected events.

Objectives

The goal of the BEM project is to develop and validate a new IT approach to managing events in the transportation and distribution sectors. The focus is on managing the unexpected, as this type of event can sometimes deeply affect physical and organisational flows, and a re-optimisation is required to bring the system back into normal operation.

Flux management systems are among the solutions most commonly found on the IT market, and notably include process management engines, as well as graphical editors. These engines all have their limitations:

- They are unable to coordinate, activate and synchronise processes.
- They are unable to manage situations that do not match the defined flux model they are processing, which leaves the engine without a solution in the event that normal operation is no longer possible.
- They are incapable of bringing the engine back into normal operation after an unexpected event. Ideally, doing so would follow an optimal path towards that state.

The goal of BEM is to propose a process management solution built on top of state-of-the-art artificial intelligence engines, and give them temporal coordination capabilities. In short, BEM is designed to minimise the negative consequences of incidents and simplify the implementation of a flux management solution. The BEM industrial case study involves Trendy Foods, a Belgian leader in food distribution for convenience stores.

Results

CETIC produced an initial analysis of the Trendy Foods logistics platform, including a set of concrete exceptional situations. A Goal-Oriented Requirements Engineering (GORE) analysis of the project has been performed, using the KAOS approach and the Objectiver tool for requirements engineering.

CETIC is involved in the specification of this logistical chain management tool, the key to which is an engine incorporating:

- An event-based process management solution, with temporal coordination capabilities.
- A description of its logistical process, written in the form of business-specific logical rules.
- A classification of states designed to automate the management of exceptional events, and the elaboration of an optimal path to achieve stability in those states.

Added value for companies

With the BEM solution, enterprises will benefit from:

- Minimal detrimental fall-out resulting from accidents.
- A simplified and affordable, yet optimised implementation of intelligent workflow management to solve complex problems and deal with unexpected situations.

SSE

MODELLING
LOGISTICS

> **The BEM solution will help enterprises minimise the fall-out resulting from accidents, thanks to a simplified and affordable, yet optimised implementation of intelligent workflow management to solve complex problems and deal with unexpected situations.**

PARTNERS:
Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP),
NSI IT Software & Services SA, Orditool Belgium SA, Smolinfo SPRL, Trendy Foods Belgium SA

BIOFACT

Biomedical Manufacturing

Type of project: Wallonia – ERFD – Convergence Objective
CETIC Budget: €139,307
Duration: 2008-2011

Department: Embedded and Communication Systems
Contact: valery.ramon@cetic.be

ECS

In spite of the significant progress made in technologies for industrial robots and the emergence of robots for household chores, little has been achieved in the field of orthoses and prostheses to assist those who have lost control of a limb. Prostheses based on electromyographic (EMG) signals (i.e. the electrical signals produced by muscle activity) are available on the market today, but they have some drawbacks, notably the fact that they are able to correct a motion, but not anticipate one.

Objectives

The project is aimed at studying and developing an orthotic control system that exploits EEG signals, either alone or in combination with EMG signals. Creating such a system calls upon competencies in neurophysiology, micro-electronics, mechanics and rapid manufacturing. Technological innovation is evident throughout the various steps of the process, from the acquisition of EEG signals, to the processing, transmission, control and motorisation of the signals, to energy management and comfort for the patient.

The role of CETIC in this project is to create an embedded platform exploiting EEG signals to control the orthotic device using wireless communication protocols. The focus is on two main aspects: autonomy (low energy consumption) and portability (by a human being). Specifically, CETIC aims to:

- Implement, on an electronic card, an artificial neural network, of the DRNN (Dynamic Recurrent Neural Network) type, developed by the academic partners of the project.
- Develop a low power wireless network to transmit EEG signals and control data between the various parts of the system (the orthosis, a wireless EEG headset, a neural network, an orthosis controller).

Results

In 2011, the project partners prototyped a wireless EEG headset. For its part, CETIC developed a battery-powered printed circuit board (PCB) located in a small box attached to that headset, positioned at the rear of the head. The PCB acquires the signals emitted by EEG electrodes and wirelessly transmits the EEG data using a ZigBee-like protocol to another PCB located on the patient's leg (the latter to be developed in 2012 and to include the DRNN mentioned above). The PCB uses techniques and components that will guarantee very good immunity to the disturbances induced by external and internal noise sources.

Added value for companies

The fields of application of this research are many. All the knowledge and procedures related to the acquisition and processing of EEG signals that are developed can contribute to enhancing the quality of life of anyone with mobility impairment. In addition to the design of intelligent orthoses, other applications are possible, such as wheelchairs controlled by the human brain. Moreover, because this project involves brain-computer interfaces, the range of future application fields can potentially be broader still, and even of interest to the non-disabled. The interpretation of brain signals could be applied in road safety, for example, and in the remote control of robots and machines. CETIC will also be able to exploit the experience it has acquired in the implementation of neural networks, and in the design of portable and low power wireless communication systems to offer new services to Walloon SMEs.

HUMAN-COMPUTER INTERACTION

eHEALTH

> **This project is aimed at developing an innovative control system for orthotic devices (i.e. prostheses designed to compensate for absent articular or muscular functions) that exploit human brain activity, specifically electroencephalographic (EEG) signals.**

PARTNERS:
Cenaero, Sirris, Université de Mons (UMONS)

CALiPro

Configuration Automatisée de Lignes de Produits logiciels

CALiPro

Type of project: Wallonia – First DOC.A
CETIC Budget: €210,000
Duration: 2010-2012, 2012-2014

Department: Software and System Engineering
Contact: raphael.michel@cetic.be

SSE

Increasingly, software products are designed to include many variants, which collectively constitute a software product line (SPL). In mass consumption products, this software flexibility has become necessary for the achievement of the mass customisation required to meet the needs of an ever more demanding market.

Objectives

SPLs are common today. Examples are Enterprise Resource Planning (ERP); telecommunications services; office suites; e-business, e-learning and e-government services; Web services and Open Source software; among many others.

However, there is still a lack of tool support in the Application Engineering phase, which is the phase during which a product is assembled and configured from intermediary reusable components. Several companies that plan to adopt (or have already adopted) an SPL approach have confirmed the need for such tools and the related services.

The CALiPro project targets the improvement and automation of the configuration of an SPL by developing a set of innovative tools, services and methods to meet the needs of the collaborating companies.

Results

The second year of the project focused on the search for the best tool support. Experimentation with the satisfiability problem (SAT) solver technology revealed its limitations, and consequently SMT (SAT Modulo Theories) solvers were considered. SMT solvers offer more expressivity than SAT solvers, thanks to their embedded theory-specific solvers, and yet they are more efficient than the more generic constraint-based solvers. After a survey of the various SMT solvers available, STP, a leading solver developed at MIT, was selected. This solver was analysed during a 3-month internship at MIT's CSAIL lab, where it was developed. Based on this knowledge, specific extensions were added to support strings, which are used in the textual modelling language TVL, used to model the SPL developed at FUNDP.

Added value for companies

During the last decade, SPL development methods have progressed enormously, and success stories are becoming more and more numerous. The advantage of these approaches is their ability to massively reuse components across the products of an SPL in a planned and systematic way. This makes it possible to:

- Reduce costs, thanks to economies of scale.
- Reduce time-to-market.
- Improve the global quality of the software.

SOFTWARE PRODUCT LINES

> **CALiPro is a PhD project aimed at improving and automating the configuration phase of software product lines through the development of innovative tools, services and methods.**

PARTNERS:
Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP)

CELLAVI

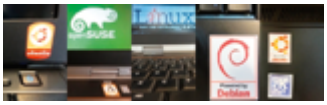
Centre of Expertise in Open Source Software

Type of project: Wallonia – ERFD – Convergence Objective
CETIC Budget: €3,056,390
Duration: 2008-2013

Departments: Embedded and Communication Systems; Software and System Engineering; Software and Services Technologies
Websites: www.cellavi.be https://forge.pallavi.be
Contact: damien.hubaux@cetic.be

OPEN SOURCE ECS

Many companies are interested in Open Source software, from both the technological and economic perspectives, but the path to successful adoption is not trivial. The Open Source paradigm involves new licensing schemes, and requires that clear economic choices be made. Moreover, while it is true that the good practices and tools used in the Open Source ecosystem can benefit all ICT companies, they must first be identified, and then assessed and adopted.



Objectives

The project is aimed at supporting the specific needs of companies:

- Software editors: Free software involves specific business models, as it creates a distinction between primary development activities and value-added activities, such as support and advanced functionalities.
- Software services companies: Free software can be incorporated into specific solutions, providing a strong competitive advantage. Still, help is needed in selecting the appropriate software components, and, where appropriate, taking into account software quality, trust issues, traceability of licenses and possible legal risks.
- End-users: Free software can be important to companies and administrative units for a number of purposes, including strategic tasks.

Results

The PALLAVI portal serves as a proof-of-concept for a software forge sized to the needs of typical SMEs. There has been considerable interest in a study conducted to facilitate the selection of a forge, in which a methodology was defined for comparing several Open Source alternatives. Based on this experience, a number of partners have decided to implement a forge on their premises, taking advantage of the collaborative tools and methods developed by the Open Source communities. The CELLAVI website is now hosted on the Forge Wiki site.

The operational aspects of PALLAVI are backed by general-purpose Open Source expertise, focusing mainly on infrastructure and aligned with local industry needs. This project tackles virtualisation techniques, and Open Source Cloud Middleware in particular.

The activities related to the project include progress on training aspects and on legal expertise, managed by MULTITEL and FUNDP/CRIDS respectively. With regard to exploitation of the research results, specific advice has been provided to several partners and local companies.

Two significant local events were co-organised in connection with the project: the 1st and 2nd editions of Open the Source. Other contributions have been made to local events taking place in the informal communities that make up the Open Source ecosystem, such as Les jeudis du libre. In order to benchmark their efforts against those of other communities, CETIC attends the Rencontres Mondiales du Logiciel Libre and makes presentations to these meetings.

Added value for companies

In addition to hosting Open Source software, the PALLAVI forge project directly benefits local companies in three major ways:

- It is an inspirational tool for companies, which they adopt to enhance their development and collaboration processes.
- It helps companies assess the potential benefits of free software by providing support in specific areas:
  - Economic: the choice of a business model, including “hybrid” versions;
  - Technical: the choice of software components and an application architecture;
  - Legal: the choice and combination of licenses; several workshops on this issue have been organised by CRIDS.
- By taking into account emerging fields, such as open hardware and automated software analysis, CELLAVI provides a decisive advantage for companies associated with the initiative, in that it helps them remain at the leading edge of development in the area of Open Source software.

SSE SST

“The experience gained from selecting and operating a forge suited to the needs of SMEs has drawn significant interest from partners who are taking advantage of the good practices emerging from Open Source communities.”

PARTNERS:
Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP), MULTITEL, Université de Mons (UMONS)

CE-IQS

Centre of Expertise for Engineering and System Quality

Type of project:	Wallonia – ERFD – Convergence Objective
CETIC Budget:	€7,131,576
Duration:	2008-2013
Departments:	Embedded and Communication Systems; Software and System Engineering; Software and Services Technologies
Website:	www.cetic.be/CE-IQS
Contact:	christophe.ponsard@cetic.be

The Centre of Expertise for Engineering and System Quality (CE-IQS), has as its objective the provision of advanced expertise for developing software-based systems to Walloon ICT enterprises.

CETIC coordinates this project and actively involves SMEs in project activities. CETIC also contributes to the main research themes, and triggers specific dissemination activities for the enterprises.

Objectives

Now, more than ever, the performance and competitiveness of companies relies on mastering ICT. CE-IQS responds to this need by closely associating ICT enterprises with innovative research carried out by a strong applied research consortium composed of major research centres and universities active in this field.

Any enterprise in Wallonia can join the project throughout its lifespan by contacting CETIC. The needs of the enterprise are discussed and matched with one or more research tasks structured around five main themes:

THEME 1: METHODOLOGIES FOR SYSTEM DEVELOPMENT AND EVOLUTION

State-of-the-art methodologies for system development are investigated, with the aim of facilitating their evolution. Specific activities are devoted to model-driven development at an earlier stage than that of code (architecture, requirements), the Agile methodologies, software product lines and measuring the evolution of software systems. CETIC's role is to work on new methodologies and productivity tools designed to maintain and improve the control of systems throughout their lifespan. The study of embedded and Open Source systems is also addressed.

THEME 2: STRATEGIES FOR SYSTEM VERIFICATION, VALIDATION AND QUALITY ASSESSMENT

The objective is to improve quality assurance practices, especially those related to testing, with a view to cost reduction, better quality and quicker time-to-market. Specifically, techniques for identifying optimal test coverage related to code quality are investigated, in order to precisely assess that coverage, test the plan design and automate the test process based on a number of techniques, including model-based testing. A complementary task is investigating formal techniques for design time verification.

THEME 3: CERTIFICATION

Certification is required in a growing number of applications with critical aspects, such as security and dependability. Also, quality assurance levels are continually rising, owing to the ubiquitous nature of software in the systems we all use. A number of standards define the certification rules to be respected, such as the Common Criteria (IEC/ISO 15408) for security IT, IEC62304 for medical software and DO-178B in aeronautics. CE-IQS helps companies prepare for certification throughout all the phases of a project, and, in particular, improves the required practices. There is also a focus on specific constraints (e.g. adapting the process to SMEs) and on specific domains (e.g. the Belgian electronics identity). In addition, CE-IQS actively represents the needs of Walloon enterprises in standardisation work groups at the national and international (ISO) levels.

THEME 4: DISTRIBUTED AND EMBEDDED SYSTEMS

Software systems are increasingly interconnected through a variety of networks. This results in richer systems, but also more complex systems from the design point of view. A variety of these systems are being investigated, including:

- Service-oriented applications implemented in highly dynamic business chains, especially those that stimulate SME ecosystems.
- Cloud applications that enable on-demand access to resources and scaled performance.
- Embedded systems, and the related new technologies emerging in the area of wireless communication and computing devices. One of the main drivers of innovation in the embedded world today is the need to extend the autonomy of these systems by reducing their consumption of electricity. "Low power" is the new motto, and new, more stringent wireless standards are appearing in response to the need for improved throughput, range and power consumption rates. Similarly, new microcontrollers are introducing complex execution models that meet the most recent consumption levels. Thanks to this intensive survey of the state of the art, CE-IQS can provide accurate, up-to-date advice, and propose advanced designs to Walloon enterprises.

THEME 5: INTELLIGENT CONTENT AND SEMANTICS

In the Information Age, the ability to filter, organise and process content is critical for companies that rely on this information to conduct their business. The aim is to identify, adapt and further develop content processing technologies, such as search engines, indexers and full-text database searches, to meet the needs of these companies. Emerging search tools, such as semantics-based search engines and semantic Web technologies, are also evaluated on industrial cases.

ICT Equipment

To be effective, this methodological research must be supported by state-of-the-art tools. Also, the systemic barriers that prevent Walloon companies – especially SMEs – from taking advantage from the high-quality return on such tools, like missing information about existing tools, acquisition and maintenance costs, casual use, installation complexity, learning curves, etc., must be removed. The aim of the ICT equipment support project is to break through these barriers by providing easy access to today's tools, and to the associated consulting and support services. This equipment (described on page 54) consists of advanced software engineering tools and software/hardware tools for designing and testing embedded and communication systems.

Results

The applied research conducted by the CE-IQS typically involves an industrial prototype or methodological deployment that results in an effective transfer to the partnering companies. These were the main achievements of CE-IQS in 2011 and they include the following examples of results transfer to CETIC's industrial partners:

- Results of the research conducted on the development and evolution methodologies theme addressing the topic of Agile software development processes. Unlike the monolithic heavyweight methods, the Agile methods favour team interaction over a strict process, and on reactivity over a locked-in plan. For these reasons, they are of value to small IT software development structures.
- Results of the research conducted on the verification and validation theme, which focused on test design activities aimed at easing the production of high-quality tests, taking domain-specific knowledge into account. This research is based on the elaboration of a structured library of test patterns that helps capture, manage and transfer the know-how about testing in a test team context. A toolset was also developed to help in the instantiation of this pattern library on a specific project, in order to produce high quality test plan documents and automatically generate specific classes of tests.
- Outputs of the activities performed in connection with the certification theme, which covered a wide range of problems. In addition to OWPL, the ISO 29110 method, related to the assessment of IT development practices, is being deployed more and more often in Walloon SMEs, since it closely matches the level of granularity they require, and can help them improve in this regard. The COSMIC function point evaluation method, related to development effort estimation, is increasingly being transferred to SMEs, based on their training and coaching needs. Some organisations have even achieved autonomy in this area. In terms of security, specific risk analysis techniques have been circulated several times now, throughout Wallonia. Finally, CETIC remains very active in representing SME needs on standardisation committees, such as the national SC27 security group, the BISI initiative and the international committee, ISO/IEC-SC7 (specifically, WG6 on quality and WG24 on SME software processes).
- Results of our investigation into the area of Service Oriented Knowledge Utilities (SOKU), in connection with distributed systems application theme. Initially, we focused on server virtualisation, and subsequently on Cloud Computing.
- Results of our investigation into heterogeneous wireless systems, in connection with the embedded systems application theme, with the focus on reducing power consumption. Several computing architectures were studied to compare their efficiencies. An industrial case study was conducted to optimise the performances of a telecoms board: various computing architectures were compared and combined to achieve the best performance/consumption ratio.
- Demonstration of the pilot versions of a wide variety of content management technologies, in connection with the intelligent content and semantics application theme. Semantic technologies were used successfully for the first time on industrial cases, eliciting a great deal of interest among CETIC's project partners.

ECS

> **The experience gained from selecting and operating a forge suited to the needs of SMEs has drawn significant interest from partners who are taking advantage of the high-quality practices emerging from Open Source communities.**

PARTNERS:
Cenaero, Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP),
Université catholique de Louvain (UCL), Université de Mons (UMONS), Université Libre de Bruxelles (ULB)

DAPCARE

DAPCARE

Type of project: Wallonia – LEAD-ERA
CETIC Budget: €123,296
Duration: 2011-2015

Departments: Software and System Engineering, Software and Services Technologies
Contact: annick.majchrowski@cetic.be

STANDARDS

DAPCARE is aimed at developing the Patient Dosimetry eBook, a standardised solution for archiving and sharing dosimetric data for patients receiving medical ionising radiation delivered in various departments of health care institutions.

Objectives

The overall project objective is to propose a software solution to DAPCARE for collecting, archiving and optimising dosimetry data through a Patient Dosimetry eBook that can be shared by health care facilities to monitor patient care.

Today, the issue of medical radiation is growing in importance, because of the increasingly large doses delivered to patients during treatment, as well as the impact of radiation on public health generally.

To address this problem and reduce the risks associated with each control mechanism, the DAPCARE project aims to calculate the minimum dose that is necessary, but sufficient to obtain appropriate image quality for a diagnosis, particularly for children in paediatric radiotherapy and adults in radiotherapy,.

It is now possible for medical imaging departments to optimise dosages with an automated management tool. However, these tools have some limitations:

- Certain areas, such as paediatric and adult radiotherapy, are not normally equipped with sufficiently powerful management tools.
- Some automated dosage records cannot be adapted to the latest treatment modalities.

The goal of the project is to provide DAPCARE with a software solution that not only meets its requirements, but also promotes the exchange of standardised patient dosimetry data. The physician should be able to easily access the Patient Dosimetry eBook from the computerised health records of the patient.

The project will be managed by three hospital institutions: the *Centre Hospitalier Belfort-Montbeliard*, the *Centre Chirurgical Marie-Lannelongue* and the *Centre Anti-Cancer Lambret Oscar*.

Results

At the heart of the project is the design of a software solution that includes the following key features:

- Extension of dosage history in paediatric and adult radiotherapy departments.
- An original proposal to calculate a theoretical dosage based on a set of weighting factors for patients treated with radiation, given that older methods do not support the dosages prescribed today.
- The harvesting of dosimetry data locally, at each institution.
- Access to the dosimetry records of other institutions with a Web service provided by the Walloon Health Network.

At this point, CETIC has produced a state-of-the-art dosimetric data exchange for Belgium and France, including an analysis of the Belgian national standard, KMEHR-Bis, and the dosimetric standard in force in France, IHE-REM.

Added value for companies

Interest in the DAPCARE software for health care institutions lies mainly in the exchange of standardised patient dosimetry data nationally, and even internationally.

SST

eHEALTH

SSE

> **The software prototype developed in the DAPCARE project is designed to allow health care institutions to collect dosimetric data on their patients and have access to records of dosages administered at other institutions.**

PARTNERS:
Centre Anti-Cancer Oscar Lambret, Centre Chirurgical Marie-Lannelongue, Centre Hospitalier Belfort-Montbéliard, CIGES, ISLOG

eHealth for Citizens

IT Evolution of Health Care for Patients

eHealth for Citizens

Type of project: Wallonia – ERFD – Convergence Objective
CETIC Budget: €1,205,509
Duration: 2009-2014

Departments: Embedded and Communication Systems; Software and System Engineering; Software and Services Technologies
Contact: gautier.dallons@cetic.be

SEMANTIC TECHNOLOGIES ECS

This project constitutes a technological response to the challenges posed by the evolution of health care, as the sector faces a major demographic shift. An ageing population, combined with an increase in chronic illnesses, is changing the way health care is provided. Add to this a shortage of medical specialists and the need to find new solutions to address health care issues becomes even more pressing. Our eHealth for Citizens project is mainly aimed at designing and implementing a technological service-oriented platform capable of devising and supporting innovative eHealth services.

Objectives

An important project objective is to enable, enhance and support technological evolution to allow patients to be cared for in their homes. The focus is on creating customised services to meet the health care needs of patients, such as monitoring services. The platform will offer a wonderful opportunity for achieving better quality medical care, while bringing new added value services to the eHealth marketplace.

The project addresses various research topics:

- Development of a multi-modal Graphical User Interface (GUI) to meet patient needs and designed in accordance with their capacities.
- Service composition, which examines what specialised services to provide to the patient and the mechanisms for delivering those services in an automated and transparent way.
- Communication protocol design, which focuses on the design of an interoperable protocol to share information between medical devices and the platform.
- Security and certification, which involves selecting the various mechanisms that must be implemented in order to secure the platform and ensure confidence in its services.
- Data integration, where the consolidation of medical data is key to providing specialised services to the patient, in the case of a fall, for example, and for detecting emergencies.
- Legal constraints, which concerns the legal requirements that must be met by the platform because of the sensitivity of the data contained in medical records.

Results

- In 2009, CETIC put together the requirements for the earliest versions of the demonstrations, and conducted state-of-the-art studies on service composition techniques and eHealth platforms. The first validation scenario identified in consultation with physicians and patient organisations is related to the follow-up of diabetic patients at home.
- In 2010, CETIC began developing demonstration scenarios on home care for diabetic patients. An in-depth study was undertaken with Walloon hospitals and diabetologists to document their specific needs and create the scenarios. On the basis of these scenarios, CETIC designed the architecture of the platform and the services that would be implemented. A strong focus was placed on improving communication among the actors participating in the care of these patients, which will be based on a communication link between this eHealth platform and the public sector Walloon Health Network.
- In 2011, the focus was on the interaction between the eHealth platform and other existing platforms, like *Réseau Santé Wallon*. A connector has been designed to push medical information to hospital practitioners.

Added value for companies

Through the experimentation performed during the project, technologies have been developed that can be used to build new and innovative medical applications. CETIC has also developed extensive experience in the creation of applications that call for multidisciplinary competencies.

SERVICE ORIENTED ARCHITECTURE

eHEALTH

SSE

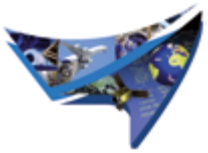
“An important project objective is to enable, enhance and support technological evolution to allow patients to live independently at home, both safely and well.”

SST

PARTNERS:
Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP), ImmuneHealth, Université catholique de Louvain (UCL)

HM+

Health Monitoring in Aeronautics



Type of project: Wallonia – Marshall Plan – Aeronautics and Space Pole (Skywin)
CETIC Budget: €51,900
Duration: 2008-2011

Department: Embedded and Communication Systems
Website: https://www.skywin-hmplus.be
Contact: christophe.ponsard@cetic.be

AERONAUTICS

Health monitoring is a broad, multi-disciplinary domain involving specialised skills that are already available in Wallonia. However, prior to the project, these skills had never been brought together in a coordinated project, nor had there been practical experience in applying them in the aeronautics market.

Objectives

Three specific applications are envisioned:

- Actuator systems and damage simulation software for use inside aircraft (this application is managed by Sonaca).
- Engine and equipment monitoring inside aircraft, a cryogenic actuator (managed by Techspace Aero).
- Electrical distribution systems and arc fault detection inside aircraft (managed by Thales Alenia Space ETCA).

The research topics are the following: design, integration and validation of new sensors and actuators, electronics and interfaces inside aircraft, damage assessment, critical embedded system certification methodologies, algorithms for default detection and error recognition, and signal processing from sensors inside aircraft.

Results

CETIC is contributing to HM+ by monitoring engine oil system status in terms of temperature, pressure, rejection rate, etc. With its extensive expertise in embedded systems design, CETIC is assisting with the migration of the detection algorithms developed by the Université Libre de Bruxelles onto the platform prototype designed by our industrial partners. This task takes into account the embedded platform's physical constraints (like processor and memory limitations) at the engines' working temperatures. Specifically, CETIC has developed a platform prototype to monitor engine oil system status and helped port the detection algorithms from Matlab Simulink onto the embedded system designed in the project.

Another important aspect for industrial usage is certification for critical embedded systems, following standards RTCA DO-178B (software) and RTCA DO-254 (hardware). CETIC has studied the certification potential of the platform software and hardware related to these certification standards.

Added value for companies

Health monitoring is important for quickly and appropriately reacting to the evolution of the condition of aircraft. Besides increased reliability and safety, smarter processing of the data gathered enables improvement of the energy efficiency of aircraft and extension of their life cycle.

SOFTWARE CERTIFICATION

ECS

> **The overall aim of the project is to increase reliability and safety inside aircraft through the use of health monitoring techniques.**

PARTNERS:
Cissoïd, CRIBC (BCRC), Deltatec, GDTech, Open Engineering, SONACA, Samtech, Thales Alenia Space ETCA, Techspace Aero, Université catholique de Louvain (UCL), Université Libre de Bruxelles (ULB), University of Liège (ULg) and Université de Mons (UMONS)

LOCOTRAC

Low Cost Train Automatic Control

LOCOTRAC

Type of project: Wallonia – Marshall Plan
CETIC Budget: €229,893
Duration: 2011-2014

Department: Software and System Engineering
Contact: renaud.delandtsheer@cetic.be

TRANSPORT

The LOCOTRAC project is aimed at developing lower-cost technologies, in order to allow the deployment of state-of-the-art safety mechanisms, such as Automated Train Protection (ATP), on regional and local lines. The project will incorporate these technologies into new products (ground, on-board and telecoms) designed for such lines.

Objectives

CETIC is in charge of a specific work package dedicated to software hardening. This process is aimed at developing low cost software-based control systems to provide a high degree of reliability (SIL levels), when executing on a low assurance, low cost hardware infrastructure.

Generally, a high degree of reliability is achieved through hardware redundancy. An alternative approach is software hardening, which is applied where hardware is not reliable, but must continuously deliver credible evidence that all its computations have been correctly executed. Such evidence is obtained by executing all software operations (arithmetic, memory, control, etc.) at least twice, using different portions of the hardware, and ensuring that the results are consistent.

CETIC's objective is to develop an automated tool that will transform software code by inserting such redundancy into it. This tool must itself be reliable enough to be used in the development of high-assurance systems. To achieve this objective, CETIC will follow a CENELEC-qualified development process.

Results

In just under a year, CETIC has developed a set of hardening rules that will be implemented in the tool. These rules will provide the necessary evidence of the health status of hardware running critical software.

CETIC has also included techniques from the Deploy project, which were transposed to generate a risk analysis automatically, with help of a constraint solver engine similar to ProB. This helped in the assessment of the basic principles to be used in the translation rules mentioned above.

CETIC has also proposed a set of safety architectures that will guarantee that the delivered software will be reliable enough for the transportation sector.

Added value for companies

CETIC's contribution will make it possible to mass-produce low cost, high integrity systems for automated train protection applications (ATP), such as TBL1+. These systems are designed to prevent train collisions by ensuring that the train driver obeys the signalling rules by stopping at red lights.

The targeted market segments are the regional lines that cannot afford the state-of-the-art technology that relies on costly high integrity hardware.

SAFETY

SSE

> **The systems developed are designed to prevent train collisions by ensuring that train drivers obey signalling rules by stopping at red lights.**

PARTNERS:
Alstom, ACIC S.A, CE+T S.A., Infrabel, Logiplus sprl, MITRA Innovations, Q3S sprl, SEE sprl, STIB S.A, Université catholique de Louvain (UCL), Université de Mons (UMONS)

MidFlex

Flexible Middleware for IPv6-based Low Power Embedded Systems

MIDFLEX

Type of project: Wallonia – First DOC.A
CETIC Budget: €170,240
Duration: 2011-2014

Department: Embedded and Communication Systems
Contact: sebastien.dawans@cetic.be

ULTRA LOW POWER

Embedded intelligent systems are gradually becoming commonplace in our everyday lives as a means to measure and control our environment. This expansion is combined with growing diversity in electronic systems, in terms of communication protocols (Wi-Fi, Bluetooth, IEEE 802.15.4, etc.), size, user interface, processing power, memory, energy source and sensing/actuating capabilities. Interconnecting such heterogeneous devices is a real challenge, and requires strong expertise in several technological domains.

A software component is designed to be installed between the user application, the operating system and sometimes the hardware itself - known as middleware. Its purpose is to facilitate the application of complex and heterogeneous sensor networks. Existing middleware meets this need to a limited extent.

Objectives

This project is the subject of a PhD thesis funded by the Walloon First DOC.A program. It is aimed at providing a simple and coherent network application interface, which will harness the flexibility and configurability of the underlying technologies and protocols to achieve end goals, such as minimal energy consumption or device mobility support. In light of the Future Internet initiatives and the upcoming Internet of Things, this thesis places a strong emphasis on the interconnection of networked objects to the Internet and to common consumer devices, like smart phones and tablets. These innovations will help facilitate the design of applications with impacts that will reshape the world as we know it today.

INTERNET OF THINGS

Results

In 2011, CETIC studied the implementation and deployment of WSN applications based on current standardisation technologies, such as 6LoWPAN and RPL, IETF's IPv6 Routing Protocol for Low Power and Lossy Networks. These studies were made possible thanks to a development cycle comprising three distinct test environments: a software time accurate simulator for WSN (COOJA), physical sensor platforms in CETIC's Wireless Lab and several large-scale academic wireless sensor test beds that are available for experimentation. Among the latter are INRIA Lille's SensLAB test bed and TU-Berlin's TWIST test bed, which are crucial for studying the impact of Radio Duty Cycling (RDC), a key enabler for network longevity, on the stability of RPL, and the Contiki operating system's embedded IPv6 stack. These test beds also allow the study of the scalability of such protocols in two respects: total node count, and node density. These topics are relevant to the vision of the coming Internet of Things, which will likely involve the interconnection of a potentially huge number of smart objects, with hard constraints on device memory, processing power and power consumption. In the fall of 2011, CETIC initiated a collaboration with SICS, the founder of the Contiki Open Source operating system, through a 3-month internship in Stockholm. This ongoing collaboration will lead to the publication of scientific results in 2012 at international WSN workshops and conferences.

Added value for companies

This research project is having a direct impact for Walloon companies keen to integrate Internet of Things solutions into their products, and CETIC's expertise is already guiding companies in design choices for sensor network hardware and software. In the future, middleware components developed in Contiki and other operating systems will become available in the public domain, with CETIC as an enabler for technological transfer.

ECS

> **MidFlex is aimed at developing middleware that will facilitate the design and deployment of IPv6-based sensor network applications.**

PARTNERS:
Université catholique de Louvain (UCL) - IP Networking Lab

NAPLES

New Agile Platform for the Lifelong Engineering of Software

Type of project: Wallonia – Technological Innovation Partnership
CETIC Budget: €606,338.25
Duration: 2010-2013

Department: Software and System Engineering
Contact: christophe.ponsard@cetic.be

SOFTWARE LIFE CYCLE
SOFTWARE INDUSTRY

The NAPLES project is developing a platform that will provide resources for software engineering operations to the various stakeholders in a software project, including the customer.

Objectives

Increased market pressure is forcing software development firms to improve the productivity of their development teams and the dependability of the software solutions they deliver to their customers. The chief means for achieving a positive impact on productivity and dependability is through reuse at the various stages of a software development project. Next in importance is improved communication among stakeholders throughout the project life cycle.

Although advocated by many, well-orchestrated reuse in software development projects is not yet a reality. To enable reuse, several roadblocks must be removed. First, existing software reuse techniques must be better publicised, as they are not always well known by software engineers in industry. Second, the application of reuse techniques must become easier, in re-engineering existing software solutions, for example, as this practice often requires too much effort initially. Third, reuse techniques must be included in the software development process of many organisations, which has not been the case up to now.

With regard to communication among the software project stakeholders, the major roadblock has been the lack of awareness of each other's work and needs. Although all reference models of software development practices attempt to organise everyone's work and interactions, practitioners find these models either too high-level, failing to provide enough practical guidance (CMMI, ISO 12207), or too intrusive, in that they impose too many fine-grained tasks that not everyone in an organisation will be prepared to perform (RUP).

The NAPLES project is aimed at improving this situation by developing a platform to:

- Facilitate the reuse of material (artefacts) from a large knowledge base built within NAPLES from past projects.
- Encourage and ease the production of new reusable material to add to the NAPLES knowledge base.
- Promote workflow-oriented software development, in which each stakeholder can select and customise the workflows of recognised practices to perform many tasks throughout the software development life cycle. Tedious workflow tasks, particularly those requiring interaction between software engineering tools and the project's IT environment, are to be automated.
- Make the production and consumption of reusable artefacts a reality through the streamlining of reuse activities in workflow templates for every discipline in the software development life cycle.
- Provide a portal where the software project stakeholders, including the customer, can obtain an accurate project status at a selected level of detail. The portal will also allow common software engineering operations, such as reporting bugs, to be performed without direct interaction with software engineering tools.

Results

The NAPLES project has enabled CETIC to achieve the following:

- Development of an audit questionnaire to capture the reuse practices already in place in an organisation, and the reuse practices that an organisation wishes to promote.
- Development of a selection method for identifying software engineering tools to include in the NAPLES platform, and application of the selection methods for building three different NAPLES platform instances, one each for SIS, OSL and CETIC (the latter being exclusively Open Source).
- Implementation of initial workflow templates for requirements management in the Bonita workflow solution, and automated interactions between workflow tasks and requirements engineering tools via the protocol defined by the Open Services for Lifecycle Collaboration (OSLC).

Added value for companies

To guarantee the industrial applicability of the NAPLES platform, its main requirements are being developed by the two industrial partners. Then, all the partners will become involved in designing the architecture of the platform and take part in its development. This development will be based on an Agile methodology. The final result will be validated through several industrial case studies, starting with the industrial partners and CETIC.

SSE

"The NAPLES platform improves reuse in software development projects and streamlines the application of recognised software engineering practices."

PARTNERS:
Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP) – PRECISE,
Océ Software Laboratories, Siemens IT Solutions and Services

PIPAS

Adaptative Piloting of Hospital Processes

Type of project: Wallonia – WIST 3.0
CETIC Budget: €205,878
Duration: 2011-2014

Department: Software and System Engineering
Contact: christophe.ponsard@cetic.be

SSE

The PIPAS project is aimed at developing model-driven (process) software to help define, pilot and supervise the multiple health care processes that may be involved in the care of a patient, especially in the cancer domain.

Objectives

Hospitals the world over are facing increasing challenges regarding the quality of care, notably in the cancer domain, where patients suffering from multiple pathologies have to follow complex treatments. Clinical pathways are increasingly being modelled, in order to precisely define the key steps involved in those treatments and to help in formulating responses to the challenges they impose. At the same time, medical research is progressing by conducting clinical studies to evaluate new treatments. Such studies rely on protocols that explicitly describe the steps of the treatments, which in turn drive hospital services to increasingly adopt process-oriented approaches. Clinical pathways and protocols are two types of critical medical process.

Process management systems provide IT support for this type of approach, which explains the growing interest they have been generating in the medical field. However, current systems are still encoding rigid and purely imperative processes, and they do not support the coordination of multiple processes that may interact.

To create systems capable of coordinating medical systems, the PIPAS project is aimed at developing software that will enable:

- Definition of imperative and declarative models of multiple care processes. These models are capable of representing the case of a single patient, and they reveal the static conflicts that have to be managed.
- Execution of models to pilot the care team members and to manage the dynamic conflicts that occur at runtime.
- Monitoring and evaluation of executing processes using performance indicators derived from the model.
- Exploitation of information during process execution, using dashboards and specific views of the actors involved.

The software will also be able to respond to non-functional requirements, which will ensure its industrial interoperability with clinical systems, as well as its adaptability and usability.

Results

At this point in the project, the consortium has identified various goal-driven modelling techniques for clinical pathways, while CETIC has developed a constraint-based local search (CBLS) framework that will drive the workflow enactment engine with pro-active resource management (patients, doctors, beds, etc.).

Added value for companies

The software developed in the PIPAS project will be reusable by medical software editors wishing to integrate the adaptive piloting of hospital processes and clinical pathways.

It will also be possible for hospitals that manage their IT infrastructure and support themselves, as well as the broader group of workflow management system editors, to adopt the underlying principles of the PIPAS project.

eHEALTH

CLINICAL PATHWAYS

> **The principles and tool developed by PIPAS for piloting hospital processes and clinical pathways will typically be reusable by hospitals managing their own IT infrastructure, as well as by medical software editors and workflow management system editors.**

PARTNERS:
Centre du Cancer, Université catholique de Louvain (UCL)

PSOPP

Porting Software on Parallel Processors

Type of project: Wallonia – Collective Research
CETIC Budget: €328,998
Duration: 2011-2012

Department: Embedded and Communication Systems
Contact: laurent.deru@cetic.be

METHODOLOGIES

The increase in algorithm complexity and the amount of data handled by IT systems in many sectors of the economy lead enterprises to want to increase their computing power. At the same time, processor vendors are hindered in their quest to deliver better performances to their customers by the technical limitations of hardware. The fact is, the available power per core has not increased at all in the past few years. As a result, vendors are now providing multi-core CPUs and multi-processor architectures as an alternative. Moreover, thanks to the multiplication of processing units in GPUs, the processing power of graphics cards has improved dramatically recently, and FGPA-based accelerators have increased their computing power and the range of their features significantly. Productivity tools, which originally required dedicated expertise in HDL, are now available that make development and interfacing a great deal easier. Unfortunately, most existing software cannot benefit immediately from parallel execution. Moreover, a lack of established standards and easy-to-use methodologies means that there has been no widespread migration towards the new platforms that have appeared in the last three years or so.

Objectives

This project is aimed at developing a methodology that makes it possible to adapt existing software to run on multi-core processors, on GPU- or FPGA-based accelerator platforms, in order to benefit easily and quickly from the computing power of these architectures. In the first phase, the state of the art will be examined and the specifications identified. Next, a methodology will be developed to enable SMEs to adapt their software to parallel platforms. This will be supported by a set of tools to ease the process of designing parallel software on GPUs and to facilitate the migration of the most critical part of the software to an FPGA. This methodology will then be applied on actual industrial use cases in order to validate the approach selected and to improve the tools and the methodology based on the output of these use cases. After the end of the validation phase, a promotion phase will allow as many Walloon SMEs as possible to benefit from the methodology and tools developed. The output of the project will also include additional project documentation and the source code of the developed tools.

Added value for companies

In order to respond to the needs of SMEs, the project will take into account the actual environment in which the selected applications will be used. Some companies have large computing centres, and so their focus is on optimising their assets in terms of efficiency, but without allowing their past investments to become obsolete. These companies are also concerned about the amount of space taken up by the centres, and their electrical consumption. SMEs, by contrast, usually have much more limited computing capability. They will be more interested in increasing that capability cost-effectively by adding one or more mainstream GPU cards, or by adding an FPGA-based accelerator card, which is a more expensive option, but one that will provide greater potential for increasing processing capacity. Not only will SMEs benefit from additional computing resources, but they will also be better able to use them, since the tools provided with the methodology should facilitate development. Enterprises with a number of computers equipped with powerful graphics cards may also be able to take advantage of this additional processing power, thanks to network computing middleware which allows the processing capability of computers to be used during the night.

ECS

FPGA

> **This project is aimed at providing a methodology to allow SMEs to adapt their software that is designed to run on mono-core processors to run on multi-core processors, on GPU or on FPGA-based accelerator platforms, in order to increase the computing power of these architectures easily and quickly.**

PARTNERS:
Cenaero, Université de Mons (UMONS)

QDFCA

Quality Design for Competency Assessment

QDFCA

Type of project: Wallonia – Marshall Plan
CETIC Budget: €138,747.50
Duration: 2009-2012

Department: Software and System Engineering
Contact: christophe.ponsard@cetic.be

METHODOLOGIES

The aim of the QDFCA project is to improve the functionalities of the ExAMS platform.

Objectives

The QDFCA project (Quality Design For Competency Assessment) aims at evolving an Open Source for managing an evaluation process with new concepts and technologies. The platform provides processes both for evaluators and evaluees: the former can construct a structured, sound and standardised evaluation, while the latter benefit from a high-quality feedback.

The platform's objectives are the following:

- To help evaluators implement procedures for constructing and managing standardised quality evaluations.
- To offer precise monitoring to those whose system is being evaluated, and provide them with personalised diagnostic feedback.
- To guarantee the best quality improvement (validity, reliability, equity, etc.).

This platform is a great success, and its uptake is continuously expanding in the European market. Nevertheless, since new demands are being expressed all the time, the platform needs to be enriched with new functionalities to meet client requirements and to stay competitive in the marketplace. These requirements mainly concern the following two issues: (1) the need for greater interoperability between the platform and the clients' systems; and (2) the need for more complex and specific evaluations.

The objective of the QDFCA project is to transform the platform into a real Assessment Management System, covering assessment needs from classical standardised testing to the evaluation of high-level competencies.

Results

During the life of the project, a series of actions was carried out to raise both the functional and non-functional maturity levels of the ExAMS platform. The main results produced by CETIC are the following:

- Deployment of a new server infrastructure supporting virtualisation.
- Security of the data on the various instances of the platform: Dependencies between the instances and isolation of the instances.
- Security of the server: Analysis of Web technologies and their vulnerabilities, availability, mirroring, IP fail-over, etc.
- Test-oriented behaviour-driven development (BDD) techniques.

To ensure the best collaboration among the platform proponents, special attention has been given to the Open Source aspects of project management. A scientific study on intellectual property and Open Source licenses was performed.

Added value for companies

Continuous training of staff is a key activity that will ensure the maintenance and renewal of skills within companies. The work culture requires great flexibility, and training methods of must adapt to it. This platform enables companies to deliver e-learning courses with a competency-based approach, and also facilitates the task of the trainer.

SSE

> **CETIC applies its technological expertise to help this platform reach the highest possible level of performance and interoperability. Technology quality and high performance are key success factors for the project.**

PARTNERS:
Assess Group sa, University of Liège (ULg) – SMART

SAT

Smarter Airborne Technologies

Type of project: Wallonia – Marshall Plan – Aeronautical and Space Pole (Skywin)
CETIC Budget: €321,166
Duration: 2010-2013
Department: Software and System Engineering
Website: www.skywin-sat.be
Contact: christophe.ponsard@cetic.be

AERONAUTICS

For this project, CETIC will model the generic certification process, including the variations in embedded systems design that may potentially impact the certification process.

Objectives

The objective of the SAT project is to develop new technologies for aircraft and smarter airborne systems. Five pilot projects are included: two competency centres, and three technologies and their associated applications.

- Ceces_2: This is a centre for the study of electronic components subjected to radiation and extreme temperature environments (Communauté d'Expertise pour Composants en Environnements Sévères). The behaviour of sensitive components, like MEMS (microelectromechanical systems) sensors and FPGAs (field-programmable gate arrays), will be studied in this project. The partners involved are: Thales Alenia Space ETCA (project leader), Cissoid and UCL.
- Certif_2: This is a centre for the certification of critical and aeronautical embedded systems, following the embedded software (RTCA DO-178B) and hardware (RTCA DO-254) standards of the US FAA (Federal Aviation Administration) and EUROCAE (European Organisation for Civil Aviation Equipment). The modelling of the certification process, including variations in design, and the management of software and hardware product lines will be considered in this project. The partners involved are: CETIC (project leader), Thales Communications Belgium, Barco Silex and FUNDP.
- PHM Compact: The objective of this part of the project is to develop a compact hydrogen maser (atomic clock), based on the cavity magnetron, for use in space and civil applications. The partners involved are: Gillam FEI (project leader), Entreprise Dardenne, UCL and ULg.
- HMI Aveugle: The objective of this part of the project is to develop new human-machine interfaces (HMI) for blind interactions between pilot and cockpit instruments and commands. The favoured approach will be multi-modal, using voice, video, touch screens, etc. The partners involved are: MULTITEL (project leader), Thales Communications Belgium and Gillam FEI.
- Simulation Radio/Aéroport: The objective of this part of the project is to study the issue of radio system congestion at airports, specifically considering the problems of air traffic control and communication through airport speakers. A virtual reality-based approach, combined with real equipment prototypes, will be followed in this study. This project will involve the two Walloon civil airports (Charleroi and Liege). The partners involved are: Thales Communications Systems (leader), M3 Systems and UCL.

Results

CETIC is concentrating its effort on the Certif_2 sub-project, which it is managing, and has coordinated the gathering of industrial requirements among the partners involved. Two case studies have been identified, and, in collaboration with the academic partners, an initial model of incremental certification has been defined. This model combines three key components: a variability model, a certification process model and a safety model. The specifications of the tools required to efficiently support the incremental certification process were also developed.

Added value for companies

The certification costs for enforcing the safety standards applicable in aeronautics are very high, and the development effort required for certified systems is 3 to 5 times greater than it is for uncertified systems. Of course, certification is required to access key markets, and so every new product release must be examined. The incremental process proposed will help companies develop efficient reuse strategies, based on configuration differences, which will result in substantial savings. This will improve competitiveness and provide better access to key markets.

SOFTWARE CERTIFICATION

> **SAT is developing new technologies for aircraft and smarter airborne systems.**

PARTNERS:
Barco Silex, Cissoid, Entreprise Dardenne, Facultés Universitaires Notre-Dame de la Paix de Namur (FUNDP), Gillam FEI, M3 Systems Belgium, MULTITEL, Thales Alenia Space ETCA, Thales Communications Belgium, Université catholique de Louvain (UCL), University of Liège (ULg)

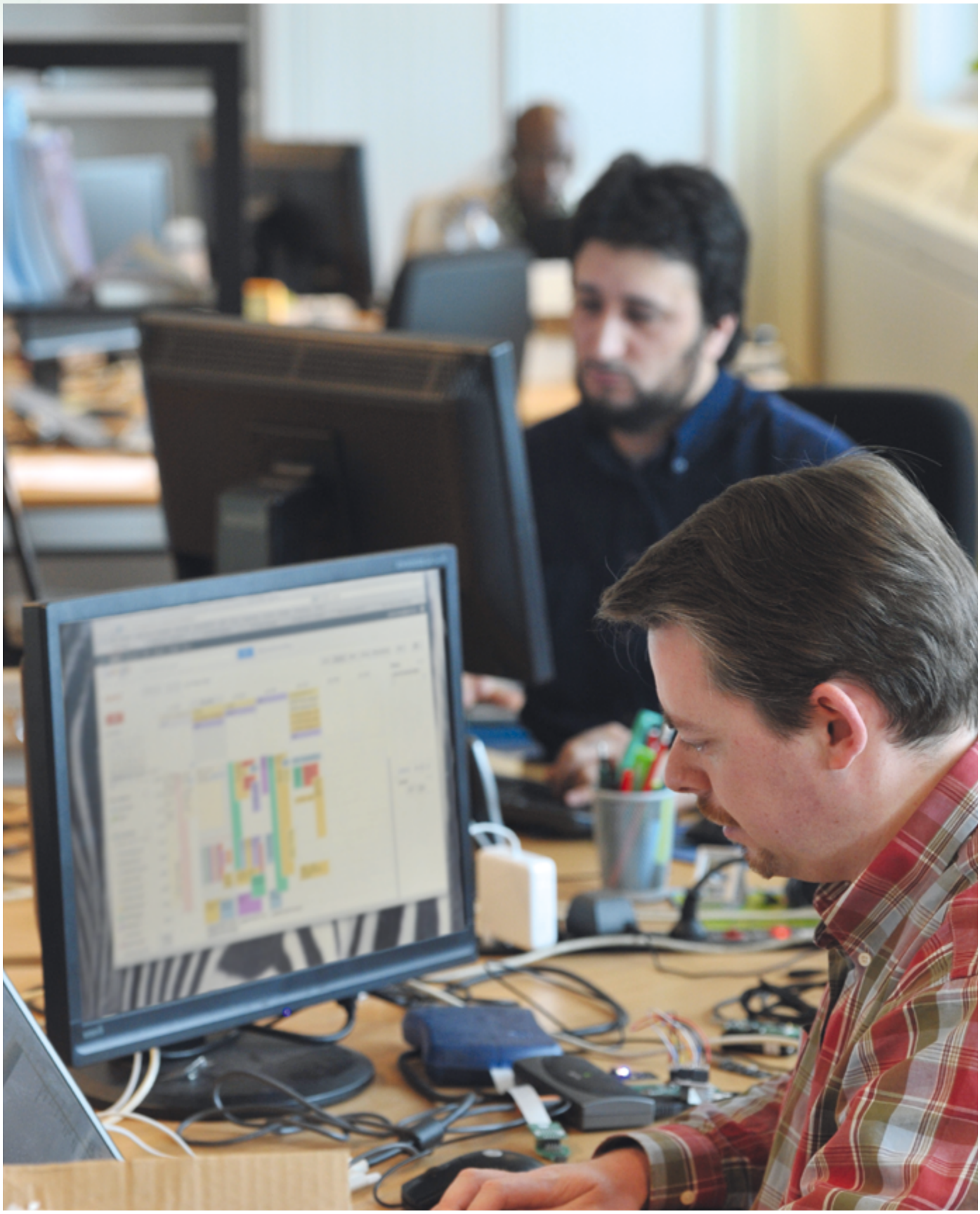
EUROPEAN RESEARCH PROJECTS

With the Seventh Framework Programme (FP7) coming to a close at the end of 2013, CETIC looks back proudly on its track record, which includes participation in five FP7 projects, namely, RESERVOIR, DEPLOY, SCube, PONTE and ExSec on BonFIRE, and a sixth one, PaaSage, coming in 2012. Throughout the FP7 period, CETIC's research effort on the European stage has mostly focused on technologies for the Future Internet. These projects foster closer collaboration with large corporations and research groups, such as Thales, Atos, Telefonica, IBM, INRIA, CSTC and Fraunhofer.

Leveraging the expertise built up through European research projects, CETIC has passed its knowledge to regional companies via direct training, and to local SMEs via transfer activities, thanks most notably to European Research Area projects, like ComodIT and AMACS.

CETIC is currently working on aligning its strategic research agenda with that of Horizon 2020, the new framework programme scheduled to start in 2014, and will further its interactions with other Future Internet research experts and large European companies. The main line of research in Horizon 2020 remains similar to that of FP7, although with greater emphasis on research to generate significant economic impact on the competitiveness of European businesses, and to accelerate recovery from the current economic downturn.

Needless to say, advances in the Future Internet are still at the forefront of the Digital Agenda for Europe, as they are for CETIC. Through leveraging its FP7 experience, CETIC will continue to enhance its expertise in Cloud deployment and in secure, dependable and context-aware Cloud Computing, as well as in semantic interoperability, areas where CETIC is already delivering valuable services to many regional companies in need of expert guidance.



AMACS

Automatic Monitoring of Activities using Contactless Sensors

Type of project:	European Commission/Wallonia – ERANET	**Department:**	Embedded and Communication Systems
CETIC Budget:	€149,799	**Website:**	www.amacs-project.eu
Duration:	2010-2013	**Contact:**	valery.ramon@cetic.be

WIRELESS TECHNOLOGIES

The ultimate objective of this project is to make it possible for the elderly presenting age-related risks or pathologies (e.g. risk of falling, cognitive decline) to safely stay in their home environment as long as possible.

Objectives

In order to achieve this, AMACS will develop and evaluate, in real-life situations, an ICT-based system that can automatically monitor the activities of daily living (ADLs) of the elderly living alone at home. Examples of ADLs are: sleeping, cooking, making a phone call, using the toilet and washing. Monitoring is based on the measurements taken by various contactless sensors installed in the home environment: home security sensors (presence or motion detectors), sensors that measure the consumption of public utilities (electricity, water, gas) and video cameras. The development and evaluation of our prototype will be based on measurements recorded in the living quarters of a few seniors.

Monitoring ADLs will enable us to detect changes in a senior's behaviour, i.e. changes in their ADL patterns, including both acute and gradual changes. Acute changes are abnormal events that are critical and require immediate attention. Examples include falls and evidence of running water or gas. We also want to detect gradual changes, which are important for the early detection of health problems (such as the early stages of dementia). Examples of such changes are sleeping disorders, ADL decline and behavioral disturbances. Information about these activities and about changes in behaviour in general can then be discussed with these elderly individuals, entered into their medical records and provided to their care-givers (general practitioners, visiting nurses, family members and other health professionals), so that their care plans can be modified accordingly. This would increase the quality of the care the elderly receive, as well as their quality of life, and allow them to stay longer in their homes.

CETIC and their Walloon partners are in charge of the definition, design and development of the exchange platform that collects the information about ADLs and changes in seniors' behaviour, and effectively transmits this information to the seniors themselves and to their medical records, and to their caregivers. They are also responsible for adapting the software solutions used by the general practitioner and the nurse as required to take into account this additional information.

Results

CETIC and its Walloon partners have defined the functional and non-functional specifications of the exchange platform used by the general practitioner and the nurse, including its interfaces with the software, to take into account additional information gathered on the seniors being monitored.

Some modules of the exchange platform have also been implemented: the database (containing the contacts, incidents, ADLs, etc.), the messaging module, which allows users to exchange e-mail messages, the communication module, which manages the sending and receipt of alerts, and the module that generates ADL reports for the general practitioner.

Added value for companies

The project results may be of interest to any company providing ICT services in the health care sector, and in particular to companies proposing health telemonitoring systems. CETIC and its partners could extend their product portfolio with solutions based on the deployment of video cameras, security sensors and sensors measuring the consumption of public utilities.

The project results may also be of interest to SMEs active in sectors like energy management, comfort management and home automation. These sectors use sensors that are similar to those used in this project, and so there is an opportunity here for CETIC's partners to extend their activities beyond the health care market.

CETIC's partners – Intersysto, PCSOL and Smolinfo – are SMEs which are already active in eHealth-related solutions. They each currently sell a product dedicated to a single domain (doctors, patients, paramedics), and could extend their market by interfacing these products with ADL events.

eHEALTH

ECS

"AMACS is an EraSME project, the goal of which is to develop and evaluate, in real-life situations, an ICT-based system that can automatically monitor the activities of daily living (ADLs) (sleeping, cooking, making a phone call, etc.) of elderly people living alone at home."

PARTNERS:
MOBILAB of KHKempen University College, KULeuven, Vlaamse Katholieke Hogeschool voor Wetenschap & Kunst, Fontys Paramedische Hogeschool, Intersysto, PCSol, Smolinfo

BonFIRE-ExSec

Experimenting Scalability of Continuous Security Monitoring

Type of project: European Commission – FP7 – Future Internet Research Experimentation
CETIC Budget: € 178,217.10
Duration: 2011-2012
Departments: Software and System Engineering; Software and Services Technologies
Website: www.bonfire-project.eu
Contact: syed.naqvi@cetic.be

CLOUD COMPUTING

The ExSec experiment is one of the four research experiments selected from among 28 proposals submitted in response to the first call for experiments issued by the BonFIRE project. The ExSec experiment is aimed at determining an empirically validated elasticity function for security monitoring, and is designed to study the impact of scalability and heterogeneity on the performance of security solutions. The test scenarios have been set up to reflect real-life situations, in which organisations running heterogeneous Cloud technologies can collaborate and share their resources.

Objectives

The overall objective of the BonFIRE project is to make it easy for researchers to experiment with their innovative ideas in the area of service orientation and distributed computing. The project offers a federated Cloud infrastructure to support experimentally driven research and to lead the development of the Future Internet from a service-based application standpoint. In this regard, the main objective of the ExSec experiment is to determine an empirically validated elasticity function for security monitoring, along with verifying the scalability of the security monitor on different application loads for a number of virtual machines. Another important aspect of the experiment will be to verify that scalability behaviour on various Cloud technologies, such as different types of hypervisors and Cloud managers.

Results

It is envisioned that ExSec will address security concerns in the deployment of federated Cloud infrastructures. Security constitutes the cornerstone for broader acceptance of Future Internet-based virtualisation technologies, as the majority of stakeholders are skeptical about security assurances. The ExSec results will provide this cornerstone by establishing the limits to the adaptability of security solutions, in terms of determining their suitability for the unique characteristics of real life federated Cloud infrastructures, i.e. scalability of resources and heterogeneity of underlying technologies. The experimental results will stimulate further research in the area of Cloud security to develop solutions that can address its requirements in better ways.

Added value for companies

The ExSec results will enable CETIC to help companies firmly embrace Cloud technologies. Businesses are far more sceptical about using off-site computing and storage resources than the scientific community. The direct involvement of commercial interests, including a company's reputation, does not allow them to adopt a new technique without having convincing proof of its effectiveness. The ExSec experimental results will help CETIC advise companies deploying a Cloud solution about the best security architecture for their Cloud architectures and performance requirements. It is clear, therefore, that these results will enable businesses to adopt the right security solutions for their Cloud solutions, in terms of cost and performance.

SERVICE ORIENTED ARCHITECTURE

COMPUTER SECURITY AND TRUST

> **The BonFIRE-ExSec experiment is aimed at studying the impact of scalability and heterogeneity on the performance of security solutions. The ultimate objective of this investigation is to develop an empirical way to quantify this impact under various operating conditions and parameters of Cloud deployments.**

PARTNERS: ATOS Origin, Cloudium Systems, Compultense University of Madrid (UCM), Germany Fraunhofer Fokus, Hewlett-Packard, I2CAT Foundation, Interdisciplinary Institute for Broadband Technology (IBBT), INRIA, Nextworks, Poznan Super Computing and Networking Centre (PSNC), RedZinc, SAP AG, Supercomputing Centre of Galicia (CESGA), Technical University of Berlin (TUB), The 451 Group, University of Edinburgh (EPCC), University of Manchester, University of Southampton (IT Innovation Centre), University of Stuttgart (HLRS)

C2A

Connect to All

Type of project: European Commission – Interreg IV
CETIC Budget: €327,000
Duration: 2008-2012

Department: Embedded and Communication Systems
Website: www.c2a-project.eu
Contact: lotfi.guedria@cetic.be

TRANSPORT

The C2A project is aimed at designing, developing and implementing an intelligent interconnection system between embedded hybrid equipment components in transport vehicles. The goal is to optimise and extend embedded resource usage so that new and innovative services can be created. C2A is a CBC project (Cross Border Cooperation between France and Wallonia) of the European Interreg IV-A program.

Objectives

Certain types of embedded equipment are becoming increasingly common in transport vehicles. Apart from mandatory devices, such as a digital tachograph, other equipment is now available, such as radio communication systems (GSM/GPRS), localisation devices (GPS) and a variety of miscellaneous tools and equipment for specific needs (data loggers, PC tablets, cameras, mobile phones, on-board computers, etc.). However, in practice, there is sub-optimal exploitation of these technologies, owing to selective and closed hardware and software interfaces. Usually, equipment has very limited capability to share its hardware resources (communication interfaces, embedded sensors, etc.). This results in service duplication, elimination of the redundancy of system features and not the best use of the available hardware and software resources.

To address this problem and allow rationalisation of investments, the C2A project is aimed at developing a generic technology for interoperability (an "intelligent communicating bus"), which will allow communication and resource-sharing between embedded devices in the vehicle.

The project is structured around two main actions:

- R&D, which consists of the design, development and implementation of an embedded system prototype that allows the connection and automatic recognition of a wide range of peripheral devices.
- Dissemination, the object of which is to implement a communication protocol structured around the R&D work in the project, and involving both ICT services companies and transportation and logistics operators.

Results

Two proof-of-concept prototypes were developed in 2011. They illustrate some of the innovative features of the system, such as the automatic recognition of peripherals, the continuous monitoring of the status of available resources and the activation of simple services based on the data gathered. The prototypes have been enhanced slightly, and experimentation has shown that the core architecture needs to be redesigned in a more flexible way. This new system architecture should allow for a truly dynamic instantiation and scalable management of peripherals, signals and services. The architecture was subsequently proposed and an initial implementation of the core functionalities was performed using development libraries well suited for dynamic instantiation and effective inter-process communication. The final objective is to supply an open reference implementation of the C2A concept through a demonstrator covering a wide range of peripherals and services.

Added value for companies

C2A is a technological innovation that will enable optimised use of existing equipment in transport vehicles. ICT companies can develop new features and services by interfacing their solutions to the C2A system and accessing an extended data set. They can also implement their own services on top of the C2A architecture, or even integrate the C2A building blocks into their own solutions. As well, companies and operators in the transportation and logistics fields can deploy these new services and benefit from a flexible system well tailored to their needs, but also easily adaptable and extendable.

STANDARDS

ECS

"C2A is aimed at supplying a smart platform for interconnecting embedded equipment in transportation, enabling interoperability, efficient resource-sharing and easy ICT service deployment."

PARTNERS:
Carinna, CReSTIC/URCA, Docledge, Forem, Gunnebo, INFOPOLE Cluster TIC, Monnier Borsu Sotradel, NeXXtep Technologies, Smolinfo SPRL

ComodIT

Information System Automation

Type of project: European Commission - ERANET
CETIC Budget: €316,365
Duration: 2011-2012

Department: Software and Services Technologies
Website: www.comodit-project.eu
Contact: michael.vandeborne@cetic.be

PRIVATE CLOUD

Thanks to this ambitious project, the current and very cumbersome approach of manually managing highly distributed systems will be replaced with an integrated and scalable approach for managing such systems. ComodIT will create a comprehensive list of the underlying components of a distributed system and consolidate the parameters involved, in order to determine the optimal way to assemble them. For practical purposes, users will control their infrastructure through a central 'orchestration' unit that offers a seamless interface for managing every application and component of the Cloud, whatever the underlying operating system.

Objectives

The ComodIT project has a three-pronged objective:

- Formalise: A standardised way to describe all the requirements, methods and resources;
- Orchestrate: A single touch-point for managing resources, provisioning and configurations; and
- Automate: A platform for automating the various IT processes and for reacting to events occurring within the infrastructure.

SERVICE ORIENTED ARCHITECTURE

Results

The ComodIT project results are expected to address market needs by:

- Providing an integrated solution for simplified management of the information systems.
- Reducing the cost of installation and management of the information systems.
- Improving the overall quality of the information systems by minimising the number of human errors and increasing the coherence of the systems as a whole.
- Allowing rapid deployment of information systems to improve business flexibility, and consequently reducing time-to-market.
- Providing a new platform and commercial avenues for software vendors who intend to opt for the Software as a Service (SaaS) paradigm.

Added value for companies

As the emerging markets strive ever-greater flexibility in managing IT solutions, the ComodIT project will leverage the advantages of the Cloud Computing technologies to serve these enterprises. The key benefit of the ComodIT project results for companies will be to provide simplified, yet flexible computing solutions that can scale up to very large infrastructures, and can seamlessly support the features generally sought by SMEs (such as "on-demand" and "pay as you grow"). The simplified management of underlying computing resources will enable information systems managers to coherently add or remove virtual machines, applications or any other piece of their IT infrastructure via a simple request through the ComodIT interface. Thanks to this abstraction layer, no consideration need be given to an operating system flavour or version in order to install and configure any piece of software. This means, for instance, that a single click in the graphical user interface would open the same firewall port or install the same Web server on multiple machines, however heterogeneous they may be.

SST

> **"The ComodIT project is aimed at simplifying and securing Cloud Computing technologies by developing a new approach to automating the provisioning and management of complete and integrated IT and mobile infrastructures during their entire life cycle."**

PARTNERS:
Aurigae, Guardis, Mobile Interactiva

DEPLOY

Industrial Deployment of Advanced System Engineering Methods for High Productivity and Dependability

Type of project:	European Commission – FP7 – ICT – Integrated Project	**Department:**	Software and System Engineering
CETIC Budget:	€829,776	**Website:**	www.deploy-project.eu
Duration:	2008-2012	**Contact:**	christophe.ponsard@cetic.be

FORMAL METHODS

DEPLOY is a research project of the European Commission (FP7) aimed at promoting the use of formal methodologies in European industry and developing industrially scalable formal methods.

Objectives

The overall objective of DEPLOY is to make major advances in industrial engineering practices for the creation of dependable systems through the deployment of formal engineering methods and tools.

Industries are facing the dual challenge of mastering the development of ever more complex systems, and providing ever-higher levels of assurance. Formal engineering methods provide an answer to both these challenges through precise modelling of the system and powerful reasoning support for the models (using automated analysis tools such as theorem provers and model checkers), and subsequently via their exploitation in domain-specific models and in code generation.

Industries are now increasingly considering formal engineering methods. DEPLOY is aimed at overcoming the problems of integrating these methods into industrial development life cycles, and at presenting evidence of their overall efficiency and benefits in order to encourage their adoption.

Results

Throughout the lifetime of the project, DEPLOY methods and tools were intensively deployed in real industrial settings by the industrial partners of four major sectors, in order to test them against the industrial imperatives of cost-effectiveness, scaling and the ability to cope with the evolution of requirements. Its main outcomes are the following:

- Methodological guides and training plans, and a report on the industrial application of formal methods and tools.
- Industrial extension of the method to manage requirements, reason on dependability, and support verification and validation, primarily using proof and model-checking techniques.
- Extension of the RODIN Open Source platform, in order to respond to industrial needs in terms of robustness, interface user-friendliness and modularity.
- Production of an industrial Frequently Asked Questions section for the adoption of formal engineering methods.

Added value for companies

For our industrial partners, achieving greater system dependability is essential to maintaining the competitive edge they currently enjoy through their excellence in engineering. DEPLOY has provided a validated methodology for introducing formal engineering techniques in a controlled and measurable way, based on large-scale experiments conducted simultaneously and deployed in four major industrial sectors, whose core business is the construction of safety-critical, business-critical and mission-critical systems. Such systems require a high degree of dependability.

DEPLOY also produced a professional Open Source development environment for formal engineering methods, and because the industrial deployment partners are committed to further improvement of their development processes. That environment was built on the existing, and successful, Eclipse-based RODIN environment.

Particular engineering problems for our industrial partners include the following: the difficulty of requirements validation, the rapidly growing complexity of system testing, the difficulty of maintaining the quality and safety of systems that are evolving, and the problems caused by trying to integrate components of diverse origin. DEPLOY addressed all these issues, helping our industrial partners achieve real improvements in their engineering processes, and, in the longer term, will lead to improvements in European industrial practice generally.

SSE

> **DEPLOY is a technological answer to the increasing complexity of engineering systems, and to our increasing dependence on automated systems for critical tasks, notably in safety-critical contexts.**

PARTNERS:
Bosch, Clearsy, ETH Zurich, Newcastle University, SAP, Siemens Mobility, Space System Finland, Systerel, University of Southampton, University of Düsseldorf

PONTE

Efficient Patient Recruitment for Innovative Clinical Trials of Existing Drugs for other Uses

Type of project: European Commission – FP7 – ICT – Specific Targeted Research Project
CETIC Budget: €694,875
Duration: 2010-2013
Departments: Software and System Engineering; Software and Services Technologies
Website: www.ponte-project.eu
Contact: philippe.massonet@cetic.be

LINKED DATA SEMANTIC

To simplify and accelerate the clinical trials process, PONTE developed an IT platform to help with finding new uses for existing drugs. It will offer vital assistance throughout each stage of the process – from the moment an idea is generated through to the selection of suitable volunteers for the trial. The platform will then utilise data stored by individual hospitals to establish whether or not there are sufficient patients who meet the criteria for a trial to proceed.

Objectives

PONTE is aimed at providing a platform based on a Service Oriented Architecture (SOA) and a semantic approach that will automatically and intelligently identify patients who are eligible to participate within well specified clinical trials for drug repositioning, with specific focus on mitigating patient safety risks, reducing clinical trial costs and improving clinical trial efficacy. Working in this direction involves decision support mechanisms fed with information retrieved from a semantic search engine. That search engine operates on top of a data representation linking data stored in drug and disease knowledge databases, clinical care and clinical research information systems.

CETIC is contributing to:

- Data representation and organisation: Semantic data and metadata representations for clinical trials supporting interoperability of clinical care information system data, and enabling searching, data mining and advanced machine learning across clinical care information systems following an SOA approach.
- Semantic search: Development of a search engine based on semantic query expansion and benefitting from e-health resources already published as Linked Data.
- Standardisation activities: Continuous monitoring of the activities of e-health-related international bodies and interaction with e-health-related projects, particularly in the area of semantic interoperability between clinical research and clinical care information systems.
- Security: Definition and implementation of the specific security policies required by an e-health platform.
- Overall management, as coordinator of the project, with a focus on quality assurance tasks.

eHEALTH

Results

PONTE is progressing towards four main outcomes:

- Consistent linking of clinical research information systems with clinical care information from Electronic Health Records (EHRs) through the development of a Semantic Specification Language. An innovative ontology-based search engine able to mine information based on this semantic data representation.
- Integration of a wide spectrum of existing clinical data standards into an innovative core, ontology-driven scheme that encompasses the entire range of clinical research and clinical care processes covered in the PONTE project. Scalability is considered to be of major importance, and the proposed platform will be implemented following SOA concepts.
- Incorporation of advanced authentication and data confidentiality techniques, and exploration of techniques for providing access control and privacy protection services.
- Investigation of current legislation related to access to patient health data and use of that data for the PONTE platform, among other legal issues, all of which will guide the creation of the PONTE architecture throughout the duration of the project.

Added value for companies

SST

Data collection on drug treatments is increasingly considered to be mainly a means for evaluating the effectiveness of new medicines and pharmaceutical formulas for existing diseases and disorders, and for experimenting with existing drugs and their application to new diseases and disorders. The latter stems from the crisis that is being experienced in pharmaceutical research and the shrinking of the world economy, both of which have caused a reduction in new research funding and the practice of re-positioning existing medications for new uses.

Nevertheless, bridging the gap between basic science and clinical practice is a new scientific challenge, and one that can result in successful clinical applications at modest cost.

> **PONTE will simplify the whole clinical trials process, so that it will be easier to come up with an idea and select the right patients. As well as saving money, this will give the public quicker access to the drugs that may be able to help them.**

PARTNERS: Addenbrooke's Hospital – Cambridge University Hospitals – NHS Foundation Trust (ADDEN), Gottfried Wilhelm Leibniz Universitaet Hannover (LUH), Institute of Communications and Computer Systems / National Technical University of Athens (ICCS/NTUA), Institute of Psychophysiology and Rehabilitation of the Kaunas University of Medicine (IoPR), National Research Council – Institute of Clinical Physiology (CNR), Strategic Medicine Inc (SMI), Technische Universität Dresden (TUD), University of Athens (UoA)

S-CUBE

Software Services and Systems Network

Type of project: European Commission – FP7 – ICT – Network of Excellence
CETIC Budget: N/A
Duration: 2009-2012

Departments: Software and System Engineering; Software and Services Technologies
Website: www.s-cube-network.eu
Contact: philippe.massonet@cetic.be

CLOUD COMPUTING

The Software Services and Systems Network (S-CUBE), will help enable Europe to lead the software services revolution by establishing an integrated, multidisciplinary and vibrant research community.

Objectives

The S-CUBE project, which is expected to have a long-lasting impact on European research, will pursue the following objectives:

- Re-align, re-shape and integrate the research agendas of key European players from different research areas. By synthesising and integrating diversified knowledge, an enduring foundation for steering research and for achieving innovation at the highest level will be established.
- Inaugurate a Europe-wide common programme of education and training for researchers and for industry. This will create a common culture that will have a profound impact on the future of the field.
- Establish a proactive mobility plan to enable cross-fertilisation, which will foster the integration of research communities and the establishment of a common software services research culture.
- Establish trust relationships with industry. European Technology Platforms (specifically NESSI) will have a catalytic effect on shaping European research, strengthening industrial competitiveness and addressing the main societal challenges.
- Define a broader research vision and perspective. This will shape the software services-based Internet of the future, as well as accelerate economic growth and improve the living standards of European citizens.

Results

The main outcomes of the project are the following:

- S-CUBE Publications, which is a browsable repository of S-CUBE publications and deliverables.
- Public deliverables, published by the S-CUBE consortium (including abstracts and full-text articles), grouped according to the work packages that released them.
- S-CUBE Case Studies, which is a collection of S-CUBE case studies in services engineering.

CETIC contributes to the area of quality-driven and adaptable service composition and service composition models. The aim is to integrate security and service monitoring research challenges into S-CUBE activities.

Added value for companies

The S-CUBE project is motivated by the need to integrate research expertise, and a strong collaboration of researchers in the field of software services and systems is required to address the following key issues:

- Research fragmentation: Every research community (e.g. Cloud Computing, software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result, the solutions proposed are not aligned with, or influenced by, activities in related research fields.
- Future challenges: One example is building service-based systems in such a way that they can self-adapt, while guaranteeing the desired level of service quality. Self-adaptation may be required as a result of changes in a system's environment, for example, or in response to predicted and unpredicted problems.

SST

SSE

> **S-CUBE will help enable Europe to lead the software services revolution, in turn helping to shape the software services-based Internet that will form the backbone of our future interactive society.**

PARTNERS: Centre for Scientific and Technological Research, City University London, Consiglio Nazionale delle Ricerche, The French National Institute for Re- search in Computer Science and Control, Lero – the Irish Software Engineering Research Centre, MTA SZTAKI – Computer and Automation Research Institute, Tilburg University, Universidad Politécnica de Madrid, Université Claude Bernard Lyon, University of Crete, University of Duisburg-Essen, University of Stuttgart, University of Hamburg, Vienna University of Technology, Vrije University (Amsterdam)

SPES

Support Patients through eService Solutions

SUPPORT PATIENTS THROUGH E-SERVICE SOLUTIONS

Type of project: European Commission - ERDF
CETIC Budget: €206,906
Duration: 2011-2014

Departments: Embedded and Communication Systems; Software and System Engineering; Software and Services Technologies
Website: www.spes-project.eu
Contact: valery.ramon@cetic.be

eHEALTH

Telemedicine is one of the main sectors that can help support greater social cohesion in Europe. It is expected that cooperation with international partners will lead to innovative and shared solutions in this field, in turn contributing to geographical integration of the partners involved. Success in this endeavour will aid in the deployment, testing and adoption of scalable and portable e-health instruments at the regional/local level, which is becoming a priority for health service providers.

Objectives

SPES is aimed at transferring the approach and results achieved in the OLDES project (www.oldes.eu), in order to implement an e-health and entertainment platform in the province of Ferrara (Italy), the city of Vienna (Austria), the city of Brno (Czech Republic) and the city of Kosice (Slovakia), focusing on the following health issues: respiratory problems, dementia, disabilities and social isolation respectively.

OLDES was funded by the EU 6th Framework Programme (FP6) to develop a new technological solution designed to ease the life of the elderly in their homes by creating a platform capable of providing them with an easy-to-use entertainment and health care platform. This platform is based on a low-cost computer and a highly user-friendly graphical user interface, providing the patient with an entertainment system that interacts with a call centre through a central server, and a telemedicine system that collects medical data through sensors (glucometer, ECG belt, etc.) installed in the senior's home.

At the same time, SPES patients will have the opportunity to test an easy-to-use telemedicine solution designed to reduce their displacement costs and the time required to visit health care service providers (hospitals, physicians, medical centres), while improving the quality of their daily lives (notably by giving them independence) and their general well-being.

Results

At this stage of the project, CETIC has defined the Software Requirements Specifications (SRS) for the generic SPES platform, as well as the specifications for each of the pilots.

Added value for companies

Telemedicine favours the emergence of a completely new market of health care service providers, mainly consisting of SMEs that can play a major role in supporting the delivery of health care in the future through the provision of health and social care at home. By raising the level of competitiveness of the regions involved, SPES will also encourage local authorities to adopt ICT solutions that are replicable and generalisable by other actors.

ECS

WIRELESS TECHNOLOGIES

> **SPES is aimed at transferring the approach and results achieved in the implementation of the OLDES project to support patients in four European locations through eService solutions specially tailored to manage respiratory problems, dementia, disabilities and social isolation.**

PARTNERS:
ENEA, Province of Ferrara, AUSL – Local Health Authority of Ferrara, CUP2000 SPA, FSW – Vienna Social Fund, University of Vienna, City of Košice, Technical University of Kosice, Czech Technical University in Prague, Pro DEEP

STRUCTURED COLLABORATIONS

CETIC Partners

Collaborative work exchanges with key partners is at the heart of CETIC's activities.CETIC constantly aims to collaborate with its partners in a sustainable way, in order to share and enrich their respective expertise through common projects.

Technology Guidance

Technology guidance at CETIC consists of contributing to the efficient technology transfer from this applied research centre to Walloon SMEs.

Trapist

IT for transportation and logistics companies

Objectives

Trapist is a technological guidance project for transportation and logistics companies. In an industrial sector that is constantly evolving, it is critically important to implement up-to-date technologies to meet new challenges and stay competitive. Initiated by Wallonia, the project was awarded to two research centres, Multitel and CETIC, which are jointly responsible for providing their expertise and transferring it to interested companies. As a partner in the project, CETIC focused its work on road transportation and embedded systems in the transport vehicle cabin.

Transfer of Expertise to SMEs

Among the companies that received guidance, Market-IP was supported by CETIC in optimising its applications (geography-based marketing, fleet management and planning, and GPS tracking). In addition, various analyses of standards, technologies, architectures and equipment where conducted for our industrial partners to help them achieve their goals. For example, we studied ways to track goods in a multimodal transportation context.

Collaboration with Research Centres

As part of this support activity, a collaboration between CETIC and the Road Research Centre led to the study of a new system of truck data processing involving the curviamètre, which is a device that measures the resistance of the road surface to pressure, and indirectly the level of road wear. CETIC prototyped the data post-processing chain for this system.

WallisTIC

ICT for SMEs

Objectives

The WallisTIC technology guidance project is aimed at helping Walloon SMEs adopt new technologies and integrate them into their processes, products and services. Six main areas of ICT expertise are covered for the technological transfer developed: Service-oriented technologies, Software engineering, Open Source, Internet of things, Wireless networks, IPv6, Applied networks.

Transfer of Expertise to SMEs

To accelerate Wallonia's economic growth, Walloon SMEs in all sectors should integrate the latest ICT into their operations whenever possible, as these technologies are at the heart of competitiveness and productivity. Importantly, these companies can be helped in the adoption process by Wallonia's ICT applied research centres.

Collaboration with Research Centres

Both MULTITEL and CETIC are collaborating on this project.

ConstrucTIC

Fostering the use of ICT in the building industry

Objectives

ContrucTIC is aimed at fostering the use of Information and Communication Technologies in the building industry. Several topics are covered:

- Connected and mobile solutions: Making ICT information available to building contractors on-site, including technical files.
- Solutions for optimising the allocation of resources: Simplifying the transfer of information between construction sites and company offices (dispatching and reporting), geo-localisation of equipment.
- Solutions for optimising execution time: Planning the various activities and resources of the company.
- Harmonisation of practices among the various actors, all along the building value chain.
- Optimisation of internal processes in the design phase, ordering, the purchasing process, preparation and the execution of the construction work.
- Project portals and document management: Allowing collaborative management among the various project stakeholders.

Transfer of Expertise to SMEs

This technological guidance targets Walloon companies active in the building industry, especially SMEs. The experts at applied research centres ensure specific technical support for the innovative use of ICT, based on their sectors (buildings, roads, IT). In addition, many companies in the construction and civil engineering fields, as well as in the building trades, and the ICT companies serving them have been contacted, with a view to organising workshops to include representatives from both the building industry and ICT companies, in order to facilitate the exchange of best practices and the alignment of supply and demand.

Collaboration with Research Centres

This guidance brings together the Belgian Building Research Institute (as coordinator), the Belgian Road Research Centre and CETIC, and made it possible for us to share and leverage technology watch activities, analyse concrete use cases and forecast the technology needs of the targeted sector.

ACCORD-Wallonie, Research Dedicated to Industry

ACCORD-Wallonie is the organisation that incorporates Wallonia's 22 accredited research centres, including CETIC:

- CEBEDEAU
- CELABOR
- CENAERO
- CENTEXBEL
- CER Groupe
- CERTECH
- CETIC
- CEWAC
- CORI
- CRIBC
- CRIC-OCCN
- CRM Group
- CRR
- CSTC
- CTIB-TCHN
- CTP
- IBS
- IMMUNE
- HEALTH
- INISMa
- MATERIANOVA
- MULTITEL
- SIRRIS

Its role is to drive research to support Walloon SMEs, providing them with easy access to all the competencies of the ACCORD-Wallonie research centres.

ACCORD-Wallonie offers technological guidance for the following sectors covered by the research centres: bio-industry, health, material coating processes, durable construction, transportation, ICT, and environment, recycling and energy. The organisation wants to help SMEs address the industrial and economic issues facing these sectors.

More information: www.accord-wallonie.be

Walloon Competitiveness Clusters Facilitate Exchange and Partnership

A Competitiveness Cluster is a grouping of companies, training centres and public or private research units in a leading sector of the economy covering a particular geographical area of Wallonia. CETIC actively collaborates with Walloon Competitiveness Clusters in order to align R&D directions and objectives with industry needs.

The Cluster members commit to a partnership-based approach intended to generate synergies with respect to common projects of an innovative nature. These partnerships are structured around a market and the related technological and scientific fields, and must achieve the critical mass needed for competitiveness and international visibility that will enable them to develop a virtuous circle of growth. These are the Competitiveness Clusters:

- Logistics in Wallonia: transportation and logistics
- Skywin: aerospace
- GreenWin: innovation in green chemistry and durable materials
- BioWin: health
- WagrALIM: the food industry
- Mecatech: mechanical engineering

More information: www.polesdecompetitivite.eu

ICT EQUIPMENT

To be effective, methodological research must be supported by state-of-the-art tools. Also, the barriers that prevent Walloon companies, especially SMEs, from benefitting from the high-quality returns such tools generate, need to be removed: ignorance of the existence of tools, acquisition costs, infrequency of use, complexity of installation and learning curve, for example. The aim of the support project, ICT Equipment, is to break down those barriers by providing access to state-of-the art tools and the associated consulting and support services.

ICT Equipment consists of:

- a **Software Engineering Lab**, equipped with software development tools;
- a **Wireless Lab**, equipped with software and hardware tools for the design and test of wireless systems;
- a **Cluster** infrastructure, for experimenting with large scale distributed systems.

The tools and equipment for the labs were selected based on their industrial significance, and that choice was verified by the CE-IQS project partners prior to acquisition. They are all subject to continuous evolution and upgrades.

Public calls to tender were issued for this set of tools and equipment. The tools were deployed in the labs and the teams concerned acquired the training necessary for their use through the implementation of specific prototypes related to real industrial cases. These studies allowed them to check their level of mastery of the tools and to produce documentation to facilitate their use by our industrial partners. Several preliminary studies were undertaken in collaboration with Walloon enterprises to define the standard services to be offered in association with this equipment.

SOFTWARE ENGINEERING LAB

This lab focuses on advanced tools for code analysis, targeting specific properties such as security (absence of vulnerabilities, e.g. Fortify), reliability (absence of run-time errors, e.g. Polyspace) and maintainability (quality of architecture, documentation, complexity, e.g. CAST). These tools rely on advanced analysis techniques, such as static analysis and abstract interpretation. This lab also features mainstream requirements engineering, business modelling, testing and effort estimation tools.

WIRELESS LAB

This lab focuses on the new wireless technologies associated with multiple electronic technologies that make the choice of an appropriate solution so difficult. CETIC selects software and hardware tools encompassing all the emerging technologies for the Wireless Lab, especially those related to new protocols and standards introduced to increase throughput, improve range, reduce power consumption and optimise performance trade-offs.

Several tools were acquired in 2009 for the Wireless Lab for the modelling, simulation, design and test of embedded systems (hardware and software): an advanced software environment, high-bandwidth oscilloscopes, an advanced signal generator and several protocol sniffers. A CAN bus simulator and a number of telecommunication systems complemented these tools in 2010. Advanced development kits for FPGAs and wireless transceivers were added in 2011. All these tools are now fully operational, and CETIC engineers have been trained to make the best use of all the available features.

DISTRIBUTED ARCHITECTURE CLUSTER

Since 2006, CETIC has operated a cluster with a Cloud Computing-oriented architecture. Within the scope of the SINUS project (Convergence Objective), CETIC acquired a new Distributed Architecture Cluster in which flexibility and virtualisation are favoured over raw computing power. The new equipment is the platform on which the tools in the Software Engineering Lab run, and it is also the live test bed for experimentation in Cloud Computing and other distributed system applications, like SOA. The cluster is heavily used internally for CETIC's research projects, but is also available for experimentation conducted by its partners and other enterprises.

PUBLICATIONS

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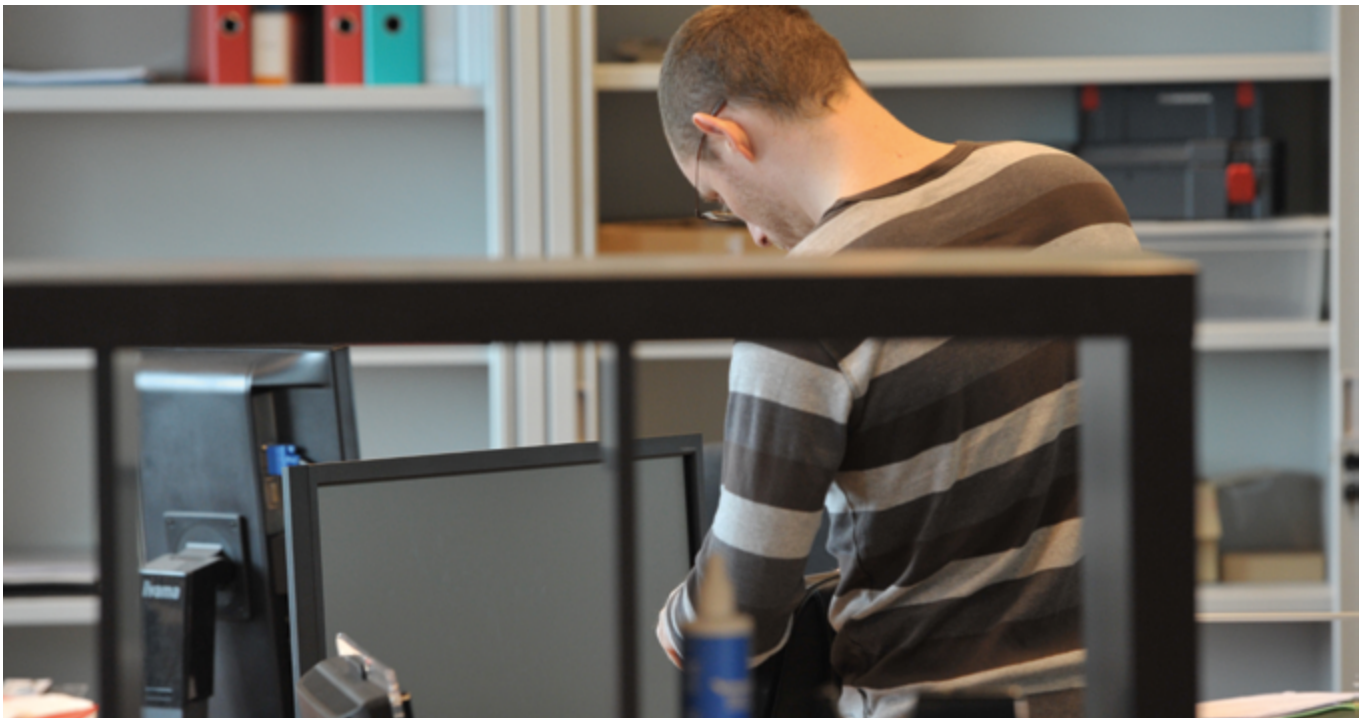
- Benny Rochwerger, David Breitgand, Amir Epstein, David Hadas, Irit Loy, Kenneth Nagin, Johan Tordsson, Carmelo Ragusa, Massimo Villari, Stuart Clayman, Eliezer Levy, Alessandro Maraschini, Philippe Massonet, Henar Muñoz, Giovanni Toffetti, RESERVOIR – When One Cloud Is Not Enough, Computer, vol. 44, no. 3, pp. 44-51, doi:10.1109/MC.2011.64, February 2011
- Raphaël Michel, Andreas Classen, Arnaud Hubaux and Quentin Boucher, A Formal Semantics for Feature Cardinalities in Feature Diagrams, Fifth International Workshop on Variability Modelling of Software-intensive Systems, Namur (BE), January 27-29, 2011



DISSEMINATION

CETIC organised the following events in 2011 in Belgium:

- November 8 – as a member of ACCORD-Wallonie, a networking session to promote the Walloon research centres' Technology Guidance activities
- October 6 – with the INFOPOLE Cluster TIC, a workshop to discuss the opportunities of B2B mobile applications
- May 26 – an event to celebrate its 10th anniversary and promote the technology transferred to SMEs in Wallonia
- April 28 – with the INFOPOLE Cluster TIC, a workshop to discuss the transfer of semantic technologies to industry
- March 22 – with the INFOPOLE Cluster TIC, a workshop to discuss trust and security in the transportation and logistics sector
- March 17 – in collaboration with Walloon Open Source partners, Open the Source II
- March 1 – with the INFOPOLE Cluster TIC, a workshop to discuss OpenNebula and Cloud Open Source management
- January 27 – with the INFOPOLE Cluster TIC, a workshop to discuss the EXTRA project and knowledge management

CETIC contributed to the following fairs and events in 2011:

- December 6 – CETIC presentation at the Wireless Community meeting (BE)
- December 6 – CETIC presentation at the Innovation Convention (BE)
- December 1 – CETIC presentation at the Outsourcing Workshop (BE)
- November 29 – CETIC contribution to PICARRE IP training (BE)
- November 23 – CETIC presentation at the IP-Forum AWT/Aastra (BE)
- November 23 – CETIC presentation at the S-CUBE meeting (ES)
- November 22 – CETIC stand at ConstrucTIC Technology Guidance (BE)
- November 22 – CETIC presentation at the LVL HMI Meeting 2011 (BE)
- November 21– CETIC contribution to CloudCamp (BE)
- November 17 – CETIC contribution to Innov'action (BE)
- November 15 – CETIC contribution to 'Digital Preservation and Access to Cultural Resources' (LU)
- November 11 – CETIC tutorial at Software Services and Cloud Computing training (RO)
- November 10 – CETIC participation in the BioWin information day (BE)
- October 31 – CETIC presentation at ER'2011 (BE)
- October 27 – CETIC contribution to Meet & Match 2011 (BE)
- October 26 – CETIC presentation at eChallenges (IT)
- October 20 – CETIC presentation at Patient Numérique (BE)
- October 17 – CETIC contribution to the opening of Garocentre (BE)
- October 17 – CETIC presentation at the workshop on ontology and taxonomies for critical infrastructures (BE)
- September 30 – CETIC presentation at the Digital Innovators Tour (BE)
- September 30 – CETIC presentation at the Cloud Law or Legal Cloud Conference (BE)
- September 29 – CETIC presentation at the Internet of Services event (BE)
- September 26 – CETIC contribution to ISC Cloud 2011 (DE)
- September 22 – CETIC presentation at the Network and Information Security Workshop (BE)
- September 22 – CETIC contribution to the AST's AGORA (BE)
- September 15 – CETIC presentation at Jeudis du Libre on Open Source solutions for companies (BE)
- September 12 – CETIC contribution to ESORICS 2011 (BE)
- September/October – CETIC participation in the EC's Info Days (EU)
- August 21 – CETIC contribution to DEPEND 2011 (FR)
- July 11 – CETIC presentations at RMLL2011 (FR)
- July 7 – CETIC presentation at the Summer School on Ontology and Semantics (ES)
- June 30 – CETIC presentation at the NCP Workshop (BE)
- June 24 – CETIC presentation at Formal Methods 2011 (IR)
- June 16 – CETIC contribution to the INFOPOLE Cluster TIC GA (BE)
- June 12 – CETIC presentation at the SAT/SMT Solver Summer School (USA)
- June 9 – CETIC presentation at the SMIG Workshop (BE)
- June 8 – CETIC presentation at the AWT M-Forum (BE)
- June 6-7 – CETIC participation in the EU Summit on the Future Internet (BE)
- June 5-9 – CETIC presentation at ICC 2011 (Japan)
- May 30 – CETIC presentation at Lab'InSight (BE)
- May 24-26 – CETIC presentation at the DEPLOY meeting (FR)
- May 22-27 – CETIC contribution to ISO-JTC1-SC7 (FR)
- May 26 – CETIC presentation at INFORSID 2011 (FR)
- May 19-20 – CETIC presentation at ICT Proposers' Day (HU)
- May 17-19 – CETIC contribution to the PONTE review meeting (BE)
- May 12 – CETIC presentation at the Music Linked Data Workshop (UK)
- May 5 – CETIC contribution to the Belnet Security Conference (BE)
- May 4 – CETIC contribution to the REWIC panel (BE)
- April 27 – CETIC presentation at the MIC's e-Health round table (BE)
- April 12-14 – CETIC presentation at the PONTE meeting (NL)
- April 6-8 – CETIC presentations at Med-e-tel 2011 (LU)
- April 5 – CETIC presentation at the Software Test Day (FR)
- March 29-30 – CETIC presentation at INNOVACT (FR)
- March 11 – CETIC presentation at CENTAL (BE)
- March 3 – CETIC contribution to OpenESB Day (FR)
- February 17 – CETIC contribution to the DSPValley network meeting (BE)
- February 10-11 – CETIC contribution to the Future Networks 2011 Concertation Meeting (BE)
- February 3 - CETIC participation in the Pôle Hainuyer Scientific Day (BE)
- February 1-2 – Meeting for research centres from Finland and Belgium, including CETIC (FI)
- January 27-29 – CETIC sponsorship of VaMoS2011 (BE)
- January 27-28 – CETIC organisation of RESERVOIR/OpenNebula training (BE)
- January 27 – CETIC success story presentation at the SPW/NCP Info Day (BE)
- January 25-27 – CETIC contribution to Computers, Privacy and Data Protection (BE)
- January 19-20 – CETIC contribution to IT@NetworkingAwards 2011 (BE)

CETIC has extended the publication of its newsletter to include a blog format, available online at www.cetic.be.

In 2011, CETIC published four press releases, gave more than ten interviews and collected over 30 press clippings.

ACRONYMS

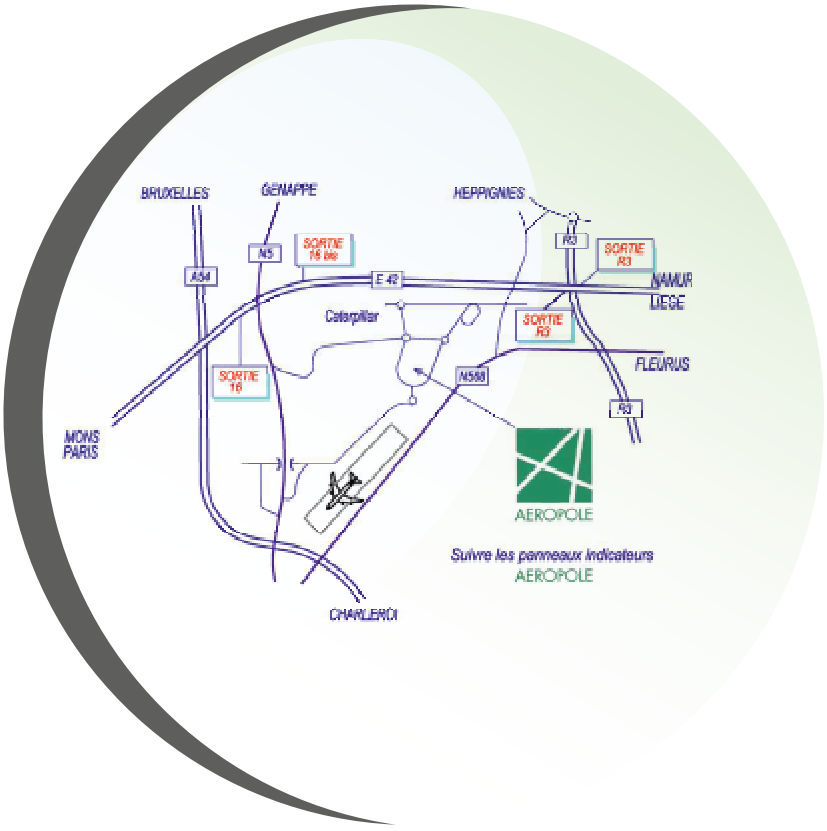
- ASBL: Association Sans But Lucratif – Non-profit organisation
- API: Application Programming Interface
- BSM: Business Service Management
- CAN/FMS: Control Area Network/Fleet Management System
- CED: Cloud Encryption Device
- CETIC: Centre d'Excellence en Technologies de l'Information et de la Communication – Centre of Excellence in Information and Communication Technologies
- CE-IQS: Centre d'Expertise en Ingénierie et Qualité des Systèmes – Centre of Expertise in Engineering and Quality Systems
- CELLAVI: Centre d'Expertise en Logiciel Libre à Vocation Industrielle – Centre of Expertise in Open Source Software
- CMM: Capability Maturity Model
- CMMI: Capability Maturity Model Integrated
- CNR: Consiglio Nazionale delle Ricerche
- CReSTIC: Centre de Recherche en Sciences et Technologies de l'Information et de la Communication
- CRM: Customer Relationship Management
- CRID: Research Centre on IT and Law
- CUH: Cambridge University Hospitals
- DRNN: Dynamic Recurrent Neutral Network
- EC: European Commission
- ECS: Embedded and Communication Systems
- EEG: Electroencephalogram
- EMG: Electromyogram
- ERP: Enterprises Resource Planning
- ESB: Enterprise Service Buses
- EU: European Union
- FEDER/ERDF: Fonds Européen de Développement Régional – European Regional Development Fund
- F/OSS: Free and Open Source Software
- FP6: Sixth Framework Programme
- FP7: Seventh Framework Programme
- FPGA: Field Programmable Gate Array
- FUNDP: Facultés Universitaires Notre-Dame de la Paix de Namur
- GPRS: General Packet Radio Service
- GSM: Global System for Mobile Communication
- GUI: Graphical User Interface
- HDL: Hardware Description Language
- HMI: Human-Machine Interface
- IaaS: Infrastructure as a Service
- ICS: Intelligent Content and Semantics
- ICT: Information and Communication Technologies
- IGRETEC: Intercommunale pour la Gestion et la Réalisation d'Etudes Techniques et Economiques
- IoPR: Institute of Psychophysiology and Rehabilitation of the Kaunas University of Medicine
- IP: Internet Protocol
- IP: Integrated Project
- IS: Information Services
- ISO: International Organisation for Standardisation
- ISO/IEC 15408: Common Criteria for Information Technology Security Evaluation
- IST: Information Society Technology
- ISV: Independent Software Vendor
- IT: Information Technology
- KM: Knowledge Management
- LUH: Gottfried Wilhelm Leibniz Universitaet Hannover
- NTUA: National Technical University of Athens
- OCCI: Open Cloud Computing Interface
- OSLC: Open Services for Lifecycle Collaboration
- OVF: Open Virtualisation Format
- OWPL: Observatoire Wallon des Pratiques Logicielles
- PaaS: Platform as a Service
- PALLAVI: Plate-forme d'Accueil pour le Logiciel Libre à Vocation Industrielle
- PCB: Printed Circuit Board
- QMS: Quality Management System
- R&D: Research and Development
- R&D&I: Research and Development and Innovation
- RE: Requirements Engineering
- SaaS: Software as a Service
- SLA: Service Level Agreement
- SME: Small or Medium-sized Enterprise
- SMI: Strategic Medicine Inc
- SOA: Service Oriented Architecture
- SOC: Service Oriented Computing
- SOI: Service Oriented Infrastructure
- SOKU: Service Oriented Knowledge Utility
- SPL: Software Product Line
- SPW: Service Public de Wallonie
- SSE: Software and System Engineering
- SST: Software and Services Technologies
- STREP: Specific Targeted Research Projects
- TSP: Trust, Security and Privacy
- UCL: Université catholique de Louvain
- ULB: Université Libre de Bruxelles
- ULg: University of Liège
- UML: Unified Modelling Language
- UMONS: Université de Mons
- VHDL: Very High Speed Hardware Description Language
- VO: Virtual Organisation
- VOIP: Voice Over Internet Protocol
- VSE: Very Small Enterprise
- WPAN: Wireless Personal Area Network

CONTACTS

cetic
Your Connection to ICT Research

CETIC
Aéropole de Charleroi-Gosselies
Bâtiment Éole
Rue des Frères Wright, 29/3
B-6041 Charleroi
Tel: +32 71 490 700 Fax: +32 71 490 799
VAT No. 0474 549 932

www.cetic.be - info@cetic.be



ANNUAL REPORT 2011

CENTRE OF EXCELLENCE IN INFORMATION AND COMMUNICATION TECHNOLOGIES

Your Connection to ICT Research

CETIC
Aéropole de Charleroi-Gosselies
Bâtiment Éole
Rue des Frères Wright, 29/3
B-6041 Charleroi
Tel: +32 71 490 700 Fax: +32 71 490 799
VAT No. 0474 549 932

www.cetic.be - info@cetic.be

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