

ABOUT CETIC

As an applied research centre in the field of ICT, CETIC's mission is to support economic development by transferring the results of the most innovative research in ICT to companies, particularly SMEs. The knowledge developed by CETIC is made available to companies to help them integrate these technological breakthroughs into their products, processes and services, enabling them to innovate faster, save time and money and develop new markets.

CETIC is continuously expanding its expertise through its active involvement in European and regional research projects.

CETIC is a non-profit organisation, accredited as Applied Research Center by the Walloon authorities.

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

CETIC is located on the Aeropole of Charleroi in Wallonia, Belgium.

CETIC was founded in 2001 by the Université catholique de Louvain (UCL), the University of Namur (UNAMUR) and the University of Mons (UMONS).



CETIC'S RANGE OF EXPERTISE

THE SUCCESS OF AN ICT PROJECT DEPENDS ON:	CETIC'S RANGE OF EXPERTISE	
The use of proper practices in order to meet requirements, budget and timing	Methodological research, with a view to enhancing the quality, efficiency, security and safety of new and increasingly complex ICT systems. CETIC helps IT companies to produce high quality software products and services. It focuses on the use of lightweight approaches specifically adapted to SMEs, while ensuring compliance with international standards.	Software Quality (SSE department)
Proper choices amongst rapidly evolving Information Technologies	CETIC provides companies with advanced technological expertise by taking advantage of the newest distributed, dynamic and web-oriented architectures, which strongly impact the way software and data are assembled, deployed and managed. CETIC helps companies in the adoption of new paradigms such as Cloud Computing and Big Data.	Future Internet (SST department)
The ability to exploit the huge potential of numerous smart connected objects around us	CETIC has developed exceptional prototyping skills in embedded systems and wireless technologies to help industry build new and innovative products.	Internet of Things (ECS department)

HOW TO WORK WITH CETIC

CETIC is a trusted and skilled partner in research and innovation in the application of ICT in various fields of expertise. For each assignment with a company, CETIC will put together a multi-disciplinary team dedicated to understanding its unique requirements and delivering what is required to achieve the defined goals.

Companies can collaborate with CETIC in 3 different ways:

Innovation (R&D&I) Activities

CETIC offers its expertise to companies wishing to externalise or needing assistance to integrate breakthrough technologies into their R&D&I process. Activities include knowledge transfer and consulting, feasibility study, design and engineering, proof-of-concept, prototyping and testing. CETIC helps its customers reducing risk and accelerate time to market for new growth opportunities.

Financing Innovation

An SME conducting R&D activities and which is ready to innovate can quickly obtain simple and flexible financial support through several funding instruments offered by local authorities.

- For SMEs established in Wallonia, the most efficient and lightweight instrument are the technology vouchers provided by the Agence de Stimulation Technologique (AST). When working with an accredited research centre like CETIC, an SME is eligible for reimbursement by Wallonia of up to 75% of the total cost of R&D through the Chèques Technologiques program. These technology vouchers are available up to a maximum amount of €20,000 per SME annually. Further information about these vouchers can be found at www.ct.innovons.be.
The software feasibility studies from the regional research administration (DG06), also provide up to 75% of required funding.
- Brussels-based SMEs can benefit from regional funding for their R&D activities as well. Funding is available from INNOVIRIS, the Brussels Institute for Research and Innovation.
- CETIC is also accredited 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.

Regional and Collaborative Research Projects

Another means for companies to innovate is to set up collaborative research projects. One of CETIC's goals is to involve companies, especially SMEs, in collaborative R&D programs funded by European and regional authorities, strengthening their market position, and helping them improve their existing products and acquire new expertise.

Setting up Collaborative Research Projects

CETIC offers its comprehensive experience in building projects, large and small, from proposal elaboration to setting up and coordinating consortia. CETIC has an excellent track record in the context of competitive calls for proposals, such as FP7, ERANET, or Competitiveness Clusters, for example.

Trusted Third-Party Auditing and Advice

As a research centre and non-profit organisation working in close proximity to academic institutions, CETIC is often asked by public and private organizations, from its neutral point of view, to:

- Help with needs identification, choosing technologies and suppliers, contract follow-up, evaluation of software development costs, etc.
- Conduct technological and methodological audits of software product and development life cycle processes, and providing recommendations on the adoption of best practices, architectural change, code refactoring, etc.
- Escrow procedure, including source code quality assessment, replication of the tool chain,...
- Provide support as regards the adoption of software related norms and standards, in order to anticipate a possible certification process.

Business Ethics

While performing technology transfer, CETIC takes all possible measures:

- to protect IP between companies potentially competing with each other. By applying strict confidentiality rules, and focusing on the technology, CETIC lets companies develop their own competitive advantage in their business field.
- to avoid any conflict of interest between CETIC itself and ICT providers. Especially, CETIC does not deliver mainstream software products. Any state-of-the-art proof-of-concept made by CETIC is transferred to the company itself, if it has internal IT skills, or to their chosen ICT provider. CETIC does not operate or maintain any software product.

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

SOFTWARE QUALITY

Helping Enterprises Reach Higher Levels of Quality
in Their Software Development Processes and Products

Creating high quality software on time and within budget is a risky endeavour. If this risk is not well managed, major rework and maintenance costs will be incurred. With its strong software engineering expertise and its status as trusted third party, the **Software and System Engineering (SSE)** department actively helps organizations effectively manage the software product development and maintenance life-cycle.

CERTIFICATION AND STANDARDS

Certification is required in a number of industrial domains as a condition for accessing a particular market or to comply with regulatory provisions. However, integrating certification constraints into a development process can result in very large overheads.

Mastering the certification process is not a trivial task, and requires knowledge of the standard concerned and how to integrate it into the software life-cycle.

CETIC is actively developing expertise and experience in these areas (IEC 62304 for medical devices, EN-50128 for railways, DO-178B for avionics, Common Criteria for security), as well as mastering a number of support tools, providing the organisation with the necessary independent insight on the best standards to integrate and how to achieve certification with minimum overhead in their business context. The SAT project (see project portfolio), for example, is developing incremental certification support.



SOFTWARE BEST PRACTICES ASSESSMENT

Software process models like CMMI and ISO/IEC12207 are designed to improve software product quality through better processes. For SMEs and VSEs, however, these standards are too expensive to implement. Most cannot afford the resources, in terms of employees, cost or time, or see a net benefit in establishing software life cycle processes. To overcome these difficulties, a dedicated standard, ISO/IEC 29110 (i.e. Software Lifecycle for Very Small Entities) has been developed and published.

CETIC, a key contributor to this new ISO/IEC 29110 standard, has extensive expertise in the assessment of application development practices, and has created a lightweight process assessment to demonstrate their process maturity to its customers and to efficiently improve their own practices.

SOFTWARE CODE QUALITY

Business demands, time-to-market pressures and resource constraints drive development teams to make trade-offs. These trade-offs have a direct impact on the quality of software design and code, and, if they are ill-considered, they can result in structural risks to an application, increased development and maintenance costs, and loss of market share.

For the past decade, CETIC has acquired extensive expertise in the application of quality models based on ISO9126/SQuaRE that is the foundation of its toolled application code analysis expertise with targeted quality attributes, such as maintainability, security and reliability. CETIC has also developed specific quality models and tool chains for Open Source ecosystems and security critical applications.

Using CETIC's methodology and best-of-breed tooling, the quality of an application is measured in terms of cumulative technical debt, an expression which quantifies the cost of the non-quality of an application and is a figure on which both manager and developer can agree.

This expertise enables companies to monitor and control the structural quality of their applications cost-effectively, without significant impact on the delivery cycle. Direct benefits include a lower cost of delivered projects, better time-to-market and increased team productivity. The customer is then able to install a quality gate in order to control application delivery. From the supplier side, this is the opportunity to set up a long-lasting relationship of trust with their customers. It also provides better risk control over the IT maturity of new businesses.

SOFTWARE DEVELOPMENT SIZING

Many projects fail because their development effort has been incorrectly sized. This has a major impact on the project's organisation and schedule. The risk of failure is even greater in the outsourcing market: for the customer, who expects a high-quality product having the required functionalities to be delivered on time; and for the supplier, who must satisfy customer needs while achieving a reasonable profit margin.

CETIC's expertise in this area is founded on COSMIC (ISO/IEC 19761), a widely used method for estimating software functional size. The COSMIC function point estimation method is based on objective criteria. It allows measures to be repeated, and it is applicable to requirements documents early in the software life-cycle. Using the ISBSG project cost database, the functional size generated by COSMIC is then converted into development effort. With these estimates, project managers can plan and budget their development projects more accurately.



REQUIREMENTS ENGINEERING AND SYSTEM MODELLING

Poor requirements gathering and modelling practices are all too common in enterprises, and they lead to poor effort estimates, costly requirements and design-related bugs, and more laborious testing and acceptance, which ultimately put project success at risk.

CETIC's expertise in Requirements Engineering and System Modelling covers the whole spectrum of methods and application contexts. Lightweight methods combining structured templates and UML-based notations provide a good level for SME and in non-critical application domains. Model-based approaches help in automating specific development steps and provide greater design assurance. They also support business decision-making and process optimisation, especially in the medical and logistics domains (PIPAS, BEM and SimQRI: see project portfolio). CETIC has developed a specific expertise and Open Source toolset for the optimisation which is able to efficiently manage large business systems. They also enable a software product line approach (CALiPro), the development of greener IT systems (ASCETIC) and more efficient Human-Computer Interfaces (QualiHM) (see project portfolio). Finally, fully formal models enable a deep reasoning on the system as required in specific safety critical domains such as transportation.

CETIC advises organisations regarding the best methods and tools to adopt in order to achieve the best return on investment, properly manage risks in this process and achieve better governance.

SECURITY ENGINEERING AND ASSESSMENT

Today, IT system and software security has become critically important, because increasingly sophisticated technologies and ever-greater interconnectivity is empowering malicious users whose actions can have a dramatic impact on the privacy of both enterprises and individuals. Security expertise addresses these concerns specifically, throughout the software engineering life-cycle, with audit based security requirements engineering, security policy modelling, secure architecture design, security-oriented code analysis and preparation for security certification, such as the Common Criteria.



FUTURE INTERNET

Exploiting Distributed Resources,
Giving Meaning to Data

The **Software and Services Technologies (SST)** department covers key areas shaping the Future Internet: Service-Oriented Architectures (SOA) – also known as the Programmable Web, Cloud Computing, Semantic Web, Big Data and Open Source software technologies.

CETIC helps companies to take advantage of the latest trends and technological advances in these fields and in particular to build scalable and flexible applications and infrastructures.

SEMANTIC WEB RESOURCES

Exploiting Semantic Web resources is about linking together the increasingly large amounts of unstructured data and annotating them with meaningful information.

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

These skills have been used to analyze information extracted from the Internet in Deciweb

In PONTE (see project portfolio), CETIC studied and modelled several health-related data sources as ontologies, and published them on a Web platform, making them available for consultation and linking.



SECURITY IMPLEMENTATION AND DEPLOYMENT

Threats to IT infrastructure are growing at a time when companies are increasingly required to provide access to their data and resources. To maximise security, CETIC has developed expertise on the PEP-PDP architecture, in which Policy Enforcement Points (PEP) are melded into the infrastructure middleware to intercept user requests and query the Policy Decision Point (PDP) engines that make decisions on accessing and using the requested resources.

In I2MSteel, CETIC evaluated the use of the PEP-PDP security implementation of software service applications in steel industry. Feedback from this usage case allows CETIC to advise on deployment of PEP-PDP security framework in industrial contexts.

CETIC will continue its efforts to improve decentralised security architectures, in order to develop the capability of modelling ever more advanced access-control techniques.

CLOUD INFRASTRUCTURE MANAGEMENT

CETIC masters Open Source Cloud infrastructure managers, as well as open standards for infrastructure definition and interoperability. Cloud infrastructure managers are used to aggregate local and remote IT resources in order to provide scalable infrastructures as a service (IaaS).

In the SaaS-WMS project (see project portfolio), CETIC started implementation of self-adaptation of infrastructure based on Open-Stack orchestration capabilities.

PROGRAMMABLE WEB

The Programmable Web provides composable Web services, which are small pieces of software available through the Internet, for next-generation applications. CETIC adapts the architecture of applications that are consuming, or providing, Web services, in order to make them scalable and ready to be delivered as a service (SaaS).

Mastering SOA shortens the time-to-market of innovative solutions, thanks to the composition of the Web services, and consequently reduces the overall development effort. Providing efficient and well-designed Web APIs that are in line with standards is a key factor in the adoption of these services by third parties.

In the I2MSteel project (see project portfolio), CETIC defined and implemented key Web services that combine data sources in steel production process and provide interoperability between existing isolated applications.

CLOUD-READY SOFTWARE DEPLOYMENT

Cloud Computing is about scalability and flexibility, and requires specific software architectures. The deployment of the application also has to be taken into account from its inception. CETIC designs software architectures, which are ready to be deployed on countless servers.

The ability to make the right choice of architecture or provider of the Cloud Computing infrastructure, is important when validating proofs-of-concept which are vendor-independent and which take advantage of IaaS and PaaS offerings. Both in PaaS and goCloud (see project portfolio), CETIC helped automate application deployment in the Cloud.

SCALABLE DISTRIBUTED STORAGE

The advent of cloud technology has made available abundant inexpensive storage resources, but they are often scattered and unstructured. As a result, database management systems, such as NoSQL databases, are responsible for handling huge amounts of data, as well as the required redundancy and load balancing capabilities. CETIC maintains a state of the art of distributed storage solutions and a taxonomy of NoSQL databases, which enables CETIC to help companies find the right storage solution based on the kind of data to be managed.



BIG DATA MANAGEMENT

The promise of Big Data is the possibility of managing all the data available to companies by means of a scalable data management infrastructure. This infrastructure allows the management of the three Vs: the volume of data to be managed, the velocity (speed) at which the data should be processed, and the variety (heterogeneity) of data formats that should be taken into account. CETIC experiments with different Big Data installations and distributions, in order to deploy relevant use cases.

OPEN SOURCE SOFTWARE

Questions are still being raised about the Open Source movement, in terms of the availability of local support, the quality of the software developed and the compatibility of licenses. Interest in open data and open hardware is also growing.

CETIC has expertise in the process of selecting Open Source licenses and an understanding of its impact on business models, all of which enables them to help companies release their applications into the Open Source realm and select the license that aligns best with their own business model.

INTERNET OF THINGS

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 transparently accessible on the Internet. The underlying technologies will enable these systems to seamlessly collaborate over the Internet, making overall Internet services much more dynamic, scalable and powerful.

The **Embedded and Communication Systems (ECS)** department examines emerging technologies that will enable the Internet of Things, including methodologies, hardware and software design and prototyping, and wireless telecommunication.

METHODOLOGIES

There is a great temptation, when studying a system, to focus only on the result viewed from the perspective of the demonstrator. However to systematically and efficiently achieve the highest level of performance of these systems, it is vital to consider their entire life cycle. 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 mastery of the methodologies involved and of their associated tools.

In the CE-IQS project (see project portfolio), CETIC studies the all-important teething (test) phase 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.

SMART GRIDS

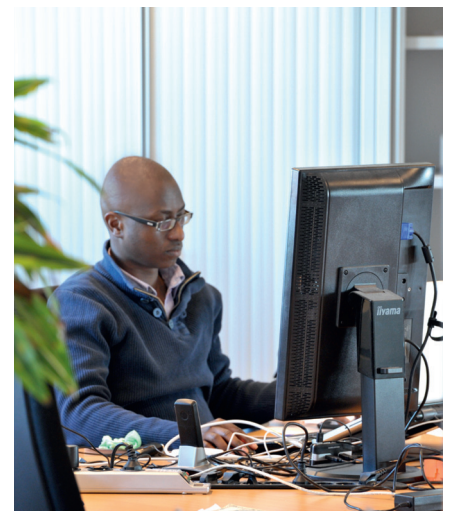
Research on Smart Grids is receiving a strong impetus driven by multiple factors: the need to use renewable energy more efficiently, the need for more effective energy management to lower the cost of energy and the current state of electrical infrastructures, which cannot evolve significantly because of the huge costs involved. Smart Grids can also optimise the energy cost for enterprises exposed to complex management of their consumption in the face of highly variable pricing policies for energy.

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

CETIC studies Smart Grid architectures and solutions for industry. It collaborates with enterprises for internal solutions (at plant level, for example), and for external solutions, like micro-grids, on which enterprises rely to power their renewable energy production units.

MODELLING AND SIMULATION

CETIC has integrated advanced tools for modelling and simulating embedded systems into its Software Engineering laboratory and its Wireless laboratory. CETIC offers advice and services to enterprises using these methodologies and the tools that support them. The Software Engineering Lab and the Wireless Lab are equipped with advanced modelling and simulation tools, and CETIC can assist in the process of selecting the best solutions, as well as in seamlessly integrating them into the environment of the enterprise, and then facilitate their efficient and rapid adoption.

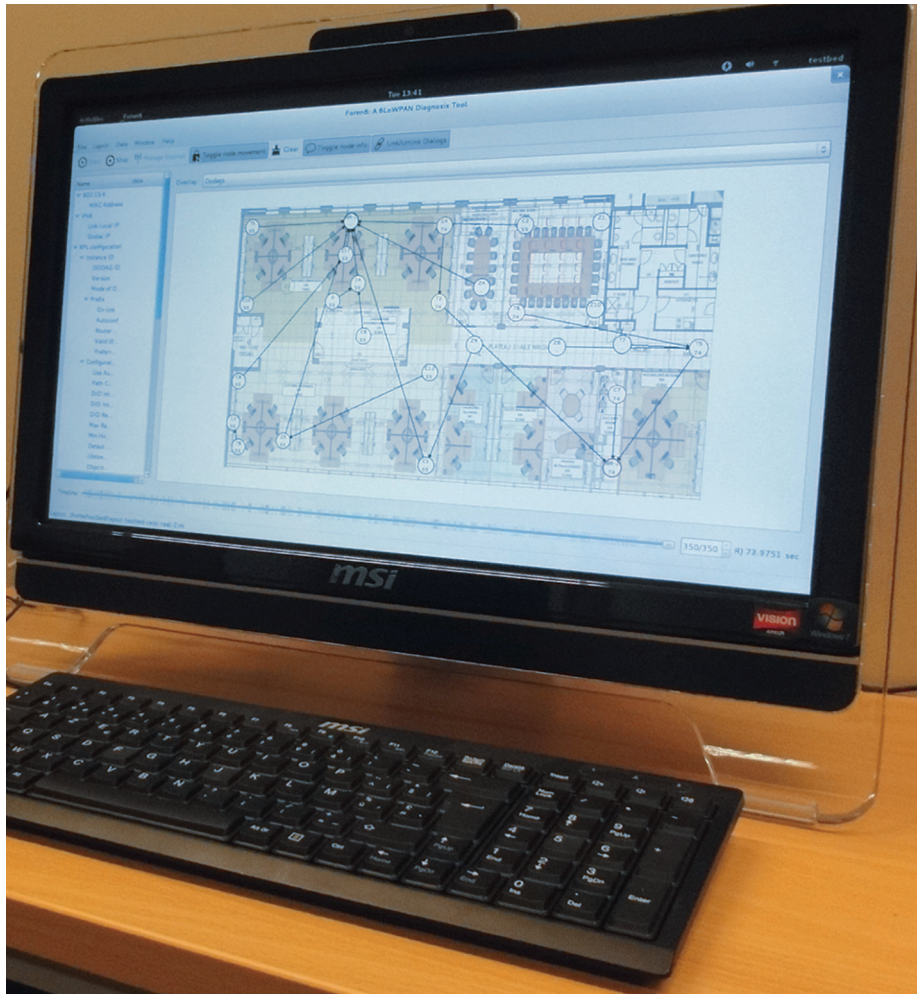


IPV6 SENSOR NETWORKS

IPv6 is the cornerstone of communication in the Internet of Things (IoT), and is required for addressing objects globally. 6LoWPAN, the emerging standard for IPv6 wireless communication, and the Contiki operating system enable Wireless Sensor Networks (WSN) for the IoT.

These new technologies, among 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.

The MidFlex project (see project portfolio) explores the capabilities of these technologies and experiments with advanced routing algorithms in large scale academic WSN, like INRIA Lille's SensLab and TU Berlin's TWIST. CETIC collaborates in this area with SICS in Sweden, at the origin of Contiki.



ADVANCED ARCHITECTURES

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

The huge rise expected in the number of functionalities and the overall complexity of future embedded systems in the world of the IoT will require advanced design techniques, to the point where the key differentiators for successful solutions will ultimately be autonomy, reliability and performance.

In 2013, CETIC started on the design of an highly efficient electronic patch merging advanced monitoring features with Ultra Low Power capabilities (see project e-Patch in the project portfolio).

FPGA

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, particularly in terms of allowing input/output interface reconfiguration. But the FPGA has two significant drawbacks that limit its adoption: the level of expertise and the design time required.

ECS studies the tools and techniques, like porting C to HDL, that will make it easier to develop HDLs, facilitate the use of FPGAs and shorten development time. In the POLCA project (see project portfolio), CETIC, with its partners, studies new approaches based on mathematical transformations to improve the efficiency of parallelization in embedded systems and high performance computing. The practical tools will be designed to implement the generation process. Ultimately, CETIC will focus on the definition of methodologies supporting these tools and guide enterprises in the use of advanced FPGA solutions.