ITEA 2

INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

## Project Results

# Speeding high quality imaging

## High performance computing on multicore processors offers improved medical treatment

***High-quality images of the body are now allowing new medical treatments. However image-processing times need to be cut significantly for real-time results. The ITEA 2 HiPiP project developed affordable image-processing applications based on high performance computing multicore, multiprocessor technologies to cut throughput times, latency and jitter, lower hardware costs and allow 3D template matching. Applications include minimally invasive surgery, mass cancer screening, radiotherapy scheduling and aging research.***

The challenge was to achieve high throughput processing of large and heterogeneous data sets. Significant improvements have now been made in methodology and processing strategies to increase the speed to such a level that these novel applications can be used by customers in real-life cases.

Key applications include:

- ***Detailed brain imaging*** to improve the treatment of diseases related to the brain and neural system, as well as tumours;
- ***Real-time simulation for radiotherapy*** to improve the outcome of treatments by better use of patient imaging data;
- ***Mass screening for cervical cancer*** to enable fast and systematic screening of a population at risk with minimal use of highly-trained personnel;
- ***Minimal invasive surgery*** where detailed images are needed in real time; and
- ***Transmission electron microscopes*** offering identification and analysis of particles and macromolecules in 3D imaging.

### AFFORDABLE APPROACH

HiPiP focused on the application of parallel processing with multicore technologies in an affordable way. Bull had extensive knowledge of parallelism and was keen to adapt its high performance computing technologies to time-critical and demanding applications in new areas. Philips wanted to increase the speed of image processing while reducing the cost of its medical imaging equipment.

Key objectives included: reducing complex image-processing latency for immediate use of image information; enabling high throughput image processing to handle very large and heterogeneous data sets; shortening image-processing times for medical operations and predictable low response times; diagnosis and use of high resolution instruments; and providing inexpensive solutions for complex tasks.

### NEW ALGORITHMS

This required development of new algorithms with process scheduling and memory access not normally carried out in traditional operating systems. Results included 30% more throughput, 50% lower latency and 20% less jitter. Server-based support was also developed to allow massive image processing, enabling for example reductions in processing time of up to 97%.

Advanced management of computing resources or virtualisation made possible background and real-time processing on

## HiPiP
## (ITEA 2 - 07022)

**Partners**
Bull
CEA
DosiSoft
FEI
Imstar
Philips Healthcare
Technolution

**Countries involved**
France
The Netherlands

**Project start**
October 2008

**Project end**
September 2011

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## Project Results

the same hardware. This enabled Philips, for example, to achieve a more than 50% reduction in process hardware costs in its medical imaging systems. Previously, each kind of image needed its own processor, with another processor for all kinds of background tasks.

### MARKETABLE PRODUCTS

For Philips, HiPiP has not only increased speeds but also improved real-time aspects of multicore processing. A doctor can now see a processed image taken a tenth of a second before, allowing much improved hand-eye co-ordination during minimally invasive surgery. Moreover better images result while reducing patient exposure to X-rays.

Electron microscopy specialist FEI has increased speeds by a factor of more than 100 using novel algorithms in combination with graphical processing units with hundreds of cores in their post-processing workstations – reducing processing time from hours to minutes. CEA has speeded up massive brain scan studies for Alzheimer's disease research with image processing cut from a week to hours. And DOSIsoft has speeded up planning for oncology radiotherapy – allowing more targeted treatments with less specialist manpower. IMSTAR has been able to make a step change from manual to automated high-throughput medical screening systems, enabling improved performance at a reasonable price. Automated tissue and cellular imaging can now be run continuously with only unusual cases having to be referred back to a doctor.

Bull extended its systems with real-time capabilities for image processing and other time-critical applications. And it now has a scalable real-time high performance computing infrastructure ready for use in other commercial projects.

### COMMERCIAL AND MEDICAL BENEFITS

HiPiP has boosted Europe's global position with a greater understanding of real-time parallel processing. And it has brought about important benefits in patient care through faster, more targeted treatment and reduced X-ray exposure.

## Major project outcomes

**DISSEMINATION**

- 9 presentations
- 4 papers
- 5 posters at conferences and meetings
- 1 PhD thesis
- 1 website on a result

**EXPLOITATION**

*3 new products*

- Philips: New High end iXR system with significant dose reduction, product introduction at RSNA 2011
- FEI: New product to complete data processing pipeline; bring supercomputing to the desktop
- DOSISoft: Virtual radiotherapy simulation workstation to be released in 2012

*4 new services*

- Technolution: Systems engineering for the OEM-market
- CEA: Complete software platform for neuro-imaging research
- CEA: fast dynamic PET reconstructions
- IMSTAR: Mass cancer screening

*1 new system*

- Bull: HPC Real-time Infrastructure

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ITEA 2 – Information Technology for European Advancement – is Europe's premier co-operative R&D programme driving pre-competitive research on embedded and distributed software-intensive systems and services. As a EUREKA strategic Cluster, we support co-ordinated national funding submissions and provide the link between those who provide finance, technology and software engineering. Our aim is to mobilise a total of 20,000 person-years over the full eight-year period of our programme from 2006 to 2013.

ITEA 2-labelled projects are industry-driven initiatives building vital middleware and preparing standards to lay the foundations for the next generation of products, systems, appliances and services. Our programme results in real product innovation that boosts European competitiveness in a wide range of industries. Specifically, we play a key role in crucial application domains where software dominates, such as aerospace, automotive, consumer electronics, healthcare/medical systems and telecommunications.

ITEA 2 projects involve complementary R&D from at least two companies in two countries. We issue annual Calls for Projects, evaluate projects and help bring research partners together. Our projects are open to partners from large industrial companies and small and medium-sized enterprises (SMEs) as well as public research institutes and universities.

EUREKA

**HiPiP**
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