

Project Results

Power-management strategies boost mobile performance

Energy optimisation extends the autonomy of mobile embedded devices and communicating networks

Mobile devices are hugely dependent on their ability to manage limited battery capacities to reach reasonable autonomy. The ITEA 2 GEODES project addressed power consumption in complex distributed communications systems from a global and coherent point of view, covering internal nodes in a device and the network environment in which it has to function. The results are being applied in several areas, and the power-management strategy has been summarised in a freely available handbook.

Mobile embedded devices now offer more functionalities than ever with even greater connectivity. Power optimisation is no longer confined to the device itself but also needs to take into account its environment through the networks it accesses. The challenge is similar in large sensor networks, involving groups of communicating nodes with heterogeneous capabilities – central processing unit, memory, etc.

MINIMISING ENERGY CONSUMPTION

GEODES focused on minimising energy consumption for two reasons: consumer awareness of the need to focus on energy use for environmental concerns; and device autonomy which requires products to use less energy despite implementing many more functions and with feature set an important selling point.



While new hardware architectures are barely able to keep up with performance demands, battery technology is not evolving fast enough to address energy problems. Energy efficiency is becoming a differentiation factor and motivating the design of low power embedded systems with energy management to cut power consumption, maximise battery life and decrease thermal dissipation.

The slow evolution of battery technology has put the autonomy of embedded devices under pressure. In recent years, embedded processors have gone through an amazing evolution, demanding even better battery performance. Many attempts have been made to reduce the growing gap; the most common involves tailoring power consumption to performance.

SERIES OF MECHANISMS

GEODES investigated mechanisms for reducing power consumption, focusing on two:

1. Those on the level of individual nodes such as stand-by mechanisms, where nodes are switched to standby to reduce energy consumption; and
2. Those on the network level, such as transmit power control, where correct power levels need to be assigned to nodes to minimise total power consumption while keeping the whole network connected.

Major innovations included:

- Power-aware applications;
- Power-aware components at operating-system level;
- Energy-efficient techniques for the network (new MAC protocols, new routing algorithms);
- Middleware for quality of service (QoS) handling and node interoperability; and
- SystemC simulator for power estimation.

GEODES (ITEA 2 ~ 07013)

Partners

CNRS (IRISA, LEAT)
 ENEA
 Eolane
 Infineon Technologies Austria
 Philips
 Sensaris
 Technicolor
 Thales Communications & Security
 Thales Netherlands
 Twente Institute for Wireless and
 Mobile Communications (WMC)
 University of Twente
 Vienna University of Technology (TUV)

Countries involved

Austria
 France
 The Netherlands
 Sweden

Project start

September 2008

Project end

September 2011

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Project Results

OVERCOMING THE POWER/ PERFORMANCE GAP

Project results will help overcome the power/performance gap for next-generation devices. Applying systems/software awareness to power issues is key to bridge opposing evolution towards greater performance requirements and longer device autonomy. Coupling this awareness with a well-balanced offline/inline power optimisation can bring major energy savings and be considered an enabling technology.

There is massive potential for energy-efficient wireless-sensor networks (WSNs) and embedded systems in the Internet of Things (IoT) with machine-to-machine (M2M) connections. GEODES techniques can help facilitate deployment of M2M IoT systems with efficient energy management and communications solutions for extended operation.

Markets where GEODES techniques can be applied include:

- Wireless M2M connectivity through SIM-equipped devices;
- Protection of critical infrastructure such as perimeter protection of oil-pumping

stations;

- Environmental monitoring and fire-fighter protection; and
- Airport security with vast IP-based video-surveillance networks.

OUTCOMES ALREADY EXPLOITED

GEODES results and outcomes have already been implemented. The power-management strategy is summarised in a freely available two-part handbook (<http://geodes.ict.tuwien.ac.at/PowerSavingHandbook/>). The approach is being applied internally by project partners to improve the autonomy of existing devices and as part of the design approach for new products.

Key outcomes include orders-of-magnitude energy savings such as doubling the autonomy of video-surveillance applications and lifetime extensions such as a 100% improvement in WSN lifetime verified on multiple prototype demonstrators across diverse domains. And up to 11% total energy consumption reduction has been achieved for TV set-top boxes – in a 10 million unit market, this would save some 62 GW of power a year.

Major project outcomes

DISSEMINATION

- More than 50 publications (e.g. FDL, DSD, DATE, DAC, INDIN, ISWCS, EURASIP,...)
- 4 public workshops (WUPS, ERCIM, RWTH) & 3 public tutorials (DATE, WUPS)
- Numerous presentations at other events (e.g. GDR SoC/SIP, WWIC, RESCOM, PERCOM)
- 1 public handbook viewable online: <http://geodes.ict.tuwien.ac.at/PowerSavingHandbook/>

EXPLOITATION

- 2 open source software:
 - ♦ Powwow framework from IRISA, available at <http://powwow.gforge.inria.fr/>
 - ♦ TUV SystemC ISS for node power estimation
- 6 new products with new features being released:
 - ♦ Sensaris Senspack & Rempods, Philips wireless products for lifestyle area, Technicolor Set Top Box, WMC Figo system, ENEA OSE RTOS new services
- Other products with new features expected in 1-3 years:
 - ♦ Thales personal communication system MOOVE, supervision & surveillance, EOLANE videosurveillance equipment

STANDARDISATION

- 3 contributions to standardisation bodies (SystemC AMS, Zigbee, IETF 6LoWPAN)
- 2 supports to other standard bodies
 - ♦ EU Code of Conduct on power saving modes in Set Top Boxes,
 - ♦ Multicore Association standard for the APIs

PATENTS

- Method and SW architecture to develop Power-Aware applications, Thales Communications & Security, patentee registered and applied in FR & PCT
- Modular Wireless Physiological Monitoring and Communication System Sensaris, in progress in US
- Method and apparatus to configure a WSN Thales Communications & Security, registered

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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.



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