## PROJECT RESULTS

Enhanced network management

Taking control of heterogeneous networks

ENERGy provided the management tools to deal with complex and heterogeneous networks, and developed automation to help the administrator (re)configuring the system. The results of ENERGy improve the quality of experience for end users by maintaining the network and associated services in accordance with business policies.
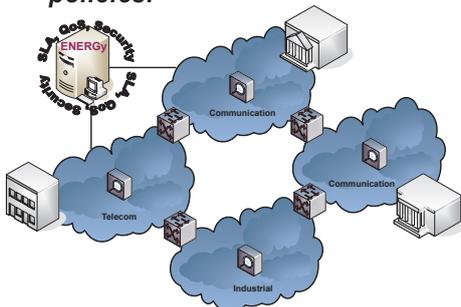
Management of complex and heterogeneous networks

Communications networks are designed to reach operational objectives such as higher data rates, higher throughput and more capacity. Achieving optimal solutions for various specific (sub-)markets results in a patchwork of heterogeneous environments, where end-to-end services are provided by distributed sub-systems and limited by complicated inter-system exchanges. Achieving a coherent and universal management of such an architecture requires a critical and focused effort. Furthermore, the interoperability between the components of the various systems requires technical adaptations that influence their performance.

A growing market
In recent decades, network operators have invested billions of euro in infrastructure. This not only includes hardware, but also management tools designed to optimise network use. The

pressure to achieve a return on this investment, through economies of scale, for example, is enormous. In 2002, €32 billion – about 3% of total revenue – was spent on operations support systems (OSS) and the integration of dissimilar systems. ENERGy aimed to provide a unified generic platform for the delivery of global management services. ENERGy developed technologies and strategies dramatically improving this situation:

- Focusing on auto-configuration and self-management to:
  - Manage heterogeneous network services and resources
  - Deploy and configure network equipment – servers, hubs and switches, etc., and
  - Control, monitor, update and report on network, applications and services status – Quality of Service, faults, security level, …;
- Simplifying network management by transcribing network information into a form manageable by humans with improved interpretation of high-level management objectives such as service-level agreements (SLAs) or specifications (SLSs), business services representation and correlation of networks alarms;
- Mastering the complexity of network heterogeneity, which is increasing due to the greater numbers of stakeholders and a wider range of technologies;
- Providing a high quality of service (QoS) based on reliable and cost-aware services and minimum downtime – the ENERGy Network Management Systems (E-NMS):
  - Detects and repairs network faults and errors, while keeping the network protected from

security threats,

- Implements network policies automatically, based on information retrieved from the network to ensure the best service for end-users; and
- Keeps track of, and reports on, network resources and service use; and

• Decreasing monitoring traffic and cost by minimising the monitoring information per monitored network element – i.e. reconfiguration of logging means and dynamic adaptation to network status – and minimising the number of monitoring points in the network by careful placement of monitors and distributed aggregation of monitoring information.

Improving network management
ENERGy provided the right tools to manage networks:

• **Network and service management** using a business-oriented services-based approach to assess the quality and efficiency of the end-user experience;
• **Policy-based management** to deal with high level objectives;
• **Automation – or computer-assisted operations –** in service and policy management;
• **Ontology-based inference engine** to compute reconfiguration solutions dynamically:
  - Semantic to map the system modelled to the 'real' managed system, and
  - Dynamic invocation of effectors for reconfiguration;
• **Web-based network management** – using web services, etc.;
• **Security management** – the implementation of security safeguards provides reasonable assurance that all the components related to security, transaction processing and network availability are well protected, preventing any unauthorised access while assisting with the verification and recording of the current network configuration;
• **Tele-management and tele-**

distribution used to provide monitoring information and moreover to dynamically manage the system – software update, dispatch of security log, …; and
• **Quality of experience (QoE) management**
  - Maximising service reusability to facilitate automation of service creation and to energise developments – applying service-oriented architecture (SoA) and new generation operations systems and software (NGOSS) concepts and principles, and
  - Improving distributed execution and monitoring to perform, manage and feedback applications ubiquitously using business-process management (BPM) and business-activity management (BAM) technologies under the web services umbrella.

Wide range of applications possible
ENERGy focused on telecommunications next-generation networking (NGN) services management, voice-over-IP (VoIP), video-on-demand (VoD), Internet television (IPTV) and industrial networks but the results could be applied to fields such as communications, telecommunications and general industry.

Major project outcomes

Award/label
• One award (CUORE)
• One label (INES)

Dissemination
• Five publications
• Participations in 15 conferences/workshops

Exploitation
• Integration in several product ranges

Standardisation
• Contributions to standardisation bodies – W3C-GRDDL, ORACLE, IBM-SCA, ACF, TMF-NGOSS/SID and PNO