Project Achievements

Network management based on distributed paradigms

The goal of this project was to develop novel technologies for a vastly distributed and logically meshed network management system that facilitates self-management and dynamic behaviour of nodes. This will enable adaptable services and the management of networks of increasing scale, heterogeneity and transience, thereby reducing operating expenditures (OPEX).

Main focus

This project addressed a key issue of telecommunications management: the inability of existing network management systems to adapt and evolve towards the service and network requirements of large-scale heterogeneous networks. Currently deployed management systems are constrained by rigid standards for interoperability, by static rather than dynamic or self-aware control paradigms and by rigid architectures that inhibit flexibility and distribution. The objective was to investigate large-scale distribution techniques and architectures suitable for network management systems, create new modelling techniques to capture this distribution and its inherent dynamic behaviour and to build a prototype system using an appropriate peer-to-peer paradigm. The project was extended to allow more detailed study of the scalability and security aspects of distributed management.

Madeira produced an innovative architectural framework, mechanisms for building interface protocols, and a reference software implementation. In addition, Madeira developed a case study focusing on the relationship between fault and configuration management in a dynamically forming network with transient elements from the perspectives of equipment vendors, service providers and network operators.

Approach

In order to set a context for the project, a scenario that examined configuration and fault management for a self-forming wireless LAN network in a large exhibition space was used to define requirements for a distributed management system. Those requirements drove the specification of distributed management architecture.

The project identified specific technologies that might be applied to distribute
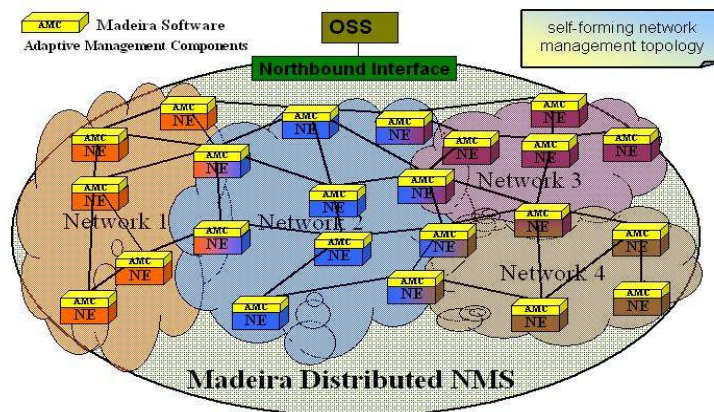
The Madeira distributed management system running across 4 networks

Madeira

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management and pinpointed areas where an advance of the state of the art in those technologies was needed. The study of those areas formed the main research work of the project. The results of this research were used to enhance the architecture and to focus the platform and application development.

A prototype distributed management platform that provides the key services required by distributed applications was developed. Two such distributed applications, based on the scenario, were developed and prototyped.

During the project, two critical areas – scalability and security – were identified as requiring special study. The project was extended to examine those specific areas in detail.

Achieved results

The Madeira project developed and demonstrated a novel approach for distributed management. The Madeira management system uses a peer-to-peer approach coupled with advanced modelling and policy-driven decision making to automatically build a logical management overlay across

distributed network nodes.

The management system is self-forming, self-configuring and self-healing. It facilitates the deployment of truly distributed management applications that are scalable and robust and that can be controlled using distributed policies.

The distributed fault management application showed that, if the fault analysis and alarm correlation are distributed, a simple set of rules can be used even for complex networks. Topological consistency is always maintained, and duplicate alarms are easy to eliminate.

The self-configuring northbound interface demonstrated that an automatically forming distributed management system can work towards traditional management systems. It publishes a single point of contact for such systems and can interact with such systems using well-known techniques such as Web services.

Further, the project demonstrated that a distributed management system can be secured by applying well-known techniques. The scalability of the system has been assessed using simulators and mathematical techniques as

well as specifically targeted measurements on real systems.

The project has published 7 academic papers and plans to publish a further 4 papers. The project also plans to publish a comprehensive article on the project in a major journal.

The Madeira project has already been used as an input for IST FP7 and Celtic project proposals, where the Madeira approach is proposed for extension to management of broadband networks, home area networks, and ad-hoc networks.

Impact

The management of a network using the Madeira approach is self-configuring, self-optimizing, and self-healing. Applications running on it can be built and distributed, can be autonomic, and can be controlled using distributed policies. This means that management of networks can be changed from the current vertically oriented open loop control model to a horizontally oriented closed loop model, where network management is largely automatic and operator intervention is minimized.

Such an approach has the potential to considerably reduce the OPEX of operators. In the case of vast heterogeneous networks, it may be that a Madeira-like approach is the only approach that is feasible for network management. SMEs can use the interfaces and application programming interfaces (APIs) provided by Madeira to deploy specific distributed management applications in networks.

The results of the project will be used by the industrial partners to evaluate the value and degree of distribution that is appropriate to employ in the network management products and services that they develop and purchase.

About Celtic

Celtic is a European research and development programme, designed to strengthen Europe's competitiveness in telecommunications through short and medium term collaborative R&D projects. Celtic is currently the only European R&D programme fully dedicated to end-to-end telecommunication solutions.

Timeframe: 8 years, from 2004 to 2011

Clusterbudget: in the range of 1 billion euro, shared between governments and private participants

Participants: small, medium and large companies from telecommunications industry, universities, research institutes, and local authorities from all 35 Eureka countries.

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