



Management of the Future Internet

At A Glance: FLAMINGO

Management of the Future Internet



Project Coordinator

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Partners: *UT (NL), INRIA (FR), UZH (CH), JUB (DE), UNIBWM (DE), UPC (ES), iMinds (BE), UCL (UK)*

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The FLAMINGO project will strongly integrate the research of leading European research groups in the area of network and service management, strengthen the European and worldwide research in this area, and bridge the gap between scientific research and industrial application.

Main Objectives

FLAMINGO has several objectives, such as to lead the scientific network and service management community, to organize conferences and workshops, develop open source software, establish joint labs, jointly supervise Ph.D. students, develop educational and training material, interact with academia and industry, and contribute to (IETF and IRTF) standardization.

Three major and federating challenges will be investigated:

- Network and service monitoring, based on flow-based techniques, enabling scalable monitoring systems to share collected data and feed the knowledge plane and decision algorithms of the Future Internet.
- Automated configuration and repair, based on self-* features and frameworks, enabling billions of devices and managed objects to manage themselves in a fully distributed and autonomic way.
- Economic, legal, and regulative constraints, which do border management systems and operational solutions of the FI.

In order to be successful, management of the Future Internet needs to be addressed in a holistic way from the single isolated device up to the content and the services.

FLAMINGO provides a unique consortium of leading academic researchers, with complementary knowledge and strong ties to industry, and covering the entire spectrum from network management core functions to application domains, which are necessary to build, integrate, and disseminate the knowledge of the management plane for the Future Internet.

FLAMINGO strongly impacts the European development of network management technologies, the development of standards and open-source software in this area, the organization of interoperability and testing labs, and the training of current and the education of future researchers in this area.

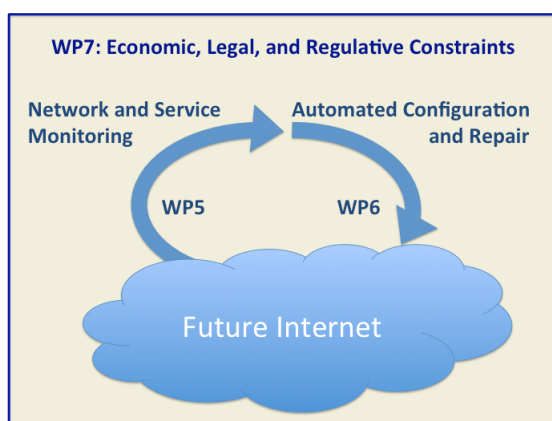
Technical Approach

The FLAMINGO project is focused around three key research activities (see figure below). Before any management decision can be taken, it is essential to first *monitor* the managed objects (networks, services, traffic, devices etc.). The output of the monitoring process is then used to *automatically* configure and repair the managed objects. Monitoring as well as the automated configuration and repair should be performed within the boundaries of the economic, legal and regulative *constraints*.

Key Issues

Monitoring: To make informed network and service management decisions, it is essential to have a thorough understanding of the traffic flowing through the network. The problem with monitoring traffic, however, is that line speeds increase faster than the speed of monitoring equipment. Also traffic can be encrypted, in particular in combination with emerging cloud services. It is therefore important to investigate novel and scalable network and service monitoring approaches. The FLAMINGO consortium will focus on new flow analysis techniques, propose novel distributed techniques to capture and analyse management data, and develop new query languages to detect flow patterns. These novel approaches will be validated for the purpose of security management and privacy awareness.

Automated Configuration and Repair: Due to the billions of objects that need to be managed, and the resulting scalability problems, it is necessary to re-think existing management approaches. A centralized and hierarchical approach can no longer address these challenges adequately. What we need is automated configuration and repair of managed objects, such that these objects react to their environment in an adaptive way, according to certain rules. This paradigm is sometimes called Autonomic Networking, and builds upon self- and distributed management approaches. Such approaches require the development of new concepts, like coordination protocols, association strategies, information modelling, knowledge processing, and learning capabilities. These novel concepts will be investigated and validated by the application in content-aware networking, optical networks, cloud-based services, personal and wireless sensor networks.



Economic, Legal, and Regulative Constraints:

The Future Internet will see management decisions to be taken and optimized, based not only on technological, but also on commercial deployment and economic viability concerns. Therefore a cross-disciplinary approach is needed, taking into account a) cost-awareness, b) incentives for service provisioning, c) fulfilment schemes, d) business policies, and e) legal/regulative aspects.

While the technological dimension covers Internet-based communication systems, P2P systems, and cloud computing, the integrated economic dimension addresses long-term management decisions, incentives, pricing mechanisms, economic models, cost benefit analysis, and business indicators. These areas are complemented by legal and regulative constraints, which have to be evaluated to ensure that contracts concluded will be legally valid and provider-dependent cost models as well as accounting models are legally compliant with regulations.

Expected Impact

The impact of the FLAMINGO Network of Excellence will be as follows:

- Strengthen Europe's position in the field of network and service management. To achieve this, FLAMINGO creates training material to facilitate researchers within industry to keep up with the latest developments in this field. The project develops network management course material and makes such material available to universities worldwide. In addition, FLAMINGO support researchers by creating and coordinating network and service management related data in various on-line systems, including Wikipedia and the Simpleweb. Finally the project organizes joint workshops and scientific events.
- Develop technologies for future generations of European high-speed networks, in particular scalable monitoring techniques and network components that operate autonomically.
- Contribute to standardization, in particular within the IETF to the evolution of the NETCONF and YANG standards, as well as several other working groups. FLAMINGO also organizes pre-standardization in this area within the IRTF-NMRG.