Enhanced, Ubiquitous, and Dependable Broadband Access using MESH Networks

EU-MESH will develop, evaluate, and trial a system of software modules for building dependable multi-radio mesh networks with QoS support that provide ubiquitous and ultra-high speed broadband access, while supporting novel procedures for efficient usage of both the wireless spectrum and fixed broadband access lines.

Main Objectives

EU-MESH’s goal is to develop, evaluate, and trial a system of software modules for building dependable multi-radio multi-channel mesh networks with QoS support that provide ubiquitous and ultra-high speed broadband access.

The system will be based on a converged infrastructure that uses a wireless mesh network to aggregate capacity from both subscriber broadband access lines and provider fixed broadband links to form a virtual capacity pool, and provide access to this capacity pool for both stationary and mobile users. It will support low operational and management costs, through novel configuration and management procedures that achieve efficient usage of both the wireless spectrum and fixed broadband access lines. This will increase the competitiveness of existing providers, lower the barrier for small and medium enterprises to enter the mobile broadband access market, and enable innovative services.

Existing mesh systems are based on non-standard solutions, do not achieve efficient resource utilization, have sub-optimal channel and power control that prohibits large-scale deployment, and lack a comprehensive security solution combining proactive and reactive mechanisms.

To address the above, EU-MESH’s objectives are to develop

- algorithms that combine channel access with power and channel control to reduce interference,
- QoS and opportunistic routing algorithms to support scalable end-to-end QoS and efficient resource usage,
- location-aware automated (re-)configuration procedures that adapt to varying network conditions to provide robust connectivity,
- lightweight application layer procedures for seamless mobility over heterogeneous and multi-operator mesh networks, and
- secure routing, communications, and handover in multi-operator mesh networks, and intrusion detection and mitigation mechanisms that exploit cross-layer monitoring.

The system will be assessed through local experiments and metropolitan scale trials, from the perspective of a pure wireless network operator and a wired/wireless telecom provider.
Technical Approach

EU-MESH’s approach includes cross-layer control and monitoring, and joint consideration of QoS, mobility, and security requirements at the architecture design phase.

The work plan involves four phases: identification of requirements; architecture design; research and development activities for mesh configuration and link control, resource management, QoS routing, mobility, and security; integration; and finally experiments and trials. The specific work packages and their approach are as follows:

• WP1 Project Management and Assessment.
• WP2 Requirements and Architecture: Definition of user and application requirements, and architecture of the EU-MESH system. The architecture will follow a cross-layer design principle, and will be the basis for the work in WP3-5.
• WP3 Mesh Configuration and Link Control: Procedures for automated configuration and management, cross-layer wireless network monitoring, and efficient topology control.
• WP4 Resource, QoS, and Mobility Management: Models and algorithms for efficient resource management based on cross-mechanism optimization, QoS routing metrics and opportunistic routing algorithms, and mobility support.
• WP5 Security: Combined proactive (secure routing and handoffs) and reactive security based on cross-layer monitoring for ensuring high dependability and availability.
• WP6 Experiments and Trials: Integration of software modules, definition and execution of experiments and trials, assessment of results.
• WP7 Dissemination, Standardization, and Exploitation.

Key Issues

Key issues addressed by the EU-MESH project include the following:

• Cross-layer architecture design that integrates requirements for QoS, mobility, and security.
• Investigate combined impact of various control mechanisms, such as channel access, power control, channel assignment, and routing on the overall performance of a mesh network.
• Support seamless mobility over heterogeneous and multi-operator mesh networks.
• Integrate proactive and reactive security procedures in single and multi-operator mesh networks.
• Assess the developed system from the perspective of a pure wireless network operator and a wired/wireless telecom operator.

Expected Impact

EU-MESH will achieve the following expected impact:

• Align work and contribute to IEEE and ITU-T standards related to the integration of mesh networks with heterogeneous fixed access technologies, in order to provide ubiquitous broadband access to both fixed and mobile users.
• Develop a scalable converged infrastructure that supports flexible network and service models, which can in turn contribute to new business models.
• Lower the barrier for small/medium size providers to enter the high growth potential mobile broadband access market, through reduced deployment costs and time while exploiting underused communication resources, and enable the introduction of innovative services that require pervasive broadband access.