System infrastructure for the Magnets WiFi mesh

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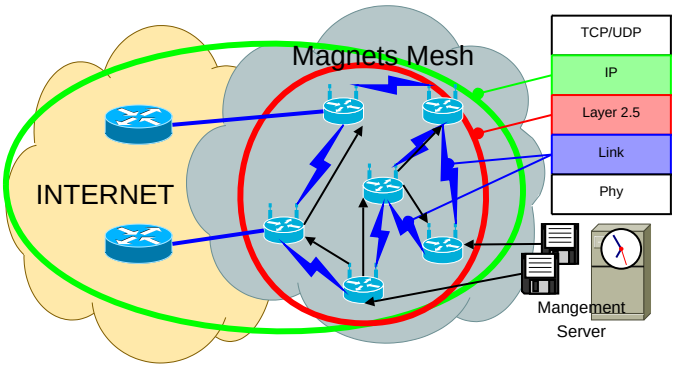
Wireless access networks have the potential to revolutionize the way people experience the Internet by enabling ubiquitous high-speed Internet access. Yet, our understanding of wireless networks is still in its infancy and we urgently need to gain experience with how protocols behave in complex environments. The MagNets[1] project offers such an opportunity by combining a wireless access network, available to students at TU Berlin, with a research environment for deploying and evaluating novel wireless protocols. The network consists of an 802.11-based multi-hop high-speed wireless backbone with point-to-point links and a high-capacity mesh network which serves as both access and backhaul network. Initial experiments with the backbone have shown that it provides an actual throughput of up to 62 Mbps and has improved our understanding of the influence of interference by co-located access points.

However, to explore the multitude of available routing protocols, interacting control loops (e.g., TCP with 802.11 MAC), QoS strategies, application dynamics, multimedia distribution protocols, etc. we need a software framework that provides, among others, easily programmable packet handlers, access to cross-layer information, instrumentation support, a good library of often used functionality and easy maintenance of the overall system. Moreover we need a facility that enables time-shared experiments, e.g., of different protocols, and for different research projects.

In this poster we describe the design of such a system infrastructure for the Magnets WiFi mesh. It consists of a routing framework, a software distribution system, and a management framework.

The basis for the management framework is the LabTool that was originally developed for our wired router lab. It enables concurrent and long-running experiments via time-shared access to network components such as routers and switches. At the beginning of an experiment it retrieves a possibly saved configuration from a central database and configures the reserved components accordingly via a management network. At the end of the reservation, it can store the actual configuration of all components.

Unfortunately in mesh networks we cannot use a management network but rather have to rely on the wireless network itself for distributing configuration and software modules. On the nodes, we therefore rely on the OpenWRT Linux distribution[2] as a minimal system. next, we couple the LabTool



with a software distribution system, e.g., the viral software distribution platform of the Berlin Roofnet [3] to distribute configurations and software components. These components may contain routing algorithms for the routing framework. The framework thereby provides the basic functionality needed by all routing protocols, such as addressing, forwarding, and hardware abstractions, but allows an instantiation of different routing stragegies.

The framework uses a layer-2.5 approach as depicted in the Figure. The 2.5 layer is a mesh-wide protocol that separates the global IP-based routing in the Internet from the routing in the mesh. Thus, the mesh is seen as a single flat subnet to external IP routing, but within the mesh we can support mobility, multi-path routing, addressing, cross-layer optimization etc. Moreover, it lies on top of the Link Layer to be independent of the specific wireless hardware and MAC protocol. Our layer-2.5 approach is based on the Click Router[4], a modular software router package with a scripting language that enables easy instrumentation and implementation of new routing protocols.

By combining the efforts of many different groups in the wifi-mesh area we hope to build a sensible system that gives maximal flexibility to the researcher while still abstracting a lot of every day tasks. With a good network management we hope that a lot of different research topics can be followed concurrently and that collaborations with external researchers will be fostered.

[1] http://www.deutsche-telekom-laboratories.de/~karrer/magnets.html
[2] www.openwrt.org
[3] http://sarwiki.informatik.hu-berlin.de/Software_Distribution_Platform
[4] http://www.read.cs.ucla.edu/click/