Magnets – A Next Generation Access Network

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Magnets
Magenta Networks
The world's most attractive networks!

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Abstract

Magnets is a next-generation WiFi-based wireless infrastructure consisting of a wireless mesh with 50 nodes, and a high-speed wireless backbone with a raw end-to-end throughput of 108Mb/sec. The main theme in the design of the Mangets and its key distinguishing characteristic from similar efforts is heterogeneity. It is integrated with cellular networks based on GPRS, UMTS and next-generation wireless technology based on WiMAX. Magnets combines a research environment where new protocols and future architecture ideas can be deployed and experimentally evaluated. It encompasses a production environment where students at the TU Berlin are offered free access to the network.

Design Goals

Magnets is designed with three-fold goal:

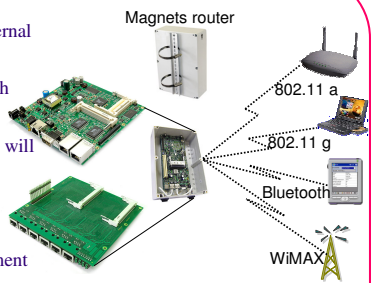
- Provide a combination of semi-production environment and research testbed
  - Traffic created by students of TU Berlin
  - Asses the research outcome suitability w.r.t realistic traffic assumptions
- Serve as a platform for investigating interoperability issues (stemming from carefully planned, high speed backbone to an untethered, low-capacity, and extended diameter urban mesh.
- Leverage and help evaluate the multi-tier design approach in the contexts of mesh environments (a design trend followed in p2p and sensor networks.

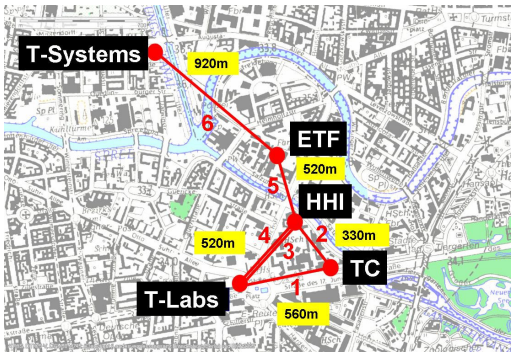
Back Bone

- Five nodes on top of high-rise with unobstructed line of sight,
- Unlicensed spectrum (2.4GHz and 5GHz),
- Workstation support for management and services,
- 12 WiFi access points (APs) supporting 802.11a/g modes (at 54Mbps) and proprietary Turbo Mode (108Mbps), with outdoor suitability, attached to routers
- APs are connected to directional antennas, 8 operating at 2.4GHz and 4 operating at 5GHz
- Shortest link 330 meters and longest link 920 meters
- Multi-path routing (T-Labs to HHI via 2 separate links (3,4) or via TC (link 2)

WiFi Mesh and Heterogeneous Nodes

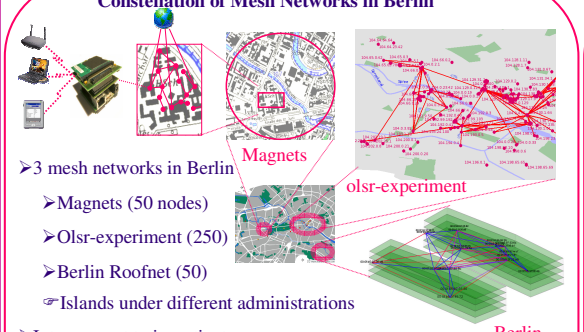
- 50 Mesh Nodes, H/W: RouterBoards with multiple Mini PCI cards, ability to attach external storage attachment. Each node is equipped with 3 to 6 WiFi interfaces
- Phase I: 15 nodes will be deployed and with operational success, the diameter of the mesh will extended in an ad hoc fashion
- By taking advantage of multiple Mini PCI slots, GPRS, UMTS and WiMax technologies will provide an opportunity to superimpose multiple network configurations
- Issues with TCP performance during vertical handovers between multiple access technologies will be explored
- Investigations will be carried out on operator-driven optimizations for resource management and load-balancing, as well as opportunities for the separation of control and data planes
- As an extension, few nodes will be furnished with low-range Bluetooth and Zigbee communication interfaces for integrating sensor networks





Magnets WiFi backbone in the heart of Berlin

Constellation of Mesh Networks in Berlin



- 3 mesh networks in Berlin
  - Magnets (50 nodes)
  - Olsr-experiment (250)
  - Berlin Roofnet (50)
  - ☞Islands under different administrations
- Interconnect to investigate
  - Routing policies among different meshes
  - Multi-operators/providers (virtualization)

Preliminary Measurements on the Backbone

Link	Freq [GHz]	Channel	Level [dBm]	TCP [Mpbs]	UDP [Mbps]	RTT [ms]
1	5	Dynamic Frequency Selection	-49 -49	26.3 24		2 2
2	2.4	7	-55 -55	13.6 13.7	12.6 7.7	3 3
3	2.4	1	-58 -57	12.3 12.3	15.3	21 21
4	2.4	13	-56 -56	16 15.5	15.7 13.3	3 3
5	2.4	13	-76 – -80 -74 – -77	6.4 4	2.9 1.6	10 10
6	5	Dynamic Frequency Selection	-81 -81	5.2 1.7	8.7	150 – 200 150 – 200

Conclusions

- How shall we deploy wireless access networks?
  - Real experiences: Antenna setup, lightning protection
  - Environmental influence (radar, interferences of APs)
- How do protocols perform?
  - Planning (raw 54 Mbps) vs measured (TCP 13-16 Mbps)
  - Future: network capacity, end-to-end throughput, latency, influence of routing protocol, SIP and video adaptation
- How far can / shall we design new protocols?
  - Open router platform for cross-layer optimization
  - Clean-slate approach: information and experimentation

www.deutsche-telekom-laboratories.de/~networks/magnets.html

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