Plug-and-Play Routers and Base Stations

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Outline

• Plug-and-play base stations
  – Problems
  – Assumptions
  – Concept
  – Performance analysis

• Plug-and-play routers
  – Problems
  – Concept: management hierarchy
  – Merging existing hierarchies

• Conclusion
Plug-and-Play Base Stations

- bootstrapping base stations
- configure wireless properties
  - ESSID, channel, protocol, TX power, etc.
- coordinate configuration with
  - neighbored stations
  - complete access network
Assumptions

• each base station has at least two network interfaces
  – one to provide wireless services to its mobile clients
  – one for uplink connectivity (wired or wireless)
• each base station has a X.509 certificate
• each base station has a (statistically) unique identifier
System Overview
Basic Concept

- management functionality is entirely distributed
- base stations request/collect management information and but act autonomous
- neighbored base stations exchange management information
- epidemic replication for information that needs to be network-wide consistent
- management information is categorized into global, local and private
Information Categories

- Private information
- Global information
- Local information

Internet
Integration of External Information

- user-controlled mobile nodes inform base stations
- specialized measurement nodes inform base stations
- can improve the self-healing and self-organization functions
Quantitative Evaluation

- prototype is a Perl implementation on a Linux host
- supports a real mode and a simulation mode
- simulation mode runs the prototype in parallel on one host
- topologies generated at random
Convergence Time for Initial Self-Organization

![Graph showing the relationship between Topology Diameter [Hops] and Time [sec]. The graph includes a line for the Mean and a dotted line for the Standard Deviation.]
Spread Time of new Global Information

- Mean
- Standard Deviation

Time [sec] vs Topology Diameter [Hops]
Plug-and-Play Routers: Problems

- router interfaces can run in two modes:
  - IP client mode: the interface receives its IP either statically or from a remote server
  - IP server mode: the IP is pre-defined and the router provides IPs to clients (e.g. through DHCP)
- nowadays: IP address spaces for routers are statically defined
- plug-and-play: need automatic assignment/distribution of IP address spaces
Concept: Management Hierarchy

- management hierarchy to prevent bottlenecks and single point-of-failures
- tree-root manages complete address space
- delegate sub-spaces lower-level routers
- minimize interaction with parent routers
Merging Different Hierarchies

- no address space conflicts:
  - one of the root-nodes becomes overall root
  - the other one attaches
- with address conflicts:
  - same as before, but
  - need to reconfigure parts of the tree
  - might run out of address space
Conclusion

• PnP base stations
  – fully decentralized approach
  – current state
    • prototype available
    • prototype implementation scales well
  – what is the future?
    • need more management applications
    • merge with IP self-configuration
    • more extensive evaluation

• PnP routers
  – partially distributed approach using hierarchy tree
  – preliminary prototype available
  – prototype needs to be refined
  – evaluation has to be carried out
Thanks!

Questions?