Wireless Mesh Networking

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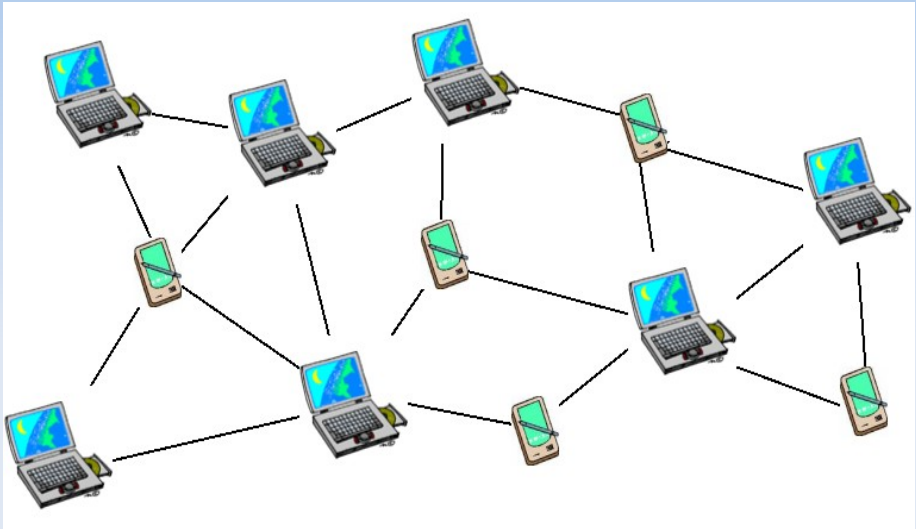
What is it?



A wireless mesh network is a network where the devices connect to each other, rather than to a central server.

- There are three types of wireless mesh networks:
  - Fixed
  - Peer-to-Peer
  - Node-to-Node
- I am focusing on peer-to-peer networks today.

Characteristics

- Dynamic
- Fully Mobile
  - There are *no* fixed devices on the network
- Decentralized
  - Maintenance-free
- Expandable by addition of connections to other networks
- Freedom

Advantages

- Better connection probability
  - For example, cell phones often lack connection because of physical obstruction in the path to a tower.
  - You are more likely to have another device within range, whether or not you are in range of the tower.
- Enhanced reliability
  - By way of route redundancy
- Easier network configuration
  - Essentially, no configuration

Difficulties

- Many devices on one frequency band
  - 2.4GHz spectrum is already busy
- Complicated routing
  - “The biggest challenge”
- Latency
- There's a lot of demand on devices
  - Drains battery life
- Security

Protocols

- Ad-Hoc On-Demand Distance Vector (AODV)
  - This is primarily a routing protocol for ad-hoc networks.
  - It does not build routes until they are needed.
    - Remains silent at other times.
  - Capable of multicast and unicast.
  - Building a Route:
    - When a connection is needed by a node, it broadcasts a request on the network. (RREQ)
    - If another node has the route needed, it sends a reply directly to the source. (RREP)
    - If it does not, it rebroadcasts the RREQ.

Development

- First Generation:
  - In the first generation one radio provides both backhaul (packet relaying) and client services (access to a laptop).
- Second Generation:
  - In the second generation, one radio relayed packets over multiple hops while another provided client access. This significantly improved backhaul bandwidth and latency.
- Third Generation:
  - Third generation wireless mesh products use two or more radios for the backhaul for higher bandwidth and low latency.

Applications

- The one-laptop-per child program
  - This program aims to produce a laptop that costs about $100 for sale to third-world countries to be given to children in an effort to help them learn to interact in our world.
  - The laptop's wireless devices create a mesh network between each other, so that internet access can be spread out across the landscape, where wires don't exist.
  - At the very least, the laptops will be able to communicate with each other locally even if none of them can connect to the Worldwide Web. They may form a mini-web of their own.
  - http://www.laptop.org/en/laptop/hardware/

Other Applications

- Environments with autonomous machines communicating with each other
  - A good example would be a wind farm. The windmills have computers in them that need to talk to each other, and running lines would get expensive.
- Environments where fixed connections are unavailable or insufficient.
  - Such as third-world countries or Upstate New York.
- Cell phones.