

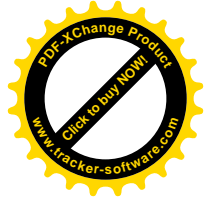
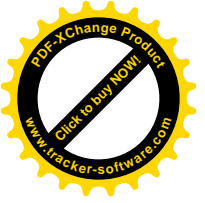
FLUG Wireless Mesh Network Talk

By Jeff Liebermann jeffl@cruzio.com
2015-02-28

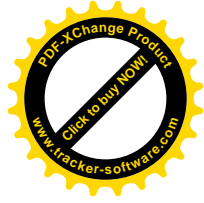
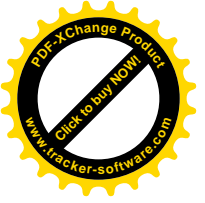
This document located at:

<http://802.11junk.com/jeffl/FLUG-talk-2015-02-28/>

- How Wi-Fi works
 - One transmitter on the air at a time.
 - CSMA/CA. Half Duplex. Store and forward repeaters.
 - Half or full duplex backhaul.
 - Indoor and outdoor are very different.
- Buzzwords etc.
 - Mesh is ad-hoc networking. All wi-fi is on MAC layer 2.
 - Repeater and WDS. Partial mesh, no routing. Acts as both access point and store and forward repeater at same time.
 - Metricom. Partial mesh with geographic routing.
 - WDS, NPG, OLSR, etc
- Routing
 - Each hop reduces max speed by using air time to send extra packets.
 - Table OLSR - Optimized link state routing.
 - Dynamic OLSR - self organizing.
 - Hierarchical CBRP (Cluster based routing protocol)
 - AODV - On Demand Distance Vector.
 - CBRD - Cluster Based Routing Protocol.
- Types of mesh networks.
 - Ad-hoc pretzel. No controller as in infrastructure.
 - Single band store and forward. Most common.
 - Dual band. One for users, one for backhaul.
- Advantages of Wireless Mesh Networks.
 - Saves on cost of wired backhaul.
 - Self configuring, self provisioning, self organizing, self healing, self-monitoring.
 - Grow or move as needed.
 - Standardized as 802.11s with HWMP routing. Used by OLPC for small mesh networks.
http://en.wikipedia.org/wiki/IEEE_802.11s
- Disadvantages or why mesh sucks.
 - Doesn't scale.
 - Maximum speed limited by number of hops.
 - Congestion near wired access points.
 - High collision rate due to hidden nodes.



- o Usually requires omnidirectional antennas, which are not optimum pattern for rooftops. Directional antennas create hidden nodes.
- o What's wrong with this picture?
<http://wndw.net/pdf/wndw3-en/ch08-mesh-networking.pdf>
- o 802.11 not designed for large networks. Polling is more efficient for WISP.
http://www.solectek.com/files/pdf/techtalk/White_Paper-polling_MAC_advantage_v1.2.pdf
- o Indoor vs Outdoor. Few AP's versus thousands.
- o Low percentage of packet delivery due to interference, hidden nodes, and retransmissions. MIT Rooftop Networks.
- o <http://802.11junk.com/jeff1/FLUG-talk-2015-02-28/MIT-roofnet-b.pdf>
- o <http://pdos.csail.mit.edu/grid/pubs.html>
- o <http://pdos.csail.mit.edu/grid/>
- o Speed drops to the slowest speed (802.11b=1Mbit/sec, 802.11a/g=6Mbits/sec)
- o Limited encryption. Must use RADIUS server. Cannot encrypt IP header.
- o <http://telehash.org>
- o Too many wireless mesh routing protocols (70)
http://en.wikipedia.org/wiki/Wireless_mesh_network#Routing_protocols
- o Google does not support Ad-Hoc networking in Android.
- o
- Examples
 - o San Francisco (6 -> 22 nodes per square mile)
 - o Philadelphia (Cost over-runs)
 - o Meraki. Bought by Cisco for \$1.6 billion in 2012 mostly for cloud management technology.
 - o Tropos
 - o
 - o Metricom
- Links and reading
 - o Wireless Networking in the Developing World
<http://wndw.net>
 - o <http://www.muniwireless.com>
 - o <https://www.eero.com>
- Speed slowdown with repeater demo
 - o <http://www.techrepublic.com/blog/linux-and-open-source/using-jperf-to-check-network-performance/>
 - o Iperf <https://iperf.fr/>
 - o Jperf <http://sourceforge.net/projects/iperf/files/>



- Jperf
<https://code.google.com/p/xjperf/downloads/detail?name=jperf-2.0.2.zip>
-