Wireless technology for last mile access

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Technologies

- 802.11 family
  - 802.11B/G
  - 802.11A
  - 802.11N
- 802.16 family (WiMAX/WiBRO)
  - 2004 “fixed WiMAX”
  - 2005 “mobile WiMAX”
- LMDS MMDS and DOCSIS for “wireless cable”
- Motorola Canopy, Proxim, others (proprietary)
- Cellular Technology family
  - CDMA (EVDO)
  - GSM/UMTS/HSDPA/HSUPA/LTE
  - PHS

802.11 Family

- 802.11 Legacy –
  - 2Mb/s
  - Fhss
  - Circa 1997
  - Source of the original band plan for 2.4Ghz ISM band
- 802.11a –
  - 54Mb/s symbol rate,
  - 23 Mb/s throughput
  - OFDM 8 indoor and 3 outdoor (non-overlapping) channels in the 5Ghz ISM band
  - Originally much more expensive to implement that 802.11b

802.11 Family - continued

- 802.11b
  - 2.4Ghz
  - 11 Mb/s symbol rate
  - 4.3Mb/s throughtput
  - DSS
- 802.11g
  - 2.4Ghz
  - 54Mb/s symbol rate
  - ~19Mb/s net throughput
  - OFDM

802.11 Family - continued

- 802.11n
  - 2.4Ghz and/or 5Ghz multiband
  - 300Mb/s data rate (for 2 streams)
  - ~75Mb/s throughput
  - Draft expected to be ratified in 2009
  - Typical AP and client implementations will have 2-6 air phys.

802.11 Family Shared Characteristics

- Common traits:
  - Newer version generally downwardly compatible with older versions in the same band.
    - With some performance penalties for supporting the older versions
  - Can step down to lower rates in order to support greater distance (link budget) or better noise rejection)
  - Separately defined Multicast and Broadcast rates.

802.11 Family Shared characteristics

- BSS (Basic Service Set) – “Ad-hoc Mode” (not supported by 802.11a)
  - Hosts are individually responsible for participation in the network.
- IBSS (Infrastructure Basic Service Set)
  - One node, the AP is responsible for coordinating:
    - Authentication of wireless clients
    - Handling channel contention
    - Repeating packets
- Ethernet style CSMA/CD shared medium
  - Coordination on some elements in IBSS mode, for example:
    - Beacon interval
    - Basic rate and wakeup interval (for power saving)

WiMAX

- Worldwide Interoperability for Microwave Access
- Two standards
  - 802.16d (2004) Fixed
  - 802.16e (2005) Mobile
- Originally started as an effort to standardize a high-speed wireless backhaul method for 10-60ghz microwave systems. Basically Point to Point in this role

WiMAX - Continued

- Evolved towards wireless Metro-area-network technology in this role it competes against DSL and Cable as an last mile access technology
- Added mobility (via embedded mobile ip) to the mix, considered a competitive alternative to 4G (LTE for example) cellular systems.
- The density of a deployment for the support of fixed vs mobile use cases is rather different.

WiMAX - Continued

- Properties:
  - Up to 70Mb/s data rate
  - Up to 50Km range
  - Not both at once
  - 10Mb/s at 10Km is more realistic in non-built-up areas
  - Time Division Duplex scheduling algorithm assigns time slots to clients and the BST to deterministically assign bandwidth up and downstream.

WiMAX Deployment

- Fixed and Mobile systems for last-mile are generally deployed in 3 approved licensed profiles in 2.3Ghz 2.5Ghz and 3.5Ghz (start lobbying your regulator)
  - Sprint/Clearwire in the US are deployed in the 2.5Ghz band which is shared with legacy ITFS television applications.
- Also in the 5Ghz ISM band, though traditional carriers are unlikely to deploy last mile on that. (Could easily work for WISPS)

WiMax Deployment - continued

- In North America 700Mhz may be used in the future (Following the retirement of analog TV) in Europe blocks in the 500-800mhz range are being considered for this application (follow what's going-on in ITU-R and what your local regulators thinking is in this area.
- Variable width channels 3.5 5 7 10 Mhz for fixed, 5 8.75 and 10 Mhz for mobile. Allow you to slice and dice spectrum depending on availability.

LMDS/MMDS

- A legacy technology
- Notable because there are some successful deployments in Asia
- Based on the Docsis cable standard,
- Roughly speaking 11 * 10 MB/s channels
- Like Cable plants and DVB sattelite systems bandwidth is asymmetric due to the shared nature of the return path
- Requires dedicated spectrum (successful deplyments in the US used the ITFS TV bands

Canopy

- Proprietary but popular with the WISP community.
- Available point to multi-point frequencies include 900Mhz, 2.4Ghz, 4.9Ghz, 5.3Ghz, 5.4Ghz, and 5.7Ghz with
- PTMP speeds include 4.4Mb/s 7Mb/s and 14Mb/s
- Shares the TDD property with WiMAX

Canopy - Continued

- Proprietary features mimic cellular BST features
  - GPS synchronized transmission on the same frequency by adjacent radio systems for example.
  - Typical CPE have a range of 5-6Km
- Canopy point-to-point backhaul 7 and 14Mb/s up to 300Mb/s throughput using dedicated hardware.
- Motorola hedging it's bets on WiMAX

Proxim Tsunami .11/MP/.16

- Another popular MP wisp platform. mix of standards based and mildly proprietary 802.11 derived gear.
- Also hedging the bets with WiMAX

Cellular Technology

- Oddly enough people do deploy them for fixed or mobile data specific applications
  - American Samoa EVDO rev A deployment for example.
- Current work with Micro/Nano/Pico BSTs is producing equipment that's less costly than a traditional BST
- Liscensed spectrum.
- Data-only applications potentially have different regulatory requirements than becoming a “telco”

Cellular Technology - Continued

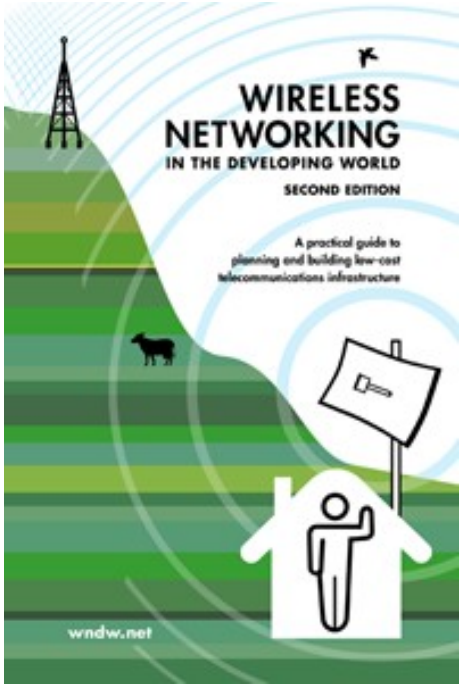
- For geographically limited networks interoperability may not be an issue.
- CPE is mature, relatively cheap
- Long term evolution path
- If you're building a Telco anyway or are one already, why not?

My Take

- WiMAX has an air of inevitability about it
  - But it's been pretty much a wash thus far.
  - The reliance on licensed spectrum makes it safe for carriers but adds a significant initial hurdle to deployment. On the mobile and consumers it's also a barrier.
  - This model has working for cellular vendors for almost 2 decades now.
- Proprietary gear engineered around specific needs has been a staple of early WISP deployments in all sorts of emerging markets.
- But...

My take – Part 2

  - It's frequently costly
  - You end up tied to a single vendor
- WIFI derived technology is “unreliable” due to:
  - Shared spectrum
  - Shared collision domain
  - Diversity of implementations
- But:
  - Fast and unreliable (within limits) frequently beats slow and reliable (consider Ethernet vs ATM Ethernet vs SDH etc)
  - It's cheap...
    - The wisp business consumes the older generation technology (RF, chipsets, etc) as the consumer electronics industry moved forward which means we benefit from massive economies of scale without having to invest in them.



My Take - part 3

- The enterprise side of the wireless business is investing in fairly heavy-weight centrally managed systems (Aruba, Cisco Meru etc)
- These have their benefits especially if you're looking to solve a mobility problem along the way, but they come with a lot of overhead and expense that may be unecessary.

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