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Wireless: The headache you can't see!

(WISP Challenges & Lessons Learned – the hard way…)

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Agenda

- **Why Fixed-Wireless?**
- **Today's Fixed-Wireless Technology**
- **Challenges**
- **Lessons Learned**
- **What's next? → WiMax**

Why Fixed-Wireless?

- **Fixed-WISP business is booming**
  - Market-segment in 2005 – $16.8M
  - Market-segment in 2009 - $1B (projected)
  - Market consolidation well underway (M&A)
  - Operators are growing with excellent profit margins

- **Improved Equipment / Coverage**
  - Overall technology has improved (better performance, further distance, more frequency options)
  - Costs have radically declined for both access and back bone network wireless equipment
  - Wireless provides 5-6 times the service area of DSL, and 2.7-3.3 times the service area of T1

- **Public Perception!!**
  - “WiMax” has increased overall awareness of WISP opportunities
  - Proven track record and referrals from other customers

Fixed-Wireless operates using microwave technology…

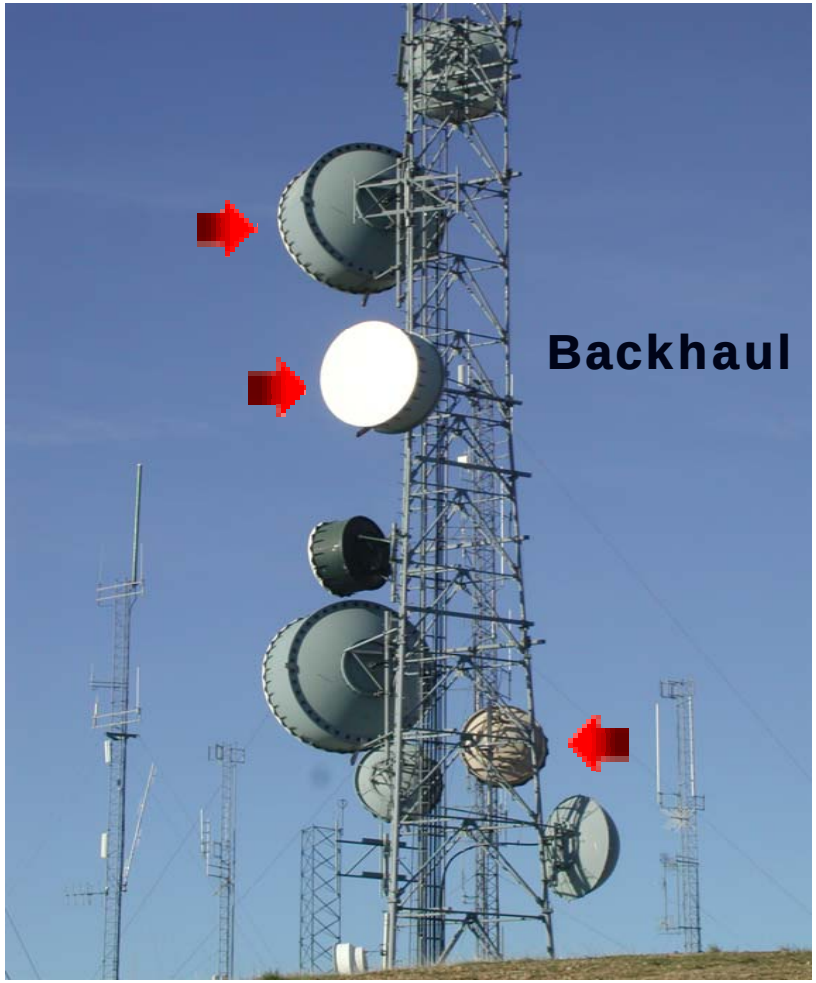
Technology (cont'd)

- **Fixed wireless – NOT WiFi or cellular-based technology**

- **Wireless Back Bone Network (Back Haul)**
  - Frequencies: 11GHz, 18GHz, 23GHz, & 38GHz licensed frequencies
  - Point-to-Point
  - Range: up to 10 miles between sites (depending on frequency used)
  - Capacity: up to 800Mbps (that's all and not available everywhere!)

- **Pre-WiMax Wireless Access Network (AP/SU)**
  - Frequencies: 2.4GHz / 5GHz unlicensed spectrum
  - Point-to-Point or Point-to-Multipoint
  - Range: up to 8 miles (can increase distance with external antenna)
  - Capacity: up to 10Mbps
  - LOS (Line of Sight) to AP – typically required
    - Some NLOS products available…

Technology (cont'd)



Challenges

- Deployment
- RF Spectrum Management
- Access Network Technology
- Site Issues (Access, Security)
- Environmental Issues

Challenges (Deployment)

Must haves!!

- LOS (Line of Sight) **YES!!!**
- Available Frequency **YES!!!**
- Cabling / Internal Wiring **YES!!!**
- Roof Access (space on roof?) **YES!!!**
- Weather Proofing **YES!!!**
- Power **YES!!!**
- Tools (ex: Crane, Helicopter) **YES!!!**
- FCC/FAA Permission **YES!!!**
- City/State Permits **YES!!!**

- Numerous cases where we also have to paint the subscriber unit to match external building color

- Numerous cases where we have to deal with foliage, etc… (we try to make yearly contributions to the Arbor Day Foundation)

Challenges (Deployment)

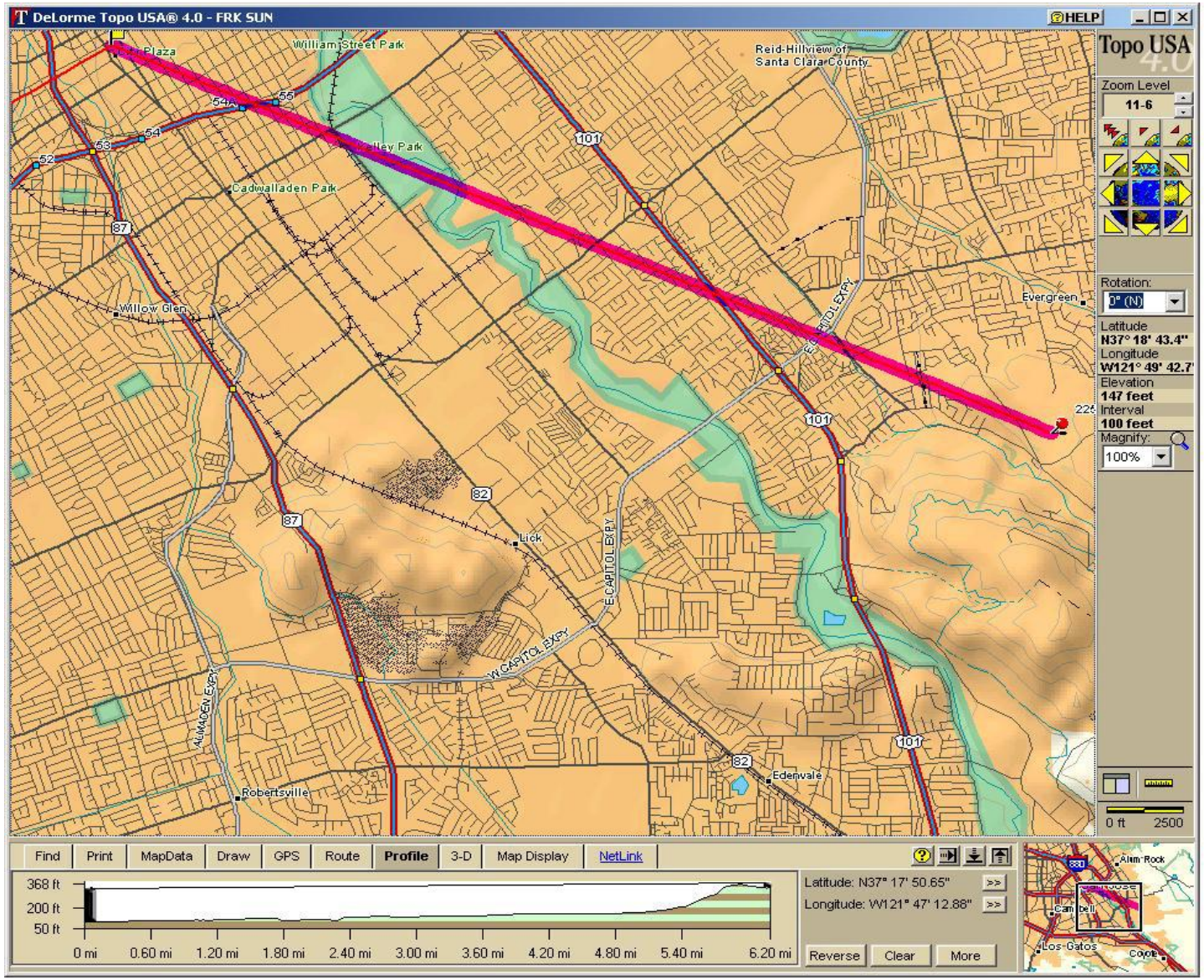
Typical installation at base station (wireless POP) – property owners don't want any more antennas installed!

Challenges (RF Management)

"RF knows no masters, only friends…"

- **<u>Licensed Spectrum (Back Haul)</u>:**
  - Requires FCC prior-coordination to 'light up' microwave between two points (application approval can take up to 90 days)
  - FCC 'rules' govern your network build out
    - Illegal to turn up link without frequency PCN – can get fined!
    - If requested frequency isn't available, you can't use your "engineered" design
  - Requires true engineering (path profiling, link budget, site surveys, power limitations, weather, etc)
    - In-house work can turnaround within a couple of business days – if you require a site visit or structural analysis you could be waiting days, weeks, even months!
  - FCC does not guarantee interference free communication on a licensed path

Challenges (RF Management)



Not all problems are RF related

Terrain

Challenges (RF Management)

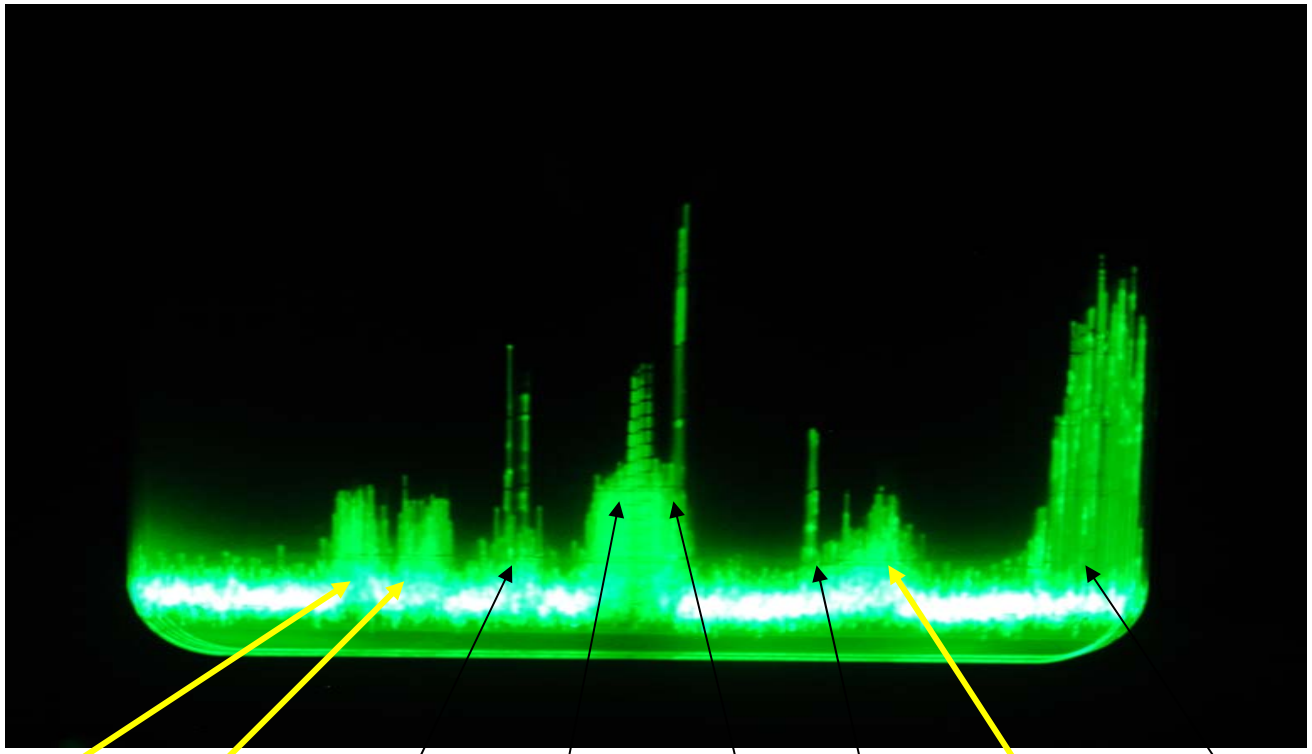
- **Unlicensed Spectrum:**
  - UNII band (part 15) – first come first serve spectrum use so you have to find a way to co-exist with other WISP's or operators using the same unlicensed band
    - Illegal to restrict other operators just because you were there first!
    - Landlords are aware of this rule and therefore you can't have exclusivity in your contracts when it comes to spectrum usage
  - Ever changing environment – today your link works and tomorrow it doesn't because someone turned up new gear in the same frequency (or in your path)
  - Sub-6 GHz spectrum will become increasingly congested as various wireless devices proliferate
    - (ex: cordless phones, WiFi routers)

Challenges (RF Management)

It’s a jungle out there!!!

Challenges (RF Management)

Using a spectrum analyzer to find interference… and possibly a new available frequency? (sample 5GHz energy output)



Challenges (Access Network Technology)

- **Current wireless access network gear does not follow IEEE 802.16d standard**
  - Depending on the wireless product deployed, WISPs may encounter the following limitations:
    - No VLAN support
    - No protocol support (ex: OSPF, BGP)
    - No standardized security (ex: DES, AES)
    - Giant broadcast domain within a wireless sector
    - No authentication mechanisms (NAC)
    - Half-duplex transmission (single frequency)
    - Frequency hopping (varies by product)
    - CPU load limitations
    - Limited troubleshooting tools (limited tools for WISPs / vendor specific)
    - However!! For some of these, there are some simple workarounds - they just cost $$$... (ex: CPE router)

Challenges (Site Issues / Access & Security)

- Many of our base stations are located atop mountains with no physical security
- The mountain tops are shared with other operators (competitors!)
- At our base station, people cutting cables and / or steal our gear
- At the customer prem, we've had roofers remove our gear because they had to do their work

Challenges (Environmental)

"I'm sorry, the reason why your service is down is because our base station is on fire! Thanks for calling."

Lessons Learned

- **Deployment**
  - Installs must be tailored for the environment – how we install in Chicago is totally different compared to Southern California (ex: in Chicago we apply special coating to access gear so ice doesn't form or radome to cover antenna face protecting feed horn)
  - Customers with poor LOS/signal levels are not installed due to problematic service quality issues that are irresolvable (challenge for new carriers looking to grow revenue)
  - Developed customer-install documents for each antenna-type and forged relationships with property owners… otherwise they wouldn't let us install!
  - Adequate backup battery power at base stations - we can't get site generators so we have to load up on battery packs to maintain SLAs (road traffic!)
  - Professional install required… no self-install CPE for end-user
    - Hard to find the right people who understand WISP operations to install! Field OPS guys are not formally educated to understand RF.

Lessons Learned (cont'd)

- **RF Management**
  - Huge amount of effort required up-front in doing channel allocation planning… and wireless RF Engineers required. Furthermore, tools required to do planning are VERY expensive!
  - Self-induced interference is a common problem – you could be working on a site in Santa Clara and someone in San Jose is complaining!
  - Due to FCC-rules, you sometimes have to manually congest airwaves to protect your spectrum in use
  - To manage/mitigate the impact of unlicensed fixed-WISP operators, we formed a group called BANC – Broadband Access Network Coordination (www.wbanc.com) and we work with others to publish used frequencies at common sites
  - The long term viability of any wireless carrier (ex: WISP) depends on it's ability to obtain licensed spectrum ($$$,$$$,$$$)

Lessons Learned (cont'd)

- **Technology**
  - Pre-WiMax really wasn't designed to deliver multiple services (VoIP, Video) – it was focused on Internet access. Manufactures and operators worked hard to catch up with one another.
  - Due to product design, limited RF channels were available so we couldn't deploy certain access network gear – we had to find a way to hack the product to give us more channels which led to more spectrum options.
  - Depending on the requirements, we had to deploy different vendor's technology to meet needs… interoperability and OPEX increase with non-standard gear but we didn't have a choice.
  - Depending on how the product was designed, we had to adjust network design.
  - We had to develop our own tools to support the technology because, until recently, manufactures didn't have a formal NMS/EMS tool.

Lessons Learned (cont'd)

- **Site Issues (Access/Security)**
  - Due to vandalism issues, we had to use higher quality locking cabinets, install security systems and cameras.
  - Limited access to certain sites at night time due to safety issues – we adjusted our working schedules accordingly to still meet SLA guidelines.
  - We needed to purchase 4x4 vehicles to access terrain challenged sites and roadways affected by weather.
  - We have employed armed guards at every site! ☺
- **Environmental**
  - RF Planning has a lot to do with this… design needs to compensate for environment in which it's deployed.
  - Develop install procedures for different environments – no 'one-size fits all'

Lessons Learned (cont'd)

- **General**
  - Like all big network operators, we realized that we needed to implement proper OA&M procedures (small WISP's don't consider this a priority because they are worried about staying in business)
  - And for our roofer friends…we have added a sticker to our gear that says:

"Warning – this device is electrically charged and may emit a high power shock!"

What's Next?

- **WIMAX (802.16d)**

  - **True WiMax certification requires "WiMax-forum" approval** (guarantees interoperability)

  - **Key Advantages:**
    - Lower Cost, Wider Coverage, Higher Capacity
    - Supports more 'network' related features
    - Standard for all usage models (fixed → mobile)

  - Currently running field trials on 'sample' gear. However, key challenge still exists: "We don't know what we don't know" because gear is just starting to ship.

  - Our first shipment of 802.16d gear scheduled to arrive – EoQ2

  - FMC?

* THANK YOU *

ANY QUESTIONS?

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