Broadband Wireless Access Technologies and Applications

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Emerging Technologies

International Symposium on Advanced Radio Technologies
Agenda

• The Wired Network
• Wireless Access Technologies
• Wireless Trials
• ILEC perspectives
• Broadband Wireless Applications
• Summary
The Wired Network

Central Office

OC-3

DS1 - DS-3

Copper

Hi-Cap Business

POTS/DSL

OC-3

Copper

RT

DS0 - DS1

Residential Access
(the last mile)

USAM

Copper < 4kft

VDSL
Wireless Access Technologies

- Hi-Cap Business 20-40GHz Fixed Terrestrial Wireless Optics
- Residential Wireless Data & Voice Fixed Wireless Access (FWA) < 5.8GHz
- Residential Ultra High Speed Access Fixed Wireless Access (FWA) > 10 GHz
- Home RF Ntwks.
  - TV, PC, POTS
- Small Business 20-40 GHz Fixed Terrestrial Wireless Optics
- DS0-DS1
- Hi-Cap Business Satellite 20-40GHz
- OC-3
- DS1-DS3
- Central Office
- Central Office
- OC-3
- OC-3
Wireless Access Technologies

Hi-Cap Services - Terrestrial

• Markets - Large to Medium size businesses
• Products - OC3 and DS3 Data Services
• Spectrum 20-40GHz worldwide or Wireless Optics
• Major Players - Winstar, Teligent, Nextlink, ART
  Air Fiber, TerraBeam
• Current Technologies - Point to Point/Multipoint

  **Strengths:** Low installation costs, re-usable

  **Weaknesses:** LOS, Roof costs, Links too short

• Future Technologies - Mesh Networks (MP2MP)
Hi-Cap Services - Satellite

- Markets - Large to Medium Businesses/Residential
- Products - Fractional DS3/DS1 Data Services/TV
- Players - Astrolink, Spaceway, SkyBridge, Teledesic, Hughes & Gilat, DBS: Echostar, DirectTV
- Current Technologies - LEO, GEO, VSAT, DBS

**Strengths:**
- Large coverage area
- Rural coverage
- Wide downstream bandwidth
- Broadcast services

**Weaknesses:**
- High Latency in GEOs
- Satellite complexity in LEOs
- Sat lifetime 7-15 years
- CPE costs
- Installation
Wireless Access Technologies

Fixed High Speed Access - Terrestrial

- Markets - Small Business, SOHO, Residential
- Products - T1 Data, Fast Internet Access, Telephony, TV
- Players - Sprint, American Telecasting, CAI Wireless, AT&T, MCI Worldcom, United Online, ...
- Current Technologies - MMDS, Unlicen. (2.4, 5.8 GHz)

**Strengths:**
- Longer Links
- Flexible Architecture
- Low Entry Costs - Unlicensed Bands
- Fast Deployment for High Speed Internet Access

**Weaknesses:**
- LOS typically required
- External Antenna Installation on home
- Frequency Re-Use
- Interference Management
- Backhaul $
Wireless Access Technologies

Fixed Ultra High Speed Access - Terrestrial

- Markets - Small Business, SOHO, Residential
- Products - Ultra High Speed Data, Telephony, TV
- Players - Qwest, Korea Telecom, BT, France Telecom
- Current Technologies - VDSL (22 Mbps down, 3Mbps up)

**Strengths:** Uses existing Copper, Supports voice/data/video

**Weaknesses:** 4000 ft. reach, Requires OC3/12 backhaul

- Future Technologies - Fixed Wireless Multipoint to Multipoint
Wireless Access Technologies

Home RF Networking

- Markets - Small Business, SOHO, Residential
- Products - Wireless LAN, Home Gateways, Portables
- Players - Aironet, WiLAN, Proxim, NEC
- Current Technologies - 2.4GHz/802.11, 64GHz/IEEE1394

Strengths: Avoids Rewiring homes, Multiple clients, Portability, Access sharing, Flexible reconfiguration of home LAN

Weaknesses: High Costs, Lack of security, Not all voice/data/video services supported

- Future Technologies - Home Gateway/Distribution
Wireless Access Trials

LMDS Trials - Vladan Jevremovic

• Boulder Technical Trial (Nov. 16-20, 1998)
  31GHz / B-block, 1.85 mile link
  Spectralink SP1000, Point to Point, 10MHz / 8T1
  Examine: Fade Margin, Cross Polarization Isolation, T1 Loopback
  BER, XDSL Interoperability, Voice, Data

• Front Range Customer Trial (10/99 - 3/00)
  31GHz / B-block, 6 mile link, Spectralink SP1000
  Held Order - No Fiber, Needed Voice & Data Services
  99.98% reliability / 1.75 hours of outage per year
  No customer complaint logged during trial
Wireless Access Trials

Optical Trials - Thomas Schwengler

• Lucent Visit (Oct, 1999)
  Multibeam (4Tx & 1Rx), 1550nm, 2.5Gbps
  Low BER ($10^{-12}$ observed), 100% BER in Fog

• Long Range Lightpoint Trial (1/00 - present)
  Multibeam (2Tx & 4Rx), 850nm, OC-3/OC-12, Comm Available

• Short Range Lightpoint Trial (7/00 - present)
  Link < 1mile, Low BER ($10^{-12}$ observed in clear weather)
  Single Beam, 850 nm, DS-3/OC-3/OC-12, Comm Available
  Gigabit Ethernet Trial (9/00)
Wireless Access Trials

Fixed Wireless Internet Access - WBU

• Adaptive Broadband Technical Trial
  5.8GHz Unlicensed UN-II band
  TDMA TDD Technology, 3-6 sectors per Base Station
  17.5 MHz channel per sector = 20 Mbps/Sector
  Subscriber Unit Outside Home - LOS to Access Point
  Tested Interference Susceptibility, Spectral Emission, Application tests, Network stability, EMS beta testing
  Application - High Speed Internet Access (W-DSL)
  Friendly Customers Trial
ILEC Perspectives

- Broadband Wireless Access Equipment Costs are not driving the business case costs
- Re-occurring Roof leases, operations costs and CPE Installation costs are the business case cost drivers
- Self installation, and plug and play hardware is critical
- Reliability of Wireless Access Technologies < Fiber when considering all weather conditions
- Optical links and Microwave links are complimentary and can provide high reliability when used together
- New Access Technologies are expensive to scale into large ILEC provisioning systems
ILEC Perspectives

- In Region - New Revenues only from data services (No Long Distance revenues, Local Voice not new revenue)
- Excellent for CLEC out of region play in small markets
- Will bring fiber further out and closer to the home; Wireless can help with last mile solutions (e.g. DSL reach extension & gap fill strategy)
- Need wireless access technologies that will support the next generation services (VoIP, VPNs)
- Need network integration and product interoperability
- Need technology to mitigate LOS requirements/cost
- Need residential and SOHO broadband wireless access that looks like DSL service to our customers
Broadband Wireless Applications

- Applications care about layers 3-5 (Not Layer 1)
- The “Killer” Applications:
  Residential - Fast Internet, Voice, Television
  Business - Data, PBX, VConf, VPNs, ASPs, Web hosting
- Emerging Technologies:
  Voice/Video over IP - (MPLS, Diffserv, IPv6)
  Mobile IP
  Gigabit Ethernet
  Passive Optical Network
  Optical switching
Summary

• Wired access technologies have a wireless equivalent
• CLECs well suited to implementing Broadband Wireless in areas where competition is weak & service lacking
• ILECs concerned about scaling and integration
• DS1-DS3 data is moving toward edges of network
• Wireless access networks can and will connect to core fiber networks (Mobility and Portability increase access)
• Application compatibility with Layer 3 and up are critical to successful services