Broadband Wireless Access Technologies and Applications

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Emerging Technologies

Agenda

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

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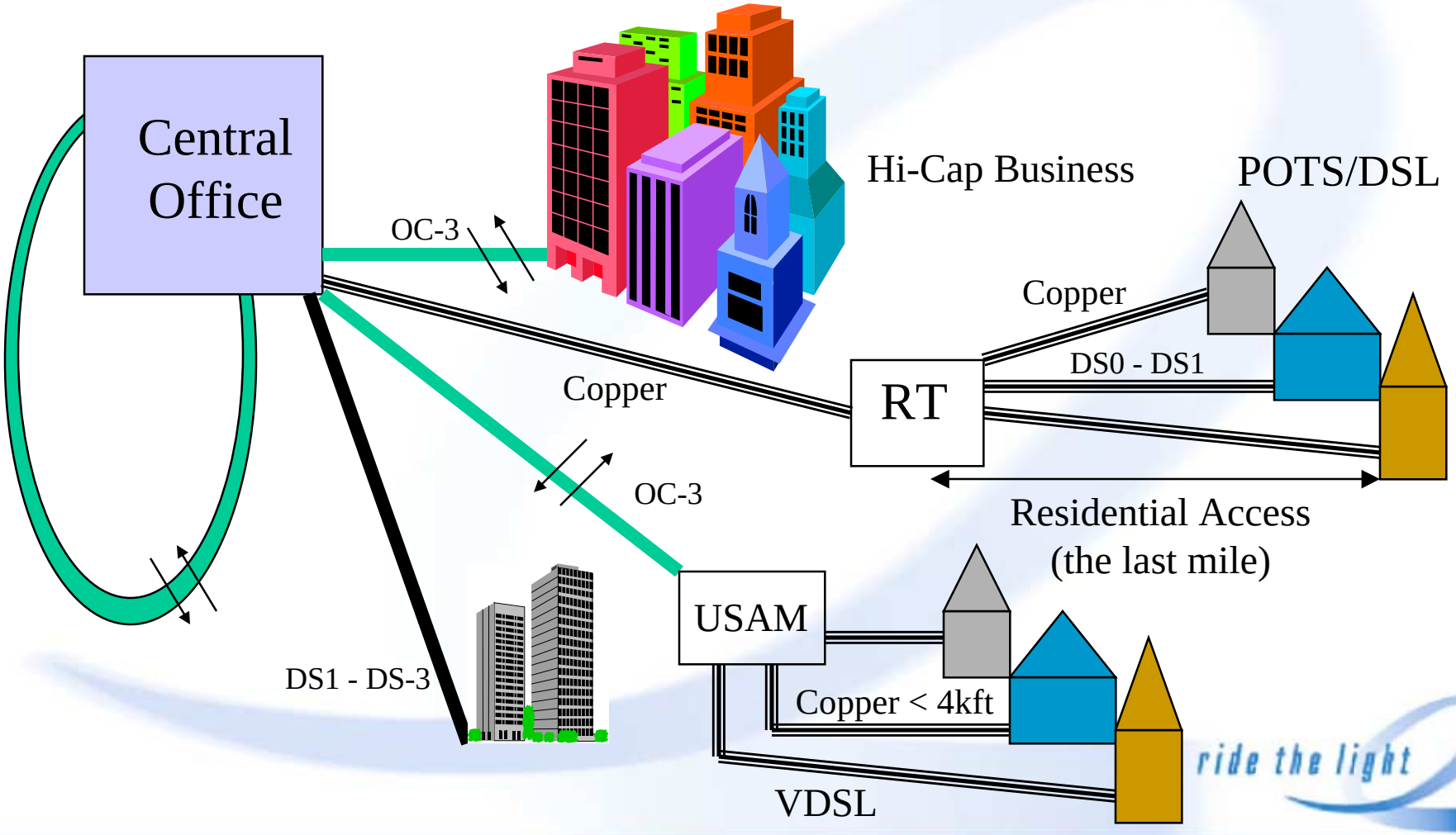
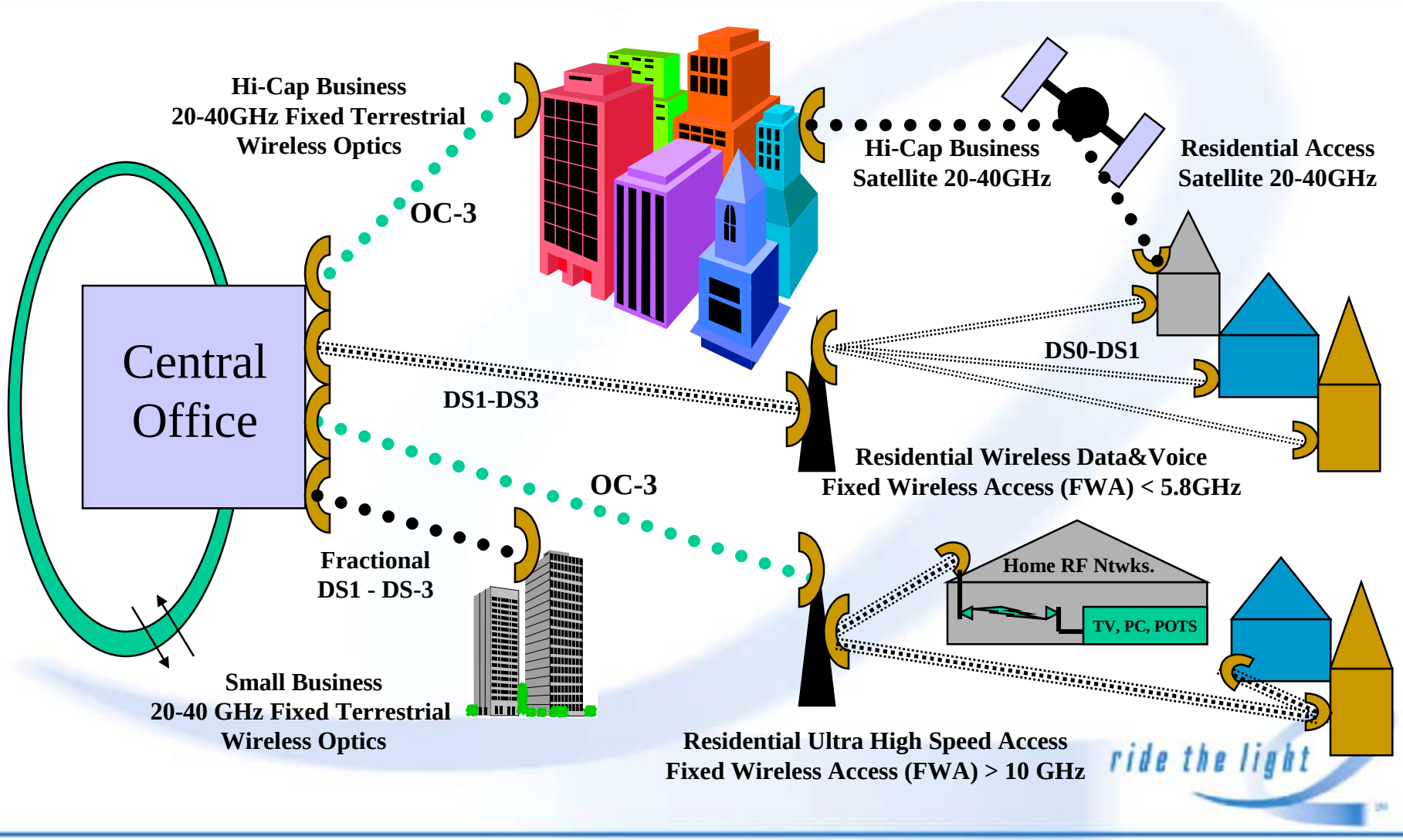
The Wired Network



Wireless Access Technologies



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)**

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Wireless Access Technologies

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

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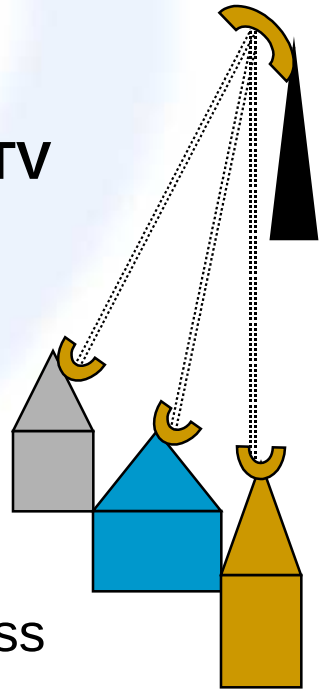
Wireless Access Technologies

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 $

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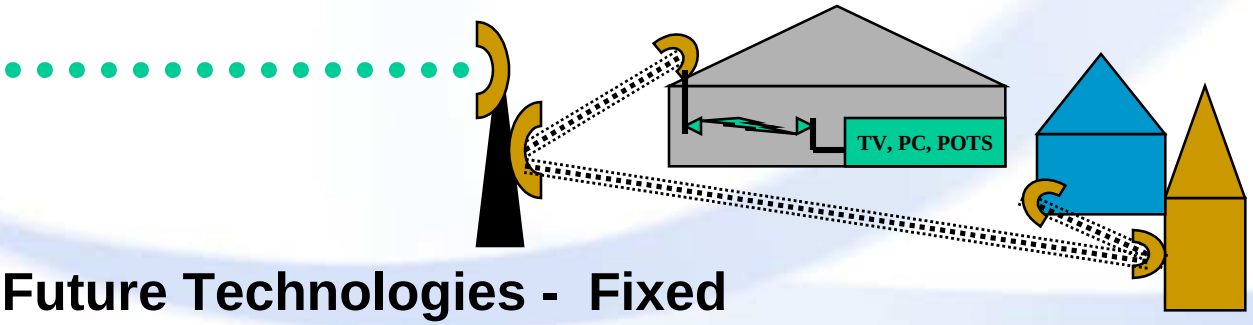
Wireless Access Technologies

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**

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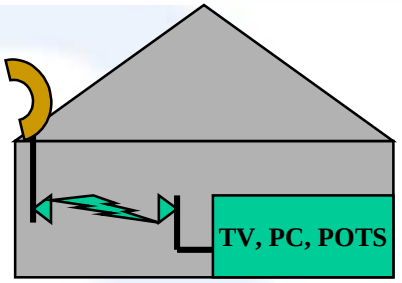
Wireless Access Technologies

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**

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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

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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)**

  Long Range Link - 1.85 miles, Walnut CO - Adv. Tech.

  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)

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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

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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**

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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

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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

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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

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