

Lawrence Behr Associates, Inc.

Notes on the “Last Mile”



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Inspiration



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Topics

- Background
- Backhaul Through the Eyes of the Wireless Carrier
- Cost Comparison
- “Old” Wired Backhaul Architecture
- “New” Fiber Backhaul Architecture
- Fixed Wireless Backhaul

Background

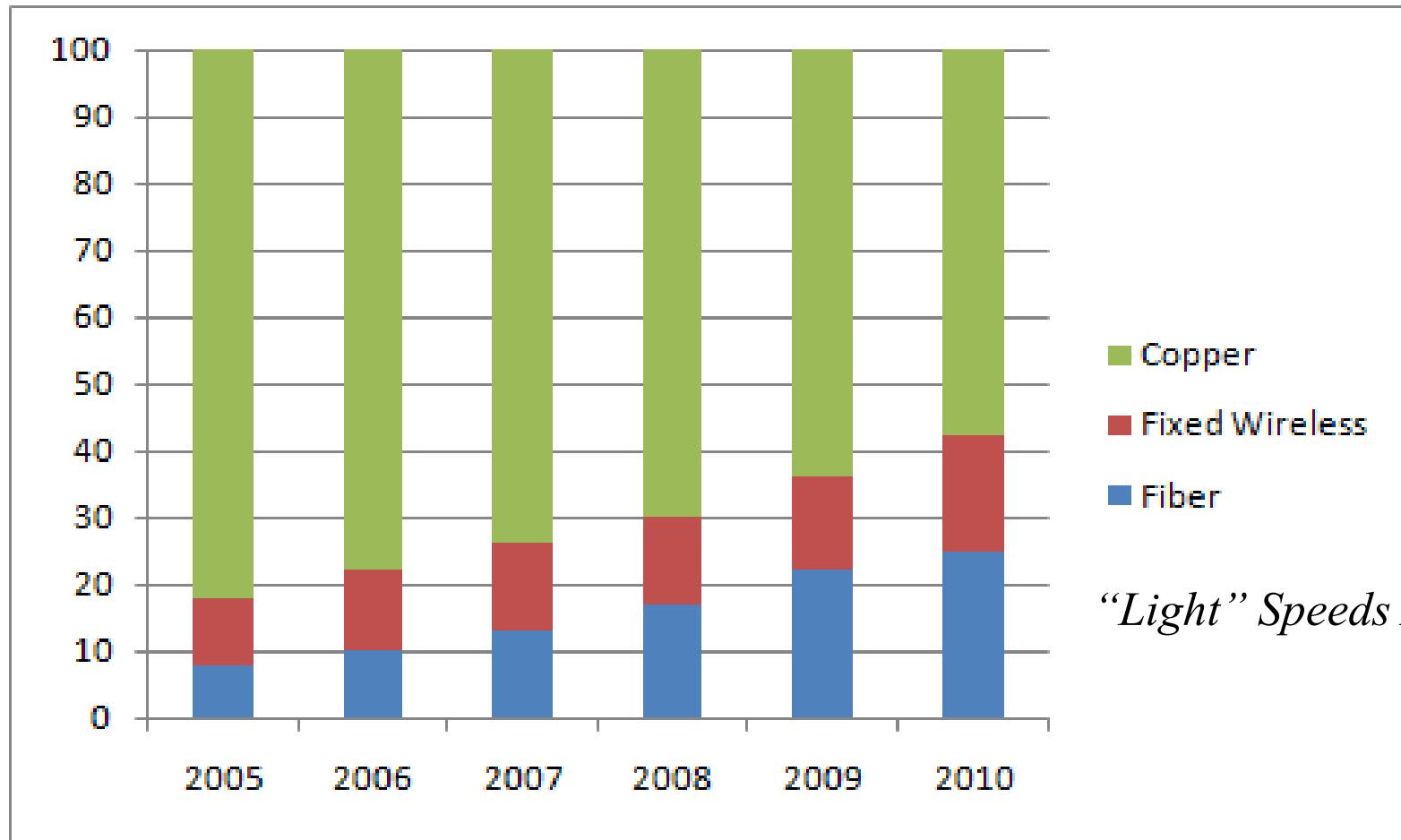
- **The rise of data volume in wireless networks**
- **Fiber Fed IPTV and “Mobile Broadband” (AT&T Uverse vs. 4G mobile TV)**

Backhaul Bottlenecks

Backhaul "bottlenecks" is the key 2010 network issue for 3G wireless service providers.

Advice to Operators: Long term planning for IP based networks is crucial for high speed wireless (ie LTE, WiMax and 4G).

Cell Site Backhaul by Physical Medium



“Light” Speeds Ahead

Source: Wireless Carrier

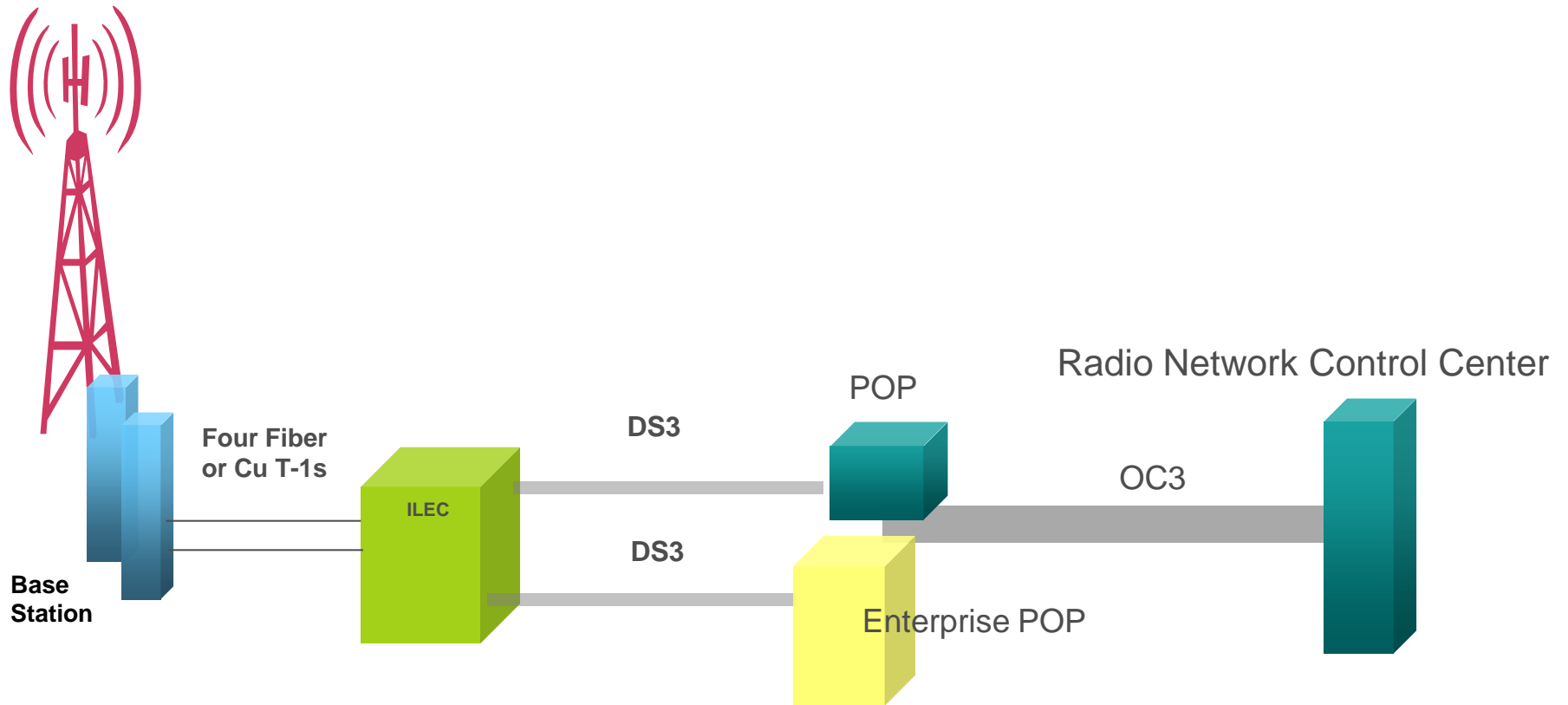
Fiber Availability vs. Microwave Reliability

Is Fiber *available* in rural areas for a network of wireless cell sites? If not, do you have the \$\$ to build the network?

If not, will a multi-site fixed wireless backhaul network be reliable to meet customer demands?



Old Wireless Backhaul Architecture



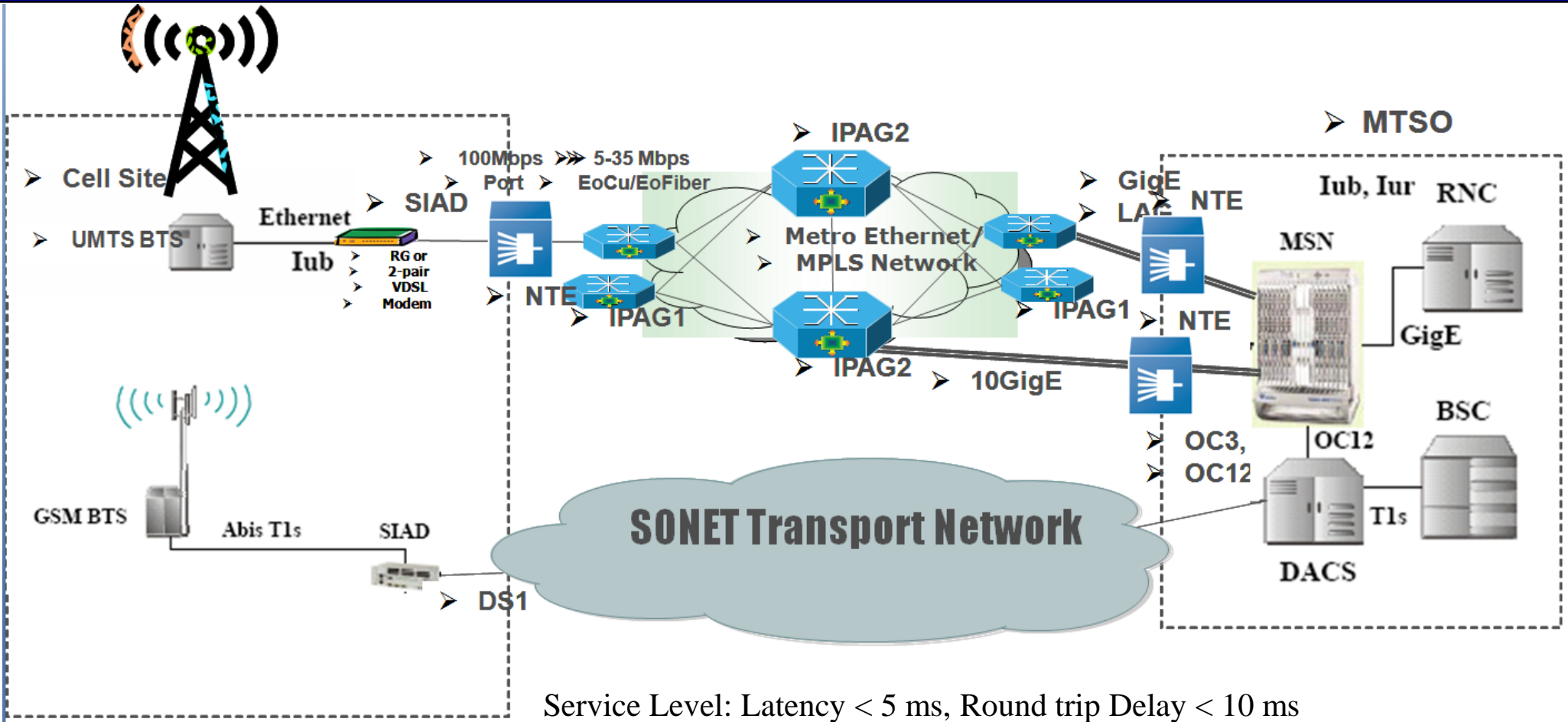
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New Fiber Backhaul Architecture



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A Wireless Carrier View on Microwave Backhaul

- **Deploying multiple T-1s in a timely manner can be problematic so wireless backhaul is becoming slightly more popular among transport engineers**
- **Periodic maintenance of microwave equipment (seldom needed on fiber transport)**
- **Microwave equipment needs to be periodically upgraded
Hardware upgrades are high capital expenses**
- **Expensive tower leases**

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ILEC Cost Comparison Fiber vs. Microwave

Fiber T-1 (per base station)

- \$450 per month \approx \$5000 annually
- Eight T-1s \approx \$3500 per month (common for 3G data)
- 12 T-1s or buy DS3 \approx \$6000 per month (required for LTE)
- Low maintenance, high bandwidth capacity, power limitations
- Base station equipment costs, Call before you dig!

Microwave T-1 (per path)

- 2.5 GHz , 50 Mbps, 23 dBm, 3 mile path \approx \$ 5000 fixed
- 11 GHz, 300 Mbps, 12 mile path \approx \$15,000
- Install costs \approx \$5000 to \$10,000.
- Maintenance \approx \$2000 annually except for cold winter regions
- Reliability

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Fiber Only as Backhaul

- **Advantage - Optical fiber with “infinite” bandwidth. OC-3 capacity 155 Mbps. Fiber can be used for wireless backhaul, IPTV and future services**
- **Advantage - Lease fiber to others.**
- **Disadvantage - Installation time and costs**
- **Disadvantage - 10 km single-mode fiber (SMF) using 1310 and 1550 wavelengths with 10 mW power threshold**

Vendor View on Microwave Backhaul

- **MW Backhaul offers dependable T1 transmis.**
 - **BER < 1×10^{-6} @ sensitivity threshold**
 - **23 dBm transmit power**
- **Easy transition to IP**
- **Links that are fast (50 Mbps) and easy to install**
- **Links that work in a variety of conditions**
- **23 dBm transmit power**
- **Reasonable “Total costs”**



Question

Will the \$ 7.2B public funding really see a return on our investment?

Will public funded access bring high-speed broadband to bona-fide rural areas serving critical needs, not just enhancing existing networks?

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