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November 19, 2009

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NOV 19 2009

Federal Communications Commission
Office of the Secretary

Ms Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: *Comment Sought on International Comparison and Consumer Survey Requirements in the Broadband Data Improvement Act*, GN Docket No. 09-47; *A National Broadband Plan for Our Future*, GN Docket No. 09-51; *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, GN Docket No. 09-137

Dear Ms. Dortch:

On November 18, 2009, William Hunt, Monisha Merchant, Jeff Martin and Nicholas Pujet of Level 3 Communications, LLC ("Level 3") and the undersigned, on behalf of Level 3, met with Carlos Kirjner, Senior Adviser to the Chairman on Broadband, and Arnab Das, Kevin King, Tom Koutsky, B.J. Neal and Stagg Newman, all of the Omnibus Broaband Initiative. Level 3's presentation is summarized in the attached documents, copies of which were provided to the FCC participants.

During the course of this meeting, Level 3 referenced the fact that it has applied for BIP/BTOP support for opening up additional access points along its fiber backbone.

Sincerely,

John T. Nakahata
Counsel to Level 3 Communications, LLC

cc: Carlos Kirjner
Arnab Das
Kevin King
Tom Koutsky
B.J. Neal
Stagg Newman

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Perspectives On Broadband Backhaul Economics

November 18th 2009

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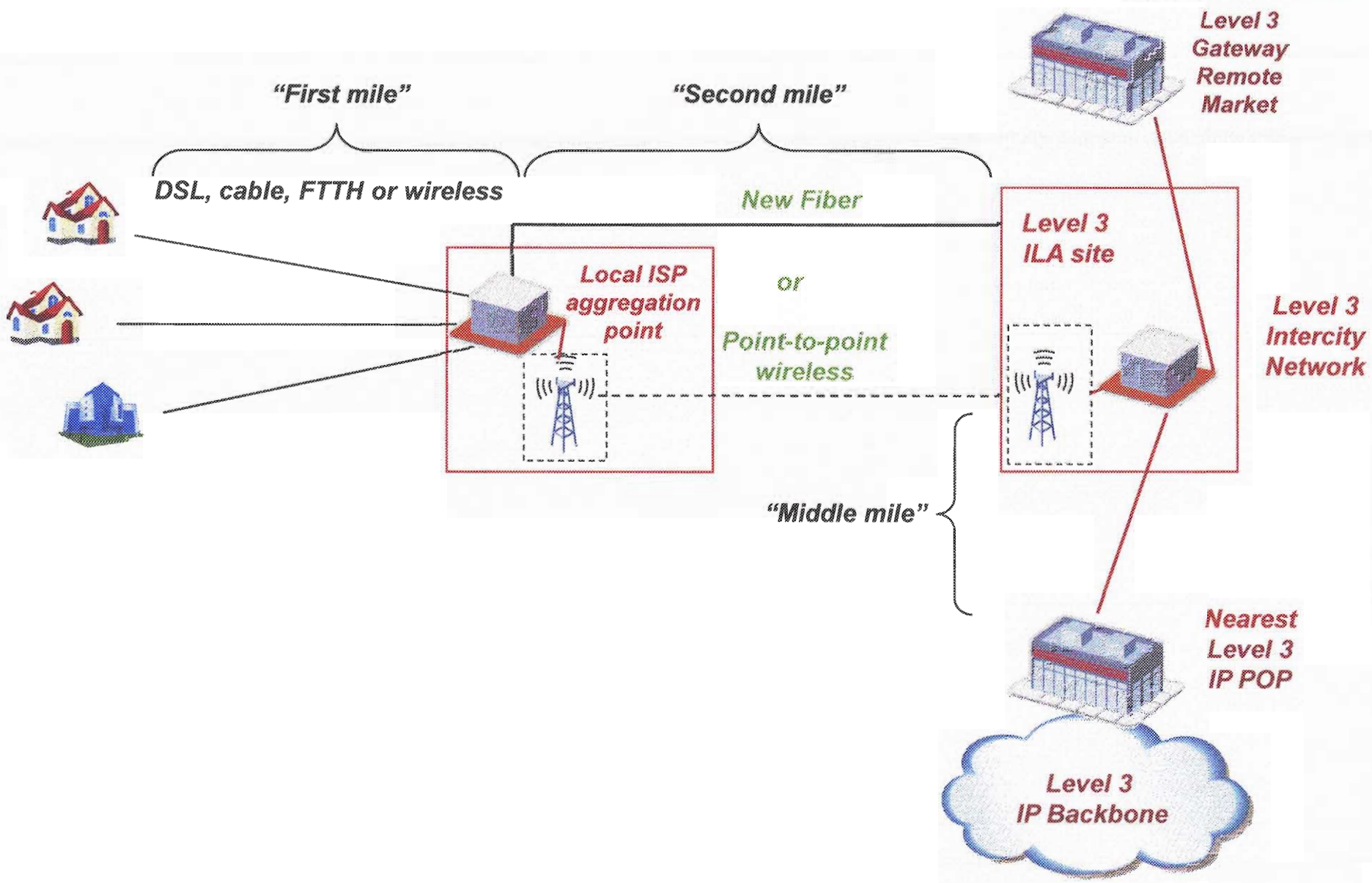
Rural Backhaul Architectures



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Backhaul Observations

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- **Backhaul capacity required : no standard formula**
  - Once aggregated across thousands of consumers, average bandwidth provisioned per end-user appears to be 75-100 kbps today in urban and suburban areas
  - Capacity required has been growing rapidly, driven first by P2P file transfers and now online video adoption (was 17 kbps/end-user five years ago)
  - For on-demand HDTV streaming, the middle-mile transport provider would need to provide much higher speeds (at least 2 Mbps per end-user)
  - Mix of end-users matters: businesses will have higher usage during the daytime and lower usage at night - the converse holds for residential customers

- **Fiber vs. wireless backhaul**
  - Wireless can be quicker and cheaper to deploy for endpoints 1-20 miles apart, and allows for flexible deployments (i.e. gear can be moved and redeployed easily as demand evolves)
    - 6 - 11GHz is best in rural areas (longer range); 18-23GHz in urban areas (lower frequencies require bigger antennas and are more prone to interference from nearby links)
    - can become impractical beyond 20 miles or 2 hops (latency and uptime issues)
    - limited in bandwidth (gigabit wireless available but limits the range)
    - Shorter reach and lower capacity in high rain zones
  - Fiber is typically more expensive upfront, but much more reliable and scalable
    - Has become the technology of choice to support 3G/4G buildouts in urban and suburban areas

Backhaul Observations - continued

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- **OCn vs. Ethernet**
  - Level 3 believes that OCn, Fast Ethernet and Gigabit Ethernet are efficient means of providing middle-mile connections to the Internet core network
  - Ethernet is the most efficient as shared backhaul if multiple providers are sharing the same middle-mile connection
  - Ethernet equipment is typically cheaper due to much higher volumes driven by enterprise users
  - Fast Ethernet should be limited to smaller population centers (e.g. <1,000 end users)

- **Deployments and Economics**
  - In urban or suburban environments, microwave backhaul typically pays back in 2-4 years and fiber backhaul in 4-5 years
  - In rural environments:
    - Paybacks vary widely depending on distance to intercity fiber, population in each town, etc.
    - We believe most rural broadband providers buy wireline second-mile and middle-mile services from incumbent telcos - and thus typically have only one provider to choose from
    - Independent wireless carriers also rely mostly on incumbent wireline backhaul
    - AT&T and Verizon wireless carriers self-provide (wireline or microwave) in most cases
    - Emerging wireless broadband providers (Clearwire, Open Range) deploy their own second mile backhaul solutions, bring the traffic to a competitive middle mile provider (such as Level 3), and buy waves back to their data centers and IP transit
  - Broadband providers rarely work together to procure backhaul – they usually prefer to use a neutral wholesaler such as Level 3 to aggregate demand and provide efficient backhaul

See detailed cost assumptions on the next page and in the appendix

Typical Backhaul Costs

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		Costs	Comments
Opening up transport services at an ILA		[redacted]	First cost reflects fully protected transport covering speeds from DS1 to 10Gb as well as Ethernet.
Build an ILA hut on existing owned property **Build an ILA hut and acquire land for it**		[redacted]	
Building a wireless tower on an ILA		[redacted]	Approval process could be streamlined - Tower cost depends on whether it is monopole or SST, and reqts to camouflage adds to the cost. - Today need to negotiate with large number of local authorities - Can take months/years Where available, buying fiber IRU's from existing providers can be 10x cheaper than building new fiber
Building aerial fiber		[redacted]	
Building trenched fiber (includes 3 conduits + one high-count fiber cable)		[redacted]	
Pulling fiber through existing conduit (96 count fiber cable)		[redacted]	
Costs at cell site - Microwave backhaul	**Equipment capex*** (not including OSP**)	[redacted]	
	Opex (easement, access fees)	[redacted]	
Costs at cell site - Fiber backhaul	**Equipment capex** (not including OSP**)	[redacted]	
	Opex (easement, access fees)	[redacted]	

* Assuming 50-100 Mbps per site
** OSP = Outside Plant Construction (laying fiber etc.)

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Backhaul Observations - continued

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- **Competition**
  - In rural service territories, there is little competition for second-mile and middle-mile transport services
    - The greater the population, the greater the competitive alternatives. As the routes reach into less populated areas, the number of competitors decline quickly
  - Our analysis suggests there is an inverse correlation between the level of competition (as measured by the number of on-net buildings in a wirecenter served by a facilities-based alternative provider) and the price an ILEC charges for circuits

- **Access to Capital**
  - Access to capital is a key impediment to the deployment of adequate, efficient and reasonably priced middle-mile and second-mile transport infrastructure in all markets
  - Need is greatest in the rural areas where the market has deployed little if any capital for new middle-mile or second-mile transport
  - Without appropriate incentives, service providers looking for the best return on investment will continue to allocate capital to large markets with better established demand and lower risk

Backhaul Observations - continued

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- **Maximizing Use of Deployed Assets**
  - As capacity and demand increases in suburban and rural areas, more second-mile and middle-mile backhaul service will have to be delivered over fiber
  - In many areas of the country, existing long haul fiber facilities already exist that, with some capital investment, can be used to provide fiber backhaul services in a scalable and efficient manner
  - Given the demand characteristics from many of these areas, providing incentives for suburban and rural ISPs to aggregate demand and use existing fiber infrastructure makes economic sense
  - Rural and suburban ISPs can flexibly purchase capitalized capacity leases from existing long haul network owners on terms that allow them to "own" capacity and efficiently upgrade capacity periodically as the business grows
  - Much capital and operational efficiency can be gained by leveraging such "capacity IRUs" over existing fiber assets (see next page)

Leveraging Efficiencies from Existing Fiber Assets

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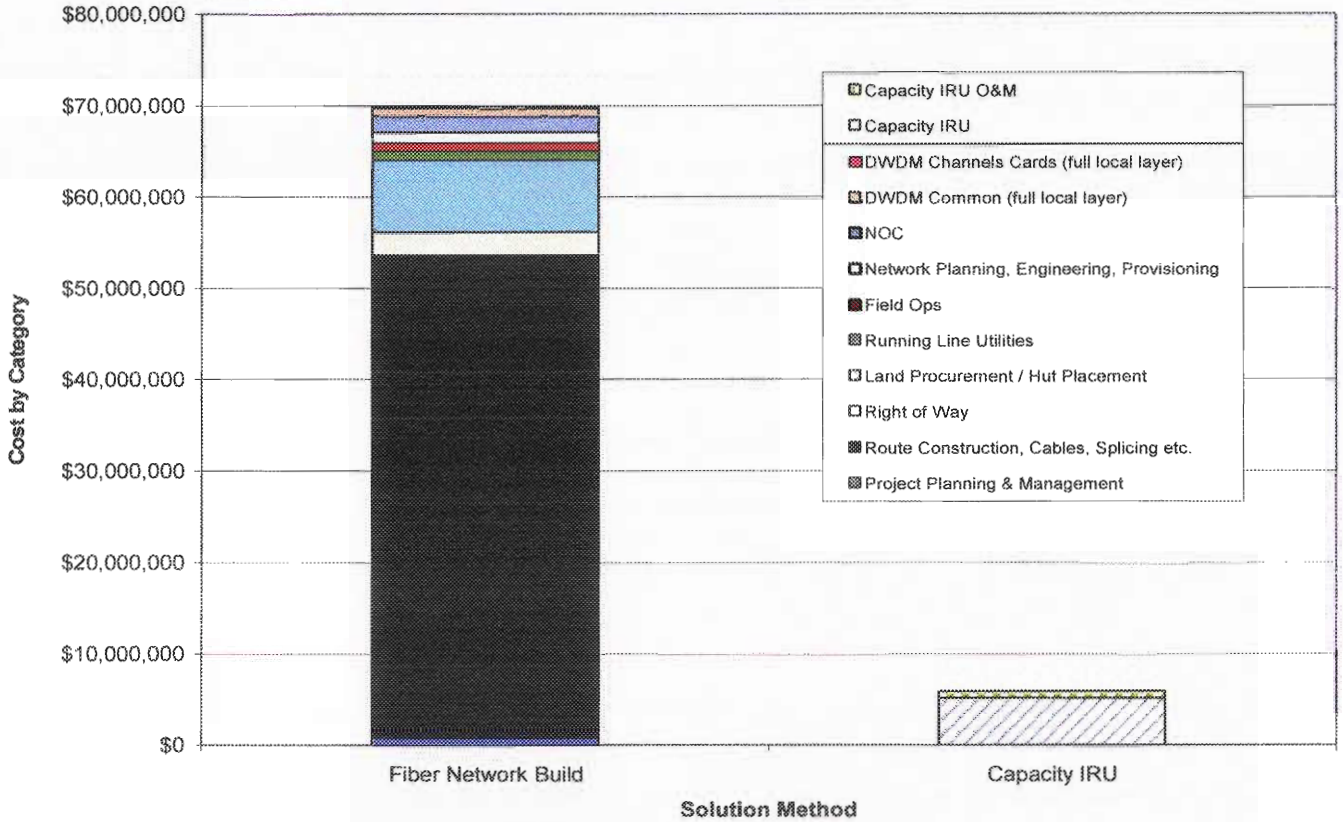
Much capital and operational efficiency can be gained by leveraging capacity IRUs over existing fiber assets

- Today optical technologies can enable hundreds of Gigs of traffic on a single fiber pair
- New fiber plant does not need to be purchased or constructed by operators even when available fiber counts are low
- Carriers can avoid inefficient overlapping operational cost structures by sharing lit systems through capacity IRUs
- Overbuilding existing long-haul intercity fiber infrastructure is extremely costly and unnecessary when competitively priced alternatives already exist

New Fiber Network Build vs. Capacity IRU
5-Year Total Cost (Nominal) by Solution Method and Cost Category
500 mile network. 8 intermediate amplifier/distribution locations. GigE bandwidth at each location.



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Backhaul Observations - continued

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- **Government subsidies**
  - The type of government action required will depend upon the size of the market
    - Level 3 believes that any area of less than 30,000 people will require some form of direct government subsidy in order to justify building middle-mile facilities. In those instances, Level 3 believes that direct government funding would be the fastest most efficient way for carriers to reach an internet gateway and establish alternative competitive middle-mile transport
    - Traditional tax credits may not provide enough of an incentive if the party receiving the tax credits is not a federal tax payer or does not expect to be one for a number of years
  - The government should narrowly tailor the scope of what it wishes to fund through direct funding

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Appendix

Analysis of Point-To-Point Wireless vs. Fiber costs (conducted in 2006)

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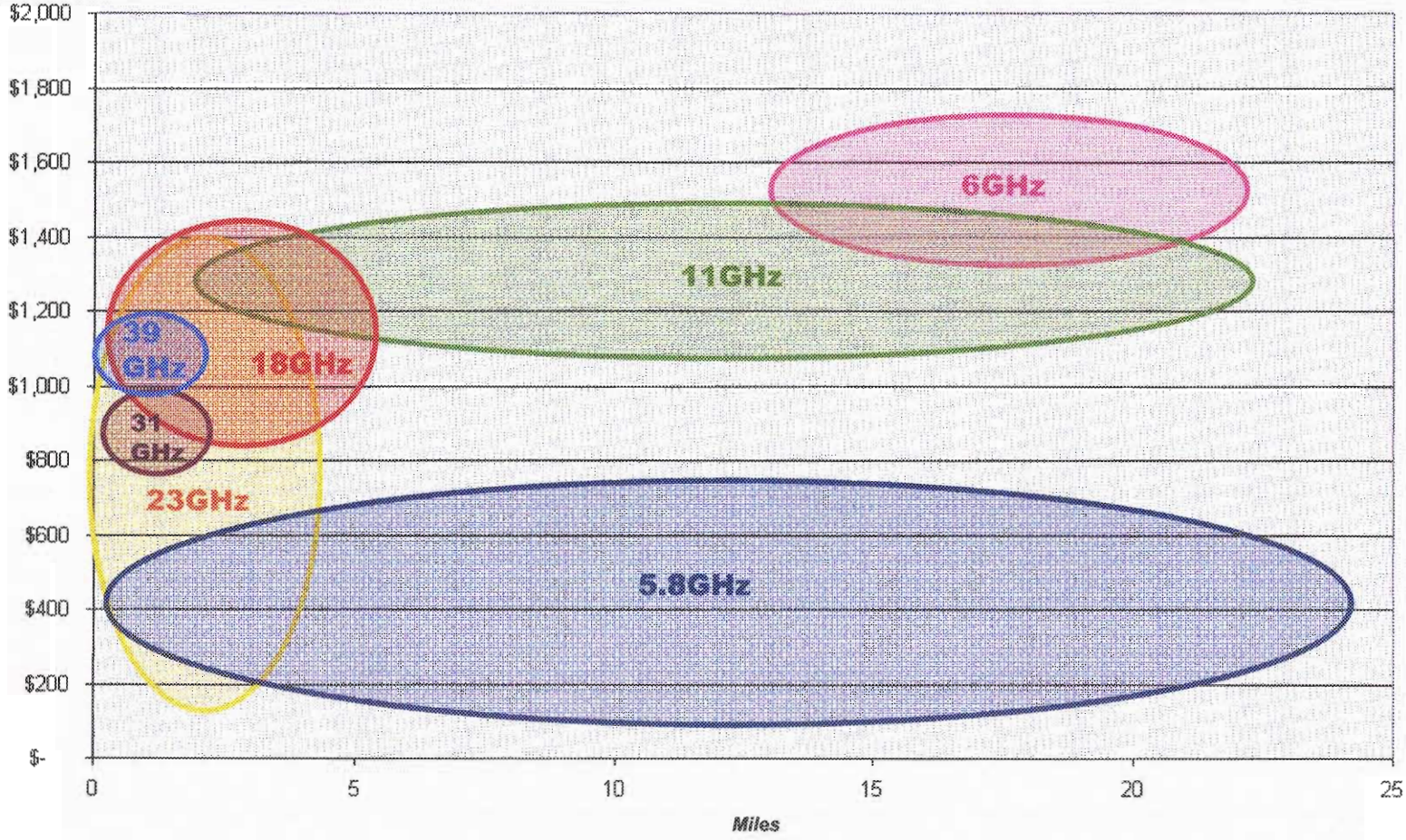
Equipment Only Unit Cost vs. Reach Optimized for Minimum *10Mbps* Throughput

Analysis we conducted in 2006

- *Unlicensed 5.8GHz solutions are the clear unit cost winners*
- *The licensing fee for common carrier bands (6GHz, 11GHz, 18GHz, 23GHz) would increase their unit cost by an additional ~$300/Mbps*



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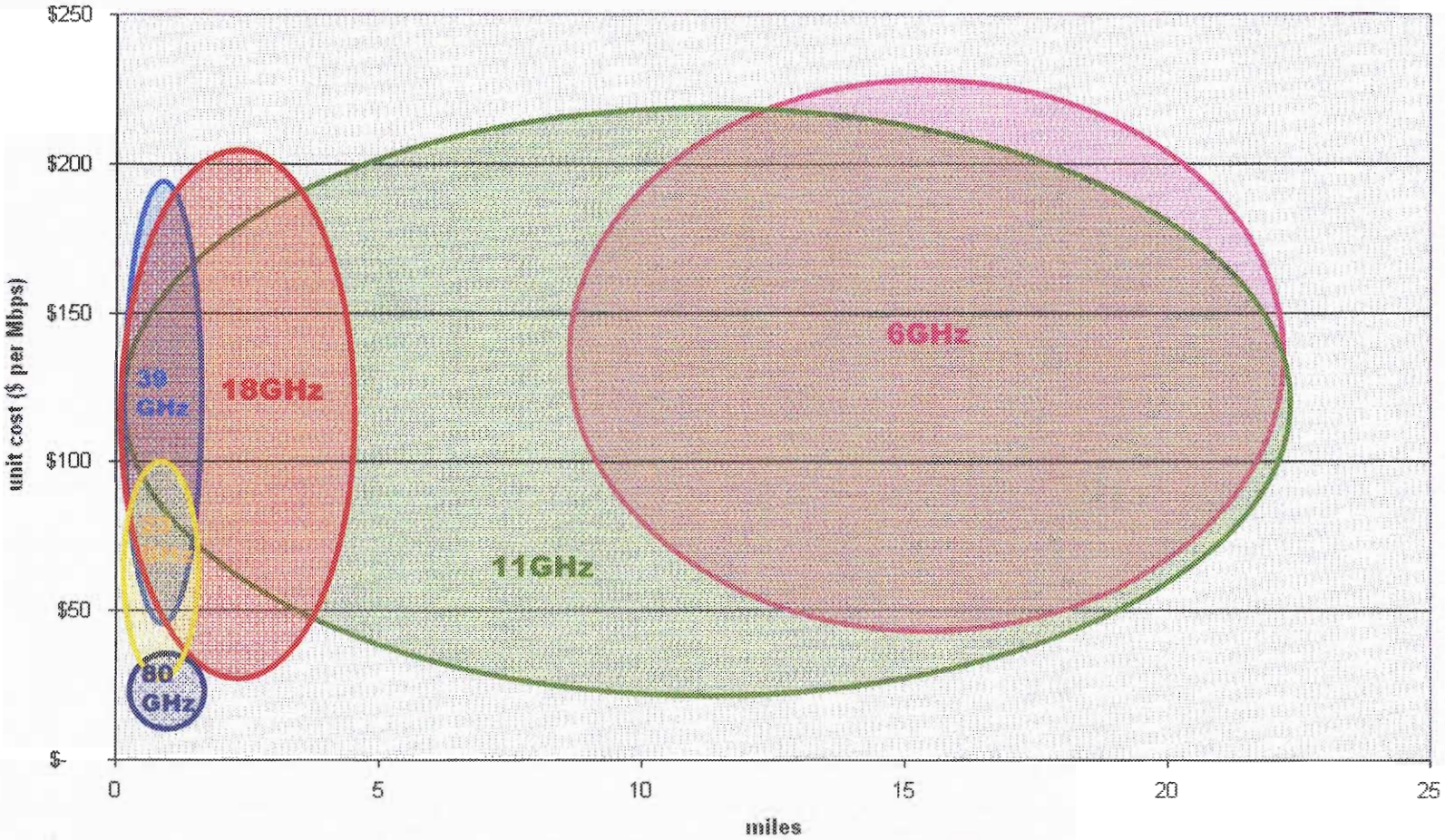
Equipment Only Unit Cost vs. Reach Optimized for Minimum *600Mbps* Throughput

Analysis we conducted in 2006

- *Unlicensed frequency bands no longer an option at that speed*
- *11GHz field of use expands – wide spectrum for high bit rate applications, good propagation, less sensitive to rain fade than higher frequency bands*
- *80GHz gigabit radios have very limited range but the best unit cost due to high throughput*



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Economic Analysis

Analysis we conducted in 2006

- Initial economic analysis has focused on PTP configurations – best suited for
  - Delivery of medium/high capacity services
  - Extension of Ethernet or private line services off metro core or intercity fiber network

- This analysis includes cost input from 17 wireless equipment manufacturers
  - All links designed for five-9's link availability
  - Non-negotiated pricing at 100 link quantities

- Results should be viewed as directional/indicative only
  - Highly dependent on application specifics – rain region, availability of desired spectrum, tower or building access/leasing terms, and equipment choice and volume

Point-to-Point Model Parameters

Analysis we conducted in 2006

Wireless Assumptions	**Amount**
• Installation CAPEX	[redacted]
• Wireless Radio CAPEX	Based on input from equipment manufacturers
• Radio Link reach and configuration	Frequency band/equipment dependent
• Site Rental and Power	[redacted] per month per radio/antenna pair
	[redacted] per antenna for every foot >2ft
	[redacted] more for each additional antenna
• Site maintenance	[redacted] per month per radio pair
• Riser costs (per link)	[redacted]
• Common carrier license fees	[redacted]
• Coordination fees	[redacted]

Fiber Assumptions	**Amount**
• Aerial Construction Cost	[redacted] per ft
• Trenching Construction Cost	[redacted] per ft
• Entrance / Inside Plant Costs	[redacted]
• Electronics	Varies by 10M/100M/600Mapplication, based Fujitsu/Lucent gear
• Maintenance	[redacted] of electronics CAPEX per year
• OPEX	[redacted] per year per link

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Fiber vs. Wireless Comparison

5 year PV, *10Mbps* point-to-point application, Dallas Rain Region

Analysis we conducted in 2006

- Wireless solutions are more cost effective for delivery of low speed services at essentially all reaches
  - Cross-over sensitive to installation/ISP cost assumptions
- 31/39GHz solutions degrade significantly with distance
- Difference between unlicensed band and common carrier driven mainly by add'l opex for the >2ft antenna sizes required for common carrier frequencies

[redacted]

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Fiber vs. Wireless Comparison

5 year PV, *100Mbps* point-to-point application, Dallas Rain Region

Analysis we conducted in 2006

- 39GHz spectrum applicable for delivery of OC-3 or lower rate services where only no common carrier frequencies are available (Tier 1/congested markets)
- 31GHz burdened by equipment availability/commitment issues
- At higher capacities fiber-based solutions offer better performance
- Otherwise common carrier frequencies offer better performance
  - Opex impacts of antenna size erodes cost performance

[redacted]

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Fiber vs. Wireless Comparison

5 year PV, *600Mbps* point-to-point application, Dallas Rain Region

Analysis we conducted in 2006

- Wide swing in 39GHz results attributed to small number of vendor solutions – but even so aerial fiber can be a better choice
- Erosion of PV performance for common carrier frequency bands due to opex impact of multi-carrier implementations – PV is more than doubled over single antenna scenario
- 80GHz radios are clear winners for short links – and offer gigabit throughput, but are susceptible to fog/rain fade

[redacted]

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Extended On-Net and Tower Access Availability

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