Revisiting Cost and Affordability Assumptions for High Speed Data Services in Low Population Density Locations

Benjamin M. Compaine
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Abstract

The Telecommunications Act of 1996 expanded the notion of Universal Service to encompass increased access to advanced telecommunications services to all sections of the United States including rural, insular, and high cost areas.

The 1996 Act, as well as many state policies, assume that residents in low density, i.e., high cost, areas should have available telecommunications at prices comparable to those charged in lower cost areas. That is, unlike other items such as housing and transportation, which vary from place to place based on costs and market considerations, telecommunications services are assumed to have to be priced equally across the country, regardless of costs or ability to pay.

The two most common services for providing high broadband Internet services to residences have been via the cable systems that already provide video service and the Digital Subscriber Line (DSL) service of telephone providers. However, the technology and economics of both services are such that the enterprises that implement these services have made it clear they are unlikely to offer them in the least dense population areas. Several providers of direct broadcast satellite service are available to nearly any location in the continental U.S. The economics of existing multipoint microwave services are more favorable to rural deployment. The possible freeing up of 700 MHz spectrum would further support rural deployment at costs that would suggest pricing slightly higher than current cable and DSL.

While the technologies are well known, there is far less fine grained research and data on the living costs and income of rural residents. Although some items, like market priced broadband would be higher priced than in high density areas, there is some data suggesting that other substantial household expenses, such as housing and transportation, are considerably lower in rural areas. Incomes are also lower, although on average the disparities between rural and urban incomes have diminished considerably over many decades.

This paper raises questions that need be asked not so much about the technology as the expectations policy makers should have about the prices of broadband data services in rural areas as well as the ability of residents of rural areas to pay market prices for high speed Internet service.

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Section 1: Universal Service

Among the goals of Universal Service, as mandated by the Telecommunications Act of 1996, are items that update the original concept of universal service that were largely centered on getting a dial tone into all households.[1] Specifically the 1996 Act added:

- increase access to advanced telecommunications services throughout the Nation;
- advance the availability of such services to all consumers, including those in low income, rural, insular, and high cost areas at rates that are reasonably comparable to those charged in urban areas.[2]

This paper addresses the issue of whether rate-payer subsidies are appropriate and equitable for implementation of broadband services in high cost, especially rural, areas. It further examines:

- The stakes: why this issue is worth examining
- The players and stakeholders
- The relevant technologies for broadband, as well as their current and projected costs.
- The income as well a the cost elements involved in rural economies

Universal Service Concepts: Old and New

The 1934 Telecommunications Act left the details of what was universal service to decades of evolving policy. Over time, policies and procedures for allocating joint and common costs developed that resulted in local telephone rate tariffs that were roughly comparable nationwide -- in high cost territories and localities that had much lower costs for providing service. The 1996 Telecommunications Act was very specific in mandating that new telecommunication services that reached "Low income rural, insular, and high cost areas" must be served at rates (prices) comparable to high density, low cost areas.

This legislative mandate incorporates no means test of residents of rural, insular or high cost areas. There is no expectation that they could or should pay the "full cost" of advanced telecommunications. "Low income" and "rural" are lumped together, as if rural is synonymous with low income.

Moreover, this mandate seems to be based on untested assumptions. The focus of universal service policies, up to and including the 1996 Act, has been on cost: the cost of serving varying constituencies. Only in limited cases at the margin (i.e., "Lifeline" services) has ability to pay been incorporated.

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With the end of the telephone monopoly in 1984, policies other than largely accounting mechanisms internal to AT&T and its operating subsidiaries have had to be created to maintain the cross subsidies that were implemented over the years: subsidies from subscribers in lower cost/high population areas to higher cost/low density areas; subsidies from business subscribers to residence subscribers; subsidies from long distance calling to local services.[3] The break-up of AT&T into separate long distance and local exchange companies required the creation of new, more explicit, mechanisms for maintaining subsidies. This was largely accomplished through use of subscriber line charges imposed on local phone bills and access charges paid by long distance providers to local exchange carriers, incorporated into long distance calling rates.[4] The Telecommunications Act of 1996 imposed more specific conditions for universal service, particularly in section 254, which the FCC had to implement.[5]

Characterizing "Advanced Telecommunications Services"

The 1996 Act has tried to craft an operational definition of advanced telecommunications service:

> High speed, switched broadband...that enables users to originate and receive high quality voice, data, graphics and video telecommunications using any technology. (Section 706)

The policy questions that arise from that seemingly simple and benign requirement for national policy to foster broadband to high cost areas are several, with substantial economic winners and losers. This paper raises those questions and provides limited data by which to test their appropriateness as they apply to "advanced telecommunications services." Specifically it asks:

> Why has public policy singled out those who live in a rural area guaranteed to "comparable rates" to low service cost areas for telecommunications, but not other essential and universal commodities, such as auto insurance, housing or other costs where there are urban/rural differences?

What's at Stake in Implementing Rural Broadband?

Policy-makers are charged with decisions on who, if anyone, should receive any sort of subsidies for providing broadband access in rural areas. Similarly, how much, if anything, should be earmarked for such an investment and operation. If one class of user is charged more than the marketplace would otherwise determine (either directly or through taxes) while other classes are charged less than a market price would dictate, the consequences may be unexpected or unintended. The assumption that underlies special treatment for telecommunications services in

rural areas is that residents of rural areas cannot afford or would be unwilling to pay a price that would be high enough to encourage service providers to invest in the needed infrastructure.[6]

But there are consequences for accepting this assumption. For example, users on the economic margin in low cost areas who must pay more than they otherwise would may decide to forgo the service. On the other hand, wealthy ranchers, farmers and merchants in high cost areas could be getting services at a lower price than they would actually be willing to pay.

Some economic stakes are readily identified.

- In 2002, the Universal Service Fund – collected by a charge to all telephone subscribers' monthly bills, made payments of $3 billion to phone companies serving high cost areas, up from $2.2 billion in 2000.[7]
- This compares to $673 million that went directly to subsidize low income subscribers, up 29% from 2000.[8]
- The high cost area subsidy was 75% greater than the $1.7 billion in total subsidies made to schools, libraries and rural health facilities.[9]
- A widely cited estimate for the build out of a broadband-capable infrastructure (based on running wires) for low-density America was $11 billion.[10]

The stakeholders include the obvious players and some less so:

- The telecommunications companies, although even within this category there are different flavors with different stakes: the "incumbent" local exchange carriers (ILECs), primarily the reconstituted remains of the original local Bell companies; the upstart "competitive local exchange telephone companies (CLECs); the rural telephone companies, numbering in the thousands and individually often serving customers numbering only in the thousands.
- The cable television system operators, which in their implementation of offering local exchange service start to look in part like CLECs;
- Even newer and more experimental players, using labels like WISPs (wireless Internet service providers), as well as satellite carriers.
- State governments have become more involved. State Public Utility Commissions have always been major players in the regulatory arena. But as states have come to perceive the importance of an advanced telecommunications structure for their ability to hold or even attract business, to keep their residents (and taxpayers) from emigrating to greener (or higher bandwidth) locales, they see their stakes in the outcome moving higher. As just one example, North Carolina's "e-NC" project states as its objective: "To ensure all [in the state]...have access to high-speed Internet service at comparable prices to urban areas."[11]
- The federal government, with programs that need refunding, such as the Department of Education's Community Technology Centers Program[12] or the Department of Commerce's Technology Opportunities Program Grants[13] to create and improve technology access in low income and rural areas.
- Consumers, who may have very different interests. Consumers who want advanced telecommunications services, especially in less densely populated areas, may favor modesty higher rates if that will encourage investment. Others, who do not see benefit from improvements in the infrastructure, may support current or lower prices.

Section 2: The Current State of Broadband Access

By 2002 high speed and broadband Internet access was spreading rapidly through the U.S. In the Federal Communications Commission's (FCC) first annual report, in 1999, it found 375,000 such residential lines as of July 1998, or a household penetration of .4%.[14] In September 2001 just over 19% of US Internet households had high speed Internet, nearly double the proportion from a year earlier.[15] By 2002, the FCC reported just shy of 20 million high speed access lines, 17.4 million of which were in residences and small businesses.[16]

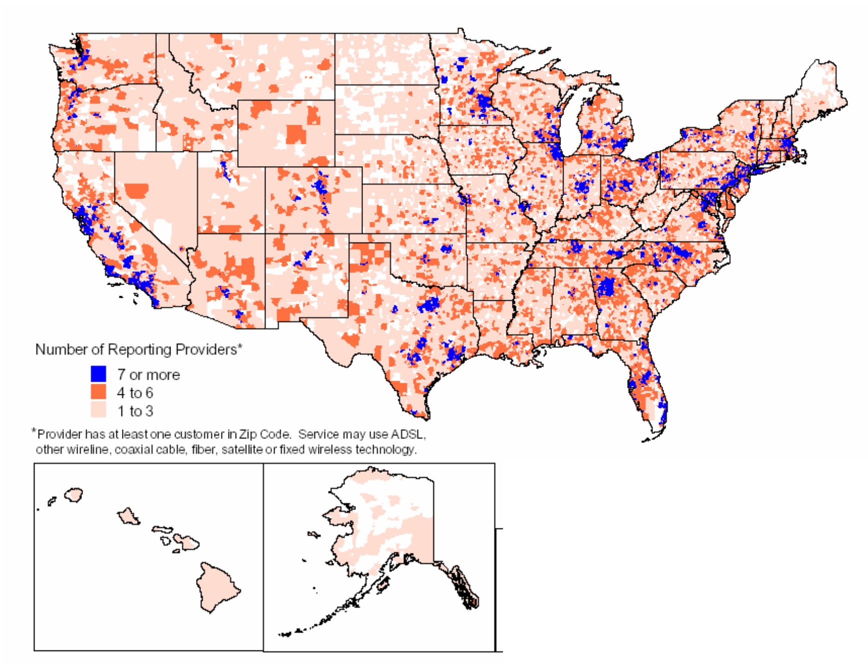
According to data gathered by the FCC, at the end of 2002, at least one broadband access provider had actual subscribers in 88% of the ZIP codes in the United States.[17] Nearly three-fourths of the ZIP codes -- 71%– had more than one broadband provider[18]. It should not be a surprise that 99% of the highest population density ZIPs (top decile) had broadband available. But it was also true that 60% of the lowest density ZIPs (bottom decile) had broadband providers as well, up from 43% a year earlier.[19] In all cases, these figures did not include satellite-based broadband offerings.

Figure 1 shows the density of broadband provision by ZIP codes in 2002 and 2001.

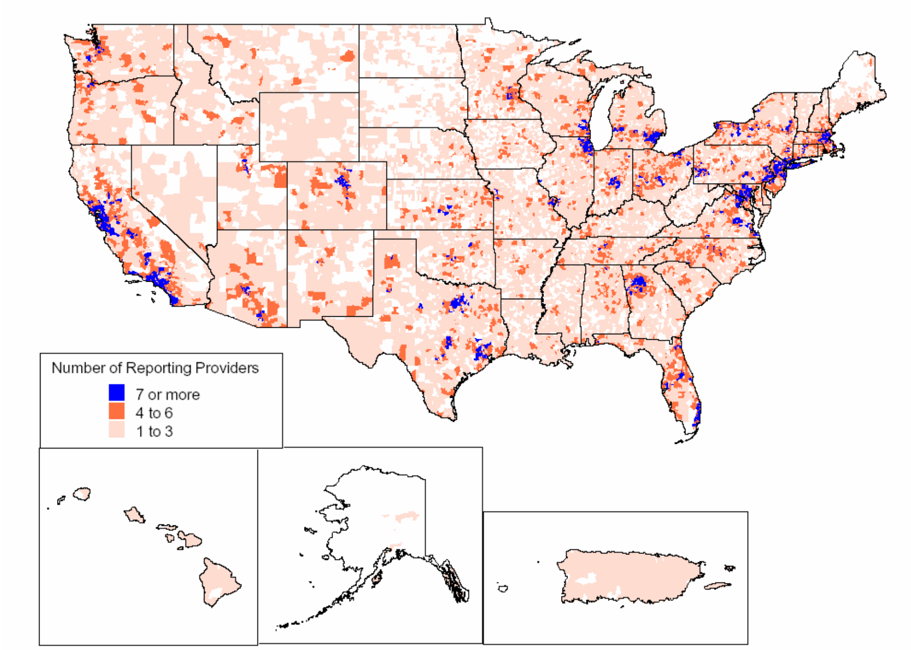
Figure 2 shows that households in urban areas, particularly in central cities, were nearly twice as likely to have broadband than those in low-density, rural areas. However, given the substantial year over year growth rate (79% in the Figure 2 data for the U.S.), high speed Internet connection may have approached 50% of Internet households by mid-2003 (22%-25% of all households).[20] These figures do not include high speed satellite subscriptions.

Figure 1
High-Speed Providers by Zip Code

December 31, 2002

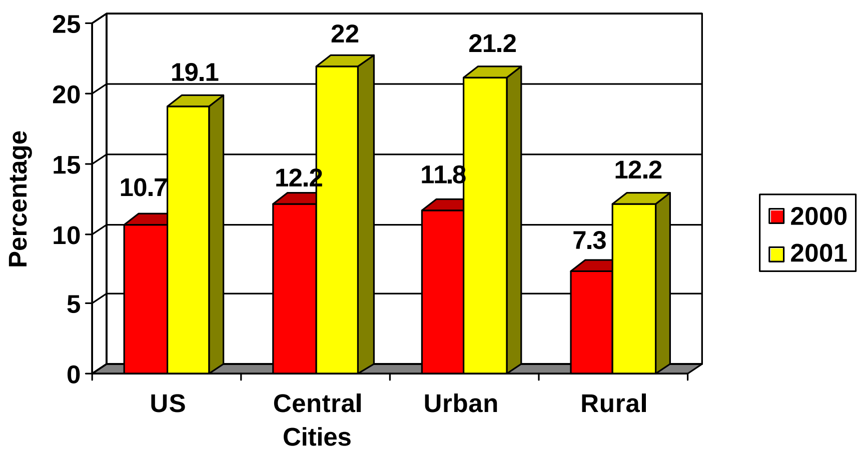


June 30, 2001



Source: "High-Speed Services for Internet Access: Status as of December 31, 2002," U.S. Federal Communications Commission, Industry Analysis and Technology Division, Wireline Competition Bureau. June 2003, p. 19.

Figure 2: Higher-Speed Internet Connection by Geographic Area as a Percent of Total U.S. Internet Households



Source: “A Nation Online: How Americans Are Expanding Their Use Of The Internet,” U.S. Department Of Commerce, Economics And Statistics Administration, National Telecommunications and Information Administration, February 2002, P. 36.

Section 3: Challenges Facing Carriers for Broadband in Low Density Areas

DSL

With cable companies bypassing the most low density territories, broadband Internet access, when available at all, it is most likely to be provided using Digital Subscriber Lines (DSL) from the telephone provider, by two-way satellite, or by newer technologies, such as fixed wireless. Although telephone service is already established virtually everywhere, there remain substantial challenges to upgrading the rural infrastructure to make DLS service available.

DSL, with several variations, is technologically viable only to subscribers who are within a maximum of 18,000 feet of a central office, although other factors, such as load coils and wire gauge, also enter into the calculation. A survey of rural carriers fund that 54% of their loops were under 12,000 feet, 29% were between 12,000 to 18,000. Another 11% were between 18,000 and 30,000, while 6% exceed 30,000 feet.[21] One trade association survey put the cost of upgrading lines longer than 18,000 at $4,121, with costs as high as $9,328 for lines serving the most isolated subscribers.[22]

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Cable

Costs for upgrading basic cable systems for two way data depend on at least four variables:

- The network's initial bandwidth
- The bandwidth available after the upgrade
- The average number of homes connected to each "loop" or cable ring
- The density of the households connected to each cable ring[23]

By definition the last of these variables is lower in rural areas. Cable television was available to about 96% of all households in the United States in 2002,[24] making it nearly as ubiquitous as telephone. Roughly 86% of the households that can get cable TV service also have broadband Internet service available. At the end of 2002, just over 13% of those household subscribed to cable broadband.[25] (Of course, not all household with access to cable TV service want or have personal computers. So the real "take rate" would be considerably higher than 13%. In addition, some cable-ready households may opt for competitive DSL service).

While it is widely believed that cable does reach 96% of US households, it has been level at that proportion for several years. Moreover, there is also some controversy on the accuracy of this number. The Rural Utilities Service (RUS), a development agency of the U.S. Department of Agriculture, has offered its own calculation that only 81%-86% of actual houses have access to cable service. It estimates that most of the 16% to 19% of houses not passed are in rural areas.[26]

By and large it is considered uneconomical to deploy cable in most areas where it does not exist today, in large measure because technologies such as satellite are cheaper and faster to deploy for multi-channel television. Operating costs are another problem. Whereas the annual cost per location to operate a modern data-cable system is about $100 in areas with 10,000 lines per square mile and $292 with as few as 5-100 lines per square mile, it jumps to $646 for the less dense territories with 0 to 5 lines per mile.[27]

Satellite

Two-way data services using earth orbiting satellites is a relatively recent service. It is being offered, for the most part, by the vendors who have been providing direct broadcast satellite (DBS) video service. DBS was originally targeted at the 4% (or 16%-19% using RUS assumptions) of US households who are in areas that are not served by any cable operator, though it now competes directly with cable throughout the country.

In it's earliest incarnation as a consumer/small business Internet access service, satellite operators were largely restricted to a hybrid offering. This involved an upstream link to the service provider by conventional telephone dial-up, with all the bandwidth limits and restrictions involved in any dial-up ISP. The downstream path was provided by a higher speed path via satellite to the home dish antenna.

Technology improvements by 2002 allowed the two major national DBS providers –Echostar's Dish Network and the GM-owned Hugh's Electronics DirecTV– the capability to provide a true two-way broadband service. Satellite broadband service, however, does not scale well. To adequately serve an expanding customer base, the DBS operators face bandwidth capacity limits on their satellites and a history of outages. Moreover, the pricing of their services has been slightly higher than either cable or DSL Internet options and the cost of initial equipment and installation for the end user is substantially high. Table 1 contrasts high speed Internet service from the Direcway unit of Hughes Network Systems with typical DSL service.

Table 1
High Speed Satellite Access vs. DSL

	Direcway Satellite*	DSL
Data rate	Up to 400 kbps down; 128 kbps up	Up to 1.5 mbps down, 128 kbps up
Upfront cost	$99 OR $579	Generally none: modem included with 1 year contract
Monthly cost	$99/mo, 12 months, then $60/mo OR $60/mo	$50/month. This is typical price for DSL and cable modem in US
Contract requirement	12 months OR none	12 months on promo; none other
Source: Hughes Network Systems, at www.iwantdway.com/htb_two.html		

Bringing Broadband Access to Low Density Areas

Emphasis on bringing broadband to low density areas continues to look at the cost of "wiring." The National Exchange Carriers Association broadband cost study is focused on the cost of "plant upgrades" that would be required to offer DSL service in rural areas, the estimated cost projected at $10.9 billion. NECA's study uses under five households per square mile as its limit for "rural."[28]

Among the current providers of broadband, satellite is the only technology that is available everywhere in the continental United States. DSL is still being implemented. Cable is not likely to be installed where it is not now available, except to the extent to which housing or business development creates new higher density clusters that may eventually be wired. A fourth option, broadband wireless fixed access (BFWA), has been made available in a few locations, but offers the potential as a technology with an economic model that would be appropriate for low population density areas.[29]

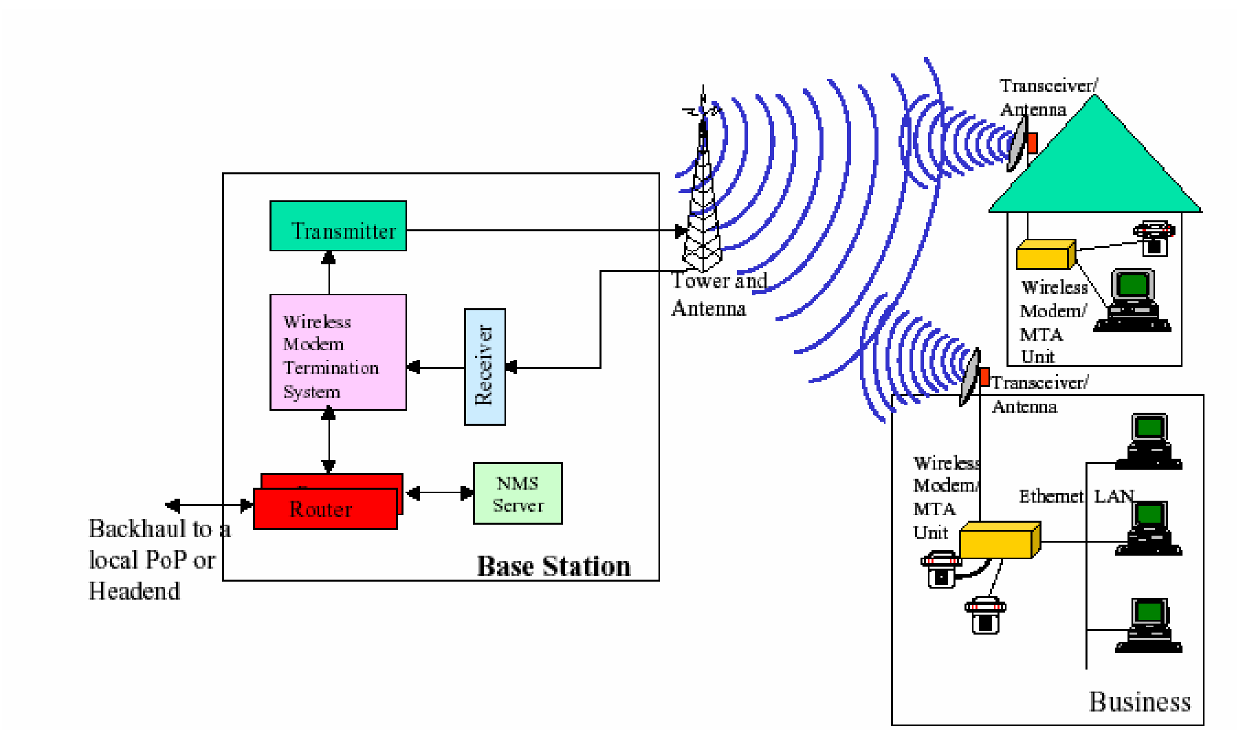
Broadband Fixed Wireless Access (BFBA)

Using Current Spectrum Available

In 2003 Broadband Fixed Wireless Networks operated in the 2.6 GHz frequency of FCC-licensed MMDS (Multichannel Multipoint Distribution Service) spectrum. The typical setup of

an MMDS system is shown in Figure 3. The wireless system consists of head-end equipment (satellite signal reception equipment, radio transmitter, other broadcast equipment, and transmission antenna) and reception equipment at each subscriber location (antenna, frequency conversion device, and set-top device).[30] Signals for traditional MMDS services originate from a variety of sources, just like at cable head-ends, and may include traditional video programming. As a broadband data provider, the MMDS system operator would in addition function much as an wireline-based ISP, with only the process for the last mile (or miles) configured differently.

Figure 3
General Diagram for BFWA



Source: Wanichhkorn and Sirbu, p. 7 (see note 27)

BFWA has not been shown to be a cost-effective alternative to cable or DSL in most locations.[31] However, it does offer a cost-effective alternative in geographic areas of the lowest population density, of five or fewer lines per square mile. There, the annualized cost per location of BFWA is at least half the cost of either of the alternatives.[32]

Using More Efficient Spectrum

The choice (or lack thereof) of spectrum used for a service may have a substantial effect on costs. Critical variables such as capacity, propagation, sensitivity to physical obstacles, and the like have in impact not only on the quality of the service but in the cost of the equipment, the amount of equipment, and the ease of use and maintenance. For example, 700 MHz spectrum is in the UHF band and in 2003 was allocated to television broadcasters. However, it is officially scheduled to be returned to the FCC in 2006 with the intention that it will be auctioned. When (if ever) available, it will offer several advantages for broadband data over current 2.6 GHz spectrum. This includes longer propagation range, better ability to penetrate walls, and less susceptibility to rain and snow fading.[33]

Relative Costs for Cable, DSL, BFWA

The cost of providing broadband generally decline as household density increases. There are substantial differences in absolute costs as well as differentials as density declines for the varying technologies discussed above. Table 2 is based on statewide data from Delaware.[34] For BFWA it uses data reflecting both current MMDS spectrum as well as possible future 700 MHz spectrum. In both cases it is based on use of indoor antennas.[35]

Table 2
Annualized Cost per Location for Alternative Broadband Delivery

POPULATION	BFWA			
DENSITY/SQ MI	MMDS	700MHz	CABLE	DSL
<5	**$332**	**$267**	$646	$707
5-100	**285**	**254**	292	364
101-200	249	230	**189**	274
201-650	252	233	**136**	228
651-850	248	227	**121**	212
851-2250	252	217	**113**	202
2251-5000	243	211	**109**	195
>5000	245	211	**112**	190
Average	265	225	**151**	236
Ave Price/Month			$45.31	$51.36
				$59.95 (satellite)

Sources: Wacnichkorn and Sirbu (see note 27); ARS (see note 36)

The data in Table 2 highlights the substantial costs involved with both DSL and cable in getting to the most remote households. Although current MMDS is also more expensive in these areas, it is roughly half the cost or less of cable and DSL. In the 5-100 lines/sq mile bracket, current MMDS, at $285 annually, is about 41% more costly than DSL in many suburban locations of 650-850 lines/sq mile. In absolute dollars, the difference is about $6 per month. Should 700 MHz spectrum become available for this use, the cost difference from DSL would be $3.50 per month.

Table 2 also captures the approximate range of the infrastructure costs needed to deliver broadband to households or businesses. The full cost would include additional items, among them marketing, billing and customer service expenses. This cost data does provide a basis for approximating what a BFWA price might look like. In mid-2002, the nationwide average price for DSL service was $51.36. The comparable price for cable services was $45.31.[36]

Using the annualized cost data in Table 2, it is feasible to approximate a price that would be charged for a BFWA service to lower density areas (under 100 households/square mile) using both current and potential technologies. The average price charged in medium to high density localities for DSL in 2002 was about three times the annualized costs averaged over these areas. Cable operators were charging roughly 4.5 times their annualized costs in the same areas. As seen in Table 3, those two points would suggest a monthly price of $72 to $108 for BFWA using MMDS in the least densely populated areas. A similar calculation based on the costs of using the 700 MHz spectrum, should it become available, projects to current monthly price of $63 to $94. These prices are roughly comparable to current satellite broadband data services, at $60 to $100 monthly, depending on whether the user or provider makes the upfront payment for the customer premises equipment.

Table 3
Projected Price of BFWA Service in Low Density Areas

Delivery	Operating Costs* Annual	Operating Costs* Monthly	Average Price/ Month	Price/Cost Ratio
DSL	$200	$16.70	$51.36	3.0
Cable	120	10.00	45.31	4.5
MMDS	289	24	72.00 -108	3.0
700MHz	250	21	63.00 - 94	3.0
Satellite			60.00	

*DSL: Density >650/mile; Cable: Density >200/mile;
BFWA: Density <200/mile

Source: Calculated from Table 2

Section 4--Income and Living Costs in Rural Areas

Having examined arrange of costs involved in providing broadband infrastructure and how that compares to the actual prices being charged for the service, the following sections look at the relative factors that constitute the ability to pay, with an emphasis on rural incomes and living costs.

Both living costs[37] and income[38] vary across the U.S. by region and between rural and urban areas within and across regions. There is not, however, useful and reliable official data that systematically can adjust either cost of living nor income any finer than by state averages or a single national urban/rural measure.

Living Costs

Mark Nord, a researcher with the U.S. Department of Agriculture, considered differential living costs by looking at the measure of poverty levels across the country. He noted that while official poverty thresholds are constant nationwide, “the cost of living almost certainly varies across regions and between rural and urban areas.”[39] As it happens, there is no usable base of official statistics on which to base an adjustment. A program by the Bureau of Labor Statistics, the “Family Budget” series, estimated regional cost-of-living difference, but was ended in 1981.[40] More recently, several federal agencies commissioned the National Academy of Sciences (NAS) to address the geographic cost-of-living issue as part of a broader overhaul of the poverty measure. As housing costs alone accounted for 44% of poverty-level budgets, the NAS panel proposed using this single expense to estimate regional differences in the cost of living. It thus determined that the cost of living was 81% of the national threshold in nonmetro areas of the East South Central states, while it was as much as 22% higher in the largest cities of the Pacific region.[41] Nord then used a qualitative measure call “food insecurity” to adjust the housing-only measurement of the NAS panel. With this overlay, he concluded that the NAS adjustments were in the right direction, but overstated both the under and over adjusted percentages of the NAS data. His general finding was that for families with incomes around the poverty threshold, the mean cost of living for households is about 20% greater in metropolitan areas compared to nonmetropolitan areas.[42] Nord’s analysis suggests that even at incomes five times the poverty level there is evidence that households in metropolitan areas face higher living costs.

Income Levels

Balancing the lower cost of living in many rural areas, there is also general data that suggests that incomes are lower in rural areas. However, the differential has been decreasing. In rural regions (Southeast, Southwest, Plains and Rocky Mountains), the differential from the national average fell from 64% at the time of the Great Depression to 90% by 1979.[43] Additional research confirmed that, when adjusted for empirical price differentials among regions, the pattern of convergence was maintained through the 1980s and into the 1990s.[44] The study by National Exchange Carrier Association reported median household income of $40,600, compared to $46,600 in nonrural areas, or 12.9% lower. This data is roughly consistent with long term studies that have tracked regional differences in per capital personal income (PCPI) which showed a diminishing income gap among regions.

The literature on income, however, is not very fine grained. It concentrates on large regions (e.g., Northeast, Southwest) or at best by state, which average high density urban areas with less dense rural areas. One way to get a fix on relative living costs in specific areas is by looking at housing costs relative to incomes. Housing is the largest single item in household budgets, though it varies with income. Various compilations in different parts of the country provide a range of under 20% of household income for higher income households to 44% at the poverty income level.

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Income and Housing Costs

In an attempt to create a level playing field of income and cost of living, Table 4 combines the largest item in the household budget, housing, with median income in nine cities around the U.S.[45] To see how this phenomenon translates into real income differentials, Table 4 (and Figure 4) shows the calculation of the cost of housing proportionate to the median household income in various cities. Average home and apartment rental in Boston is the highest in the selection, but median incomes in Cedar Rapids, Iowa and Sioux Falls, South Dakota, smaller cities associated with rural parts of the country, show both higher income levels and lower housing costs.

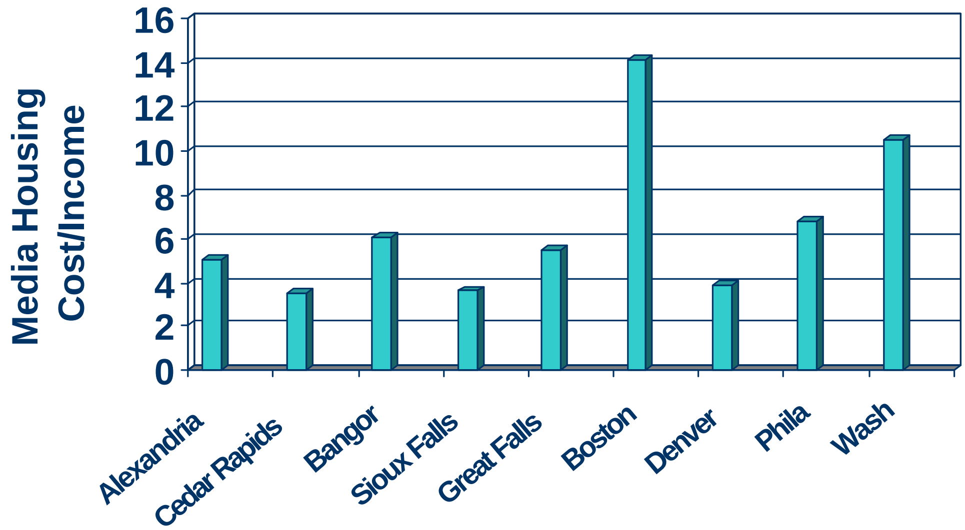
The table shows that a median priced house in the Boston area costs about 14 times the median Boston income. At the other extreme, a median priced house in Cedar Rapids is only 3.5 times income. The cities in this selection indicates that urban areas are not necessarily more expensive than rural areas, at least on a housing/income basis. Denver has next to the lowest ratio in this group. The three largest cities is this group, Philadelphia, Washington and Boston also have the highest ratio of house costs to income. The three cities with the lowest ratio of income to house purchase cost are Cedar Rapids, Sioux Falls, and Denver. Table 4 further shows a similar pattern in rent to income for the same locales, with Alexandria, LA being the outlier of a small city with a relatively high rent/income ratio.

Table 4
Income and Housing Costs in Selected Cities, 2000

	Median HH Income	Income Index (Boston=100)	Median House Cost	House Index (Boston =100)	House Cost /Income	Salary index Boston=100	Median Monthly Rent	Rent/ Income
Alexandria, LA	26097	66	132000	24	5.1	50	430	19.8
Boston, MA	39629	100	560000	100	14.1	100	803	24.3
Cedar Rapids, IA	43704	110	154000	28	3.5	51	521	14.3
Bangor, ME	29740	75	180000	32	6.1	56	475	19.2
Sioux Falls, SD	41221	104	150000	27	3.6	50	521	15.2
Great Falls, MT	32436	82	180000	32	5.5	50	407	15.1
Denver, CO	39500	100	152200	27	3.9	64	631	19.2
Philadelphia, PA	30746	78	210000	38	6.8	63	569	22.2
Washington, DC	38101	96	400000	71	10.5	86	618	19.5

Source: Median income and housing costs from Synergos Technologies, http://www.ersys.com. Other columns calculated.

Figure 4:
Housing Costs in Selected Rural vs Urban Cities



Source: Table 4.

Table 5 and Figure 5 focus on incomes and poverty data from high and low density counties. Like Table 4, it is a purposive selection, in this case from counties in various regions of the country and with low and high population characteristics. With the exception of Rapides Parish, Louisiana, the low density -- i.e., rural -- counties had lower proportions of poverty than the high density cities, despite the median household income in the rural counties being lower than any of the urban areas except Philadelphia.

Income and Auto Insurance

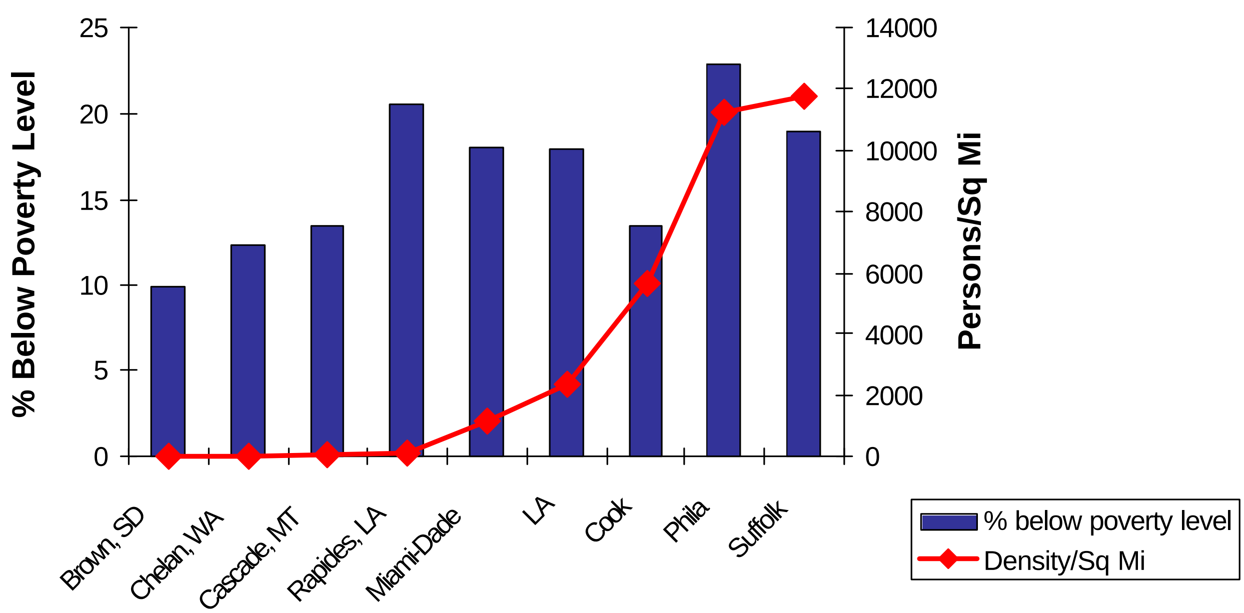
After housing, the second largest component of household expenses is transportation, primarily automobile ownership.[46] On average, 18% of after tax consumer expenditures are devoted to private transportation—personal cars and trucks. Of the ongoing operating expenses of a personal vehicle, the largest single component is insurance. Nationally, auto insurance averages about $800 annually, or just under $67 per month.[47] In aggregate compilations, auto insurance does not vary greatly by geographic region as a percentage of expenditures, ranging from a high of 2.2% in the South to 2.0% in the West and Midwest. In dollar terms the variance looks greater: $849 in the West to $768 in the South.

Table 5
Poverty and Income in Urban and Rural Counties, 1999-2000

County	State	% Persons below poverty level, 1999	Median HH money income, 2000	Land Area (sq miles)	Persons per sq mile, 2000
Rural Counties					
Brown	South Dakota	9.9	35,017	1,713	21
Chelan	Washington	12.4	37,316	2,921	23
Cascade	Montana	13.5	32,971	2,698	30
Rapides	Louisiana	20.5	29,856	1,323	96
Urban Counties					
Miami-Dade	Florida	18.0	35,966	53,924	1,158
Los Angeles	California	17.9	42,189	4,061	2,344
Cook (Chicago)	Illinois	13.5	45,922	946	5,686
Philadelphia	Pennsylvania	22.9	30,746	135	11,234
Suffolk (Boston)	Massachusetts	19.0	39,355	59	11,788

Sources: Bureau of Economic Analysis, Bureau of Labor Statistics, National Agricultural Statistics Service, National Center for Health Statistics, U.S. Census Bureau at http://www.fedstats.gov/qf/
Bureau of Labor Statistics, Current Population Survey, "State and County Employment Wages from Covered Employment and Wages, 2001 (NAICS basis)." at www.bls.gov/data/home.html

Figure 6
Poverty Level and Population Density in Urban and Rural Counties



Source: Table 5

In reality, auto insurance is highly variable. It is dependent on factors that include sex, age, driving record, value of the vehicle, coverages selected as well as the location in which the vehicle is domiciled. This later turns out to be a variable of considerable significance. A report for the U.S. Congress noted that annual insurance premiums between the central city and the suburbs often exceeds $1000.[48] Differences between inner cities and rural areas can be far more dramatic.

Table 6
Auto Insurance in Three Communities, 2000

City/Town and ZIP	Lowest Rate*		Low to High Gap
	Annual	Monthly	
Philadelphia, PA 19122	$3940	$328	+$3323
Carlisle, PA 17013	1070	89	+ 2253
Atchison, KS 66002	617	51	---

*For identical coverage on 1996 Ford Taurus GL, married male driver, age 50. Used lowest quote if more than one.

Source: http://www.insuremarket.com, May 4, 2000.

As an example, Table 6 shows the insurance cost that for an owner of the same car in different geographic areas. Age, car model and driving record are held constant. Only the place of domicile of the vehicle is varied. In this example, the insurer in a low income neighborhood in Philadelphia might pay nearly four times that of a resident of the suburban town of Carlisle, Pennsylvania, about 120 miles west of Philadelphia and more than six times as much for auto insurance than a resident in rural Atchison, Kansas.[49] The difference is $277 per month.

Section 5: Findings and Discussion

The underlying rationale for government policies on universal telephone have been that 1) that it is the public interest to have telephone service that is universally available and affordable; 2) that the costs of providing telephone service in rural areas is greater than in high population density areas; 3) that residents and small businesses in high cost areas should pay about the same for telephone service as in lower cost areas. In the opening years of the 21st century there is a policy debate over whether this same rationale should be applied to high speed Internet service.

Whether and what sort of cost shifting or outright government subsidies depend on assumptions, on the one hand, about the costs involved in providing high speed connections in rural areas, On the other hand, it depends on assumptions about the ability (and willingness) of residents of rural areas to pay for the service.

The Supply Side—Broadband Technologies

It is clear from Section 2 of this paper that by many measures high speed connections are rapidly spreading to households that are online. It can be no surprise that the percentages are lower in rural areas than in urban areas. Given the sizeable capital expenditures needed by the two mainstream broadband technologies—cable and DSL—the players started their roll out where they could get the greatest number of subscribers per unit of investment. But in the "is the glass half full or half empty" arena, investment is also being made in many of the most rural areas. Three-fifths of the least densely populated ZIP codes have some broadband available, an increase of 40% in one year.

The cost structure suggested by Table 2 – as well as oft-stated positions from incumbent cable and telephone companies—means that it is unlikely that neither cable data nor DSL services will extend to the most rural stretches of the U.S. in the foreseeable future. However, other implementations for high speed data, including using existing fixed wireless spectrum and potential spectrum, are more economically promising, as was seen in Table 2. Assuming no change in expected costs (a conservative assumption when it comes to this sort of technology, which historically has decreased over time), the prices that would need to be charged to bring broadband access to low density areas via some form of fixed wireless would be about the same as the satellite DBS providers are charging and 20% to 40% more than 2002 prices for DSL and cable.

The Demand Side—Affordability and Willingness to Pay

Describing the various current and potential technologies for broadband is relatively easy and straightforward. Any type of infrastructure that could be widely implemented in the next decade either exists or is known about today. Costs are known and changes may be projected.

Less well explored has been what prices are reasonable to be considered practical in the marketplace and whether those residents of low density areas would be willing to pay a rate that would cover the full cost of receiving broadband access to the Internet. This paper is not an attempt at market research—what are households ready to spend from their disposable income. The data in Section 4 does raise to a higher level of salience the need to more closely examine what residents of rural areas could be asked to spend before public funds are used to subsidize and maintain systems at below costs.

The need for subsidies for telecommunications stems from the dual assumptions that costs per user are higher and incomes lower in rural areas. The preponderance of evidence supports this. However, the data on the true cost of living in rural vs. urban areas is not very fine grained. Studies cited in Section 4 note that most federal government-created cost and income data is aggregated by large regions (i.e., Northeast, Southwest), by state, or by various measures of cities and metropolitan areas. There is little fine grained data on living costs in Pike County, PA or Atchison County, KS and the like.

Moreover, this examination of available data found that measures include market baskets that may not be valid measure of living costs. Housing (as much as 44% of disposable income at the poverty level) and transportation are the two largest elements of living costs. But the examples in Tables 3 and 4 suggest the need to dig deeper: while average household income in Great Falls, MT is only 82% of the median income in Boston, housing is only 32% the cost of Boston. (There is also the counter-intuitive example that incomes in Cedar Rapids are higher while housing costs lower than Boston).

There is also the finding that, in the arbitrary sampling of counties in Table 4, the poverty level in some very rural counties is considerably lower than in the most dense urban areas. The cumulative impact of the data in both tables begs for more thorough research into the notion that rural residents are poor or should not be expected to be able to spend more for telecommunications services than their urban counterparts.

The case of auto insurance is another data point worth further consideration. Although much discussion and political capital is expended over telephone rates of $20 or $25 per month, auto insurance differentials can be hundreds of dollars per month between inner city – and often low income—drivers and rural—and often well-off – drivers. Should urban and suburban dwellers have a level playing field for automobile ownership with low cost rural dwellers?

Discussion

There are two elements to the issue of broadband service in low density territories. One is the relevant technologies available, including the economics of those technologies. The other element is the capacity and willingness of users to pay for the services provided by the technologies.

There is much written in the popular press, academic literature and government papers about what technologies are available or could be available. What seems to be glaringly lacking in the policy discussions is empirical data on the affordability and willingness of consumers in rural areas to pay the full cost of telecommunication services. Should the public debate include the trade-offs of living in rural areas (e.g., lower crime, cheaper housing) with life in urban areas (e.g., available broadband but high auto insurance)? Would the inner city car owner paying the $328 per month in Table 6 volunteer to see his $25 phone bill double or broadband Internet connection cost $60 instead of $40 if in return his auto insurance bill went to the $51 of his rural counterpart?

There is broad-brush data that indicates that the gap between incomes in rural and urban areas has substantially diminished since the 1930s. At the same time, the available data, some of which was described in this paper, suggest that some major household costs are substantially lower in rural areas than in more densely populated areas. Yet there is no adequate official compilation of area specific living costs. There is even less work that adequately describes true living standards across low density areas by region as well as in urban areas by region.

In the context of rural income and living costs, the prices that would need be charged for high speed Internet access in the least densely populated areas are not far removed from costs for cable and DSL that have attracted tens of millions of households that already have such services available. Two way satellite, though not up to the standards of the existing wire-based service, is nearly universally available. Services relying on fixed wireless have been implemented on a small scale and could be expanded, at prices roughly similar to satellite.

The ongoing questions, then, are first, is universal broadband access a necessity, in the way basic telephone service was considered at the time of the 1934 Telecommunications Act? The State-Federal Joint Board has concluded that the answer is "not yet." But it remains to be determined whether broadband access should or should not be subsidized should it be so determined. So the second question is: Should residents (and small businesses) in low density areas have broadband made available even in the absence of market determinants that they think it has the value imputed by the rates being paid by users where it is available? That is, is it equitable to offer direct or indirect subsidies as opposed to full user payment?

Public policy in the realm of telecommunications service for rural areas has to date been that voice telephone services needs to be subsidized, though other areas, such as video, does not. Before future policy on broadband (or high speed or advanced services—whatever term and level of service is settled on) is set, it appears that a closer examination of the assumptions of the ability to pay should be a critical part of the process.

NOTES

[1] Communications Act of 1934, Pub. L. No. 73-416, 48 Stat. 1064 (1934).

[2] Telecommunications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56 (1996), Sec 254(b)

[3] Stuart Benjamin, Douglas Lichtman, Howard Shelanski, *Telecommunications Law and Policy* (Durham, NC: Carolina Academic Press, 2001), pp. 618-619.

[4] Ibid, p. 713.

[5] Ibid, p. 773-780. Classes of users that were designated for funding included low income consumers, high cost areas, schools and libraries and health care providers.

[6] Or, as Benjamin, Lichtman and Shelanski ask, "…Why should rich and poor telecommunications service consumer [for example, in urban areas] be taxed to provide cheap telecommunications services to rich and poor telecommunications service consumers [for example, in rural areas]?", p. 781.

[7] Universal Service Administrative Company, "Annual Report, 2002, p. 2. Available at http://www.universalservice.org/download/pdf/2002AnnualReport.pdf.

[8] Ibid.

[9] Ibid.

[10] Victor Glass, "NECA Rural Broadband Cost Study: Summary of Result," National Exchange Carrier Association, 2000, p. 4.

[11] This was provided in a listing of the goals of the North Carolina's Rural Internet Access Authority when I first came across it in November 2002, at http://www.e-nc.org/whatis.shtml. However, that link is now empty. The replacement copy says "To provide high-speed Internet access at *competitive* [my emphasis] prices (at least 128K for residential customers and at least 256K for business customers) to all North Carolinians within three years." http://www.e-nc.org/Webpage.asp?page=10, accessed August 22, 2003.

[12] "The purpose of the Community Technology Centers (CTC) program is to assist eligible applicants to create or expand community technology centers that will provide disadvantaged residents of economically distressed urban and rural communities with access to information technology and related training." At http://www.ed.gov/offices/OVAE/AdultEd/CTC.

[13] "The Technology Opportunities Program (TOP) is a highly-competitive, merit-based grant program that brings the benefits of digital network technologies to communities throughout the United States. TOP awards matching grants to public and non-profit organizations to demonstrate practical applications of telecommunications and information technologies." At http://www.ntia.doc.gov/otiahome/top/whoweare/whoweare.htm.

[14] U.S. Federal Communications Commission, "Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996," CC Docket No. 98-146, January 28, 1999, p. 47.

[15] "A Nation Online: How Americans Are Expanding Their Use Of The Internet," U.S. Department Of Commerce, Economics And Statistics Administration, National Telecommunications And Information Administration, February 2002, P. 36.

[16] U.S. Federal Communications Commission, "High-Speed Services for Internet Access: Status as of December 31, 2002," Industry Analysis and Technology Division, Wireline Competition Bureau, June 2003, p. 3.

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[17] Industry Analysis and Technology Division, Wireline Competition Bureau, June 2003, p.1. For reporting purposes, the FCC refers to "high-speed lines" rather than the term "broadband." It considers any line rated at 200 kbps in either direction as high speed.

[18] Ibid., p. 4

[19]Ibid.

[20] The FCC reported that high speed access line to residences and small businesses increased 58% in 2002 over 2001. Extrapolating using that growth rate for Q4 of 2001, all of 2002 and the first half of 2003 and subtracting an estimate for the small business component yields at least 45% of Internet households with high speed.

[21] National Telephone Cooperative Association, "NTCA Members Internet/Broadband Survey Report," November 2000, p. 12. NTCA describes itself as a national association of approximately 500 local exchange carriers in 44 states that provide service primarily in rural areas. The data is based on responses from 38% of its members.

[22] Victor Glass, "Small Equipment Manufacturers Quietly Bridge the Digital Divide," GoDigital In The News, N.D. at http://www.godigital.com/docs/articles/americasnetwork.shtml. These numbers were cited in the NECA Rural Broadband Cost Study" authored by Glass, but were not part of the publicly available summary.

[23] Alan Miles, Jag Sanger and Luis Ubiñas, "Cable: All Bundled Together," *Future Intelligence*, McKinsey & Company, 2000.

[24] "Industry Statistics," National Cable Television Association, accessed April 28, 2003 at http://www.ncta.com/industry_overview/indStat.cfm?indOverviewID=2.

[25] Calculated from data cited in n. 13.

[26] "Exparte Comments of the Rural Utilities Service," In the Matter of Annual Assessment of the Status of Competition in Markets for the Delivery of Video Programming, FCC Docket 99-230, submitted June 22, 2000. Accessed April 29, 2003 at http://www.usda.gov/rus/telecom/telecomact/word_files/cablavail-xp.doc

[27] Kanchana Wacnichkorn and Marvin Sirbu, "The Role of Fixed Wireless Access Networks in the Deployment of Broadband Services and Competition in Local Telecommunications Markets: An Engineering, Economic, and Public Policy Analysis," TPRC, September 2002. May be access from http://intel.si.umich.edu/tprc/archive-search-abstract.cfm?PaperID=86

[28] Glass, "NECA Rural Broadband Cost Study, p. 6.

[29] Wacnichkorn and Sirbu, p. 1.

[30] "MMDS Overview," Wireless Communications Association, at http://www.wcai.com/mmds.htm, accessed May 12, 2003.

[31] Wacnichkorn and Sirbu, p. 28

[32] Ibid.

[33] Ibid, p. 23.

[34] Ibid, pp 26-28.

[35] Wacnichkorn and Sirbu also provide data on costs based on outside antenna. I assume here that to provide a more

level comparison in both cost and ease of installation/use to cable and DSL, indoor customer premises equipment (CPE) would be the favorable scenario. The cost difference for MMDS for low density areas is negligible, while for UHF aggregate costs using indoor equipment is about 7% more. Indoor CPE is actually less expensive than outdoor only after density exceeds 100 lines/mile. (Table 13, p. 26).

[36] "ARS, INC. Study Finds Broadband Prices Held Steady In Second Quarter 2002," http://www.ars1.com/press/pressreleases/PR_Broadband082102.pdf accessed May 3, 2003.

[37] Mark Nord, "Does it Cost Less to Live in Rural Areas? Evidence from New Data on Food Security and Hunger." *Rural Sociology*, 65:1 (March 2000), p. 104.

[38] S. Deller, M. Shields, and D. Tomberlin, "Price Differentials and Trends in State Income Levels: A Research Note," *The Review of Regional Studies*, 26:1 (Summer 1996), p. 99.

[39] Nord, p. 104.

[40] Ibid, p.105.

[41] Ibid, p. 107.

[42] Ibid., p.115.

[43] D.H. Garnick, "Accounting for Regional Differences in Per Capita Personal Income Growth: An Update and Extension," *Survey of Current Business*, January 1990, pp. 24-34.

[44] Deller, et al, p.110.

[45] This was a purposive sample, limited by the availability of cities with comparable data. Similar data apparently does not exist for truly low density areas. Rather, cities in largely rural areas (e.g., Sioux Falls, Bangor, Cedar Rapids) are used as surrogates.

[46] U.S. Bureau of Labor Statistics, "Consumer Expenditures Survey, 2001," Table 52 at http://www.bls.gov/cex/2001/share/region.pdf

[47] Ibid.

[48] U.S. Congress, Joint Economic Study Committee, "Auto Choice: Impact on Cities and the Poor," 105th Congress, March 1998, accessed July 24, 2003 at http://www.house.gov/jec/tort/cities/cities.htm.

[49] Personal observation also suggests that gasoline is considerably less expensive in Northeastern Kansas than in Philadelphia.