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Current Development: The Digital Divide - An Appalachian Ohio Perspective

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The Digital Divide - An Appalachian Ohio Perspective

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The objective of this paper is to assess the role of satellite communication with respect to the Digital Divide in the United States. A secondary objective is to review the capabilities, capacity, and availability of current solutions in light of potential applications in other markets and situations.

This paper contains a review of the Digital Divide in general with additional attention to local Ohio developments and the use of satellite broadband Internet service. We then discuss different satellite-based solutions for residential and commercial Internet access.

I. Digital Divide - Current Perceptions

Based on a survey conducted in 2000, a 2001 report by the U.S. General Accounting Office stated, "Internet users (are) more likely to be white, well-educated, and have a higher-than-average household income," adding that Internet usage rates were similar in urban and rural areas. [1]

More recent survey data by the Pew Internet and American Life Project (May, 2002) acknowledge that "growth in the Internet population" has occurred across every demographic group but that this growth has been stalled since late 2001. [2] Further analysis of the most recent data indicate that some demographic groups are under-represented among Internet users with respect to the general population:

- Americans over 65 years old (4% of Internet users; 15% of the population)
- Americans with household incomes under $30,000 (18%; 28%, respectively)
- Blacks (8%; 11%, respectively)
- Rural residents (21%, 26%, respectively)
- No college (38%, 49%, respectively

The Benton Foundation, which has been central to the study of the divide and maintains the online Digital Divide Network resource, currently reports:

While a consensus does not exist on the extent of the divide (and whether the divide is growing or narrowing), researchers are nearly unanimous in acknowledging that some sort of divide exists at this point in time. [3]

Analysis of the trends behind Pew and Benton findings, however, has caused editorial writers from each end of the political spectrum to declare that the Digital Divide is over:

- "It may turn out that the 'digital divide' - one of the most fashionable slogans of recent years - is largely fiction," states the Washington Post. [4]
- "Researchers mining the data from their survey of 2000 U.S. households came across an interesting fact about the "digital divide." There isn't one. Or, at least, the divide that once was clear seems to be disappearing. [5]
- "A digital divide separating the computer and Internet haves from the have-nots turns out to be more of a gully or a small ditch than the Grand Canyon. The political dividers will have to find another gap to exploit," states the Washington Times. [6]

The editorial writers above cite a multitude of studies that independently agree that, on the matter of Internet access alone, the effects of income, ethnicity, race, and education are diminishing. Granted, access to the Internet does not equate with effective use of information, and may indeed be the wrong "divide" to measure. [7]

Recent Pew efforts have studied Internet non-users, over half of which are intentionally offline.In February 2002, the U.S. National Telecommunications and Information Administration (NTIA) stated that Internet use is increasing for people regardless of income, education, age, races, ethnicity, or gender. [8] Specifically, studies over time conducted by the Pew Internet Project have indicated that the rate of Internet use by black Americans rose from 23% in 1998 to 43% by 2001, compared to 58% by 2001 for whites, 75% for Asians, and 50% of English-speaking Hispanics. [9] Similarly, a current UCLA Center for Communication Program showed that the while 80% of American adults with college experience use the Internet, 65% of those who did not finish high school use the Internet - a gap that 5% wider a year earlier.

II. The Appalachian Ohio Digital Divide

The conclusions of the previous section are supported by analysis of existing and planned broadband Internet infrastructure buildouts in rural southeastern Ohio. A State-sponsored survey indicated that broadband Internet service is available or planned for all villages with over 500 residents and for nearly 80% of the region's residents.

Yet, the Appalachian region encompassing Ohio University should qualify as part of the Digital Divide. Appalachia spans from New York to Georgia, containing a growing population of 22 million across about 1000 miles, 400 counties, and 13 states. The region is characterized not only by its terrain but also by its poverty. In Ohio's 29 Appalachian counties, the poverty rate is 50% higher than the statewide average; eight Ohio counties near the University are considered "distressed" due to poverty or unemployment. The Appalachian Regional Commission (ARC), the source of these statistics, was created in 1965 as part of the "War on Poverty" to fund development projects including highways and telecommunication infrastructure. [10]

Despite these circumstances, the southeastern Ohio region is surprisingly well-connected. A series of studies funded by the State recently made the following conclusions about broadband Internet infrastructure in Appalachian Ohio: [11]

1. For corporate enterprises, connectivity is available in Appalachia. Key issues are linking companies with service providers and improving the quality of "last mile" lines.
2. Appalachian costs are higher but only the portion related to distance. Companies pay rates based on distance charges for their data traffic from business locations to the providers' facilities. The lower rent and labor costs make these technology costs more acceptable when evaluating the total cost of doing business in Appalachia.
3. Lagging deployment of residential broadband impacts innovation. However, if carriers invest as promised, smaller Appalachia markets will quickly catch up with more urban areas. Internet technology usage in Appalachian households and businesses lags behind statewide and national averages. Usage is the key driver for continued investment.
4. By 2003, broadband competition will exist in 38% of Appalachian cities and towns, with both DSL (Digital Subscriber Line) and cable modem service. In 79% of Appalachian cities and towns, residents will have access to at least one form of broadband, and businesses throughout the entire 29-county region will be able to purchase T1 connections. If providers make investments as planned, we may be winning the war on infrastructure (supply) but losing the war on usage (demand).

For almost a decade, the State of Ohio has provided $600 million in special funding for network infrastructure and operations through a program known as SchoolNet to local school districts. Since enactment of the Telecommunications Act of 1996, the mechanism known as E-Rate also provided over $130 million to Ohio schools and libraries. SchoolNet claims that all eligible classrooms (over 92,000) have computers and are connected to the Internet. [12]

Local libraries in Ohio are well-funded by the State and generally provide computers for access to the Internet. In addition, fines levied by public utility regulators have funded public computing sites including in this region.

The State has negotiated with SBC Communications, the largest local-exchange telephone carrier in the state, to provide T-1 data service to public entities at a flat, non-distance sensitive rate. For a flat rate of about $400/month, such entities may connect a T-1 circuit between any two points in Ohio. The State is also developing infrastructure to support wireless low-speed public-safety mobile computers.

III. Satellites in the Digital Divide

A satellite connection remains the only available means for broadband Internet connection for many rural Americans. Digital subscriber line (DSL) and cable modem networks offer superior cost and performance to known Internet satellite configurations and would be preferable if available. Current satellite Internet solutions appear to provide a competent value and are being adopted by U.S. customers at twice the rate of broadband service in general. Pew reports that there are 1.4 million wireless or satellite subscribers representing 4% of U.S. Internet users.

Internet service is provided over Ku-band transponders on the following satellites that cover North America:

Position	Satellite	Service Provider	# Transponders
91.0 W	Galaxy 11	DirecWay (Hughes)	4
91.0 W	Nimiq 1	DirecPC Canada	1
95.1 W	Galaxy 3C	DirecWay	4
99.0 W	Galaxy 4R	DirecWay	5
107.3 W	Anik F1	Verestar (Telesat)	1
101.0 W	AMC-4	Tachyon	
116.8 W	SatMex 5	DirecWay, others	7, 2
129.0 W	Telstar 7	StarBand	2

Source: Lyngemark Satellite, www.lyngsat.com, accessed July, 2003

Operators often engage resellers or partners whose scope of effort may range from re-branding to operations. Regulations dictate that installations with transmitters be performed by certified technicians; national firms such as installs.com are engaged by satellite firms to perform installations and are dispatched to rural areas as needed.

Service offerings vary by operator but generally fall into the following classes:

- Inroute via dialup modem ("telco return")
- Single workstation, satellite inroute at 64 or 128 kbps

- Ethernet LAN workgroup, satellite inroute at 128 or 256 kbps

Hughes Network Services, designer of DirecWay, provides a network utilizing the Internet Protocol (IP), over which both TCP and UDP transport services may be used; this is much like a traditional, terrestrial Internet service provider (ISP). For the consumer-class service, Hughes supplies the Internet gateway and provides IP address assignment, routing, domain name resolution, and network management. For higher classes of service, the operator may provide static IP addresses (necessary for running a server in the field) as well as multicast (necessary for streaming audio/video). Transmission of MPEG-2 compressed video over IP, realtime or not, is a valid application for this technology. The level of technical support needed increases with each service class. The datarate of the outroute is also a function of the class of service, with a rate of up to 48 Mbps possible. Under TCP/IP networking (unlike voice telephone), there is no consistent formula that translates the number of computer"seats" into a required datarate in either direction. Unlike the terrestrial Internet, these sending rates are under the control of the network manager.

An attractive advancement to satellite Internet is Virtual Private Network (VPN) technology. A VPN is a virtual IP circuit between any pair of devices over which the contents are encrypted. This service would be implemented between, for instance, a corporate firewall and a satellite-attached remote workstation. Setup and operation of such a "tunnel" increases the amount of information to be sent and thus decreases the useful throughput of the channel. This approach is used extensively in work-at-home settings over cable modem and DSL where traffic must be encrypted.

Three technical issues differentiate satellite Internet service from terrestrial service: TCP dynamics, capacity, and reliability. These issues are not obstacles per se but require different expectations by customers in the context of the digital divide. These are largely known within the satellite community [13] but not among Internet users, rural or otherwise.

1. TCP does not natively expect to have so many packets"in the pipeline" at a time. Due to propagation delays inherent in satellite communication as well as a slightly-higher error rate, TCP starts and accelerates slowly. Research is ongoing in this area, (see RFC 2760)but the only solutions are proprietary.
2. Satellite Internet network performance is related to capacity, the sale of which is a business decision. Inroute satellite channel access is based on variations of TDMA and bandwidth reservation, both of which are very effective under load. With future Ka-band satellites with spot-beam antennas and frequency reuse, transponders could multiply their inroute capacity dramatically. Absent these features, beyond a certain subscriber level or demand level, delays could be problematic for Ku band configurations.
3. Users of terrestrial networks are unaccustomed to outages of any duration, while satellite Internet may encounter occasional weather-related downtime. Customers may need to make an aesthetic tradeoff for greater reliability

through larger antennas. A mesh of satellite and terrestrial dialup backups would be necessary to raise reliability to a commercial level, say 99.99%.

IV. Satellites and the Digital Divide in Appalachian Ohio

Direct broadcast television satellite service is very popular in southeastern Ohio, given that entire townships lack cable television service, which foretells the potential for satellite Internet service. About one-third of townships (an Ohio township covers about 50 square miles) in the counties in and around Ohio University have no cable television franchise. The region has numerous satellite television receiver dealers/installers but, per the National Rural Telecommunications Cooperative, there is only one satellite high-speed internet dealer in Ohio's formal Appalachian region.

The Ohio Academic Research Network (OARnet) recently deployed unique infrastructure to one community that lacks broadband. Residents of New Straitsville, Ohio, are using Tachyon satellite service over SatMex5 to connect to the Internet. This demonstration project is intended to provide connectivity for job training in the field of medical records and may be duplicated in other local towns in the region.

In 2000, the village had a population of 774, a median family income of $27,557, and a stated unemployment rate of 10.4%; its schools are in a state of "academic watch,"failing the majority of state standards. These demographics are typical for the region, but New Straitsville is among the largest communities not served by broadband.

In this system, local users send packets through Tachyon's Internet gateway which is connected to a node known as the the San Diego National Access Point (NAP), to which both Internet2 and the commodity Internet are connected. The datarates for this project are 256 kbps inroute, 400 kbps outroute, and may be increased with demand.

The first phase of this project also provides wireless LAN access to New Straitsville residents. This kind of network, known as WiFi, is based on the IEEE 802.11b standard using inexpensive off-the-shelf equipment that can be installed by most users. A later phase may expand the wireless LAN footprint or to connect local businesses (for a fee).

V. Conclusions

We may conclude that the digital divide is now narrowed by 1.4 million, the number of satellite Internet subscribers in the U.S. The whole notion of a digital divide based on geography is being dismissed, and the satellite Internet industry deserves credit. In the U.S., design and refinement of satellite Internet products and services is largely the work of the private sector. Indeed, this progress has taken place "one consumer at a time." Projects such as OARnet's are intended to seed the demand-side and spur economic development aspects the digital divide in Appalachia.

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