Will Technology Trickle Down to Rural America?

A NetAction Report

by Kalyani Manohar

Today, the concept of a "globally networked village" is euphemistic, as the information super highway primarily connects cities, excluding towns and villages from its network. Much of the hype surrounding the Internet has been diminished by evidence that information and communication technologies (ICTs) tend to be implemented in ways that reinforce prevailing power hierarchies.

This trend is not indicative of the ineffectiveness of the Internet as a medium with the potential to knock down traditional social and economic barriers. It is however, indicative of the fact that forces behind the deployment of ICTs are avoiding regions that are sparsely populated. Access to the Internet is turning into a powerful criterion for growth and development. So much so that communication networks are divvying up the country into parcels of haves and have-nots, with the latter living in the leeward side of the digital divide.

The National Telecommunications and Information Administration, the U.S. Department of Commerce and the Economics and Statistics Administration released a report in October 2000 on the state of the "digital divide." According to the report, in August 2000, 58.5 percent of American households did not have Internet access.[1] A previous report by the NTIA (1999) found that Americans living in rural areas were less likely to have Internet access, irrespective of their income level. At the lowest income levels, those in urban areas are more than twice as likely to have Internet access than those earning the same income in rural areas.[2] As the titles suggest, the October 2000 report is more optimistic than the 1999 NTIA report. Yet both emphasize that there is a digital divide: "A digital divide remains or has expanded slightly in some cases, even while Internet access and computer ownership are rising rapidly for almost all groups."[3] As far as broadband technology goes, only 7.3 % of households are connected compared to central cities and urban areas which have penetration rates of 12.2% and 11.8% respectively.[4]

A report released last year by the Consumer Federation of America and Consumers Union[5] corroborates the NTIA's conclusions. The report concludes that the lack of access to ICTs has created a rift that separates those Americans connected to the Internet from those who are not. This "digital divide" persists and is not likely to disappear any time soon; and as the title of the report indicates, the disconnected are disadvantaged and disenfranchised.

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[1] "Falling Through the Net: Toward Digital Inclusion;" National Telecommunications and Information Administration, Economics and Statistics Administration and U.S. Department of Commerce; October 2000.
[2] "Falling Through the Net: Defining the Digital Divide;" National Telecommunications and Information Administration and U.S. Department of Commerce; August 2000.
[3] NTIA et al. page xvi, October 2000.
[4] *Ibid.* page xviii. The term "broadband" is used in this study to include the two most common technologies, Digital Subscriber Line (DSL) and cable modems, and Integrated Services Digital Network (ISDN).
[5] "Disconnected, Disadvantaged and Disenfranchised," Consumer Federation of America and Consumers Union. Washington DC, October 2000.

On Election Day 2000, 49% of U.S. households were still not online and 57% of those not online said that they do not plan to go online any time soon.[6] Is it that people do not value the importance of ICTs, or is access not a matter of choice for a large portion of Americans? The Consumer Federation of America and Consumers Union Report (October 2000) found that the digital divide is not the result of a failure of those without access to appreciate the importance of technology. It states that approximately 93% of those without access believe that computer skills are vital, 83% believe that understanding technology is critical to success, and 84% believe that children learn more when they have access to technology.

There is a will to learn. Is there then a way to bridge a divide that threatens to create a schism in society? This paper examines alternative communication technologies that are economically viable -- yet increase Internet access for those on the other side of the digital divide.

The Network Economy

A good starting point for this research was to first examine the reasons why vast swathes of potential users do not have access to ICTs. What is it about the network economy that discourages potential investors from setting up a strong network infrastructure in areas which have a relatively low user base?

High sunk costs: Traditional broadband networks that use fiber optic or DSL technology incur high infrastructure costs. Consequently in the early period of such networks, costs are higher relative to the utility of the network, but as more users get onto the network, costs start going down. Once a network is built, marginal cost approaches zero. Due to high initial costs, network providers try to offer as many services to as many users as possible, leading to a large amount of market concentration. Market concentration in turn makes it difficult for competition.[7] Marketing an innovative new technology is therefore challenging in the face of high barriers to entry.

S-Shaped Curve in the diffusion of ICTs: Attaining critical mass is essential to ensure the economic viability of ICTs. The rate of adoption can be diagrammatically represented as an S-shaped curve, with time plotted on the x-axis and the number of users on the y-axis. Early in the introduction of a service, few people will try it, but with the onset of network externalities and reinvention, the rate

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[6] Pew Research Center; *Who's Not Online: 57 % of Those Without Internet Access Say They Do Not Plan to Log On*, Pew Internet and American Life Project (http://www.pewinternet.org/); September 2000.
[7] Garcia, Linda. "Network Architecture and Place-Space Relationships: The Impact of Networking Technologies on the Geographic Distribution of Economic Activities;" Working Paper. November 1999.

of adoption takes off.[8] This is when the technology attains critical mass. This critical mass is difficult to attain in sparsely populated areas that have a narrow user base.

Tendency toward vertical Integration: Complexity of the network industry coupled with it's need to offer as many services to as many users as possible has led to a trend toward vertically integrated firms and high market concentration. Companies operating at different layers of the network architecture inter-operate with each other so as to take advantage of economies of scale and scope.

Network Externalities: The various components of a network are interrelated. Consequently an innovation at one point of the network is bound to affect usage of other parts of the network.[9] For example a new access device such as dumbed-down cheap personal computers is bound to lower the price of connectivity to the Internet thereby increasing network congestion. This could in turn lead to the phenomenon of "network tipping," where people drop off the network due to network congestion.

Limited time and resources required that this author select technologies for the purpose of this study in a judicious manner. Both the access device as well as the transport technology were considered when examining the potential of a particular ICT. The focus of this paper is on alternative wireless access technologies. Since convergence is creating hybrid solutions, alternative access technologies using cable modems and digital set top boxes have been included in the appendix.

ALTERNATE INTERNET ACCESS TECHNOLOGIES

Terrestrial/Fixed Wireless

Spread Spectrum Technology

When building out infrastructure into scattered rural communities is economically unfeasible, an obvious means to "get connected" would be to create a virtual or wireless network. Two technological developments coincide to increase the viability of wireless devices for Internet access in rural areas and in developing countries. The first is the advent of spread spectrum technology and the second is the decreasing cost of digital radios.

Spread spectrum technology employs frequency hopping, an idea that has its roots in the "Secret Communications System" patented by Vienna-born actress Hedy Lamarr and her friend George Antheil in 1942. Lamarr conceived of this idea as a means to allow the United States to

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[8] Rogers, Everett. *Communication Technology: The New Media in Society*, New York, NY: The Free Press, 1986.
[9] Boyer, Kenneth. "Network Externalities," *Networks, Infrastructure and the New Task for Regulation*, Ed. Werner Sichel and Donald L. Alexander; Ann Arbor, MI: University of Michigan Press, 1996.

use radio-controlled missiles against the Germans without the radio signals being intercepted or jammed. A simple radio signal sent to control a torpedo would have been easy to block. However, if the signal hopped from frequency to frequency at split-second intervals, anyone trying to listen in or jam it would hear only random noise. When both the sender and the receiver are hopping in tandem, the message would come through loud and clear.[10]

Conventional wireless signals that transmit signals over a single frequency are easily susceptible to interference from other wireless users and from obstacles like buildings and trees. In addition, signals cannot share the same frequency. The deliberate variation of the frequency of the transmitted signal results in a much greater bandwidth thereby allowing many users to use the same frequency. The number of users per spectrum can be scaled up to millions even in urban congested areas. The digital radio firm Omnipoint, for example, utilizes spread spectrum wireless technology to potentially accommodate 490,000 users per square mile.

Signals transmitted using this technology require no license to operate in most countries. In the U.S., the FCC has designated Part 15 of the spectrum for transmission of signals. Only the design of the radios has to be licensed by the FCC. Cost is limited to the price of the radios as there is no communications charge, and no telephone company charge.

Spread spectrum technology can be used to gain High speed Internet access that bypasses the PSTN or cable company. Beyer, Vestrich, and Garcia-Luna-Aceves (1999) have created a viable schema for a rooftop community network that can be used by a geographically scattered rural community to create an Internet access infrastructure.[11] Setting up such a network requires installing an Internet radio and a small antenna. The Internet radio acts as a hub as well as a modem by serving as a connection to the Internet as well as a repeater to forward to other users' traffic within the community network. The digital radio uses frequencies in the unlicensed spectrum, and contains a microcomputer that runs the Internet Radio Operating System (IROS) software. The IROS, much like the traffic police, controls the routing of packets between source and destination.

The antenna, which is three feet long and an inch in diameter, is mounted on the roof and connected to the Internet radio with a cable. The Internet radio, in turn, is connected to the user's computer, which is configured with the appropriate TCP/IP addresses, much like they are configured for dial-up access to the Internet. Being packet-based, it is an always-on connection

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[10] Weise, Elizabeth; "Hedy Lamarr-Inventor, A sultry screen star who didn't just act -- she invented;" *Associated Press*.

[11] Beyer, David A.; Mark D. Vestrich, J.J. Garcia Luna Aceves; "The Rooftop Community Network: Free, High-Speed Network Access for Communities;" *The First 100 Feet: Options for Internet and Broadband Access.* Ed. Deborah Hurley and James H. Keller. MIT Press: Cambridge. 1999.

that only uses resources when data is actually being transferred. Because of the limited frequencies that SS can use, the effective range is much smaller; often limited to less than 20 miles and requiring line of sight between radios. They can cover 10-mile distances at speeds up to 2 Mbps and can reach as far as 30 miles at slower speeds.

By taking advantage of the "bursty" nature of the Internet, members of a community network can share a single high speed Internet connection. This could be a cable, DSL or satellite broadband connection that leads into one residence that acts as the "Airhead." The Airhead is the Internet radio that serves as hub into the rest of the Internet, and as a virtual router to other users in the network. The Airhead in turn could divvy up the costs between the network users.[12]

According to David Hughes, principle investigator of the NSF field tests using wireless spread spectrum technology, more than 60 companies have produced spread spectrum, no-license radio devices.[13] Internet radios are still being produced primarily for the corporate consumer, however, and are priced between $2000 and $6000. Beyer et al estimate that current technology permits large-scale production of Internet radios that could be priced as low as $500. A chicken and egg situation prevails. The high price prevents attainment of a critical mass, yet without lowering prices Internet radios will remain out of reach for the mass market. Manufacturers of digital radios are also constrained by limitations imposed by the FCC. FCC regulations limit a transmitter's maximum output to one watt of power and limit the number of spectrum hops a signal can make.

The NSF has successfully implemented a number of Wireless Field Tests to demonstrate the potential of wireless spread spectrum technology in bringing Internet access to remote sparsely populated regions.[14] One of their earliest successful attempts was the link between the Rocky Mountain Internet (RMI) POP in Alamosa and the Monte Vista Middle School, in Colorado. Under the guidance of David Hughes, Principal Investigator for the NSF Wireless Field Tests, a 14.2 mile 115 Kbps link between the two locations was set up to bring Internet access to the school and its 25 classrooms.

This link was set up using two FreeWave radios using spread spectrum technology within the 902-928 MHz range. An 8dBi gain antenna was installed on the rooftop of the building at the Alamosa end. The radio was placed in the computer room of RMI, Alamosa and connected via a 25-foot cable to the rooftop antenna. The radio was connected to the NSF Field test router, which

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[12] Beyer et al, 1999.
[13] Hughes, David R.; "The Local Wireless Option;" *The First 100 Feet: Options for Internet and Broadband Access*. Ed. Deborah Hurley and James H. Keller. MIT Press: Cambridge. 1999.
[14] For more information on NSF Wireless Field Tests see http://wireless.oldcolo.com/.

was in turn connected to the RMI router. Large deciduous trees, which were higher than the antenna, surrounded downtown Alamosa and threatened to disrupt the radio signal.

At the Monte Vista end, an eight-foot omni antenna was set up on a 30-foot vertical mast on the roof of the one-story school building. The antenna was tuned to the 915 MHz radio range. The radio was placed up on the mast as close as possible to the antenna to prevent as much signal attenuation as possible. The following limitations were experienced: First, the original FreeWave radios only produced 300 milliwatts of power. Second, the distance between the radios was 14.2 miles. Third, the intervening distance between the two radios was filled with mature trees.

The project was successfully implemented at a total cost of $4,500. No monthly operating fees were incurred for the wireless substitute for local loop 56Kbps telco charges.[15]

The significance of this project will be to develop a working model of how to permit US scientific and educational institutions to reach counterpart institutions in a large number of lesser developed nations with poor telecommunications infrastructures.

Multipoint Multichannel Distribution System (MMDS)

MMDS was originally licensed as a service to provide one-way wireless video programming. It is still referred to as "wireless cable" although the wireless cable industry could not compete with wired and satellite-based video programming providers. Recent revisions in FCC regulations permit MMDS spectrum to be used for bi-directional services, making it a viable channel for the provision of broadband Internet access. Several holders of MMDS licenses view MMDS as a means of reaching out to users who cannot make use of DSL or cable. MCI/WorldCom and Sprint collectively own licenses worth $3 billion, covering areas – some rural – populated by more than 50 million people.[16] Sprint's MMDS service is delivered using land-based radio transmitters positioned at the tallest feasible location in a metropolitan area. A single transmitter can serve customers over an area totaling more than 3,000 square miles.

Customers obtain the MMDS signal using a small digital transceiver placed on their roof with line of sight to the transmitter. The digital receiver receives the signal and transfers it to a wireless modem, which communicates with their individual PC or Macintosh computer or Local Area Network (LAN).[17]

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[15] From the report prepared by David Hughes, Principal Investigator, made to the National Science Foundation (http://wireless.oldcolo.com/course/montev.txt). January 1996.

[16] United States Department of Commerce, National Telecommunications and Information Administration, United States Department of Agriculture, Rural Development, Rural Utilities Service; *Advanced Telecommunications in Rural America: The Challenge of Bringing Broadband Service to All Americans*; April 2000.

[17] See http://www.sprintbroadband.com/prsite/articles/MMDS.html.

Given the high cost of setting up a transmission tower, network economics will probably require a fairly large user base to spread fixed costs. According to the NTIA/USDA report (April 2000), MMDS will probably serve only those rural areas surrounding a non-rural town or a cluster of towns. It also mentions that MMDS has so far been deployed in towns with populations as low as 6,000.

Satellite Technology

When Cairncross (1997)[18] wrote about the death of distance, he must surely have been referring to the capacity of satellite systems to render geography meaningless. There are two primary satellite system technologies, differentiated according to the height of their orbit. These are Geosynchronous Earth Orbit Satellites (GEOs) and Low Earth Orbit Satellites (LEOs). Apart from these two, a nascent third alternative is stratospheric telecommunications services.

GEOs

As the name suggests, these satellites remain in the same position over the earth's surface. To do so, the satellite's orbit must be at a specific height within the Clarke belt, which is about 22,000 miles above the equator. A single geostationary satellite can "see" approximately 40 percent of the earth's surface. A geostationary satellite can be accessed using a dish antenna aimed at the spot in the sky where the satellite hovers.

Hughes Network Systems DirecPC is probably the best known satellite system covering North America. Users in remote areas can subscribe to the DirecPC service as long as they enjoy a clear line of sight to the southern sky. Setting up DirecPC Internet access would require an antenna, a satellite modem and DirecPC Satellite Access software (included with the satellite modem).

The cost of installation is $200 and the monthly service fee is $30. Downstream data rates are as high as 400 kilobits/second. Regular telephone lines carry upstream data. DirecPC provides an alternative in remote rural areas. The USDA/NTIA (April 2000) report states, "Because DirecPC provides customers in the most remote rural areas with the same quality of service provided to those in urban areas, it provides a preview of the potential for satellite broadband to eliminate geography and location as a cost factor" (page 17).

Two new Ka-band commercial geostationary satellite systems being designed to provide Internet access to small-business and residential users are iSky and NetSat28. NetSat28, however, will only target small businesses, home office and high-end residential users.

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[18] Cairncross, F. (1997). *The Death of Distance: How Communication Revolution Will Change Our Lives. Boston,* MA: Harvard Business School Press.

Besides all these new systems, a number of satellite service providers are upgrading their initial one-way Internet access offerings into two-way services. One such system is Hughes Network Systems' DirectPC, a spin-off from its digital direct-to-home TV service, DirecTV.

LEOs

Low earth orbit satellites do not remain in a stationary position above the earth's surface. They constantly orbit between a height of 450 and 700 miles. LEOs essentially function as part of a fleet of "birds" constantly revolving in such a way that at any time at least one satellite is within line of sight from any point on the earth's surface. The ill-fated Iridium network, for example, consisted of 66 constantly moving satellites, each of which covered a particular area for only a few seconds. The Iridium network, through a contract with Motorola, provided wireless voice, data, fax and paging services with global roaming facilities. Although it was a technical marvel in its time, mismanagement and unrealistically high initial pricing forced Iridium into bankruptcy and led to the decommissioning of the satellite network. Another often cited reason for the failure of Iridium's narrowband mobile satellite services is the increasing demand for broadband data services.

SkyBridge and Teledesic are putting the newest generation of LEO broadband satellites into orbit. Teledesic plans to build a LEO system of 288 satellites, which will start service in late 2004. The cost of setting up these constellations will run into billions. Given the bankruptcy of Iridium, the future off these ventures is a little uncertain. When asked about the future of LEO satellite systems David Finkelstein, senior vice president of marketing and business development at SkyBridge is quoted as saying, "We still think there will be enough low-hanging fruit, especially in rural areas, since deployment of fiber is so heavily concentrated in cities."[19] Headed by French telecommunications giant Alcatel, SkyBridge plans to begin offering Ku-band LEO satellite service in 2002. SkyBridge claims to be a solution for last mile connectivity – especially in rural America and other less developed parts of the world.

VSAT technology

The VSAT consists of two modules - an outdoor unit and an indoor unit. The outdoor unit consists of an Antenna and Radio Frequency Transceiver (RFT). The antenna size is typically 1.8 meters or 2.4 meters in diameter, although smaller antennas are also in use. The transceiver receives or sends a signal to a satellite transponder in the sky. The indoor unit (IDU) is the size of a desktop computer and functions as a modem that also interfaces with end user equipment like stand alone PCs, LANs, telephones or an EPABX. VSAT is used both by home users who sign up with

[19] Jones, Jennifer and Cathleen Moore; "Finkelstein added Satellite technology starts to enter IT's orbit;" *InfoWorld*; vol 22, Issue: 16; page 20; Framingham. April 17, 2000.

a large service such as DirecPC and by private companies that operate or lease their own VSAT systems.

The USDA and NTIA report titled "Bringing Broadband to Rural America" mentions Tachyon, a broadband data satellite system that uses VSAT technology. Tachyon connects end users to their ISPs using satellite links This promises to help ISPs reach customers in rural areas. Network traffic is carried via satellite between Tachyon Access Points (TAPs) at subscriber premises and a satellite. The TAP is a small outdoor unit comprised of a small satellite dish (less than one meter in diameter) that sends and receives satellite data. An indoor Tachyon network server consists of a PC enclosure with a custom satellite modem connected to subscriber LAN equipment via a 10/100BaseT Ethernet interface and standard Internet protocols.

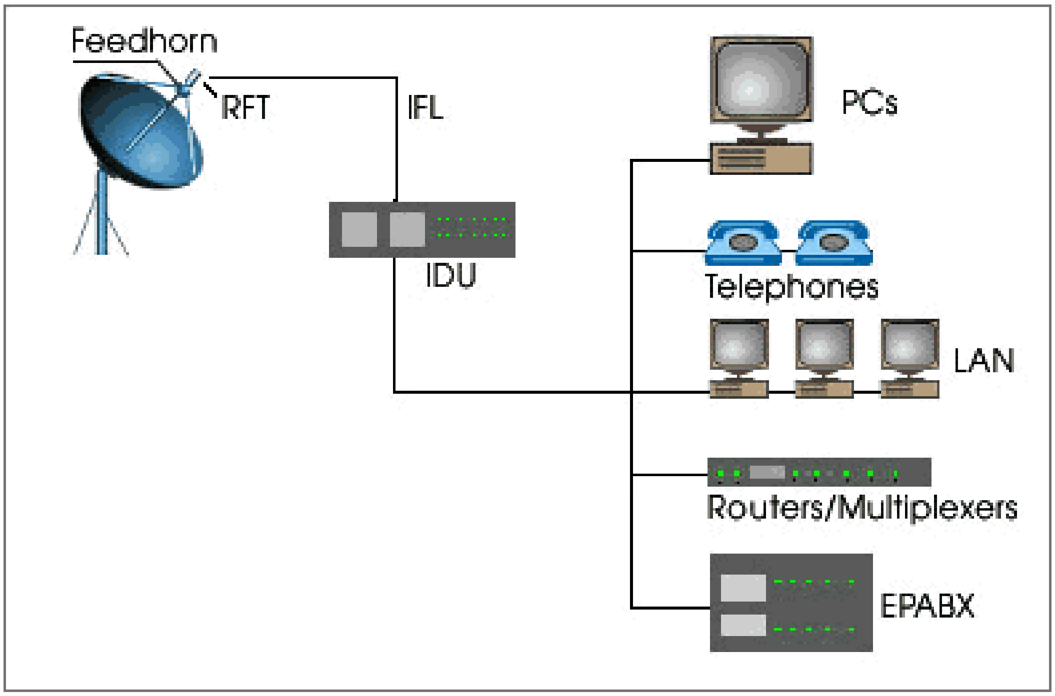


Image Source: BhartiBT, "What is a VSAT"[20]

A+Net Internet Services is one ISP that uses Tachyon's satellite links to connect to their end users. Their pricing chart is as follows:

Service Level	Base (1)	Enhanced (2)	Premium(3)	Exceed Bandwidth Allotment
CL1	$279	$335	$387	$0.20/MB
CL2	$629	$685	$737	$0.20/MB

[20] See http://www.bhartibt.com/tutorial/whatvsat.html.

CL3	$819	$875	$927	$0.20/MB
C1	$599	$655	$707	$0.20/MB
C2	$1,231	$1,287	$1,339	$0.20/MB
C3	$1,883	$1,939	$1,991	$0.20/MB

A+Net Setup and Tachyon Access Point (TAP) installation is $995. A TAP could be set up in conjunction with a rooftop community network, in remote rural areas that cannot set up an Internet radio link to the nearest ISP.

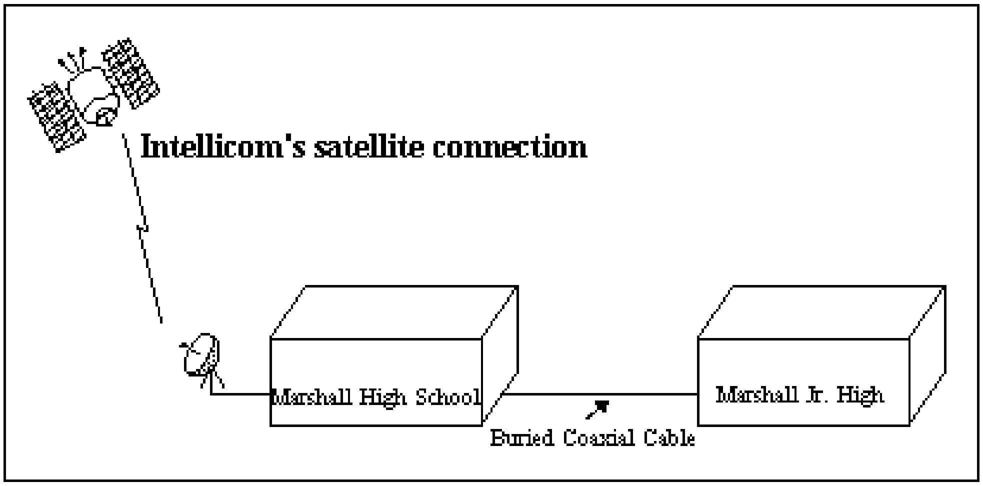
In rural areas in the US, wireless is an alternative to making expensive long distance calls to connect to commercial ISPs. Based in Fremont, CA, Intellicom, provides high speed, two-way, satellite connections for ISPs and schools, like the University of Illinois at Urbana-Champaign, the Marshall Community Unit School District in Illinois, and Cibola Internet Systems. The entire system, once procured, can be set up within 24 hours at a cost of $33,000 for installation and service. Monthly fees are $1700 for the fastest service that has uplink speeds of 66Kbps and downlink speed of 2Mbps.

Marshall, IL, is a rural town located several hours from any major city. Due to the costs associated with long-distance leased lines, the district decided to explore other alternatives. They elected to use Intellicom's bi-directional satellite link to provide Internet access to the school and all residents of the district. The district has satellite dishes installed at two locations. The first dish is located at the high school, with a coaxial cable connecting the junior high to the high school. This allows both buildings to share access to the Internet. The second dish is located at the elementary school and provides Internet access for the building.

The district has also installed a dial-in modem pool with ten modems attached to it. In addition to offering after hours access to the district staff, they are reselling access to the community to offset the cost of the satellite network. The network configuration is as depicted below.

Stratospheric Telecommunications Services

Developed by Sky Station International Inc., these satellites are positioned on floating platforms a mere 21 kilometers above the earth’s surface. The ITU and the FCC have designated spectrum in the 47 GHz band for use by high-altitude stratospheric platforms, paving the way for planned commercial service to commence in the year 2002.



Source: A Guide to Networking a K-12 School District
From **Error! Bookmark not defined.**.

One of the main advantages of STS is that the platforms do not require a launch vehicle to be put in place as they are suspended by multiple helium balloons. Sky Station plans to float these platforms above every major metropolitan area. The system will provide uplink data rates of up to 2Mbps and downlink rates10Mbps to an area of approximately 19,000 square kilometers (7,500 square miles). With coverage extending into rural areas outside this zone, this system provides a possible broadband connection for ISPs to areas that do not have access to cable, DSL or fiber optic networks.

The use of higher frequencies is advantageous as it requires lower power receivers. The downside is that they are subject to interference from trees, windows and heavy rain. However, should the deployment of STS platforms take place according to estimated costs, a broadband Internet connection would cost only a few cents per minute.

CONCLUSION

This sampling of a few innovative technologies is indicative of the fact that the digital divide is not insurmountable. There already exist a wide range of innovative access technologies. Despite the seeming cornucopia at the technological level, actual deployment remains fairly thin. This leaves one wondering whether Internet access technologies will really trickle down to all Americans who want it. Unfortunately the workings of the network economy inhibit the trickling of technology into high cost sparsely populated rural areas.

The economy by it self cannot bring high speed net access to rural areas. Regulatory incentives such as the Rural Telecommunications Modernization Act and the E-rate plan will go a long way in creating incentives to invest in broadband infrastructure for rural areas. In addition, the high success rate of pilot projects work to plant the seeds of competition as well as demonstrate that there exists a demand for Internet access in rural areas.

Advances in technology, and the gradual decrease in prices have made a broadband infrastructure possible. The natural state of the network economy can accommodate these so called "high cost" areas, albeit with a little initiative from within the community, and with seed money from the state.

APPENDIX

Cable Modem

Cable television originated in 1948 as a service to households in mountainous or geographically remote areas where reception of over-the-air television signals was poor. Antennas were erected on mountain tops or other high points, and homes were wired and connected to these towers to receive the broadcast signals.[21] It is unfortunate today that cable hasn't so far been leveraged to provide Internet access in the very areas where it was born.

According to a report from the US Department of Commerce and other entities (April 2000),[22] cable television service providers are generally unwilling to extend their cables into rural areas where the subscriber density is less than 10 per mile. NTIA spoke to approximately two dozen small cable companies serving 1,000 customers or fewer about the deployment of broadband over their cable systems. Approximately half of the companies currently offer, or plan to offer, cable modem service to small towns, some of which would likely be rural. These companies reiterated that, because cable service is more economical where there is a higher density of customers, it is unlikely that they will build out to isolated customers in the rural countryside. The NTIA report also states that current practice in the cable industry is to provide broadband from a node passing between 500 to 1000 homes (350 to 700 customers) with the expectation that only a fraction of customers will take the service.

The deployment of coaxial cable is fairly high with the NTIA estimating that between 81% to 97% of Americans have access to cable TV. To utilize this coaxial cable for two-way Internet access, cable companies are required to invest in the installation of equipment that allows for downstream as well as upstream traffic. As mentioned earlier this makes investing in smaller communities economically not viable for cable TV companies.

Mid-sized communities, however, can make use of cable for net access through turnkey solutions where a larger service provider farms out equipment to small cable TV companies who

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[21] National Cable Television Association; The History of Cable Television; (http://www.ncta.com/glance.html).
[22] United States Department of Commerce et al.; April 2000.

want to upgrade their network for net access. For example, Softnet's ISP Channel offers data services in such towns as Atchison, Kansas; Kennebunk, Maine; Lake Travis, Texas; and Bonneville, Mississippi. While these towns do not fall under our definition of rural, they are certainly smaller than the large metropolitan areas where cable modem service first appeared. Another example is @Home Solutions, which specializes in supplying Internet access capabilities on a turn-key basis to small and mid-sized cable system operators, many of whom serve primarily rural areas. @Home Solutions has signed an agreement that will provide turnkey service and financial support to Falcon Communications, Inc., the nation's largest rural cable system operator.[23]

While cable is good for small towns it is not the answer for scattered rural communities for the following reasons:

Upgrading a cable system for two-way broadband service requires substantial financial investment. It has been estimated that the cable industry will expend $21 billion to upgrade their systems to reach roughly one half of the homes passed in the United States and an additional $31 billion to upgrade their systems to reach all homes passed *(NTIA p 15)*. Even cable companies that utilize turnkey systems will not find it feasible to run cable lines to places with a population below 1,000 (9,993 towns in the table below).

With the arrival of direct broadcast satellite for television, it is even less likely that cable systems will extend further into the countryside.

Cable, however, can be used to provide unidirectional net access. In such a situation downstream traffic is carried via the cable TV's coaxial cable and the upstream traffic can be carried via regular phone lines. SoftNet, for example, allows cable systems to offer Internet access at up to 1.5 Mbps downstream, with the return channel being provided on a telephone dial-up system.[24]

Selwynn identifies a third more innovative means of providing unidirectional Internet access via coaxial cable. InterTech corporation provides downstream access via coaxial cable and upstream access via satellite.   Upstream traffic is routed via a VSAT in conjunction with HTTP/Proxy servers at the head-end. This provides much faster speeds, and often even exceeds those offered by a conventional, dedicated T1 circuit.[25]

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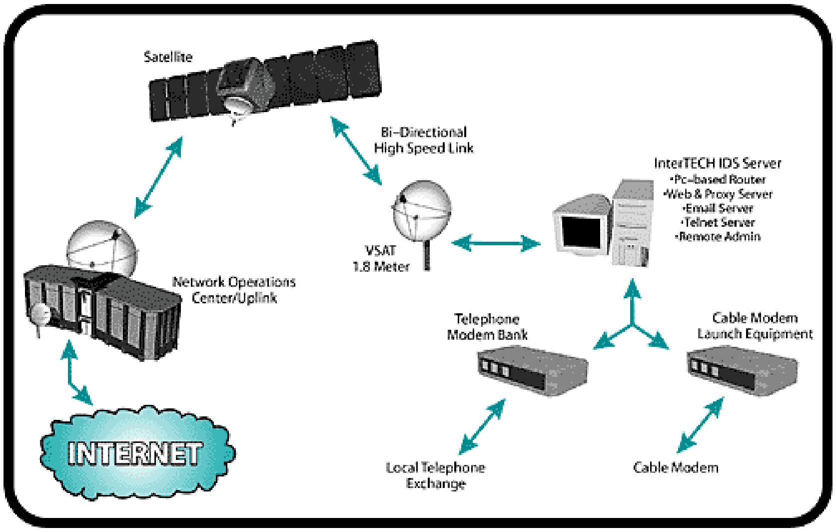
[23] Selwynn, Lee; *Bringing Broadband to Rural America: Investment and Innovation in the Wake of the Telecom Act*; Economics and Technology Inc: Boston, MA; December 1999.
[24] Ibid.
[25] For more information, see http://www.intertech.net.



Source: http://www.intertech.net.

Digital Set Top Boxes

The “idiot box” is finally attaining maturity with the onset of interactive television. Using a set-top box, keyboard and enhanced remote control, an essentially one-way medium has been converted into one that enjoys the power of interactivity. Set-top boxes come in varying flavors, depending on the level of service. Some merely enable users to use their current analog television sets to decode digital broadcasts. An Internet enabled set-top box enables a television set to interface with the Internet. It contains a Web browser (in other words a Hypertext Transfer Protocol client) and the Internet's main program, TCP/IP. The service to which the set-top box is attached may be through a telephone line as, for example, with WebTV, or through a cable TV company.[26]

Microsoft-owned WebTV Networks, Inc provides Internet access via the television. Users connecting to the WebTV network would require an Internet Receiver, (a set top box), a phone line, and any television set. The costs are $99 for the Internet Receiver and $21.95/month for WebTV Classic service.

Downstream traffic is carried via coaxial cable and upstream traffic via regular phone lines. Users have to dial into the local WebTV access number. In case WebTV does not have a local number to dial into users can dial into their local ISP’s number. WebTV charges are then $11.95 per month. Users would have to pay this fee in addition to the per month charge of the local ISP.

The following is a hypothetical situation for a user interested in using WebTV in a small rural community, Libby, Montana, where WebTV does not provide a local number to dial into.

[26] See **Error! Bookmark not defined.** for more information on set-top boxes.

The local community based ISP is KooteNet. KooteNet charges $16/month or $168/year. This would bring the monthly cost of using WebTV to $28 ($312/year).

A monthly fee of $28 is in itself fairly high. The disadvantage of interactive TV is that it becomes unaffordable for those who do not have a local ISP. As recently as 1994 Lincoln County (where Libby is located) still had about 800 four-party lines and also did not have an ISP with a local dial-up number. KooteNet was born with the help of a $25,000 loan from the Lincoln County Commission. Within four months of its being in operation, it had 120 subscribers and was able to pay back this amount. Regulation at the State level has generally stressed the need to allow local exchange customers to access an internet provider by making a local call.[27] Recent studies show that a very large percentage of households can dial into a local number to reach an ISP.

A federal technology literacy grant has enabled the use of set-top boxes for Internet access for giving fourth- and fifth-grade students of San Jose's Cesar Chavez Elementary School a chance to surf the Web on their television sets. The program gives school children from low income families access to the Internet using a television, phone line, set top boxes and wireless keyboards distributed free of cost by the school. Neon Technology, an Internet appliance company, donated many of the digital set-top boxes.[28]

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[27] See Michigan Telecommunications Act of 2000 Sec 202 (g).
[28] Stanford, Cheraine; "School Project Connects Families with Inter;" *San Jose Mercury News*; *06/07/2000.*