# High-speed Internet Access: The Future for the World and the Implications for Developing Countries[1]

Laurence Wolff

*The developed world will see a rapid transition to high bandwith or "broadband" communications over the next five years. This type of change will permit faster communications and additional computer applications, as well as the combination of voice, television and Internet communications, making a wide array of services far more efficient. The options for broadband connections include Internet via cable, via telephone (DSL), via optical fiber, via satellites and via ground based wireless networks. For developing countries satellite connections may be most appropriate for reaching rural areas.*

**Internet via Cable**

Currently the leading providers of broadband in the United States are cable companies. Over 90 percent of US homes have nearby access to cable. In order to provide access, cable companies have deployed fiber optics in their transmission networks, leaving the "last mile" to the existing network of coaxial cable. The cable company's central facility can serve up to 1,000 homes. Cable modems can provide a wide variety of services, including TV, Internet, and telephone, with Internet access always on. Where cable is already available, as in the United States and some European countries, the costs to the consumer are quite reasonable. One provider is advertising Internet access via cable at a cost of $29.95 per month if the customer provides the modem. For most developing countries, this option is not realistic, since cable systems are not already installed.

**Internet via Telephone (DSL)**

Copper telephone lines have been installed in more than 600 million phone lines worldwide. A new technology, called "digital subscriber line" (DSL), exploits the long dormant capacity of these lines to handle wide band Internet. It provides a fifty-fold increase (1.5 MBPS downstream and 0.5 MBPS upstream) speed of data transmission. The technology requires a heavy investment in the central telephone offices, since the signal deteriorates beyond 5.5 kilometers of transmission over normal telephone wires. One advantage over cable is that the signal is not shared with other users and telephone wires are physically secure. Another advantage is that businesses generally are not already connected to cable. DSL is also relatively inexpensive in the United States. While cable has a two-year head start, DSL is rapidly catching up. Newspaper ads in the United States offer DSL access at $49.95 per month, which includes telephone usage.

DSL technology offers wide opportunities in middle income countries, especially in Latin America and Southeast Asia, since with deregulation of phone provision, many of these countries have an increasing number of telephone connections. However, most telephone companies still charge for phone connections by the minute. DSL may remain beyond the reach of homes, and therefore it may not pay for phone companies to make the investment in their central telephone offices.

[1] This article summarizes five articles on high-speed data and Internet access, which appeared in the October 1999 issue of *Scientific American*. The complete articles may be accessed at www.scientificamerican.com.

**Internet via Optical Fiber**

By far, optical fiber provides the most rapid transmission of Internet and other services. The capacity of optical fiber is so enormous that it can handle all kinds of communications simultaneously—telephone, television, Internet, etc. Until recently the problem has been one of high costs—currently about $1,500 to install in individual homes. This cost may go down with the use of "fiber-to-curb" technology, with the remaining 30 meters to one kilometer covered by metallic connections. In the near future, this approach will mainly be used in construction of new homes and developments, and it does not yet appear financially feasible in most developing countries.

**Internet via Satellites**

A new breed of satellites employing digital technologies may improve the reliability, capacity, and speed of data communications, including Internet connections. Ultra-small relatively inexpensive antennas will capture the signals directly. Two types of satellite systems are possible. The first, geo-stationary satellites would orbit 36,000 kilometers above the equator at the same speed as the earth's rotation. They would use sophisticated signal processing to account for the transmission delays caused by the distance the radio signals must pass. In the second option, low earth orbit satellites could circle the earth every two hours at altitudes of 1,500 kilometers. While they reduce the distance delays, many more would have to be constructed. The estimated costs of an antenna is currently $500 to $1,000 per installation. Speeds would be up to 12 times faster than DSL. While satellite costs could range from $4 billion to $10 billion, there would be no need for wires. Despite these advantages, satellites have up to now received scant attention. Nonetheless, several countries have announced plans to launch satellites in 2002, and it is estimated that satellites could eventually cover 15 to 20 percent of the world market.

Satellites will be of especial value in rural and low populated areas of the world, as well as those areas that currently have inadequate hard-wired telephone service. Antennas could be set up in community centers and schools and therefore serve entire communities, before eventually expanding to individual homes. Therefore, they offer a clear opportunity to help ensure that poorer countries or regions are not left behind in the race for broadband Internet access.

**Internet via Ground-based Wireless Networks**

The fifth and potentially least expensive means of providing wide band Internet access is that of "local multi-point distribution services" (LMDS). This technology is similar to that of cell phones; however it operates on a much wider bandwidth than cell phones, thus permitting data transmission of up to 155 MBPS. A voice network can be utilized concurrently with data transmission. The technology is limited by "rain fade," distortions of the signal caused by raindrops as well as wall hills and even leafy trees. One proposed solution to this problem would be to provide more than one transmitter per site.

A major advantage of LMDS is that it can be deployed quickly and relatively inexpensively. There is no need for an existing copper or fiber optic network. In addition, central equipment can be moved as needed without high costs. Therefore, it could be a cost-effective medium of choice in densely populated areas, which have inadequate telephone access.

In summary, for developing countries**,** cable as well as fiber optics are not financially feasible at this time. DSL technology over telephone lines is feasible in urban areas of middle income countries. Wireless systems offer the greatest opportunities since they short-circuit the need for hard wiring. Satellite systems would be especially feasible for reaching rural areas and for widespread installation in schools and in community centers. Ground-based wireless networks are the most cost-effective means of providing access in urban areas. But as new technologies evolve and cost structures change, actual deployment of any and all of these alternatives could vary significantly. But there is no doubt that high-speed Internet access

will expand rapidly throughout the world, and that developing countries must move promptly to keep from falling behind.