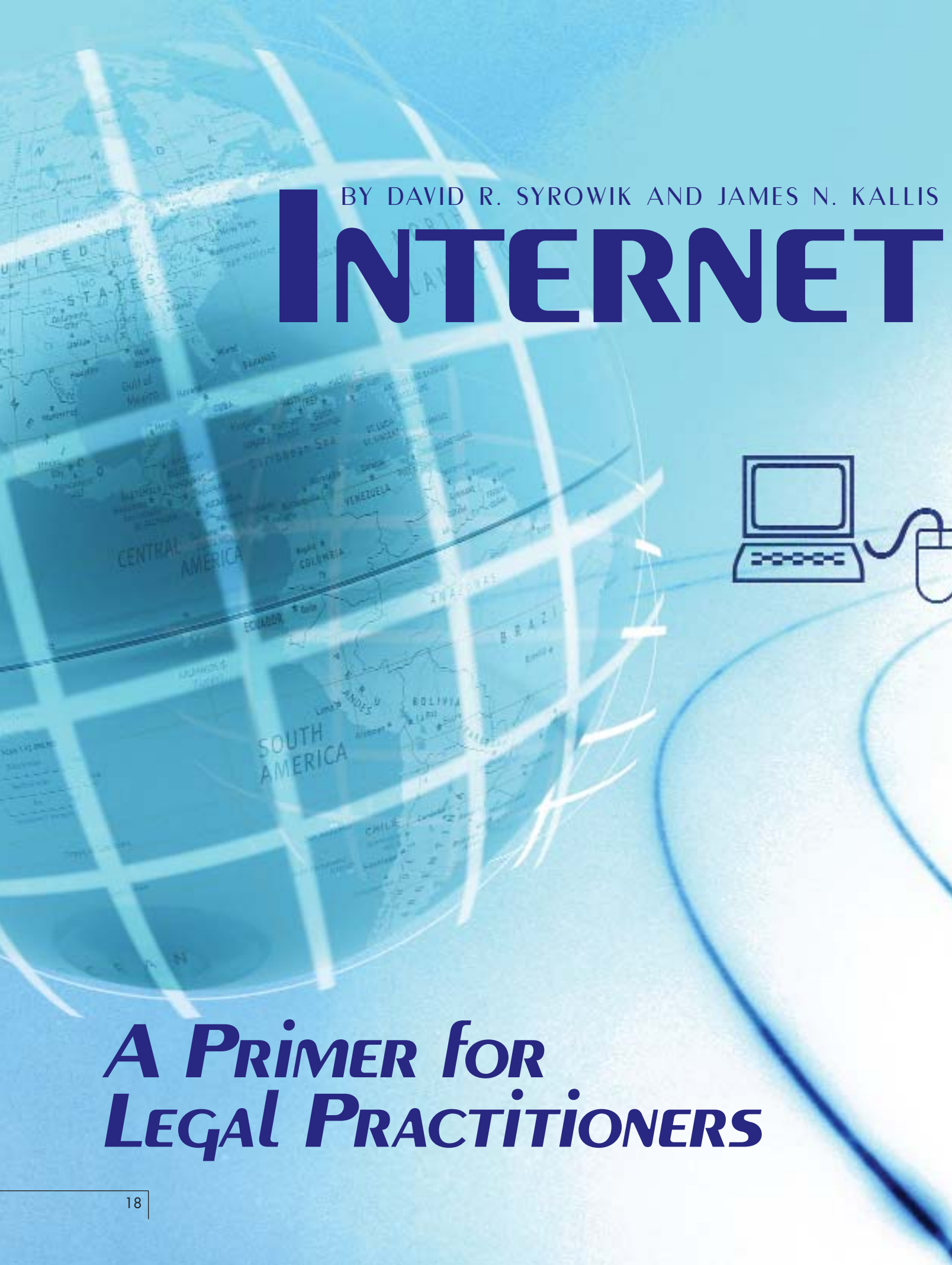


BY DAVID R. SYROWIK AND JAMES N. KALLIS

INTERNET

A PRIMER FOR LEGAL PRACTITIONERS

Access Technologies

Fast Facts

Telecommunications companies are battling for the "last mile" of infrastructure access to users.

The FCC is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable.

In 1999, the President's Information Technology Advisory Committee reported:

> *"Information Technology will be one of the key factors driving progress in the 21st century—it will transform the way we live, learn, work, and play. Advances in computing and communications technology will create a new infrastructure for business, scientific research, and social interaction. This expanding infrastructure will provide us with new tools for communicating throughout the world and for acquiring knowledge and insight from information."*[1]

Since this glowing forecast in 1999, the telecommunications industry experienced a crash from which it is still recovering.[2] The good news is much of the communications infrastructure is in place to provide services as they become economically feasible.[3]

What is Information Technology?

While many might think Information Technology simply means technology relating to computers, a better definition is: the combination of telecommunications and computing to obtain, process, store, transmit, and output information in the form of voice, pictures, words, and numbers.[4] The continuing convergence of computing and telecommunications has occurred because information such as voice and data can be encoded into digital signals, which then can be handled by computers and modern digital telecommunications networks.[5]

Except for the Internet, telecommunications services (including existing telephone networks) are subject to considerable federal and state regulation, despite the Telecommunications Act of 1996, which was designed "to promote competition and reduce regulation in order to secure lower prices and higher quality services for American telecommunications consumers, and encourage the rapid development of new telecommunications technologies."[6]

This article provides an overview of technical, business, and legal considerations for Internet access telecommunications technologies. A one-way telecommunications model is provided as a basis for four Internet access telecommunications models discussed in the article. Finally, some telecommunications trends are identified.

One-Way Telecommunications Model

Technical Considerations

The graphic below is a simplified one-way telecommunications model that provides the foundation for the four subsequently described Internet access models. The simplified one-way model is drawn from Daniel Minoli's book entitled *Telecommunications Technology Handbook* (Artech House, Inc. (1991)).

One-Way Telecommunications Model

An information source generates a message that may include audio (including voice), data, video, graphics, and text. The source may digitize the message for storage, transmission, etc. A transmitter modulates the message as a signal and then transmits the signal over a channel. A channel is a physical medium, such as cable, telephone line, or power line, or a non-physical medium (e.g., the atmosphere or space) through which signals travel. The channels may be divided into paths by frequency or time to communicate multiple signals. A simple example is different television program signals travel on the same cable; upon receiving a signal from the channel, a receiver demodulates the signal to extract and forward the message to a destination.

The most common high-speed or broadband (high-speed does not necessarily mean broadband[7]) Internet access technologies include cable, telephone (i.e., DSL), and wireless. In these technologies, the one-way model is modified for two-way communications in which signals flow in both directions over the channel between the source and destination. In these technologies, the destination is also a source, the source is also a destination, and the transmitter and receiver are replaced by transceivers or transmitter/receiver combinations.

Business Considerations

Telecommunications companies are battling for the "last mile" of infrastructure access to users. The "last mile" refers to the relatively low data speed communications link that connects a user to the relatively high data speed network of a service provider. As we will see as we review other models, the winner of this battle may well end up being the provider for all of a user's local and long distance telephone service, broadband Internet access, and video/cable service.[8]

Legal Considerations

The Federal Communications Commission (FCC), an independent U.S. government agency, is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. The regulatory picture is complicated by the emergence of competing Internet access techniques such as cable modem, DSL, fixed and mobile wireless, and satellite. As the number of competing technologies increases, arguments for government intervention must be reexamined. Meanwhile, telecommunications companies litigate to improve their position.[9]

Telephone "DSL" Model

Technical Considerations

A two-way telephone DSL model, based on the prior simplified model, is shown below.

Land-line and wireless telephone technology use "circuit switching" in which a regular telephone line over the Public Switched Telephone Network (PSTN) connects the caller and callee when a telephone call is placed. The entire two-way conversation then flows over this telephone line.

The line carrying messages between the information source (such as the Internet) and the transceiver represents equipment provided by an Internet Service Provider (ISP) between the Internet and this transceiver. The "last mile" of infrastructure access to the user is called a "local loop," which extends from the central office in a locale to the user's transceiver.

A Digital Subscriber Line (DSL) brings Internet access to a user over a land-based telephone line. The telephone line requires no external power at the destination, and typically extends three miles or so between the central office and the transceivers. A DSL access multiplexer (DSLAM) located at the central office aggregates user connections into a single Internet connection. The DSLAM sends voice traffic to the PSTN and data traffic to a packet-switched data network for the ISP.

DSL transceivers communicate by encoding digital information into signals for transmission over telephone lines and by decoding received signals into digital information.

Business Considerations

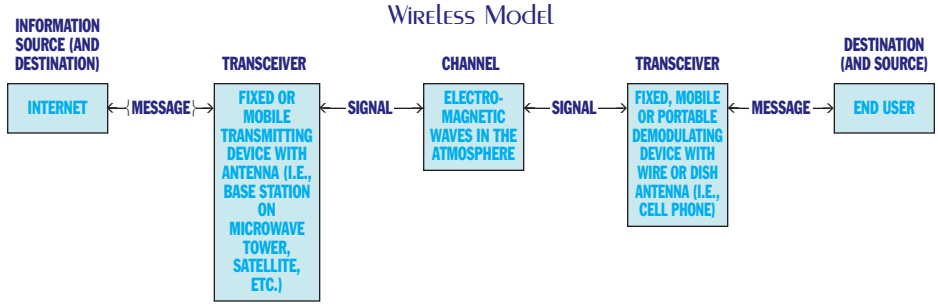
DSL provides 11 million end-user links in the United States,[10] but is regarded as a temporary solution until the "last mile" to the user is resolved because the data speed transfer rate of DSL technology is limited.

Legal Considerations

Regulatory agencies have forced telephone companies to lease their fixed-lines, or local telephone "loops," and their DSL equipment to competitors at a rate set by regulators rather than the market to provide DSL service while the companies provide voice band service. This "line sharing" has resulted in a lack of a coherent broadband policy, because there is little incentive for companies to expand their existing networks if such expansions must be leased to others at artificially low rates. Ironically, the Telecommunications Act of 1996 was designed to promote competition and reduce regulation.[11]

The U.S. Court of Appeals for the District of Columbia on March 2, 2004 rejected FCC rules forcing the Baby Bells to open their phone networks to rivals at regulated prices. Also, the court struck down a decision of the agency to give states responsibility for determining which parts of a local phone network should be available to rivals at regulated prices. The court chastised the FCC for failing to develop lawful unbundling rules (how to separate different services over the same channel) since the Telecommunications Act of 1996.[12]

Wireless Model



Wireless Model

Technical Considerations

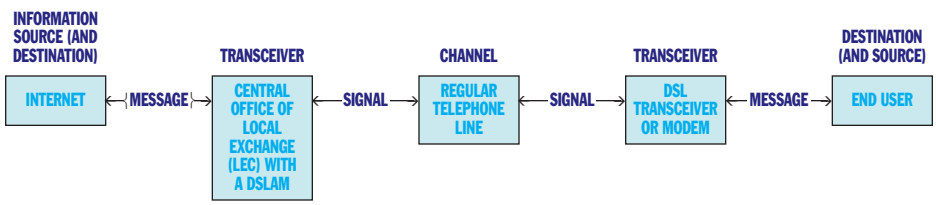
A two-way wireless model, also based on the original simplified model, appears above.

Wireless systems have a fixed, portable, or mobile transceiver at each end of a channel. An end user's handheld cell phone and automobile cell phone are respective examples of portable and mobile transceivers. New third generation (such as 3G or IMT-2000) networks/cell phones support Internet access.

One kind of fixed transceiver or base station may provide wireless service over a specific geographic area. This system is called a "fixed-fixed" system, where an antenna of the transceiver is mounted on a radio tower and end user premises are provided with rooftop antennas as part of their transceivers. A "fixed-portable" system uses a fixed transceiver and portable cell phones.

Another type of wireless system uses a mobile transceiver within a satellite. The user's

Telephone "DSL" Model



dish antenna receives and transmits signals to the satellite. In a one-way satellite system, an end user makes a telephone call to send signals from the end user to the source.

Another popular wireless Local Area Network (LAN) technology used between the source and the user is called "Wi-Fi" (such as Wireless Fidelity or IEEE 802.11). A fixed base station transceiver sets up a Wi-Fi zone user devices, such as lap-top computers located within 300–500 feet of the base station, can access.

Business Considerations

Wireless Internet technology is rapidly becoming a viable competitor for the "last mile."[13]

Legal Considerations

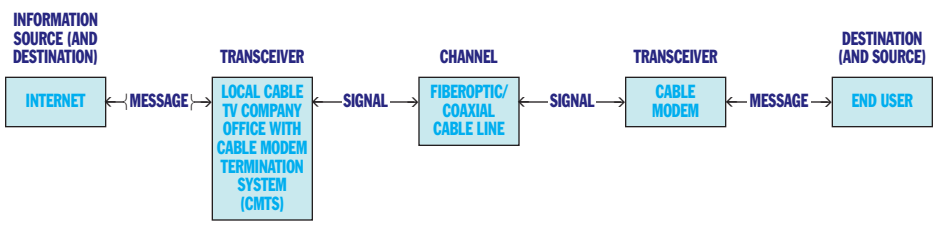
Availability of alternative "last mile" technologies such as wireless Internet technology lessens the strength of arguments for compulsory sharing of a particular technology. The 1996 FCC rule[14] prohibiting unreasonable restrictions regarding antennas, including satellite receivers, may well be outmoded and unnecessary given the variety of newer receptors/transceivers. The 1996 rule seemed to provide users with the right to place a dish on their premises without municipal or contractual restriction, but the rule carves out an exception that allows local governments, community associations, and landlords to enforce certain restrictions, which have hampered user access to satellite signals. For example, many condominium associations prohibit the placement of satellite receivers in areas viewable by the public.

Cable Model

Technical Considerations

When cable television (CATV) systems originated, only television service was provided to end users. Now, high-speed data and television service both may be provided over the "last mile" to users. A two-way cable model is shown below.

Cable Model



A cable modem termination system (CMTS) translates messages from the Internet into signals for transmission over the cable to the user. Likewise, the CMTS translates signals received over the cable from the user to extract messages from the user for the Internet. The CMTS aggregates many user connections into a single Internet connection to the ISP and adds television signals for the users.

Some systems use a channel of only coaxial cable while others use fiber-optic cable that extends to neighborhoods. Then, the signals move from the fiber-optic cable into coaxial cable for distribution to users.

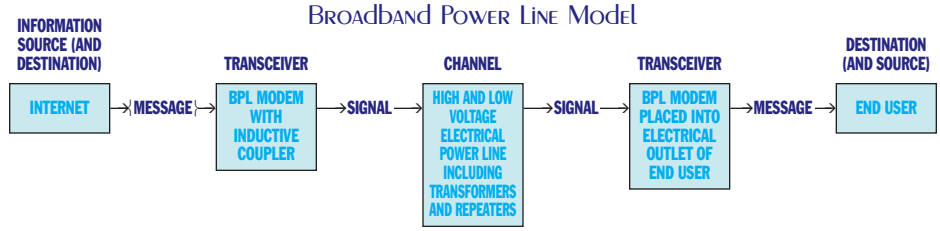
Coaxial cable inherently has a given bandwidth and can be viewed as having a group of channels through which signals of different frequencies travel. For example, a particular television program can be given a particular bandwidth slice, while data signals are given a separate bandwidth slice.

A relatively new telephone service called Voice over Internet Protocol (VoIP) uses "packet-switching." Packet-switching divides a message into smaller "packets" that are sent along different paths to the destination where they are then reassembled.

Business and Legal Considerations

There are about 60 million CATV end user lines in the United States. Regulatory agencies sometimes force CATV companies to lease their lines to competitors who, in turn, provide telephone service to end users. Congress intended in the deregulation of cable to stimulate competition and reduce prices.[15] But the trend has been toward higher prices because much consolidation has occurred, resulting in decreased competition. In addition, some question whether regulation or competition is an appropriate answer to the problem of higher communications rates.[16] The FCC is still struggling with the issue of whether or not to apply telephone regulation rules to VoIP.[17]

Broadband Power Line Model



Broadband Power Line Model

Technical Considerations

The broadband power line (BPL) model for broadband access is a largely experimental one-way technology. A BPL model appears above.

It is attractive because electric distribution networks are present almost everywhere. Inductive couplers connect BPL modems to voltage power lines (that is, the electric lines on utility poles) to transfer data signals onto the power lines. A significant problem with this model is the transformers that lower (or transform) voltages on the power lines from thousands of volts into low voltage such as 220/110 volts, also break apart the data signals. Another problem is the low voltage power lines in the "last mile" of distribution network can interfere with amateur radio frequencies.

Business Considerations

The BPL technology is costly because repeaters (a repeater is a device that regenerates an attenuated signal and then forwards this signal along the next step of the transmission path) are needed to periodically amplify the data signals on the power lines, and because only costly solutions are available for solving the problem of data signals breaking apart.

Telecommunications/Information Technology Trends

Various technology information trends include the following:

- Use of mobile phones is increasing at the expense of fixed-line phones.[18]
- Everyone wants (and is getting) faster Internet access speeds.

- Information technology and telecommunications continue to converge as new Internet technology dominates older telecommunications technology. For example, new Internet-based technology that interconnects offices via virtual private networks provides advanced data services and connectivity.
- Voice calls are being conducted using VoIP, which may eventually replace separate voice networks where voice and data are provided over a single communications channel.[19]
- Presently, a large amount of optical fiber is in place. However, the "last mile" to the end user typically is a copper telephone wire. The future may bring a fiber-optic or wireless "local loop" to provide this "last mile" to the end user.

Conclusion

Information Technology has revolutionized our businesses and personal lives: our children research their school assignments using the Internet, we buy our gifts from online retailers, we research our medical problems online, and we communicate with people all over the world through new technologies. While no one can deny information technologies have transformed "the way we live, learn, work, and play," no one can reliably predict who or what may be the winner of the "last mile." ◆

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Footnotes

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