Chapter 3.18
Broadband Solutions for Residential Customers

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HOME NETWORKING

The term "home networking" implies that electronic network devices work together and communicate amongst themselves. These devices are classified in three categories: appliances, electronics and computers. Home networks include home theater, home office, small office home office (SOHO), intelligent appliances, smart objects, telecommunications products and services, home controls for security, heating/cooling, lighting and so forth. The suite of applications on each device, including the number of connected devices, is specific to each home. The home network configurations are challenges, besides the unpredictable problems that could be higher compared to a traditional business environment. These are important issues that have to be considered by developers supporting home networking infrastructure. In addition, home networks have to operate in an automatically configured plug-and-play mode. Home networks support a diverse suite of applications and services discussed next.

BROADBAND APPLICATIONS

Home networks carry phone conversations, TV programs and MP3 music programs, link computers and peripherals, electronic mail (e-mail), distribute data and entertainment programs, Internet access, remote interactive services and control of home appliances, lights, temperature and so forth. The most important remote interactive services include remote metering, home shopping, medical support, financial transactions, interactive TV, video telephony, online games, voice-over Internet Protocol (VoIP) and so forth. Home applications based on multimedia require Internet connections and higher data transfer rates. For example, video programs compressed to MPEG-2 standards require a 2-4 Mbps transfer rate; DVD video requires 3-8 Mbps; and high-definition TV requires 19 Mbps. Since the existing phone line connected to a modem does not support data rates higher than 56 Kbps, rather than installing a modem for each computer, the high-speed

connection may be provided by a single access point called broadband access. Broadband access provides information and communication services to end users with high-bandwidth capabilities. The next section provides an overview of broadband access solutions.

BROADBAND ACCESS SOLUTIONS

The circuit between a business or home and the local telephone company's end office is called a local loop. Originally, local-loop service carried only telephone service to subscribers. But today, several local-loop connection options are available from carriers. These include dial-up circuits, Integrated Services Digital Network (ISDN) and broadband. "Last mile" refers to the telecommunication technology that connects a subscriber's home directly to the cable or telephone company. Broadband transmission is a form of data transmission in which a single medium can carry several channels at once. The carrying capacity medium is divided into a number of subchannels; each subchannel transports traffic such as video, low-speed data, high-speed data and voice (Stamper & Case, 2003). The broadband access options include Digital Subscriber Line (DSL), cable modems, broadband integrated services digital network (B-ISDN) line, broadband power line and broadband wireless, with a data rate varying from hundreds of Kbps to tens of Mbps.

Digital Subscriber Line

DSL is a technique for transferring data over regular phone lines by using a frequency different from traditional voice calls or analog modem traffic over the phone wires. DSL requires connection to a central telephone office, usually less than 20,000 feet. DSL lines carry voice, video and data, and DSL service provides transmission rates to maximum 55 Mbps, which is faster than analog modems and ISDN networks. In addition to high-speed Internet access, DSL provides other services, such as second telephone line on the same pair of wires, specific broadband services, video and audio on demand. The priority between these services depends on the users and geographical area. For example, Asian users demand video services, while North American telephone companies use it for Internet access service.

Globally, the DSL market reached 63.8 million subscribers by March 2003, and future growth is expected to reach 200 million subscribers—almost 20% of all phone lines—by the end of 2005 (DSL Forum Report, 2003). xDSL refers to all types of DSL technologies, classified into two main categories: symmetric (upstream and downstream data rates are equal) and asymmetric (upstream and downstream data rates are different). DSL services include asymmetric DSL (ADSL), rate-adaptive DSL (RADSL), high data-rate DSL (HDSL), symmetric DSL (SDSL), symmetric high data-rate DSL (SHDSL) and very high data-rate DSL (VDSL) with data rates scaling with the distance and specific to each technology. For example, ADSL technology supports downstream data rates from 1.5 Mbps to 9 Mbps and upstream data rates up to 1 Mbps. VDSL technology supports downstream rates up to 55 Mbps. Also, VDSL provides bandwidth performance equal to the optical fiber, but only over distances less than 1,500 meters. SDSL technology provides data rates up to 3 Mbps. SHDSL supports adaptive symmetrical data rates from 192 Kbps to 2.31 Mbps with increments of 8 Kbps on single pair of wire or 384 Kbps to 4.6 Mbps with increments of 16 Kbps on dual pair of wire. SDSL has been developed as a proprietary protocol in North America, but it is now moving to an international standard called G.SHDSL or G.991.2. This is the first technology developed as an international standard by the International Telecommunications Union (ITU). It incorporates features of other DSL technologies and transports T1, E1, ISDN, ATM and IP signals. ADSL service is more popular in North America, whereas