Chapter 4

Network Management and Mobility

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QUICK LOOK at Chapter 4, Network Management and Mobility

This section introduces you to the business issues, challenges, and IT solutions in Chapter 4. Topics and issues mentioned in the Quick Look are explained in the chapter.

Every aspect of the enterprise depends on connectivity, and almost everyone wants mobility. Connectivity and mobility are network issues discussed in this chapter.

At work and in our personal lives, we need or expect immediate network connectivity to texts, tweets, social media, databases, news, apps, and everything else. We expect the Internet to be like water. Just turn it on and it's there . . . without any extra effort. The same view applies to all networks. For the most part, networks are transparent or invisible to us until service is degraded (slow) or the unthinkable happens—a crash or *unplanned downtime*. The social media meltdown in mid-2009 caused by hack attacks against Twitter, Facebook, blogging service LiveJournal, and gossip site Gawker was a pain point for hundreds of millions of users worldwide.

Recently, 4G networks—*purely digital networks*—have been deployed. Advances in 4G mobile broadband, primarily *WiMAX* and *LTE*, are making access to everything from anywhere a reality, as you will read in the opening case. The world's first dual network, *4G WiMAX and Wi-Fi*, on trains delivers wireless broadband Internet free to all passengers on the train and at the stations, and it also supports the operations of the train system. This innovative network uses WiMAX (802.16) technology for the connection to the train and Wi-Fi (802.11) technology for passenger access on the trains and at the stations. The network provides speeds up to 6 Mbps download and 4 Mbps upload on trains moving at speeds up to 90 mph and can accommodate over 1,000 simultaneous users. This level of performance provides a true 4G network experience sufficient for data-intensive rail applications such as emergency phones, video displays in the trains and stations, and video surveillance equipment. As with all IT, what is now an amazing and blazing mobile network will soon become an expected level of service as 4G networks roll out worldwide. The combination of a 4G network with the killer features—device management, multitasking, social media aggregator, and/or unified e-mail inbox—of Apple's iPhone OS 4.0 (mobile operating system) or Sprint's HTC EVO 4G, released in summer 2010, allows commuters in New Mexico to be at work from the time they arrive at the train station.

Exciting developments and disruptions are occurring in networks and collaboration. New 4G networks, multitasking mobile operating systems, and collaboration platforms are revolutionizing work, business processes, and other things that we have not yet imagined. We look at networks, collaboration, and mobility in this chapter. All of this power carries an environmental price tag and health risk. We examine environmental and ethical issues associated with the huge energy consumption needed to support those networks as well as impacts on our lives and privacy.

World's First 4G WiMAX Rail Network

The RailRunner high-speed train is a new service for New Mexico commuters, running 95 miles from Belen to Santa Fe. Beginning in 2010, the New Mexico Department of Transportation (NM-DOT) offers passengers free public 4G WiMAX Internet in all trains along the entire route and at all 15 stations to assist with the state's goal to relieve traffic congestion by making public transportation services more attractive to commuters. The WiMAX network also supports NM-DOT's on-train operations—namely, emergency communications, video displays, security cameras, and on-train payment processing. The on-train payment is for commuters' convenience. This 4G network is the first of its kind on a rail transit system and one of the highest-performing systems in the world.

The cost to develop the network was $2.7 million. The contract had been awarded by NM-DOT to the team of INX and AzulStar (*Azulstar.com*) in March 2009.

Mobile Broadband WiMAX/Wi-Fi Configuration

The network utilizes both WiMAX (*802.16*) technology for the connection to the train and Wi-Fi (*802.11n*) technology for passenger access within the trains and at the stations. Network speeds are up to 6 Mbps for download and 4 Mbps for upload on trains moving at speeds up to 90 mph; network capacity allows over 1,000 simultaneous users.

> *Technical details:* Commonly called WiMAX, 802.16 is a group of broadband wireless communications standards for metropolitan area networks (MANs). WiMAX provides connectivity without a direct line of sight to a base station up to 31 miles away and shared data rates up to 70 Mbps (megabits per second, roughly 1 million bits per second). The most current generation of Wi-Fi technology is 802.11n, which supports multiple-input-multiple-output (MIMO) technology devices.

Figure 4.1 WiMAX base station tower. (*elzeva/iStockphoto*)

As part of the project, AzulStar deployed 22 WiMAX base stations along the 95-mile route to achieve a superior level of performance and reliability. Figure 4.1 shows a WiMAX base station tower. Other rail networks use low bandwidth (slow) satellite or cellular Internet services. Hardware for the high-performance network was provided by industry leaders Alvarion, Dragonwave, and Cisco Systems.

Another mobile network in New Mexico is the WiMAX/Wi-Fi intelligent transportation network for Highway 550. This network coordinates signals and counts traffic in real time, transports live video from 25 traffic cameras, and provides secure mobile access to New Mexico DOT field personnel.

Sources: Azulstar.com (2010), *MobileTechNews.com* (2010), and AP (2010).

For Class Discussion and Debate

1. Scenario for Brainstorming and Discussion: There are always expected outcomes as well as *unintended consequences* (which may be positive or negative) of any new technology. Consider the following two examples. One outcome of the invention and widespread use of automobiles 100 years ago was the growth of suburbs, as people no longer had to live near their workplace. One outcome of the invention of the elevator was ever-taller buildings, as building height was no longer constrained by people's ability to climb flights of stairs. Both automobile and elevator technologies eliminated constraints on people and buildings.

a. Think about New Mexico's WiMAX/Wi-Fi network for commuters. Discuss potential consequences of the 4G WiMAX/Wi-Fi Rail Network. What constraints have been eliminated?

b. Assume that other cities have implemented similar systems and that commuters own mobiles with the latest mobile OS (operating systems). Brainstorm some far-reaching impacts of such a networked transportation system.

c. Identify several risks or negative unintended consequences. Discuss your estimate of their costs—both financial and nonfinancial ones.

d. What impact might this network have on other transportation methods? Would those changes be helpful or harmful to the environment?

e. Taxpayers pay for the development and maintenance of networks that are used at no cost by commuters. How do all taxpayers benefit from this tax-supported network?

2. Debate: Assume that your city/region has a free WiMAX/Wi-Fi network like the one in New Mexico. Also assume that you have about a one-hour commute by train and you rely on the DOT's network to perform your job.

a. Identify four business-related risks that you face as a user who relies on the DOT network as well as how those risks might impact you or your job; for example, if you needed to complete an important proposal, and you missed the deadline because of the unplanned network downtime/outage.

b. Assume that each risk actually happened. *Debate the following*: Who is responsible or is no one responsible of the consequences of each one? Take the position that it's no one's fault ("technology crashes happen"), the DOT's fault as the provider, or the user's fault. That is, when things go wrong with the network, who gets the blame and who suffers the consequences?

4.1 Business Networks

Business networks support four basic functions or needs: mobility, collaboration, relationships, and search. Brief descriptions of these functions are:

- **Mobility:** Secure, reliable access from anywhere at acceptable speeds.
- **Collaboration:** Working as a team or with others, with members having access to and sharing documents or other types of files.
- **Relationships:** Maintaining contact or interaction with customers, supply chain partners, shareholders, employees, regulators, and so on.
- **Search:** Looking for and finding data, documents, spreadsheets, e-mail messages, and so on easily and efficiently.

Common to all network functions is traffic (signals) and the circuits that transmit the traffic. The fundamentals of networks and network communalizations are discussed next.

NETWORK BASICS

Networks transmit signals between a sender (source) and a receiver (destination), as shown in Figure 4.2. Signals carry the voice or data being transmitted.

Switching Signals Along the Path from Sender to Receiver. Networks need to be connected to other networks, including the Internet. Transmission of a signal over a series of networks is made possible by *switches* and *routers*, which are hardware devices, and *nodes* on the network. Switches and routers make decisions about how to handle packets or frames. Signals lose energy as they travel along a network and need to be strengthened. Repeaters amplify or regenerate signals to keep them moving along their paths.

The transmission of the signal by the switches and routers is called *switching*. The two types of switching are:

- **Circuit switching:** Once a connection is made between the source and the destination, the path of the signal along the nodes is dedicated and exclusive. Circuit switching is older technology that was used for telephone calls. Plain old telephone service (POTS) and most wireline (wired) telephone calls are transmitted, at least

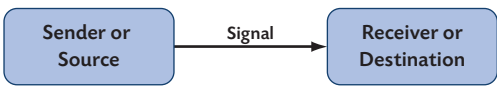

Figure 4.2 Overview of the transmission of a signal from a sender/source to a receiver/destination.

in part, over a dedicated circuit that is used only for that call. The distinguishing characteristic is that the circuit cannot be used by any other call until the session (connection) is ended.

- **Packet switching:** The path of the signal is digital and is neither dedicated nor exclusive. That is, the networks are shared. For example, a file or e-mail message is broken into smaller blocks, called **packets**. The network breaks a file or e-mail message into blocks (packets) of a specific size. Each packet carries part of the file or e-mail message as well as network information such as the sender's IP address, receiver's IP address, and instructions telling the network how many packets the file or e-mail message has been broken into. When packets are transmitted over a shared network, such as the Internet, they follow different paths to the destination, where they are reassembled into the original message once all of them have arrived. For a flash demo of packet switching, visit *pbs.org/opb/nerds2.0.1/geek_glossary/packet_switching_flash.html*

Wireless networks use packet switching and wireless routers. Routers are devices that forward packets from one network to another network. Routers connect networks that use different network technologies. Wireless routers are actually wired routers with **wireless access points (WAP)** built in, providing both wired and wireless at the same time. Figure 4.3 shows wireless routers, which use antennae to transmit and receive signals.

Network Terminology. To understand networks and the factors that determine their functionality, you need to be familiar with the following basic network terminology.

- **Bandwidth:** The throughput capacity of a network, which is a measure of the speed at which data is transmitted. Bandwidth depends on what protocol is used (802.11b, 802.11g, 802.11n, 802.16, etc.) and how much of the signal is available for processing. The weaker the signal, the lower the bandwidth, and the slower the transmission speed. As an analogy, consider a pipe used to transport water. The larger the diameter of the pipe, the greater the throughput (volume) of water that flows through it.
- **Protocol:** The standards or set of rules that govern how devices on a network exchange information (communicate) and how they need to function in order to "talk to each other." An analogy is a country's driving rules. In Australia, Bermuda, and the United Kingdom, the protocol is to drive on the left-hand side of the road. In China, Russia, and North American countries, the protocol is to drive on the right.
- **TCP/IP.** TCP/IP (Transmission Control Protocol/Internet Protocol) are the Internet protocols or the suite of Internet protocols. TCP/IP suite was created by the

Figure 4.3 Wireless routers use antennae to transmit signals. (*Joachim Wendler/iStockphoto*)

U.S. Department of Defense (DoD) to ensure and preserve data integrity as well as maintain communications in the event of catastrophic war. TCP/IP is used by most networks to ensure that all devices on the Internet can communicate.

- **Broadband:** This term is short for *broad bandwidth*. It's a general term that means fast transmission speed. In contrast, *narrowband* refers to slow speeds.
- **Download (speed):** How quickly data can be received from the Internet or other network, or how fast a connection can deliver data to a computer or mobile device.
- **Upload (speed):** How quickly data can be sent to a network or how fast a connection can transfer data from the source computer or mobile device. Typically, networks are configured so that downloading is faster than uploading.
- **Fixed-line broadband:** Describes either cable or DSL Internet connections. Fixed-line broadband differs from mobile broadband, which is wireless and uses a mobile broadband signal network.
- **Mobile broadband:** Describes various types of wireless high-speed Internet access through a portable modem, telephone, or other device. Various network standards may be used, such as GPRS, 3G, WiMAX, LTE UMTS/HSPA, EV-DO, and some portable satellite-based systems. These standards are discussed in the chapter.
- **3G:** Short for *third generation* of cellular telecommunications technology. 3G networks support multimedia and broadband services, do so over a wider range (distance), and at faster speeds than the prior generations—1G and 2G. 3G networks have far greater ranges because they use large satellite connections that connect to telecommunication towers.
- **4G:** Short for *fourth generation*. 4G mobile network standards enable faster data transfer rates.

3G AND 4G

4G technologies represent the latest stage in the evolution of wireless data technologies. 4G delivers average download rates of 3 Mbps or higher. In contrast, today's 3G networks typically deliver average download speeds about one-tenth of that rate. Even though individual networks, ranging from 2G to 3G, started separately with their own purposes, soon they will be converted to the 4G network. What is significant about 4G networks is that they do not have a circuit-switched subsystem, as do current 2G and 3G networks. Instead, 4G is based purely on the packet-based Internet Protocol (IP).

In general, users can get 4G wireless connectivity through one of two standards: WiMAX or LTE (long-term evolution).

- WiMAX is based on the IEEE 802.16 standard and is being deployed by Clearwire for wholesale use by Sprint, Comcast, and Time-Warner Cable to deliver wireless broadband.
- LTE is a GSM-based technology that will be deployed by Verizon, AT&T, and T-Mobile.

By the end of 2010, Clearwire had built out its 4G WiMAX network to all major markets in the United States and Verizon was offering its 4G LTE services commercially in 25 to 30 major U.S. markets.

IP NETWORKS

IP networks form the backbone of worldwide digital networking. They have encouraged the merger of voice, data, video, and radio waves, which can be digitized into packets and sent via any digital network. This convergence is happening on a global scale and is changing the way in which people, devices, and applications communicate. As shown in Table 4.1, improved network performance, which is measured by its *data transfer capacity*, provides fantastic opportunities for mobility, mobile commerce, collaboration, supply chain management, remote work, and other productivity gains.

TABLE 4.1 Growth of High-Capacity Networks

Network Standard	Generation	Data Transfer Rates (Capacity)	Used by	Upgrades
GSM (Global System for Mobile Communications)	2G	9.6 Kbps	Cingular, T-Mobile, most European carriers	Upgrades include GPRS, EDGE, UMTS, HSDPA.
CDMA (Code Division Multiple Access)	2.5G	307 Kbps	Verizon, Sprint	Upgrades include 1xRTT, EV-DO, EV-DV.
EDGE (Enhanced Data for Global Evolution)	3G	474 Kbps	Cingular, T-Mobile	
EV-DO (Evolution, Data Only)	3G	2.4 Mbps	Verizon, Sprint	Third upgrade to CDMA.
EV-DV (Evolution, Data and Voice)	3G	3.1 Mbps	Not in the U.S.	Most advanced CDMA upgrade.
HSDPA (High-Speed Data Packet Access)	3.5G	10 Mbps (6–7 Mbps is more realistic)	Cingular	Most advanced GSM upgrade.
			Features and Advantages	
WiBro (Wireless broadband)	4G	50 Mbps	Provides *handover functionality* and, therefore, ubiquitous connection. 4G networks will integrate wired and wireless networks to enable seamless service anytime, anywhere. Developed and launched in South Korea.	
WiMAX (IEEE 802.16e) (Worldwide Interoperability for Microwave Access)	4G	70 Mbps	Enables delivery of the *last mile* (from network to user) wireless broadband access, as an alternative to cable and DSL. The technology has a technical lead over the competition.	
LTE (Long-Term Evolution)	4G	277 Mbps	This standard is developed by the Third Generation Partnership Project (3GPP), the same standards body already responsible for the GSM, GPRS, UMTS, and HSDPA standards.	

NETWORKED DEVICES

Devices must be able to communicate with a network; they do so based on protocols. Network devices and technologies—including laptops, PDAs, cell and smartphones, wikis, intranets, extranets, GPSs, POS (point of sale) terminals, and RFID (radio frequency identification)—communicate with networks to send/receive data. This data must be rapidly collected, processed, shared, and acted upon. New feature-rich wireless devices make collaboration easier and faster. Consider these developments in networked devices and developments that point toward a more integrated, always-connected business environment and lifestyle:

- In 2007, approximately 5,000 tweets were sent per day. By mid-2010, there were more than 50 million tweets per day or 600 tweets per second.
- By 2011, over 85 percent of handsets shipped globally included some form of browser. In mature markets, such as Western Europe and Japan, approximately 60 percent of handsets shipped were smartphones with sophisticated browsing capability.
- Sprint's first 4G phone, the HTC EVO 4G, was released in summer 2010 with speeds 10 times greater than 3G phones. The handset runs a combo of EV-DO Rev. A and WiMAX, with calls still being made over CDMA and the EV-DO/WiMAX options for data.
- On its first day of sale in April 2010, approximately 300,000 iPads were sold and iPad users downloaded more than 1 million apps and over 250,000 e-books from Apple's iBooks store.

- Within 30 hours of its release in June 2007, Apple sold 270,000 iPhones. iPhones combine a mobile phone, iPod media player, and Web accessibility running on AT&T's wireless network. By October 2008, sales of iPhones had reached 10 million units.
- Mobile handsets equipped with high-speed data transfer technology (e.g., HSDPA) were introduced in 2006. **HSDPA** (high-speed downlink (or data) packet access) allows for data speeds up to 10 Mbps, as shown in Table 4.1. In January 2007, Cingular launched Motorola's V3xx, the first 3G phone for Cingular capable of running on 3.6 Mbps HSDPA. The V3xx is tri-band GSM/EDGE/HSDPA, meaning that it can run on any of those three networks, as listed in Table 4.1.
- Advances in GPS positioning and short-range wireless technologies, such as Bluetooth and Wi-Fi, can provide unprecedented intelligence. They could, for example, revolutionize traffic and road safety. Intelligent transport systems being developed by car manufacturers allow cars to communicate with each other and send alerts about sudden braking. In the event of a collision, the car's system could automatically call emergency services. The technology could also apply the brakes automatically if it was determined that two cars were getting too close to each other.

Advancements in networks, devices, and RFID sensor networks are changing enterprise information infrastructures and business environments dramatically. The preceding examples and network standards illustrate the declining need for a physical computer, as other devices provide access to data, people, or services at anytime, anywhere in the world, on high-capacity networks using IP technology. Slow wireless speeds, compared to wireline speeds, had been a constraint. 4G networks and advanced handsets operating on multiple network standards offer universal connectivity/mobility.

Mobile Network Evaluation Factors. Pressures to deliver secure service to customers and business partners at reduced costs, to be environmentally responsible, and to support the 24/7 data needs of mobile and remote workers have increased demands on corporate networks. When evaluating mobile network solutions, the factors to consider are:

1. **Simple:** Easy to deploy, manage, and use
2. **Connected:** Always makes the best connection possible
3. **Intelligent:** Works behind the scenes, easily integrating with other systems
4. **Trusted:** Enables secure and reliable communications

Review Questions

1. What is the difference between circuit switching and packet switching?
2. What is the difference between 3G and 4G?
3. What is broadband?
4. What are the mobile network standards?
5. What factors should be considered when selecting a mobile network?

4.2 Wireless Broadband Networks

Enterprises are moving away from unsystematic adoption of mobile devices and infrastructure to a strategic build-out of mobile capabilities. As the technologies that make up the mobile infrastructure evolve, identifying strategic technologies and avoiding wasted investments are difficult. But the cost and competitive pressures to do so continue to intensify. Factors contributing to mobility include the following:

- New wireless technologies and standards
- High-speed wireless networks
- Multitasking mobile devices
- More robust mobile OSs and applications

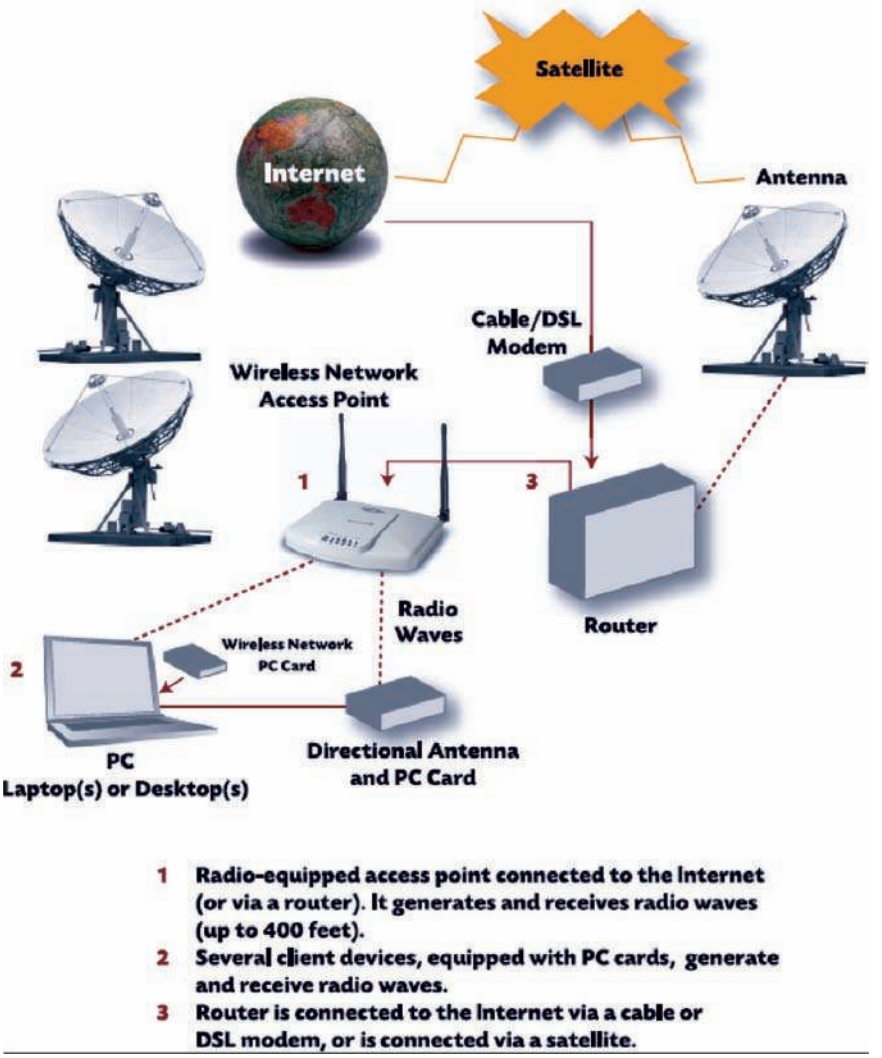

Figure 4.4 How Wi-Fi-works.

- Increased competitive pressure as others start adopting mobile technology
- Overall increased speed of business

Mobile Infrastructure. Mobile infrastructure consists of the integration of technology, software, support, security measures, and devices for the management and delivery of wireless communications.

WI-FI NETWORKING STANDARDS

Wi-Fi is a technology that allows computers to share a network or Internet connection wirelessly without the need to connect to a commercial network. Wi-Fi networks beam large chunks of data over short distances using part of the radio spectrum, or they can extend over larger areas, such as municipal Wi-Fi networks. Municipal networks are not common because of huge expenses. The city of Philadelphia debated whether to go forward with its plans to install a wireless network, which would cost the 135-square-mile city $10 million to install, or about $75 per square mile. The cost for running the network the first two years would be $5 million.

Wi-Fi networks usually consist of a router, which transmits the signal, and one or more adapters, which receive the signal and are usually attached to computers. See Figure 4.4 for an overview of how Wi-Fi works. More powerful transmitters, which cover a wider area, are known as base stations. Wi-Fi networking standards are:

- **802.11b.** This standard shares spectrum with 2.4-GHz cordless phones, microwave ovens, and many Bluetooth products. Data is transferred at distances up to 300 feet.

- **802.11a.** This standard runs on 12 channels in the 5-GHz spectrum in North America, which reduces interference issues. Data is transferred about five times faster than with 802.11b, improving the quality of streaming media. It has extra bandwidth for large files. Since the 802.11a and b standards are not interoperable, data sent from an 802.11b network cannot be accessed by 802.11a networks.
- **802.11g.** This standard runs on three channels in 2.4-GHz spectrum, but at the speed of 802.11a. It is compatible with the 802.11b standard.
- **802.11n.** This standard improves on the previous 802.11 standards by adding multiple-input-multiple-output (MIMO) and many other newer features. Frequency ranges from 2.4 GHz to 5 GHz with a data rate of about 22 Mbps, but perhaps as high as 100 Mbps.

WIRELESS WIDE AREA NETWORKS (WWANS)

There are three general types of mobile networks: wide area networks (WANs), WiMAX (Worldwide Interoperability for Microwave Access), and local area networks (LANs). WANs for mobile computing are known as **WWANs (wireless wide area networks).** The breadth of coverage of a WWAN depends on the transmission media and the wireless generation, which directly affect the availability of services. Two components of mobile and wireless infrastructures are wireless local area networks and WiMAX.

WLAN (Wireless Local Area Network). WLAN is a type of local area network that uses high-frequency radio waves rather than wires to communicate between computers or devices such as printers, which are referred to as nodes on the network. A WLAN typically extends an existing wired LAN. WLANs are built by attaching a wireless access point (AP) to the edge of the wired network.

WiMAX. The WiMAX Forum (*wimaxforum.org*) describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL." WiMAX is an 802.16-based broadband wireless metropolitan area network (MAN) access standard that can deliver voice and data services at distances of up to 30 miles, without the expense of cable or the distance limitations of DSL. WiMAX does not require a clear line of sight to function. Figure 4.5 shows the components of a WiMAX/Wi-Fi network.

Thirty-two percent of enterprise respondents to Forrester's *Enterprise Network and Telecommunications Survey of North America and Europe* in 2007 cited "mobile

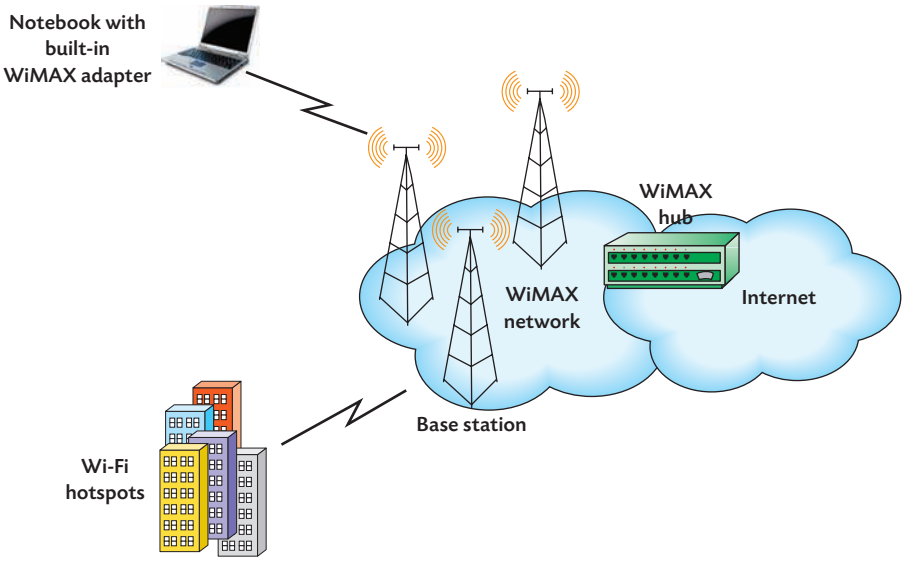

Figure 4.5 WiMAX/Wi-Fi network.

and wireless strategy and policies" as a priority (Forrester, 2007). An additional 15 percent stated that enterprise mobility is a critical priority for their business.

Review Questions

1. What factors are contributing to mobility?
2. How does Wi-Fi work?
3. What is a WLAN?
4. Why is WiMAX important?
5. What major vendors are helping drive the mobile enterprise?

4.3 Network Management and Portals

Effective communication is key to success in everything from business partnerships to personal and professional relationships. With few exceptions, when the network goes down or access is blocked, so does the ability to operate or function. Imagine a network meltdown in which you could not access the Internet, e-mail, voice-mail, software, and data files. At most companies, employees would have nothing to do without network connectivity. Obvious damages when a company cannot operate or fulfill orders include lost sales and productivity, financial consequences from not being able to send and receive payments, and inability to process payroll and inventory.

MODEL OF THE NETWORK, COLLABORATION, AND PERFORMANCE RELATIONSHIP

In the 21st century, performance depends on the capabilities and qualities of networks and collaboration technologies. Figure 4.6 presents a model of key network and collaboration factors that influence profitability, sales growth, and ability to innovate.

As the model in Figure 4.6 illustrates, an enterprise's network capability depends on proper planning, maintenance, management, upgrades, and bandwidth of the network to ensure that it has sufficient capacity and connectivity to link people, locations, and data. It also requires that those who need to access the network be equipped with the devices making it possible to do so. As a comparison, a highway system needs to be planned carefully to support peak traffic demands, monitored for

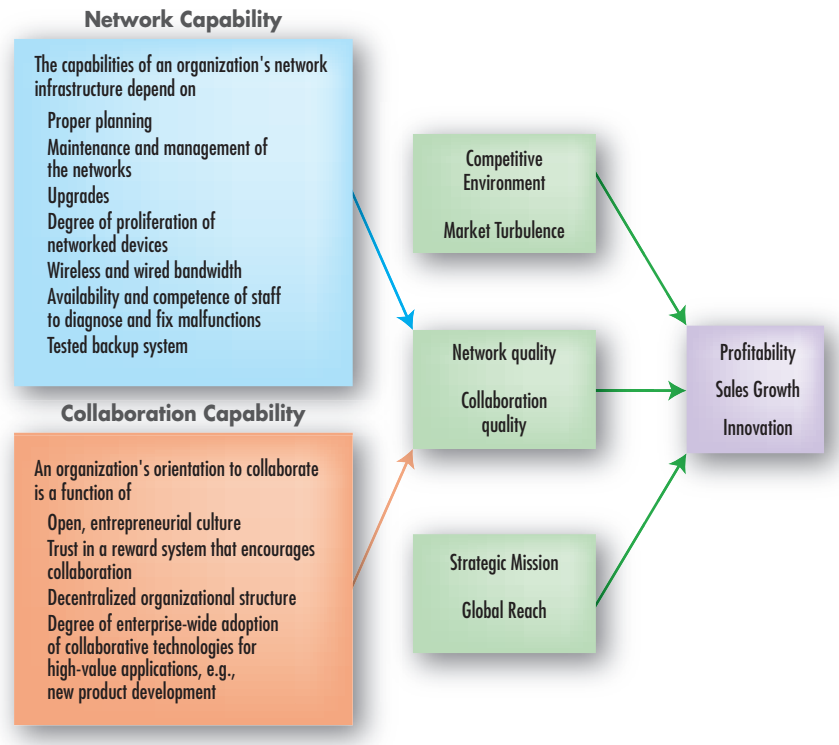

Figure 4.6 Model of network, collaboration, and performance relationship.

compliance with driving rules, cleaned and maintained regularly, and expanded (upgraded) when it no longer meets the needs of those who rely on it.

When problems inevitably occur (e.g., a network crash or car crash), trained staff are needed to restore the network promptly or to switch to a backup system to minimize disruption during the restoration. *IT at Work 4.1* illustrates the importance of these factors and the consequences of bad planning and testing.

The network architecture is certainly critical because it provides the infrastructure for collaborative work within the company and with external partners and customers, regardless of their location. Often overlooked is the fact that the capability and willingness to collaborate depend on a corporate culture that people trust and that gives them the information, tools, and authority to plan and make decisions. When knowledge workers have such authority, the organization has a decentralized (also called *flatter*) organizational structure. A decentralized organization is more responsive to opportunities and problems than a centralized organization where top-level managers, who are typically less involved in day-to-day operations, make decisions.

The purpose of this model is to illustrate that network infrastructure alone does not improve business performance. Rather, what matters is how network capabilities combine with collaboration technologies to support employees and cross-functional work, connect remote locations, service customers, and coordinate with supply chain partners.

IT at Work 4.1

U.S. Customs' Network Crash at LAX Strands Passengers

Los Angeles Airport (LAX) is the fifth-busiest U.S. airport. In August 2007, more than 20,000 international travelers were stranded at LAX for up to 11 hours because the U.S. Customs and Border Protection (CBP) Agency could not process passengers due to a network crash. A network crash brings immigration to a halt. The crash and long outage was blamed on the cumulative effect of poor network planning, insufficient disaster preparation, a malfunctioning router and network interface card (NIC), mistakes in diagnosing the cause of the outage, and the lack of staff available to repair the network.

Immediate Causes of the Crash and Crisis. The outage started with a malfunctioning NIC on a single workstation on the CBP's local area network (LAN). Instead of simply failing, the NIC began sending packets through the network causing a "data storm" that crashed the LAN. Later, a switch on the network also crashed, compounding the problem. Misdiagnosing the problem and blaming it on routers provided to Sprint wasted about six hours. Sprint tested the lines remotely, then sent a Sprint technician on site to run more tests, and finally concluded after six hours that the routers were fine and that it was a LAN issue.

Policy Remained in Force, but Not a Backup System. Because of a zero-tolerance policy, all travelers must be processed and screened through national law enforcement databases located in Washington, D.C. There was a backup system consisting of a local copy of the database in case of a loss of connectivity to Washington. But the backup system ran on the same LAN and there was no backup system for a LAN failure.

Human or Machine Error? Human errors were a bigger part of the outage than technological ones. Michael Krigsman, the CEO of Brookline, a Massachusetts-based software and consulting company, wrote on his blog that the cause was a breakdown common in low-cost equipment and gross incompetence. Some experts were baffled that a single NIC could have caused so much trouble. However, a single NIC can take down an older network such as the CBP's, but not updated ones. Furthermore, if a network is not well managed, it increases the number of hours offline while the problem is identified and fixed. Newer networks are a lot more intelligent and able to self-diagnose.

CBP's Response to Avoid Another Crash. The CBP recognized the need to improve its IT staff, equipment, and infrastructure. It planned to improve diagnostic capabilities at both the human and technological levels to prevent such a head-scratching incident from happening again. It also plans to get the right technology and staff in place at LAX and other ports.

Sources: Compiled from Krigsman (2007) and Poeter (2007).

Discussion Questions: How would you rate the network quality of the CBP's system? Use the network capabilities shown in Figure 4.6 to support your answer. What were the technical and management factors that contributed to the failure of the backup system?

CONVERGENCE AND INTEROPERABILITY OF INFORMATION SERVICES

Various information services—data, documents, voice, and video—have functioned independently of each other. Traditionally, they were transmitted using different protocols (standards) and carried on either packet-switched or circuit-switched networks, as shown in Table 4.2. Multiple networks were needed because of the lack of **interoperability** or connectivity between devices. Interoperability refers to the ability to provide services to and accept services from other systems or devices. Lack of interoperability limited access to information and computing and communications resources—and increased costs. Technical details on interoperability and networking protocols are in Technology Guide 4 (TG4) on the book's Web site.

TCP/IP Architecture. The Internet protocol suite is the standard used with almost any network service. The Internet protocol suite consists of the IP (Internet Protocol) and TCP (Transmission Control Protocol), or TCP/IP. TCP/IP refers to the whole protocol family.

IP is the single most popular network protocol in the world, and it provides the architecture that made convergence possible. In preparation for transmission, data and documents are digitized into packets based on the Internet protocol and sent via packet-switched computer networks or **local area networks,** called **LANs.** LANs connect network devices over a relatively short distance. LANs are capable of transmitting data at very fast rates but operate in a limited area, such as an office building, campus, or home. They provide shared access to printers and file servers and connect to larger networks, such as **wide area networks (WANs)** or the Internet. WANs cover a much larger geographic area, such as a state, province, or country.

A comparison of the basic network protocols is presented in Table 4.2. Packets of data are transmitted using TCP. TCP does error checking to provide reliable delivery. If any packets are dropped along the way and never arrive at the destination, TCP will request that the packets be re-sent. For data and document delivery, error

TABLE 4.2 Networks, Protocols, and Transfer Methods of Information Services

Information Service	Network	Format	Protocol	Transfer Method
Data and documents	Packet	Converted to packets based on Internet Protocol (IP).	TCP (Transmission Control Protocol)	Each packet can take a different route to the destination, where the packets are recompiled. If a packet does not arrive (gets dropped), the entire transmission is re-sent. For non-real-time data, documents, or e-mail, TCP provides for error correction, packet sequencing, and retransmission.
Voice	Circuit	Sent as analog signals between the telephone and telco's central office (*local loop*). Traffic between central offices is digital.		Whether analog or digital, each call creates a circuit that reserves a channel between two parties for the entire session. The entire message follows the same path in order.
Video streams	Packet	Compressed and converted to IP packets.	UDP (User Datagram Protocol)	Real-time data transfer with no checking for missing packets. Bad packets are dropped.
Voice over IP, or IP telephony	Packet	Voice communication is digitized into data packets.	Typically UDP, though sometimes TCP	Real-time. TCP/IP error checking is inappropriate for voice. Requesting retransmission because of dropped packets would delay and ruin the conversation.

checking is necessary to ensure that all content has been delivered. Since the error-checking process can cause delivery delays, TCP is not well suited for digital voice or video transmissions. For those transmissions, a dropped packet would be insignificant.

Voice that is sent as analog signals, or audio sound waves, is sent over circuits on circuit-switched telephone networks. Video streams are compressed and sent as IP packets using the **User Datagram Protocol (UDP).** This suite of protocols is referred to as the UDP/IP model. UDP does not check for errors; as a result, it has less overhead and is faster than connection-oriented protocols such as TCP. With UDP, the quality of the transmission (lack of errors) is sacrificed for speed. Compared to TCP, UDP sends packets much faster, but less reliably.

Voice over IP (VoIP), or **IP telephony,** involves an analog-to-digital conversion. With VoIP, voice and data transmissions travel over telephone wires, but the content is sent as data packets. VoIP has grown to become one of the most used and cost effective ways to communicate. IP telephony solutions make use of packet-switched connections from the Internet for the exchange of voice, fax, and other data formats instead of using the traditional dedicated circuit-switched connections. Benefits including cost savings, improved productivity, flexibility, and advanced features make IP telephony an appealing technology.

IP telephony is evolving beyond basic telephony upgrades as enterprises look for increased flexibility and mobile solutions for their workers and business processes. It is more expensive to operate and manage two separate networks. A converged network that combines voice and data traffic on the same IP infrastructure could reduce administrative costs, while providing an easier path for growth and new applications. *IT at Work 4.2* explains the value of convergence and IP telephony at Thrifty Car Rental.

IT at Work 4.2

Thrifty Car Rental Uses IP Telephony to Increase Efficiency and Customer Service

Thrifty Car Rental operates more than 1,200 locations in 64 countries, including in-terminal rentals at 86 U.S. airports, off-terminal rental services at 57 additional airports, and services at all major airports in Canada. More than 30 percent of Thrifty's callers were rate shoppers. Agents were bogged down providing pricing information that could have been easily retrieved from an automated self-help system or Web site. The company wanted to use its agents more profitably and to reduce its operational dependence on human talent for each and every customer interaction.

Online reservation requests at thrifty.com were growing rapidly. While the company's Web site had strong transactional capabilities, it lacked the same high-quality customer service Thrifty provided in its brick-and-mortar and telephone-based world. The company wanted to improve its Web-based customer service functionality and differentiate itself from other car rental providers in its market.

To enable Thrifty to keep pace with the industry, its new customer-contact solution blended human help with automated, self-help services across all channels of interaction—phone, Web, chat, and e-mail. To integrate these channels and provide intelligent contact management, Thrifty invested in Cisco IP Communications, which is an enterprise solution of IP telephony, unified communications or messaging, and customer contact. Its IP-based customer-contact solutions resulted in substantial cost savings. **Unified messaging (UM)** is the concept of bringing together all messaging media such as e-mail, voice, mobile text, SMS, and fax into a combined communications medium. Minimally, UM can involve a unified mailbox with alert service. Or it can give users the ability to retrieve and send voice, fax, and e-mail messages from a single interface, such as handhelds or PCs.

For Web collaboration, Thrifty deployed Cisco's Intelligent Contact Management (ICM), an intelligent, multichannel routing system. ICM interacts with customers via phone, Web, or e-mail. ICM is integrated with an automatic call distributor (ACD), private branch exchange (PBX), interactive voice response (IVR), databases, and desktop applications. Thrifty also installed Web Collaboration Option, which is a Web-centric visual collaboration tool. This tool enables customers to interact with agents over the Web while conducting a voice conversation or text chat.

Thrifty receives 4 million calls per year; the company had required 150 agents in its two customer contact locations during regular seasons and 180 during the peak summer season to handle them. With the IP telephony customer-contact solution, between 35 and 40 fewer agents are required. Employee turnover has dropped to 20 percent from a high of 40 percent since installing the Cisco solution.

Sources: Compiled from Thrifty (*thrifty.com*) and Cisco Systems (*Cisco.com*).

Discussion Questions: Why did Thrifty Car Rental need IP telephony? What benefits did Thrifty gain from implementing Cisco's unified communications and Web collaboration option?

BARRIERS TO FULL INTEGRATION OF INFORMATION SERVICES

Users will increasingly have the option to take broadband connections with them via *full-service broadband*—anytime, anywhere access from the screen or device of choice. While worldwide growth in wireline (wired) and wireless telecommunications (telecom) is forecasted to remain steady, the growth rate of wireless is eight times greater than the growth rate of wireline. Wireline usage will still be widely used because VoIP will lessen the migration to wireless.

Developing software for wireless devices had been challenging because there was no widely accepted standard for wireless devices. Therefore, software applications had to be customized for each type of device with which the application communicated. To keep down the cost of wireless services, software engineers have had to develop code that optimizes resource usage. Supporting different displays can force painstaking changes to multiple software modules and applications. Different CPUs, operating systems, storage media, and mobile platform environments create time-consuming porting and testing issues.

The Internet and WWW. Many people believe that the Web is synonymous with the Internet, but that is not the case. The Internet functions as the *transport mechanism*, and the Web (WWW) is an *application* that runs on the Internet, as do e-mail, IM, and VoIP. The Web is a system with universally accepted protocols for storing, retrieving, formatting, and displaying information via client/server architecture. The usual protocol is HTTP, which stands for hyper-text transport protocol.

Internet Application Categories. The Internet supports applications in the following categories:

- **Discovery or search.** Discovery involves browsing, finding, and retrieving information. It can involve querying, downloading, and processing information from databases. Software agents to contend with the vast information on the Internet and intranets can automate discovery.
- **Communication.** Developments in Internet-based and wireless communication such as podcasting, RSS, and micro-blogging are transforming business communications, marketing channels, and supply chain management—to name a few.
- **Collaboration.** Online collaboration between individuals, groups, and organizations is common. Numerous tools and technologies are available, ranging from online meetings with screen sharing to videoconferencing and group support systems. Collaboration software products, called groupware or workflow, can be used on the Internet and other networks.

NETWORK COMPUTING INFRASTRUCTURES

In addition to the Internet and Web, intranets, extranets, information portals, and enterprise search engines are major infrastructures of network computing.

Intranets. An intranet is a network serving the internal informational needs of a company, using Internet tools. Intranets are portals (gateways) that provide easy and inexpensive browsing and search capabilities. Enterprise search engines are discussed later in this section. Using screen sharing and other groupware tools, intranets can be used to facilitate collaboration. Companies deliver policies and pay stub information for direct deposits, benefits, training materials, and news to their employers via their intranets.

IT at Work 4.3 describes Labatt Brewing Company's use of an intranet portal, named The Pub, for enterprise collaboration and search. The Pub was built using Microsoft Office SharePoint Server (MOSS) and Microsoft SharePoint Services (MSS). **SharePoint** is an integrated suite of capabilities that provides content (unstructured information) management and **enterprise search** to support collaboration. An enterprise search system provides extensive capabilities for searching structured and unstructured data sources easily. The enterprise search system provides fast

IT at Work 4.3

Canada's Labatt Brewing Company Builds "The Pub," an Intranet for Enterprise Collaboration and Search

How does an enterprise ensure that its employees get the information they need when they need it? For Labatt Brewing Company, the solution was to leverage the power of the SharePoint platform to build a world-class intranet portal. Labatt is part of Belgium-based Interbrew S.A., one of the largest brewing groups in the world, with more than 180 types of beer available in over 110 countries worldwide. And Labatt Blue is the best-selling Canadian beer in the world.

Traditionally, the company used employee meetings and postings on bulletin boards to keep employees informed, but with Labatt employees spread across Canada, the company was faced with the challenge of delivering information to employees in a consistent and timely manner. Much of Labatt's corporate information had been tough to share because it was housed in silos belonging to various business units, meaning employees had difficulty finding up-to-date, pertinent information.

Labatt's Intranet's Architecture and Benefits. After determining Labatt's business and technology requirements, the Labatt IT team decided that an intranet would provide the most efficient way of delivering the single point of access to employees. The intranet would also provide document management and collaboration. The intranet, which was named "The Pub," was built using Microsoft Content Management Server, Microsoft Office SharePoint Portal Server, and SharePoint Team Services.

Using The Pub, Labatt rolled out new programs to its employees, such as the *Innovation Database*. Labatt wanted innovative ways to improve every aspect of the business, and the Innovation Database provides a forum for employees to submit ideas and receive recognition and rewards for ideas that are implemented. Through the seamless deployment of Microsoft technology as the infrastructure for Labatt's intranet, The Pub, the company has been able to empower employees, improve employee communication, and create efficiencies with the IT department, while having a significant impact on employee productivity and collaboration. About 70 percent of Labatt's employees use the portal, which has significantly improved productivity and collaboration across the board. With the robust search function within The Pub, employees are able to quickly locate the documents they need and obtain the information they require to make better business decisions.

Using Microsoft SharePoint Services, a team Web site was designed to significantly improve the way teams manage information and activities. Team workspaces provides a common point of access for project or departmental information, including documents, contacts, tasks, and discussions. The benefits of The Pub are summarized here:

- Empowers employees
- Helps improve overall employee communication
- Creates efficiencies with the IT department
- Helps make a significant impact on employee productivity and collaboration

Sources: Compiled from *Labatt.com,* Microsoft case study *Labatt Breweries of Canada*, and Imason (2010).

Discussion Questions: How do information silos block productivity? Why was a single point of access an important feature? How has sharing information via The Pub improved collaboration at Labatt? Why might workers not be in favor of extensive document and data sharing?

query response times and consolidated, ranked results (like the results of a Google search) that help users easily locate the information they need. Other elements of SharePoint are:

- Browser-based collaboration and document management platform.
- Content management system that allows groups to set up a centralized, password-protected space for document sharing. Documents can be stored, downloaded and edited, then uploaded for continued sharing.
- Web-based intranet that can improve management of and access to data.
- Enterprise information portal that can be configured to run intranet, extranet, and Internet sites.

Extranets. An extranet is a private, company-owned network that uses IP technology to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. Extranets can use virtual private networks (VPNs). VPNs are created using specialized software and hardware to encrypt/send/decrypt transmissions over the Internet. By encrypting transmissions, a VPN creates a private tunnel within the Internet or other public network, as shown

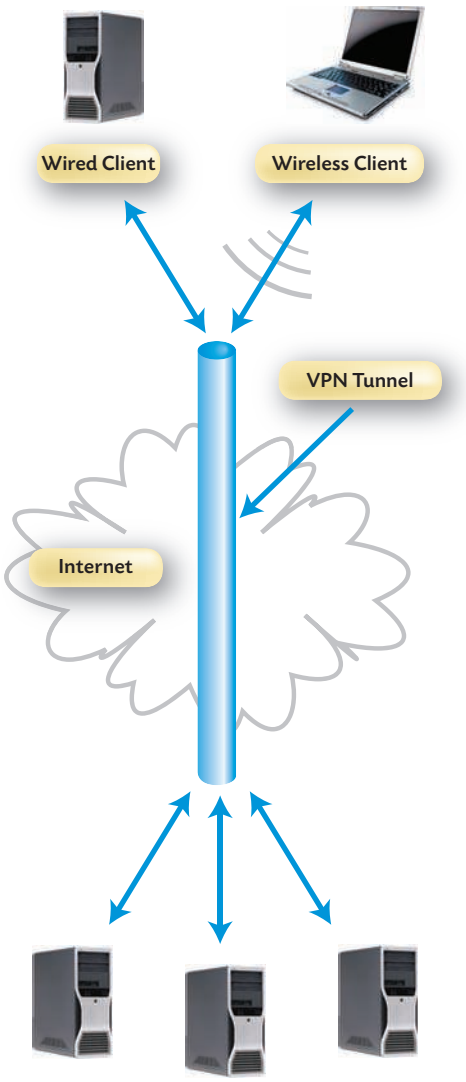

Figure 4.7 Virtual private network (VPN) created by encryption.

in Figure 4.7. A VPN connects remote sites or users together privately. Instead of using a dedicated, physical connection such as a leased line, a VPN uses virtual connections routed through the Internet from the company's private network to the remote site or employee.

Basically, an extranet is a network that connects two or more companies so they can securely share information. In some cases, an extranet is an extension of the company's intranet that is designed to connect to a customer or trading partner for B2B commerce. In other cases, an extranet is a restricted portal that, for example, gives account customers instant access to their account details. In this way, customers can manage their own accounts quickly and easily. United Rentals' extranet portal at *URdata.UR.com* makes it convenient for account customers worldwide to request equipment, manage rental equipment by project, view invoices, calculate job costs, and so on—and at lower cost. Figure 4.8 illustrates the interface of an extranet, the use of usernames and passwords for access control and authentication, and self-help features.

Extranets usually have a central server that stores data, documents, and applications. Authorized users can remotely access them from any Internet-enabled device, which can drastically reduce storage space on individual hard drives. To protect the privacy of the information being transmitted, extranets need secure communication lines, encryption technologies, and access and authentication control.

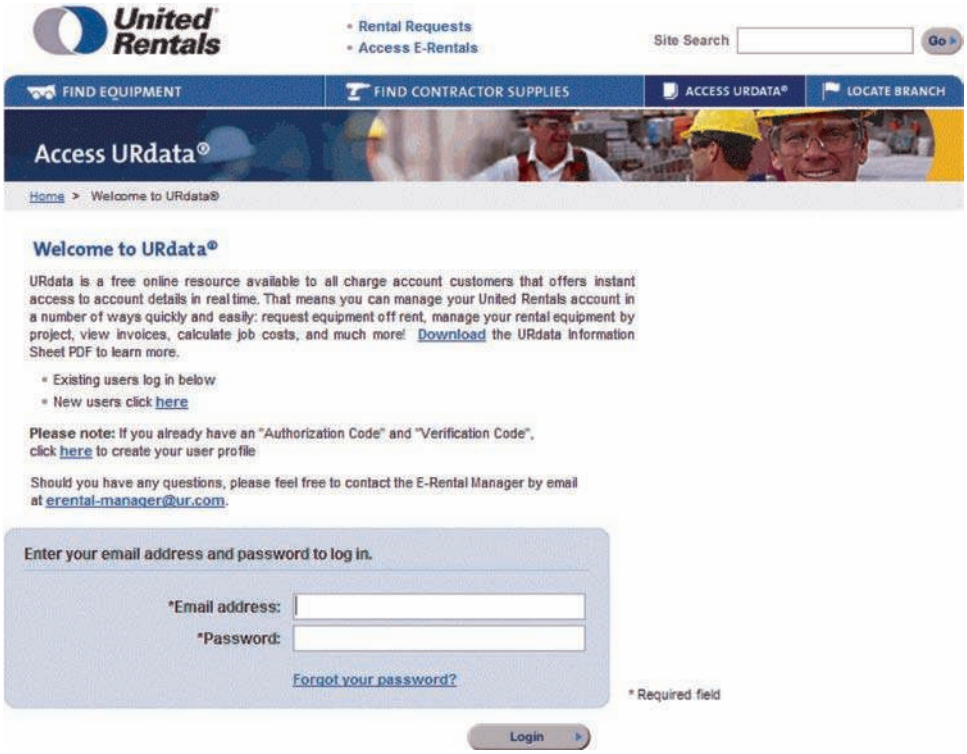

Figure 4.8 United Rentals' extranet portal.

ENTERPRISE SEARCH

As companies produce, store, and consume more and more business information, volume grows and the cost of managing it increases. Most content is difficult to manage and access. Fulcrum Research claims that 80 percent of enterprise content is unstructured—stored in Word documents, spreadsheets, and pdfs. Forrester Research estimates that content volume is growing at a rate of 200 percent a year. At this rate, the volume of data stored in many organizations reaches the point where the levels of information actually interfere with productivity rather than contribute to it.

What's Involved in Enterprise Search. Enterprise search (see Figure 4.9) starts with **content indexing,** which is created by software that crawls through directories

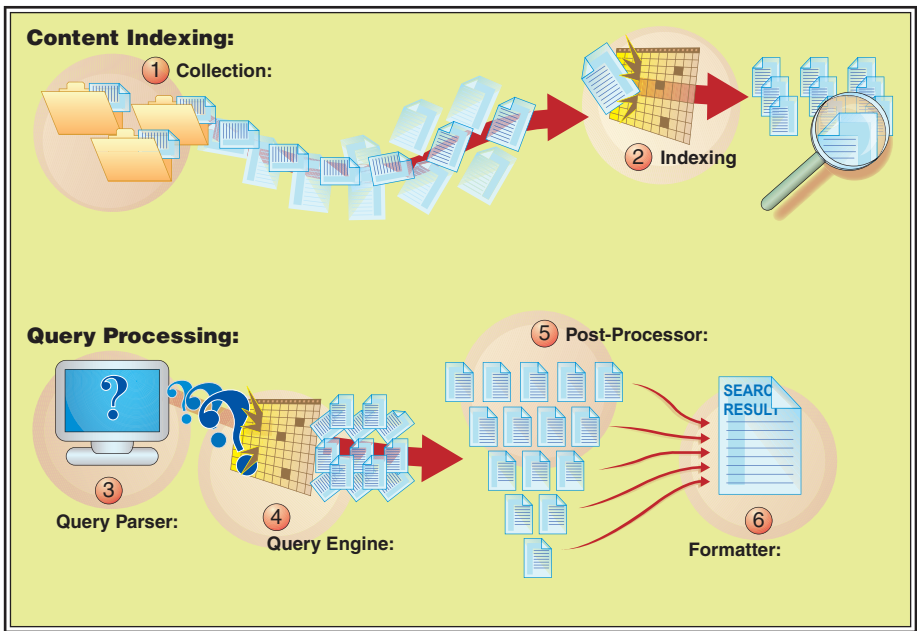

Figure 4.9 Overview of enterprise search.

and Web sites to extract content from databases and other repositories. Content indexing is done on a regular basis, so if one of those repositories is updated, the search engine will have some sort of procedure that enables it to go in and source and index that updated content.

Content that's been collected is *indexed.* That is, a searchable index of all the content is created. Additional processing, such as metadata extraction and autosummarization, might be done, depending on the search engine that is used.

Once the index is created, it can be queried—just as users do Google searches of the Internet. For example, to query an enterprise, a user enters search terms into a search box on the intranet screen. Of course, what matters is not how searchable the enterprise's content is, but finding the content that is needed.

INFORMATION PORTALS

Challenges facing workers are information overload and information scatter—huge amounts of information scattered across numerous documents, e-mail messages, and databases at different locations and in different systems. Accessing relevant, accurate, and complete information is time-consuming and requires access to multiple systems. To minimize wasting employee time, companies use portals. A **portal** (or information portal) is a Web-based gateway to content on a network, as you read in *IT at Work 4.3* about Labatt's intranet portal. Portals can include discussion boards, document sharing, and workspaces. Users can upload presentations or documents to share with peers.

It is estimated that Internet searchers are successful at finding what they seek only 50 percent of the time or less. Not surprisingly, the same problem applies to intranets. Consequently, companies incur the costs of time wasted searching for information that could not be found and then re-creating it—and costs arising from not being able to use existing information at the time it was needed.

Review Questions

1. How might a company's business performance be affected by its network's capabilities?
2. What are the benefits of an IP-based network?
3. What is a virtual private network (VPN)?
4. What is the difference between an extranet and an intranet?
5. What is enterprise search?
6. What is an information portal?

4.4 Collaboration

Collaboration is a key driver of overall performance in companies worldwide, according to the study "Meetings Around the World: The Impact of Collaboration on Business Performance." The survey was conducted by Frost & Sullivan and sponsored by Verizon Business and Microsoft Corp (Frost and Sullivan, 2006). The impact of collaboration on performance was twice as significant as a company's aggressiveness in pursuing new market opportunities (its strategic orientation) and five times as significant as the external market environment. The study also showed that while there is a global culture of collaboration, there are regional differences in how people in various countries prefer to communicate. Of all of the collaboration technologies that were studied, Web conferencing (also known as Web-based meetings) was used more extensively in high-performing companies than in low-performing ones. These results make sense when combined with estimates from *NetworkWorld* (*networkworld.com*) that 90 percent of employees work away from their company's headquarters and 40 percent work at a remote location, away from their supervisors.

Several factors are driving the need for messaging and collaboration. People need to work together and share documents. Groups make most of the complex decisions

in organizations. And organizational decision making is difficult when team members are geographically spread out and working in different time zones. Nearly 87 percent of employees around the world work in remote offices.

Messaging and collaboration tools include older communications media such as e-mail, videoconferencing, fax, and IM—and newer media such as blogs, podcasts, RSS, wikis, VoIP, Web meetings, and torrents (for sharing very large files). As media move to IP, there will not be much left that is not converged onto data networks. One of the biggest components of many Web 2.0 sites and technologies is collaboration. Much of Web 2.0 is about harnessing the knowledge and work of many people.

VIRTUAL COLLABORATION

Leading businesses are quickly realizing the benefits of e-collaboration. For example, the real estate franchiser RE/MAX uses an e-collaboration platform to improve communications and collaboration among its nationwide network of independently owned real estate franchises, sales associates, and suppliers. Similarly, Marriott International, the world's largest hospitality company, started with an online brochure and then developed a collaborative e-commerce system that links corporations, franchisees, partners, and suppliers, as well as customers, around the world. There are many examples of collaboration.

Information Sharing Between Retailers and Their Suppliers: P&G and Walmart. One of the most publicized examples of information sharing is between Procter & Gamble (P&G) and Walmart. Walmart provides P&G access to sales information on every item Walmart buys from P&G. The information is collected by P&G on a daily basis from every Walmart store, and P&G uses the information to manage the inventory replenishment for Walmart.

Retailer–Supplier Collaboration: Asda Corporation. Supermarket chain Asda (*asda.com*) has begun rolling out Web-based electronic data interchange (EDI) technology to 650 suppliers. Web-EDI technology is based on the AS2 standard, an internationally accepted HTTP-based protocol used to send real-time data in multiple formats securely over the Internet. It promises to improve the efficiency and speed of traditional EDI communications, which route data over third-party value-added networks (VANs).

Lower Transportation and Inventory Costs and Reduced Stockouts: Unilever. Unilever's 30 contract carriers deliver 250,000, truckloads of shipments annually. Unilever's Web-based database, the Transportation Business Center (TBC), provides these carriers with site specification requirements when they pick up a shipment at a manufacturing or distribution center or when they deliver goods to retailers. TBC gives carriers all of the vital information they need: contact names and phone numbers, operating hours, the number of dock doors at a location, the height of the dock doors, how to make an appointment to deliver or pick up shipments, pallet configuration, and other special requirements. All mission-critical information that Unilever's carriers need to make pickups, shipments, and deliveries is now available electronically 24/7.

Reduction of Product Development Time: Caterpillar, Inc. Caterpillar, Inc. (*caterpillar.com*) is a multinational heavy-machinery manufacturer. In the traditional mode of operation, cycle time along the supply chain was long because the process involved paper-document transfers among managers, salespeople, and technical staff. To solve the problem, Caterpillar connected its engineering and manufacturing divisions with its active suppliers, distributors, overseas factories, and customers, through an extranet-based global collaboration system. By means of the collaboration system, a request for a customized tractor component, for example, can be transmitted from a customer to a Caterpillar dealer and on to designers and suppliers, all in a very short time. Customers can also use the extranet to retrieve and modify detailed order information while the vehicle is still on the assembly line.

GROUP WORK AND DECISION PROCESSES

Managers and staff continuously make decisions. They design and manufacture products, plan marketing strategies, develop policies, prepare financial statements, determine how to meet compliance mandates, design software, and so on. By design or default, group processes emerge, and those processes can be productive or they can be dysfunctional.

Group Decision Processes. Group work involves processes that can be quite complex depending on the task, human factors, and available decision support. Some characteristics of group work are:

- Group members may be located in different places or work at different times.
- Group members may work for the same or for different organizations.
- A group can be at a single managerial level or span several levels.
- There can be synergy (process and task gains) or conflict in group work.
- There can be gains and/or losses in productivity from group work.
- Some of the needed data, information, or knowledge may be located in many sources, several of which are external to the organization.
- The expertise of non–team members may be needed.
- Groups perform many tasks; however, groups of managers and analysts concentrate frequently on decision making.

Despite the long history and benefits of collaborative work, groups are not always successful. Process gains and losses from group work are listed in Tables 4.3 and 4.4.

TABLE 4.3 Benefits of Working in Groups, or Process Gains

- It provides learning. Groups are better than individuals at understanding problems.
- People readily take ownership and responsibility of problems and their solutions.
- Group members have their egos embedded in the decision, so they will be committed to the solution.
- Groups are better than individuals at catching errors.
- A group has more information (knowledge) than any one member. Groups can leverage this knowledge to create new knowledge. More creative alternatives for problem solving can be generated, and better solutions can be derived (e.g., through stimulation).
- A group may produce synergy during problem solving. The effectiveness or quality of group work can be greater than the sum of what is produced by independent individuals.
- Working in a group may stimulate the creativity of the participants and process.
- A group may have better and more precise communication working together.

TABLE 4.4 Dysfunctions of the Group Process, or Process Losses

- Social pressures to conform may result in groupthink. Groupthink refers to team members thinking alike, being intolerant of new or different ideas, or otherwise yielding to pressure to conform.
- Group work is a time-consuming serial process since only one member can speak at a time.
- Meetings can lack coordination and be poorly planned.
- Group members can display inappropriate behaviors, e.g., dominating a topic or the meeting time or fear of contributing because of groupthink.
- Group members can have a tendency to either dominate the agenda or free-ride by relying on others to do most of the work.
- Some members may be afraid to speak up.
- Groups have a tendency to produce compromised solutions of poor quality.
- These can be nonproductive times due to socializing, waiting for latecomers, or air-time fragmentation.
- Group members can have a tendency to repeat what was already said.
- Meetings can be costly because of travel, participation, and so on.

Improving Meeting Processes and Small-Group Dynamics. Meetings are a universal—and universally disliked—part of business operations. More and more companies are team-based (e.g., project management teams), with most work being done in meetings. Meetings can be more effective if one understands what can go wrong and intelligently manages decision processes and group dynamics to avoid problems. For example, newly formed groups whose members do not know each other have very different dynamics than groups with an established history and routine, and they need more socialization time before they become productive. Researchers have developed methods for improving the processes of group work, namely, increasing the benefits of meetings and minimizing the detriments. Some of these methods are known as group dynamics. The challenges of group work processes are more intense for virtual teams, as described in *IT at Work 4.4*. Virtual teams are groups of people who work interdependently with shared purpose across space, time, and organization boundaries, using technology to communicate and collaborate.

IT at Work 4.4

Virtual Teams at Sabre, Inc.

Sabre, Inc. is one of the leading firms providing travel reservation services worldwide. Sixty thousand travel agents in 114 countries rely on Sabre to make travel arrangements for their clients. The total volume of reservations processed by the system each year exceeds 400 million, which represents 40 percent of all travel reservations worldwide. Consumers may be familiar with *Travelocity.com*, which is Sabre's business-to-consumer (B2C) travel site; corporate travel agents would recognize Get-There, the world's leading supplier of business-to-business online travel reservation systems operated by Sabre.

With employees working in headquarters and field offices scattered around the globe, Sabre made a decision to use virtual teams to improve customer focus, enhance productivity, and grow market share and profitability. The company discovered that cross-functional teams were better suited for the marketplace demands than the single-function teams it had used in the past. A typical virtual team at Sabre includes representatives from several areas of the company: Account executives sell reservation systems, technicians install and service the systems, trainers teach travel agents how to use the systems, account management specialists handle billing and collections, and customer service representatives respond to miscellaneous inquiries.

Following the introduction of virtual teams, Sabre encountered several challenges related to managing and working in the teams. One of the primary challenges was building trust among team members. Managers and employees soon recognized that building trust requires a high level of responsiveness to electronic communications from other team members, dependable performance, and a proactive approach to completing team tasks.

The second challenge involved generating synergy in virtual teams—making the team greater than the sum of its parts. To resolve this challenge, Sabre offered team-building activities, as well as extensive classroom and computer-based training that preceded the launch of new virtual teams.

A third challenge was that team members had to cope with the feeling of isolation and detachment that characterizes virtual teamwork. The company discovered that certain employees preferred independent work and operated well without much social interaction. Thus, Sabre conducted interviews with potential team members to determine their suitability for virtual teamwork. Furthermore, the teams are only partially virtual because they occasionally involve face-to-face interactions during certain meetings and team-building exercises. In addition, employees have the option of working either from home or from an office where they can interact with other employees, who may or may not be their teammates.

The fourth challenge involved balancing technical and interpersonal skills among team members. Sabre was surprised to find that despite the infrequent face-to-face communications, interpersonal abilities were extremely valuable and important to virtual teams. As a result, the company made a change in its hiring and team-member selection practices, to shift the emphasis from technical to interpersonal skills.

A fifth major challenge was employee evaluation and performance measurement. Over time, the company implemented a system of team-level and individual metrics that were intended to measure objective, quantifiable contributions of each team member and the performance of the virtual team as a whole. Nevertheless, the company admits that striking the right balance between the measures of individual contributions and group performance is difficult.

The results of creating virtual teams at Sabre have been quite positive. Most managers and employees of the company agree that the shift from functional face-to-face teams to cross-functional virtual teams improved customer service. Customers' ratings support these assertions.

Sources: Compiled from Kirkman et al. (2002) and *saber-holdings.com*.

Discussion Questions: Are the challenges faced by virtual teams at Sabre unique to this company, or are they common throughout the business world? What additional challenges with virtual teams might Sabre encounter in the future? If you were an employee at Sabre, would you prefer to work in a physical face-to-face environment or in a virtual team?

COLLABORATION SUPPORT TECHNOLOGIES

Enterprise collaboration tools have been popular for over a decade. Portals, intranets, extranets, and shared workspaces are examples. Lotus Notes, for example, has been around for over ten years. More recent technologies—Web 2.0 or Enterprise 2.0 technologies such as wikis, blogs, and microblogs—provide more options to promote and support enterprise collaboration. These newer tools have a number of benefits—like a community-oriented paradigm and no software to install. However, Web 2.0 tools have not significantly displaced e-mail or texting, which remain the primary enterprise collaboration tools for information workers. Studies show e-mail and texts are used on an hourly basis.

Google Wave. **Google Wave** is a new type of platform consisting of e-mail, instant messaging, and documents. Google is positioning Wave as "what e-mail would look like if it were invented today." Google Wave attempts to be a complete collaboration solution, to solve this paradox, but its answer is currently incomplete. See *wave.google.com/* for the latest on Google Wave features.

What is a wave? According to Google, a wave is equal parts conversation and document. People can communicate and work together with richly formatted text, photos, videos, maps, and more. A wave is shared in that any participant can reply anywhere in the message, edit the content, and add participants at any point in the process. Playback is a feature that lets anyone rewind the wave to see who said what and when. Lastly, a wave is live. Participants can see what others are typing as they type, making conversations faster.

Information Content and Context. Storing content is not enough. Content needs to remain related to its context. Content management tools are emerging to manage content in context for regulatory reasons, such as to enable an audit trail of work done and to support enterprise search and organizational learning.

Review Questions

1. What is virtual collaboration?
2. Why is group work challenging?
3. What are the benefits of working in groups?
4. What are the dysfunctions of group processes?
5. What is Google Wave?
6. How are information content and context related?

4.5 Legal and Ethical Issues

Management needs to consider ethical and social issues, such as quality of working life. Workers will experience both positive and negative impacts from being linked to a 24/7 workplace environment, working in computer-contrived virtual teams, and being connected to handhelds whose impact on health can be damaging. A 2008 study by Solutions Research Group found that always being connected is a borderline obsession for many people. According to the study, 68 percent of Americans may suffer from disconnect anxiety—feelings of disorientation and nervousness when deprived of Internet or wireless access for a period of time. The study also found that 63 percent of BlackBerry users admitted to having sent a message from the bathroom. Technology addiction has gone so far that U.S. psychiatrists are considering adding this "compulsive-impulsive" disorder to the next release of the DSM (*Diagnostic and Statistical Manual of Mental Disorders*) in 2011. Approximately 25 percent of people stayed connected with work while on vacation in summer 2008, which was about double what it had been in 2006, according to a CareerBuilder.com survey (Perelman, 2008).

Consider these developments and their implications:

- **Debate over DWY** (Driving While Yakking). Several studies show cell phones are a leading cause of car crashes. Yet driving while talking, or DWY, is not illegal. It is estimated that cell phone–distracted drivers are four times more likely to be in a car wreck. Laws have been passed to discourage drivers from cell phone use when they should be paying attention to safety. The hands-free July 2008 California law is not expected to solve the problem of car accidents due to cell phone distractions based on New York City's lack of improvement after having had a hands-free law for several years. At any given moment, more than 10 million U.S. drivers are talking on handheld cell phones, according to the National Highway Traffic Safety Administration (*NHTSA.dot.gov*). Why is this a problem? Cell phones are a known distraction, and the NHTSA has determined that driver inattention is a primary or contributing factor in as many as 25 percent of all police-reported traffic accidents. This doesn't include the thousands of accidents that *are not* reported to the authorities.
- **Health risks.** The U.S. Food and Drug Administration (FDA) recommends minimizing potential risk by using hands-free devices and keeping cell phone talk to a minimum. A few studies have indicated that using a cell phone for an hour each day over a 10-year period can increase the risk of developing a rare brain tumor and that those tumors are more likely to be on the side of the head used to talk on the phone. More research is needed in this area.
- **RF emissions and SAR.** According to the Cellular Telecommunications Industry Association (*ctia.org/*), **specific absorption rate,** or **SAR,** is "a way of measuring the quantity of radio frequency (RF) energy that is absorbed by the body." For a phone to pass Federal Communications Commission (FCC) certification and be sold in the United States, its maximum SAR level must be less than 1.6 watts per kilogram (1.6 W/kg). Canada has the same (1.6 W/kg) cap as the United States. In Europe, the maximum level is 2 watts per kilogram. The SAR level that is reported shows the highest SAR level measured with the phone next to the ear as tested by the FCC. Keep in mind that SAR levels can vary between different transmission bands (the same phone can use multiple bands during a call) and that different testing bodies can obtain different results. Also, it's possible for results to vary between different models of the same phone, such as a handset that's offered by multiple carriers. In March 2010, Apple had banned an iPhone app that measures cell phone radiation (*news.cnet.com/8301-17852_3-10464388-71.html*), but other online sources of SAR are available.

The importance of understanding ethical issues has been recognized by the Association to Advance Collegiate Schools of Business (AACSB International, *aacsb.edu*). For business majors, the AACSB International has defined Assurance of Learning Requirements for ethics at both the undergraduate and graduate levels. In *Standard 15: Management of Curricula* (AACSB Accreditation Standards, 2006), AACSB identifies general knowledge and skill learning experiences that include "ethical understanding and reasoning abilities" at the undergraduate level. At the graduate level, *Standard 15* requires learning experiences in management—specific knowledge and skill areas are to include "ethical and legal responsibilities in organizations and society" (AACSB International Ethics Education Resource Center, 2006).

Life Out of Control. The technologies covered in this chapter blur work, social, and personal time. IT keeps people connected with no real off-switch. Tools that are meant to improve the productivity and quality of life in general can also intrude on personal time. Managers need to be aware of the huge potential for abuse by expecting 24/7 response from workers. See *IT at Work 4.5* for a look at life in a connected world.

IT at Work 4.5

Life Connected

Changes brought about by the Internet are as profound as previous historical milestones such as the Renaissance or Industrial Revolution. Every person can be a creative artist and freely distribute work to millions—characteristics of both the Renaissance and Industrial Revolution. Google's existence is a testament to the power of the individual in the connected age—a better research tool than major corporations had in the 1990s. VoIP, wikis, and WiMAX enable anyone to call or share files for free.

Communication technologies—writing, printing, cable, telephone, radio, and TV—have always played a central role in human history. The marginal cost of collecting, storing, accessing, and transmitting information is approaching zero.

Major companies face small but powerful challenges and competitors that are undermining traditional business models. Consumers and employees can counteract marketing strategies by posting harsh criticisms in blogs. eBay shops can underprice. Intranets, extranets, and social networks are diminishing boundaries between companies and individuals' lives—and making them more transparent. People check Internet resources for ratings and prices before they buy books, vacations, cars, and so on. Amazingly, in places such as Tanzania, political activists worked on a new constitution using a wiki. Communication and collaboration tools can collectively create a compelling force whose impacts are not yet known.

Businesses have to learn to cope with a world that is far more competitive, dynamic, and connected.

Discussion Questions: How has the use of communication tools impacted your ability to get your work done? How has it impacted your personal life? How has IT been liberating or overwhelming? What ethical issue does this raise for managers?

Key Terms

3G *96*
4G *96*
bandwidth *95*
broadband *96*
circuit switching *94*
content indexing *108*
converged network *00*
download speed *96*
EDGE *97*
enterprise search *105*
EV-DO *97*
EV-DV *97*
extranet *106*
fixed-line broadband *96*
Google Wave *113*
GSM (Global System for Mobile Communications) *97*
HSDPA high-speed downlink *98*
interoperability *103*
intranet *105*
IP network *96*
IP telephony *00*
LTE *97*
mobile broadband *96*
packet *95*
packet switching *95*
portal *109*
protocol *95*
SAR (specific absorption rate) *114*
SharePoint *105*
TCP/IP *95*
Transport Control Protocol (TCP)
upload speed *96*
unified messaging (UM) *104*
User Datagram Protocol (UDP) *104*
voice over IP (VoIP) *104*
WAN (wide area network) *103*
Wi-Fi *99*
WiMAX *100*
wireless access point (WAP) *95*
WLAN (wireless local area network) *100*
WWWANs (wireless wide area networks) *100*

Chapter Highlights and Insights

(Numbers refer to Learning Objectives)

1 In preparation for transmission, data and documents are converted into digital packets based on the Internet Protocol (IP) and sent via computer (i.e., packet-switched) networks or LANs.

1 Data, voice, and video networks are converging into a single network based on packet technology, such as IP and VoIP.

2 Real-time awareness, provided by Web-based collaboration solutions, can significantly improve the outcome of complex operations involving numerous remote or mobile workers.

2 Convergence eliminates the need for separate networks. When all information services are handled the same way by one high-speed packet network, the technical barriers to collaborative work are eliminated. Multimedia applications become possible because the network does not restrict the kinds of computing devices that could be used.

2 Broadband wireless computing allows users to collaborate via the Internet at any time, share files, or perform other group work functions that previously required a PC and wireline infrastructure.

3 The major drivers of mobile computing are large numbers of users of mobile devices, especially cell phones; widespread use of cell phones throughout the world; new vendor products; declining prices; increasing bandwidth; and the explosion of collaboration tools.

3 Intranets distribute frequently needed employee handbooks, government forms, policies, and other materials to employees over the company network.

3 An extranet connects the company with its customers or trading partners for B2B commerce and real-time supply chain management. Extranets give account customers instant access to their account details.

3 Wireless technology can give a company a competitive advantage through increased productivity, better customer care, and more timely communication and information exchange.

3 VoIP can be customized as a strategic tool because of its virtualization, customization, and intelligence capabilities. Location-based advertising and advertising via SMSs on a very large scale is expected.

3 Mobile portals provide multimedia broadcasts and other content (e.g., news and sports) to billions.

4 Messaging and collaboration tools include older media such as e-mail, videoconferencing, fax, and IM—and new media such as podcasts, RSS newsfeeds, wikis, VoIP, Web meetings, and torrents (for sharing very large files). As media move to IP, there will not be much left that is not converged onto data networks.

5 Managers and staff continuously make decisions: They design and manufacture products, develop policies and strategies, prepare financial statements, determine how to meet compliance mandates, design software, and so on.

5 Collaboration and communication technologies covered in this chapter blur work, social, and personal time. IT keeps people connected with no real off-switch. Tools that are meant to improve the productivity and quality of life in general can also intrude on personal time. Managers need to be aware of the huge potential for abuse by expecting 24/7 response from workers.

Questions for Discussion

1. Why will 4G wireless networks bring about significant changes in connectivity?
2. There is a growing demand for video to handheld devices. Explain at least three factors enabling or driving this demand.
3. Why attend class if you can view or listen to the podcast?
4. Discuss some of the potential applications of wireless technologies in the financial sector.
5. Discuss the components of a mobile communication network.
6. Explain the role of protocols in mobile computing and their limitations.
7. Discuss the impact of wireless computing on emergency response services.
8. Describe the ways in which WiMAX is affecting the use of cellular phones for m-commerce.
9. Which of the current mobile computing limitations do you think will be minimized within two years? Which ones will not?
10. Discuss the ethical issues of social networks and anytime, anywhere accessibility.
11. What health and quality-of-life issues are associated with social networks and a 24/7 connected lifestyle?

Exercises and Projects

1. CALEA is the Communications Assistance for Law Enforcement Act, a federal requirement to allow law enforcement agencies to conduct electronic surveillance of phone calls or other communications. What dilemmas are caused by the convergence of voice, video, and data and the requirements of CALEA?
2. Compare the various features of broadband wireless networks (e.g., 3G, Wi-Fi, and WiMAX). Visit at least three broadband wireless network vendors.
   a. Prepare a list of capabilities of each network.
   b. Prepare a list of actual applications that each network can support.
   c. Comment on the value of such applications to users. How can the benefits be assessed?
3. Compare the advanced features of three search engines.
   a. Prepare a table listing five advanced features of each search engine.
   b. Perform a search for "VoIP vendors" on each of those search engines.
   c. Compare the results.
   d. In your opinion, which search engine provided the best results. Why?
4. Read *IT at Work 4.2,* "Thrifty Car Rental Uses IP Telephony to Increase Efficiency and Customer Service," and answer the discussion questions.

Group Assignments and Projects

1. Each team should examine a major vendor of mobile devices (Nokia, Kyocera, Motorola, Palm, BlackBerry, etc.). Each team will research the capabilities and prices of the devices offered by each company and then make a class presentation, the objective of which is to convince the rest of the class why one should buy that company's products.
2. Each team should explore the commercial applications of mobile communication in one of the following areas: financial services, including banking, stocks, and insurance; marketing and advertising; manufacturing; travel and transportation; human resources management; public services; or healthcare. Each team will present a report to the class based on its findings.

3. Each team will investigate an online (Web) meeting software suite, such as GoToMeeting or Lotus Sametime. Download the free trial version and/or video demonstration. The teams will investigate the features and business purposes of the software and then present a report to the class based on their findings.

Internet Exercises

1. Visit *Sprint.com*. What are the features of its 4G phone that make it suitable for managers or business purposes?
2. Visit the Google Apps Web site. What types of collaboration support are available?

BUSINESS CASE

Green Mobile Network to Cut Carbon Emissions 42 Percent by 2013

Four incentives are driving mobile network operators (carriers) to develop greener mobile networks. The four incentives are:

- **To reduce costs.** Energy consumption is one of the biggest operating costs for both fixed and mobile networks.
- **To overcome limited availability of reliable electricity.** Many developing countries are high-growth markets for telecommunications, but they have limited reliable access to electricity.
- **To be more socially responsible.** Many organizations have adopted corporate social responsibility initiatives with the goal of reducing their networks' carbon footprints.
- **To gain competitive advantage.** Network infrastructure vendors are striving to gain competitive advantage by reducing the power requirements of their equipment.

All of these factors will continue to converge over the next several years, creating significant market potential for greener telecom networks.

Mobile network operators worldwide have embarked on bold initiatives to improve the energy efficiency of their wireless networks and reduce the carbon footprint and greenhouse gas (GHG) emissions associated with network operations. According to a Pike Research report (*pikeresearch.com/*), these green network initiatives will reduce network carbon emissions by 42 percent by 2013. Mobile operations in Asia Pacific, the leading region for the reduction of carbon emissions by mobile operators, will be Asia and Pacific Islands, followed by Europe and North America.

In 2010, Clearwire, the largest 4G service provider in the United States, announced that it has begun trials in Chicago of its first high-efficiency "green" base station cabinets. This new generation of base station cabinets is capable of achieving up to 90 percent reduction in electrical operating expenses and would not require the use of HVAC equipment in the majority of the company's nationwide deployment. Following completion of the trials, the new base station designs are expected to be introduced throughout the Clearwire network.

Questions

1. Rank the four incentives according to how you believe they motivate a company to invest in greener IT.
2. Explain the reasons for your ranking.
3. Review predictions of global warming and related issues. Consider the expected surge in the use of 4G networks, which will increase electricity consumption to power the networks and cool the equipment. Based on your research, estimate the impact on the environment if mobile network operators did not invest in greener networks.
4. Bottom line: Is it profitable for operators to go green? Explain.

NONPROFIT CASE

Kaiser HealthConnect Network Shaping the Future of Healthcare

Founded in 1945, Kaiser is recognized as one of America's leading healthcare providers and nonprofit health plans. Its mission is to provide high-quality, affordable healthcare services and to improve the health of 8.6 million members in nine states and the District of Columbia. Medical teams are supported by industry-leading technology advances and tools for health promotion, disease prevention, state-of-the art care delivery, and chronic disease management.

In mid-2010, every medical facility in its health system was connected to *Kaiser Permanente HealthConnect*, the largest private sector electronic medical records (EMR) system in the world. The development and implementation of KP HealthConnect took ten years to build and represented a $4-billion-dollar strategic investment for Kaiser.

KP HealthConnect: A Strategic Investment

KP HealthConnect is a comprehensive health information system that securely connects more than 8.6 million people to their physicians, nurses, and pharmacists; their personal information; and the latest medical knowledge. KP HealthConnect:

- Includes bedside documentation, clinical decision support, and barcoding for medication administration
- Helps facilitate collaboration among both primary and specialty care teams
- Provides the healthcare teams with access to patient information and the latest best practices all in one place to further improve patient safety and quality care while increasing convenience and coordination.

The system has been in all 431 outpatient facilities since 2008. In 2009, more than 3 million people logged in a total of 27 million times to check their own records.

The Payoff: Good Healthcare and Customer Satisfaction

With easy-to-use, Web-based tools, all members have access to medical records and tools to communicate with their providers. *My Health Manager* on the Web site *kp.org/myhealthmanager* gives registered members the ability to manage their health online, such as:

- Scheduling appointments
- Ordering prescription refills
- Sending and receiving secure messages to/from their doctor over the Internet
- Having 24/7 online access to lab test results, eligibility, and benefits information—even their children's immunization records

In addition, all Kaiser physicians routinely use the EMR when caring for their patients in medical offices and hospitals.

In 2010, four regions rated Kaiser's health plans highest in customer satisfaction in the *J.D. Power and Associates 2010 U.S. Member Health Insurance Plan Study*. The study measures member satisfaction by examining seven key factors that reflect the relationship between the health plan and members: coverage and benefits, provider choice, information and communication, claims processing, statements, customer service, and approval processes.

According to Kaiser, the KP HealthConnect has improved the quality of care and service to its members and communication between members and Kaiser professionals to help make getting well and staying healthy even more convenient. It ensures patient safety and quality care by providing access to comprehensive patient information and the latest best practice research in one place. KP HealthConnect also coordinates patient care between the physician's office, the hospital, radiology, the laboratory, and the pharmacy, which helps to eliminate the pitfalls of incomplete, missing, or unreadable charts. The fully implemented system has enabled Kaiser to streamline and retire many outdated systems. KP HealthConnect directly or indirectly supports the majority of its hospital and health plan operations nationwide.

Sources: Compiled from Kaiser Permanente News Center (2010), Versel (2010a, 2010b).

Questions

1. To see Kaiser Permanente members, physicians, and employees talk about KP HealthConnect, view a video at *www.youtube.com/kaiserpermanenteorg*. What did you learn?
2. What benefits does KP HealthConnect offer healthcare providers? Members? Patients?
3. Research the annual rate of medical errors in one or two countries. What are several reasons for these errors? How does KP HealthConnect help to reduce medical errors?
4. Why is KP HealthConnect a strategic investment for Kaiser?

ANALYSIS USING SPREADSHEETS

Cost Comparison of Web Collaboration

DUMBO Company (a fictitious company) needed to cut travel costs and productivity losses (wasted time) but still maintain the benefits of person-to-person collaboration. One option was Web conferencing, which could be used internally for collaboration and externally for sales demonstrations to customers in geographically dispersed areas. The company's CFO, Eileen Griffin, decided to invest in one of the large vendors' Web meeting software, either on a pay-per-use basis or per a user licensing plan based on the number of seats or participants. Griffin estimated that Web conferencing cost estimates should be based on the following:

- Approximately 1,000 meetings per year (based on approximately 3 meetings per week)
- An average of 8 participants per meeting
- Each meeting lasting about one hour, which takes into consideration the need to get the meeting set up at least 15 minutes in advance and 45-minute meetings
- 300 unique participants, consisting of 100 employees and 200 customers

Griffin wants you to research and develop a spreadsheet comparing the pay-per-use basis vs. buying seats (licenses) for Microsoft's LiveMeeting and Cisco's WebEx. Precise cost comparisons are difficult because there are so many variables, but a basic cost analysis between LiveMeeting and WebEx is feasible. Using a spreadsheet, perform the following calculations. Visit the book's Web site to download the spreadsheet to help with your analysis.

1. Calculate the total minutes per year for Web conferencing at DUMBO.
2. Research LiveMeeting and WebEx to find the costs for a pay-per-use basis or the cost to buy the software.
3. Prepare cost comparisons of the vendors' licensing options and pay-per-usage.
4. Identify other criteria that should be taken into account when making such a decision (for example, vendor support or the ability to integrate with Outlook).
5. Make a recommendation to CFO Griffin.

Resources on the Book's Web Site

More resources and study tools are located on the Student Web Site and on WileyPLUS. You'll find additional chapter materials and useful Web links. In addition, self-quizzes that provide individualized feedback are available for each chapter.

Cases for Chapter 4 are available at wiley.com/college/turban:

4.1 Handhelds and Portal Tackle Super Bowl Logistics

4.2 Social Media Collaboration at DrKW

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