MODUL SITEM INFORMASI MANAGEMEN

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MODUL PERTEMUAN 07

Emerging Technologies

DISUSUN OLEH

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EMERGING TECHNOLOGIES

1. Kemampuan Akhir Yang Diharapkan

After reading this session, you will be able to answer the following questions:

1. *What are the current trends in com- puter hardware platforms?*
2. *What are the current trends in soft- ware platforms?*
3. *What are the challenges of manag- ing IT infrastructure and management solutions?*

2. Uraian dan Contoh

1. INFRASTRUCTURE COMPONENTS

IT infrastructure today is composed of seven major components. Figure 5.9 illustrates these infrastructure components and the major vendors within each component category. These components constitute investments that must be coordinated with one another to provide the firm with a coherent infrastructure.

In the past, technology vendors supplying these components were often in competition with one another, offering purchasing firms a mixture of incom- patible, proprietary, partial solutions. But increasingly the vendor firms have been forced by large customers to cooperate in strategic partnerships with one another. For instance, a hardware and services provider such as IBM cooper- ates with all the major enterprise software providers, has strategic relation- ships with system integrators, and promises to work with whichever database products its client firms wish to use (even though it sells its own database management software called DB2).

COMPUTER HARDWARE PLATFORMS

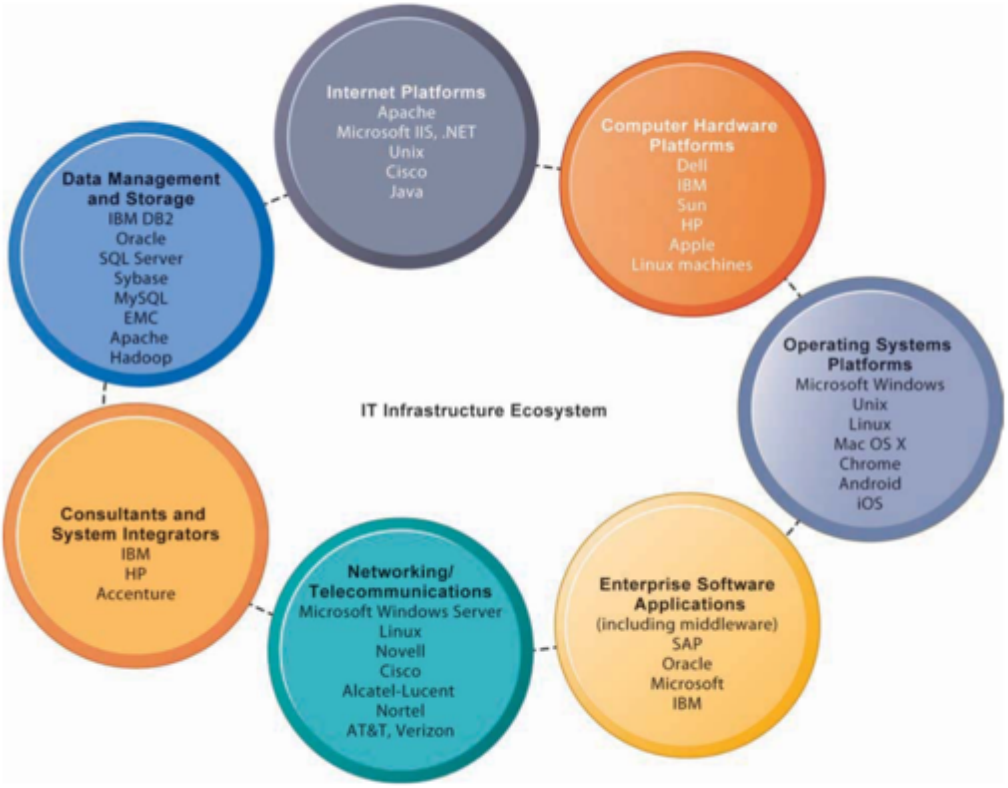
Firms worldwide are expected to spend $448 billion on computer hardware in 2013, including servers and client devices. The server market uses mostly Intel or AMD processors in the form of blade servers in racks, but also includes Sun SPARC microprocessors and IBM chips specially designed for server use. **Blade servers**, which we discussed in the chapter-opening case, are computers consisting of a circuit board with processors, memory, and network connec- tions that are stored in racks. They take up less space than traditional box-based servers. Secondary storage may be provided by a hard drive in each blade server or by external mass-storage drives.

The marketplace for computer hardware has increasingly become concen- trated in top firms such as IBM, HP, Dell, and Sun Microsystems (acquired by Oracle), and three chip producers: Intel, AMD, and IBM. The industry has collectively settled on Intel as the standard processor for business comput- ing, with major exceptions in the server market for Unix and Linux machines, which might use Sun or IBM processors.

Mainframes have not disappeared. Mainframes continue to be used to reliably and securely handle huge volumes of transactions, for analyzing very large quantities of data, and for handling large workloads in cloud computing centers. The mainframe is still the digital workhorse for banking and telecom- munications networks. However,

the number of providers has dwindled to one: IBM. IBM has also repurposed its mainframe systems so they can be used as giant servers for massive enterprise networks and corporate Web sites. A single IBM mainframe can run up to 17,000 instances of Linux or Windows Server software and is capable of replacing thousands of smaller blade servers (see the discussion of virtualization in Section 5.3).

FIGURE 5.9 THE IT INFRASTRUCTURE ECOSYSTEM



There are seven major components that must be coordinated to provide the firm with a coherent IT infrastructure. Listed here are major technologies and suppliers for each component.

OPERATING SYSTEM PLATFORMS

Microsoft Windows Server comprises about 35 percent of the server operating system market, with 65 percent of corporate servers using some form of the **Unix** operating system or **Linux**, an inexpensive and robust open source relative of Unix. Microsoft Windows Server is capable of providing enterprise- wide operating system and network services, and appeals to organizations seeking Windows-based IT infrastructures.

Unix and Linux are scalable, reliable, and much less expensive than mainframe operating systems. They can also run on many different types of processors. The major providers of Unix operating systems are IBM, HP, and Sun, each with slightly different and partially incompatible versions.

At the client level, 90 percent of PCs use some form of the Microsoft Windows **operating system** (such as Windows 8, Windows 7, or Windows Vista) to manage the resources and activities of the computer. However, there is now a much greater variety

of operating systems than in the past, with new operating systems for computing on handheld mobile digital devices or cloud-connected computers.

Google's **Chrome OS** provides a lightweight operating system for cloud computing using netbooks. Programs are not stored on the user's PC but are used over the Internet and accessed through the Chrome Web browser. User data reside on servers across the Internet. **Android** is an open source operating system for mobile devices such as smartphones and tablet computers devel- oped by the Open Handset Alliance led by Google. It has become the most popular smartphone platform worldwide, competing with iOS, Apple's mobile operating system for the iPhone, iPad, and iPod Touch.

Conventional client operating system software is designed around the mouse and keyboard, but increasingly becoming more natural and intuitive by using touch technology. **iOS**, the operating system for the phenomenally popular Apple iPad, iPhone, and iPod Touch, features a **multitouch** interface, where users employ one or more fingers to manipulate objects on a screen without a mouse or keyboard. Microsoft's **Windows 8,** which runs on tablets as well as PCs, has a user interface optimized for touch, but also works with a mouse and keyboard.

ENTERPRISE SOFTWARE APPLICATIONS

Firms worldwide are expected to spend about $301 billion in 2013 on software for enterprise applications that are treated as components of IT infrastructure. We introduced the various types of enterprise applications in Chapter 2, and Chapter 9 provides a more detailed discussion of each.

The largest providers of enterprise application software are SAP and Oracle (which acquired PeopleSoft). Also included in this category is middleware soft- ware supplied by vendors such as IBM and Oracle for achieving firmwide inte- gration by linking the firm's existing application systems. Microsoft is attempting to move into the lower ends of this market by focusing on small and medium- sized businesses that have not yet implemented enterprise applications.

DATA MANAGEMENT AND STORAGE

Enterprise database management software is responsible for organizing and managing the firm's data so that they can be efficiently accessed and used. Chapter 6 describes this software in detail. The leading database software providers are IBM (DB2), Oracle, Microsoft (SQL Server), and Sybase (Adaptive Server Enterprise), which supply more than 90 percent of the U.S. database software marketplace. MySQL is a Linux open source relational database product now owned by Oracle Corporation, and Apache Hadoop is an open source software framework for managing massive data sets (see Chapter 6).

The physical data storage market is dominated by EMC Corporation for large-scale systems, and a small number of PC hard disk manufacturers led by Seagate and Western Digital.

Digital information is doubling every two years, with a staggering 1.8 zettabytes created in 2011 alone (IDC, 2011). All the tweets, blogs, videos, e-mails, and Facebook

postings, as well as traditional corporate data, add up to thousands of Libraries of Congress.

With the amount of new digital information in the world growing so rapidly, the market for digital data storage devices has been growing at more than 15 percent annually over the last five years. In addition to traditional disk arrays and tape libraries, large firms are turning to network-based storage technologies. **Storage area networks (SANs)** connect multiple storage devices on a separate high-speed network dedicated to storage. The SAN creates a large central pool of storage that can be rapidly accessed and shared by multiple servers.

NETWORKING/TELECOMMUNICATIONS PLATFORMS

Companies worldwide are expected to spend $408 billion for telecommuni- cations equipment in 2013 and another $1.7 billion on telecommunications services (Gartner, 2012). Chapter 7 is devoted to an in-depth description of the enterprise networking environment, including the Internet. Windows Server is predominantly used as a local area network operating system, followed by Linux and Unix. Large, enterprise wide area networks use some variant of Unix. Most local area networks, as well as wide area enterprise networks, use the TCP/IP protocol suite as a standard (see Chapter 7).

The leading networking hardware providers are Cisco, Alcatel-Lucent, Nortel, and Juniper Networks. Telecommunications platforms are typically provided by telecommunications/telephone services companies that offer voice and data connectivity, wide area networking, wireless services, and Internet access. Leading telecommunications service vendors include AT&T and Verizon. This market is exploding with new providers of cellular wireless, high-speed Internet, and Internet telephone services.

INTERNET PLATFORMS

Internet platforms overlap with, and must relate to, the firm's general networking infrastructure and hardware and software platforms. They include hardware, software, and management services to support a firm's Web site, including Web hosting services, routers, and cabling or wireless equipment. A **Web hosting service** maintains a large Web server, or series of servers, and provides fee-paying subscribers with space to maintain their Web sites.

The Internet revolution created a veritable explosion in server computers, with many firms collecting thousands of small servers to run their Internet operations. Since then there has been a steady push toward server consolida- tion, reducing the number of server computers by increasing the size and power of each and by using software tools that make it possible to run more appli- cations on a single server. The Internet hardware server market has become increasingly concentrated in the hands of IBM, Dell, and Sun (Oracle), and HP, as prices have fallen dramatically.

The major Web software application development tools and suites are sup- plied by Microsoft (Microsoft Expression Studio and the Microsoft .NET family of development tools), Oracle-Sun (Sun's Java is the most widely used tool for developing interactive Web applications on both the server and client sides), and a host of independent

software developers, including Adobe (Creative Suite) and Real Networks (media software). Chapter 7 describes the compo- nents of the firm's Internet platform in greater detail.

CONSULTING AND SYSTEM INTEGRATION SERVICES

Today, even a large firm does not have the staff, the skills, the budget, or the necessary experience to deploy and maintain its entire IT infrastruc- ture. Implementing a new infrastructure requires (as noted in Chapters 3 and 14) significant changes in business processes and procedures, training and education, and software integration. Leading consulting firms providing this expertise include Accenture, IBM Global Services, HP, Infosys, and Wipro Technologies.

Software integration means ensuring the new infrastructure works with the firm's older, so-called legacy systems and ensuring the new elements of the infrastructure work with one another. **Legacy systems** are gener- ally older transaction processing systems created for mainframe computers that continue to be used to avoid the high cost of replacing or redesigning them. Replacing these systems is cost prohibitive and generally not necessary if these older systems can be integrated into a contemporary infrastructure.

CONTEMPORARY HARDWARE PLATFORM TRENDS

The exploding power of computer hardware and networking technology has dramatically changed how businesses organize their computing power, putting more of this power on networks and mobile handheld devices. We look at eight hardware trends: the mobile digital platform, consumerization of IT, grid com- puting, virtualization, cloud computing, green computing, high-performance/ power-saving processors, and autonomic computing.

THE MOBILE DIGITAL PLATFORM

Chapter 1 pointed out that new mobile digital computing platforms have emerged as alternatives to PCs and larger computers. Smartphones such as the iPhone, Android, and BlackBerry smartphones have taken on many functions of PCs, including transmission of data, surfing the Web, transmitting e-mail and instant messages, displaying digital content, and exchanging data with internal corporate systems. The new mobile platform also includes small, lightweight netbooks optimized for wireless communication and Internet access, **tablet computers** such as the iPad, and digital e-book readers such as Amazon's Kindle with Web access capabilities.

Smartphones and tablet computers are becoming an important means of accessing the Internet. These devices are increasingly used for business computing as well as for consumer applications. For example, senior execu- tives at General Motors are using smartphone applications that drill down into vehicle sales information, financial performance, manufacturing metrics, and project management status.

CONSUMERIZATION OF IT AND BYOD

The popularity, ease of use, and rich array of useful applications for smartphones and tablet computers have created a groundswell of interest in allowing employees to use their personal mobile devices in the workplace, a phenomenon popularly called *"bring your own device" (BYOD)*. BYOD is one aspect of the **consumerization of IT**, in which new information technology that first emerges in the consumer market spreads into business organizations. Consumerization of IT includes not only mobile personal devices but also business uses of software services such as Google and Yahoo search, Gmail, Google Apps, Dropbox (see Chapter 2), and even Facebook and Twitter that originated in the consumer marketplace as well.

Consumerization of IT is forcing businesses, especially large enterprises, to rethink the way they obtain and manage information technology equipment and services. Historically, at least in large firms, the central IT department was responsible for selecting and managing the information technology and applications used by the firm and its employees. It furnished employees with desktops or laptops that were able to access corporate systems securely. The IT department maintained control over the firm's hardware and software to ensure that the business was being protected and that information systems served the purposes of the firm and its management. Today, employees and business departments are playing a much larger role in technology selection, in many cases demanding that employees be able to use their own personal computers, smartphones, and tablets to access the corporate network. It is more difficult for the firm to manage and control these consumer technologies, and make sure they serve the needs of the business. The Interactive Session on Management explores some of these management challenges created by BYOD and IT consumerization.

GRID COMPUTING

Grid computing involves connecting geographically remote computers into a single network to create a virtual supercomputer by combining the compu- tational power of all computers on the grid. Grid computing takes advantage of the fact that most computers in the United States use their central pro- cessing units on average only 25 percent of the time for the work they have been assigned, leaving these idle resources available for other processing tasks. Grid computing was impossible until high-speed Internet connections enabled firms to connect remote machines economically and move enormous quantities of data. Grid computing requires software programs to control and allocate resources on the grid.

The business case for using grid computing involves cost savings, speed of computation, and agility. For example, Royal Dutch/Shell Group is using a scal- able grid computing platform that improves the accuracy and speed of its scien- tific modeling applications to find the best oil reservoirs. This platform, which links 1,024 IBM servers running Linux, in effect creates one of the largest com- mercial Linux supercomputers in the world. The grid adjusts to accommodate the fluctuating data volumes that are typical in this seasonal business. Royal Dutch/Shell Group claims the grid has enabled the company to cut processing time for seismic data, while improving output quality and helping its scientists pinpoint problems in finding new oil supplies.

VIRTUALIZATION

Virtualization is the process of presenting a set of computing resources (such as computing power or data storage) so that they can all be accessed in ways that are not restricted by physical configuration or geographic location. Virtualization enables a single physical resource (such as a server or a stor- age device) to appear to the user as multiple logical resources. For example, a server or mainframe can be configured to run many instances of an operating system so that it acts like many different machines. Virtualization also enables multiple physical resources (such as storage devices or servers) to appear as a single logical resource, as would be the case with storage area networks or grid computing. Virtualization makes it possible for a company to handle its computer processing and storage using computing resources housed in remote locations. VMware is the leading virtualization software vendor for Windows and Linux servers.

By providing the ability to host multiple systems on a single physical machine, virtualization helps organizations increase equipment utilization rates, conserving data center space and energy usage. Most servers run at just 15–20 percent of capacity, and virtualization can boost server utilization rates to 70 percent or higher. Higher utilization rates translate into fewer comput- ers required to process the same amount of work. Virtualization also facilitates centralization and consolidation of hardware administration. It is now possible for companies and individuals to perform all of their computing work using a virtualized IT infrastructure, as is the case with cloud computing.

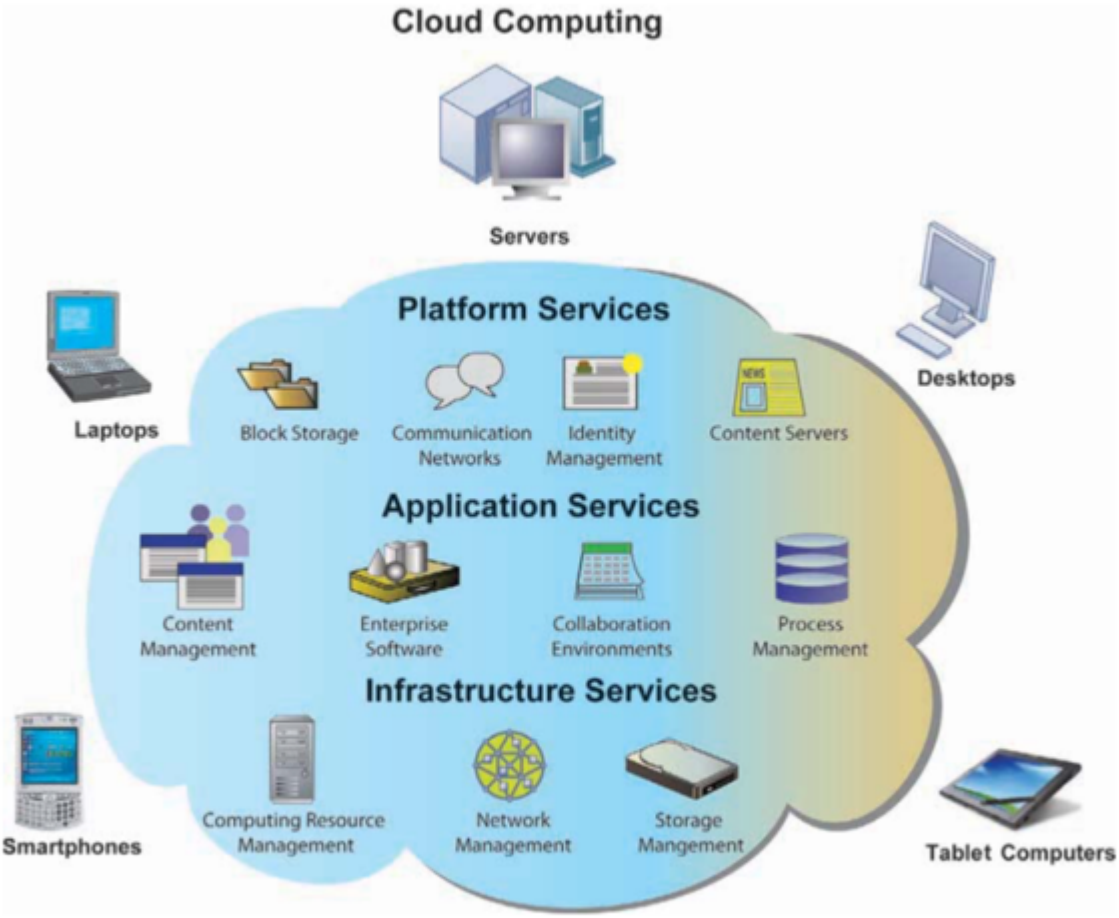
CLOUD COMPUTING

Cloud computing is a model of computing in which computer processing, storage, software, and other services are provided as a pool of virtualized resources over a network, primarily the Internet. These “clouds” of computing resources can be accessed on an as-needed basis from any connected device and location. Figure 5.10 illustrates the cloud computing concept.

The U.S. National Institute of Standards and Technology (NIST) defines cloud computing as having the following essential characteristics (Mell and Grance, 2009):

- On-demand self-service: Consumers can obtain computing capabilities such as server time or network storage as needed automatically on their own.
- Ubiquitous network access: Cloud resources can be accessed using standard network and Internet devices, including mobile platforms.
- Location-independent resource pooling: Computing resources are pooled to serve multiple users, with different virtual resources dynamically assigned according to user demand. The user generally does not know where the computing resources are located.
- Rapid elasticity: Computing resources can be rapidly provisioned, increased, or decreased to meet changing user demand.
- Measured service: Charges for cloud resources are based on amount of resources actually used.

FIGURE 5.10 CLOUD COMPUTING PLATFORM



In cloud computing, hardware and software capabilities are a pool of virtualized resources provided over a network, often the Internet. Businesses and employees have access to applications and IT infrastructure anywhere, at any time, and on any device.

Cloud computing consists of three different types of services:

- **Cloud infrastructure as a service:** Customers use processing, storage, networking, and other computing resources from cloud service providers to run their information systems. For example, Amazon uses the spare capacity of its IT infrastructure to provide a broadly based cloud environment sell- ing IT infrastructure services. These include its Simple Storage Service (S3) for storing customers' data and its Elastic Compute Cloud (EC2) service for running their applications. Users pay only for the amount of computing and storage capacity they actually use. (See the chapter-ending case study.)
- **Cloud platform as a service:** Customers use infrastructure and programming tools supported by the cloud service provider to develop their own applica- tions. For example, IBM offers a Smart Business Application Development & Test service for software development and testing on the IBM Cloud. Another example is Salesforce.com's Force.com, which allows developers to build applications that are hosted on its servers as a service.
- **Cloud software as a service**: Customers use software hosted by the vendor on the vendor's cloud infrastructure and delivered over a network. Leading

examples are Google Apps, which provides common business applications online and Salesforce.com, which also leases customer relationship management and related software services over the Internet. Both charge users an annual subscription fee, although Google Apps also has a pared-down free version. Users access these applications from a Web browser, and the data and software are maintained on the providers' remote servers.

A cloud can be private or public. A public cloud is owned and maintained by a cloud service provider, such as Amazon Web Services, and made available to the general public or industry group. A private cloud is operated solely for an orga- nization. It may be managed by the organization or a third party and may exist on premise or off premise. Like public clouds, private clouds are able to allocate storage, computing power, or other resources seamlessly to provide computing resources on an as-needed basis. Companies that want flexible IT resources and a cloud service model while retaining control over their own IT infrastructure are gravitating toward these private clouds. (See the chapter-ending case study.)

Since organizations using public clouds do not own the infrastructure, they do not have to make large investments in their own hardware and soft- ware. Instead, they purchase their computing services from remote providers and pay only for the amount of computing power they actually use (utility computing) or are billed on a monthly or annual subscription basis. The term on-demand computing has also been used to describe such services.

Cloud computing has some drawbacks. Unless users make provisions for storing their data locally, the responsibility for data storage and control is in the hands of the provider. Some companies worry about the security risks related to entrusting their critical data and systems to an outside vendor that also works with other companies. Companies expect their systems to be available 24/7 and do not want to suffer any loss of business capability if cloud infrastructures malfunction. Another limitation of cloud computing is that users become dependent on the cloud computing provider, and this may not necessarily be desirable, as discussed in the chapter-ending case. Nevertheless, the trend is for companies to shift more of their computer processing and storage to some form of cloud infrastructure.

Cloud computing is more immediately appealing to small and medium- sized businesses that lack resources to purchase and own their own hardware and software. However, large corporations have huge investments in complex proprietary systems supporting unique business processes, some of which give them strategic advantages. The cost savings from switching to cloud services are not always easy to determine for large companies that already have their own IT infrastructures in place. Corporate data centers typically work with an IT budget that accounts for a mix of operational and capital expenses. Pricing for cloud services is usually based on a per-hour or other per-use charge. Even if a company can approximate the hardware and software costs to run a specific computing task on premises, it still needs to figure in how much of the firm's network management, storage management, system administration, electric- ity, and real estate costs should be allocated to a single on-premises IT service. An information systems department may not have the right information to ana- lyze those factors on a service-by-service basis.

Large firms are most likely to adopt a **hybrid cloud** computing model where they use their own infrastructure for their most essential core activities and adopt public cloud computing for less-critical systems or for additional process- ing capacity during peak business periods. Cloud computing will gradually shift firms from having a fixed infrastructure capacity toward a more flexible infra- structure, some of it owned by the firm, and some of it rented from giant com- puter centers owned by computer hardware vendors. You can find out more about cloud computing in the Learning Tracks for this chapter.

GREEN COMPUTING

By curbing hardware proliferation and power consumption, virtualization has become one of the principal technologies for promoting green comput- ing. **Green computing** or **green IT**, refers to practices and technologies for designing, manufacturing, using, and disposing of computers, servers, and associated devices such as monitors, printers, storage devices, and networking and communications systems to minimize the impact on the environment.

Reducing computer power consumption has been a very high "green" priority. Information technology is responsible for about 2 percent of total U.S. power demand and is believed to contribute about 2 percent of the world's greenhouse gases. Cutting power consumption in data centers has become both a serious business and environmental challenge. The Interactive Session on Organizations examines this problem.

HIGH-PERFORMANCE AND POWER-SAVING PROCESSORS

Another way to reduce power requirements and hardware sprawl is to use more efficient and power-saving processors. Contemporary microproces- sors now feature multiple processor cores (which perform the reading and execution of computer instructions) on a single chip. A **multicore proces- sor** is an integrated circuit to which two or more processor cores have been attached for enhanced performance, reduced power consumption, and more efficient simultaneous processing of multiple tasks. This technology enables two or more processing engines with reduced power requirements and heat dissipation to perform tasks faster than a resource-hungry chip with a single processing core. Today you'll find PCs with dual-core, quad-core, six-core, and eight core processors.

Intel and other chip manufacturers have developed microprocessors that minimize power consumption, which is essential for prolonging battery life in small mobile digital devices. Highly power-efficient microprocessors, such as ARM, Apple's A4 and A5 processors, and Intel's Atom are in netbooks, digi- tal media players, and smartphones. The dual-core A5 processor used in the iPhone 4S and the iPad2 has about 1/50 to 1/30 the power consumption of a laptop dual-core processor.

AUTONOMIC COMPUTING

With large systems encompassing many thousands of networked devices, computer systems have become so complex today that some experts believe they may not be manageable in the future. One approach to this problem is autonomic computing. **Autonomic computing** is an industry-wide effort to develop systems that can

configure themselves, optimize and tune themselves, heal themselves when broken, and protect themselves from outside intruders and self-destruction.

You can glimpse a few of these capabilities in desktop systems. For instance, virus and firewall protection software are able to detect viruses on PCs, automatically defeat the viruses, and alert operators. These programs can be updated automatically as the need arises by connecting to an online virus protection service such as McAfee. IBM and other vendors are starting to build autonomic features into products for large systems.

2. CONTEMPORARY SOFTWARE PLATFORM TRENDS

There are four major themes in contemporary software platform evolution:

- Linux and open source software
- Java, HTML, and HTML5
- Web services and service-oriented architecture
- Software outsourcing and cloud services

LINUX AND OPEN SOURCE SOFTWARE

Open source software is software produced by a community of several hundred thousand programmers around the world. According to the leading open source professional association, OpenSource.org, open source software is free and can be modified by users. Works derived from the original code must also be free, and the software can be redistributed by the user without additional licensing. Open source software is by definition not restricted to any specific operating system or hardware technology, although most open source software is currently based on a Linux or Unix operating system.

The open source movement has been evolving for more than 30 years and has demonstrated that it can produce commercially acceptable, high-qual- ity software. Popular open source software tools include the Linux operat- ing system, the Apache HTTP Web server, the Mozilla Firefox Web browser, and the Apache OpenOffice desktop productivity suite. Open source tools are being used on netbooks as inexpensive alternatives to Microsoft Office. Major hardware and software vendors, including IBM, HP, Dell, Oracle, and SAP, now offer Linux-compatible versions of their products. You can find out more out more about the Open Source Definition from the Open Source Initiative and the history of open source software at the Learning Tracks for this chapter.

Linux

Perhaps the most well-known open source software is Linux, an operating system related to Unix. Linux was created by the Finnish programmer Linus Torvalds and first posted on the Internet in August 1991. Linux applications are embedded in cell phones, smartphones, netbooks, and consumer electronics. Linux is available in free versions downloadable from the Internet or in low- cost commercial versions that include tools and support from vendors such as Red Hat.

Although Linux is not used in many desktop systems, it is a major force in local area networks, Web servers, and high-performance computing work. IBM, HP, Intel, Dell, and Oracle have made Linux a central part of their offerings to corporations.

The rise of open source software, particularly Linux and the applications it supports, has profound implications for corporate software platforms: cost reduction, reliability and resilience, and integration, because Linux works on all the major hardware platforms from mainframes to servers to clients.

SOFTWARE FOR THE WEB: JAVA, HTML, AND HTML5

Java is an operating system-independent, processor-independent, object-ori- ented programming language that has become the leading interactive environ- ment for the Web. Java was created by James Gosling and the Green Team at Sun Microsystems in 1992. In November 13, 2006, Sun released much of Java as open source software under the terms of the GNU General Public License (GPL), completing the process on May 8, 2007.

The Java platform has migrated into cell phones, smartphones, automobiles, music players, game machines, and finally, into set-top cable television systems serving interactive content and pay-per-view services. Java software is designed to run on any computer or computing device, regardless of the specific microprocessor or operating system the device uses. Oracle Corporation estimates that 3 billion devices are running Java, and it is the most popular development platform for mobile devices running the Android operating system (Taft, 2012). For each of the computing environments in which Java is used, Sun created a Java Virtual Machine that interprets Java programming code for that machine. In this manner, the code is written once and can be used on any machine for which there exists a Java Virtual Machine.

Java developers can create small applet programs that can be embedded in Web pages and downloaded to run on a Web browser. A **Web browser** is an easy-to-use software tool with a graphical user interface for displaying Web pages and for accessing the Web and other Internet resources. Microsoft's Internet Explorer, Mozilla Firefox, and Google Chrome browser are examples. At the enterprise level, Java is being used for more complex e-commerce and e-business applications that require communication with an organization's back-end transaction processing systems.

HTML and HTML5

HTML (Hypertext Markup Language) is a page description language for specifying how text, graphics, video, and sound are placed on a Web page and for creating dynamic links to other Web pages and objects. Using these links, a user need only point at a highlighted keyword or graphic, click on it, and immediately be transported to another document.

HTML was originally designed to create and link static documents composed largely of text. Today, however, the Web is much more social and interactive, and many Web pages have multimedia elements—images, audio, and video. Third-party plug-in applications like Flash, Silverlight, and Java have been required to integrate these rich media with Web pages. However, these add-ons require additional programming and put strains on computer processing. This is one reason Apple dropped support for

Flash on its mobile devices. The next evolution of HTML, called **HTML5**, solves this problem by making it possible to embed images, audio, video, and other elements directly into a document without processor-intensive add-ons. HTML5 will also make it easier for Web pages to function across different display devices, including mobile devices as well as desktops, and it will support the storage of data offline for apps that run over the Web. Web pages will execute more quickly, and look like smartphone apps. Although HTML5 is still under development, elements are already being used in a number of Internet tools, including Apple's Safari browsers, Google Chrome, and recent versions of the Firefox Web browser. Google's Gmail and Google Reader have adopted parts of the HTML5 standard as well. Web sites listed as "iPad ready" are making extensive use of HTML5 including CNN, The New York Times, and CBS.

WEB SERVICES AND SERVICE-ORIENTED

ARCHITECTURE

Web services refer to a set of loosely coupled software components that exchange information with each other using universal Web communication standards and languages. They can exchange information between two differ- ent systems regardless of the operating systems or programming languages on which the systems are based. They can be used to build open standard Web-based applications linking systems of two different organizations, and they can also be used to create applications that link disparate systems within a single company. Web services are not tied to any one operating system or program- ming language, and different applications can use them to communicate with each other in a standard way without time-consuming custom coding.

The foundation technology for Web services is **XML**, which stands for **Extensible Markup Language**. This language was developed in 1996 by the World Wide Web Consortium (W3C, the international body that oversees the development of the Web) as a more powerful and flexible markup language than hypertext markup language (HTML) for Web pages. Whereas HTML is limited to describing how data should be presented in the form of Web pages, XML can perform presentation, communication, and storage of data. In XML, a number is not simply a number; the XML tag specifies whether the number represents a price, a date, or a ZIP code. Table 5.2 illustrates some sample XML statements.

By tagging selected elements of the content of documents for their mean- ings, XML makes it possible for computers to manipulate and interpret their data automatically and perform operations on the data without human inter- vention. Web browsers and computer programs, such as order processing or enterprise resource planning (ERP) software, can follow programmed rules for applying and displaying the data. XML provides a standard format for data exchange, enabling Web services to pass data from one process to another.

Web services communicate through XML messages over standard Web protocols. Companies discover and locate Web services through a direc- tory much as they would locate services in the Yellow Pages of a telephone book. Using Web protocols, a software application can connect freely to other applications without custom programming for each different application with which it wants to communicate. Everyone shares the same standards.

The collection of Web services that are used to build a firm's software sys- tems constitutes what is known as a service-oriented architecture. A **service- oriented architecture (SOA)** is set of self-contained services that commu- nicate with each other to create a working software application. Business tasks are accomplished by executing a series of these services. Software developers reuse these services in other combinations to assemble other applications as needed.

Virtually all major software vendors provide tools and entire platforms for building and integrating software applications using Web services. IBM includes Web service tools in its WebSphere e-business software platform, and Microsoft has incorporated Web services tools in its Microsoft .NET platform.

Dollar Rent A Car's systems use Web services for its online booking system with Southwest Airlines' Web site. Although both companies' systems are based on different technology platforms, a person booking a flight on Southwest.com can reserve a car from Dollar without leaving the airline's Web site. Instead of struggling to get Dollar's reservation system to share data with Southwest's information systems, Dollar used Microsoft .NET Web services technology as an intermediary. Reservations from Southwest are translated into Web services protocols, which are then translated into formats that can be understood by Dollar's computers.

Other car rental companies have linked their information systems to air- line companies' Web sites before. But without Web services, these connections had to be built one at a time. Web services provide a standard way for Dollar's computers to "talk" to other companies' information systems without having to build special links to each one. Dollar is now expanding its use of Web services to link directly to the systems of a small tour operator and a large travel reserva- tion system as well as a wireless Web site for cell phones and smartphones. It does not have to write new software code for each new partner's information systems or each new wireless device (see Figure 5.11).

SOFTWARE OUTSOURCING AND CLOUD SERVICES

Today, many business firms continue to operate legacy systems that continue to meet a business need and that would be extremely costly to replace. But they will purchase or rent most of their new software applications from external sources. Figure 5.12 illustrates the rapid growth in external sources of software for U.S. firms.

There are three external sources for software: software packages from a commercial software vendor, outsourcing custom application development to an external vendor, (which may or may not be offshore), and cloud-based software services and tools.

Software Packages and Enterprise Software

We have already described software packages for enterprise applications as one of the major types of software components in contemporary IT infrastructures. A **software package** is a prewritten commercially available set of software programs that eliminates the need for a firm to write its own software programs for certain functions, such as payroll processing or order handling.

Enterprise application software vendors such as SAP and Oracle-PeopleSoft have developed powerful software packages that can support the primary business processes of a firm worldwide from warehousing, customer relationship management, and supply chain management, to finance and human resources. These large-scale enterprise software systems provide a single, integrated, worldwide software system for firms at a cost much less than they would pay if they developed it themselves. Chapter 9 discusses enterprise systems in detail.

Software Outsourcing

Software **outsourcing** enables a firm to contract custom software develop- ment or maintenance of existing legacy programs to outside firms, which often operate offshore in low-wage areas of the world. According to the indus- try analysts, spending on offshore IT outsourcing services was approximately $251 billion in 2012 (Gartner, 2012). The largest outsourcing expenditures are to domestic U.S. firms providing middleware, integration services, and other software support that are often required to operate larger enterprise systems.

For example, Cemex, Mexico's largest cement manufacturer, signed a 10-year $1 billion outsourcing deal with IBM in July 2012. Under the deal, IBM respon- sibilities include application development and maintenance as well as IT infra- structure management at Cemex company headquarters in Monterrey, Mexico, and around the globe. IBM will take over and run Cemex's finance, accounting, and human resources systems (McDougall, 2012).

Offshore software outsourcing firms have primarily provided lower-level maintenance, data entry, and call center operations, although more sophisti- cated and experienced offshore firms, particularly in India, have been hired for new-program development. However, as wages offshore rise, and the costs of managing offshore projects are factored in (see Chapter 13), some work that would have been sent offshore is returning to domestic companies.

Cloud-Based Software Services and Tools

In the past, software such as Microsoft Word or Adobe Illustrator came in a box and was designed to operate on a single machine. Today, you're more likely to download the software from the vendor's Web site, or to use the software as a cloud service delivered over the Internet.

Cloud-based software and the data it uses are hosted on powerful servers in massive data centers, and can be accessed with an Internet connection and stan- dard Web browser. In addition to free or low-cost tools for individuals and small businesses provided by Google or Yahoo, enterprise software and other complex business functions are available as services from the major commercial software vendors. Instead of buying and installing software programs, subscribing compa- nies rent the same functions from these services, with users paying either on a subscription or per-transaction basis. Services for delivering and providing access to software remotely as a Web-based service are now referred to as **software as a service (SaaS)**. A leading example is Salesforce.com, which provides on-demand software services for customer relationship management.

In order to manage their relationship with an outsourcer or technology service provider, firms need a contract that includes a **service level agreement (SLA)**. The SLA is a formal contract between customers and their service providers that defines the specific responsibilities of the service provider and the level of service expected by the customer. SLAs typically specify the nature and level of services provided, criteria for performance measurement, support options, provisions for security and disaster recovery, hardware and software ownership and upgrades, customer support, billing, and conditions for terminating the agreement. We provide a Learning Track on this topic.

Mashups and Apps

The software you use for both personal and business tasks may consist of large self-contained programs, or it may be composed of interchangeable compo- nents that integrate freely with other applications on the Internet. Individual users and entire companies mix and match these software components to create their own customized applications and to share information with others.

The resulting software applications are called **mashups**. The idea is to take different sources and produce a new work that is "greater than" the sum of its parts. You have performed a mashup if you've ever personalized your Facebook profile or your blog with a capability to display videos or slide shows.

Web mashups combine the capabilities of two or more online applications to create a kind of hybrid that provides more customer value than the original sources alone. For instance, ZipRealty uses Google Maps and data provided by online real estate database Zillow.com to display a complete list of multiple listing service (MLS) real estate listings for any zip code specified by the user. Amazon uses mashup technologies to aggregate product descriptions with partner sites and user profiles.

Apps are small pieces of software that run on the Internet, on your computer, or on your mobile phone or tablet and are generally delivered over the Internet. Google refers to its online services as apps, including the Google Apps suite of desktop productivity tools. But when we talk about apps today, most of the attention goes to the apps that have been developed for the mobile digital platform. It is these apps that turn smartphones and other mobile handheld devices into general-purpose computing tools.

An estimated 1 billion people used apps in 2012 worldwide, with about 200 million in the United States (eMarketer, 2012). By 2012, over 32 billion apps had been downloaded. Many are free or purchased for a small charge, much less than conventional software. There are already over 700,000 apps for the Apple iPhone and iPad platform and a similar number that run on devices using Google's Android operating system. The success of these mobile platforms depends in large part on the quantity and quality of the apps they provide. Apps tie the customer to a specific hardware platform: As the user adds more and more apps to his or her mobile phone, the cost of switching to a competing mobile platform rises.

Some downloaded apps do not access the Web but many do, providing faster access to Web content than traditional Web browsers. At the moment, the most commonly downloaded apps are games, news and weather, maps/navigation, social networking,

music, and video/movies. But there are also serious apps for business users that make it possible to create and edit documents, connect to corporate systems, schedule and participate in meetings, track shipments, and dictate voice messages (see the Chapter 1 Interactive Session on Management). There are also a huge number of e-commerce apps for researching and buying goods and services online.

3. Latihan dan Jawaban

1) What are the current trends in computer hardware platforms?

   Increasingly, computing is taking place on a mobile digital platform. Grid computing involves connecting geographically remote computers into a single network to create a computational grid that combines the computing power of all the computers on the network. Virtualization organizes computing resources so that their use is not restricted by physical configuration or geographic location. In cloud computing, firms and individuals obtain computing power and software as services over a network, including the Internet, rather than purchasing and installing the hardware and software on their own computers. A multicore processor is a microprocessor to which two or more processing cores have been attached for enhanced performance. Green computing includes practices and technologies for producing, using, and disposing of information technology hardware to minimize negative impact on the environment. In autonomic computing, computer systems have capabilities for automatically configuring and repairing themselves. Power-saving processors dramatically reduce power consumption in mobile digital devices.

2) What are the current trends in software platforms?

   Open source software is produced and maintained by a global community of programmers and is often downloadable for free. Linux is a powerful, resilient open source operating system that can run on multiple hardware platforms and is used widely to run Web servers. Java is an operating-system– and hardware-independent programming language that is the leading interactive programming environment for the Web. HTML5 makes it possible to embed images, audio, and video directly into a Web document without add-on programs. Web services are loosely coupled software components based on open Web standards that work with any application software and operating system. They can be used as components of Web-based applications linking the systems of two different organiza- tions or to link disparate systems of a single company. Companies are purchasing their new software applications from outside sources, including software packages, by outsourcing custom application development to an external vendor (that may be offshore), or by renting online software services (SaaS). Mashups combine two different software services to create new software applications and services. Apps are small pieces of software that run on the Internet, on a computer, or on a mobile phone and are generally delivered over the Internet.

3) What are the challenges of managing IT infrastructure and management solutions?

Major challenges include dealing with platform and infrastructure change, infrastructure management and governance, and making wise infrastructure investments. Solution guidelines include using a competitive forces model to determine how much to spend on IT infrastructure and where to make strategic infrastructure investments, and establishing the total cost of ownership (TCO) of information technology assets. The total cost of owning technology resources includes not only the original cost of computer hardware and software but also costs for hardware and software upgrades, maintenance, technical support, and training.

4. Daftar Pustaka

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