Chapter- 5

IT Infrastructure and Emerging Technologies

🔖 Topic- 8: What is IT infrastructure, and what are the stages and drivers of IT infrastructure evolution?

8.1.1: Defining IT Infrastructure

An IT infrastructure consists of a set of physical devices and software applications that are required to operate the entire enterprise. But IT infrastructure also includes a set of firmwide services budgeted by management and composed of both human and technical capabilities. These services include the following:

- **Computing platforms** used to provide computing services that connect employees, customers, and suppliers into a coherent digital environment, including large mainframes, midrange computers, desktop and laptop computers, and mobile handheld and remote cloud computing services
- **Telecommunications services** that provide data, voice, and video connectivity to employees, customers, and suppliers
- **Data management services** that store and manage corporate data and provide capabilities for analyzing the data
- **Application software services**, including online software services, that provide enterprise-wide capabilities such as enterprise resource planning, customer relationship management, supply chain management, and knowledge management systems that are shared by all business units
- **Physical facilities management** services that develop and manage the physical installations required for computing, telecommunications, and data management services
- **IT management services** that plan and develop the infrastructure, coordinate with the business units for IT services, manage to account for the IT expenditure, and provide project management services
- **IT standards services** that provide the firm and its business units with policies that determine which information technology will be used, when, and how
- **IT education services** that provide training in system use to employees and offer managers training in how to plan for and manage IT investments
- **IT research and development services** that provide the firm with research on potential future IT projects and investments that could help the firm differentiate itself in the marketplace

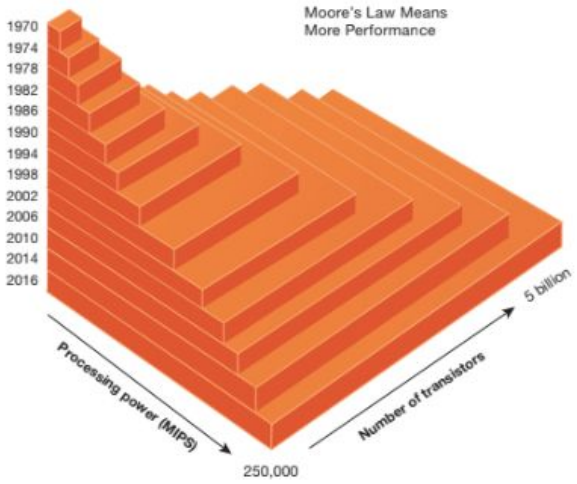
8.1.3.: Moore's Law and Microprocessing Power

In 1965, Gordon Moore, the director of Fairchild Semiconductor's Research and Development Laboratories, wrote in Electronics magazine that since the first microprocessor chip was introduced in 1959, the number of components on a chip with the smallest manufacturing costs per component (generally transistors) had doubled each year. This assertion became the foundation of Moore's Law. Moore later reduced the rate of growth to a doubling every two years.

There are at least three variations of Moore's Law, none of which Moore ever stated:

1. the power of microprocessors doubles every 18 months,
2. computing power doubles every 18 months, and
3. the price of computing falls by half every 18 months.

FIGURE 5.4 MOORE'S LAW AND MICROPROCESSOR PERFORMANCE



Packing more than 5 billion transistors into a tiny microprocessor has exponentially increased processing power. Processing power has increased to more than 250,000 MIPS (about 2.6 billion instructions per second).

Source: Authors' estimate.

Figure 5. 4illustrates the relationship between the number of transistors on a microprocessor and millions of instructions per second (MIPS), a common measure of processor power. Figure 5. 5shows the exponential decline in the cost of transistors and the rise in computing power. For instance, in 2016, you could buy an Intel i7 quad-core processor chip with 2.5 billion transistors for about one ten-millionth of a dollar per transistor.

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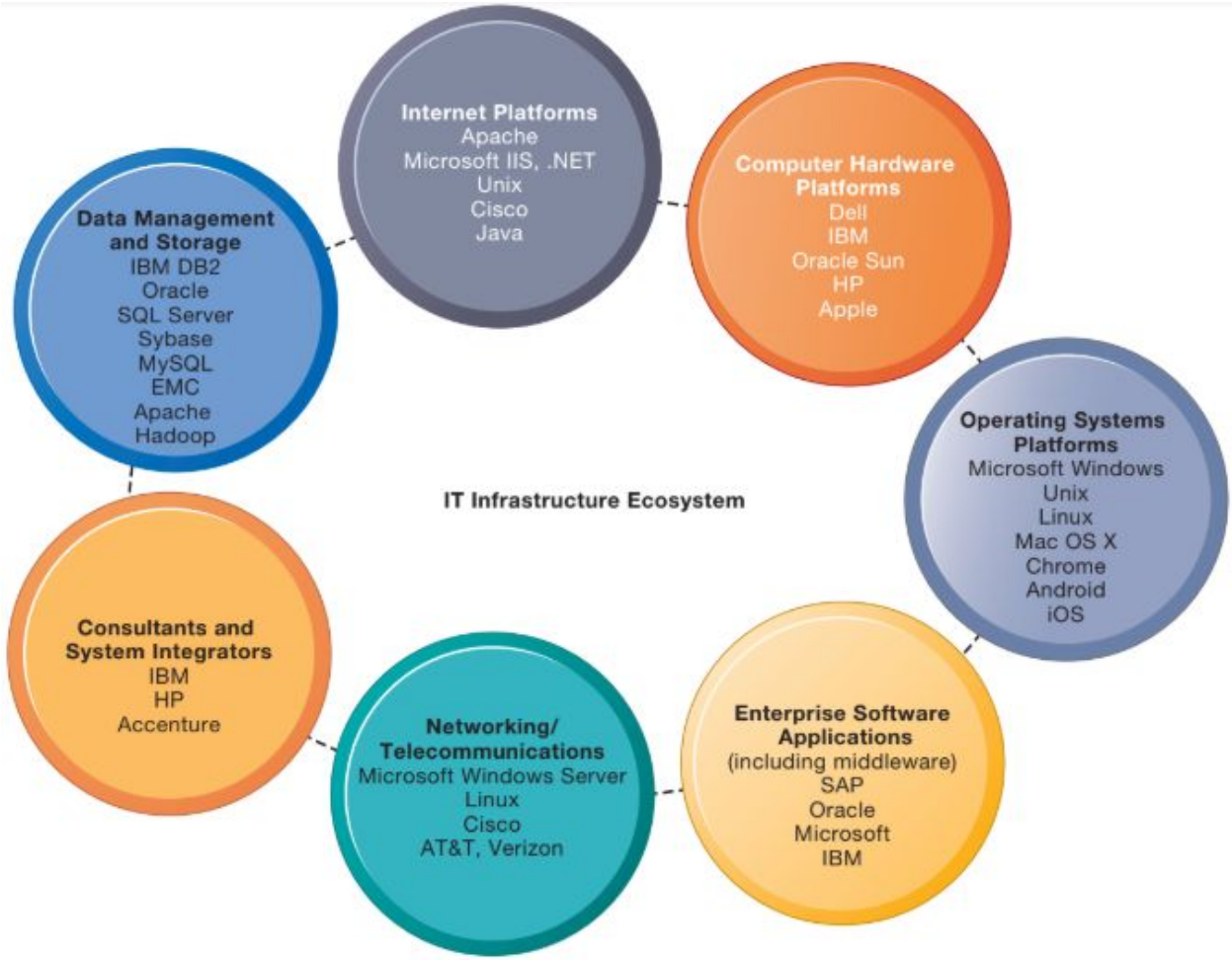
9.1.1: Components of IT infrastructure

IT infrastructure today is composed of seven major components. Figure 5. 8 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.



- **Computer Hardware Platforms** Firms worldwide are expected to spend $626 billion on computer hardware devices in 2016, including mainframes, servers, PCs, tablets, and smartphones. All these devices constitute the computer hardware platform for corporate (and personal) computing worldwide. The computers with Intel microprocessors in the first computer hardware platform use complex instruction set computing (CISC) with several thousand instructions built into the chip. This requires a considerable number of transistors per processor, consumes power, and generates heat. Mobile devices in the second computer hardware platform are not required to perform as many tasks as computers in the first computer hardware platform.

They are able to use reduced instruction set computing (RISC), which contains a smaller set of instructions, consumes less power, and generates less heat. RISC processors for mobile devices are manufactured by a wide range of firms, including Apple, Samsung, and Qualcomm, using an architecture designed by ARM Holdings.

- **Operating System Platforms** The leading operating systems for corporate servers are Microsoft Windows Server, Unix, and 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 Oracle-Sun, each with slightly different and partially incompatible versions.

- **Enterprise Software Applications** Firms worldwide are expected to spend about $321 billion in 2016 on software for enterprise applications that are treated as components of IT infrastructure. The largest providers of enterprise application software are SAP and Oracle.

- **Data Management and Storage**, Enterprise database management software is responsible for organizing and managing the firm's data so that it can be efficiently accessed and used. The leading database software providers are IBM (DB2), Oracle, Microsoft (SQL Server), and Sybase (Adaptive Server Enterprise). 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 very large data sets

- **Networking/Telecommunications** Platforms Companies worldwide are expected to spend $1.44 trillion for telecommunications services in 2016 (Gartner, Inc., 2016). 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

- **Internet Platforms:** Internet platforms include hardware, software, and management services to support a firm's website, 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 websites.

- **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 infrastructure. Implementing a new infrastructure requires significant changes in business processes and procedures, training and education, and software integration. Leading consulting firms providing this expertise include Accenture, IBM Global Business 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 generally 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.

9.1.2: Current trends in computer hardware platforms

Seven Hardware Trends:

- *the mobile digital platform,*
- *consumerization of IT and BYOD,*
- *quantum computing,*
- *virtualization,*
- *cloud computing,*
- *green computing, and*
- *high-performance/power-saving processors.*

- **The Mobile Device Platform:** The iPhone and Android smartphones have taken on many functions of PCs, including transmitting 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 some web access capabilities.

- **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 that originated in the consumer marketplace as well, such as Google and Yahoo search, Gmail, Google Apps, Dropbox, and even Facebook and Twitter.

- **Quantum Computing** Quantum computing uses the principles of quantum physics to represent data and perform operations on these data. While conventional computers handle bits of data either as 0 or 1 but not both, quantum computing can process bits as 0, 1, or both simultaneously. A quantum computer would gain enormous processing power through this ability to be in multiple states at once, allowing it to solve some scientific and business problems millions of times faster than can be done today.

- **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 storage device) to appear to the user as multiple logical resources.

- **Cloud Computing** Cloud computing is a model of computing in which computer processing, storage, software, and other services are provided as a shared 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. 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 the number of resources actually used.

- **Green Computing** 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.

- **High-Performance and Power-Saving Processors** A multicore processor 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 and servers with 16-core processors.