

# Themes and Concepts

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Threaded throughout the book are some basic themes listed in Table 1 that have driven the evolution of computing and communications technology in recent decades, and some core concepts listed in Table 2 that support these themes and recur over and over through the various topics in the book. While reading the book, it is helpful if you keep in mind these themes and concepts, which will help you to unify and assimilate this large body of knowledge. You may also find it helpful to occasionally review these themes and concepts as you work your way through the book.

**Table 1** Recurring themes throughout this book.

Theme	Description
Information technology	Information is recognizable patterns that inform or affect people. Technology puts scientific principles to use. Information technology applies technology to the storage, communication, and manipulation of information.
Application	An application uses information technology to provide features and functionality to the benefit of users, groups of users, organizations, and commerce.
Infrastructure	An infrastructure is the foundation of information technology that supports all applications, and includes equipment (computers, storage, peripherals), the network, and much software.
System	A system is a collection of pieces that work together to achieve higher-level goals that the pieces could not achieve by themselves. Collectively the infrastructure and application are a system.
Architecture	The architecture of a system is the specification of the pieces, what they do, and how they interact.
Complexity management	A complex system has so many pieces with such complicated interactions that people have difficulty understanding or keeping track of them. Complexity management techniques expand the complexity of systems that are feasible to design, operate, and maintain.
Reuse	The cost of implementing software systems is spinning out of control, necessitating ways to reuse existing software to create new systems and applications. Expanding the infrastructure, application components, and frameworks contribute to reuse.

**Table 1 Recurring themes throughout this book.**

<b>Theme</b>	<b>Description</b>
Interoperability and standardization	Infrastructure and applications must integrate many elements, and they must work together to achieve systems goals. This is a major challenge in a networked world, where systems and applications may span different organizations and countries, and elements may be designed by many different companies. Standardization is a process that makes this work.
Mobility	Users and software can change location while using an application.
Availability and security	An application must be available to its users most of the time, and should be able to withstand systematic attacks by thieves and vandals.
Performance and quality	Most applications place requirements not only on functionality, but also on performance metrics like response time, completion time, or throughput, as well as the subjective quality of audio, video, and images.
Scalability	Application performance requirements must be preserved as the numbers of users or other measures of capability increase, by adding to but not replacing infrastructure, and at a reasonable cost.

**Table 2 Some core concepts of information technology that support the themes.**

<b>Concept</b>	<b>Description</b>
Data and information	Information is the basic commodity of computing and communication, but is represented in the infrastructure by data—a collection of bits. Information adds structure and interpretation to data.
Representation	Data or information in one format can be transformed into another format that is more easily manipulated, stored, or communicated.
Server and client	Two pieces of a system often assume a server to client (producer to consumer) relationship. The consumer can pull services or information from the producer, or the producer can push services or information to the consumer. Intermediate possibilities include event notification and subscription.
Modularity and interfaces	Modularity partitions a system in a way that separates concerns and contains complexity. Modules interact through carefully specified interfaces, often determined by industry standardization.
Processing and communication	Processing recovers information from data, or modifies information by changing data. Communication allows data and information to be exchanged among the modules of an application, and is supported by the network.
Software	The computer is the first machine whose functionality is not determined at the time of manufacture, but is specified by software added later. A software program is a representation of the processing steps.
Abstraction	Abstraction hides unnecessary detail, focusing attention on properties and behavior that are essential.

**Table 2** Some core concepts of information technology that support the themes.

<b>Concept</b>	<b>Description</b>
Location	Entities must be located in order to find them. Location is specified by naming, addressing, and referencing. Routing determines a path to the entity, and caching and mobile code locate data and programs near where they are used.
Algorithm and protocol	An algorithm is a well-specified set of steps to accomplish a goal. A protocol is a distributed algorithm that serves to coordinate two or more modules.
Concurrency	Two activities are concurrent when they are overlapped in time. Concurrency is the key to serving multiple users, and is important for performance and scalability.