Part II

Enterprise Information Infrastructure

Chapter III

Enterprise Information Infrastructure (EII)

STRATEGY AND RATIONALE

The American business in the Information Wave in the 21^{st} century increasingly relies on computer and information networks for the conduct of vital operations. The computerized telecommunications networks, customer interfaces, services, applications, and related technologies create the Enterprise Information Infrastructure (EII). The industry which supports the development of EII and other information infrastructures (NII – National Information Infrastructure, GII – Global Information Infrastructure, and Local Information Infrastructure) is valued domestically at about $1 trillion in 2000. Not surprisingly, with this kind of money at stake, the emerging technologies that will define information infrastructures in the future have become the subject of much discussion and many grand schemes.

But suppliers are not the only ones anticipating benefits from the new information infrastructure. Business users also hope to increase their productivity and quality of life through the application of technologies and services in a wide variety of contexts. But despite all the great expectations of industry insiders and technology users, the general business practitioners remain largely unaware of exactly what is taking place because the majority of these services are invisible to the naked eye.

The EII includes more than just the physical facilities used to transmit, store, process, and display voice, data, images, and video. It encompasses:

- A wide and ever-expanding range of equipment including cameras, scanners, keyboards, telephones, fax machines, computers, telecom switches, compact disks, video and audio tape, cable wire, satellites, optical transmission lines, microwave nets, switches, televisions, monitors, printers, and much more,

- The information itself, which may be in the form of print-outs, scientific or business databases, images, sound recordings, library archives, video programming, and other media,

- Applications and software that allow users to access, manipulate, organize, process, and digest the proliferating mass of information that EII's facilities will put at the users' fingertips,

- The network standards and transmission codes that facilitate interconnection and inter-operation between networks, and ensure the privacy of persons and the security of the information carried, as well as the security and reliability of the networks,

- The people—largely business professionals—who create the information, develop applications and services, construct the facilities, and train others to tap its potential.

Hence, the EII is an array of computerized networks, online devices, intelligent appliances, applications, standards, and services that people use to interact with digital information. One feature that distinguishes the EII from the previous computing environment is an unprecedented degree of distributed user empowerment. Never before in the history of communication has anyone possessing relatively an inexpensive, networked personal computer had such access to and control over information.

The goal of EII is to support the urban, agricultural, industrial infrastructures in order:

1. To empower an enterprise in better positioning itself in the marketplace through the optimization of using resources from other infrastructures (urban, agricultural, industrial, etc.),

2. To empower an enterprise's workers and executives in broadening their cognition about operated/managed processes and resources.

The strategy of EII should lead towards the gradual development of a comprehensive, compatible, reliable, secure, and safe complex of digital resource processes and services according to the master plan. Such EII should fit into an array of other EII's (e.g., in a Supply Chain Management System), NII, GII, and LII's.

This chapter covers the main concepts and components of the Enterprise Information Infrastructure (EII) whose mission is to exchange a message in a service manner. It is very difficult to separate the communication process from the information process in computer and software environments, computer-telecommunication networks, and the Internet. Hence, one can call these processes info-communication processes and systems.

EII GENERAL ARCHITECTURE

In the 2000's, funds spent on information management are at the level of 15% of the Gross Domestic Product, which means that these funds exceed $1 trillion. The cost of information management in the United States is comparable to the cost of health care, which is the number one industry in this country. Such an amount of funds requires tremendous developmental and operational stages and phases at the strategic, tactical, and operation levels. Similar to civil engineering projects, information management projects require planning of general solutions and designing of detail outcomes.

The difference between the architectural approach and the engineering approach is in the level of abstraction. The architectural solutions are more conceptual whereas engineering outcomes are more technical. The architectural approach is the response to the complexity of expected outcomes. Prior to spending a few million dollars for a new information system, one must provide its information architecture and the business and social implications associated with it.

The enterprise information architecture should be at the level of synthesis as a result of empirical experience and theoretical knowledge. An architect is more an artist than an engineer; he/she must know more principles governing the planning process and have strong intuitive instinct about what principles (rules) should be chosen for a given architectural project.

The system architect begins his/her work when the user's business strategy and preliminary budget have been determined. Thus, system architecture planning begins with the task of harmonizing business/corporate strategies with information technology (IT) potential and user needs. Good system architecture should be driven by the following principles which determine what is possible and what is effective in a given information architecture:

1. Cybernetization - good system architecture should be "viable" and open-ended
2. Systematization - good system architecture should have a goal, structure, and measurable outcomes
3. No redundancy - good system architecture should avoid component redundancy
4. Categorization - good system architecture should recognize self-contained components at the same levels of abstraction
5. Primitiveness - good system architecture should be based on generic components and relationships.
6. Completeness - good system architecture should recognize all major components and their relationships
7. Value engineering - good system architecture should not contain unnecessary components

The information management discipline is very young; it is at most 50 years old. However, its professional development has been very strong, especially in the last two decades of the 20^{th} century. Since the beginning, IS have been developed as islands of automation that have been a consequence of an autonomous and eclectic (non-architectural) approach. In the 1980's personal computers triggered the creeping, quiet revolution known as the Computer Age. In the 1990's, the Internet launched the Communication Age and the phenomena of telecommunication networking and video services. We no longer deal with IS only; we now have to include into an information architecture other forms of information-communication systems and services.

These new systems and services require a new approach towards IT applications in the enterprise. A set of these systems and services is what I call the Enterprise Information Infrastructure (EII). This is the second civilization infrastructure, which follows the already developed urban infrastructure.

Figure 3-1 depicts the architecture of EII. The EII is composed of the following levels:

1. Telecommunications Layer – physical information transmission over public telecommunications lines and facilities,

2. Computer Networks Layer – managed online information transmission among associated computers,

3. Internet Layer – public cyberspace for information exchange,

4. Computing Layer – physical processing of information,

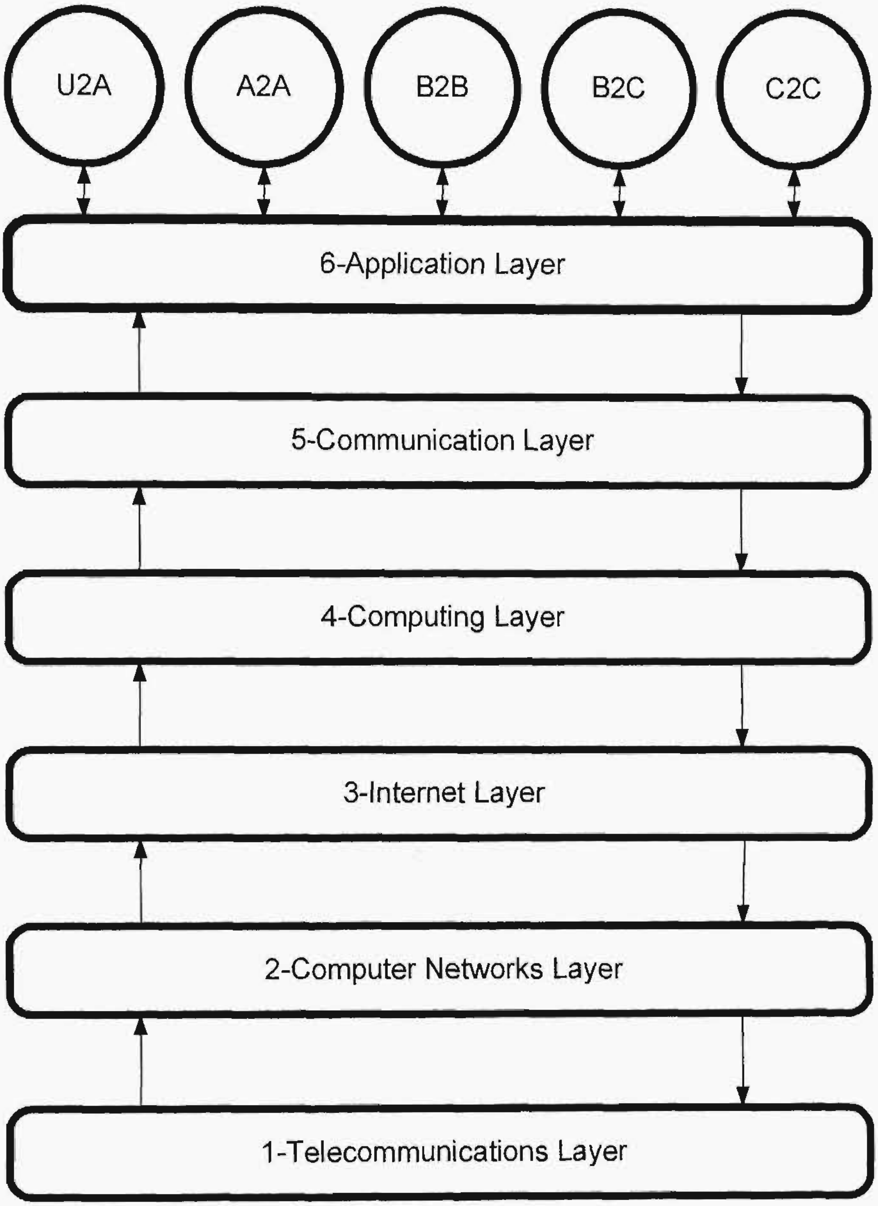
5. Communication Layer – facilities and systems of providing online information,

6. Application Layer – final result of info-communication handlings and processings applied by the end-users.

The EII architecture should lead towards the definition of:

- System strategy and its integration with a business strategy,
- Prioritized systems and services application projects,
- Data modeling,
- Software needs,
- Computer needs,
- Network needs,
- Staff needs,
- Budget,
- Implementation schedule,

Figure 3-1: The EII Generic Model (U2A–User-To-Application, A2A–Application-To-Application, B2B–Business-To-Business, B2C–Business-To-Consumer, C2C–Consumer-To-Consumer)



- Training plan,
- Other.

The EII layers will be described in the following sections and chapters (Application Layer). The set of these layers creates an interconnected matrix or even a labyrinth of technology, where it is very difficult to separate one technology from another.

TELECOMMUNICATIONS LAYER

The Telecommunications Layer emerged from the telegraph (1837), and evolved to the telephone (1876), satellite (1945), wireless (1958), cable (1960), and "the information super-highway" (1990's) which transmits voice, data, graphics, and video in one packet.

The universal access to telecommunications services and its integration with computer services and network services transforms these technologies into the information utility technology, which can be characterized by the following attributes:

1. Central online real-time facility,
2. Many subscribers at remote locations,
3. Information storage, retrieval, processing provided,
4. Services provided at the subscriber's own location,
5. Service is fast, immediate, easy to understand, and reliable,
6. Service is relatively inexpensive, based on the unit costs,
7. Other.

Telecommunications provides the means to transmit messages over distances through the following levels:

1. Access and transmission technologies, such as:
   - Telephony (intra-LATA-local services, IXC-interexchange carriers-long distance, and specialized common carriers (SCC), such as Telenet and Tymnet,
   - Cable television,
   - Nonwireline media – microwave radio, digital radio, satellite communications, cellular communications.

2. Switching technologies which are provided in two categories:
   - Circuit switching, when the customer pays per used time of transmission,
   - Packet switching, when the customer pays per volume of sent messages. These messages are organized into "packets" or "cell relays" or "frame relays." The second technology leads to so-called broad band transmission (B-ISDN) and the third technology supports narrow band transmission (N-ISDN).

3. Telco switching networks that make connections among 170 million subscribers in the U.S. via:
   - Integrated Digital Networks – they integrate voice, data, graphics, and voice into one binary stream transmitted through a digital path connecting switching equipment and transmission lines. AT&T provides such a service, called ISDN (Information Services Digital networks), which is controlled by a programmable software.
   - Intelligent Networks – consist of integrated hardware and software, distributed throughout the telecommunications service provider's network. Vendors can easily develop telecommunications services that deliver certain communications service under the form of software-oriented "building blocks," e.g., a "900" number which charges those who call them.
   - Advanced Intelligent Networks – are the intelligent networks whose services can be designed by CAD-Computer Aided Design software. This ability dramatically reduces the time between conception of a service and its implementation.

It is important to notice that these telecom networks are invisible networks for user computer networks such as LAN, MAN, WAN, and GAN that are described in the next section. The latter networks are built upon the telecom networks. However, LAN is the only network which is out of the telecom facilities since it is developed inside a company's building. Although there are some examples of outsource LAN's, they have to operate through the telecom facilities.

COMPUTER NETWORKS LAYER

This layer interconnects computers and applies the Telecommunications Layer for information's physical transmission. If telecommunications services are invisible for end-users, this layer is visible for them.

LAN

Local Area Networks (LAN) allow a great number and variety of user computers and devices such as printers to exchange large amounts of information at high speed over limited distances. LAN interconnects users within an area of 16 miles. LAN is a private network. Design elements for LAN fall into three main categories (Digital, 1982):

- Topology
- Access and control methods

A network topology is created by the geometric arrangements of the link and nodes that make up a network. A link (also called a line, channel or circuit) is the communications paths between two nodes. A node can be defined as an end point to any branch of a network. The hardware and software chosen for each node is determined by the functions of that node in the network.

Most LAN's are based on simple structure topologies, like the bus, star or ring. These topologies are shown in Figure 3-2.

Bus topology is organized as an open ring. Messages placed on the bus are broadcast out to all nodes. Nodes must be able to recognize their own address in order to receive transmissions. However, unlike nodes in a ring, they do not have to repeat and forward messages intended for other nodes. As a result, there is neither the delay nor the overhead associated with retransmitting messages at each intervening node, and nodes are relieved of network control responsibility at this level. The bus topology is now the most popular solution. Its commercial name is Ethernet, which has a branching-bus topology, with a