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Intelligent Networks and International Business Communication: A Systems Theory Interpretation

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Intelligent Networks and International Business Communication: A Systems Theory Interpretation

Richard A. Gershon

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Abstract

The combination of computer and telecommunications has collapsed the time and distance factors that once separated nations, people and business organizations. This monograph will examine the subject of intelligent networking which provides the technology and electronic pathways that makes international business communication possible. I will introduce the Information & Telecommunications Systems (ITS) model as a way to explain both the internal structures and processes of intelligent networking as well as its external consequences on people and organizations. We start with the assumption that the intelligent network is not one network, but a series of networks designed to enhance worldwide communication for business and individual users alike. Two major arguments are presented. First, what gives the network its unique intelligence are the people and users of the system and the value-added contributions they bring to the system via critical gateway points. Second, as intelligent networks grow and evolve, they often exhibit self-learning qualities in what Monge, Heiss & Magolin (2008) describe as *network evolution.* This is a crucial element in helping us to understand what makes an intelligent network, intelligent.

1. Introduction

International business has been transformed by the power of instantaneous communication. The combination of computer and telecommunications has collapsed the time and distance factors that once separated nations, people and business organizations (Castells, 2000; Tapscott, 1996). This monograph will examine the subject of intelligent networking which provides the technology and electronic pathways that makes global communication possible. I will introduce the Information & Telecommunications Systems (ITS) model as a way to explain both the internal structures and processes of intelligent networking as well as its external consequences.

Part I. considers the internal structures and system processes of the intelligent network. We start with the assumption that the intelligent network is not one network, but a series of networks designed to enhance worldwide communication for business and individual users alike (Noam, 2001, Gershon, 1997). What gives the network its unique intelligence are the people and users of the system and the value-added contributions they bring to the system via critical gateway points. Intelligent networks, by definition, presuppose permeable boundaries; that is, structured entry points that allow users to access and contribute to the overall system design. The same gateway points also means opening up the system to any number of unwanted influences and outcomes. Accordingly, special attention is given to what I call the *permeability predicament.*

Part II. examines system outcomes (or external consequences) of intelligent networks. Central to the discussion is that intelligent networks do not operate in a vacuum. Rather, the use of intelligent networks are part of a greater human and organizational decision-making process (Monge & Contractor, 2003). As Berners-Lee (1999) points out, the Internet is as much a social creation as it is a technical one. Nowhere is this more evident than in the creation of social networking sites like *Facebook* and *Twitter.* The ITS model provides a specific way of understanding the social and technological consequences of intelligent networking on people and organizations. This paper has identified eight such consequences. They include: 1) Decentralization, 2) Immediacy, 3) Interactivity, 4) Personalization, 5) Mobility, 6) Convergence, 7) Virtual Communication and 8) Artificial Intelligence. While several of the aforementioned terms are familiar words in the business and communication literature, they nevertheless provide an essential understanding of how intelligent networks operate. As intelligent networks grow and evolve, they often exhibit self-learning qualities in what Monge, Heiss & Magolin (2008) describe as *network evolution.* This is a crucial element in helping us to understand what makes an intelligent network, intelligent.

1.1. Systems Theory as an Investigative Framework

Systems theory provides a useful framework with which to analyze and describe a set of structures and processes that work together to produce a particular outcome. Systems theory can trace its origins to the fields of biology and engineering. One of the principal founders of systems theory was Ludwig von Bertalanffy, a theoretical biologist. Bertalanffy published *General Systems Theory* (1968) which made the argument that systems theory was equally appropriate for the social sciences as it was for biology. In the field of communication, systems theory was first adopted by Katz & Kahn (1966) in an influential work, entitled: *The Social Psychology of Organizations.* In this book, the authors argue that organizations function as complex open systems that involve interaction between component parts as well as interaction with the environment.

Throughout the decades of the 1970's and 80's, a number of researchers utilized systems theory as a way to better explain the relationship between organizational behavior and communication. Kurt Lewin was particularly influential in developing the systems perspective within organizational theory and coined the term *systems of ideology,* resulting from his dissatisfaction with behavioral psychology (Ash, 1992). Systems theory took on increasing importance in helping to understand the principles of exchange, feedback and interdependency; concepts that are fundamental to the operations of highly complex organizations (Miller, 1995).

The fields of sociology and anthropology have also helped to advance a number of rich theoretical perspectives that look at patterns of human communication and interaction. In particular, is network analysis (or social network analysis) which shares some distinct parallels with systems theory and communication. The goal of network analysis is to understand the process by which participants create and share information with one another in order to reach a mutual understanding (Degenne & Forsé, 1999; Wasserman & Faust, 1994; Monge & Eisenberg, 1987; Rogers & Kincaid, 1981). Network analysis emphasizes the importance of human and organizational relationships since it defines the nature of the communication links or ties between people, groups and organizations. How a person lives and interacts with one's surroundings is highly dependent on the individual's larger network of social connections (i.e., manager-employee, colleague to colleague, etc.) (Butts & Carley, 2007; Robins & Pattison, 2005; Butts, 2001; Gargiulo & Benassi, 2000). Network analysis, therefore, requires an appreciation for the properties of communication networks, such as message content, methods of delivery and network density (i.e., primary and secondary link strength). More recently, network analysis has undergone an important theoretical resurgence with the rapid emergence of social networking sites like *Facebook, and Linked-In* (Ellison et. al., 2010; Robins & Kashima, 2008; Bae & Gargiulo, 2004).

Another area for consideration is the relationship between systems theory and technology. Such efforts find unique expression in the work of DeSanctis & Poole (1994) and *Adaptive Structuration Theory* (AST). AST is based on the work of Anthony Giddens (1984) and his theory of structuration which argues that all human action is performed within the context of a pre-existing social structures that exhibit an identifiable set of behavioral rules and norms. AST holds that organizations operate as systems with observable patterns of behavior and human interaction. This, in turn, gives rise to adaptive, behaviors. Specifically, AST looks at technology influence from two vantage points:

1) the types of structures that are imposed on users through the use of technology and
2) the structural changes that later emerge as a consequence of the user's interaction with such technologies.

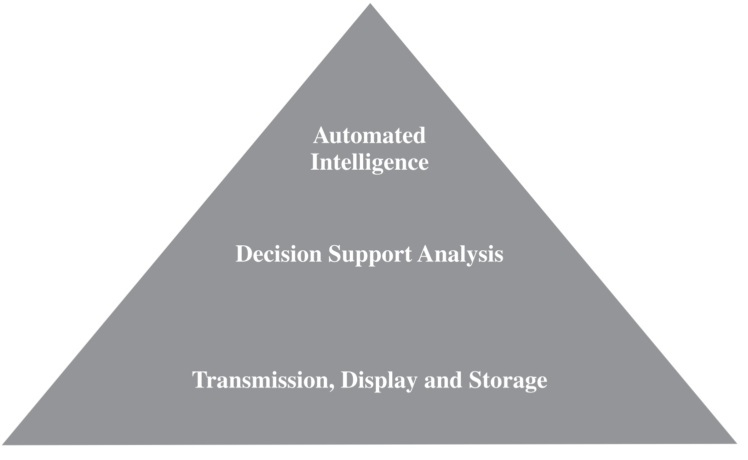
In this monograph, we seek to answer two basic questions. First, what makes an intelligent network, intelligent? Specifically, what are the defining characteristics and features that comprise so called "intelligent networks?" Second, what are the social and technological consequences of intelligent networks on people and business organizations? The significance of this research lies in its presentation and analysis of how intelligent networks are used to support advanced communication technologies and software applications. It is incumbent upon today's media scholars to understand the very network platforms that make such communication technologies as Smart phones, E-commerce and Internet social networking sites possible. Select principles of systems theory will be used in examining the questions under investigation. The reason for selecting a systems theory approach is based on the assumption that intelligent networks (like human biology) do indeed function as integrated systems. One important goal of this paper is to provide the reader with a unified theory of communication and intelligent networking. Systems theory provides us with a distinct lens and labeling scheme that best accomplishes this task.

1.2. Systems Theory and Network Intelligence

Intelligence can be defined as the ability to reason, problem solve, think abstractly, comprehend complex ideas and learn. Similarly, Halal (2000) describes organizational intelligence as the "capacity of an organization to create knowledge and use it to strategically plan and adapt to its environment." (p. 67). Intelligent networks, therefore, are the systems of communication that organize, transmit and display information with the goal of improving organizational performance. Intelligent networks are also responsible for providing decision support capability. As noted earlier, what gives the network its unique intelligence are the people and users of the system and the value added contributions they make via critical gateway points (e.g., desktop/laptop computers, smart phones, electronic readers etc.). What do we mean by value-added contributions? They represent the kind of hardware and software improvements that contribute to improved organizational performance. Today's intelligent networks provide three levels of functionality as illustrated in Figure 1. They include: 1) Transmission, Storage and Display, 2) Decision Support Analysis and 3) Automated Intelligence.

Figure 1.

Intelligent Network: Three Level Hierarchy



Source R. Gershon, 2011

The first level can be described as *Transmission, Display and Storage (TDS).* The role of the intelligent network is provide the proper switching and routing of information between a sender and an intended audience. This can vary in size and complexity from a simple television broadcast to an international videoconference involving a

London based senior project manager, an international research and design team (operating in Helsinki, Los Angeles and Madrid), a New York based sales and marketing team and a Malaysia based manufacturing facility. In both cases, the goal is to transmit information / entertainment to an intended audience.

The second level can be described as *Decision Support Analysis.* Here the emphasis is on providing the user with critical information for the purpose of planning, research and decision-making. The intelligent network is responsible for providing the organization and its users immediate access to a whole host of internal and external data base services that might include investigating infectious diseases (i.e., U.S. Center for Disease Control and Prevention) or pursuing a criminal investigation of a suspected international terrorist (i.e., Interpol, U.S. Department of Homeland Security). Depending on how the information is organized and sorted, there is an abundance of information that can provide the user with critical analysis capability.

The third level can be described as *Automated Intelligence.* The goal of the intelligent network is to make preprogrammed decisions. This is intelligent networking in its highest form and speaks to the principles of network evolution. The network is designed to make recommendations to the user and/or take corrective action based on established algorithms. Once again, examples can vary in size and complexity starting with a proprietary software recommendation system built by electronic commerce companies like Amazon, Netflix and Apple. Such companies make personalized product recommendations (i.e., books, films and music) via their EC websites based on past selections. At a more complex level, automated intelligence might refer to a Traffic Alert and Collision Avoidance System (TCAS) used by the field of aviation to reduce the incidence of mid-air collisions between aircraft. The key element is the principle of adaptation; that is, the ability to monitor external conditions, process incoming information, make recommendations and/or take corrective action as needed.

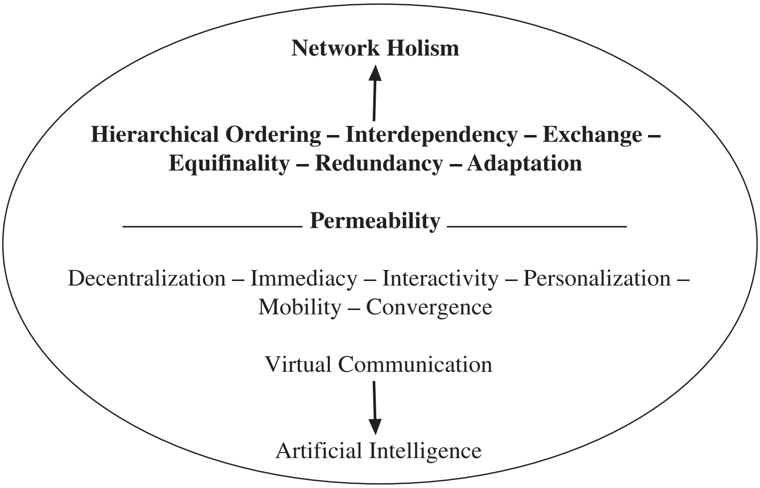
2. The Intelligent Network: Internal Structures and Processes (Part I.)

When engineers discuss the architecture of a network; they are describing how the physical parts of the network are organized, including: 1) information storage sites (host computers), 2) Information pathways (switching and routing of information) and 3) Terminals (gateways and access points).[1] The first task of the systems theorist is to identify the relevant parts that make up the system and to analyze how they work together. We begin with the premise that there are eight feature elements that comprise an intelligent network system. The six system structures include: 1) Hierarchical Ordering, 2) Interdependency, 3) Exchange, 4) Equifinality, 5) Redundancy and 6) Adaptation. The two system processes include: Network Holism and Permeability. The top half of Figure 2. illustrates the Information & Telecommunications Systems (ITS) model as a way to explain the internal structures and processes of intelligent networks.

1 Virtually all information networks in use today are based in some form on the Open Systems Interconnection (OSI) standard that was developed in 1984 by the International Organization for Standardization, a global federation of national regulatory agencies and standards groups representing over 130 countries. The centerpiece is the OSI Reference Model, a set of seven layers that define data transmission standards over an intelligent network. The seven layers of the OSI model include: 1) Physical, 2) Data link, 3) Network, 4) Transport, 5) Session, 6) Presentation, 7) Application.

Figure 2.

The Information & Telecommunications Systems Model
Internal Structure and System Processes Network Holism

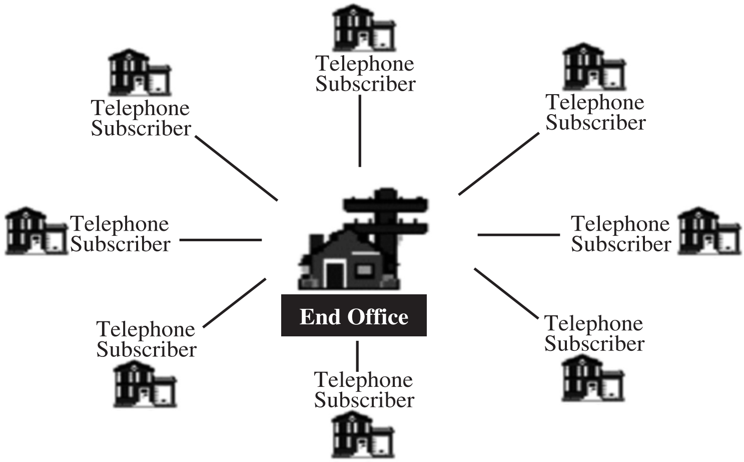


Source: R. Gershon, 2011

2.1. Hierarchical Ordering

The principle of hierarchical ordering suggests a prescribed set of steps necessary for the completion of a process or task. The U.S. public switched telephone network (PSTN) is premised on a type of hierarchical ordering scheme. It defines the procedures for the set-up, management and completion of a call between telephone users. Prior to 1984 and the break up of AT&T (then the world's largest telephone company), the U.S. system network hierarchy utilized a Class 5 telephone switching and call processing standard. The classic telephone network hierarchy provided for five levels of switching offices, with the Class 5 (or End Office) serving as the main gateway between the end user and the public switched telephone network The end office (EO) is responsible for providing dial-tone to the customer. All telephone calls are initially routed through the end office in what is called a star network configuration. (See Figure 3.).

Figure 3.
Star Network Configuration



Source: Chan, Chin Bong

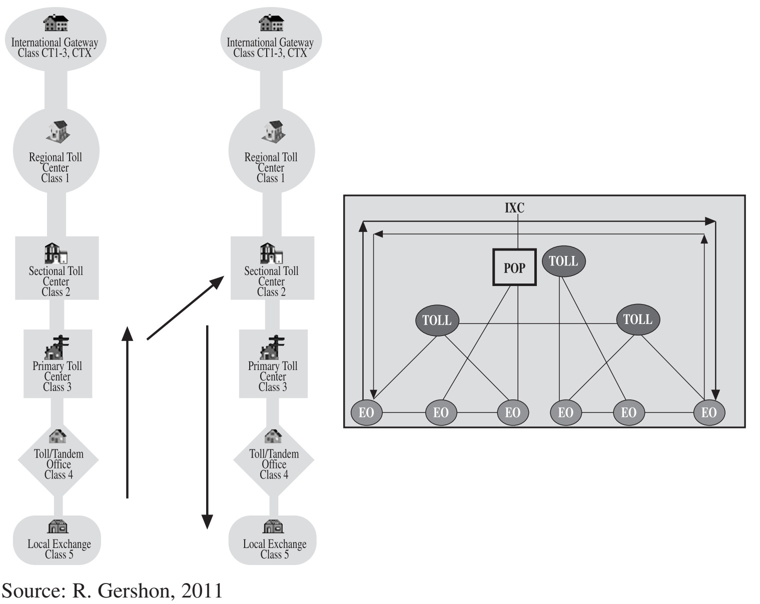
A telephone network must ensure a low probability of blocking; that is, a failure to establish a connection. The network must be designed with alternative routing methods so that calls can be routed to their proper destination when some part(s) of the trunk group are being fully utilized or have failed. When a telephone call is placed, the EO (Class 5 switch) determines the best available transmission path that the call will take based on a prescribed set of routing options. In principle, a long distance telephone call can be routed through the entire hierarchy of switching centers (See Figure 4.). This, however, is highly undesirable and would be used only as a last resort (referred to as a final choice path). If the first primary route is unavailable, then the system tries to find the second best route, third best route and so forth. The best route is the one that is most direct. Hence, the principle of hierarchical ordering. The same network hierarchy must also accommodate cell phone and email traffic since it provides the backbone (or primary transmission capability) for long-haul Internet and cellular telephone traffic.

Digital Switching Technology. Since 1984, the combination of competitive telephone services coupled with advancements in digital switching technology have allowed many of the switching levels previously described to be combined. Today's PSTN consists of fewer levels, consolidating many of the functions of the old AT&T Telephone switching hierarchy into 2 layers: Class 5 and Class 4 (toll offices). What has not changed is the prescribed hierarchy of switching calls. The term *points of presence* (POP) refers to the gateway point between the interexchange carrier (IXC) (i.e., AT&T, Verizon, Sprint) and the provision of long distance telephone service.[2] (See Figure 4.). Point of presence is also a location and access point for servicing Internet traffic.

Figure 4.

The U.S. Telephone Network Hierarchy

AT&T Network Hierarchy (pre-1984) AT&T Network Hierarchy Today



Source: R. Gershon, 2011

2 Common Channel Signaling System No. 7 (SS7) is the global standard prescribed by the International Telecommunications Union (ITU) that defines the procedures and protocols by which network elements in the public switched telephone network organize and coordinate digital signaling information involving call setup, control, network management, and network maintenance. Each and every public network connected switch must have an SS7 connection. The SS7 network and protocol is also used for ensuring efficient and secure worldwide telecommunications.

2.2. Interdependency

In 1962, F.H. Allport introduced his concept of *collective structures* by which he identifies the importance of interlocking behaviors. In order for an organization (or group structure) to function, it is necessary that other persons perform certain acts that are complementary in purpose. In a functioning system, the many parts that comprise the system are said to be highly interdependent. A highly complex organization cannot properly function without certain internal and external departments providing active assistance to one another. Weick (1979) takes up the same argument and suggests that one of the major goals of organizing is the reduction of equivocality (or uncertainty) within the information environment. This is accomplished through the use of assembly rules (i.e., protocols and procedures) and communication cycles (i.e., information sharing) between and among organizational players. The principle of interdependency can be seen in the area of intelligent networking and financial services.

Finance and Interdependency. Intelligent networks are at the heart of international business finance. The world's financial markets have been revolutionized by the application of computer and telecommunications to the banking and investment process. The international transfer of electronic funds is premised on strong, interdependent relationships between banks, the investment community, business and individual participants.[3] Electronic Funds Transfer (EFT) operates as information (or the promise of actual funds) and not as physical currency. The real impact of EFT on organizations and the public is greater convenience by not having to physically handle money during routine transactions. EFT

3 SWIFT (the Society for Worldwide Interbank Financial Telecommunication) is a member-owned cooperative located in 208 countries through which banks, security institutions and corporate customers conduct the exchange of financial messages and data on a daily basis. SWIFT's charge is twofold: First, they provide proprietary communications platform, products and services that allow their customers to connect and exchange financial information securely and reliably. They also act as the catalyst that brings the financial community together to work collaboratively to shape market practice, define standards and consider solutions to issues of mutual interest.

has permeated the world of business and personal finance in five ways. They include:

1. ***Electronic Funds Transfer*** – the national and international transfer of money between banks and other financial institutions.
2. ***Direct Deposit*** – the transfer of money directly into the bank account of an organization's employees.
3. ***ATMs*** – the public use of terminals and automated teller machines which enables the user to deposit and withdraw funds via electronic access.
4. ***Credit and Debit Cards*** – the public use of credit and debit cards as the basis of payment, between users and retailers that can include, restaurants, gas stations, supermarkets, department stores etc. (Kim et. al., 2002).
5. ***Electronic Commerce*** – the purchase of goods and services via the Internet which enables the transfer of funds from one's bank account (e.g., PayPal).

Interdependency and Credit. A credit card transaction provides a good illustration of intelligent networking and the principle of interdependency. Let's assume for a moment that a person pays for dinner using a credit card. The credit card transaction sets up a three way interdependent relationship between the person buying dinner, the restaurant and the credit card company. At the restaurant, the cashier swipes the credit card through a reader at the point of sale. The credit card terminal dials a stored telephone number via modem to the credit card company (CCC). The CCC maintains an internal data base that authenticates the person and guarantees to the merchant that the said person has a sufficient line of credit to cover the cost of purchase. Specifically, the CCC authenticates the person by examining the magnetic stripe (or magstripe) on the back of the card for a valid card number, expiration date and credit card limit. Afterwards, the credit card transaction requires the physical administration and processing of the credit card claim, including direct payment to the merchant and issuing a billing statement to the credit card holder. The person, in turn, must make a full or partial payment to the CCC and that information must be processed accordingly. In sum, no part of a credit card transaction can take place without the interdependent relationship of the three main system parts.

2.3. Exchange

In a system, exchange refers to something that is 1) coming in (input), 2) processed (throughput) and 3) going out (output). In a financial context, exchange refers to the transfer of goods and services between a manufacturer / distributor and the consumer. A variation on this idea is the principle of *exchange efficiency* which is an important concept found in management theory. It has to do with creating the optimum conditions through which a consumer can obtain a product or service. A simple example of exchange efficiency can be seen with speed lanes in a supermarket, thereby, allowing customers to move quickly through the checkout line. Another example of exchange efficiency can be seen with retail clothing companies who specialize in catalogue shopping such as L.L. Bean and Eddie Bauer. In the latter examples, exchange efficiency is made possible through a combination of an Internet website and an easy-to-use shoppingcatalogue supplemented with a toll free telephone number.

Electronic Commerce. Today, electronic commerce has taken the principle of exchange efficiency to a whole new level in terms of retail trade. E-commerce represents the ability to buy and sell products and services electronically via the Internet. They include business-to-consumer (B2C), business-to-business (B2B), and consumer-to-consumer (C2C). Of particular note, is B2C electronic commerce which involves selling products and services directly to consumers via the Internet. B2C comes in two general formats, including: traditional retailers (e.g., Sears, Target, etc.) as well as those companies whose primary business model depends on the Internet as the basis for retail trade (Amazon.com, Google etc.). The EC merchant, in turn, provides customers with 24/7 technical support capability as well as the ability to track the status of their package delivery via the Internet (Dell Computer, Federal Express, etc.). B2C electronic commerce has fundamentally changed how retail trade is conducted in terms of information gathering, production and distribution. It has created an altogether new business model that maximizes the potential for instantaneous communication to a worldwide customer base. Nowhere is this more evident than in the field of music sales and distribution. The speed and efficiency of producing Internet delivered music using

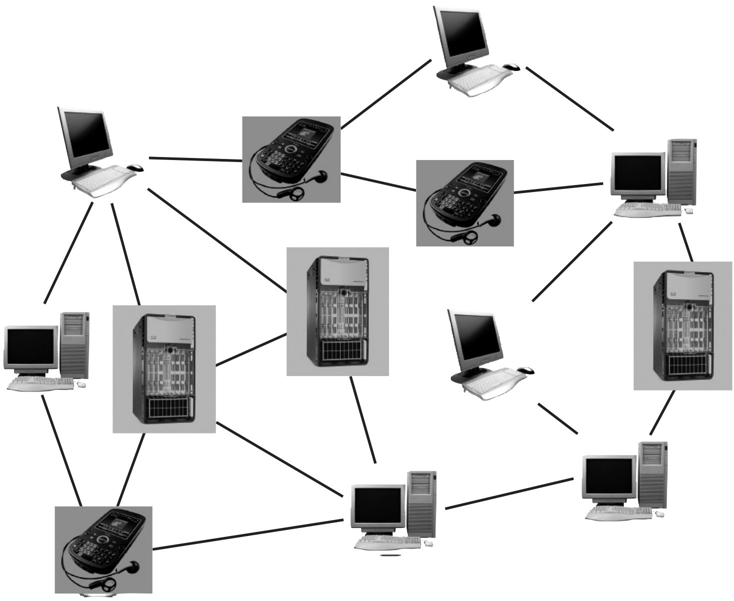
MP3 file-sharing software, has fundamentally changed the cost structure of music recording and distribution on a worldwide basis. Specifically, the combination of the Apple iPod and iTunes media store has created the first sustainable music downloading business model of its kind (Gershon, 2009). It has redefined the way music and video entertainment is distributed to the consumer and given new meaning to the term exchange efficiency.

2.4. Equifinality

In a highly complex system, there are a variety of pathways that allows a person or organization to achieve its goals. Equifinality is a system structure that allows one to "reach the same final state from differing initial conditions and by a variety of paths" (Katz & Kahn, 1978, p. 30). A telephone network, for example, must ensure a low probability of blocking; that is, a failure to establish a connection. As we saw earlier, the public switched telephone network must be designed with alternative routing methods so that calls can be routed to their proper destination when some part(s) of the trunk group are being fully utilized or have failed.

The Internet and Distributed Architecture. The beginnings of the Internet can be traced back to the early 1960s. At the peak of the cold war, researchers in the Advanced Research Projects Agency (ARPA) of the U.S. Department of Defense built a computer network to share resources among ARPA researchers and contractors located throughout North America. In organizing and managing the network, ARPA took a decidedly hands off approach which would have some long term effects on the evolution of the network and its use. ARPA's basic approach utilized two important design principles. First, ARPA was designed utilizing a distributed network architecture approach. No single person or network entity could control the flow of information. This was done as a defense measure against a possible nuclear or terrorist attack that might try and destabilize the network. Second, the original ARPA network was designed utilizing the principles of permeability (or open network architecture). In principle, any person (or computer terminal) should be be able to communicate with any other person (or computer terminal) on the network. There was to be no central gatekeeper. The Internet is one of the earliest examples of an information system that utilizes a mesh network configuration. (See Figure 5.) A mesh network is reliable and offers redundancy. If one node is unable to function, the remaining set of nodes (or access points) can still communicate with each other; albeit, through one or more intermediate nodes.

Figure 5.
Open Network Architecture:
Mesh Routing Configuration



Source: R. Gershon, 2011

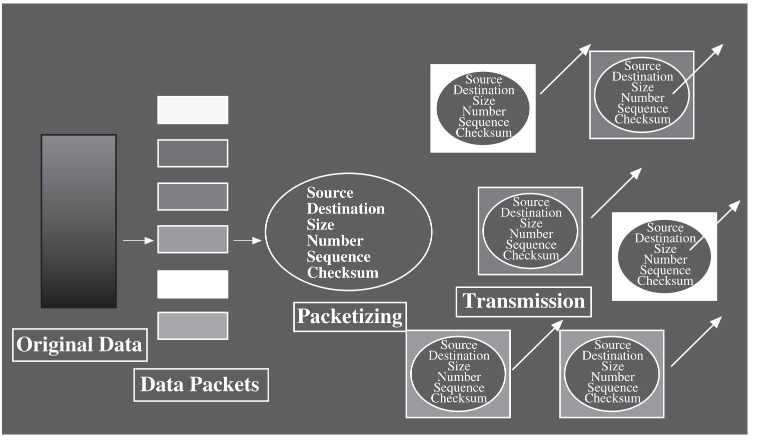
Telephone Signaling. A traditional telephone call is considered an in-band form of signaling; the user hears dial-tone and directly connects with the called party over an assigned dedicated circuit. In a circuit switched call, the voice or data message is sent directly to the end receiver in an orderly fashion, one information item after another on a single track. The main limitation of a circuit switched call is that only one set of users can communicate over the circuit at one time. In contrast, out-of-band signaling is a technique, whereby, the call set-up and management does not take place over the same path as the conversation. It utilizes multiple pathways to establish a voice, data and/or video link between a set of users. Out-of-band signaling is at the heart of Internet communication (Gershon, 2009).

Packet Switching. Packet switching represents the ability to take a digital based message and divide it into equal-sized packets of information. The packets are then sent individually through the network to their destination where the entire message is reassembled after all the packets arrive (Louis, 2000).[4] Today, packet switching dominates data networks like the Internet. An email message or Voice Over Internet Protocol (VOIP) telephone call from San Francisco to New York is handled much differently than a circuit switched call. With packet switching, system routers determine a path for each packet on the fly, dynamically, ordering them to use any route available to get to the destination point. (See Figure 6.). Data packets from other calls race upon these circuits as well, making the most use of each pathway, quite unlike the circuit switched telephone call that occupies a single path to the exclusion of all others.[5]

4 The principle of packet switching was first developed by electrical engineer Paul Baran in the early 1960's while working for the Rand corporation. He was asked to perform an investigation into survivable communications networks for the U.S. Air Force. Additional R&D work in packet switching technology was performed by Donald Davies and Leonard Kleinrock who did early research in the area of digital message switching as part of their work on the ARPANET; the world's first packet switching network and forerunner of the Internet (Louis, 2000).

5 A typical packet length on the Internet is about one kilobyte (or a thousand characters). A large message may be divided into thousands of individual packets. The beginning of a packet is called the "header" and records the following information:
Source – The Internet Protocol (IP) address of the computer sending the packet.
Destination – The IP address of the destination computer.
Size – The combined length of the header and data packet in bytes.
Number – The total number of packets in the complete message.
Sequence – The sequence of packets making up the communication.
Checksum – A measure for assessing the integrity of the received packets.

Figure 6.
Packet Switching Overview



Source: R. Gershon, 2009

After reaching their destination point, the individual packets are reassembled in order by a packet assembler. The difference in routing paths practically ensures that packets will reach their destination points at different times. This approach is acceptable when calling up a web page since a tiny delay is hardly noticed. But one notices even the smallest delay with voice communication. A circuit switched call sounds better because information goes in sequence with very little delay. In contrast, delays in packet switching can cause voice quality to suffer or image delays when using mobile devices. For this reason, telephone carriers do not use the general Internet to route VOIP calls. Instead, they have built specialized packet switched networks dedicated for this purpose.

Advancements in digital switching and signaling technology as well as the development of fiber optic technology have altered the basic design and operation of the modern telephone network. The PSTN has become more of an all purpose computing platform thus creating the ability to blend voice, data and video signals over the same network. In addition to voice communication, the PSTN supports Internet data traffic, including website display, email, MP3 file-sharing and video-streaming.

2.5. Redundancy

The principle of entropy involves the third law of thermodynamics and states that all matter has a tendency to become less and less organized and become randomly arranged. In all systems there is a tendency for a system to pull apart and become less organized. Shannon & Weaver's (1949) seminal *Mathematical Theory of Communication* was responsible for seeing the fundamental parallel between information and the concept of entropy. In order to overcome the natural entropy found in all communication networks, energy must be spent to organize matter into structured forms. In terms of information theory, entropy is associated with the amount of redundancy (or system backup) that is built into a message delivery and storage system. Building redundancy into a telecommunications network is essential given the likelihood that at some point most networks will indeed fail. In the case of sending a facsimile (FAX), for example, the system will automatically engage in redial mode in an effort to successfully complete the transmission.

Feedback. Feedback is a well documented term in the field of communication dating back to the work of Norbert Weiner (1954). In a telecommunications context, feedback refers to a subsystem process that helps to monitor, control, and validate an information system's overall performance. Cybernetic theory emphasizes the role of *feedback* as a way to maintain the system. Feedback is a core process found in most forms of intelligent networking. There are different kinds of feedback, including verification feedback which indicates whether the system is working properly. An iTunes music purchase or an Amazon.com book order, for example, provides a method of verification feedback, whereby, the consumer knows that the said purchase order and payment was correctly received. Another kind of feedback is called *corrective feedback* which helps to maintain the proper functioning of the system. Both wired and wireless systems of telephone communication are equipped with test and measurement equipment that are designed to provide immediate feedback when and if a certain part of the network goes down. Test and measurement is an essential diagnostic tool used in the routine maintenance of any intelligent network system.

Critical Infrastructure and Disaster Recovery. The principle of redundancy is at the heart of all critical infrastructure systems including, electrical power, transportation, finance, military defense and government services. Consider what would happen if the financial record-keeping at American Express was suddenly and irretrievably lost. The enormity of accurately recreating the lost data would fully destabilize the company and have a cascading effect on the world's financial markets. Hence the term, *critical infrastructure.* Select examples of intelligent networking and critical infrastructure can be seen in Table 1.

Table 1.

Select Examples of Intelligent Networking and Critical Infrastructure

- Banking and financial record keeping.
- Infectious Disease and FBI criminal surveillance data bases.
- Nuclear reactor and power grid operation and maintenance.
- Airport traffic control.
- Broadcasting and cable television transmission.
- International business and supply chain management / operations.
- University and student record keeping.
- Bridge, tunnel and highway operation and maintenance.
- Cellular telephone switching and routing of calls.
- Hospitals and medical record keeping.
- Internet email and electronic commerce data transmission.

All critical infrastructure networks require a plan for duplicating computer operations (i.e., redundancy) after a catastrophe occurs, such as a fire or earthquake. It includes routine off-site backup as well as a procedure for activating vital information systems in a new location. The lessons of 9/11 and Hurricane Katrina demonstrated the importance of redundancy and the challenges of disaster recovery. Those companies that did not have disaster recovery systems had enormous difficulty in recreating their vital network and information infrastructure.

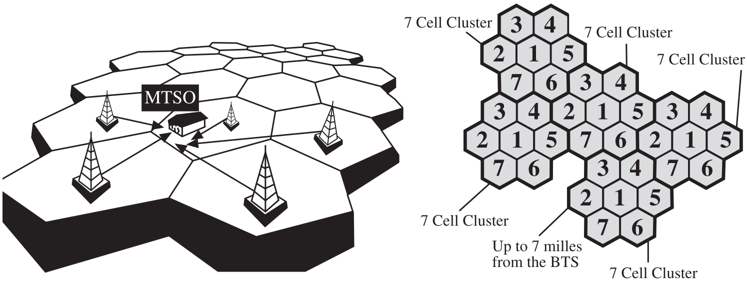
2.6. Adaptation

The term *adaptation* is central to biology, particularly evolutionary biology. The ability to adapt enables living organisms to cope with environmental stresses and pressures. Adaptation is part of the natural selection process and increases the survival capability of the person or animal. Adaptation can be structural, behavioral or physiological. Structural adaptation refers to physical body elements that help an organism to survive in its natural habitat (e.g., skin color, shape etc.). Behavioral adaptations are the different ways a particular organism behaves to survive in its natural habitat (e.g., sensitivity to impending danger). Physiological adaptations are systems present in an organism that allow it to perform certain biochemical reactions (e.g., sweating, digestion, etc.) (Holland, 1995). Adaptation, in a telecommunications context, refers to an information system that possesses self-correcting features, including the ability to monitor, react and adjust to changes in the environment. A simple example is a computer system that utilizes a type of virus protection software. As soon as the network system senses a potential virus, it automatically triggers a firewall protection to prevent the system from being corrupted.

Adaptation and Cellular Telephone Networks. A cellular telephone system is designed to service customers within a specified geographical area, known as a Cellular Geographic Service Area (CGSA). The CGSA is designed as an interlocking grid of cell sites (or coverage areas). The CGSA is often visually depicted as a series of hexagonal zones or circles. Each cell has its own base transceiver station (BTS) and a dedicated set of over-the-air frequencies. The actual cell size depends on population density (including expected number of users), physical terrain and traffic. The Mobile Telephone Switching Office (MTSO) oversees the primary switching and control functions for the cellular system. Each BTS is connected via landline to the MTSO. (See Figure 7.) The MTSO is designed to interface with the public switched telephone network.

Figure 7.

Cell Sites and BTS Configuration



Source: R. Gershon, 2009

The Principle of Frequency Reuse. Cellular telephone systems are organized into cell clusters. A cluster is a group of cells. Each of the seven numeric cells are assigned a bloc of frequencies that can only be used within that designated cell. The clusters are then repeated over and over again to form the entire CGSA. Cellular telephony operates on the principle of frequency reuse in nonadjacent cells; that is, users can share the same set of frequencies in nonadjacent cells without causing interference. One of the principle advantages of cellular telephony is the ability to reuse the same set of frequencies over and over again thus optimizing spectrum efficiency and avoiding co-channel interference (Gershon, 2009).[6]

Monitoring and Adaptation. As a moving vehicle passes from one cell to another, the system must be able to determine the location of the moving vehicle and automatically switch to an available frequency as it enters the new cell. In order to accomplish this, the BTS monitors the calls in progress and can sense the signal strength of the mobile units in their own areas as well as adjoining cells. The results are sent to the

6 The principle of frequency reuse is not unique to the business of cellular telephony. Radio and television stations effectively share the same block of frequencies across the U.S. with enough space in between in order to ensure efficient spectrum use and to avoid co-channel interference.

MTSO, which determines when the telephone call should be handed off upon entering a new cell site (Jones et. al., 2009; Louis, 2000). The ability to monitor and adapt to a moving vehicle is based on a prescribed set of programmed algorithms. The changeover (or handoff) must be smooth and without disruption to the telephone call.

3. System Processes

A process refers to the dynamic interplay and reactions between a set of system structures. The interaction between one or more of the said structures working together results in a system process. In the ITS model, we have identified two system structures. They include: 1) network holism and 2) permeability.

3.1. Network Holism

Collectively, the six system structures thus described contribute to a sense of network holism; whereby, the overall system design has greatly expanded and improved in value over time (Monge & Contractor, 2003). Monge et. al. (2008) would later rework the same argument and refer to it as the principle of network evolution. The public switched telephone network, for example, has improved in value from a system once designed for voice communication to one that fully supports a variety of enhanced information services. Similarly, cable television has moved well beyond its Community Antenna Television (CATV) origins as a purveyor of improved television reception to a modern day information system capable of delivering hundreds of video television channels as well as HDTV, high-speed Internet access and cable telephony (Parsons, 2008).

As Noll (1997) points out, the combination of telephone, cable and satellite communication networks provide the structural basis for today's information economy.

> ... [the real secret] is that much of the superhighway is already here and has been developing and evolving over the past 100 years. It is today's network of networks comprised of the public switched telephone network, the coaxial cable of CATV, communication satellites and packet switched networks for data communication... The public telephone network goes everywhere and is essential to business in today's information economy (p. 167).

HBO and Satellite/Cable Networking. Cable television distributes broadcast and satellite delivered programming by means of coaxial and/or fiber optic cable to people's homes. Cable television (also called community antenna television or CATV) was first developed in the late 1940's in communities unable to receive conventional broadcast television signals due to distance or geographic factors. The real move to modern cable television began on November 8, 1972, when a fledgling company named Home Box Office (HBO) began supplying movies to 365 subscribers on the Service Electric Cable TV system in Wilkes Barre, Pennsylvania (Gershon & Wirth, 1993).

From the beginning, HBO developed two strategies that helped to promote its rapid growth and development. First, HBO introduced the principle of premium television. Specifically, HBO achieved what no other television program provider had accomplished to date; namely, getting people to pay for television. What HBO did was change public perception about the nature of television entertainment. HBO offered a unique innovative service that emphasized recently released movies and other specialized entertainment. While HBO was not the first company to introduce a monthly per channel fee service, they were the first to make it work successfully. Thus marked the beginning of premium television entertainment (Parsons, 2008, 2003; Mullen, 2003).

Second, HBO utilized microwave and later satellite communications for the transmission of programming. Prior to HBO, there was no precedent for the extensive use of satellite delivered programming in the U.S. HBO's 1975 decision to use satellite communication demonstrated the feasibility of using satellites to deliver television programming to cable operating systems. Satellite communication provides an efficient means of reaching isolated places on the earth and are considerably less expensive than terrestrial communication links for wide area point-to-multipoint broadcast applications. Satellite communications offers a distinct economies scale. Cost bears no relationship to the distance involved and/or to the number of users. The same satellite can feed one or a thousand earth stations as long as they fall within the same footprint (or area of coverage). (See Figure 8.) The development of the satellite/cable interface set into motion the principle of *cable networking;* that is, television programming designed exclusively for cable operating systems (Parsons, 2003; Gershon & Wirth, 1993). It would usher in a whole new era of cable programmers that were equally capable of leasing satellite time and delivering their programs directly to cable operating systems, including: WTBS, 1976; ESPN, 1979; CNN, 1980; and MTV, 1981.

Figure 8.

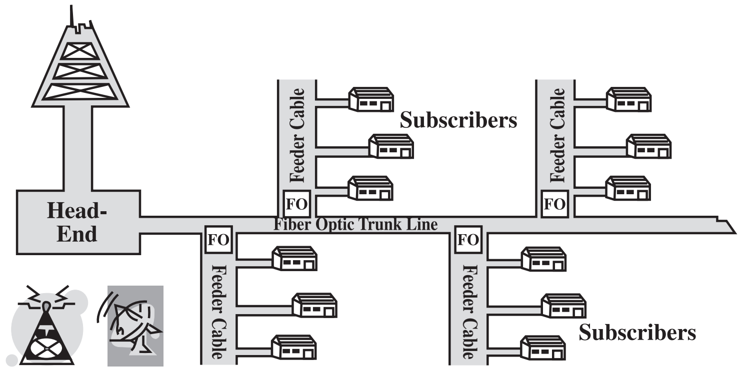
The Satellite / Cable Network Interface

Source: R. Gershon, 2011

Cable Television and Broadband Delivery. Cable television distributes broadcast and satellite delivered programming by means of coaxial and/or fiber optic cable to people's homes. Cable television (also called community antenna television or CATV) was first developed in the late 1940's in communities unable to receive conventional broadcast television signals due to distance or geographic factors. Today, cable television has become much more than a conveyor of television entertainment. Cable television has become the all essential broadband link into people's homes, thus enabling high-speed Internet access, cable telephony and energy monitoring systems. During the mid-1990s, the technical capabilities of cable operating systems have been greatly enhanced with the integration of fiber optic cable. The physical design of today's cable operating systems has evolved into hybrid-fiber coax (HFC) structure.[7] This can be seen in Figure 9.

Figure 9.

Cable Television HFC Network Architecture



Source: Chan, Chin Bong, 2009

The cable television industry is currently undergoing a major redefinition as to its core business. While television entertainment will continue to be the main engine that drives cable television forward, the very nature of cable services will undergo a profound change (Yassini, 2004). The future is also about smart cities and the cable industry's broadband delivery network as a purveyor of enhanced information services, including high speed Internet access, high-definition television, telephone communication, home security and energy monitoring to name only a few. In a multichannel digital universe, the

7 In a modern HFC cable plant, the trunk cables and amplifiers are replaced by fiber optic cable that runs directly from the headend point to an optical node in a neighborhood. The node converts the optical signal into an RF signal which is then passed on to end user's home via coaxial cable. Optical nodes are spaced to serve a neighborhood with 500 to 1000 homes. Another important benefit of the HFC architecture is that it enables the user to engage in reliable two-way interactive communication with the cable headend point, thus making possible high speed Internet access, enhanced video on demand etc.

origins of entertainment, information and utility based services will become less distinguishable. The future of electronic media will give new meaning to the term "television programming."

Google and Internet Search Capability. The success of the Internet today is due in large measure to a combination of factors, including hypertext linking, improved website design and powerful search engines. Search engines are primarily software tools that help the user perform key word searches and locate specific information throughout numerous Internet host sites. Search engines are to the organization of content what the HTML protocol is to Internet navigation. Search (and search engines) are the most common activity on the Web because people go on-line with a purpose. The user actively seeks out the content that is displayed on his/her screen.

Google Inc. is the world's preeminent search engine and was founded by Larry Page and Sergey Brin in 1998. From its very beginning, one of Google's stated missions was to organize the world's information. This would require a very powerful intelligent network (or set of networks) to accomplish this goal. The power and networking capability of the Google search engine has proven highly adaptive and grown exponentially over time. The ever increasing amount of data now generates its own unique networking effect (i.e., network evolution) (Autletta, 2009; Monge et. al., 2008). There is an automatic self-learning quality that is built into the system that engenders the development of other Google software products and services (e.g., Google key word search, G-Mail, Google Maps, Google Earth etc.). The more people use the Google search engine, the more powerful the network becomes. This is at the heart of network evolution. Over time, the Google search engine network has become greater than the sum of its parts.

3.2. Permeability

A second important network process is permeability which allows information to flow in and out of the system or organization. Intelligent networks, by definition, presuppose permeable boundaries; that is, structured entry points that allow users to access and contribute to the overall system design. The level of permeability varies according to the openness of the system. The biological equivalent would be the human body's ability to interface with the external environment, (e.g., breathing, eating, learning). The intelligent network must adhere to an internal logic (i.e., system protocols) while having the capacity to grow and develop. Nowhere is this more evident than in the internal logic structure and accessibility of the Internet. Two of the more important system features that facilitate permeability can be seen in the area of protocol design, including TCP/IP and HTML.[8] Similarly, open source software such as the Linux operating system speaks to the importance of permeability by enabling source code to be made available to all would be software designers as well as the aggregate products that might result.

The Permeability Predicament. Today, the Internet has rapidly grown in size and complexity due to the many contributions of its users, including powerful search engines, unique web site design, aggregation of content and electronic commerce to name only a few. In sum, the Internet is made better by the users of the system and the contributions they make via critical gateway points. The principle of permeability is central to this discussion since the Internet must allow easy access points for its users (e.g., personal computers, smart phones, E-Readers etc.). At the same time, permeability also means opening up the system to any

8 *TCP/IP Communication Protocol.* During the beginning stages of the original Department of Defense ARPA Network (forerunner of today's Internet), the incompatibility of computers from different vendors was a major problem that limited the scope and range of what the network could do. What was needed was a common communication protocol that could cut across various platforms and vendor equipment. To that end, the TCP/IP (Transmission Control Protocol / Internet Protocol) was adopted by ARPA (and later the Internet) for use by all the interconnecting nodes.

HTML Communication Protocol. As the popularity of the Internet increased, newcomers often found the arcane navigational commands difficult to use. Such would-be users had to master a complex set of computer commands and procedures before they could access the Internet. In 1989, Tim Berners-Lee of CERN, a Swiss Physics Lab, developed a navigational protocol for the Internet and distributed the program for free. This protocol was based on the principle of Hypertext (or non-linear text) which is the foundation of multimedia computing (Berners-Lee, 1999). HTML (Hyper Text Markup Language) protocol was used to interlink documents and servers to each other. The simplicity of its design and ease of use has greatly contributed to the Internet's exponential growth and worldwide popularity.

number of unwanted influences and outcomes. I call this the permeability predicament. From a systems theory perspective, the biological equivalent is the human body's susceptibility to various kinds of colds and viruses. What are some of the unwanted influences that affect network design and critical infrastructure? Such examples might include privacy loss and network security threats.

Privacy Loss. One of the unintended consequence of intelligent networking is the loss of individual privacy. Rapid advancements in computer and Internet technology have taken individual record keeping out of the control of the private citizen. Intelligent networking enables both government and private sector organizations to maintain enormous data bases containing information related to professional, financial and criminal conduct. The implications for such things as government surveillance, employee monitoring and direct marketing are enormous. The public has come to realize that both government and private sector organizations have a strong interest in knowing more about the private lives and shopping habits of ordinary citizens (Myers, et. al., 2008; Han & Kamber, 2006; Kruger, 2005; Gutwirth, 2002; Fischer-Hubner, 1998; Splichal, 1996; Samoriski et. al., 1996; Hausman, 1994). The problem has to do with how such information is gathered and used. Issues pertaining to privacy loss fall into four broad categories: 1) Information gathering, 2) Information storage, 3) Information analysis and 4) Information distribution.

The collection of personal information is not a new idea. But advancements in network surveillance and data mining techniques makes information gathering, analysis and distribution much easier. In particular, are issues pertaining to data mining which involves the process of extracting human tendencies or recognizable patterns based on information available in various kinds of data bases. Data mining has become an increasingly important tool used by modern business to transform data into business intelligence (Han, J. & Kamber M., 2006). Data mining has become especially important for those companies engaged in Internet marketing where the emphasis is on building customer relationships and developing so called "targeted ads." Data mining has proven to be a two edged sword. On the one hand, data mining makes it possible for companies like Amazon to remember one's past book orders and make purchase suggestions. Similarly, American Express is sometimes able to determine that a user's credit card was stolen because a recent purchase doesn't fit the person's general buying patterns. The problem occurs when the information being stored or transmitted is wrong (Stein, 2011). The individual might find himself/herself being put under surveillance by local law enforcement or being denied a mortgage loan because of faulty data analysis.

Part of the problem has to do with the fact that personal information turns up in variety of data bases ranging from Facebook entries to E-commerce purchase orders. EC companies are routinely able to track the cyber movements of Internet uses regardless of whether the Web is accessed via computer, smart phone or E-reader. The information is then organized, categorized and sold to variety of information marketers. A second problem has to do with the fact that regulatory oversight has not been able to keep pace with technological change; especially where commercial interests in data collection often compete with individual privacy concerns (Gutwirth, 2002). While the Internet has emerged as the all important information tool, it sometimes lacks essential features of confidentiality and is routinely threatened by breaches in security (Fischer-Hubner, 1998). At issue, is the right to privacy versus technological efficiency. Nowhere is this more evident than in the passage of the USA Patriot Act in 2001.[9] In the final analysis, the desire for marketing efficiency and greater security is not without its social costs.

Network Security Issues. Critical infrastructure such as electrical power, banking and finance, transportation and government services run on information networks. A network security threat is generally understood to mean unlawful attacks against an intelligent network and the information contained in such networks. Such attacks are

9 In the aftermath of the September 11th, 2001 terrorist attack on the world trade center, the U.S. Congress passed the highly controversial USA Patriot Act. It was signed into law on October 26, 2001. The Patriot Act gives Federal law enforcement officials broad powers to wiretap and monitor Internet activity for the purpose of ferreting out potential terrorist threats. The Patriot Act eases restrictions on foreign intelligence gathering by permitting surveillance of telephone and email communication as well as inspecting individual medical and financial records. Part of the new surveillance strategy also includes data mining (See "Privacy in the Age of Terror," 2001).

directed against critical infrastructure resulting in the destabilization of a network and/or violence against persons and property (Clayton, 2011). The goal is to intimidate an organization in furtherance of a political, military or social objective. Clark (2010) coins the term *cyberwarriors* to describe a new class of military actions taken by a country to penetrate another nation's computer networks for the purpose of intelligence gathering and/or causing severe disruption.

The continuing evolution in large open networks has brought about a corresponding increase in security threats. Not only have cyberwarriors discovered more vulnerabilities, but the tools used and technical knowledge to penetrate such networks have become simpler (i.e., permeability predicament). In general, there are four kinds of network security threats. They include: 1) Unspecified, 2) Structured, 3) Internal 4) Denial of service. (See Table 2.).

New computer viruses appear daily on both simple and complex systems alike. A computer virus can be defined as a program or piece of executable code that has the ability to replicate itself. The code or list of instructions attaches itself to an executable file like Microsoft's *Outlook Explorer* email program or social networking site, *Facebook.*

Table 2.

Four Types of Network Security Threats

- **Unspecified Threats**: These threats primarily consist of random hackers using various tools such as password crackers, credit card number generators, malicious telephone and email scripts in order to access a user's account or obtain proprietary information.
- **Structured Threats**: These threats are more closely associated with Industrial or government espionage. Such efforts are more deliberate in design and planning. The goal is to access proprietary information.
- **Internal Threats**: These threats are typically initiated from a disgruntled employee. The internal threat poses a serious problem to an organization given the fact that the said employee may have direct access (i.e. network clearance) to sensitive information.
- **Denial of Service Threats**: These threats involve so called "cyber-terrorists" whose goal is to disrupt or destabilize a proprietary network as part of a personal, political and/or social cause.

Source: Adapted from R. Ducharme, 2004

It then spreads as files are copied and sent from person to person. The computer virus has the ability to hide in the system undetected for days or months until the right set of conditions are set into place. The right conditions can be a certain date or opening up a select email file; at which time, the virus is activated. The essential element of any computer virus is the Trojan or trapdoor (Clark, 2010). In computer parlance, a Trojan appears to be one thing but does something else. It feigns a kind of ruse, thereby, allowing the unauthorized user a back door entrance into the system. Afterwards, the Trojan can seize, change or eliminate the user's data altogether (Szor, 2005).

The success of the infamous 2000 "Love Bug" virus, for example, depended on Microsoft's *Outlook Explorer* email program which acted as the carrier and five lines of embedded code that created an email message with the subject line "I LOVE YOU." Once opened, the worm attached itself to every name in the victim's email address book When the user saw the subject tag line, *I love you,* curiosity got the better part of reason and the victim paid a high price for carelessly downloading the attachment. The Love Bug virus is an example of cyber-terrorism that struck more than 45 million computers worldwide and caused an estimated $10 billion worth of damages (Dibbel, 2001). In the final analysis, the kind of computer virus may say as much about the author as it does about the virus itself.

> As a form of writing, the computer virus is elaborate, inscrutable, abstract… Like their close cousins the graffiti artists; virus writers want above all else for their names to be known (Dibbel, 2001, pp. 46-47).

4. The 8 System Outcomes of Intelligent Networks (Part II.)

Predicting the future as any Wall Street broker (or technology futurist) can tell you is a risky business. One of the underlying assumptions in technical forecasting is the ability to recognize the natural patterns and trajectories of technology development over time. A systems theory approach would argue that if you want to understand the future, one needs to understand past and present design practices. Such design practices can be thought of as innovation links that when strung together along a technology continuum will guide us towards understanding the future.

In Part II. of this monograph, we consider the following question. What are some of the social and technological consequences of intelligent networks on people and organizations? Specifically, how do intelligent networks affect both human and organizational behavior within the context of international business communication?

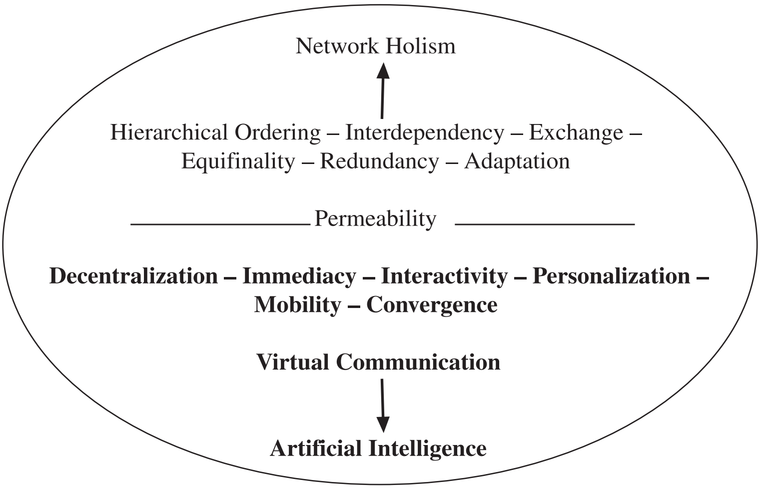
We start with the fact that intelligent networks do not operate in a vacuum. Rather, the use of intelligent networks are an integral part of a greater human and organizational decision-making process. One problem in measuring the consequences of technological innovation is untangling cause-and-effect relationships. As Rogers (1995) points out, once a primary innovation has been fully diffused into a system, there is no going backwards. Basic patterns of social and organizational behavior are forever changed. Moreover, the systemic consequences are both direct and indirect. As Rogers (1995) observes,

> Ideally, we should only measure the consequences that are exclusively the outcome of an innovation, the changes that would have occurred if the innovation had not been introduced. But many important consequences are unanticipated and indirect (p. 412).

The intelligent network can be characterized by eight system outcomes. They include: 1) Decentralization, 2) Immediacy, 3) Interactivity, 4) Personalization 5) Mobility 6) Convergence, 7) Virtual Communication and 8) Artificial Intelligence. Figure 10. illustrates the second half the ITS model as a way to explain the systemic consequences of intelligent networking.

Figure 10.

The Information & Telecommunications Systems Model Eight System Outcomes



Source: R. Gershon, 2011

4.1. The Industrial Age Gives Rise to the Knowledge Economy

The industrial age saw the formation of major industries throughout the world. It was a time of great capital investment where much was spent on the creation of national infrastructure be it, steel plants, railroads, telephone communication, automobiles etc. The so-called captains of industry (i.e. Carnegie, Vanderbuilt, Rockefeller etc.) were tough, no nonsense type business men who demonstrated a willingness to be aggressive (and at time ruthless) in order to make their business ventures succeed. Writers like Toffler (1980) suggest that the character of the industrial age was forged by several guiding principles, including 1) centralization, 2) synchronization and 3) standardization. Centralization is at the heart of industrialized thinking. It presumes that management is the central organizer, operating in a top-down fashion, located in a central facility. The principle of centralization gave rise to so-called "industrial centers" (i.e., Detroit, car manufacturing; Pittsburgh, steel plants and New York City, finance and investment). Standardization presumes that a factory's output is maximized when large quantities of a product can be produced identically for the least cost. The principle of standardization hastened the development of such things as standardized car assembly, standardized letter routing (i.e., zip codes), standardized food etc. It follows that if work is centralized and standardized, efficiency requires that all participants be at the same place at the same time. The assembly line cannot function properly if one person or group of workers delays the process. Hence the principle of synchronization. As the cost of equipment rose and the demand for higher output increased, the issue of time became ever more critical thus increasing the need for clocks, start times and a greater sense of punctuality.

4.2. The Knowledge Economy and Intelligent Networking

Social / scientific terms like *knowledge economy, information society,* or *digital age* do not lend themselves to precise definition or meaning. What is beyond dispute, however, is the role of intelligent networks in helping to advance the transmission, storage and display of media and information content within the context of international business communication. The knowledge economy involves the full integration of transnational business, nation-states and technologies operating at high speed. It is a global economy that is being driven by free-market capitalism and the power of intelligent networking (Friedman, 2005). The knowledge economy stands in marked contrast to many of the basic patterns and assumptions of the industrial age. The once highly centralized business has given way to the transnational organization that operates in multiple countries throughout the world (Gershon, 2006). Instead of time and communication being highly synchronized, today's working professional lives in a digital world of asynchronous and virtual communication that allows for the international collaboration of projects regardless of time zones, geographical borders and physical space (Tapscott, 1996). We have entered the era of global virtual teams where work is produced across multiple time zones and geographic spaces. The knowledge economy has become a society of networks. We don't talk with people; we network with them (Noam, 2001).

4.3. Decentralization

Since the late 1940's, there has been a slow, paradigmatic shift away from top-heavy, centralized decision-making toward decentralization where greater responsibility has been given to the regional manager for routine decisions. The combination of computer and telecommunications technology has had a major effect on the spatial reorganization of activity for the transnational organization (O'Hara-Devereaux, & Johansen, 1994; Huber, 1990; Hiltz & Turoff, 1981). Time and distance factors have become less important in determining where a company chooses to locate today (Noam, 2001; Poole, 1990).

The Transnational Corporation. The transnational corporation (TNC) is a nationally based company with overseas operations in two or more countries. Strategic decision-making and the allocation of resources are predicated upon economic goals and efficiencies with little regard to national boundaries. The TNC has become a salient feature of our present day global economic landscape (Gershon, 2006, 1997; Compaine & Gomery, 2000, Albarran & Chan-Olmsted, 1998). Through a process of foreign direct investment, the TNC relies on the use of advanced information technology as a way to stay globally connected. At the heart of transnational business operations is the importance of *organizational control* which describes the need for a system-wide method for managing, tracking and evaluating a TNC's domestic and foreign operations. Organizational control provides the ability to centralize decision-making, thereby, giving senior management the tools necessary to plan, allocate resources and take corrective action in order to meet changing international conditions. The intelligent network has become the vital nervous system enabling the TNCs multiple divisions and subunits to function independently while being part of a larger communication network. As a consequence, traditional divisions and departmental hierarchies tend to be flatter, thereby, permitting direct communication between and among organizational players (Bartlett & Ghoshal, 1998).

Global Virtual Teams. International project teams are the key to smart, flexible and cost effective organizations. A global virtual team represents working professionals from a TNC's worldwide operations assembled together on an as-needed basis for the length of a project assignment. They are staffed by working professionals from different countries (Martins et. al., 2004; Maznevski & Chudoba, 2000; Lipnack & Stamps, 1997). More and more, the transnational organization use global virtual teams as part of a larger effort to share international expertise across the entire TNC. The global virtual team offers up certain distinct advantages, including shared access to information, collaborative research and design work, reduced travel costs etc.

Advancements in communication technology and intelligent networking have elevated the principle of teamwork to a whole new level in terms of collaborative effort (DeSanctis et. al., 2000). At the same time, global virtual teams brings with it a unique set of challenges. Foremost, are issues pertaining to trust involving differences of culture, geographic dislocation, complex problem solving and the effective collaboration of ideas. Specifically, how does one creatively engage a group of people that one has never physically met and trusting that everyone is equal to the task? (Evaristo, 2003; Potter & Balthazard, 2002; Jarvenpaa, et. al., 1998; Handy, 1995). The global virtual team presents both opportunities and challenges in terms of utilizing the principles of virtual communication in tandem with intelligent networks.

4.4. Immediacy

Telecommunications has collapsed the time and distance factors that once separated nations, people and business organizations. Communication is instantaneous. The combination of high-speed voice, data and video communication allows both large and small organizations the ability to coordinate the production, marketing and delivery of products on a worldwide basis. The full impact of immediacy and the need for timely information can be seen in the area of supply chain management and business process.

***Supply Chain Management and Business Process*.** Supply chain management (SCM) is a complex business model that takes into consideration the entire set of linking steps necessary to produce and deliver a product to the end consumer. SCM has two distinct and equally important parts: 1) the philosophy and 2) the methodology. SCM philosophy is grounded in the belief that everyone involved in the supply chain is both a supplier and customer and requires access to timely, up-to-date information. The goal is to optimize organizational efficiency and to meet the needs of any and all suppliers and customers. SCM forces companies to move away from an organizational structure designed around functional silos toward one designed around the end-to-end flow of business processes. The principle of SCM is dedicated to the proposition that time and immediacy are the most valuable of business resources. A well designed SCM system requires the ability to give real time information to an extended network of suppliers, manufacturers, distributors and retailers (Tarn et. al., 2002; Zheng et. al., 2000). SCM makes it possible for companies like Dell Computers to engage in just-in-time manufacturing and Netflix Inc. to offer direct-to-home DVD film delivery.

***Just-in-Time Manufacturing*.** Most companies have access to excellent hardware and software capability that enables them to operate in a global business environment. The distinguishing factor often centers on speed and turn around time. Faster product cycles and the ability to train and produce worldwide production teams have transnationalized the manufacturing and distribution process. It is the ability to apply time-based competitive strategies at the global level that enables the TNC to manage inventories across borders. At the heart of time base competitiveness is just-in-time manufacturing which allows a company to meet an order in the least amount of time. Just-in-time manufacturing relies on the use of supply chain management and enterprise resource planning systems (ERP) for the purpose of tracking customer orders. ERP tends to focus on internal business processes within the boundaries of a single organization. Both SCM and ERP systems are dedicated to the proposition that time and immediacy are the most valuable of business resources. As Goldhar & Lei (1991) point out,

> We are now in a global competitive environment in which flexibility, responsiveness and low cost / low volume manufacturing skills will determine the sustainability of competitive advantage. The strategic picture is clear... [Today's manufacturers] must also manage that most precious of all resources: time... (p. 38).

Dell Computers and Just-in-Time Manufacturing. The company known as Dell Computers was established by Michael Dell in 1984 and has grown to become one of the world's preeminent manufacturers of desktop and laptop computers. Dell builds computers to customer order and specification using just-in-time manufacturing techniques. The company has built its reputation on direct sales delivery to the end consumer combined with strong customer support. Dell's business model is simple in concept, but very difficult to execute in practice (Kraemer & Dedrick, 2002).

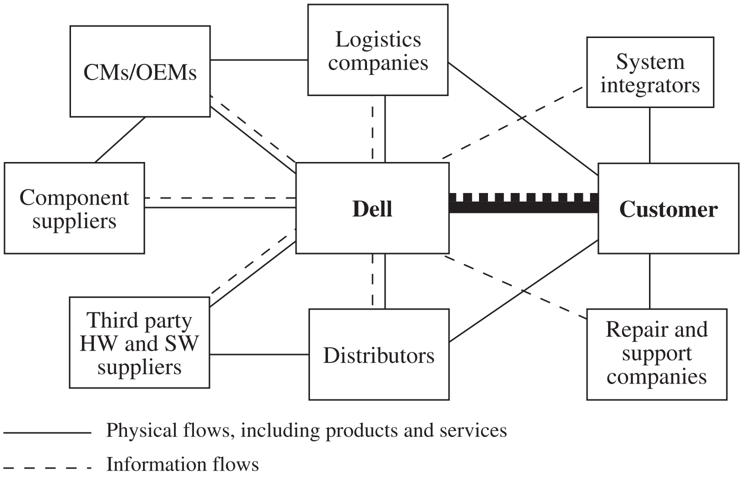
Michael Dell started out as a pre-med student at the University of Texas. Dell soon became fascinated by computers and created a small niche in the assembly and sale of PCs and PC components out of his dormitory room. Dell bought excess supplies at cost from IBM dealers which allowed him to resell the components at 10-15 % below the regular retail price. He then began to assemble and sell PC clones by purchasing retailers' surplus stock at cost and then upgrading the units with video cards, hard disks, and memory. Dell then sold the newly assembled IBM clones at 40% below the cost of an IBM PC (Thompson & Strickland, 2006). By April 1984, with sales reaching $80,000 a month, Dell dropped out of the university and formed a company called PCs Limited. The ability to sell directly to the end user at a discounted price proved to be a winning formula and by the end of 1986, sales had reached $33 million. PCs Limited was renamed Dell Computers in 1987 and the company soon opened its first set of international offices. From 1990 to 1993, Dell experimented with traditional retail distribution in hopes of faster growth, but soon realized that such methods were less profitable and refocused on direct sales. By 1996, Internet sales had taken off and the company realized that computer savvy shoppers preferred the convenience of custom ordering what they wanted directly from Dell and having it delivered to their door. During this time, Dell had become master innovators involving two important business processes. The first process was customization using a just-in-time manufacturing capability. Dell built computers to customer order and specification, thereby, eliminating excess inventory and the need for storage. The second important process was direct-to-consumer sales delivery thus avoiding costly investment in retail store infrastructure. It was process model that other computer manufacturers like HP and Gateway would later adopt (Fields, 2006).

Today, Dell has an international workforce of 35,000 employees located in 34 countries and three major regions of the world, including the Americas, Europe/the Middle East and Asia Pacific. Dell's selection of geographic location and production facilities has been largely driven by its foreign direct investment strategies, including foreign market growth potential and labor costs. Each of the three regional hub sites have their own headquarters and set of assembly plants. Because of Dell's build-to-order philosophy, Dell has evolved a highly sophisticated manufacturing and logistics capability. A global network of suppliers and contract manufacturers support each production facility. Instead of producing all the necessary components internally, Dell contracts with other manufacturers to produce subassembly parts, such as motherboards, microprocessors, monitors etc. Dell maintains control over the final assembly portion, paying particular attention to customized feature elements (Kraemer & Dedrick, 2002).

Dell's global inventory management system requires an efficient method of communication in order to meet customer demands and to ensure a ready supply of parts on hand to support various kinds of configuration requests. Over time, Dell has built a complex, global wide SCM / ERP systems that track information between suppliers, distributors, and other key component players that involve product manufacturing and support. In addition, Dell has established a specific network of suppliers and contract manufacturers to support each production facility. (See Figure 11.).

Figure 11.

Dell's Supply Chain Management / ERP System



Source: Kraemer & Dedrick, 2002.

4.5. Interactivity

The principle of interactivity suggests the ability to engage in two-way communication ranging from E-commerce via the Internet to on-line video game systems. There are varying perspectives on the nature of interactivity. One body of research considers interactivity from the standpoint of the technology itself. Interactivity is a function of the medium (e.g., smart phones and voice activated "blue tooth" enabled steering consoles on automobiles) where the emphasis is on hardware and software device capability. The level of interactivity is judged according to three criteria: speed (how quickly the device responds to the user's commands); range, (the level of control permitted by the device); and mapping (the degree of correspondence between a user's actions to control the device and how it responds to those actions) (Steuer, 1992).

A second body of research looks look at interactivity from the vantage point of the communication process itself. Interactivity resides in the perceptions and experiences of those who directly participate in the actual communication. This perspective is more closely associated with computer mediated communication. There is a strong social /psychological dimension. According to McMillan (2002), interactivity occurs at varying levels of engagement where the emphasis is on the communication of ideas as well as the shared meaning and experience of the communicant and his/her surroundings. The latter point holds particular importance when it comes to human computer interface design as well as virtual reality simulations.

Human Computer Interface Design. One application involving the principle of interactivity can be seen in the evolution of human computer interface design. In 1963, Douglas Engelbart of the Stanford Research Center pioneered the development of the computer mouse which was later advanced by the Xerox corporation in the 1970s. The computer mouse functions as a pointing device that detects and highlights text and visual displays on a two dimensional screen. The computer mouse frees the user to a large extent from using a keyboard. It was a simple but masterful form of ergonomic design that greatly improved the way in which people interfaced with computers.[10]

10. In 1967, Engelbart applied for and received a patent for a wooden shell with two metal wheels (computer mouse U.S. Patent No.3,541,541). The patent was issued in 1970. Engelbart described the patent as an "X-Y position indicator for a display system." The device was nicknamed a mouse because the tail (or connection cord) came out one end. The first integrated mouse that was shipped as a part of a computer and intended for personal computer use was the Xerox 8010 Start Information System in 1981.

Engelbart's research and design contribution demonstrated a systems theory perspective using the principles of co-evolution as it might apply to the use of technology. In biological terms, each party in a co-evolutionary relationship exerts synergistic pressure on the other, thereby affecting each other's evolution. The classic example are bees and the flowers they pollinate. Both have co-evolved so that each has become dependent on the other for survival. Engelbart reasoned that the state of knowledge and information display is only as good as the available technology to manage it. He thus set out to create an interface design that would be faster and more efficient in terms of manipulating information on a screen.

The development of the Graphic User Interface (GUI) icons by Xerox corporation and later Apple in the 1980s further advanced the cause of human-computer interface design. A GUI offers graphical icons, and visual indicators, as opposed to text based interfaces and/or typed command labels to fully represent the information and program selections available to a user. GUI has become a standard feature on all Apple, Microsoft and Linux based operating systems. Touch screen technology came along in the 1980s and 1990s and was used in a variety of communication devices including automated banking and tourist attractions, including ATM machines and information kiosks. Direct touch is interactivity in a very pure, highly tactile sense. Later, touch screen technology would be incorporated into the design of various kind of digital devices, including laptop computers, smart phones, global positioning "navigation" systems (GPS) and electronic readers (e.g., Apple, *iPad* and Amazon, *Kindle).*

The next and evolving generation of interface software involves speech recognition systems evidenced by the work being done in both the military and healthcare fields. Speech recognition software allows the user to dictate into a computer or hand held recorder thus enabling an electronic text version of the spoken words to appear on the users' screen. Each successive generation requires less formatting of the software (e.g., identifying specialized words). Also, the software adapts to the user by keying in on select words and phrases and storing it in its internal memory. A variation on speech recognition systems are voice command systems using blue-tooth technology in cars.[11]

Virtual Reality is the consummate form of data modeling and simulation. While a videogame is played on a two dimensional screen, virtual reality (VR) invites the user to physically enter into a three dimensional space and engage one's surroundings directly. The simulated environment can be realistic (e.g., flight simulation, VR surgery etc.) or imagined (walking on the planet, Mars). There is a shared common space involving action and reaction to one's movements. This is interactivity in its highest form. In the television / film series, *Star Trek: The Next Generation,* science fiction writer/producer Rick Berman illustrates such an environment in the program's depiction of the holodeck.[12]

Virtual reality combines many of the feature elements found in intelligent networking, including interactivity, mobility, virtual communication as well as artificial intelligence. A properly constructed VR space elicits both physiological as well as psychological reactions on the part of the user (Biocca & Levy, 1995). VR can elicit changes in perceptual experiences on the part of the individual based on the realism of the simulation. A highly realistic simulation involving a sudden and dramatic increase in speed, or sense of falling, can stimulate sensory-motor reactions on the part of the individual such as fear, nervousness, increased heart rate, etc. (Slater

11. Bluetooth represents an industry standard for personal wireless communication devices; referred to as personal area networks. Bluetooth provides a way to connect and exchange information between Bluetooth compatible devices such as PCs and laptop computers, cellular telephones, printers and video game consoles using unlicensed short-range radio frequencies (i.e., typically 1-100 meters). Bluetooth simplifies the discovery and setup of services between devices. Many of today's cars are equipped with Bluetooth readiness. This allows the user to receive a call on his/her cell phone, while enabling the call to be played through the vehicle's speakers.

12. A holodeck is a virtual reality facility located on a starship or starbase. The holodeck was first seen in the pilot episode of Star Trek: The Next Generation, "Encounter at Farpoint." In later episodes, the holodeck is used for research, combat training as well as entertainment. The holodeck is depicted as an enclosed room in which objects and people are simulated.

& Usoh, 1995). Virtual reality represents a unique form of interaction between humans and machines.

Central to virtual reality design is the human / computer interface. The quality, color and realism of the simulated environment begins with the use of a head mounted display. A second feature element is the tracking system, which relays the user's position and orientation to the computer. In a virtual environment, the visual display must change in accordance to the user's point of view and movement (Heudin, 1999). The third feature element is in the area of haptic design. A VR environment must give the user a realistic sense of physical touch. There must be action and reaction to the user's sense of touch and movement. Today, VR technology is being used in a variety of settings, including aerospace, military defense and medicine. Writers like Hillis (1999) suggest that as the quality of the simulation becomes more realistic, it becomes increasingly difficult to distinguish between mediated reality and the actual process or event.[13]

4.6. Personalization

As de Sola Poole (1990) once wrote, the mass media revolution is undergoing a reversal; "instead of identical messages being disseminated to millions of people, intelligent networking permits the adaptation of electronic messaging to the specialized or unique needs of individuals."(p. 8). Customization has become a standard feature of the digital age. From iPods to digital video recorders, consumers now have the ability to compile, edit and customize the media they use (Napoli, 2001).

The Internet and Micromarketing. Broadcast television and large circulation newspapers are no longer seen as the primary or best means of advertising to smaller niche audiences. More and more companies are using the Internet to communicate and personalize the information

13. During the Persian Gulf and Iraq Wars, for example, U.S. pilots commented on how eerily similar an actual bombing run was to their flight simulation exercises.

exchange between the advertiser (or seller) and the end consumer. We are witnessing the demassification of media and entertainment product made possible by the Internet and electronic commerce trends. For marketers, the steady shift from mass to micromarketing is being driven by a combination of technological change as well as strategic opportunity (Chan Olmsted, 2006; Dimmick, 2003).

Personalized marketing involves knowing more about the particular interests and buying habits of one's customers. Advanced portal software permits users to receive personalized information in the form of specialized content (i.e., daily news updates, stock reports, weather, book recommendations etc.). Amazon.com, for example, routinely sends out information updates to its customers notifying them of newly published books based on information obtained and analyzed from previous purchasing selections. Similarly, DVD rental service Netflix utilizes the power of the Internet to promote a proprietary software recommendation system. The software recommendation system makes suggestions of other films that the consumer might like based on past selections and a brief evaluation that the subscriber is asked to fill out. The proprietary software recommendation system has the added benefit of stimulating demand for lesser known movies and taking the pressure off recently released feature films where demand sometimes outstrips availability. The focus on lesser known films is in keeping with Anderson's (2006) "long tail" principle.[14] The Internet's interactive capability changes the basic relationship between the individual and media, challenging marketers to shift their emphasis from persuasion sales to relationship building (Chan-Olmsted, 2006).

14. *The Long Tail* principle was first used by Chris Anderson in an article written for *Wired* Magazine October 2004. The term later became the title for a book written by Anderson in 2006. The term describes the niche strategy of businesses, such as Amazon.com or Netflix, that sell a large number of unique items, in relatively small quantities. Such companies have learned the value of selling small volumes of hard-to-find items to a large number of customers. This stands in marked contrast to the blockbuster (or major hit) approach used by filmmakers and book publishers. The success of the Long Term principle is made possible by the Internet and advancements in electronic commerce.

The principle of personalization also reflects the principle of push vs. pull technology, whereby, traditional television is push technology (e.g., point-to-multipoint broadcasting), whereas, the Internet is a decidedly pull technology. The importance of personalized viewing options has not been lost on traditional broadcast and cable television programmers. Video services indigenous to the Internet; most notably, Netflix, Hulu and You Tube, have become immensely popular and both broadcast and cable programmers are examining alternative methods for distributing their programs via the Internet, through a combination of network owned and third-party controlled websites. Allowing viewers to select programs using Internet Protocol Television (IPTV) or Netflix dramatically reduces the cost to the television / film program service provider. While a cable operator has to incur the increased costs associated with the provision of new television programs as well as providing extra channel capacity; there is no corresponding increase in distribution costs for the online service provider (Wildman & Ting, 2009). In sum, videostreaming via the Internet poses the most significant challenge to the future of video-on-demand cable service.

***Netflix and Personalized Marketing*.** Netflix is an on-line subscription based DVD rental service. Netflix was founded by Reed Hastings in 1997. The story goes that Hastings found an overdue rental copy of Apollo 13 in his closet and was forced to pay $40 in late fees. The business that emerged from Hastings' frustration was a rental company that uses a combination of the Internet and the U.S. Postal Service to deliver DVDs to subscribers directly. Netflix is the quintessential example of process innovation and personalized marketing in action. Netflix offers the public a cost effective and easy to use EC system by which consumers can rent and return films (Shih et. al., HBS).

Netflix was conceived at a time when the home video industry was largely dominated by two major home video retail chains; *Blockbuster Video* and *Hollywood Video* as well as numerous "mom-and-pop" retail outlets. The challenge for Hastings was whether he wanted to duplicate the traditional bricks and mortar approach used by such companies as Blockbuster. The alternative was to utilize the power of the Internet for placing video rental orders and providing on-line customer service.

There are two issues that are central to the Netflix business model. The first is product inventory. Netflix has contracted with all major U.S. studios and select international studios for the rights to use their movie inventory as part of their program service. The second issue is delivery time which it considers to be a key measure of customer satisfaction. Netflix made the decision to partner with the U.S. Postal Service (USPS) to deliver DVDs to its on-line subscribers. DVDs are small and light, enabling inexpensive delivery and easy receipt by virtually all U.S. customers.

Neflix offers its customers a great value proposition; namely, unlimited DVDs for a fixed monthly price. In practical terms, the average consumer may only receive two to five DVDs in a week's time given the particular service plan as well as personal viewing habits. The general perception is that Neflix provides greater value to the consumer when compared to traditional video rental stores which charge by the individual DVD rental unit. Netflix offers consumers greater convenience in the form of "no late fees." The subscriber is free to hold on to a specific video as long he/she wants (E-Business Strategies, 2002). Second, Netflix has developed a highly sophisticated enterpriser resource planning system that enables the company to offer subscribers both good selection as well as fast turn around time. Netflix has harnessed the power of the Internet to create a virtual organization. The company maintains a set of centers that serve as hub sites for DVD collection, packaging and redistribution. The company adopted the easily recognizable red Netflix envelope and presorts all outgoing mail deliveries by zip code thus cutting down sorting time by the USPS (Shih, et. al., 2007).

Third, a big part of Netflix's success is the direct result of personalized marketing which involves knowing more about the particular interests and viewing habits of one's customers. Netflix fully utilizes a proprietary software recommendation system. The software recommendation system makes suggestions of other films that the consumer might like based on past selections and a brief evaluation that the subscriber is asked to fill out. The proprietary software recommendation system has the added benefit of stimulating demand for lesser known movies and taking the pressure off recently released feature films where demand sometimes outstrips availability.

Fourth, Netflix has adapted to changing technology by offering a *Watch Instantly* feature which enables subscribers (at no extra cost) to stream near-DVD quality movies and recorded television shows instantly to subscribers equipped with a computer and high speed Internet connectivity. What is interesting to note, is that the video streaming of movies is delivering in real time and in greater numbers what cable television has failed to achieve in terms of its highly touted video-on-demand system capability. As Netflix looks to the future, the *Watch Instantly* feature is being positioned to steadily replace the traditional delivery of DVDs by mail. Hastings has said on several occasions that Netflix's purpose is not to provide DVDs via the mail, but rather to allow for the best home video viewing for its customers.

4.7. Mobility

The principle of mobility suggests the idea that telephone and computer users should not be physically tied to a communication network. This becomes especially important for people whose personal lifestyle or professional work habits require greater flexibility of movement. Ubiquity is a subset principle and has to do with expanded network coverage. Cellular and wireless communication users need to be able to access the service anytime, anywhere. Location should never be an obstacle. The use of cellular phones in moving vehicles and restaurants, for example, is strongly linked to convenience and immediate access gratification (Leung & Wei, 2000).

Smart Phones. The digitalization of media and information technology has steadily transformed the cellular telephone into a multimedia "smart phone" device. Smart phone devices like the Apple *iPhone* and the Blackberry *Smartphone* emphasize the importance of blending voice and data applications with wireless Internet access. Feature elements include: 1) Personal Planner and Calendar, 2) Text Messaging, 3) Cell Phone Cameras, 4) Email, 5) Video streaming and display, 6) GPS Locator and 7) MP3 music player. For the user, this means everything from checking one's flight reservation to watching a sports video clip on one's phone. The goal of 4th generation (4G) wireless is to provide users with high-speed Internet utilizing a variety of wireless devices, including smart phones, laptop computers and E-readers. In particular, is the future of electronic readers (E-readers). Such devices will come to play an especially important role as print media publishers transmit entire newspapers, magazines and books to users equipped with wireless E-reader equipment. E-readers will help to define the future of print media by reinventing how information is physically delivered to the end user.

Wireless communication is a major force in helping to shape digital lifestyle. In the future, more and more emphasis will be placed on higher speed and throughput for the purpose of achieving mobility and greater Internet access. Of particular note is the future of WIMAX communication which represents the next generation in broadband wireless technology. WiMAX (Worldwide Interoperability for Microwave Access) is an IP based high-capacity wireless network that can fully support high speed Internet access at a range of up to 30 miles. Some observers have called it "broadband on the go." (Goggin, 2008). WIMAX technology will figure prominently in the future of city planning and design work.

4.8. Convergence

Convergence is the merging of previously distinct media to create entirely new forms of communication expression. For communication scholars, the word *convergence* is a fairly elastic term that has come to mean different things depending on time, application and context. There are a number of driving forces that focus public attention on the issue, including the digitalization of media and communication technology, changes in technology (most notably the Internet), business merger and acquisition activities, and the search for new market opportunities (Wirth, 2006; Yoffie, 1997). While the term convergence may be elastic, it shoulders an important responsibility in helping to explain the ramifications of technologies and business enterprises that are jointly linked together.

Digital Media and Convergence. Digital media is at the heart of today's communication revolution. Digital media represents the artistic convergence of various kinds of hardware and software design elements to create entirely new forms of communication expression. From electronic commerce (Amazon.com, Google) to music and video streaming (Apple iTunes, Pandora and Netflix), digital media has transformed the business of retail selling and personal lifestyle. The combination of the Apple iPod and iTunes media store, for example, has created the first sustainable music down-loading business model of its kind. It qualifies as both a new business model innovation as well as a business process innovation since it successfully takes advantage of MP3 software distribution technology.[15] It has redefined the way product software is distributed to the consumer.

Digital technology improves the quality and efficiency of switching, routing and storing of information. It increases the potential for manipulation and transformation of data. Digital technology makes it possible to achieve convergence between different electronic media forms, including voice, data and video communication. Convergence is at the heart of digital media design, including: 1) the Internet, 2) TV / Film animation, 3) music/video streaming, 4) DVD technology, 5) videogame systems and 5) High Definition Television (HDTV). The combination of electronics and software production can be blended to

15. The German company Fraunhofer-Gesellshaft is considered the principal developer of MP3 software technology and now licenses the patent rights for its use. The person most often associated with the development of MP3 software technology is Karl-Heinz Brandenburg who was a specialist in mathematics and electronics and had been researching methods for compressing music since 1977. Brandenburg is the Director of the Fraunhofer Institute for Digital Media Technology in Ilmenau, Germany. In several interviews, Brandenberg has said that the development of MP3 software technology was the work of at least a half-dozen core developers and many others who made important contributions. One such person is Professor Dieter Seitzer at the University of Erlangen whose research involved audio coding and music transfer over standard telephone lines. The inventors named on the MP3 patent are Bernhard Grill, Karl-Heinz Brandenburg, Thomas Sporer, Bernd Kurten, and Ernst Eberlein.

create entirely new forms of media use and application. Writers like de Sola Poole (1983) describe it as a *convergence of modes.*

Business Enterprise Convergence. The clear lines and historic boundaries that once separated broadcasting, cable, telephony and Internet communication are becoming less distinct. A natural convergence of industries and information technologies are blurring those distinctions (Chan-Olmsted, 1998; Collis, et. al., 1997). This, in turn, is transforming, heretofore, separate media and telecommunications business structures into various blends of content and service provision (Küng, 2008; Wirth, 2006, Wirtz, 1999; Collis, et. al., 1997). Many of today's TNMCs engage in cross-media ownership; that is, owning a combination of news, entertainment and enhanced information services (Gershon, 2009; Küng, 2008; Compaine & Gomery, 2000; Albarran & Chan-Olmsted, 1998).

In principle, the TNMC can control an idea from its appearance in a book or magazine, to its debut in domestic and foreign movie theaters as well as later distribution via cable, satellite or DVD sale or rental. The goal is to create internal synergies and efficiencies between a company's various operating divisions. Cross-media ownership allows for a variety of efficiencies, such as:

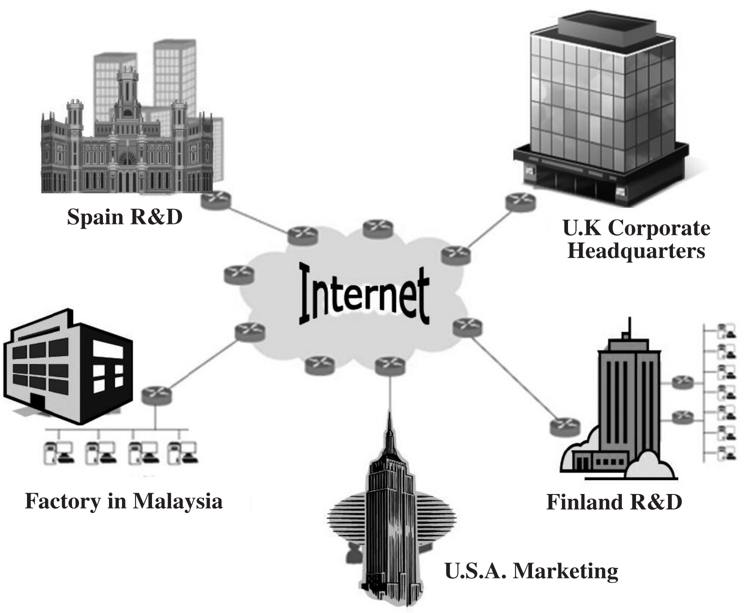
1. Cross licensing and marketing opportunities between company owned media properties.
2. Sharing of newsgathering, printing and distribution facilities between company owned media properties.
3. Negotiating licensing, rental and sales agreements across different media platforms. This can include offering clients package discounts in advertising that cut across different media platforms.

4.9. Virtual Communication

The term *virtual communication* can be used to describe the artificial space and network linkages connecting a disparate set of users using various forms of computer and communication technology. The technologies can include a combination of Internet communication, wired and wireless telephony, electronic mail and videoconferencing to name only a few. The communication, itself, can be both synchronous (real time) as well as asynchronous (different times). Consider the term virtual network and what it means to communicate across time and space without the need for a physical connection between two or more points. A *virtual private network* (VPN), for example, is a computer network that that uses a public telecommunication infrastructure such as the Internet to provide remote users (or departments) secure access to their organization's network. A VPN can range in size and scale of operation from the transnational media corporation that operates on multiple continents to a major medical hospital that must provide secure healthcare information to physicians and other medical professionals located in a variety of clinics and adjoining facilities. The major requirement is the ability to provide immediate and secure information available only to the organization and its affiliate sites. (See Figure 12.).

Figure 12.

Virtual Private Network



Source: R. Gershon, 2011

The selection and type of communication technology is based on how much information content the sender wishes the receiver to have. This could include everything from international videoconferencing capability to a simple email exchange. Researchers Daft & Lengel (1986, 1984) refer to this a media richness. The difference in quality and depth varies according to the communication medium. As Bill Gates (1999), Chairman and co-founder of Microsoft writes,

> In the digital age, 'connectivity' takes on a broader meaning than simply putting two or more people in touch. The Internet creates a new universal space for information sharing, collaboration and commerce (p. xvi.).

Computer Mediated Communication. For communication scholars, one of the more compelling aspects of virtual communication has to do with the various kinds of on-line relationships that are formed as a result of using the Internet and more specifically electronic mail and social networking. Central to the discussion is social presence theory. Social presence is the degree to which a medium is perceived as conveying the presence of the communicating participants (Short, Williams & Christie, 1976). Social presence is a feeling that others are emotionally present and that the communication exchange is warm, active and personal. The social presence of the communicating participants depends not only on words, but rather the entire context of the exchange, including the full range of verbal and nonverbal cues as well as technology and modality (Gibbs et. al, 2011; Ning Shen & Khalifa, 2008; Ramirez & Zhang, 2007; Rice, 1993; Walther, 1992).

Scholars offer differing viewpoints in terms of what distance and anonymity does to the communication process. Rice (1993) asserts that computer mediated communication (CMC) has less social presence when compared to other media. Walther (1992) found that as computer-mediated communication develops over time, communicators adapt both language and text displays to enhance immediacy and to manage relationships they develop via CMC. This idea has become especially salient today given the popularity of text messaging and social networking sites.

Computer mediated language has created entirely new forms of shared meaning. The Internet, for one, allows users to come together both nationally and internationally from the convenience of one's home or business. Such on-line relationships bring together people who share a common interest. The term *homophily* is sometimes used to describe communication networks based on a similarity of interests, including occupation, personal interests, social causes etc. (McPherson et. al., 2001). Several writers, most notably (Haythornwaite & Wellman, 1998; Kollock & Smith, 1998; Rheingold, 1993) refer to such networks as *virtual communities.* Accordingly, Internet social networking websites and news groups have become the electronic equivalent of the local neighborhood cafe.

Social Networking. Nowhere is this more evident than in social networking websites like *Facebook* and *Twitter* (Bernoff, & Li, 2008). Social networking sites allow individuals to present themselves and maintain connections with others. *Facebook* has been described by its founder, Mark Zuckerberg, as a mathematical construct that maps the real-life connections between people ("Most Innovative Companies," 2007). Each person is a node radiating links to other people they know. As friends and acquaintances join Facebook, they become part of a larger social grid that matters to the individual. It creates value to the individual by adding to one's social capital (Ellison et. al., 2007). Since that person's friends are connected to other friends on the network, there is the opportunity to virtually expand one's circle of friends and acquaintances ("Person of the Year," 2010; Hayes, 2007). Each new person and extended link adds value and dynamism to the overall network (i.e., network evolution).

4.10. Artificial Intelligence

Artificial intelligence (AI) is the study and design of intelligent agents or networks. AI is closely tied to the study of decision theory in mathematics and computer science. Decision theory is concerned with identifying the values, risks and uncertainties associated with important decisions. Most decision theory tends to be prescriptive in approach. The goal is to find the best tools, methodologies and software to help people and organizations make better decisions. The practical application of this is called decision analysis. The most systematic and comprehensive software tools developed in this way are called decision support systems (Russell & Norvig, 2003).

AI Reasoning and Problem Solving Features. The goal of artificial intelligence is to develop new approaches to reasoning and problem solving. What all AI systems share in common is the ability to reason, problem solve and take corrective action based on preprogrammed assumptions and information inputs (Kurzweil, 1990). There are two distinguishing features that characterize all AI systems. First, the AI system must have the ability to scan its external surroundings. Second, the AI system must have the ability to evaluate a situation and initiate an appropriate decision/response. The decision must be rationale (Russell & Norvig, 2003). We call this adaptation. An automobile collision avoidance system, for example, is designed to react to situations that humans can not or choose not to, due to driver error. An automobile collision avoidance system (ACAS), will automatically initiate stability control; including the use of anti-lock braking and sensing systems to determine the optimal requirements to support driver safety and prevent accidents.[16] What is important to remember is the degree to which the AI system makes preprogrammed choices on behalf of the user. In principle, the AI system can make faster calculations and decisions than humans involving high speeds as well as reacting to unexpected changes in the external environment.

Neural Networks and Adaptation. An artificial neural network (ANN), or neural network (NN), is a mathematical model based on biological neural networks. An ANN is an information processing model that parallels the way biological nervous systems, such as the brain, process information. An ANN is made up of interconnecting artificial neurons (i.e., programming constructs) that mimic the properties of biological neurons. In principle, an ANN is an adaptive

16. An automobile collision avoidance system (ACAS) uses front and rear millimeter wave detection radar in order to detect vehicles and obstacles on the road. The system automatically engages seatbelts and warns the driver when it determines that a high probability of a collision might occur. If the driver does not brake, the pre-crash brakes are applied to reduce collision speed.

network system that changes its structure based on external or internal information that flows through the network during the learning phase. They can be used to model complex relationships between inputs and outputs to find patterns in data. In short, an artificial neural network, like people, learns by example.

In practical terms, AI systems can be both simple and complex in design. The movie rental service, *Netflix,* for example, exhibits simple AI features to the extent that it knows how to create recommended film viewing lists based on user inputs as well as a preprogrammed algorithmic based rating system. In contrast, modern aviation relies on an AI flight control management system (i.e., autopilot) in order to control the aircraft. The AI flight control system can control and automate all phases of a flight operation, including take-off and ascent, level, descent, approach and landing. The AI computer software reads the aircraft's current position, makes adjustments and controls the flight control system to guide the aircraft. AI changes the nature of intelligent networks from one of information data base and transmission link to one of decision support system. It is a more dynamic interactive tool that aids the user by analyzing problems, answering questions and/or making automatic adjustments to a changing set of external conditions.

Intelligent Agents. From Douglas Engelbart's original prototype of the computer mouse to present day voice recognition systems, one of the promising areas of human / computer interface design and artificial intelligence can be seen in the area of intelligent (or software) agents. An intelligent agent (IA) is a software program that organizes information in support of personal and professional decision-making. Think of the IA as a virtual secretary whose job is to maintain the user's calendar, organize appointments, prioritize incoming information and scan relevant websites for important news and information items. In time, the IA exhibits the principles of network evolution that use knowledge and past experience as the basis for growth and improved decision-making. This could include everything from a simple Amazon product alert to aiding in a complex research and design project. In sum, Monge, Heiss & Magolin (2008) thesis of network evolution becomes more fully realized. All of the essential software elements for IA presently exists. What remains is the task of making them fully integrated.

Singularity and Network Evolution. AI continues to advance at an ever increasing pace of change in what some researchers describe as the *singularity principle* first identified by Vinge (1983) and later popularized by Kurzweil (2005, 2000). Technological singularity is the law of accelerating returns; not unlike Moore's law.[17] Singularity can be thought of as a theoretical future point of unprecedented technological progress, caused by the ability of machines to improve themselves using artificial intelligence. As technology becomes more cost effective, added resources are deployed toward its advancement, so that the rate of exponential growth increases over time. As Kurzweil (2000) points out,

> Once machines achieve the ability to design and engineer technology as humans do, only at far higher speeds and capacities, they will have access to their own designs (source code) and the ability to manipulate them (p. 17).

17. Moore's law describes a long-term trend in the history of computing hardware. Since the invention of the integrated circuit in 1958, the number of transistors that can be placed inexpensively on an integrated circuit has increased exponentially doubling, approximately every two years. The trend was first observed by Intel co-founder Gordon Moore in a 1965 paper. Moore's law is now used as a kind of general metric in evaluating the exponential growth of other digital devices, including processing speed, core memory etc.

5. Discussion

The goal of this monograph was to examine the nature of intelligent networking by exploring the question; what makes an intelligent network intelligent? In this paper, the ITS model was introduced as a way to explain both the internal structures and processes of intelligent networking as well as its external consequences. In Part I., we considered the internal structures and system processes of the intelligent network. When engineers discuss the architecture of a network; they are describing how the physical parts of the network are organized and structured. As noted earlier, the intelligent network is not one network, but a series of networks designed to enhance worldwide communication for business and individual users alike. What gives the intelligent network its unique intelligence are the people and users of the system and the value-added contributions they bring to the system via critical gateway points.

Intelligent networks, by definition, presuppose permeable boundaries; that is, structured entry points that allow users to access and contribute to the overall system design. The same gateway points also means opening up the system to any number of unwanted influences and outcomes. Such unwanted influences and outcomes can include network security threats, privacy invasion and Internet fraud. I refer to this as the permeability predicament. Providing structured gateway points to the network is at the heart of making the overall system design qualitatively better and more efficient. The downside risk is giving users with bad intentions access to the same network on-ramps. The stakes become that much higher when dealing with critical infrastructure systems.

5.1. The System Consequences of Intelligent Networking

An important task for the systems theorist is to recognize how technology affects human and organizational behavior. In Part II. of this monograph, we ask the question; what are some of the social and technological consequences of intelligent networks on people and organizations? Central to this discussion is the fact that intelligent networks do not operate in a vacuum. Rather, the use of intelligent networks are part of a greater human and organizational decision-making process. Basic patterns of social and organizational behavior are forever changed. From electronic commerce to music and video streaming, the blending of intelligent networks and digital media have transformed the business of retail selling and personal lifestyle. We have entered the era of personalization where iPod users personalize their music listening and newspaper readers customize their news selection via their Apple iPad.

5.2. The Intelligent Network and Globalization

Today's knowledge economy involves the full integration of transnational business, nation-states and technologies operating at high speed. It is a global economy that is being driven by free-market capitalism. The basic requirements for all would be players is free trade and a willingness to compete on an international basis. The once highly centralized business has given way to the transnational organization that operates in multiple countries throughout the world. Instead of time and communication being highly synchronized, today's working professional lives in a digital world of asynchronous and virtual communication that allows for the international collaboration of projects regardless of time zones, geographical borders and physical space.

Voice, data and video communication speak the common language of digital communication. Information is digitally organized; reduced to 1's and 0's on computers while racing at high speed across a variety of transmission pathways. Nowhere is this more evident than in the Internet itself. The Internet has become steadily woven into all aspects of work and leisure. It has become the all important network engine that drives globalization forward. If Gutenberg's printing press made reading more widely available to the masses (Fang, 1997) and television made the world a global village (McLuhan, 1964) then the intelligent network has become the vital nervous system that enables people and organizations to stay virtually connected. In looking to the future, the Internet has set into motion a new world of possibilities that may prove as important as the invention of language itself.

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