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Computer Networks

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Abstract: ***While the age-old concept of the network is foundational in virtually all areas of society, Computer Networks and Protocols have forever changed the way humans will work, play, and communicate. Forging powerfully into areas of our lives that no one had expected, digital networking is further empowering us for the future. New protocols and standards will emerge, new applications will be conceived, and our lives will be further changed and enhanced. While the new will only be better, the majority of digital networking's current technologies are not cutting-edge, but rather are protocols and standards conceived at the dawn of the digital networking age that have stood solid for over thirty years.***

Keywords: Applications, Communicate, Digital, Networks, Protocols, Standards, Technologies.

I. INTRODUCTION

A network is a set of devices (often referred to as *nodes)* connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.

A computer network is a system in which multiple computers are connected to each other to share information, resources and data through a communication medium between them.

It is a set of autonomous computers that permits distributed processing of the information and data and increased Communication of resources. Any Computer Networking communication need a sender, a receiver and a communication medium to transfer signal or Data from sender to the receiver. We need sender, receiver, communication channel, protocols and operating to establish a computer networking. A networks model describes the organization of various computers in a network for using resources.

II. COMPUTER NETWORK MODEL

A **computer networks** communication can be based on centralized, distributed or collaborative computing. Centralized computing involves many workstations or terminals, connected to one central mainframe or other powerful computer. Distributed computing interconnects one or more personal computers and allows various services like Data sharing, hardware sharing resources sharing or network sharing. The collaborative computing is the combination of centralized and distributed computing.

1. **Centralized computing.**

» It is also known as client-server computing.

» In this type of system, multiple computers are joined to one powerful mainframe computer.

» The server or mainframe computer has huge storage and processing capabilities.

» The computers that are connected to the mainframe or server are called Clients or Nodes.

» These nodes are *not* connected to each other; they are only connected to server.

2. **Distributed computing**

» If one computer can forcibly start, stop or control another the computers are not autonomous. A system with one control unit and many slaves, or a large computer with remote printers and terminals is not called a computer network, it is called a **Distributed System**.

» Distributed computing means that the task is divided among multiple computers.

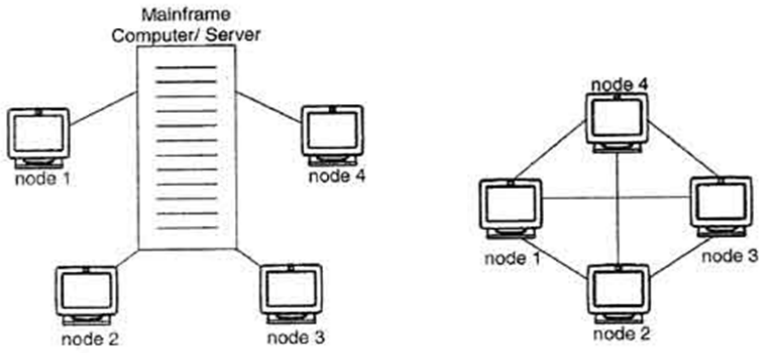
» Distributed computing interconnects one ore more personal computers or Workstations.

» In distributed computing, the nodes are capable of processing their own data and rely on network for services other than data processing.

» It allows various services like network sharing, hardware sharing and file sharing.

3. **Collaborative computing / Hybrid computing:**

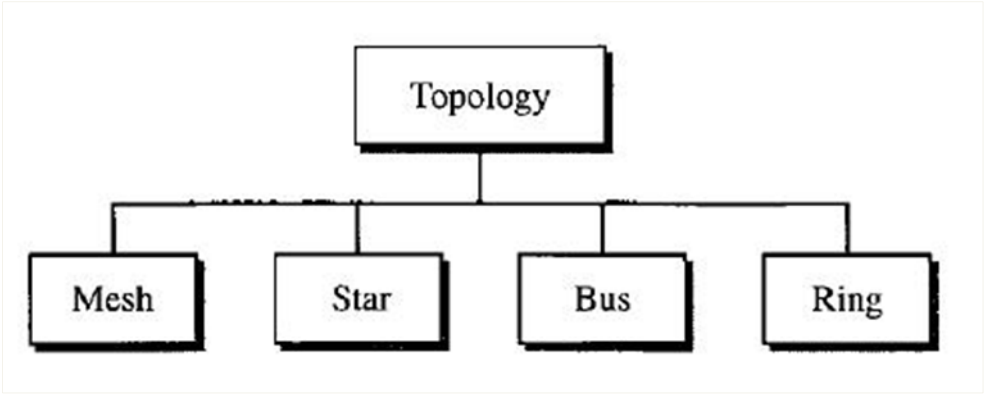
» It is the combination of centralized and distributed computing



» In collaborative computing, the nodes are able to serve the basic needs of their users but they are dependent on some other computers for processing some specific request.

III. COMPUTER NETWORK TOPOLOGY

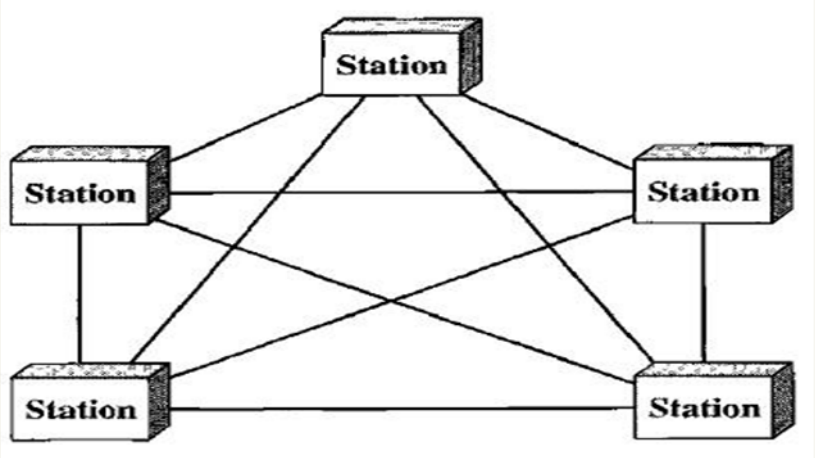
The term *physical topology* refers to the way in which a network is laid out physically. One or more devices connect to a link; two or more links form a topology. The topology of a network is the geometric representation of the relationship of all the links and linking devices (usually called nodes) to one another. There are four basic topologies possible: mesh, star, bus, and ring



Mesh: In a mesh topology, every device has a dedicated point-to-point link to every other device. The term *dedicated* means that the link carries traffic only between the two devices it connects. To find the number of physical links in a fully connected mesh network with *n* nodes, we first consider that each node must be connected to every other node. Node 1 must be

connected to *n* - I nodes, node 2 must be connected to *n* – 1 nodes, and finally node *n* must be connected to *n* - 1 nodes. We need *n(n* - 1) physical links. However, if each physical link allows communication in both directions (duplex mode), we can divide the number of links by 2. In other words, we can say that in a mesh topology, we need *n(n* -1) /2 duplex-mode links.

To accommodate that many links, every device on the network must have *n* – 1 input/output *(VO)* ports to be connected to the other *n* - 1 station.



Advantages:

1. The use of dedicated links guarantees that each connection can carry its own data load, thus eliminating the traffic problems that can occur when links must be shared by multiple devices.

A mesh topology is robust. If one link becomes unusable, it does not incapacitate the entire system. Third, there is the advantage of privacy or security. When every message travels along a dedicated line, only the intended recipient sees it. Physical boundaries prevent other users from gaining access to messages. Finally, point-to-point links make fault identification and fault isolation easy. Traffic can be routed to avoid links with suspected problems. This facility enables the network manager to discover the precise location of the fault and aids in finding its cause and solution.

Disadvantages:

1. Disadvantage of a mesh are related to the amount of cabling because every device must be connected to every other device, installation and reconnection are difficult.
2. Second, the sheer bulk of the wiring can be greater than the available space (in walls, ceilings, or floors) can accommodate. Finally, the hardware required to connect each link (I/O ports and cable) can be prohibitively expensive.

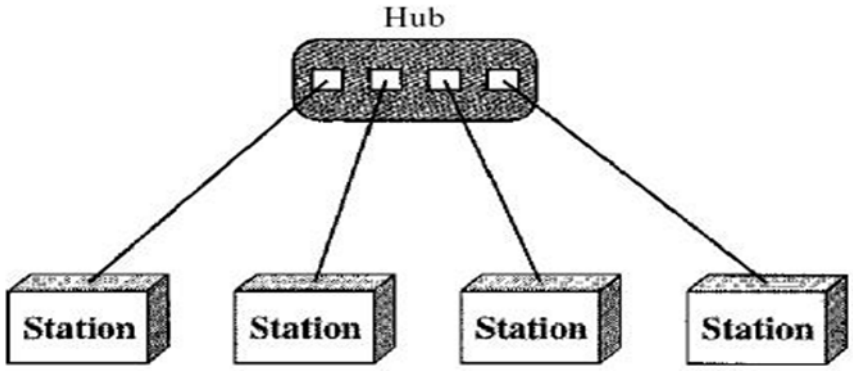
For these reasons a mesh topology is usually implemented in a limited fashion, for example, as a backbone connecting the main computers of a hybrid network that can include several other topologies**.**

Star Topology:

In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub. The devices are not directly linked to one another. Unlike a mesh topology, a star topology does not allow direct traffic between devices. The controller acts as an exchange: If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device.

A star topology is less expensive than a mesh topology. In a star, each device needs only one link and one I/O port to connect it to any number of others. This factor also makes it easy to install and reconfigure. Far less cabling needs to be housed, and additions, moves, and deletions involve only one connection: between that device and the hub.

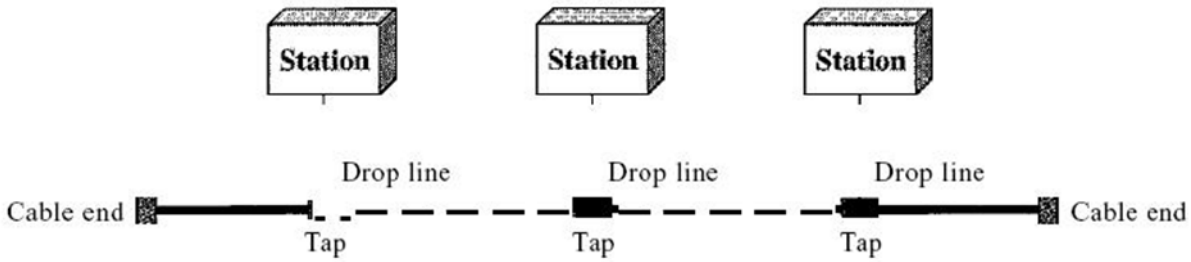
Other advantages include robustness. If one link fails, only that link is affected. All other links remain active. This factor also lends itself to easy fault identification and fault isolation. As long as the hub is working, it can be used to monitor link problems and bypass defective links.



One big disadvantage of a star topology is the dependency of the whole topology on one single point, the hub. If the hub goes down, the whole system is dead. Although a star requires far less cable than a mesh, each node must be linked to a central hub. For this reason, often more cabling is required in a star than in some other topologies (such as ring or bus).

Bus Topology:

The preceding examples all describe point-to-point connections. A bus topology, on the other hand, is multipoint. One long cable acts as a backbone to link all the devices in a network



Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection running between the device and the main cable. A tap is a connector that either splices into the main cable or punctures the sheathing of a cable to create a contact with the metallic core. As a signal travels along the backbone, some of its energy is transformed into heat. Therefore, it becomes weaker and weaker as it travels farther and farther. For this reason there is a limit on the number of taps a bus can support and on the distance between those taps.

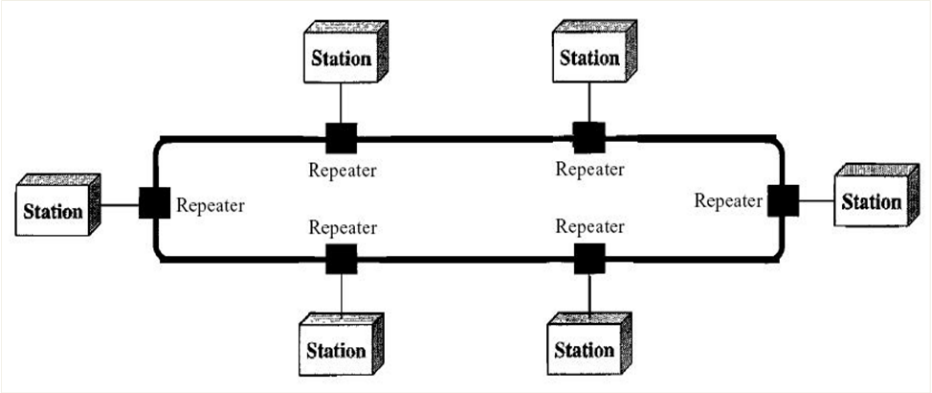
Advantages of a bus topology include ease of installation. Backbone cable can be laid along the most efficient path, then connected to the nodes by drop lines of various lengths. In this way, a bus uses less cabling than mesh or star topologies. In a star, for example, four network devices in the same room require four lengths of cable reaching all the way to the hub. In a bus, this redundancy is eliminated. Only the backbone cable stretches through the entire facility. Each drop line has to reach only as far as the nearest point on the backbone.

Disadvantages include difficult reconnection and fault isolation. A bus is usually designed to be optimally efficient at installation. It can therefore be difficult to add new devices. Signal reflection at the taps can cause degradation in quality. This degradation can be controlled by limiting the number and spacing of devices connected to a given length of cable. Adding new devices may therefore require modification or replacement of the backbone.

In addition, a fault or break in the bus cable stops all transmission, even between devices on the same side of the problem. The damaged area reflects signals back in the direction of origin, creating noise in both directions.

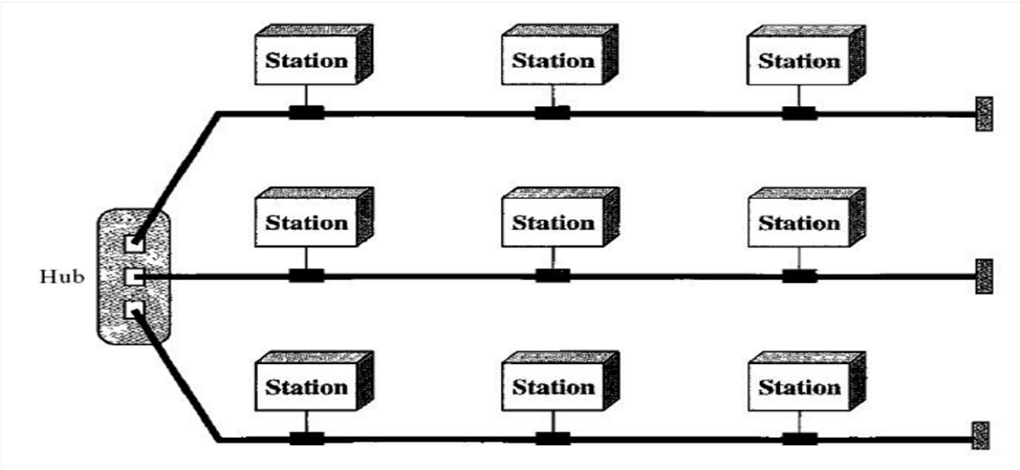
Bus topology was the one of the first topologies used in the design of early local area networks. Ethernet LANs can use a bus topology, but they are less popular.

Ring Topology In a ring topology, each device has a dedicated point-to-point connection with only the two devices on either side of it. A signal is passed along the ring in one direction, from device to device, until it reaches its destination. Each device in the ring incorporates a repeater. When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along



A ring is relatively easy to install and reconfigure. Each device is linked to only its immediate neighbors (either physically or logically). To add or delete a device requires changing only two connections. The only constraints are media and traffic considerations (maximum ring length and number of devices). In addition, fault isolation is simplified. Generally in a ring, a signal is circulating at all times. If one device does not receive a signal within a specified period, it can issue an alarm. The alarm alerts the network operator to the problem and its location.

However, unidirectional traffic can be a disadvantage. In a simple ring, a break in the ring (such as a disabled station) can disable the entire network. This weakness can be solved by using a dual ring or a switch capable of closing off the break. Ring topology was prevalent when IBM introduced its local-area network Token Ring. Today, the need for higher-speed LANs has made this topology less popular. Hybrid Topology A network can be hybrid. For example, we can have a main star topology with each branch connecting several stations in a bus topology as shown in Figure



Uses of Computer Networks:

The computer networks are playing an important role in providing services to large organizations as well as to the individual common man.

Service Provided by the Network for Companies:

» Many organizations have a large number of computers in operation. These computers may be within the same building, campus, city or different cities.

» Even though the computers are located in different locations, the organizations want to keep track of inventories, monitor productivity, do the ordering and billing etc.

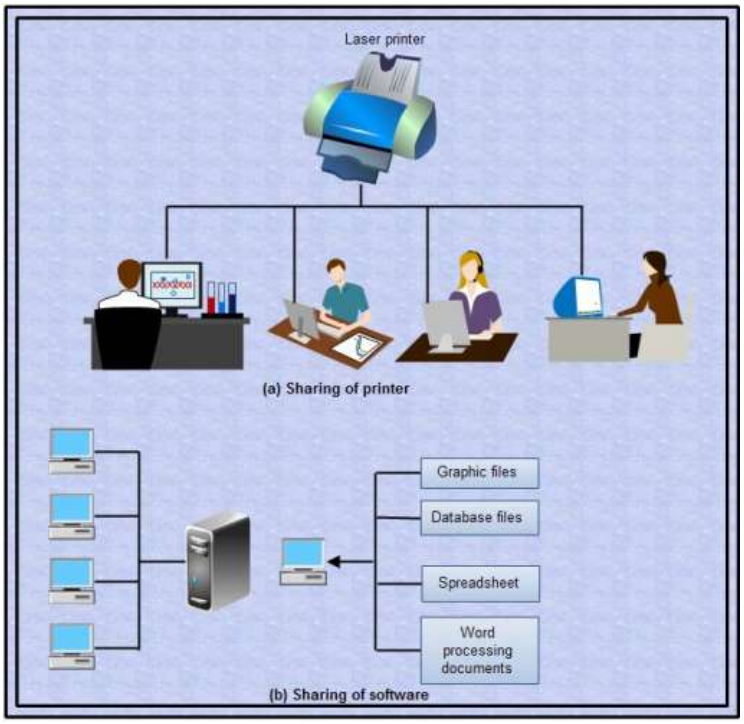
» The computer networks are useful to the organizations in the following ways:

1) Resource sharing.
2) For providing high reliability.
3) To save money.
4) It can provide a powerful communication medium.

1. Resource sharing:

» It allows all programs, equipments and data available to anyone on the network irrespective of the physical location of the resource and the user.

» Show in Fig (a) and (b) which shows a printer being shared and different information being shared.



2. High reliability due to alternative sources of data:

» It provides high reliability by having alternative sources of data. For e.g. all files could be replicated on more than one machines, so if one of them is unavailable due to hardware failure or any other reason, the other copies can be used.

» The aspect of high reliability is very important for military, banking, air traffic control, nuclear reactor safety and many other applications where continuous operations is a must even if there are hardware or software failures

3. Money saving:

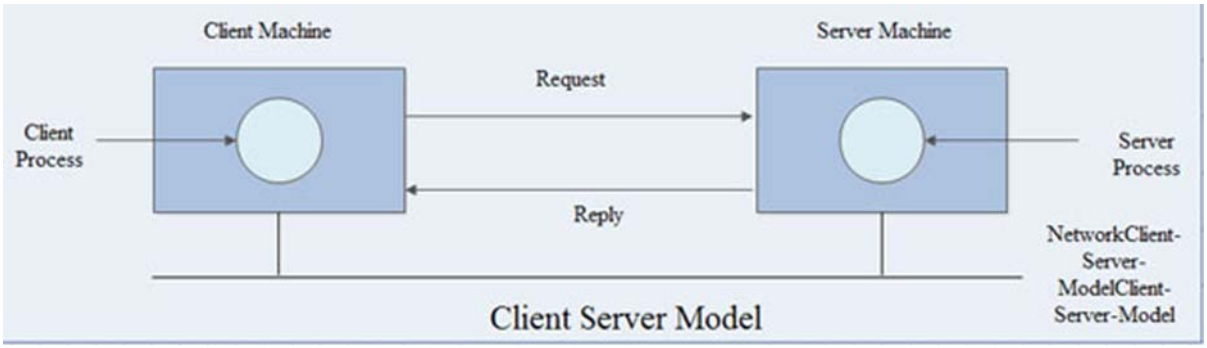
» Computer networking is an important financial aspect for organizations because it saves money.

» Organizations can use separate personal computer one per user instead of using mainframe computer which are expensive.

» The organizations can use the workgroup model (peer to peer) in which all the PCs are networked together and each one can have the access to the other for communicating or sharing purpose.

» The organization, if it wants security for its operation it can go in for the domain model in which there is a server and clients. All the clients can communicate and access data through the server.

» The whole arrangement is called as client -server model.

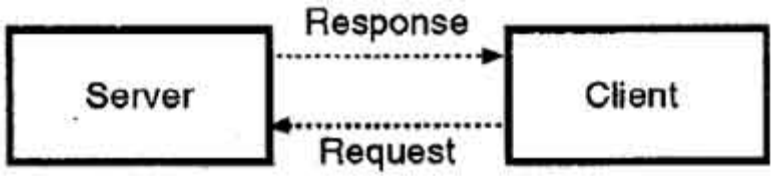


Client: The individual workstations in the network are called as clients.

Server: The central computer which is more powerful than the clients and which allows the clients to access its software and database is called as the server.

Server computers typically are more powerful than client computers or are optimized to function as servers.

Communication in client-server configuration:



Client/server communication

» The client places a request on the server machine when he wants an access to the centralized resources.

» The server responds to this request and sends the signal accordingly to the client.

» The software run at the client computer is called as client program. This software configures the computer to act as a client.

» Similarly the software run on the server computer IS called as server program. It configures a computer to act as a server.

4. Communication medium:

» A computer network provides a powerful communication medium among widely separated employees.

» Using network it is easy for two or more employees, who are separated by geographical locations to work on a report, document or R and D simultaneously i.e. on -line.

IV. NETWORKS FOR PEOPLE

» Starting in 1990s, the computer networks began to start delivering services to the private individuals at home.

» The computer networks offer the following services to an individual person.

1) Access to remote information
2) Person to person communication
3) Interactive entertainment.

1. Access to remote information:

Access to remote information involves interaction· between a person and a remote database. Access to remote information comes in many forms like:

A. Home shopping, paying telephone, electricity bills, e-banking, on line share market etc.

B. Newspaper is. On-line and is personalized, digital library consisting of books, magazines, scientific journals etc.

C. World wide web which contains information. about the arts, business, cooking, government, health, history, hobbies, recreation, science, sports etc

2. Person to person communication:

Person to person communication includes:

A. Electronic-mail (e-mail)

B. Real time e-mail i.e. video conferencing allows remote users to communicate with no delay by seeing and hearing each other. Video-conferencing is being used for remote school, getting medical opinion from distant specialists etc.

C. Worldwide newsgroups in which one person posts a message and all other subscribers to the newsgroup can read it or give their feedbacks.

3. Interactive entertainment:

Interactive entertainment includes:

A. Multiperson real-time simulation games.

B. Video on demand.

C. Participation in live TV programmes likes quiz, contest, discussions etc.

In short, the ability to merge information, communication and entertainment will surely give rise to a massive new industry based on computer networking.

V. CONCLUSION

The growing application of IT and telecommunications in the coming years will show a significant resemblance with the development of companies, the economy and society. IT will partly determine and partly support the changes. Computer networks will radically change communication between people and companies. They will also change the control of tasks, data distribution and knowledge acquisition. This will lead to completely new and flexible business organizations. Drastic changes in businesses and partnerships will have far-reaching consequences for the entire economy.

IT and telecommunications will accelerate and simplify the production and transport of immaterial products. New forms of business involving data, knowledge and communication will result in a Information Revolution. Computer networks will lift the

current businesses in the agricultural and industrial sectors up to a higher level. Fast communication between people, accurate control and a better co-ordination of tasks will enable companies to offer products and services that are exclusive and of a better quality. We have a joint responsibility to ensure that these developments are accompanied by a growth of prosperity and that the well-being of all people is served.

Since a number of barriers have to be overcome and such large numbers of people are involved, the growth of the application of IT and telecommunications will require a great deal of time. On the other hand, large, new markets are opened up, so that the economy will continue to expand for a long time. To a certain extent we can compare the growth of IT and the accompanying social and economic changes to the changes brought about by the Industrial Revolution. The Information Revolution will, however, bring about greater and more complex changes than the Industrial Revolution has. The first growing phase of the Information Revolution will therefore take at least thirty years.

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