Telecommunications and Sociocultural Change

—With on Example of Communication Satellites—

Ryu, Jai Poong*

We are apparently on the threshold of a revolutionary transformation toward the so-called "information society" through what is known as the "computer-communication revolution." Unmistakably, this is a process of global and historic significance. Although it would be presumptuous of anyone to forecast with confidence the changes for the years to come or to speculate with assurance about their implications, no one and no society can be impervious to it.

The virtue of prudence would demand that one take stock of the past and ongoing happenings and generate relevant hypotheses—however risky—that may be useful in developing plans, concepts, and theories concerning the emergent society. Given the relative recency of the present transformation and the accelerating tempo of ongoing technological breakthroughs, the tentative and explorative nature of our studies must be granted.

The purpose of this paper is to explore the relationship between the telecommunication and sociocultural change with an illustrative example of communication satellites. Since this discussion is unavoidably held within the broader framework of the information society, the latter will be discussed first.

A. Information Society and New Technology

The concept of the information society parallels closely that of the postindustrial society, whose characteristics and tendencies have been identified by such sociologists as J. Ellul (1964) and D. Bell (1973). Their observations and conceptual formulations are well known and thus will not be repeated here. It is important to note, however, that neither theorist of the above seems to have fully foreseen what would have begun to happen since the late 1970's: "a sudden increase in the potency of telecommunications and in the computing capacity (Smith: 2)," or how "all modes of communication we humans have devised since the beginning of humanity are coming toge-

* Professor, Department of Sociology, Loyola College

ther into a single electronic system, driven by computers (Wicklein: 1)."

The information society has been ushered in by the "new" technology, not a mere extension of earlier industrial machines. The term "new technology" today refers to a marriage between the computer and the television set. The convergence of computing and communications technologies placed in human hands some very unprecedented and powerful tools for manipulating and transmitting information. Thus it seems that an understanding of the nature of the information society should begin with an assessment of this new technology.

1. General observations on technological development

Today there are many emerging technologies and services provided by the new machines in the fields of the computer and telecommunications. Particularly important among them are the satellite, the microchip, the computer, the fibre optic, and the cable television. Within each of these categories, of course, there are untold hundreds of innovations and inventions. Some of them will succeed and others will fail in what has been called the "great shakeout." This shakeout refers to the abundance of competing new technologies that may be too much for the market place to bear. Technologies change quickly. Anything can and might happen and few can predict the future with much confidence.

Even the technologies which will survive the great shakeout would not mean an undiluted blessing for man. Some of the benefits to the human condition as a whole may turn out to be a part of the problems for subsequent generations. Only in recent years we have come to see more clearly the problems created by the industrial revolution in terms of environmental damages and human alienation and, perhaps, to have forgotten the benefits which have undoubtedly accrued (Douglas: 10).

Also, many of the popularly projected impacts of the new technology are fallacious. First among them is what D. Boorstin calls the "displacement fallacy," which refers to the belief that the new technology boots out the old technology. Yet modern means of communication seldom replace the previously existing means. Television has not eliminated radio; radio has not destroyed the books; the print has not stopped us from writing letters; and so on. Each new mode of communication tends to be superimposed on the old. Old technology tends to be transformed—performing certain functions differently to different people—not displaced.

The second is what I call "overgeneralization fallacy(Ryu: 388)." This often results from extrapolation of the existing tendencies into the future and/or into other areas where new technology not been introduced. Extrapolating from rapidly growing home computer sales during the early 1980s, for example, many projected confidently how the ubiquitous microchip would free us from the mundane tasks associated with everyday existence—allowing us to work, shop and bank at home. Today, scarcely three years later, many had to change their conclusions. Even the most optimistic projections concede that weaving the home computer into the fabric of American life will take much longer than originally believed.

The third is the illusion that interpersonal contact over the new technology is the same as face-to-face communication. Although the Japanese experiments with the sixth-generation computers other similar efforts might produce a device that can approximate the face-to-face contacts, it is doubtful that it will significantly alter the many millennia-old human inclinations toward milling around with others, or toward trusting some one more after the eyeball-to-eyeball confrontations. For the considerable future, then, it seems safe to assume that the new technology of interpersonal communications systems are "likely to be more readily used to arrange meetings than to replace them (Sanders, 1971).

The fourth is only partly fallacious: a belief that the emergence of the information society could make insignificant the agriculture and/or industrial manufacturing. There are, of course, reasons to believe that a new economic order is in the making-one based not on material goods but on information. In an information society, more people will be engaged in information-knowledge-education-other service enterprises than in all other sectors combined. There also is a definite trend that manufacturing is increasingly moving toward less developed countries. The fact will remain, however, that one cannot eat, wear, drive, or live in the information. While the new technology would make more efficient use of resources for production, the degree to which a society can implement the new technology would depend on the extent to which it achieved the agricultural and industrial progress. Further, no society should want to depend entirely on others for agricultural/industrial products in this volatile world.

Having cautioned ourselves about fallacious notions concerning the development of the new technology, I will take a closer look at the nature of it. The new technology include the development of the satellite, the microchips, the computer, the fiber optics, etc. In what sense are these "new?" Was not the airplane new? Was not nuclear power new? Each was new, of course, at one time or another and at one place or another. Why then is the "newness" of the computer and telecommunication so particular that many are inclined to call it the "second industrial revolution," or the "fifth communications revolution," or the "third wave," and so on?

2. The most distinguishing characteristics of the new technology

The most distinguishing characteristisc of the new technology lies in the fact that it involves technology in a part of human faculties which have not been directly affected by the technologies of the pre-information age.

From stone axes through supersonic jets to the electronics, technology has extended and often replaced a series of human faculties. Agricultural and industrial technologies have extended largely the physical faculties of man: spears extended arms: railroads the legs, binoculars the eyes, telephones the ears, and the like. On the other hand, the new technology of the information society extends and strives to replace the mental faculties of man: computer extends the brain; telecommunication the central nervous system.

One may speculate then that the information society is one in which human's interaction with his/her enviroment is largely mediated by the new technology increasingly approximating the vast potentials of human brain. This is not to suggest a view of the future world modeled after a human body with interrelated organs coordinated by the brain. The world is too complex and contains too many internal conflicts for such an analogy. There will certainly be many societies and billions of individual human beings whose lives will be outside the framework of the information world. If we can visualize the world as divided into two parts between information societies and preinformation societies, however, it will be the world dominated by the former. It is similar to the present world where industrial societies dominate the less industrialized ones.

3. What would life be like in a society dominated by the information processed through the increasingly brain-like new technology?

From the perspective of the information receiver—which should include nearly everyone—their lives would be held in the midst of rapid flows (speed) of massive amount (volume) of packaged information (integration) about the bewildering array of economic/political/social/cultural/technological/other areas (complexity) concerning both their individual and collective lives. It is important to note that the above parenthesized four characteristics of human environment in the information society are roughly analogous to those of the human brain and the central nervous system.

Both the human barin and the new technology are capable of processing a *speedy* floow of *massive* amounts of information for the purpose of such values as the self-preservation and self-enhancement in a highly *complex* environment. In the information society, they are increasingly assumed by the new technology which forms a powerful segment of human environment to which the human brain itself must respond in turn.

4. What would be the typical human response to the rapid and massive flow of packaged information in a very complex world?

A German sociologist G. Simmel (1950) observed that, when the environment presents more stimuli than one can handle, human beings respond to them selectively. Selective response is inevitable, for while the human brain is unfathomably vast in potentialities, the empirical usage of it is quite limited in actualities. If the above-stated question is rephrased, therefore, it may be: *how human beings will select which stimulus to respond to;* or *what would be their criteria for selections?* or *what would be the values underlying their choice-making endeavors?* To those questions, I present the following set of hypotheses: (a) There would be an *orientational change from substance identification to pattern recognition.* When an automobile travels at a speed of 30 miles an hour, an observer can identify the substance of the moving vehicle, for example, its model, color, etc. If it moves at 300 miles an hour, however, one can only recognize the pattern of movement of the vehicle, for example, its direction, speed, etc. In the face of repid and continuous flows of information, one can scarcely afford to grapple with the substance of the information to which he/she is exposed. In information society, an economist does not typically ask why there exists an unemployment rate of 6.7%, say, in the U.S. today. He is more typically to ask whether the 6.7% is more or less than last year or month and why the change occurred. It is the ability to recognize the patterns of changes that would be rewarded in the information society. The questions concerning the substance would be the stuff of a leisurely after dinner conversation, not of actual significance in work a day world of the information society.

(b) *Criteria for evaluating the various patterns recognized would be in favor of the systems.* Human reasoning process may take place in a number of dimensions in service of various purposes: Religious reasoning in service of promoting faith;metaphysical reasning in pursuit of a perfecting life; empirical reasoning to advance the explanatory powers of a scientific theory; and the like. The tools of reasoning in the preinformation age have largely been the linguistic logic, using words or numbers. The preeminent logic in the information society would be, however, what Assimov calls the "electronic literacy." The electronic literacy involves words and numbers, but it has an additional electronic dimension to it, for it contains the knowledge of how the whole system or its subsystem integrates its constituent parts for operation. Any given system may be designed for different purposes, but electronic logic has one overriding purpose, i.e., to make all relevant parts of the system mobilized for the purpose of maintaining and enhancing the system. When such a systm is large, complex and packaged, it is doubtful how tolerant its practitioners would be with non-electronic logic. It is thus one of my major hypotheses that, in a world dominated by electronic systems, the criteria for evaluating the recognized patterns would almost invariably be in favor of the system.

(c) *Predominant form of human experiences in information society would be indirect or vicarious.* In the fast moving, complex information society, one would rarely be able to experience his/her environment directly and personally. While the new technology would bring to our attention important facts and events as she occur, they come to us indirectly through a channel. Direct experiences are probable and rewardable in a slow-paced world. In information society, most of the important stimuli come to us indirectly on the basis of which our decisions and plans have to be formulated. More than ever, people would depend on those who create, process and disseminate information.

B. Satellite Communication among New Technologies

In the previous section, we presented general observations about the nature of technologial changes, distinguishing characteristics of the new technology, and its general effects on human lives in the emerging information society. Within that broad framework, more specific topic of the satellite communication will be discussed here. Communications satellite is one of the major pillars of the new technologies which brought about the information society. It revolutionized the communications industry and there must be a milliards of economic/technological/political/social/cultural/personal implications, emanating from it.

1. How communications satellites work

Standing in the middle of a room crowded with noisy people, it is very difficult to be seen and heard. You might not be able to communicate with all or even most people in the room, unless you stand on a high chair. Then you become visible to all the people, and you can now communicate with them. If you suppose that the people are countries and, you—chairbone speaker—are a satellite. Although the analogy is flimsy, one starts to get an idea as to how the satellites work.

It is an undisputed fact that the radio signals least subject to interference and best suited to carry large volumes of communications traffic are in the microwave frequency range. Signals of this type travel in straight lines and are not deflected appreciably by the earth's atmosphere or other physical influences. But they will not travel through the earth. This means that if someone who was in, say, London tried to beam a microwave presage to New York, it would never get there—it would either disappear in space or dissipate into the ocean. Over land and over short ocean links, this problem has been solved by erecting repeater stations every 50 or so kilometers with small antennas which "catch" the beamed signal and retransmit it towards the next station in the chain. (This whole problem is because of the curvature of the earth.) The placing of such a chain across one of the world's major oceans presents some obvious engineering difficulties, and, even then, you would have only point-to-point communications to go back to our analogy, you could pass the message across the room but not everyone would be able to hear it. Therefore, what is needed is one omnidirectional relay point in the middle of the ocean. The problem is that it would need to be a tower nearly 800 kilometers high—a point which would pose even greater engineering difficulties.

However, with the advent of the space age, it has become possible to have such a "tower" in the sky, without building the tower. Satellites launched into a circular orbit 36,000 kilometers above the equator hover above the one spot; moving around their orbit at the same speed the earth rotates. So, if you could see one of these satellites it would appear to be stationary in the sky.

From their positions in space the satellites can "see" about a third of the earth's surface, and any stations in that area with their antennas turned toward a satellite can use it to communicate among each other. While the satellites do not originate signals, neither are they just passive reflectors.

The earlier INTELSAT satellites—up to INTELSAT III—which operated through partial or full global coverage antennas only, received the signals beamed in their direction by earth stations within their coverage zone, amplified the signals greatly, and then retransmitted them at different frequencies (See appendix).

Present-day satellites have much more sophisticated antenna systems enabling them to reuse frequency ranges several times, concentrating "beams" on different parts of the earth that are high traffic areas and transmitting in opposite senses of polarization.

For the future we may look to satellites switching digital signals from one beam to another and, via inter-satellite links, from one satellite to another.

2. Characteristics of satellite communication

S. Alnes (1981:3) called them "the single most important piece of new hardware in the telecommunication revolution." It is because the satellites have several important characteristics. One is certainly the availability of bandwidths exceeding anything previously available for intercontinental communications. Although overland transmission of high-quality TV pictures by microwave radio relays or cable has been possible for some years, transatlantic TV transmission took place for the first time only after the first active satellite has been put in orbit. Intercontinental relaying of TV programs, now commonplace, is done exclusively by satellites.

Second important feature is that satellites are, in essence, microwave relay stations in the sky with transponders that can receive and transmit messages. Satellites receive microwave signals in a given frequency band and retransmit them at a different frequency. It must use a different frequency for retransmission; otherwise the powerful transmitted signal would interfere with the weak incoming signal. The equipment which receives a signal amplifies it, changes its frequency, and retransmits it is called a transponder.

Most satellites have more than one transponder. The bandwidth handled by a transponder has differed from one satellite design to another, but most contemporary satellites have transponders with a bandwidth of 36 MHZ. How the bandwidth is utilized depends on the earth station equipment.

The WESTAR satellites, which are typical, may carry any of the following:

(1) One color television channel with program sound.

(2) 1200 voice channels

(3) A data rate of 50 Mega bits per second

(4) The center 24 MHZ of each band may relay either

ⓐ 16 channels of 1.544 Mbps, or

ⓑ 400 channels of 64 Kbps, or

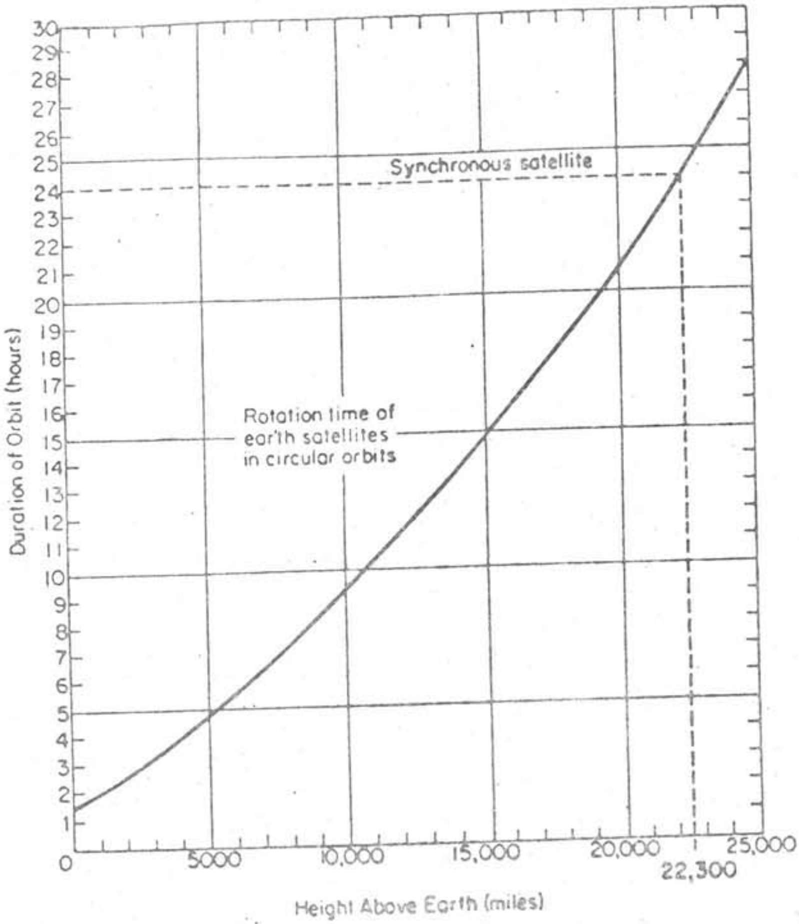
ⓒ 600 channels of 40 Kbps.

The WESTAR satellites each have 12 such transponders, two of which are spares used to back up the other 10 in case of failure.

Another, perhaps the most important of all, is the unique ability to cover the globe. Satellites compared to cable have great advantage. Cable has two fixed ends and there must be a connection between every pair of points to be in communication. Satellte systems offer, in this respect, a flexibility that can not be matched by the cable. Furthermore, this flexibility applies not only to fixed points on earth, but also to moving terminals, such as ships at sea, airplanes, and space vehicles.

With communication satellites, then, instant and reliable contact can be established rapidly between any points on earth, in addition to and well beyond the capabilities of available land lines, microwave line-of-sight relay systems, and other techniques. Satellites are the elements of a communication revolution analogous to that in transportation resulting from the airplane.

a. Satellite Orbits: Graphic presentation below shows the time a satellite takes to travel around the earth versus its height above the equator. The orbit at height of 22,300 miles is special in that a satellite in that orbit takes exactly 24 hours to travel around the earth—the earth's rotation time. If its orbit is over the equator and it travels in the same direction as the earth's surface, then it appears to hang stationary over one poitn on earth. This orbit is called a "geosynchronous" orbit. The apparently stationary



satellite is called a geosynchronous satellite.

b. Unique Properties of Satellite Links: A satellite channel is often used simply as a substitute for a point-to-point terrestrial channel. However, it has certain properties which are quite different from conventional telecommunications. It should not be regarded as merely a cable in the sky. Different types of designs are needed, especially in computer systems, to take advantage of satellite properties and avoid the potential disadvantages.

A satellite channel is unique in the following respects:

(1) There is a 270 millisecond propagation delay.

(2) Transmission cost is independent of distance. A link from Washington to New York costs the same as a link from Washington to Seoul. A computer

center can be placed anywhere within range of a satellite without affecting transmission costs. It is becoming economical to centralize many computing operations. In an international operation worldwide links can be similar in cost to national links if the regulatory authorities so permit.

(3) Very high bandwidths or bit rates are available to the users if they can have an antenna at their premises, or radio-link to an antenna, thereby avoiding local loops.

(4) A signal sent to a satellite is transmitted to all receivers within range of the satellite antenna. The satellite broadcasts information unlike a terrestrial link.

(5) Because of the broadcast property, dynamic assignment of channels is possible between geographically dispersed users. This can give economies, especially with data transmission on a scale not possible with terrestrial links, but needs new forms of transmission control.

(6) Because of the broadcast property, security procedures must be taken seriously.

(7) A transmitting station can receive its own transmission and hence monitor whether the satellite has transmitted it correctly. This fact can be utilized in "contention" forms of transmission control in which two transmissions from different locations might coincide on the same channel and destroy each other.

Thus a report of the Carnegie Corporation stated, "Simply put, satellites provide a broadband, low cost, distance insensitive means of distributing information...There is little that most terrestrial transmissions can do that satellites cannot do more cheaply and quickly and with equal or better quality and reliability."

To list the functional capabilities more specifically, satellites:

(1) Make possible live global transmissions of pictures and sound from both fixed and mobile transmitters...

(2) Make possible the easy creation of new radio and television networks and "super stations"...

(3) Make much more programming availale to cable television systems, many of which have had unused cable capacity...

(4) Make possible the creation of a direct satellite-to-home network...

(5) Make it possible to put together an audience on a national or regional basis for a program or programs which might not attract a viable audi-

ence in a smaller geographical area...

(6) Other business a cheaper way to communicate over long distances, from rooftop to rooftop if desired. Indeed, satellite communication is said to be "distance insensitive" in terms of cost...

James Traub outlined the tremendous debt that the communication revolution owes to the satellite by noting that the capacity of inexpensive, instantaneous nationwide transmission offered by the satellite has transformed cable television from a relay station into an immense industry; freed broadcast stations from much of their dependence on networks; increased the volume and efficiency of long-distance phone service; blurred the distinction between print and electronic media and created such wholly new technologies as videoconferencing.

In the mid 1980s the United States was using some fifteen satellites. One was owned by the federal government; the others, by private companies. For example, the Galaxy satellite, which transmits HBO, Turner Broadcasting, and C-Span, is owned by Hughes Communications, Inc., and COMSTAR, which carries ABC, CBS, NBC, AT&T, and ESPN among others, is owned by the Communication Satellite Corporation (COMSAT), which was authorized by the U.S. Congress in 1962.

3. Satellites & other major modes of telecommunications

Comparing Satellites to other major modes of telecommunications, we can obtain the results presented in the following table.

4. A real challenge to satellite communications: Fibre optics

A tremendous expansion of fiber-optic cable networks is planned in the telecommunications industry over the next several years. Some specialists are predicting that it will limit satellites role in the industry.

Optimists look for a radical lowering of prices for data, voice, and video transmission, making a host of services like electronic mail and teleconferencing more widely available and stimulating the growth of digital networks.

One reason for the shift to fiber-optic systems is that their lines are much less susceptible to noise and electromagnetic interference from outside sources than copper cable or satellite links are. Furthermore, virtually no electromagnetic radiation leaks from the fiber cable, making fiber more secure, the carriers say, because optical signals cannot be easily intercepted or tapped.

Characteristics	Terrestrial Microwave	Cable	Satellite	Optic Fibre
Bandwidth	Up to 100 GHZ	Greater than 350 MHZ	Most transponders: 36 54, or 72 MHZ	Limited only by electronics at terminals: theoretical bandwidth is 1 terahertz
Immunity to Interference	Easily affected by noise	Good noise immunity	Subject to interference including microwave	Immune to electromagnetic interference
Durability of Links	Storms may disable antenna towers	Rather durable	Storms can disable individual antennas but cannot affect network	Storms may knock down overhead lines, but many will be underwater
Security	Signals open to anyone; Encoding needed	Very secure; easy to detect	Signals open to anyone; Encoding needed	Very secure; easy to detect
Multipoint Capability	Easily achieved	Cable must be tapped	Easily achieved	Primarily a point-to-point medium
Flexibility	Rather flexible	Not very flexible	Easy to reconfigure	Difficult to reconfigure to meet the changing demands
Connectivity to Customer	Transmittable via small microwave antennas & appropriate electronics	Can be costly; cable must be connected to customer site	With antenna in customer premise, no local loop needed	Local loops required

Another big plus for fiber optics in long-distance point-to-point communications is that there is no noticeable delay in signal propagation, as there is when a signal is sent to and from a communications satellite.

C. Telecommunication (with emphasis on Satellite Communication) and Sociocultural Change

The development of the new technology in the fields of the computer and telecommunication has taken place almost exclusively in the economically advanced societies in North America, Western Europe, and Japan. There are of course, partial exceptions to this: Over one hundred countries are signatories to the International Telecommunication Satellite Consortium (INTELSAT); India is at a fairly advanced stage toward establishing an autonomous space program with commercial possibilities; Some of the Newly Industrializing Countries (NICs) are involved in independent computer development; People's Republic of China has adopted satellite-broadcast program for education of lower and middle level school teachers; and so on.

Moreover, even in the United States and Japan, the socialcultural implications of the new technology development have just begun to be addressed and few literature, if any, attempted a comprehensive treatment of the topic. Focusing on the sociocultural aspects—excluding other, but related economic, international, political, technological issues—literature tend to be divided into two major groups: one emphasizing the benefits and the other problems associated with the new technology.

1. Sociocultural benefits and problems in developed societies

a. *Benefits:* Members of the World Future Society tend to be optimistic in their observation that new technology has a liberating effect. Arthur Clarke, who envisioned a satellite as early as in 1945 (See Appendix), Alvin Toffler and other futurists indicate that new technology will make people's work easier by performing activities strenuous for human beings. Because people have more information sources, they will be better educated and freer. New technology will reduce or eliminate unnecessary business travels and thus make people's work less costly in time, money and labor.

One supposed great benefit is how the new technology could manage the information explosion. Individuals in modern society are inundated with information to an extent that they cannot manage them without the help, which is to be provided by the computers, various data bases, and the telecommunications technology. It is claimed that new technology not only makes a vast amount of information available, but it also is capable of synthesizing it for effective use. For example, a person can select, with the aid of new technology, the categories of information from the vast array of information.

For broadcasting, the new technology will finally free the broadcasters from the limited channels for over-the-air broadcasting. With satellites and cable, multiple channels are possible. Some cities in the U.S. already have more than one hundred cable channels, although most still have fewer than ten. This could usher in a new television of abundance, with a wide choice of programs available. As a result, the virtual monopoly of the broadcasting by a network(s) in industrial societies could be broken for the public's benefit. It is observed that this greater capability for information, entertainment and other programming will enhance freedom of expression and the media industries would reflect more closely the wishes and needs of the public through better feedback.

b. *Problems:* Critics of the new technology attempt to bring the general attention to two broad categories of the issues. The first is about potentially divisive influence of the new technology in society; the second about freedom.

In modern societies, especially in the so-called information society, information is the major economic commodity and thus constitutes the preeminent element of power. If only relatively affluent people obtain cable, satellite dishes, and other information services, the poor and the dispossessed will be left behind. The current class division surrounding the ownership of industries and the educational opportunities in an industrial society might be even more sharply drawn in the emerging information society. It is because, in the latter a full membership would require the electronic literacy, which remains a remote possibility for a great mass of the lower strata.

Further, more and more information is becoming proprietary. That is, one must pay for it. Although public libraries do subscribe to data bases, increasing numbers of data services are unavailable in public institutions. It can be obtained through paid subscriptions, but the fees are often out of reach for many.

The new technology might fragment society in another way. As people watch more and more specialized programs and utilize specialized information and entertainment services, the society might break into small communities of interest. This may insulate individuals and isolate them into mutually-indifferent communities.

A second threat critics see involves issues of control, freedom of the press, and privacy. The centralized nature of the new technology operations might allow government or private industries to accumulate great power, thus limiting individual liberty(Wicklein:1).

Also, unless policies emerge to effectively counter the tendencies toward monopolization, a few information—communication empires may come to wield too much power. Should such a development occur, media pluralism—an important pillar of democracy—might be so limited that free press might become endangered (Baker).

Many scholars (Douglas; Richardson; Salvaggio; and others) took issue with the matter of privacy in information society. With two-way cable, for example, it is possible for the cable operator to learn people's political, social and sexual views and habits. Many fear that there would be few effective safeguards against the misuse or abuse of this knowledge about private matters of the citizen life.

The debate seems to be continuing between and within the minds of concerned scholars, policy-makers, and the public. No one seems to have any definitive answers to the most profound questions. There is a tendency to agree, however, with Salvaggio's (1983) assertion that no two information societies are quite alike, and thus there will be no uniform answers to the questions about inequity, privacy, misuse, and control of information. I, too, agree with Salvaggio that "the nature of the social problems that information society can expect is dependent on the interrelated nature of such key variables as national ideology, information policy, technology, government policy-making organizations, the market place, and the information infrastructure."

2. Sociocultural benefits and problems in less developed countries (LDCs)

There had been a series of studies (D. Lerner: 1985; O. Lewis: 1961; Rao: 1964; Pool; 1968) which looked into the relations between modernization and access to the media of communication. These correlation studies have shown that few variables are as predictive of modernization as the measures of mass media exposure (Schramm: 1964). Nonetheless, I have been unable to find any attempt to look comprehensively into the questions of sociocultural benefits and problems associated with the new technology in the context of LDCs.

a. New Technology and LDCs: To observe the development of the new technologies from the standpoint of the LDCs is to experience frustration and bewilderment. First of all, LDCs need many things all at once. They need to improve agriculture and to build industries. They need to invest in public health, education, transportation, and the conventional media such as televisions and telephones. To raise an issue of investing great sums to the new technology is almost an absurdity to many LDCs.

Secondly, even if they can and will decide in favor of investment in the new technology, the difficult question of choice persists concerning various components of the new technology. As mentioned earlier, new technology refers, in essence, a convergence between the computer and telecommunication. It is difficult to separate the two. The computers make possible data bases that are concerned with storage and retrieval of information, while the telecommunications technology such as the satellites, televisions, telephone wires using digital computers, coaxial cables and fibre optics are involved in packaging and transmitting information. The two like a bow and arrow, which must exist together for any practical value. What are the LDCs to do then with the information societies sprouting up around them?

However difficult the situation may be, though, no society concerned with its own future can seem to be impervious to the new technology. In the absence of effective coördination by a viable international institution—which history doesn't support—failures to plan ahead would mean that one accepts and blindly follows others' plans with the consequence that one benefits little and suffers a lot. This should remind many of the plights of the LDCs whose failures to adapt in time to global transformation brought about by the industrial revolution resulted in many difficulties like colonialism and fragmentation, and in few benefits like lower mortality rates, which are to be later associated with difficulties such as the population explosion and poverty. Despite the difficulties, therefore, one needs to be alert to the changes in global environment and sensitive to the opportunities offered by them.

b. Indian and Other Examples: India is a poor country, but it has been rich in its desire to develop satellite communications and a total, autonomous space program. In the nearly two decades, "India has been involved with satellite communications, it has made great strides toward autonomy in its space program (Pirard, 1986)." Thus far, the Indian satellite program has achieved certain benefits in the four areas: (1) meteorological observations for routine surveillance and tracking of tropical storms, for precise forecasts of cyclones and monsoons; (2) remote sensing multispectral data to detect short-period changes, to identify environmental problems, to evaluate agricultural resources, to manage food and energy; (3) national communications throughout the Indian territory, especially for emergency situations with mobile terminals; and (4) radio and television broadcasts to small direct reception sets for instructional information and educational purposes.

After years of proposals and counterproposals, the Chinese government has finally adopted a course of satellite-TV classes as the fastest way to upgrade the qualifications of its more than eight million schoolteachers.

Algeria, South Africa, Israel and many others have purchased transponders through INTELSAT for certain limited and specific use. Of course, nearly all countries utilize satellites for interoceanic telephone lines or for major event coverage like the 1986 Philippines political turmoil or the world Olympics, etc.

c. Concluding Observations: From the analysis thus far, it seems that a full-fledged involvement in the new technology of the information society is beyond the capabilities—maybe even the desirabilities—of most LDCs. Nevertheless they cannot be indifferent to it, for there is a risk in their being reduced to a new kind of colonialism—informational or cultural—as well as economic or political. A practical option may have to be making of a limited investment in training a generation of highquality of what may be called "the electronic elites." It would be difficult to find a place for their education, for the business of new technology is intensely competitive and thus secretive. With certain capital investment possibilities for technical development at their disposal, though, they may become a vital link between the emerging information societies and the present-day LDCs. As they help their countries to take small steps into the information world, there must be a close social-scientific monitoring of the benefits and problems from each step. They may find themselves in an ironically fortunate position of harvesting the benefits and of minimizing the problems from oberving the experiences of the more advanced information societies.

References

Alnes, Stephen

1981 *Telecommunication: A Picture of Change*, Minneapolis: Upper Midwest Council Report, May.

Arlen, Gary

1983 "Videotex: Videotex Goes On-Line," *Channels*, November/December.

1984 "Videotex Not a Popular Road," *Economist*, 290, March.

Borsos, Charles

1984 "World Network Development: The Critical Points," *Telephony*, October: 43-54.

Brown, Lee

1982 "Cable TV: Wiring for Abundance," *Channels*, 1983 *Field Guide*, November/December.

1983 "Perspective: Beyond Book & Bust," *Channels*, 1984 *Field Guide*, December.

Butler, David

1980 "Telecommunications and Society-Key Policy Issues for the Future," *Telephony*, February: 38-45.

Dennis, Everette E.

1983 "Het Off the Satellite," *Northwest Orient*, 14 June.

DeFleur, Melvin & Dennis, Everette E.

1985. *Understanding Mass Communication*, Boston: Houghton Mifflin Co.

Donnelley, William J.

1981 "The Emerging Video Environment, Now York," *Young and Rubicam Issues*, 12.

Douglas, Alexander S.

1981 "Computers and Communications in the 1980's: Benefits and Problems," *Computer Networks*, February: 9-14,

Durand, Philippe

1983 "The Public Service Potential of Videotex and Teletext," *Telecommunications Policy*, June: 149-162.

Dymmel, Michael D.

1979 "Technology in Telecommunications: Its Effect on Labor and Skills," *Monthly Labor Review*, January: 13-19.

Graham, T.T. Molitor

1981 "The Information Society: The Path to Post-Industrial Growth," *The Futurist*, April: 23-30.

Hupe, Howard H.

1975 "Telecommunications and Education—A Systems Approach," *Bulletin of ASIS*, June/July: 19-20.

Jassawalla, Meheroo

1984 "The Economist Implications of Satellite Technology and the Industrialization of Space," *Telecommunications Policy* (*UK*), September: 237-248.

Leff, Nathaniel H.

"Externalities, Information Costs, and Social Benefit-Cost Analysis for Economic Development: An Example from Telecommunications," *Economic Development*

& *Cultural Change*: 255-276.

Lerner, Daniel

1958 *The Passing of Traditional Society*, Glencoe, Ill.: Free Press.

Lewis, Oscar

1951 *Life in a Mexican Village: Tepozilan Restudied*, Urbana, Ill.: University of Illinois Press.

Mahony, Sheila et al.

1979 *Keeping PACE with the New Television*, New York: Carnegie Corp.

Nyheim, Jan Henrik and Rikskringkasting, Norsk

"Planning: Looking Forward to Creativity," *InterMedia*, September: 36-37.

Parker, Edwin B.

1975 "Networks for an Information Society," *Bulletin of ASIS*, June/July: 12-14.

Pirard, Theo

1986 "India Rich in Telecommunications," *Satellite Communications*, May.

Ryu, Jai Poong

1983 "Social Impact of Electronic Development," *Tradition & Change in Korean Society*, Seoul: Bummoon Sa (in Korean language).

Salvaggio, Jerry L.

"Social Problems of Information Societies: The U.S. and Japanese Experiences," *Telecommunications Policy*: 228-242.

Schramm, Wilbur

1964 *Mass Media and National Development*, Stanford: Stanford University Press: 48ff.

Smith, Anthony

1982 "Information Technology and the Myth of Abundance," *Daedalus*, 3 Fall.

Staelin, David H.

1979 "Expanding Broadband Switched Communications Network," *Satellite Communications*, January: 26-30,

Sukerman, Lawrence

1983 "Pay TV: HBO & the Also-Rans," *Channels*, November/December.

Traub, James

1983 "Satellites: The Birds That Make It All Fly," *Channels*, November/December.

Veith, Richard H.

1980 "Informatics and Transborder Data Flow: The Question of Social Impact," *Journal of the ASIS*, March: 105-110.

Wagner, Graham A.

1984 "Telecommunications Policy-Making in New Zealand During the Last Two Decades," *Telecommunications Policy*, June: 107-126.

Weaver, David H.

1983 *Videotex Journalism, Teletext, Viewdata and the News*, Hillsdale, N.J.: Lawrence Erlbaum Associates.

Wicklein, John

1981 *Electronic Nightmare, The New Communications and Freedom*, New York: Viking Press.

Williams, Frederick

1982 *The Communications Revolution*, Beverly Hills, Calif.: Saga Publications.

Von Puttkamer, Jesco

1979 "The Industrialization of Space-Transcending Limits to Growth," *Futurist*, June: 192-197, 199-201.

(Magazine and Newspapers)

"Telecommunications-Historic Values Meet the Coming Information Society," *Commerce America*: 4-6, March 1, 1976 Journal Paper.

Salmans, Sandra 1984 "Cable Operators Take a Bruising," New York Times, March 4, Sec. 3 : 1.

"Satellite Communications" Magazine, March, 1986

"Institute of Electrical and Electronics Engineers Spectrum," Magazine, August, 1985

"Institute of Electrical and Electronis Engineers Spectrum," Magazine, November, 1985

Intelsat Booklets.

"Satellite World Dictionary" by Comm Tek Publishing Co.

"Channel Master" Satellite TV booklets.

Appendix: Historical Development of Satellite Communication

The earliest known beginning was in ancient China, some say, about 2000 years before Christ. The Chinese artisans were already launching the first rudimentary rockets, putting their festive fireworks displays into earth suborbits of several hundred feet or so. This "state-of-the-art" in satellite technology was to remain constant, until the basis of modern celestial mechanics was developed by Sir Issac Newton at the end of the 17th century. With creation of calculus and advances in the science of astronomy, the necessary theoretical models needed to launch an artificial satellite into earth orbit were available. However, another 250 years would pass before rockets were developed with enough power to test these theories.

In 1903, the Russian physicist, K.E. Tsiolkovsky, published a paper on the use of high energy liquid-fuel rockets. In 1926 the American scientist, Robert H. Goddard, launched the first liquid propellant rocket and the space was on. The Germans recognized the military significance of the rocket, and built thousands of "V-2s" which rained death and destruction on a wartime London.

A science fiction writer, Arthur C. Clarke first thought seriously in 1945 about the possibility of communicating via an artificial satellite. As a space enthusiast and a member of the British Interplanetary Society, Clarke was already thinking about ways to put objects into space and what they could do once they got there. He first revealed his ideas about geostationary(1) satellites in an article in "Wireless World" magazine entitled "Extraterrestrial Relays." He recognized the potential for rocket launches based on the German V-2 work during the war, and also the conspicuous advantage of the geostationary orbit. He proposed that these satellites be used for FM voice broadcast rather than for telephone service. Clarke also foresaw the use in space, of electric power generated by panels of solar cells. Implementation of his idea still had to wait for the Space Age(Sputnik 1957) and solid-state technology.

The Russians were first in space in 1957 with the successful launch of

(1) meaning "the geosynchronous Equatorial Orbit" sometimes known as Clarke's Belt. Unique orbit in which a body can remain essentially stationary relative to earth coordinates, 22,245 miles or 35,592km above the equator.

SPUTNIK I, a satellite about the size of a football that carried a tiny radio transmitter aloft. Shortly thereafter, the United States had launched its first satellite, EXPLORER I, whose on-board instruments detected the presence of the hitherto unknown VAN ALLEN radiation belt, which surrounds and protects the earth.

The Early Years of Satellites: Moon reflections for radar and communication purposes were repeatedly demonstrated in the late forties and early fifties. In July 1954, the first voice messages were transmitted by the U.S. Navy over the earth-moon path. In 1956, a U.S. Navy moon relay service was estabished between Washington, D.C. and Hawaii. This circuit operated until 1962, offering reliable long-distance communications limited only by the "availability" of the moon at the transmitting and receiving sites. Power used was 100 kilo watts with 26 meter diameter antennas at 430 MHZ.

Through the joint action of Bell Telephone Labs, NASA, and JPL, the ECHO experiment was performed. Successful communications across the U.S. were first established in early August 1960, between Goldstone, CA, and Holmdel, NJ, at frequencies of 960 MHZ and 2290 MHZ. The echo "balloon," in an inclined orbit at 1500 km altitude, was visible to the unaided human eye. Later in the same month, the first trans-Atlantic transmission occurred between Holmdel, NJ, and a French receiving station. This project alerted the entire world to the prospect of the new medium of communications although the specific method was never exploited commercially.

Although passive satellites have infinite capability for multiple-access communications, they are gravely handicapped by the inefficient use of transmitter power. In ECHO experiment, for instance, only one part in ten of the transmitted power is returned to the receiving antenna. Since the signal has to compete with the noise coming from various sources, special lownoise receiver must be used.

The advantge of passive satellites is that they do not require sophisticated electronic equipment on board. A radio beacon transmitter might be required for tracking, but in general, neither elaborate electronics, nor, with spherical satellites, altitude stabilization is needed. Such simplicity, plus the lack of space-flyable electronics in the late fifties, made the passive system attractive in the early years of satellite communications.

It is interesting to note that the first active U.S. communication satellite was a broadcast satellite. SCORE, launched on December 18, 1958, transmitted President Eisenhower's Christmas message with a power of 8 watts at a frequency of 122 MHZ. SCORE was a delayed-repeater satellite receiving signals from earth stations at 150 MHZ; the message was stored on tape and later retransmitted. The 68 kg payload was placed in rather low orbit. (perigee 182 km, apogee(2) 1048km)

The communications equipment was battery powered and not intended to operate for a long time. After 12 days of operation, the batteries had fully discharged and transmission stopped.

The Experimental Years: Aside from early space probes like Sputnik, Explorer, and Vanguard, as well as the SCORE and Courier projects, which were early communication satellites of the record and retransmit type, the major experimental steps in active communication satellite technology were the Telstar, Relay, and Syncom projects.

Project Telstar is the best known of these probably because it was the first one capable of relaying TV programs across the Atlantic. This project was begun by AT&T and developed by the Bell Laboratories, which had acquired considerable knowledge from the early work of John R. Pierce and his associates, and from the work with ECHO passive satellite. The first Telstar was launched from Cape Canveral on July 10, 1962. It was a sphere of approximately 87 cm in diameter, weighing 80kg. The launch vehicle was a Thor-Delta rocket which placed the satellite into an elliptical orbit with an apogee of 5600 km, giving it a period of 2.5 hour.

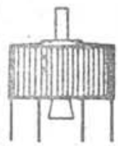
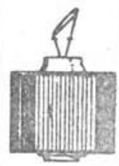
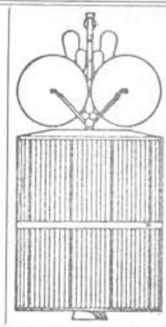
Telstar II was made more radiation resistant because of experience with Telstar I, but otherwise, it was identical to its predecessor. It was successfully launched on May 7, 1963.

The power of Telstar I and II was 2.25 watts. And they were both spin-stabilized Satellites. The overall communication capability was 600 voice telephone channels, or one TV channel. Even though the Telstar was superbly engineered, it was designed as an experiment and was not intended for commercial operation.

On August 20, 1964, a significant event occurred when agreements were signed by 11 sovereign nations which resulted in the establishment of an unique organization—the International Telecommunication Satellite Consortium, known as INTELSAT. This new organization was formed for the pur-

(2) Perigee: Lowest point—minimum altitude—of a geocentric orbit. Apogee: Highest point—maximum altitude—of a geocentric orbit

Table 1.

					Being designed
Name Year of launch	Intelsat I (Early Bird) 1965	Intelsat Ⅱ 1967	Intelsat Ⅲ 1968	Intelsat Ⅳ 1971	Intelsat V ≈1979
Diameter	28inches	56inches	56inches	93inches	600inch sails
Height	23inches	26inches	78inches	111inches	264inches
Weight in orbit	85lbs	192lbs	322lbs	1547lbs	3200lbs
Number of antennas	1	1	1	3	6
Primary power (watts)	40	75	120	400	1000
No. of transponders	2	1	2	12	27
Bandwidth of transponder	25MHz	130MHz	225MHz	36MHz	
Cost of satellite	$3.6million	$3.5million	$4.5million	$14million	≈25million
Cost of launch	$4.6million	$4.6million	$6million	$20million	≈$23million
Design lifetime	1.5 years	3 years	5years	7years	10years
Total cost per year	$5.47million	$2.70million	$1.90million	$4.85million	≈$4.8 million
Maximum No. of voice circuits	240	240	1,200	6,000	≈24,000
Cost/voice circuit/year	$23,000	$11,000	$1,600	$810	≈200

pose of designing, developing, constructing, establishing, and maintaining the operation of the space segment of a global commercial communication of over 100 member countries.

The Commerical Era: Commrecial communications by satellites began officially in April 1965, when the world's first commercial communication satellite, INTELSAT I (known as the "Early Bird") was launched from Cape Kennedy. It was decommissioned in January of 1969 when coverage of both the Atlantic and Pacific was accomplished by two series of satellites, INTELSAT II and III. Interestingly enough, Early Bird was planned to operate for only 18 months. Instead, it lasted four years with 100% reliability.

The fully mature phase of satellite communications probably is best considered as having begun with the installation of the INTELSAT IV into the global system starting in 1971. These spacecraft weigh approximately 730kg in orbit and provide not only earth coverage but also two "pencil" beams about 4 degrees in diameter which can be used selectively to give spot coverage to Europe and North and South America. INTELSAT IV is a spinning satellite, as were its predecessors, but the entire antenna assembly, consisting of 13 different antennas is stabilized to point continually toward the earth. Two large parabolic dishes form the two spot beams. Each satellite provides about 6, 000 voice circuits, or more, depending upon how the power in the Satellite is split between the spot beams and the earth coverage beam. INTELSAT IV can carry 12 colour TV channels simultaneously. See Table 1 for further details of early commercial satellites.