Telecommunications Development and Economic Growth in Northeast Asia

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The benefits of the modern economy are there to be seized by any country, yet few countries have grabbed them more quickly and energetically than the rising economies of Northeast and Southeast Asia. For decades now these countries have succeeded in combining the major factors of economic growth, namely labor, capital, human resources and productivity. In recent years as the Information Revolution has swept across continents, another factor of production has emerged in the form of information and its technology which these economies utilized in various ways.

Asian governments have not provided social insurance, unemployment protection or health care and this lack of government protection is the main reason why Asian social institutions are so strong.[1] These countries have also adhered to strongly-held state monopolies for their telephone and telecommunications sectors and have profited from these monopolies until very recently. This happened because the rate of return on investment has been about 15 to 18 percent which was used by these governments to subsidize other loss-making sectors in state enterprises. With the gusts of technological change sweeping across East Asia, industrial policies were forced to change even in totalitarian regimes like China's. Asian societies embraced and absorbed these changes comprehensively when liberalization of markets became a necessity to benefit from global trade and industry. All sectors of these economies were influenced by new technologies in communications but especially the banking, insurance, transportation and education sectors. The media began to change the way people worked and interacted so that these countries found it imperative to invest greater amounts of their national incomes in the telecommunications sector. This had led to a gigantic modernization of Asia which will reshape the world as we move into the next millennium.[2]

The old Asia was divided by culture, language, political ideology, religious philosophies and geography but with the dawn of the Dragon Century, Asia is being integrated by economic necessity, telecommunications technology and the mobility of information and innovations. This modernization is not the "Westernization" of Asia but the "Asianization" of Asia, implying regional integration and economic development. There are three billion people in Asia, half of them under age

25—a vastly growing market. This is a consumer miracle holding significant economic consequences.

While it is true that information is the most valuable commodity in today's world, it does not come cheap. The World Bank estimates that Asia's Low Income Countries (LICs) will need $90 to 120 billion just to meet basic telephone demand by the turn of the century. The three billion people now living in Asia have only 25 million telephone lines between them. Even within the region, partnerships are emerging in which the more industrially advanced countries are setting up mergers with the less advanced countries to explore their markets. We have to remember that when the economy is growing, the telecommunications industry grows faster (as in China) but even when the economy is slowing, the telecommunications industry still keeps growing. Salomon Brothers estimates that about $8 billion was raised in new equity issues in Asia in 1995 by telecommunications companies alone.

This paper will examine the changes in the telecommunications sectors in China, South Korea, Japan and to some extent in Russia. It will analyze the investment in various equipment and services technologies and focus on the evolution of competition in the markets leading to foreign participation in technology transfer.

CHINA

In the past, China's telecommunications revenues did not come from products or services but from government subsidies to the Ministry of Posts and Telecommunications. If there was a shortfall in the national budget, the telecommunications sector was starved for funds for expansion. But with the liberalization of the telecommunications markets since 1990 this sector was given top priority by the government and network expansion rapidly increased. While the GDP is growing at 12 to 13 percent per annum, the telephone sector has been growing at 41.6 percent annually since 1993. The Ninth Five Year Plan calls for installing ten million telephone lines per year throughout the 1990s reaching 100 million lines by the year 2000 so that there will be 8.5 telephones per 100 persons by the end of the decade. This will require an investment of $100 billion.

During 1994, the Chinese telecommunications sector had two major breakthroughs resulting from enhanced competition and deregulation in the services markets. One significant advance was the investment of $8.5 billion in equipment infrastructure and the other was the addition of 17 million new lines to the public switched network.[3] To add to the new services, 4.3 million new pagers and 900,000 new cellular phones were

added, making China the world's largest market for pagers with a total use of 11 million pagers. It has 1.5 million cellular subscribers. The latest technology of Synchronous Digital Hierarch (SDH), a form of digital switches, is being installed in the major cities taking China to the on-ramp of the Information Superhighway.

The most significant change has been the emergence of competition in the telephone industry. The control of the MPT over China's networks was challenged in 1994 when Unicom was established by the Ministries of Electronics, Railways and Electric Power together with the China International Trust and Investment Corporation (CITIC). Liantong is the Chinese name for Unicom and it is leading China in its ambitious goals for the Golden Projects. These are the Golden Bridge, the Golden Card (for credit users) and the Golden Customs (for computerized customs services). These three are China's version of the National Information Infrastructure now officially called CNII using high speed switching and transmission systems to deliver large quantities of data throughout the country.

While Liantong is the local network carrier, Jitong is the established long distance carrier. But neither can be deemed as China's second carrier because the MPT still controls the market. MPT's data network is called Chinapac and covers 43 cities including those in Northern China. It also has an educational network called CERN (China Educational and Research Network) with a goal of linking 1,000 universities by the year 2000 and providing access to the Internet. The Golden Bridge will provide information about the country's economy and will be owned and operated by Jitong under the Ministry of Electronics. China's financial network will be called Finet and will be owned and operated by the People's Bank of China. All these developments show that the supremacy and monopoly of the MPT is being gradually reduced as China opens up its telecommunications industry to competition and foreign collaboration.

Historically the switching market in China ha been the most difficult for foreign vendors to enter, because it has been the most regulated. In 1990 the State Council gave a directive to equipment purchasers in China that only Alcatel of France, Ericsson of Sweden and NEC of Japan should be considered for foreign collaboration. In 1992 this policy was changed to select suppliers of Stored Program Controlled (SPC) switches. AT&T then entered the market and started a joint venture for the manufacture of switching equipment. However the largest market share (30%) is enjoyed by Alcatel. In the market for supplying switches, the keenest competition is between Northern Telecom of Canada and AT&T, with Northern having invested $150 million. However, in 1994 AT&T reached a joint venture agreement amounting to one billion dollars to manufacture switches,

wireless phones, and integrated circuits in China. China will control 60% of this investment.

Despite the fact that the Chinese are smitten by the telecommunications revolution, there are vast tracts of the country that are still lacking basic services, especially in Northern China. In such areas, mobile services offer the most economic alternative. The cost of laying landlines over difficult territory is much higher than that of supplying mobile services. However the cost to the consumer is too high for farmers in remote areas to afford. For a cellular telephone the cost in remote areas like Mongolia is nearly $5,000, thus the demand for pagers and CT2 mobile telephones which offer a one-way connection. Chinese peasants on an average earn $30 a month and cannot afford to pay $2,000 for the handset alone.

Nevertheless, the cellular mobile market is growing at 100% a year with forty cellular switches and 500 base stations which are not adequate to connect the remote areas. China imports a million pagers a year in addition to domestic production. The equipment standard is the European GSM (Groupe Speciale Mobile) which is a digital standard widely used by Ericsson. Motorola is adapting its equipment for China to suit this standard. Taking a cautious approach, Motorola set up a plant in Tianjin to manufacture pagers in 1992. By 1993, this factory could not keep up with the demand for pagers being sold by Motorola at a retail cost of $200 including service. Motorola has vastly expanded its operations not only for cellular phones but for integrated services, microprocessors and automotive electronics. It now sends Chinese engineers to be trained at its own facilities in Schaumberg, Hong Kong, and Singapore. Soon Motorola will launch its Iridium project for Low Earth Orbiting Satellites (LEOs) in polar orbit so that cellular phones can provide roaming from one area to another. In December 1995, the FCC licensed three big LEOs to launch their systems for global cellular communications—Odyssey, Iridium, and Globalstar.

In addition to the manifold opportunities in China's telecommunications markets in switching, transmission and cellular units, China's satellite industry has also forged ahead. The Great Wall Industry Corporation successfully launched the Asiasat 2 satellite on November 28, 1995. The Long March rocket had failed early in 1995 when its APSTAR 5 blew up 60 seconds after launch. Disputes between Hughes Space Communications Corporation and the Great Wall Industry Corporation continue on whether the launch vehicle or the satellite itself was at fault. China's spending on space communications is expected to grow from $1.0 billion in 1994 to $1.5 billion in 2000. Similarly the demand for commercial satellite transponders is predicted to grow from 50 in 1994 to 110 by 2000. The China

Aerospace Administration (CASA) develops and manufactures satellite systems, applications and launch vehicles. It has launched 37 domestic satellites and will launch 22 satellites for Motorola's Iridium in low earth orbit. The MPT has its own satellites for telecommunications and broadcasting called Dongfang Hong (DFH 2 and DFH 2A). These area known as the Chinasat system. The launch of the third DFH satellite failed to reach geostationary orbit. These satellites are mostly constructed by Lockheed Martin, Loral and Hughes. The greatest beneficiary of China's satellite industry in terms of profits has been Hughes. But there is now a private satellite company in China called Sinosat Communications which has commissioned its satellites from Daimler Benz Aerospace. And Sinosat has established a joint venture with Euraspace.

Despite many risks, China is moving on to the Internet. Cisco Systems of San Jose will provide China with global Internet services under contract from the MPT. It will begin with the CERN network and by 1996 will link 100 universities in China's thirty provinces. Cisco will provide the networking equipment with three high-speed international links known as E1 types (two megabits per second) which will be the fastest in China. Yankee Group of Boston is a consultancy company that estimates that 90% of the backbone of the Internet worldwide is provided by Cisco routers. China, therefore, made a good choice in its Internet investment.

The problem for the MPT is how to combine the Internet with censorship of pornography contributed by individuals. The Minister for Posts and Telecommunications Wu Jichuan while extolling the benefits of the Internet quickly added that unrestricted access will not be permitted.[4] The initial sign-up fee is $36 or 300 yuan and the user fee is 100 yuan for six hours. The problem for Beijing will be to control politically sensitive and indecent information flowing on the Net. The same problem confronts the United States when Senator Exxon's bill becomes law early next year.

Another important contribution to China's telecommunications sector has come from the widespread use of fiber optic cable, both on land and under the seabed. As far back as 1989, AT&T had established a fiber optic cable manufacturing joint venture in Shanghai called Shanghai Optical Fiber Corporation. Its fiber optic cables crisscross the country for thousands of miles. China was able to leapfrog with this technology because it did not have to remove any copper wires. Its late-comer advantage in fiber optic cable was also funded by the World Bank at $623 million, which is being used for laying 620,000 new lines of fiberoptic cables. Even so, the network does not extend far enough into the northern regions or into Mongolia. One submarine fiberoptic cable has been jointly laid by AT&T and KDD for linking Shanghai with Tokyo, and Singapore is

laying a similar cable across the land route linking Shanghai with Ulan Bator.

For the northern regions of China the telecommunications savior has been Intelsat which provides voice, data and TV transmission to most of the northern region. Its satellites are linked to 20 standard A earth stations in 19 provinces. China has been using transponders on Intelsat satellites stationed over the Pacific and Indian Oceans and pays lease rent as a signatory member of the international cooperative.

Over five years ago, the Australian company Telstra constructed an earth station in Ulan Bator for receiving and transmitting signals to Intelsat. China has now leased its geostationary orbit at 87.5 degrees east for the 805 series in return for ownership of 45 percent of the transponders on the satellite. This goes to show that while China keeps its satellite market exclusively for domestic ownership, it uses international suppliers for newer technologies and services.

SOUTH KOREA

South Korea also joined the bandwagon of privatization by liberalizing its telecommunications services. Korea Telecom (KT) is part state-owned while Dacom is in the private sector. Dacom supplies all data services and competes with KT for international services. While the domestic telephone services are currently under a monopoly, it is expected that in 1996 a competitive structure for trunk calls will be in place. The Telecommunications Basic Law was changed in 1991 removing the provision for universal services. Since the entry of Dacom into the market, the issues of access charges became problematic. The same concern underlies the services of Korea Mobile Telecommunications Corporation. This is because access charges follow the principle of cost-based pricing, which does not always produce efficiency, depending on the difference between marginal cost and accounting cost. Dacom was able to enter with 5 percent lower service rates than KT which is not allowed to compete for price changes. This means that the market for Dacom was protected in order to start more competition in the services market.

Now as a result of limited market competition and liberalization of the PTT's monopoly, South Korea is on the verge of a major technological breakthrough. It has launched a successful venture in establishing digital equipment standards. Korea's mobile telephone system is linked to satellites, so that Korea has embraced the new and sophisticated CDMA (Code Division Multiple Access) standard. This is the outcome of a new joint venture set up in 1994 with Qualcom of the United States to

experiment with this standard and start its use by early 1996. This standard will be compatible with the ATM (Asynchronous Transfer Mode) switches which Korea Telecom will use for its integrated systems network in which voice, data and video will all flow from the same pair of fiber cables. The problem with the CDMA experiment is that South Korea does not have software to operate the new standard and will have to import it. Once this is done, South Korean exports will overtake Japanese cellular equipment in global markets.

In March 1995, the Government announced a new plan for a nationwide ISDN (Integrated Services Digital Network) as the first phase of the Korean Information Superhighway. In July 1995 the new Korea Net was started as a testbed for the infrastructure. All this became possible because the government changed the organization of the industry by establishing a new Information and Communication Ministry in December 1994. It was designed to establish the Korean National Information Infrastructure by the start of the 21st century.

Towards this end the government will launch a Basic Rate ISDN network linking 12 major cities with 2.5 gigabits per second optical fiber communication links. This will be extended gradually to cover medium sized cities and by the year 2010 it will cover the entire country. Multimedia services are made possible because of the plans for B-ISDN networks. Some important services which will benefit economic growth will be Telelearning and Telemedicine. Currently the Interactive telelearning applications are being tested to provide equal educational opportunities to the remote and rural areas. Two centers were set up in Hongcheon and Kangwando which will each link five remote regions. At present T1 cables are being used to link elementary schools in the remote regions. Teachers in these areas are now being exposed to teleconferencing for the first time and there is some opposition to this method of two-way learning.

For the healthcare system the installation of telemedicine is a great boon for remote areas to access specialists in the urban centers. Teleradiology and clinical information systems have been started between Kyungpook University Hospital and Uljin Health Center in 1994. Both use 1.5 MBPS optical fiber line and it cost one billion won to start these two linkups.

Modern cable television began in South Korea in March 1995 based on the Cable Television Act of 1992. In theory, cable TV is based on economic reasoning but in actual practice, in some developing countries, it is politically motivated. In South Korea it will generate $2 billion of revenue annually as society moves to pay-per-view systems. Six cable TV network providers were selected. They are KT, Korean Electric Power Company, Goldstar Telcom, Dacom, Kangnam Telecom, and Kunyang

Telecom. Twenty program providers were also selected. Imported foreign programs and collaboration with foreign programmers requires Ministry permission. One government channel has to be provided by all cable TV networks.

The telecommunications sector makes a significant contribution to South Korea's international trade. According to statistics available for 1993 South Korea's exports in the telecommunications sector amounted to $122 billion and imports were $92 billion.[5] The industry has contributed to the manufacture of equipment for all sectors of telecommunications including software for computers and cable TV.

While South Korea uses Intelsat for international services, it decided to launch its own domestic satellite. In August 1995 the Korean Mugunghwa satellite was launched from Cape Canaveral in Florida but it failed to reach the correct geostationary orbit. It is officially called the Koreasat I satellite for broadcasting and telecommunications. Before it was launched, the Erin hurricane had swept across Florida and the launch was delayed. The satellite was 6,000 kilometers short of the desired orbit at 116 degrees east, but since then, onboard thrusters have moved the satellite into its correct orbit and it is functioning as desired. The Delta II rocket of McDonnell Douglas was unable to break away one of its nine boosters. This has cut the life span of the satellite by one year to ten years. Digital direct broadcasting is now available to South Korea from the new satellite. The telemetry, tracking and command station is located at Yongin. It is a powerful Ku-band satellite and will cover the entire Korean peninsula and its neighboring areas. The footprint of the satellite will even reach the Russian Far East and will be able to provide TV programs competitive with Japan's NHK and Star TV. The cost of the satellite was 345 billion won.

JAPAN

Soon after the Diverstiture of AT&T in 1984, the Japanese Telecommunications Business Law was changed to privatize Japan's long held monopolies Nippon Telephone and Telegraph Company and the Kokusai Denshin Denwa on all domestic and foreign communications respectively. But not all the shares of the new NTT were put on the market. Despite a large number of new operators, the share of NTT continued to be the largest in the market. The Ministry of Post and Telecommunications (MPT) put many restrictions on NTT to protect the new common carriers in terms of pricing and profits, but to little avail. For NTT, labor costs constitute only 35% of total cost which makes it difficult to break it up. A Commission was appointed by the MPT to examine the future of Japan's

telecommunications industry. In its report, the Commission was critical of NTT's monopoly. It is 65% state-owned and controls 95% of domestic phone calls. It dwarfs all other competitors in the provision of mobile and long distance calls within the country. The monopoly has become even more entrenched because the physical capital for services belongs to NTT and it charges all its competitors for interconnection, just like AT&T does for MCI and Sprint.

The Study Group's report submitted in October 1995 recommends a further break up of NTT so that its local and long distance units are separated. This would help Japan to exploit the new dynamic businesses now emerging from the convergence of telecommunications, television and computers. Japan may lose its competitive edge if it does not deliver information with speed and in large quantities at an affordable cost. So far, it has been ahead of the United States in laying fiber optic cable for ISDN and introducing digital compression, but lags behind in data communications. It has therefore mounted a strong initiative to introduce fiber to the home by the year 2000. Breaking the monopoly of NTT will help newcomers cut prices and expand services. The only company that gives some measure of competition to NTT is Dainidenden. Cable television has a penetration rate of only 5% in Japan compared with 70% in the United States. Even AT&T has now divided itself into three companies voluntarily to become more competitive and slimmer, so as to focus on the technologies of the future. But the MPT did not act soon enough to restructure NTT and allowed it to become sluggish. The MPT continues to control the budget and the board appointments of NTT. But the reason for NTT's delay in reorganizing itself stems from regulation and from law. Even the 35% of its stock which is listed on the market represents only 1.3% of Tokyo's stock market capitalization.

Despite inflation and high prices in Japan, NTT's profits have been declining. Even though a digital phone line is cheaper to operate than an analog line, NTT has increased its prices by 83% for digital connections.[6] In September 1995, the MPT announced that free access to NTT's network for local calls would be made available to all telephone operators, thereby cutting NTT's revenues by 100 billion yen. Already NTT has spun off the mobile networks, the cellular phone lines and data communications into subsidiary units. Consequently in 1994, it established several joint ventures with American companies to fill the gaps in its technological and managerial organization. For example, it has joint ventures with Microsoft, Silicon Graphics, and General Magic. It also started a venture capital company in Boston with $50 million in start up costs. But because of the vested interests of the labor organization and the high ratio of labor costs to

total sales (35%), it makes it impossible to change the actual management structure to make NTT more efficient.

Japanese companies were among the early pioneers of cellular technology. NTT first marketed a cellular telephone in 1979 and yet Japan has fallen behind other industrialized countries in promoting mobile communications. Motorola was the first company to challenge NTT and was able to enter the Japanese market as a result of the MOSS (Market Oriented Sector Selective) talks. A shortage of radio spectrum and government guidelines was responsible for a geographical division of services in mobile communications. An alliance between the Nippon Idou Tsushin company and Motorola to sell cellular phones using Motorola's system led to a vast expansion of subscribers in the market who are not tied to NTT. Finland's Nokia has also entered the Japanese market and is competing in the mobile sector.

The pace of multimedia development is also progressing in Japan as in other parts of the Asia Pacific region. Japan's NTT has established a number of ties with foreign manufacturers for the provision of multimedia technology. Its alliance with General Magic in 1994 has led to the adoption of Telescript, the U.S. company's programming language, becoming the standard in Japan's message handling communications services.[7] Microsoft is developing the CD-ROM interactive technology for delivering multimedia information interactive technology for delivering multimedia information via analog or digital networks. As different parts of the telecommunications industry converge, Japan is expanding in all sectors including fiber optic submarine cable widely used by KDD for its global connections and satellites like JCSat for telecommunications and broadcasting. Until 1995, Japan's NHK did not allow any foreign satellite company to broadcast programs to Japan, but now it has given permission to Panamsat of the United States to directly broadcast foreign programs to Japanese viewers.

RUSSIA

Russia has always been in the forefront of satellite technology, having launched the Intersputnik system before America even entered the space race. Indeed, its initial successes were the stimulus for President Kennedy to launch the U.S. space program. Its Mir space station was also a pioneering effort in living in space over long periods of time. Its Proton launch vehicle has been used by India, and by the United States for launching commercial satellites. Since 1994, Russia has been selling Gorizont satellites at $50 million each to Rimsat a subsidiary of Tongasat. When Rimsat declared bankruptcy in 1995 it dealt a blow to Informcosmos

and resulted in the Russian Space Agency denying future launches to Rimsat. However, Informcosmos had found a fertile market as a direct-to-home (DTH) satellite broadcast provider in Russia. In November 1995 Informcosmos was responsible for the launch of the second DTH satellite that will provide service to China and elsewhere in Asia. The difficulty is that the United States restricts the number of launches by foreign vehicles carrying commercial payloads into orbit. The Ukraine is also competing in the global market for launching satellites. The Ukraine and China are each allowed 20 launches of U.S. payloads up to the year 2001 under agreement with the government and Russia is also trying to contract for the same number, but so far has been permitted only nine launches.

Russia has highly skilled human capital and since the end of the Cold War has ascribed priority to the telecommunications sector for civilian use. Currently Russia has cellular phones, Sprint services and cable TV. Thee is availability in Moscow of an Internet connection with a 64 kilobit line connected by fiber optic cable; it costs $2,000 to connect. There are several private companies providing services, and former military facilities like IASNET for data communications have now become civilian.[8] It is now possible for Russian citizens anywhere in the country to access Russia On-Line which provides world news. Even persons with average incomes are able to access this service because the monthly charge is $20 compared with $40 for Compuserve in the United States.

Major investors in the telecommunications sector in Russia are banks and investment companies. They have established satellite links with Finland in order to become members of the SWIFT global system (Society for Worldwide Interbank Financial Telecommunications). These services are new and remain very expensive.

While Russia was a latecomer in accessing computer technology, the country now has access to the most sophisticated systems for its educational development. However most of these facilities are clustered in Moscow and St. Petersburg so that the eastern parts of Russia are still starved for data communications. But cellular telephones and pagers are available even in these remote areas. China's 1996 project to lay a fiberoptic cable linking Shanghai to Vladivostok will help this region to access global data sources.

The only computers widely available in Russia are IBM and its clones. Apple computers are not popular. Local distributors are able to give maintenance services to IBM computers. Installing networks for the operation of interactive communications through servers is also readily available in University towns but students can only interact with each other and cannot access global databases. For information search, students can access the WWW and Gopher, but since the subscription rates are high, even students in Moscow have to link up with corporate users and get

connections through them. With the introduction of teleconferencing and video conferencing, tele-education will become more popular. This will provide the means for students in the remote regions and on the eastern seaboard to interact with those in Moscow. While Russia has a long way to go to catch up with other Northeast Asia countries in the installation of new telecommunications technologies, the gap is due more to a shortage of funds than to lack of skills.

CONCLUSION

The common thread that links this analysis of the NEA countries is their desire to establish national information infrastructures and then to join the GII (Global Information Infrastructure). In 1994 at the ITU Conference on Developing Countries held in Buenos Aires, U.S. Vice President Albert Gore described his vision of the GII and urged the policy makers of the developing world to get on its ramp with higher investments in telecommunications infrastructures. His recommendations were echoed around the world and most countries in Africa and Asia are heeding his call with assistance from the ITU (International Telecommunications Union) based in Geneva; all these countries are members.

Another common element in this analysis is that satellite and mobile systems are becoming very popular in NEA in providing services to remote and rural regions are affordable prices. Economies of scale and scope are taking effect, and technological advances are placing these systems within reach of the users in these countries, e.g., fiberoptic cables used for submarine and terrestrial connections of telephones and other value added services like fax, data and video. China is laying these cables with feverish speed while South Korea and Japan want to provide broad band ISDN services to their customers.[9]

The convergence of technologies is challenging these countries in the implementation of their policies. It is not just the technologies but governments that have to provide a framework under which telecommunication companies and cable operators can work together as they converge on other's territory. Telephone services are highly regulated by governments for tariffs and standards, whereas computers are not. Television is regulated only for its programming and pricing. When these three industries converge because of technological advances and multimedia computer services, entertainment, computing and voice and data services all come together. Both markets are important as cable and ISDN require broadband channels. However, the price of broadband is so high that consumer demand is growing very slowly, even in the United States.

Despite this, we have seen that both Japan and South Korea are racing to provide fiber optics to the home. Fixed costs are high and captive ratepayers may become the victims of the Information Superhighway. But the reasoning for it is based on social values such as equipping schools with technology and making telemedicine available to rural areas, along with satellites that beam programs directly to the home. Costs are declining rapidly—by as much as 30% a year for digital services—and it is possible that by the year 2000, NEA will be tied into the global information superhighway. As these countries' citizens begin to appreciate Cyberspace connections across continents, a new world information order will eventually be a necessary international regime.

NOTES

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