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NASA TECHNICAL MEMORANDUM NASA TM-88000

16 P.

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S. L. Ayala

Translation of "Estado actual y desarrollo esperado en la region de America Latina y el Caribe en la esfera de las comunicaciones via satelite," Presented at the regional convention of specialists from the United Nations and the economic commission for Latin America and the Caribbean on science and space technology and its applications, Cartagena, Colombia, June, 1986, pp. 1-24

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, DC 20546 SEPTEMBER 1986

(NASA-TM-88000) CURRENT STATUS AND EXPECTED DEVELOPMENTS IN THE AREA OF SATELLITE COMMUNICATIONS IN THE LATIN AMERICAN AND CARIBBEAN REGION (National Aeronautics and Space Administration) 16 p CSCL 17B G3/32 N87-15395 Unclas 40332

1. Report No. NASA TM-88000	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle CURRENT STATUS AND EXPECTED DEVELOPMENTS IN THE AREA OF SATELLITE COMMUNICATIONS IN THE LATIN AMERICAN AND CARIBBEAN REGION		5. Report Date September 1986
		6. Performing Organization Code
7. Author(s) S. Ayala		8. Performing Organization Report No.
		10. Work Unit No.
9. Performing Organization Name and Address The Corporate Word, inc. 1102 Arrott Bldg. Pittsburgh, PA 15222		11. Contract or Grant No. NASW-4006
		13. Type of Report and Period Covered Translation
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546		14. Sponsoring Agency Code

15. Supplementary Notes Translation of "Estado actual y desarrollo esperado en la region de America Latina y el Caribe en la esfera de las comunicaciones via satelite," presented at the regional convention of United Nations specialists and the economic commission for Latin America and the Caribbean on science and space technology and its applications, Cartagena, Colombia, June 1986, pp. 1-24.

16. Abstract Discusses the present capabilities of various Latin American countries in the area of satellite communications. Covers their current needs in this area and how they are now being met, as well as prospects for future advancements.

17. Key Words (Selected by Author(s))	18. Distribution Statement Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	16	

CURRENT STATUS AND EXPECTED DEVELOPMENTS IN THE AREA OF SATELLITE COMMUNICATIONS IN THE LATIN AMERICA AND CARIBBEAN REGION

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Every epoch, every era has its definitive technological /1* characteristics. For the last 100 years of the industrial age, electrical machines, chemicals, and steel have formed the technological nuclei of our lives. During the last 10 years we have experienced the beginning of what is to come in the 21st century. It will be the age of robotics, biological engineering and telecommunications. Only those countries with social policies capable of nurturing these new technologies will be assured national and international economic equilibrium in the 21st century. Soon we will make the change from the written to the electronic message. Memory "chips" have already grown from 2 to 8 to 16 to 64, and finally to 256K. We are now seeing the personal computer linked to the television, and the Z80 microprocessor will soon be a thing of the past.

In telecommunications, we have seen the rapid development of satellites, digital microwaves and optical fibers. In the short span of one generation, we have gone from the launch of the first artificial satellite in 1957, to manned spaceflight, to putting men and robots on the moon--not to mention devices capable of automatic landing on Mars and Venus, missions beyond Jupiter and Saturn, and even partially reusable space vehicles and /2 orbiting space stations from which we will be able to observe the universe as it was millions of years ago. We have seen the creation of a series special domestic and international communications systems, global systems for meteorological

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*Numbers in the margin indicate pagination in the foreign text.

observations, and systems for maritime navigation and communications, all of which now function as part of our daily lives.

Many countries are orbiting satellites of all shapes and sizes, as determined by their communications, research and military defense needs. In addition to the satellites of the international INTELSAT consortium, there are now the ANIK satellates from Canada, the WESTAR, COMSTAR, SATCOM, SDS, GALAXY and SPACENET satellites from the United States, the MOLNIYA, GORIZONT and EKRAN from the Soviet Union, EUTELSAT and OTS in Europe, Japan's SAKURA, Indonesia's PALAPA, India's INSAT, ARABSAT from the Arabic nations, Brazil's BRASILSAT, Australia's AUSSAT and Mexico's MORELOS, to name a few.

In 1986, 29 years after the launch of the first satellite, there are more than 80 satellite communications systems in the world. The first satellite which retransmitted communications signals to earth in 1985 had a total band width capacity of /3
4 MHz. The INTELSAT VI, to be launched next year, will have a total capacity of 3,366 MHz.

The first prerequisite for any type of space activity has nothing to do with recent technological developments. On the contrary, it is based on scientific calculations of the velocity needed to overcome the earth's gravitational pull. This knowledge was given us by an ancient branch of science, celestial mechanics, which was established when men first measured the movement of the stars and is currently the basis for orbiting and operating a geostationary satellite.

Obviously, activities in outer space would be impossible without the advances in rocket technology, but they would be senseless without the advances in communications technology. Communications satellites are part of the interaction between space and communications technologies.

Thanks to the combination of these two elements, satellite communications have become a key factor in solving the problem /4 of today's communication needs. The basic elements of this solution can be clearly seen if observed from an historical perspective. For the greater part of mankind's history, the words "communications" and "transportation" were virtually synonymous. Both concepts advanced at the same speed as man traveled from one place to another, or when he needed to send something physically from one place to the next, whether by carrier pigeon, over the roads of the Roman Empire, or with the equipment used by Precolombian rulers. Although there were also many different optical signal systems (from the most primitive--smoke or light--to the optical telegraph of the French revolution), for thousands of years the best system for long-distance communications was the beat of drums: the signals were easy to hear, the instruments could be transported easily, and with the proper skill, they could be used to transmit not just simple signals, but complex symbols and concepts that made up authentic messages. There was no change for thousands of years. Books and newspapers were transported physically from /5 one place to the next. If we think about it, at the beginning of the 20th century, it took European governments the same amount of time to communicate with their embassies in Beijing as it took Columbus to let the Old World know of the existence of the New.

On May 25, 1783, Carlos III of Spain issued the "Royal Ordinance on Directing, Regulating, and Governing the Important Mining Corps of New Spain and Its Royal Tribunal", and it wasn't until January of the next year that they were put into effect in Mexico, due to communications problems.

In 1865, the English learned that Abraham Lincoln had been assassinated five days after the fact, but a century later, the world saw Kennedy assassinated via television only minutes after it happened, and in 1969, it saw a live and direct broadcast of Neil Armstrong stepping onto the Moon.

There can be no doubt that communications technology strengthens the bonds between men, promotes the exchange of ideas, aids integration, and facilitates education, culture, and social, political and economic development; in short, it helps us attain the ideals of a better life. The history of /6
technology has brought with it more benefits than disadvantages. The Challenger and the Chernobyl nuclear plant are accidents which will happen due to the risk involved in any technology. Both communications satellites and uranium fusion have contributed a great deal to the mankind's development. The important thing is to make good use of technology.

Latin America has a great tradition in the use of telecommunications media. The first form of electric communications appeared around mid-19th century with the first telegraph services. Between 1870 and 1882 the first telephones were installed, and steps were taken to set up public telephone service. At the beginning of this century, growth was seen not only in urban service, but also in long-distance, since the rapid development of wires for conducting voice signals made distant transmission via telephone cables possible.

Toward the end of the 1950's, we saw the first use of low-power microwave equipment, marking the beginning of /7
wireless communications. In 1968, the first satellite communications took place.

Latin America has taken ample part in satellite communications. At the end of the 1960's and the beginning of the '70's some of the countries in this region had already built ground stations for international communications; currently, 25 countries have large antennas for communicating with other regions of the earth.

In principle, a good way for countries with economic limitations to set up domestic satellite communications services is by leasing the capacity of INTELSAT satellites. Brazil was the first Latin American country to begin operating in this way in 1974.

Argentina, Chile, Venezuela, Colombia, Peru, Trinidad Tobago and Mexico have since joined Brazil. As we all know, Brazil and Mexico now have their own system of domestic communications satellites. This alternative--setting up the required infrastructure using the leased segment--has the advantage /8
that, initially, major investments for operating and controlling an orbiting satellite are not needed, and efforts can be concentrated on setting up the ground network. The disadvantage is that with an INTELSAT satellite there are power limitations for optimizing the ground segment's technical parameters; however, if there are few stations, this disadvantage is compensated by the relatively low initial cost of renting the space segment.

Brazil operated 65 ground stations, renting 7 transponders for telephone and television services. Brazil currently has more than 100 ground stations linked by its own system of satellites. The satellites are the HS-376 type and operate on Band C.

For its part, Argentina has 37 ground stations and leases a capacity equivalent to 1-1/2 transponders for telephone, radio and television services. This country has done serious feasibility studies on setting up its own satellite system, /9
but to date has not made a final decision on acquiring one. Colombia has 22 ground stations and leases a capacity equivalent to 1 transponder. The Colombian government has coordinated studies aimed at setting up a domestic system as part of the new national telecommunications plan.

Chile has 4 ground stations and rents half a transponder for telephone services.

Peru has 6 stations for telephone and television and rents 1-1/4 transponders.

Venezuela has nearly 20 ground stations and rents a capacity equivalent to one transponder for relaying television signals.

Trinidad Tobago has 2 ground stations for receiving television signals.

The Andes Pact nations studying the possibility of setting up a satellite system for 1990 to serve the countries of that /10 region.

I believe a good alternative for some Latin American and Caribbean countries is that of several countries acquiring a jointly owned satellite.

Mexico has the Morelos satellite system made up of two hybrid HS-376 series satellites, and 242 ground stations for long-distance telephone service, television, data transmission, teleconferencing, and rural telephone and television. Each satellite consists of 22 channels or transponders, of which 18 are in Band C and 4 are in Band Ku. In Band C there are 12 transponders with a band width of 63 MHz and six transponders with a band width of 72 MHz. In Band Ku, the band width of one transponder is 108 MHz.

The satellites are operated from a control center in Mexico City by Mexican engineers and technicians.

Obviously, satellite communications have developed /11
rapidly in Latin America. There are more and more ground

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stations in these countries every day. Each Latin American country has its own specific needs. Brazil, for example, needs to communicate with the Amazon region, which makes up two-thirds of the Brazilian territory and has many isloated towns where conventional communications media are both costly and virtually impossible to set up in the immense jungle.

In Mexico, several factors led in 1980 to a project for a satellite system known today as the "Morelos": the saturation of the microwave network at some points, the potential for accessing territories which, because of difficult terrain, cannot be linked to the rest of the population, the guarantee of an orbital position with an area convenient for Mexico, and the flexibility and quality of satellite service. In 1983, the Mexican government decided to continue the project, and aimed to begin operating the system in 1985.

Our countries have very similar communications needs; /12
they must expand telephone service to all regions, their television networks lack the desired national coverage, and the domestic channels they operate are not received by the entire population. Data transmission networks with various speeds for private and governmental services must be expanded and improved. A great percentage of the population is located in isolated rural areas, which makes communications slow and difficult.

The following are the factors which should be analyzed when a country is setting up its own satellite system:

The size of the country or countries
The number of isolated, hard-to-reach towns.
The need to expand telecommunications services.
The state of ground infrastructure.

The need to establish telecommunications services at specific points, whether with mobile ground stations or fixed ground stations. /13

The orbital position to be occupied.

Today, approximately 24 transponders are in use in Latin America, and a 15% annual growth rate is anticipated.

Most satellite communications in Latin America operate on Band C and, to a lesser extent, on Band Ku. Only Mexico has transponders in this band.

The capacity and use of these bands depends on several factors, principally the following: demand, investment in ground infrastructure, maximum utilization and, of course, technical considerations. As we all know, the main reason for using frequencies greater than 10 GHz is to make better use of the radioelectric spectrum, i.e. the congestion in Band C. Both in space and on the ground, this is a restriction, so that all satellites cannot be designed for this band. Therefore, Band Ku is an alternative which gives satellite communications systems greater flexibility to expand, both in space and on the ground.

Band C has been traditionally preferred due to better /14
propagation conditions, principally in rain. Also, Band C electronics are well-known and, up to now, less expensive. This band's chief limitation, however, is interference, both in space and on the ground, and under certain circumstances, large-diameter antennas are required.

A satellite's technical characteristics depend on the particular country's needs. For example, Indonesia's satellite was designed for domestic service to a population of 120 million living on 5,000 islands which cover an area of 3,000 miles. This includes television, radio, telephone, telegraph and governmental traffic services.

Canada put the ANIK A-I and II satellites into orbit in 1972, and the ANIK II and III in 1973 and 1975, respectively. These satellites each had a 12-transponder capacity, and operated in Band C. Today the ANIK D satellites have replaced the ANIK A's and B's. The ANIK D's operate in Band C and have a 24-transponder capacity. In addition, Canada now has the ANIK C's operating in Band Ku with a capacity equivalent to 32 television signals. This has made it possible for Canada to integrate /15
marginal minorities from its northern regions into the rest of its population.

Brazil put its first communications satellite into orbit in February, 1985. The satellite had a 24-transponder capacity in Band C, and 33 DBW power, so that it could cover this country's 8.5 million k^2 territory and service its 120 million inhabitants. Brazil has recently launched its second communications satellite.

The United States' WESTAR satellites can be applied to broadcasting, telegraph and telephone systems. The HS-333's and the HS-376's have 12- and 24-transponder capacities, respectively. A hybrid satellite with 12 and 4 transponders in Bands C and Ku, repsectively, is also in operation.

The use of satellite communications, like any other electronic transfer of information, is part of telecommunications, as defined internationally. Telecommunications and electronic information were formerly two independent /16
activities. According to the minutes from UIT's 1979 world conference on radiocommunications, telecommunications is defined as the transmission, emission, or reception of signs, signals, writing, images, sound or information of any kind by filament, radioelectricity, optical means, and other electromagnetic systems.

From the user's point of view, the following setups for satellite telecommunications services are available:

1. One or more satellites totally dedicated to servicing a sole user.

2. Part of one or more satellies (for example, one transponder or one channel) dedicated to servicing the user, while other parts are dedicated to other users.

3. One satellite serving the needs of several users, each leasing a part of the satellite's capacity, but not a physical part of the satellite itself.

4. Occasional use of a satellite which is part of the general services offered by domestic telecommunications agencies. /17

These services should be adapted to each country's standards.

For example, in Mexico, Article 2 of the Consititution states that satellite communications are reserved for the state. The participation of other sectors is specified in Article 11 of the Law on General Means of Communication, which reaffirms that only the federal government, through the Secretariat of Communications and Transportation, can use satellites and international linkups to relay signals. Article 4 indicates that, when the Secretariat of Communications and Transportation cannot supply these services, authorized concessions for telecommunications services can, under Article 392 of the Law on General Means of Communication, set up the required ground stations, transfer the property to the federal government, and pay the fees for relaying signals set by the Federal Law on Services. Article 5 clearly states that telecommunications concessions can receive authorization from the Secretariat of Communications and

Transportation to set up ground stations for receiving signals from domestic satellites which need not be transferred to the federal government by the petitioners. It is important to emphasize that regulations should be drawn up and interpreted in such a such a way as not to limit widespread use, in order to expand each country's domestic communications.

In addition to the support provided by satellites as a complement to the telecommunications infrastructure, they help achieve important progress in the development of telecommunications technology.

Countries which have satellites also acquire extensive experience in controlling and operating them. Learning the setup and behavior of the various subsystems makes greater independence in this branch of technology possible. These countries can then integrate a control center or perhaps participate in the design and construction of new generations of satellites. /19

Also, even without owning satellites, these countries can develop capabilities in other areas, for example, designing and optimizing linkups for different services or for optimizing the use of transponders with the ground segment. In addition, technical personnel is trained in the installation, operation, and maintenance of ground stations, using the latest technology.

Developing these resources makes it possible for Latin American countries to become increasingly independent in this branch of technology. Here we must emphasize that the engineers graduating from our universities are qualified to participate in important telecommunications projects; however, it is also important to continuously update curricula. It gives great satisfaction to note that there is a constant effort in the engineering schools to keep the curricula up-to-date. In some universities or technological centers, basic subjects fundamental to a career in communications are offered on the undergraduate level. In addition to electronics, students must take courses in electromagnetics, signal analysis and modulation, digital /20 communications, radiation and propagation, communications, satellite and microwave circuits, and digital signal processing, among others.

There are institutions with postgraduate studies in communications, and on this level, more in-depth knowledge is offered and the career's spectrum is broadened.

Interest in continuous education must be maintained, and enhancement courses offered to professionals in the field.

Satellite technology incorporated into telecommunications systems is an important contribution to a country's social and economic development.

Laying long-distance cables is now a thing of the past. There will be fewer and fewer installations for microwave links because only two antennas are needed for more powerful and better quality coverage of great distances.

Given Latin American countries' common telecommunication needs, as previously described, one satellite for one or more /21 countries has specific applications for expanding television coverage, whether recreational, cultural or educational. Many services can also be extended: teleconferencing, long-distance telephone, public or private, data distribution and interactive networks such as bank, news or governmental networks, to name only a few. Satellites can offer access to rural populations which, due to their geographic location can not be serviced with conventional media, and populations serving as traffic nodes for connecting neighboring communities with traditional media.

The number of telephone lines will grow considerably in the next few years and the use of digital technology will intensify. Therefore, important growth will be seen in the area of long-distance circuits.

There will be considerable demand for satellite communications equipment in the years to come. Ground stations which receive only television signals, television reception stations with the capacity for telephone channels for rural /22 areas, and private network ground stations for voice and/or data can be manufactured in Latin America.

We know that we are limited in the areas of integral circuits, semiconductors, and radio frequency and test equipment, and in many cases, in the most important area: the human factor. Although it is true that the first steps have been taken, a sustained effort must be made to develop the basic personnel needed.

Some Latin American countries already have a well-developed capacity for producing equipment up to the UHF frequency. However, the manufacture of microwave equipment is only just beginning, with the exception of Brazil, where it has become highly developed in the past few years. In Mexico, for example, the telecommunications industry manufactures television reception stations and, in a few cases, equipment capable of transmitting.

The demand for rural telephone and data network equipment is a good market in Latin America, and we believe that this equipment can be developed in those countries. /23

Although some parts, such as solid state devices and integrated circuits (VLSI), must be imported, we can manufacture printed boards, antennas, and the mechanical structures, among other things.

Since the problem is complex, research in this field must be promoted and fortified.

There are currently joint efforts with industry and educational and research centers, but a coordinated effort is needed to achieve the capacity for manufacturing ground stations.

In addition, it is important to keep the curricula of institutions of higher learning up to date; the areas of microwave electronics, microprocessors, digital communications and satellite systems must be enhanced.

Our experience in television reception systems allows us to develop new, more versatile systems.

In addition to traditional communications sytems, such /24
as telephone and television, the affiliation of the computer with telecommunications and the extraordinary development of both have marked the beginning of the future of data networks and digital networks for integrated services.

It is now widely recognized that an efficient, well-developed telecommunications system is fundamental to any economy.

Without a good telecommunications system, a society's growth will be limited. Telephone and data transmission between computers, for example, facilitates the exchange of ideas and information, thus facilitating a country's diverse activities. Good telecommunications are at once the cause, consequence, and manifestation of development, and one of the numerous factors contributing to the economic growth and industrial expansion of any nation.