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A CASE STUDY OF THE ADOPTION OF THE MORELOS SATELLITE SYSTEM

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Jorge A. Borrego Flores

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SATELLITE COMMUNICATION TECHNOLOGY IN MEXICO: A CASE STUDY OF THE ADOPTION OF THE MORELOS SATELLITE SYSTEM

By

Jorge A. Borrego Flores

Michigan State University

Department of Telecommunication

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ABSTRACT

SATELLITE COMMUNICATION TECHNOLOGY IN MEXICO: A CASE STUDY OF THE MORELOS SATELLITE SYSTEM IN MEXICO

By

Jorge A. Borrego

The present work deals with satellite communication technology and its adoption by Mexico in 1985 for domestic applications. The five-year adoption planning process is reconstructed. Mody's context-analytic framework (1987) is used to outline the domestic and foreign forces that influenced the decision and the nature of subsequent domestic applications in Mexico. The case study concludes with implications for dependency theory and the practice of technology transfer in Third world settings.

With special dedication to my father and to those who believe in indigenous development of science and technology in Latin America.

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CHAPTER I

OBJECTIVES OF THE STUDY

1. Introduction

In the last two decades, the rapid expansion of telecommunication system has been one of the government's main priorities.

By the end of 1985, the Morelos Satellite System (MSS) was officially inaugurated. Mexico is now member of the exclusive group of developing countries with its own domestic communication satellite. The hybrid (C and Ku-band) spacecrafts were built by the U.S. Hughes Aircraft Corporation and were successfully launched by the National Aeronautics and Space Administration's space shuttle service.

a) Problem setting

Mexico acquired the Morelos Satellite System (MSS) on a "turn key" basis, with only a two-year training program for Mexican engineers. There was a very little transfer of technology in the contract with the Hughes corporation. The training was in operation and maintenance of the system.

Few countries have a national policy on new information technologies. Mexico is among the many who do not. No attention has been given to indigenization of the hardware in the space and earth segments. Applications of this imported technology have not been planned systematically either.

The indigenization of technologies, such as aerospace, telecommunication and computers, can be conceived only in those countries where there are high level scientists and national scientific research institutions. In Mexico, Universidad Nacional Autonoma de Mexico (UNAM) was one such. The Faculty of Sciences was founded in 1939. The institutes of astronomy, mathematics, physics and geophysics respectively were founded in 1929, 1935, 1938 and 1949. The links between the university, research centers, and governmental agencies has been very poor and their relations frequently competitive, resulting in little pioneering collaborative work.

At the present time, only 12 of 22 transponders on Morelos I are being partially used. This is 32% utilization of the channels as of September 1987. (Boletin Interno, Direccion General de Telecomunicaciones, April 1986; Landeros, 1987; Heller 1988.) Morelos II was sent into a storage orbit, in which it has remained for about three years; it is expected to commence operations by the end of 1988. Telefonos de Mexico, the government majority-owned telephone company, was to be one of the main users of MSS. The 1985 earthquakes, however, severely damaged the telephony infrastructure of the Mexico City metropolitan area, delaying many of its expansion programs.

Morelos has become a political issue in Mexico, because the State has been unable to successfully justify the program. The main contention is that Mexico has not generated its own high technology, capable of being linked to other development projects like microelectronics, computers and similar areas, reducing dependence on foreign suppliers. The contract with Hughes did not include a technology transfer program that could have benefited space researchers in Mexico such that a major component of the next generation satellite could have been built in Mexico.

I will describe and analyze how and why Mexico decided to implement satellite-based telecommunication technology and what the status of the MSS system is at present.

This is a case study of Mexico's implementation of the Morelos domestic satellite system (MSS). The main focus of this study is to determine whether or not the Morelos Satellite System has increased Mexico's technological dependence on trasnational manufacturers. Although this is primarily a case study of Mexico, to some degree I will compare Mexico's method of adoption of satellite technology with that of Brazil's.

Mexico's rapid implementation of satellite technology offers the potential of expansion and improvement in its national telecommunication system, making the country more competitive. Mexico's diversifying economy needs a better communication system to meet the challenge of the "new international economic environment".

"The functioning of any society depends upon information, and the efficient communication of it among society's members. In the broadest sense, the social, cultural, political and economic institutions in all societies are defined in terms of the characteristics of the shared information within those institutions. In the narrower economic sense, it has been recognized generally that the most important resource determining the efficiency of any economy, industry, production process, or household is information and its effective communication. The characteristics of information define the state of knowledge" (Melody, 1986 p.24).

b) Overview

This thesis is organized as follows. The first chapter describes the study's objectives and background of the Mexican satellite system.

Chapter two includes the working hypothesis of the case study, and a summary of the literature to support the research questions.

Chapter three contains the methodology and the rationale for conducting an analytical case study.

Chapter four reviews the literature on conditions under which adoption of technology can lead to national self-reliance as opposed to dependence on the transnational corporate system. A contextual analytic framework is presented to understand the influence of the foreign and domestic socio-economic and political environment on the project. Lessons from the adoption of satellite technology and its diffusion, in India and Brazil are presented, focusing on the greater attempts at technology indigenization in these nations.

Chapter five analyzes Mexican government policies and the stakeholders in the decision-making process which brought about MSS. It includes information from interviews with scholars, people in public and private institutions, intellectuals and officials of the Secretaria de Comunicaciones y Transportes.

Chapter six offers conclusions and suggestions for further study.

2. Background of the Morelos satellite system (MSS).

The Morelos satellite system began with the successful launch of Morelos I in June 1985, and Morelos II in November of the same year. At present, only Morelos I is being used, meeting the telecommunication needs of the country (New York Times, Tuesday, November 26, 1985, p. c13). Morelos II was sent into a storage orbit, in which it will remain for three years due to lack of demand. It will begin operations at the end of 1988. Placing the second spacecraft in a storage orbit significantly extended the life of the system. (New York Times, November 26, 1985 p. c13) .

Most of Mexico is a high plateau. There are lowlands in the north, and in the east and the west are the Sierra Madre Oriental and Sierra Madre Occidental mountains. The total area of Mexico is 776,604 square miles. It has more than 80 million inhabitants; approximately 65% live in 7000 urban areas (towns with more than 2,500 people); most receive television, telegraphy and telephony services, (Sanchez Ruiz, 1984; Garrido, 1985); however, about 20 million people (25%) living in the small villages do not have any telecommunication service (Sanchez Ruiz, 1984).

One of the Mexican government's priorities is to provide rural areas with telegraphy, telephony, and television services. In the initial phase of this plan, 14,000 villages, (each with 500-2500 inhabitants), have been targeted for provision of these services (National Development Plan 1983-1988).

Mexico's first involvement with satellite communication occurred in 1968, when it hosted the Olympics Games. Regular use of communication via satellite for domestic use was initiated in 1980, when Mexico rented three channels on the INTELSAT IV-AF7 spacecraft. Televisa, the broadcasting company, leased additional transponders the same year on a Western Union satellite (Senzek, 1985).

The contract for the Morelos satellite system was awarded to Hughes Communication International for US $92 million, against competition by Ford Aerospace, Europe's Satcom (Matra, British-Aerospace, and Thompson-CSF) and RCA. The contract included: two Hughes HS 376 series satellites, a master control station for telemetry and telecommand, which is located in Iztapalapa, in Mexico City and training of personnel (Morgan, Garrido, Senzek, 1985).

Another contract for US $11.2 million was given to McDonnel-Douglas Corporation for the payload assist module (PAM) to power the satellite to an elliptical transfer orbit. (Garrido, Senzek, Morgan, 1985).

The total cost of the MSS was around US $150 million, including the launch service by NASA's space shuttle service, which was valued at US $24 million. Financing of Morelos was obtained through the United States Export-Import Bank, which guaranteed, (Private Export Funding Corporation of New York provided loan, Export-Import Bank guaranteed it), a US $127.5 million loan to Nacional Financiera, S.A., the Mexican government financial institution. Other actors involved in the contract were: COMSAT, which supervised the construction and launching of the system; INSPACE, the international insurance corporation, and Aseguradora Mexicana, the Mexican insurance company. (Sistema de Satelites Morelos, Secretaria de Comunicaciones y Transportes, Direccion General de Telecomunicaciones, 1985).

The MSS had two Hughes HS-376 hybrid (C and Ku Band) communication satellites with 22 transponders which included:

- 12 narrowband 36 MHz channels in the "C" band 6/4 GHz;
- six wideband 72 MHz channels in the "C" band 6/4 GHz, and
- four 108 MHz channels in the "Ku" band 14/12 GHz (Sanchez Ruiz, 1984; Garrido, Long, Senzek and SCT, Mexico 1985. (For additional technical specifications see Appendix A).

The flexibility of this hybrid system would allow the provision of a variety of services in the "C" and "Ku" bands, such as rural telephony, rural tele-medicine, oil exploration, educational television, and agriculture extension programs. A center for telemetry and tracking control has been operating in Iztapalapa in the Mexico City area. A network of 243 earth stations has been fully operational using the MSS for domestic television, telephony and data transmissions services (Sanchez Ruiz, 1984; Garrido, Long, Senzek, 1985).

The official operator of the MSS is the Secretariat of Communication and Transportation, (SCT) through the Directorate General of Telecommunications (DGT). The main department in charge of the operation, administration and promotion of the satellite services is the Subdireccion de Explotacion de Satellites Nacionales, inside DGT.

The main users of the MSS are:

-TELEVISA, Mexico's largest privately operated broadcasting corporation;

-IMEVISION, the state television network which includes the Polytechnical Institute educational Channel 11;

-Telefonos de Mexico, S.A., a joint government and private ownership company, which has been using satellite circuits to route traffic to major cities like Mexico City, jara, Monterrey, and Hermosillo. (SCT, 1985);

-Petroleos Mexicanos (PEMEX), the State-owned oil company which has been using a 1/10 of a transponder for telephone and data transmissions between Petroleos Mexicanos's headquarters in Mexico City and production sites in the south and offshore oil installations (Senzek, Long, 1985);

-Radio networks, OIR, RADIO CENTRO, and RASA;

-major banks such as BANCOMER, BANAMEX. (Nationalized in 1982); Mexico's largest newspaper El Nacional;

-Hospital Infantil de Mexico which has been using a transponder for a tele-medicine program.

(For a detailed description of present and future users of the MSS, see Appendix D).

Under the National Development Plan, 1983-1988, Mexico's telecommunication systems will require 1000 earth stations and 34 transponders. By 1995, 42 transponders would be required. Morelos I is expected to run out of fuel by 1995, and three years later, Morelos II will have completed its operational life (Federal Executive Power, NDP 1983-1988, May 1983, Mexico).

Table 4 (list of tables) shows the present and the future users of the Morelos system as of September, 1987. This table contrasts with tables 1, 2, and 3 in chapter V, (also, in list of tables) which based on the latest study conducted in 1985, shows that, although the potential demand existed, only 1/3 of the capacity of Morelos I has been utilized.

This chapter has introduced the Mexican satellite project and the objective of this study. The next chapter will present the research questions.

Chapter II

RESEARCH QUESTIONS

The main research questions are:

RQ1:

The adoption of the Morelos Satellite System was not as systematically planned as was the system in Brazil.

By systematic planning, I refer to the participation of different government agencies, like the education, health and space research institutions to coordinate the planning of the domestic satellite system.

RQ2:

The adoption of a satellite system was not based on a national assessment of needs of Mexican society. It was proposed and promoted by self-interested individual government and private groups.

For research question two, by national assessment of needs of Mexican society, I refer to the participation of the Congress, where a special committees could have reviewed the project, in cooperation with the National Council of Science and Technology (CONACYT), UNAM's Space Studies Department, the Polytechnic Institute, and other concerned agencies to provide a consensus on the acquisition of this new technology.

RQ3:

The applications of the Morelos Satellite System reflect the special interest groups and forces that created Morelos. These applications are more private revenue oriented, as opposed to pro-social and public, as reflected in transponder assignment and plans.

RQ4:

The adoption of The Morelos Satellite System, fosters technological dependence on transnational manufacturers and foreign institutions.

Here, I refer to the unfavorable technology transfer conditions when acquiring the satellite system.

CHAPTER III

METHODOLOGY

Analytical case study.

This case study will help to determine the domestic and foreign forces which played key roles in the adoption of a domestic satellite technology by Mexico, and to identify their interaction.

I chose to conduct an analytical case study on the MSS, because it provides a in-depth analysis of decision making, over time. As such, it is the best means of understanding the complex dynamic factors and actors that have led to the adoption of satellite technology in Mexico. It offers the advantage of studying a subject by proceeding directly to the social phenomenon, providing the comprehensiveness of perspective to the researcher (Babbie, 1983).

The methodos used to collect data included telephone interview with scholars in the United States, and personal interviews with scholars, engineers, specialists, and intellectuals from public and private institutions in Mexico.

This case study is conducted along the guidelines laid down by Babbie, 1983, Chapter 10. The author covers all different aspects of case studies, i.e., the role of the observer, problems with field research, preparation for the field, sampling in field research, asking questions, recording observations, data processing (rewriting notes and creating files), data analysis, drawing conclusions, validity, reliability, and generalizability.

Primary and secondary data were collected to address the hypotheses. Secondary data was compiled, on the events that preceded the launch of the satellite system in June and November 1985. Literature search included special articles in magazines and newspapers, conference and workshop proceedings, the satellite trade in the United States, academic journals in telecommunication. In addition, internal bulletins and special publications about the Morelos Satellite System from the Secretariat of Communication and Transportation (SCT) and the Directorate General of Telecommunications (DGT), Science and Technology publications from the National Council of Science and Technology, (CONACYT).

Between August 15 and September 2, 1987, telephone interviews were conducted with different scholars in the U.S. to obtain feedback and suggestions for this study. Among the persons contacted were: William Shaw, Joseph

Rota, Elizabeth Mahan, Felipe Korseny, Noreene Janus and Emile McAnany.

Primary data was collected from September 3 to September 18, 1987 in Mexico City, through interviews with researchers and officials involved in the satellite program.

Specifically, I contacted the following people and institutions:

1-Dr. Lidia Fadul, CEESTEM, Centro de Estudios Socioeconomicos del Tercer Mundo. She published a research paper on "Communication Satellites in Latin America".

2-Dr. Delia Crovi Drueta, Universidad Nacional Autonoma de Mexico, who is currently undertaking cable communication system research in Mexico.

3-Mike Heller, Doctorate student from the Institute of Development Studies at the University of Sussex, Brighton, England. He is collecting data on the status of the regulatory mechanisms in telecommunications in Mexico.

4-Dr. Fatima Fernandez Christlieb, Universidad Autonoma Nacional de Mexico. She has been following the MSS, and is perhaps one of the most critical scholars of the program.

5-Ing. Salvador Landeros, Director of the Morelos satellite system at DGT/SCT.

6-Lic. Angeles Munoz, Director of service promotion of MSS at DGT/SCT. She also works for UNAM.

7-Dr. Rodolfo Neri Vela, first Mexican in space. He was a member of the crew that deployed Morelos II in November 1985, and is involved in space related research in UNAM.

8-Ing. Jose Hernandez Gonzalez, chief of the SCT's Department of International Affairs. Direccion General de Normatividad y Control de Telecomunicaciones, Subdireccion de Comunicacion y Desarrollo Tecnologico.

9-Lic. Manuel Gomez Ortigoza, Director of special projects of Televisa and also directs the cable television area for Televisa.

10-Universidad Metropolitana-Xochimilco's library

11-Universidad Autonoma Nacional de Mexico's library (Main and Communications's library).

13-SCT's library

If there is one major obstacle this study has faced, it has been the lack of the feasibility studies of the satellite programme. The Morelos satellite system has been strongly criticized in the past, and their officials are reluctant to provide what they call "sensitive" information. The studies of feasibility, if any, are one of these "sensitive" information that has handicapped my study, however a volume of copies publications monitoring the Mexican satellite project in the United States from different sources compensated the lack of official tion in Mexico and helped to close information gaps that were never known to the Mexican public. SCT in the present is more open to give information about Morelos, because strong criticism by the press and communication scholars in Mexico.

The next chapter reviews the literature of this study.

CHAPTER IV

LITERATURE REVIEW

This chapter reviews the literature on the role of technology, the mechanism on how it is transfered from the developed countries to the less developed countries, and policies affecting its selection and absorption.

Part two of this chapter presents the theoretical framework used, namely contextual analysis as elaborated by Mody's (1987).

Part three presents an overview of the telecommunications sector and the media in Mexico.

1. Technological dependence/independence as a result of technology adoption.

Stewart (1979), Frame and Singh (1983) describe direct and indirect modes through which the international transfer of technology occurs. There is no "step by step" formal procedure. Some countries just get it right and some, countries, on the other hand, just get a transfer of problems, rather than technology.

The degree of development of one country is an indicator of the capacity of a country to bargain when acquiring a sophisticated technology (Stewart, 1979). A "newly industrialized country" generally has devised policy guidelines and State institutions to select what technology it is going to acquire, and is in a better position to bargain, than a very undeveloped country which usually lacks institutional support.

A direct transfer of technology occurs when the country interested in a specific technology, is in direct contact with the suppliers of that technology. These include direct contracting of individuals, experts and consultant companies, engaging design and plant construction enterprises, training nationals for specific production projects, technical information activities and transfer of the technology.

A indirect mechanism occurs when a company in a major country plays the role of intermediary as a supplier of a specific technology, packaging it for the interested country. This mechanism includes: the completely package in the form of direct investments abroad in a wholly-owned subsidiary, through joint ventures, turn key arrangements, licensing and management contracts between independent parties (Stewart 1979, p.12; Frame, 1983).

Frame, (1983) presents a good historical perspective of the role of advanced nations in the control of technology. They maintain their colonies as a supplier of raw materials. The industrialized core countries are providers of finished products, creating a core-periphery relationship. This discourages the indigenous capability of those colonies. An example was the case of the flourishing textile industry in India at the time of arrival of the British.

A relatively new factor in the international economic arena is the part played by giant multinational corporations. They area an additional strong actor influencing the communication of technology transfers. The concentration of economic power represented by trasnational corporations allows them to plan the destiny of poorer nations who have less bargaining power. TNC's now have a dominant role, expanding in other countries, maintaining R&D centers in the metropolis, where innovation takes place: this trasnational corporation behavior is a simple profit-maximization strategy for some and for others a leverage strategy for economic penetration in other markets (Evans, 1979; Frame, 1983).

Melody, (1986), presents an excellent analysis of the new information environment in the world, and the problems that may beset Third World countries. The characteristics of information create special problems associated with the transfer of information technology to developing countries. The market incentive is to sell technology facility systems in TWC's to establish the infrastructure for both the domestic and international communication of information services. Melody points out that because the information is based in developed countries and their leadership in science and technology, these countries and their corporations would generate the flow from developed to developing nations. These conditions in the information market will facilitate the penetration of TWC's markets for the full range of economic goods and services by those organizations and institutions that have access to the specified information.

TNC's global economic behavior should not be blamed with all the problems in the developing world, because despite their economic power, there are ways to minimize their influence, (e.g. through different policies on investment limitations, technology transfer requirements, tax incentives for local R&D, patent policies, among others) (See Evans, 1979; Emmanuel, 1982; Ahmed, 1985). Melody recommends taking advantage of the competitive international market, to negotiate for the most favorable conditions.

After World II, and increasingly in the last two decades, developed countries governments have been supporting their big multinational corporations with a high proportion of tied aid to Third World countries to purchases from domestic corporations. They have also helped (e.g USA's EXIM Bank and Canada's Export Development Corporation), finance capital intensive projects to help their companies to sell technology.

It is in this context, that effective policies must be formulated to assess, as far as possible the technology relevant to the long range development program within the country and the impact of that innovation in an "unequal society". Satellite technology could support other development projects primarily for the "traditional" sector, or on the other hand, it would only benefit the "modern" sector, thus widening the prevailing income gap in Mexico, perpetuating the status quo.

The liberal perspective bases its idea of development in the tradition of research focusing on the use of technology to cause changes in education, skills and attitudes, based on a linear human capital model of development. In the view of this school, development is a repetition of the growth experienced in the past by developed nations. This reflects the nineteenth century mechanistic view of human progress (Herrera, 1978). Other liberal theorists view the new information society as the beginning of a new industrial revolution, urging Third World countries not to miss the boat for the second time; and to use information technologies to leapfrog in order to advance into post-industrial society (Herrera, 1978; Singh, 1983; Tehranian, 1986).

Dependency theorists point out the negative effects that technology has played in the "modernization" of the developing nations creating internal and external imbalances, and increasing inequalities. They view the information society and the communication technologies as the link between the old technologies and the new, leading to further imbalance at the national and international levels, and wider gaps between the rich and the poor, the technologically informed (advanced) and the uninformed (backward) rich and the information poor (Tehranian, 1986).

This school points out that the gaps are aggravated by commoditification, concentration and exploitation of the information resources by the transnational corporations. They propose a mechanism of national self-sufficiency and collective self-reliance in contrast to one of total disassociation as Hamelink suggests (Herrera, 1978, Tehranian, 1986).

According to Tehranian, information technologies are making the world more interdependent.

In general, adopting technology versus developing it, is the less desirable option. Singh (1983), and Morehouse, (1985), give some "least worst strategies" for countries planning to adopt new technologies. These "least worst strategies are":

-Every developing nation should make specific development decisions and technological choices entirely on its own. Where required, it may employ foreign consultants (as far as possible, individual scientists and technologists or non-governmental research institutions). These experts should be paid, preferably with its own funds, failing which, with loans from other sources, e.g. international agencies.

-Where local expertise does not exist in the areas targeted for development, it should send its own personnel for experience or training in a suitable institution abroad, preferably through direct negotiations with the institution rather than through the government, whether this institution be a university, research laboratory or industrial enterprise.

-Developing countries should make a special effort to get to know each other's strengths. Other things being equal, assistance from one developing country to another is less likely to be exploitative than assistance from an industrialized country's government (even when it is given with the best of intentions).

-If a developing country is determined to master some aspect of a frontier technology, it must allocate funds for investment in scientific and technological effort within the country, to train its scientists and technologists in other countries, developed or developing.

-Any financial assistance from an outside organization or foreign government should be in the form of a block grant to which the developing country should add its own resources for further allocation. Tied or categorical aid usually turns out to be no aid at all, but only a means of perpetuating dependence.

-If a developing country is commited to developing a strong scientific base in a frontier technology area, the quality of that base must be judged by international, not regional standards.

They recommend that a developing nation should not embark on an specific advanced in technology unless there is a strong scientific base established in that field. This applies specially to the import of high technology; technological exploitation by another country is far less likely to occur under these circumstances.

Morehouse warns those countries aspiring after high technology, that there is a risk of falling further within the web of dependence, and concludes that the "the least worst strategy" is a transitional period of selective disassociation for some countries. For others it is a mode of systematic bargaining with the different "North" countries, institutions and transnational corporations.

Melody, refering to this, suggests taking advantage of the wide range for negotiation existing in the markets to slow down the pace of introduction of massive information technology to one that is compatible with the developing country's long term development goals. TWC's must set up policy guidelines to negotiate and direct adoption of new technology to strengthen local, regional and national networks, as well as the overall economy. By doing this, Melody suggests that TWC's could set up an industrial framework in telecommunications and informatics area in order to reduce long term dependence on foreign equipment suppliers (1986, p. 26).

Another approach to this problem could be regional cooperation, (South-South) between countries with a significant and similar degree of development, e.g. Brazil, Mexico, Argentina, Venezuela, among other (Morehouse, 1985). Technology adaptations would be specific to regional conditions. By doing this, scarce "hard currency" could be saved, if barter provisions are negotiated in regional trade agreements.

2.-Contextual Analysis

We use Mody's contextual analysis, (Mody 1985, 1987) to identify how economic, political and socio-cultural domestic and foreign, factors and actors influenced Mexico's adoption of satellite communication technology. Mody's analysis of the adoption of satellites by India has shown how the decision has to do more with political, economic and socio-cultural factors and actors, then the technical advantages and cost effectiveness that the innovation could offer (1987).

Depending on the specific time and place, economic domestic and foreign factors in the adoption of this information technology could be: broadcasting corporations interests, transnational aerospace/communications consortiums, national telecommunication equipment industry, international banks (Export-Import Banks), national elites and their alliance with the international economic system.

On the political macro domestic level, contextual factors could be: a one party government, national integration and cultural preservation policies, fears of losing an orbital slot in the finite geostationary equatorial orbit, and better telecommunication facilities in order to attract transnational corporations and their investment on the macro foreign level (Mody, 1987).

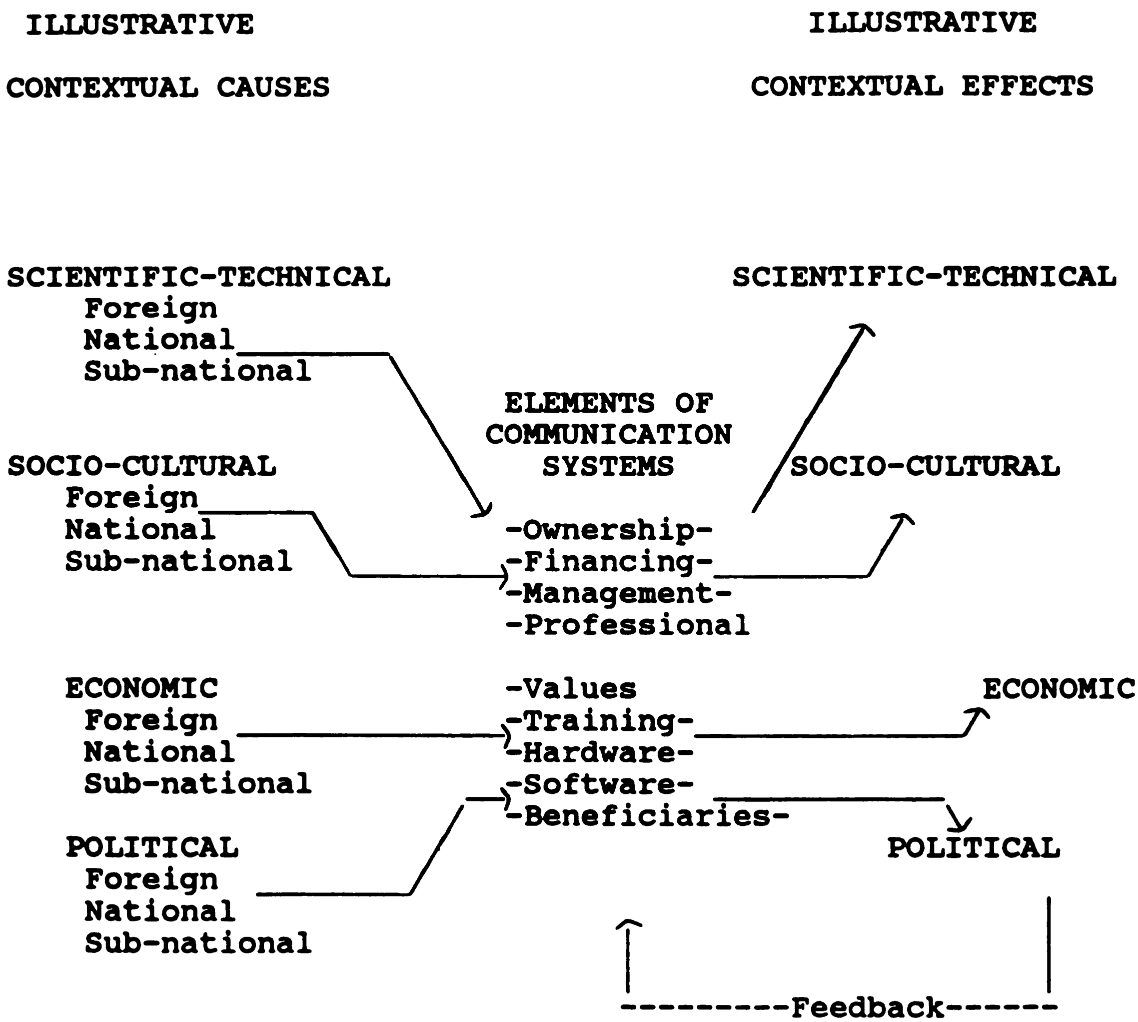
Scientific-Technical foreign-domestic actors and factors could be: NASA's application technology scientists, transnational aerospace and consulting consortia, NASA's ATS experiments on social applications (SACI/SITE) experiments, national scientists and engineers trained overseas, national space and communication research groups, PTT's and the interests of national broadcasting corporations.

Cultural forces could include pressure from domestic elites for the newest technology that will put them on par with their counterparts in New York, "nationalist" interest groups pushing for dissociation from the world business system, foreign universities and philantropic foundations urging the use of the new technologies for education and development, and super-power propaganda agencies such as the U.S. Information Agency.

The following figure illustrates the political economy framework adapted by Mody.

Figure 1

CONTEXTUAL ANALYSIS



Source: Mody (1985, 1987)

3.-Telecommunications in Mexico

To better understand the socio, economic and political setting in which the Mexican domestic satellite communication system is being configured, I will present an overview of Mexico's telecommunication and media institutions, as well as other government agencies that have a stake in the national communication system.

a) History

Because of its proximity to the United States, the telecommunication sector developed fairly early. Mexico's first telegraphic communication started in the mid-1800s; between 1878 and 1892 the first telephone links were installed in Mexico City, and public service instituted. At the beginning of this century the first long distance lines were laid, at urban locations (Landeros, 1986).
During the following years, these facilities (telegraph and telephone) rapidly developed, but with an urban bias.
Rural expansion was neglected for economic, geographic and financial reasons. Although, in 1949, SCT (at that time, the SCOP) created a special commission to deal with rural communication problems, little was achieved. In 1984, there were 31,054 villages (with a population range of 100-500) and more than 13,300 villages in the range of (500-2500); the number of rural towns linked have increased from

89 in 1964, to 1373 in 1974; in 1985, however a quarter, of the Mexican population does not receive any telecommunication services (telegraphy, telephony and television).

b) Secretaria de Comunicaciones y Transportes.

The Secretariat of Communication and Transportation (SCT) is Mexico's governmental body set up for the administration and organization of the national and international telecommunication services, through the Directorate General of Telecommunications (DGT). SCT was founded in 1959. At that time the communication sector was divided into three branches: telecommunications, postal service and telegraph services. The latter were decentralized from DGT during Lopez Portillo's administrative reforms (1976-1982). These three departments of SCT submit policy the decisions to Under-secretary of communications, final decisions being taken by the Minister of SCT and the President.

SCT provides three services:

I) Those under SCT's direct control

1) Transmission of broadcasting signals (Radio and TV).

2) Telegraphy

3) Data

4) Telex

II) Those under a license, issued to individuals or institutions (Servicios Concesionados).

1) Telephony

2) Community Antenna Television (CATV)

3) Radio paging

4) Broadcasting

5) Restricted TV signals

6) Cellular telephone

III) Private operators, with permission from SCT. (Servicios Permisionados).

1) Maritime mobil

2) Citizen band

3) FM radio

4) Shortwave

5) Mobile broadcasting transmissions

6) Private data networks

7) Private radiophone

8) Aeronautic mobile

9) Broadcasting

10) Private Branch Exchanges (PABX) (SCT, 1987)

SCT's infrastructure for its national and international services comprises mainly the federal microwave and satellite communications networks. The microwave network extends up to 16,100 kilometers (10,006.15 miles). The system has 110 terminal and 224 repeater stations, sufficient to conduct four color television channels or 3,600 simultaneous telephone conferences. It serves 110 cities transmitting TV, telephony and data in a low capacity (9.6 KB/S); the system was inaugurated in 1968 and SCT's goal is to optimize, maintain and expand the network (SCT, 1987, Review for UNIDO).

The increasing demand for these services as a result of the "Oil Boom" 1977-1982, encouraged SCT to seek a complement to its saturated microwave system; in 1981, SCT leased transponder capacity on an INTELSAT's spacecraft, and rapidly established a domestic earth station network; in the same year, the government authorized the implementation of a domestic satellite system, which after modifications, commenced operations in 1985 (SCT, 1987). Under the Morelos system, SCT has in operation 243 earth stations of different diameters; 15 of them are transmit/receive dishes. Some of them, are designed to be converted when necessary.

International communication via satellite is routed through three earth stations (Tulancingo I, II and III) via the INTELSAT system which Mexico has belonged to since 1966. At present, SCT's international telecommunications use 365 circuits, linking 20 countries (SCT, 1987).

The Central Telecommunication Tower (Torre Central de

Telecomunicaciones) in Mexico City is the telecommunications operational headquarters, mainly for the microwave network, telex network, data and telegraphy. The Iztapala operations center directs communications via satellite, and is the telemetry, telecommand and control site for Morelos operations.

c) Telephony in Mexico

Telefonos de Mexico (TELMEX) is the State-owned telephone company, which is under SCT's (DGT) supervision. In 1878, Compania Telefonica Mexicana, the first telephone company in Mexico, was granted a license from the Ministry of Communications (then called the Ministry of Communication and Public Works-SCOP); the same year, the first telephone conference was conducted between Mexico City and Tlalpan (now part of Mexico City). The first international call in the world was in 1883 between the border cities Matamoros, Tamaulipas, Mexico and Brownsville, Texas, U.S.

In 1907, the Swedish company L. M. Ericsson commenced operations, with 500 subscribers and a central battery system, considered a very modern one at the time. In 1926, Ericsson initiated the domestic manual long distance service. In 1941, the two existent companies, Ericsson and Mexicana merged their local and long distance service. By 1948, automatic lines were installed in Mexico City.

Telefonos de Mexico was created, during the government of President Miguel Aleman (1946-1952). Telephony was regarded as a strategic area by the State. Instead of nationalizing Ericsson and Compania Mexicana Telefonica, policies were devised to gradually "take over" the concessions and properties; as a result, in 1950, Mexican investors bought the majority of TELMEX stock.

In 1966, the automatic long distance service, (LADA 91), was inaugurated. In 1967, President Gustavo Diaz Ordaz hooked up the one millionth telephone. Five years later, the Federal government purchased 51% of TELMEX stock making it a State controlled corporation. In 1973, during Luis Echeverria's administration the two millionth telephone was installed (Sanchez Ruiz, 1987).

By the end of 1986, TELMEX was operating 7,827,000 telephones, and 3,995,000 lines. There were 5,642 towns linked, with a telephone density of 10.03 sets per 100 inhabitants (Excelsior, p.14 Special supplement, July 26, 1987). According to Sanchez Ruiz (1987), to 1985 there has been an annual growth of 14.8% in the telephony sector from 1963 to 1985. In the last few years (since 1982), however, this figure has drastically dropped due to a severe recession (Sanchez Ruiz, 1987).

Telefonos de Mexico has been one of the main users of SCT's telecommunication infrastructure. TELMEX, built additional microwave links for its telephony network complementing the SCT's high capacity microwave system. TELMEX is now using a little more that one transponder capacity on Morelos I and has reserved capacity to use four additional transponders (SCT, 1987), (See table 1).

d) Broadcasting

Mass Media in Mexico is highly concentrated in the hands of a few private sector elites and government agencies. The major broadcasting organization is Televisa, which some people refer to in Mexico as the Fifth Estate. To understand the interest of this media group in new communication technologies, it is necessary to look back to the origins of broadcasting.

The first radio broadcast began in 1921 on an experimental basis in Mexico City and Monterrey. In 1923 the government commisioned the first commercial stations; this new industry was strongly influenced by the U.S. broadcasting model and due to its initial economic ties with American organizations. Additionally, national newspapers and entrepreneurs saw a potential profitable market for investment which influenced the commercial direction of radio. At that time, the government was recovering from the Mexican social revolution and did not have the money or the interest to own, regulate or promote broadcasting. (Noriega, 1979; Sanchez Ruiz, 1987). The Electric Communication Law of 1926 restricted itself to technical aspects only.

In 1952, the first FM station license was granted for commercial use to Mr. Alonso Sordo Noriega (Chirinos, 1984). Today, there are 676 AM and 196 FM stations (Instituto Nacional de Estadistica Geografia e Informatica, 1986; Sanchez Ruiz, 1987).

Television in Mexico dates back to 1935. One of the pioneers in this field was Mr. Guillermo Gonzalez Camarena, who as an engineer, in 1935 was already experimenting with a closed circuit TV system. In 1940, he patented a color TV system. In Mexico, he is considered one of the inventors of Color TV, although he has received no recognition internationally.

In 1950, television transmissions began, modeled on the United States commercial pattern, with the characteristics of the Mexican radio industry. The socio-economic environment was favorable. Growth was dynamic. The country was passing through a phase of "inward oriented industrialization" through "import-substitution" policies. The expansion of domestic markets generated revenues that financed an advertising-supported broadcast system.

The same year, XHTV Channel 4 began operations with a transmission of President Miguel Aleman's fourth annual speech. In 1951, Mr. Emilio Azcarraga Vidaurreta's XEW-TV (Channel 2) started operations. The following year, Mr. Guillermo Gonzalez Camarena went on the air with XHGC-TV (Channel 5) (Olguin, 1984). In 1955 due to a limited market, the three major channels, O'Farrill's channel 4, Azcarraga's channel 2 and Gonzalez Camarena's Channel 5 formed a joint corporation, Telesistema Mexicano (TSM). By this time, there were efforts to broadcast throughout the country with repeaters.

In 1959, the Polytechnic Institute begun operations with its XE-IPN channel 11. This was the first cultural and educational TV station in Latin America (Olguin, 1984).

It was in 1960 that the Mexican government intervened with regulations for the first time. The U.S influenced system now acquired, an authoritarian distinctively Mexican face, in as much as the state exercised control but also permitted commercialization under the new Federal Law of Radio and Television. Article IV states "radio and television are activities in the public interest and for the for common good; the State must protect and regulate broadcasting to supervise its social function". Article V refers to "radio and television having the social responsibility to contribute to national integration and the improvement of social well-being". The 1960's was also a phase of consolidation in the commercial broadcast industry in Mexico, with the expansion of the State networks. Radio magnates, Emilio Azcarraga, Guillermo Gonzalez Camarena and Romulo O'Farrill invested in this new medium.

In 1967-1968, in preparation for the XIX Olympics, the government inaugurated the federal high capacity microwave network and the satellite earth station Tulancingo I. Color television was introduced in 1967 in the main urban areas. Telefonos de Mexico, the State majority owned common carrier built a complementary microwave network for a long distance service; the implementation of the national microwave network, in 1968, accelerated the growth of the TV industry.

In 1970, Telesistema Mexicano established a cable system in Mexico City, which, via two channels (7 and 10) could picks up USA network programs from the border, using the microwave links. This marked the growth of 30 other private cable companies.

Mexican television grew slowly during the 1950s and 1960s. Telesistema Mexicano monopolized the industry operating a network of 29 TV stations and repeater stations across the country, in 1967. However, the government abolished Telesistema's dominance by granting open licenses; this allowed the Garza/Sada family (Monterrey's group of industries) to establish its own separate network, Channel 8. In the north, there were three stations operating under Telecadena; because of financial constraints reasons, they merged later with Channel 8 (Valenzuela, 1985). Operating in a limited, now competitive market, TV has become a monopoly.

The XIX Olympics (1968) in Mexico, gave a big boost to Mexican TV; Telesistema's Televicentro expanded from ten to fifteen studios, constituting the largest TV production facility in Latin America; thirteen remote units and two color transmission units were acquired to cover the games; the linkage with the ATS-3 communication satellite, enabled the event to be transmitted worldwide. By 1970, the Telesistema network had grown to 47 TV stations (3 in Mexico City, 33 broadcast stations and eleven repeaters).

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During the Echeverria administration (1970-1976) the State acquired Channel 13, now re-grouped under Instituto Mexicano de la Television (IMEVISION Channels 7, 11, 13, and 22), which has become a potential rival for Televisa.

Echeverria's government strongly criticized the monopolistic "Telesistema", and there were pressures to remove particular U.S. made programmes, categorized as depicting violence. This meant more local production. As a result, Telesistema (Channels 2, 4, and 5) and the Garza/Sada system Channel 8 merged to create Televisa. This created a bigger monopoly. The joint production facilities (Televicentro and San Angel) and the pooling of personnel, actors and other associated media activities have made Televisa as competitive as any network in the world, and it has become a force in the media regulatory environment, as well as a new political element in the Mexican political system.

In 1979 Televisa owned four TV channels (2, 4, 5 and 8) with 61 retransmissions stations. Channel 2 and 5, now using Morelos, have a 100% coverage area. Out of a total of 55 million viewers in Mexico, this network attracted 41 million in 1979, the equivalent of 7 million households.

The corporation has rapidly expanded both, vertically and horizontally. It owns movie production facilities, record companies, radio stations, video distribution rights, cable television and is also in the publishing business: a total 47 firms. Its biggest source of income is advertising (93%), producing 2,000 television advertisements a year, some of which are exported. Televisa exports 24,000 hours of programs a year to the United States, Latin America, the Caribbean, and more recently, to the Arab countries and the People's Republic of China. Through its Univision network, Televisa reaches over 3,200,000 househoulds in 26 states in the United States (Skinner, 1987). It has the biggest video library on the American continent with more than 70,000 hours produced since 1962 (Moore, 1982; Mattelart and Schmucler; Valenzuela, 1985). Cablevision (Mexico City's CATV) and Galavision (pay TV for cable systems in the U.S. and Puerto Rico), also form part of Televisa (Mattelart and Schmucler, 1985).

An excellent analysis of Televisa (Skinner 1987) calls it "the octopus of the airwaves". With a virtual monopoly on Mexican television and ownership of slew of film and recording studios, publishing houses, movie theaters, and radio stations, its tentacles reach into the remote areas of Mexico. Though its profits are kept a close secret, Televisa is probably the most powerful private company in

Mexico, (p. 44).

At present Televisa transmits over 400 hours a week of television broadcasting, more than any other broadcasting company in the world. This year it hopes to export 30,000 hours of programming, much of it in the form of soap operas for the South America market. Televisa has become the main source of news and information for the Mexican masses. By 1982, up to 96 percent of the viewing people was tuned in to Televisa programming at any given time (Skinner, 1987).

Currently, there are 424 (state/private) TV stations in the country; this includes Television de la Republica Mexicana (T.R.M) now within the Mexican Institute of Television network (Instituto Mexicano de la Television-IMEVISION Channels 22, 13, 11 and 7) (Agenda 1986, IGEI, SPP, Mexico 1987).

This chapter has reviewed the different transfer of technology mechanisms and policies that will support the country's long range development.

In the second part of this chapter I looked at the contextual forces that influence the communication technology systems adoption and difussion in the social system. Looking at Mexico's contextual conditions, we can better predict how satellite communication technology will perform, who will benefit, what users and utilization we can expect in the surrounding environment. This can help to evaluate future adoption of other information technologies in Mexico and other constrained developing nations.

And last, a brief review of Mexico's telecommunication and broascast media systems. The interest groups lobbying for a satellite logically belonged to these two sectors. By looking at them, we can better understand why Mexico chose the quick "turn key" approach to implementation of satellite hardware, and how these groups influenced and affected the satellite project. The next chapter will look at the findings of this analytical case study.

CHAPTER V

FINDINGS ON THE MEXICAN SATELLITE PROGRAM

This chapter goes back to beginning of the space era and its implications for Mexico. It historically documents events leading to the Morelos system to identify major factors and stakeholders, domestic and foreign in the technology adoption.

1.-Launching of Sputnik and its repercussions in Mexico

The International Geophysics Year and the launching of Sputnik in 1957, provided the critical impetus for space research in Mexico. The pioneering body was the Universidad Nacional Autonoma de Mexico (UNAM). UNAM created the faculty of Sciences in 1939. The Institute of astronomy, mathematics, physics and geophysics were founded in 1929, 1935, 1938 and 1949, respectively. Another pioneer was the Secretariat of Transportation and Communications (SCT), Mexico's PTT and Transportation Ministry. SCT selected a team of engineers and technicians to design, construct and launch experimental rockets, and also to experiment with rocket combustibles, launching SCT 1 and SCT 2, in 1959 and 1960.

In 1962, space research began with the establishment of

UNAM's Outer Space Department (Departamento del Espacio Exterior), within the Institute Geophysics. It was dedicated to studying basic space science and related fields. This department later evolved into the Department of Space Studies (Departmento de Estudios Espaciales) which was devoted to space research, theoretical and experimental; The objective of the former was the formation of an elite group of scientists to promote activities in technology, relevant to the nation's needs, and to respond to the challenge of nations in the new space area. Another objective was to avoid dependence on advanced countries. The involved scientists promoted the idea that Mexico should be ready to develop national space technology according to the national conditions and the use of satellites (remote sensing and communication) for the social, cultural and economic development of the country.

Another important space organization was created by presidential decree in 1962 too: the National Commission for Outer Space (CONEE). CONEE was a specialized institution responsible for research, exploration and utilization of outer space, consisting mainly of SCT personnel, it served as the main interagency co-ordinator.

In 1965, CONEE signed an agreement for cooperation with NASA. In 1968 a joint venture with NASA was undertaken to survey Mexican territory using remote sensing techniques. Battles over turf between collaborating agencies, typical of government bureaucracies, led to the abolition of this valuable inter-department agency in 1976, fourteen years after its creation. Consequently, Mexican space scientists, of international stature, were unable to work closely with the government on the domestic use of satellite technology, unlike the cases of Brazil and India.

Space activities have now been conducted by groups, acting independently, such as UNAM's Department of Space Studies, Instituto Politecnico Nacional (IPN), Agriculture and Hydraulic Resources (SARH), the Secretariat of Foreign Affairs (SRE), the National Council of Science and Technology (CONACYT), and Universidad Autonoma de Baja California, among others. Although, the study of space science has been pursued, no national policy has evolved. Dispersion of resources and objectives among the different research organizations, and the lack of a concerted drive towards self-sufficiency in this field led to a brain drain of Mexican space scientists,

Some national vision on satellites has been approximated only in 1985, in reaction to the purchase of a domestic satellite by Mexico. UNAM has set up an Interdisciplinary Group on Space Activities (Grupo Interdisciplinario de

Actividades Espaciales-GIAE), pooling a group of high level researchers in basic and applied space sciences, communications, history, engineering and technology development, among others fields. One of the members of this group, Ricardo Peralta Fabi, is reputed to have completed a prototype of what may prove to be the first indigenous Mexican communication satellite, called UNISAT (EL Financiero, July 30, 1987).

This historical review of space activities in Mexico, reveals the lack of systematic planning in satellite communications. Mexico has always had experts in this area, but unfortunately their efforts have not been coordinated and harnessed productively by appropiate government policies, as in Brazil and India.

2. Lessons from satellite adoption in other developing nations.

The rapid development of satellite technology after the launch of Sputnik I, and moreso, after the SITE experiment in India demonstrated the advantages of the space technology to provide traditional terrestrial based telecommunication services. The old perception that satellite communication was solely for transoceanic telecommunications changed. The improvements in power and capacity and the decrease in circuit-cost were crucial factors in considering its future use for domestic applications.

Indonesia became the first developing country to adopt a domestic communication satellite system. The system was built by Hughes Communication International to provide telephone, telex, and television signals for 3,000 islands, scattered over 5,000 kilometers of ocean, having a population of over 160 million people. The system went into operation in mid 1976 with Palapa A01 and later A02. The word "Palapa" means "unity" (Asian Broadcasting, June-July, 1984 p.14; Long, 1985).

Indonesia's satellite adoption is similar to that of Mexico. Palapa was a rapid turn key project, too. After ten years little has been done to develop a major indigenous component for future Palapa spacecrafts, and most of the earth segment equipment is still being imported. Indonesia has become a good market for international aerospace/communications manufacturers, and much more dependent on them. Indubitably telecommunications have improved, and Palapa is serving the communications needs of the ASEAN nations (the Philippines, Malaysia, Singapore, Thailand), which, unlike Mexico's case, has taken care of an underutilized capacity. Its only problem is the favorable "terms of transfer".

In the case of India and Brazil, more systematic planning, was undertaken, aimed at self-reliance and indigeneous manufacturing capability.

a) India's Multipurpose Satellite System-INSAT.

India provides the best example of careful adoption of a high technology such as satellites. The eventual acquisition of the sophisticated multipurpose Indian satellite system (INSAT) was twenty years in the planning. It provided valuable experience on how this sophisticated technology may be introduced in a self-reliant mode by a country who was a novice in this area.

Preparations for Indian National Satellite System (INSAT) program dates back to the late 1960s when the Indian atomic energy agency begun exploring the advantages of satellite communications with NASA. The Indo-NASA Satellite Instructional Television Experiment (SITE) was conducted in 1975 to give Indians experience and insights in configuring satellite hardware to distribute educational, agricultural, family planning programming to remote villages.

SITE was probably the largest communication experiment of modern times. For the first time ever, a satellite transmitted programs directly to TV sets in isolated villages for a year, and with great success. Four hours of locally made programming were transmitted daily; on agriculture, health, family planning, nutrition and education (Mody, 1978).

What is unique about India's satellite experience is the systematic attempt at indigenization of the hardware made by a pioneering scientific agency that became the official space organisation. Given its large scientific pool, India could write its own satellite system specifications, and state the terms on which it wanted its first satellite built, e.g. that 100-200 Indian scientists and engineers would be present to learn to do it themselves during the 3-5 year design and manufacture stages. Thus, it is expected that INSAT's second generation will be built in India in the early 1990s.

After SITE in 1975-1976 India continued to experiment, using the Franco/German "Symphony" spacecraft and the Indian-made experimental communication satellite "Apple" launched in 1981. Thus India got additional experience in the field of video, audio and data transmission (Long, 1985).

In light of the SITE experience, communication satellite technology was perceived by many Third World countries as a powerful tool for development. It also meant another successful experiment for NASA's scientists, who were seeking more applications for the hardware, to create markets and thus justify their research and development budgets to Congress and the U.S. taxpayer.

Major forces influencing the adoption of satellite technology in India were primarily domestic. The main foreign force was NASA which needed to prove that its hardware was working and could be useful in developing nations. India was the site of the experiment. The Soviet Union has played a smaller role-one of scientific-technical assistance in other parts of India's space program.

On the domestic front, an elite group of Indian scientists, many trained in the U.S., were the moving forces who wanted to experiment with satellite communication technology. Its utility for delivery of educational programming to remote areas without schools was a major selling point in the planning stage. During its first experimental year, the satellite system proved itself a powerful propaganda channel reaching every village in the country with news approved by the party in power. More recently, the middle class has become an important player exerting pressure on the government to introduce commercial television (Mody, 1987), thus taking away from the educational focus that the system was designed for.

b) Brazilian Telecommunication Satellite System (SBTS)

Brazil's immense geographical area makes communication via satellite a cost-efficient method of providing telecommunication services to large isolated areas, e.g. the low population density Amazon villages.

The SACI/Exern project in late 1960s was the first step in the adoption of satellite technology. Although it was just an experimental tele-education pilot scheme, using a terrestrial infrastructure, it gave valuable information to INPE, the National Space Institute (and other involved educational institutions) in their planned adoption of a domestic satellite system. The purpose of the satellite was mainly for telecommunications. To deliver educational programs to villages was a secondary possibility (McAnany, Oliveira, 1981).

The country's first involvement with a communication satellite goes back to 1969, when its international transmission was routed through INTELSAT, using the huge earth station Tangua 1. At about the same time, interest was evinced in this technology for domestic applications, specially for tele-education, after the Stanford ASCEND project was proposed, using NASA's Application Technology Satellite Series (Schmucler, 1983).

One of the Brazilian pioneers promoting a domestic satellite is Fernando Mendoca, who received a Ph.D in space sciences from Stanford University in 1964. He created Brazil's first space research center; it later became the Instituto Nacional de Pesquisas Espaciales (INPE).

Mendoca sponsored the Advance System in Interdisciplinary Communications (SACI/EXERN) project in tele-education in the late 1960s and early 1970s. NASA selected India over Brazil for its direct-broadcast satellite pilot project. This did not discourage Mendoca. The experiment was carried out, on a smaller scale, using regular television and radio broadcasts to elementary schools in the state of Rio Grande del Norte (McAnany, Oliveira, 1985; Nettleton, 1986). Because of a lack of political support by the different government agencies (and vested interests), Mendoca's proposed satellite project did not materialize.

After the SACI educational pilot scheme, the government conducted studies in 1973 to determine the feasibility of a domestic satellite system, under Colonel Hygino Corsetti, Minister of Communications (Turner, 1985). In 1975, the

Geisel administration set up a work group for the study of the implementation of what is now the Sistema Brasileiro de Telecomunicaciones por Satelite (SBTS) (Nettleton, 1986). In 1977, they postponed the project, due to a lack of financial resources after the Budget Planning Ministry (SEPLAN) made significant cuts in the budget of Telebras, the telecommunication agency in Brazil. Telebras then decided to cancel the SBTS project at the last moment during the bidding process in selection of a foreign aerospace company (Turner, 1985; Nettleton, 1986).

EMBRATEL, the inter-state and international telecommunication agency, under the umbrella of Telebras, undertook an alternative plan, leasing transponders from the INTELSAT consortium for domestic use in combination with an expanding, well-developed microwave network. By leasing channels on INTELSAT, Brazil was committed already to domestic satellite technology, which led, later in 1985, to the implementation of Brazilsat (SBTS). Its prior cancellation, in 1977, allowed the engineers in EMBRATEL to develop additional expertise through the use of INTELSAT domestic service. Another advantage was the lower cost of the alternative plan, and more important, it enabled Telebras CPqD (R&D center) to develop its own local earth segment hardware, which in the long term, becomes the most expensive component in a satellite system.

The rapid development of this telecommunication sector involved leasing additional transponders; their high cost, added to the earth station equipment required for the INTELSAT system, as well as their unavailability, revitalized the SBTS project in 1981, under Figuereido's administration. Now favorable forces and a good relationship between the telecommunication sector, the Air Force and technical research organizations led to the authorization of the Brazilsat project (Nettleton, 1986).

The contract was awarded to the Canadian company SPAR, after careful selection and decision making. The Canadian agreement included:

1) Financing
2) Countertrade import of Brazilian goods.
3) Overall Technology transfer (TT) and training.

Financing was provided by the Export Development Corporation, a Canadian government organization, Scotia Bank, U.S. EXIMBANK, and the Royal Bank of Canada, for US $122 million.

A program was evolved, of transfer of technology and training to EMBRATEL, the TELEBRAS Center of Research and Development, (CPqD), and to the Brazilian Space Research Institute, (INPE) (Albernaz, 1984). The TT programme included:

1) Training in satellite organization to Brazilian managers;

2) Training in satellite design and launching to Brazilian scientists in INPE;

3) Training in satellite mission operations to Brazilian engineers;

4) Training in satellite control to Brazilian technicians. The long-term goal was practical industrial expertise in satellite systems and program implementation (SPAR Aerospace Limited, Summary of Brazilsat Project, August, 1987). SPAR trained Brazilians from scratch to design and build the different subsystems of the spacecraft, initially on a "turn key" basis, and later, R&D would lead to "technological self-sufficiency". The Canadian government compromised by purchasing Brazilian goods though maintaining a positive trade balance. These trade/offsets enhancements were valued at U.S. $165 million dollars, diversifying Brazil's trade ties (SPAR, Canada, 1987).

For the launch and related services, the contract by EMBRATEL was awarded to ARIANESPACE, the European Aerospace Consortium, at the cost of US $58 million. It included financing from the Lyonnais/Paribas-France for US $40 million. It also included a program of transfer of technology to the Brazilian Space Research Institute (INPE) and to the Brazilian Aerospace Institute (IAE) (Albernaz, 1984).

The total cost of the SBTS programme was valued at US $211.198 million. This included service, insurance and associated services. Other aerospace consortia competing for the SBTS contracts were: Hughes Communication International, Ford-Aerospatiale, Matra and RCA (SPAR, 1987).

It is interesting to note that political as well as economic and technical conditions on the foreign and domestic level were critical in their decisions. Canadian and French government agencies and private banks assisted the satellite and aerospace consortia in the sale of their high technology packages. The Brazilian military government's policy for telecommunications was national security and trade diversification. SPAR and ARIANE's European consortia were the best options and provided the best terms for financing and the transfer of technology, even though Brazil's traditional trading partner has been the U.S. which has proven track record in satellites.

Aerospatiale won against US Thor Delta launch service, because there were financial and technical arguments in favor of the European consortium: a saving of US $3 million. The launch from French Guyana (Kourou Space Center) is only five degree above the Equator, hence the flight is around 25% more economical in terms of fuel, than one out of Cape Canaveral, which in turn means a longer active life, in orbit, for the satellite system (Turner, 1985 p.16).

At this time SBTS is completely operational. SBTS I was launched and successfully placed in orbit in February 1985, and SBTS 2 was launched in March 1986 (Albernaz, 1986). The orbital slots occupied are 65 and 70 degrees West (Long, 1985).

Another critical factor that influenced the implementation of this information technology in Brazil, similar to Mexico, was fears that scarce orbital locations in ITU region 2 due to U.S. and Canadian spacecrafts.

Another consideration in acquiring the system was the flexibility of owning a dedicated system, relative to the fixed service offered by INTELSAT, which provided telephone and television transmissions. The market survey conducted by EMBRATEL showed that the most promising areas for marketing in the future would be television reception linked to low power transmitters, rural telephony and private data communication networks. (Albernaz, 1986).

By the end of 1985, EMBRATEL was operating 44 earth stations, and by 1987, 22 more were added to the system. Three major Brazilian TV networks own and operate 59 receiving earth stations. EMBRATEL will use most of the remaining transponder capacity to expand telephony, telegraphy and data transmissions to all areas, according to the demand (Albernaz, 1984; Long, 1985).

Brazil is using half its transponders, six for telephony, and data, and six for television. An attempt is being made to sell surplus capacity to neighboring states. There will be four transponders available, that could be rented to other South American countries. Argentina is a likely candidate for some of those surplus channels, now that its satellite system has been shelved, due to lack of economic resources. So far, however, only two countries, Peru and Paraguay, have requested the use of Brazilsat's facilities to complement their own domestic communications systems (Turner, 1985).

In the initial feasibility studies under EMBRATEL, the main disadvantage seen in adopting a domestic system, was the low capacity utilization of the satellite in the initial phase (Albernaz, 1984). Mexico faces the same problem although it does not seem to have been foreseen.

In July 1984, the Brazilian Minister of Communications eased restrictions on the manufacture, sales and use of private non-commercial satellite receiving systems. Under the present dispensation and lower cost of the equipment, direct broadcast satellite (in the "C" band, with dishes linked to low power transmitters), are the other big area of utilization of SBTS, in rural and remote areas. There are over a 1,000 of these by now.

According to McAnany (1987), EMBRATEL's excessively restrictive control on access to SBTS, its marketing failures, and its resistance to competition from the private sector in data communications have been the main reasons for its underutilization (McAnany, 1987).
However, EMBRATEL and the Ministry of Communications are seriously considering "deregulation" of the SBTS by marketing prices for leasing or selling transponder capacity (SPAR, 1987).

A very similar scenario and set of factors is seen in Mexico, where SCT's Morelos I, is being used at 32% capacity, with a total of 12 transponders.

The other services that SBTS system is expected to provide include:

1) Tele-education

2) Tele-medicine

3) Remote printing of newspapers

4) Direct communication with all the remote villages, especially in the Amazon region.

The social applications of the SBTS programme, were not a factor in the decision to purchase a satellite system. This may have been so in the late sixties and early seventies, or ever in the 1980's, but at the time of Figuereido's decision to go ahead with the SBTS, the stakeholders (EMBRATEL's engineers, and the Air Force, among others) were more concerned about solving telecommunication capacity problems, while the military government was determined to have a "space slot". The lack of this slot would prevent effective communication in the remote areas of the Amazon. This was essential to Brazil's defense strategy, and a matter of national security.

EMBRATEL has assigned one transponder for instructional services and one for special purposes, e.g.like, teleconferencing, on a part time basis (Long, 1985).

In Mexico, on the other hand social applications were a major part of the official rethoric in support of the "domsat", as presented in SCT's media campaigns. The reality is that, although social applications in fact, were considered, the engineers from SCT were more concerned with finding a solution to an overloaded microwave network to meet the increasing demand of the telecommunications sector, mainly television and telephony. And, as in Brazil, there was the fear of losing an orbital "slot".

EMBRATEL has assigned one transponder for instructional services and one for special purposes, e.g.like, teleconferencing, on a part time basis (Long, 1985).

The key agencies of R&D in the SBTS program are:

1) TELEBRAS

2) Brazilian Aerospace Institute

3) Brazilian Space Research Institute

The Special Secretariat of Informatics (SEI), now under the Ministry of Science and Technology, laid down guidelines to absorb foreign information technologies, and regulated indigenous manufacture of telecommunication, minicomputer and microcomputer equipment. Telebras CPqD (R&D center) developed the earth station equipment to be used with the Brazilsat. This is a critical aspect, because in the long run the most expensive part of a satellite system is the earth segment hardware. The Brazilian Aerospace Research Institute is designing and building two series of experimental satellites for remote sensing applications, and earth data collection and associated technology. These latter spacecraft will be launched in 1989 and 1991, and the remote sensing series will be placed in orbit in 1993 by Brazilian made rockets from the Alcantara Space Center, near Sao Luiz, in the northern state of Maranhao. (Turner. 1985; Albernaz, 1986).

Brazil's space venture includes the building and launching of a next generation of communication satellites, using all the expertise and transfer of technology programs from SPAR, ARIANESPACE, and exchanges with NASA's space cooperation agreements (Albernaz, 1984; Turner, 1985; Space Cooperation Agreement between the United States and Brazil, June 1982, Department of State).

Brazil's decision to use a satellite system is firmly based in a sound telecommunication infrastructure, and a local computer and telecommunication industry, on the same lines as more developed nations, in transition to an "information society". The only difference is that the Brazilian is one of unbalanced development.

Brazil's approach in implementing a new information technology is a judicious one, aimed at achieving a more independent and self-reliant. In Mexico, under different conditions, reliance is still placed on foreign contractors in the absence of its own telecommunication industry. Local manufacture is based on joint-ventures with TNC'S and foreign R&D capability.

Although the SBTS system is facing serious under-utilization, Brazil presents a good example, within the Latin American context, of the formulation of long term policies, with a gradual adaptation towards indigenous expertise. It would be interesting to analyze, after a period of five or ten years, the progress of this process, and the assimilation of satellite technology in Brazil and Mexico, given the similar, and yet relatively different environments.

Figure 2

Matrix of Illustrative Factors/Actors Influencing the Brazilian Telecommunication Satellite (SBTS)

	Economic	Scientific Technical	Political	Cultural
Foreign	Spar, Canada Canadian Banks and EXIM-Bank French Banks Hughes	NASA's ATS SITE SACI/EXERN Spar-Hughes Arianespace	Canadian Development Organiza. ITU/WARC arguments orbit slots	
National	EMBRATEL High cost of INTELSAT TV Networks	EMBRATEL Telebras-CPqD Air Force INPE IAE SEI	Natl integration Natl Sovereignty Natl Indep	National preserv. culture from Spanish nations
Sub-National	Need to meet regional telecommunication needs		Need for regional communications in military	Desire in remote areas by mayors for repeaters linked to dishes

3.-Role of SCT and Televisa

It seems that the idea of a domestic satellite in Mexico came from two potential users: a group of engineers in SCT/DGT who were using domestic satellite communication technology through INTELSAT, and the private broadcasting company Televisa. The idea of a satellite for domestic communicatinsponders in the INTELSAT IV-V-F7 (Boletin Interno SCT/DGT, 1981)

The second special interest group, Televisa, lobbied the Mexican government to have its own independent satellite, but it did not declare it openly. According to a Televisa's official, in 1979 an 11 meter earth station was set up in its Chapultepec production facilities to demonstrate to President Jose Lopez Portillo (1976-1982), its satellite communication capabalities. In 1980 the government was still reluctant to authorize the satellite. At that time, there was no definition in the legislation regarding the use of satellite communication. Legally, there was nothing to prevent Televisa from putting up its own satellite. Televisa had participated with the government in various multinational television events mainly with Spanish-speaking countries using satellite communication through INTELSAT. Televisa had expressed interest in the technology. It had been a broadcasting <u>corporation innovator</u> in its use of satellite links for international distribution and reception of programming for cable systems in the USA and Mexico City. It had pioneered in the use of satellites when it covered Pope Paul's visit to South America in 1964. In 1968, it televised the Olympics globally. It's UNIVISION service, which distributes programming to Spanish-speaking countries around the globe could not function without satellite access. Televisa's cable company, which picks up U.S. signals at the border and brings them to Mexico City by satellite would benefit from a domestic satellite too. Weststar was being rented to carry signals from Televisa Mexico City, to the Spanish International Network uplink in the U.S. Clearly then, an "in-house" and independent Televisa satellite would reduce bureaucratic intervention by SCT/DGT, by the FCC and INTELSAT the U.S. (FCC), and INTELSAT in Televisa's functioning at all levels.

I will now go the beginning of transoceanic communications in Mexico and how it evolved in utilization for domestic use, when technical advancements and economic conditions made the domsat technology available.

4.-From Tulancingo I to Morelos.

In 1964, by special arrangement with the U.S., Telesistema Mexicano, used an NASA's ATS spacecraft to receive TV signals of Pope Paul's visit to South America (Gomez Ortigoza, 1988). In 1966, Mexico joined the International Telecommunication Satellite Organization (INTELSAT). Two years later, in 1968, Mexico hosted the XIX Olympic Games, and used, for the first time, transoceanic satellite communication from a huge earth station, Tulancingo I (Built by Mitsubushi, Japan), 100 kilometers from Mexico City; the same time, through arrangement with INTELSAT and NASA, Mexico utilized using the experimental spacecraft Application Technology Satellite (ATS-3) to broadcast the Olympics Games globally (Shcmucler, 1984, 1986).

In 1969, SCT/DGT, established a permanent international link using the INTELSAT III, located over the Atlantic Ocean (Gall, 1986). This was a decade of accelerated growth for the telecommunication sector. The consolidation of the commercial broadcasting industry, the rapid growth of telephony and similar services (e.g. Telex) resulted from a dynamic economy, from the 1950s on; however, the rural sector, (one third of the population) did not benefit.

In 1977, DGT/SCT launched the national rural telephony plan to connect 13,500 rural towns (in the range of 500 to 2500 inhabitants) with these services. In studies conducted to optimize existing networks, it was found that from the techno-economic aspect, it was more cost-effective to use communication via satellite than to build terrestrial infrastructure to reach these far-flung areas. The possibility of a domestic satellite technology, was then considered; the alternatives being leasing transponders on INTELSAT or having a nationally controlled system. There were initial plans to build a satellite network of 1604 earth stations. According to Sanchez Ruiz (1987), this was influenced by the 1978 Stanford University study of the Iranian satellite project, (cancelled) using very small satellite dishes for rural telephony (Mike Heller, 1987).

In late 1970s, the concurrent development of the telecommunication sector was attributed to the growth in the economy resulting from the "Oil Boom" (1977-1982). International financial institutions gave multibillion dollar credits to Mexico for infrastructure development projects such as refineries and petrochemicals plants. Mexico became the "new rich" country in the international community. This significantly influenced the final decision, in favor of satellite adoption made by the Lopez

Portillo regime.

In 1980, another large earth station Tulancingo II was built by U.S. 's E-Systems, designed to link to INTELSAT V. Later in the year, SCT installed Tulancingo III which from May 1980, linked through Westar III (by special arrangement with INTELSAT) to distribute Televisa's TV programming to cable systems in the United States. (Schmucler, 1984, 1986). This year was crucial in the utilization of satellite technology for international purposes, but also marked the beginning of domestic use via the INTELSAT system. With the implementation of the satellite network, Mexico was already committed to satellite use. The question that persisted was the feasibility of having a Mexican owned domestic satellite.

Unlike India, the idea of a domestic satellite was not regarded as an alternative to means of developing national telecommunication infrastructure. In Mexico, satellite telecommunication was seen as a supplement. This is important because, in case of the failure of either, the country could alternatively use the other. The microwave infrastructure was laid by the SCT, also by the Telephone Company TELMEX (which is decentralized from SCT), and by Petroleos Mexicanos (PEMEX).

In 1981, the rapid growth of the national earth station network was SCT'a response to the demand for television and telephony saturation of the microwave network. Thanks to a joint-agreement between SCT, Televisa and State governments, Mexico was developing one of the biggest satellite earth station networks in the world; 1981 was a good year for the Mexican economy, before it was hit by the "Oil Crisis" (and other factors) in 1982.

In June 1981, the international bidding begun in the selection of an aerospace manufacturer.

5.-Influential forces

A matrix of illustrative factors that influenced Morelos is presented on the following page. The influence of each of these forces has changed over time e.g the role of Televisa in the Ilhuicahua phase of the project and how it changed during the De la Madrid government.

Figure 3

Matrix of Illustrative Factors/Actors Influencing the Morelos Satellite System

	Economic	Scientific Technical	Political	Cultural
Foreign	Hughes S-Atlanta Nippon E. Co EXIM-Bank	NASA's ATS SACI/SITE Japanese - Training Hughes		
National	SCT Televisa	SCT UNAM	Natl integration Natl Sovereignty Natl Indep Televisa	National preservation of culture
Sub-National	State Gvnts.		Regional integration	Regional preservation of culture

a) Domestic factors

The major domestic force was President Jose Lopez Portillo who authorized the satellite project in October 1980. In June 1981, after the viability studies of the project were complete, final approval was given to the "Ilhuicahua" project. Mr. Lopez Portillo was a technocrat who authorized several of infrastructural projects because of an all-important factor, the temporary "explosive" growth, post-the "Oil Boom"; two hundred million dollars was not a high price for modernization of the telecommunication sector (SCT/DGT Boletin Interno de Noticias (BIN), October 1980; SCT/DGT BIN, June, 1981). The three main actors inside SCT, were the head of SCT, Mr. Emilio Mujica Montoya, the director of General Direction of Telecommunications Mr. Clemente Perez Correa who proposed "domsat", and the group of engineers working on the implementation of the domestic satellite infrastructure to use with INTELSAT, from where the idea emerged.

Another major domestic stakeholder was Televisa's involvement was first in the Ilhuicahua project, as a provider of 44 earth stations (Agreement, October 1980) for the national satellite earth station network, and at a later stage, as potential financier of the system (Agreement July 5, 1982). As Mexico entered its worst recession, there were rumors of grounding the project in 1982, because

Mexican foreign exchange reserves were depleted (Agreement SCT-Televisa, October 1980; SCT/DGT Boletin Interno de Noticias, October 1980, p. 2,16 No.19; Agreement SCT-Televisa, July 5, 1982; Mexico City The News, Wednesday, July 7, 1982; Mexico City The News, July 7, 1982 p.4; Schmucler, 1984; Fadul, Fernandez, Schmucler 1986). Televisa felt that the project was in jeopardy, first because there were no financial resources, secondly, because a change of government could lead to cancellation, and thirdly the time factor: if cancelled or postponed, there was a risk of losing the orbital slot, since they were being rapidly filled by American and Canadian systems. Azcarraga, (a majority owner of Televisa) is quoted as having said, "if the satellite was not ordered in 1982, Hughes would not have the system ready until the 1990s". SCT was as concerned as for Televisa abouy the lack of space positions in the geosynchronous equatorial orbit (Martinez, 1986).

A subsequent major domestic actor was President Miguel de la Madrid. A few days after he was inaugurated, he passed a bill, reforming article 28 of the Constitution that defines the areas that are reserved for government control, to include communications via satellite as an exclusive function of the state (Fadul, Fernandez, Schmucler, 1986). Televisa could not now be a partner with

SCT. Televisa's involvement in the "Ilhuicahua" project created a controversy among the political and intellectual elites because of the former's increasing political clout, as well as the cultural impact of permitting a commercial entity into a socially-oriented project. He reduced the "Ilhuicahua" project to a less expensive two spacecraft configuration, instead of three. Thus, SCT officials denied any access to the private broadcasting sector in the satellite program.

In the new government, Televisa was one among many users of the future system. Three months later, the newly SCT directors confirmed the satellite project under a new name: Morelos Satellite System, (after a national hero said to be the new President's favorite). The system was not a DBS system as the "Ilhuicahua", but a hybrid one, using 22 channels for each spacecraft in the C and Ku bands. A two spacecraft system was to be launched in 1985, at a cost of around 150 million dollars. It confirmed Hughes as the aerospace consortium, and NASA's Space Shuttle as the launch service (Martinez, 1986; Fadul, 1986).

Minor domestic actors were the state governments that had agreements with SCT to finance earth stations for their states (Sonora, Yucatan, Quintana Roo, Baja California Sur, Oaxaca, Guanajuato, Guerrero states) (SCT/DGT Boletin

Interno de Noticias, 1980-1982, Fadul, 1986). Their interest was regional television and rural telephony. In respect to the former, the idea was to maintain a regional cultural identity.

The education and health sectors had a minimal role in the project, and participated in meetings to voice their needs. It was mentioned by SEP's (the Secretariat of Education) officials that with 2000 earth stations SEP could cover the whole nation, mainly to reach the rural areas (SCT/DGT Boletin Interno de Noticias, 1980). In the area of rural telephony, according to Sanchez Ruiz (1987) its role was always considered marginal and would have to be subsidized by other services. Rural telephony is cost-effective on long distance lines (Heller 1988).

These agencies were not parties to the final adoption decision. This neglect is reflective of their status in the Mexican socio-economic and political context. There is no indication anywhere that satellite technology has changed the interests of economic, political and cultural forces that set basic government priorities. The promise of "social applications" was populist rhetoric used to "sell" the satellite to the public. It is in the third year of the satellite program that social service agencies are being encouraged to design applications, given massive underutilization of Morelos's capacity; the exception was the Children's Hospital's once a week point-to-multi-point transmission for physicians at the initiative of its director. The plan is that the Telesecundaria project will start using the Ku band to transmit to schools, later in 1988 (Landeros; Munoz, 1987).

The political actors were supportive of satellite communications for national integration, sovereignty, and independence from foreign systems as a justification. There were fears of USA's DBS systems transmitting to Mexican territory, or spilling over, specially in the border areas. The national culture was threatened by the rapid development of new systems in the USA. The first 35 domestic earth stations were built in the north of the country, an area more susceptible to "spillovers" from the American systems. It was seen as crucial to reach remote places, like Mexican islands in the Pacific, that could be rapidly communicated with, which has been one of the priorities in maintenance of national sovereignty over islands within 200 miles of the mainland; as Mexico's neighbor in the north recognises a 12 maritime zone only, this a potential area of conflict for Mexico.)

Communications via satellite were seen by the political actors as a strategic method of linking rural and remote areas in the country, and as a formidable propaganda channel for the Partido Revolucionario Institucional (PRI) (Munoz, 1987).

In the last two administrations, Televisa has maintained its strong political links to the government. Televisa's owners represent powerful economic lobbies in the country, with links to the political elites. Although the Mexican state has more control on the media due to its "authoritarian mass media model", Televisa has acted freely as a broadcasting corporation would in a "democratic mass media model" (e.g. the United States or Canada (Mahan, 1982). At the time of Lopez Portillo, the relations with Televisa were considered excellent; the Director of Telecommunication department (DGT), in the Ministry of Communications and Transportation Mr. Clemente Perez Correa had strong links to Televisa's owners (Munoz, 1987).

b) Foreign factors

The prime movers in satellite adoption by Mexico were domestic. While Western equipment manufacturers (e.g. Hughes, Ford Aerospace, Spar-Canada, Aerospatiale and others) are frequently accused of selling technological solutions looking for problems, into the Third World, in this case if there was a foreign strategic commercial role, it was Japan's. Japan's market research/aid efforts led it to the right place (Mexico) at the right time (when the terrestrial microwave system was saturated). Far from being accidental, such good timing requires systematic global marketing planning; strategic donations for market development are the hall-mark of Japanese foreign aid efforts.

Japan's technical assistance in the area of satellite communications began in 1980 with the donation of the first domestic satellite earth station. This was a special dish with associated equipment, and training of Mexican engineers in this new technology. Coincidentally's SCT's plans for satellite earth station network included 2,000 dishes for the year 1983; a deminished economy decreased the demand for earth station equipment; the current plans are the installation of 800 earth stations by the end of 1988 (Esteinou, 1988); the first order, 35 earth stations came from NEC, Japan (17) and U.S. Scientific-Atlanta (18). The cooperation and assistance provided by foreign governmental agencies (e.g. the U.S. EXIM Bank) to help their own corporations, in the First World and Second World countries is illustrated by the facilities provided to complete the satellite sale to Mexico, in the face of Mexico's sudden inability to pay at under the debt crisis circumstances.

The advantages to foreign capital and national commercial houses is illustrated by Televisa's order of earth stations, for its access to SCT's national network, from a sister company which is in joint-partnership with Scientific Atlanta, a U.S. firm. Both U.S. and Mexican corporate interests seem to have benefited by a Mexican government policy on local involvement in foreign ventures.

Scientific and technical forces which influenced this MSS decision were:

-the experience gained from the successful pilot-projects with NASA's Application Technology Satellites in India; the planning of social experiments that demonstrated health, education and agriculture applications seemed worth advertising to the Mexican public.

-French and American consultants who were used for the feasibility study, which led to the development of specifications;

-Hughes which manufactured the satellite and its telemetry,

-COMSAT which supervised all stages,

-McDonnel Douglas which delivered the Payload Assist Module,

-and NASA's Space Shuttle which launched the satellite. This basic dependence on foreign technologists in the design and delivery of the hardware is the main characteristic of the speedy 5-year plan Mexico opted for; this is in contrast to lengthly efforts, at indigenized adoption, made by India and Brazil over a 20 year time period.

It is difficult to detect any foreign political or cultural force in the design of the Mexican project or in its purpose. The motivation behind the hasty, rather speedy, decision was the fear of losing a choice orbital slot to the U.S. and Canada in ITU Region II; or perhaps the fear of cultural imperialism via U.S. DBS programming. The force behind traditional super-power military or foreign aid interventionist arguments used in Mexico's mass media to undermine the satellite decision was determined by domestic circumstances as much as or more than by foreign realities.

The factor of overall importance was the ITU/WARC "orbital position" arguments, between developed and developing nations, about "first come, first served versus planned orbital allocation" mentioned in the published literature and interviews in Mexico. This Mexican fear benefited aerospace corporations, various lobbies, within the public (ministries involved, e.g. SCT) and the private sectors. Televisa acted as a pressure group during the uncertain evolutionary phase (Landeros, Gomez Ortigoza, Munoz 1987).

In the post-SITE era, satellite systems were being aggressively marketed in large Third World nations, which could potentially benefit from this technology. In an institutional brochure Hughes explains "that a domestic satellite system is Mexico's next logical step to provide better telecommunications services, if it wants to keep its leadership in Latin America", a status consequent to Mexico's "Oil Boom" (Hughes, Ilhuicahua, 1980).

CHAPTER VI

CONCLUSIONS AND SUGGESTIONS

In this chapter, I will answer the research questions posed in chapter II. In the second section, I will outline suggestions for future inquiry and alternative policy plans for future Morelos generation of spacecrafts.

RQ1: The adoption of Morelos was not as systematically planned as was the system in Brazil.

By systematic planning, I refer to the participation of different government agencies, (like the education, health and space research institutions) in coordinating the planning of the domestic satellite system. The whole process, from the initial studies to the launching of the system, took a little over five years to implement. Early satellite use was via INTELSAT's domestic service to the national satellite network, and subsequently, by SCT linking its own domsat.

It took India and Brazil about 20 years to implement indigenized satellite system for domestic use. The rapid and perhaps, precipitated implementation in Mexico was due to the different factors listed that influenced the adoption of this communication system. (SCT/DGT BIN, 1987).

What were the consequences of this speedy implementation in Mexico?

Given the strong user need (SCT and Televisa) for the hardware, it is understandable that the prime movers of the project focused on acquiring the hardware expeditiously. SCT did not envisage the need for a major pilot project to demonstrate the possibilities of broadbased utilization of the technology by diverse sectors, ranging from industry to health, agriculture and education. The promotional campaign for the project, run by SCT in 1983, promised social applications, but did not substantiate them. Thus, the users of Morelos continued to be the self-interested previous users of INTELSAT transponders (those who had prior experience of the satellite's capability). Those who were there first seemed to be the only ones served, at the present time.

Mexico was dealing with a technology, which was difficult of assimilation. Too much attention was paid to the hardware aspect of the project, leaving the software last. Mexico did not have a major pilot project to assess proper utilization of the sophisticated technology, where the education, agriculture and space researchers worked in tandem, given the unique characteristics of Mexico, to assess needs according to national development goals. This experimental trial with the technology would have prepared different interest groups to deal with such sophisticated technology. The technology adoption was done on the go with the implementation of the domestic satellite network using INTELSAT, conducted for a single interest group, the engineers in SCT/DGT.

The so-called social applications which the government promoted in the mass media institutional campaign, launched by SCT in mid 1983, did not get off the ground. Two and a half years later, in 1986, the satellite was used occasionally for a limited tele-medicine project for medical experts, from Hospital Infantil de Mexico, to 19 hospitals around the country, using point to multi-point audio/video transmission.

Two years after the deployment of the system, in 1987, SCT commenced using the Ku Band transponders for rural telephony. Initially benefiting 50,000 rural inhabitants, this programme is still at a pilot stage. SCT and Secretaria de Educacion Publica (SEP-Education sector), in 1988, will start, the "Telesecundaria" via Morelos, direct to the roofs of rural schools, using one of the Ku Band transponders (Landeros; Munoz, 1987).

The technology was first negotiated and implemented without a clear rationale of the uses and users: This is reflected in the present underutilization of one of the most advanced domestic satellite systems in the world. The engineers in SCT/DGT were more concerned about solving a telecommunication problem than having the wider vision to domesticate hardware by letting national space researchers benefit from association with Hughes during the first purchase.

Two studies on satellite demand were conducted after the decision was approved. There were initial meetings with all the sectors of the economy in October 1980, to present the domsat proposal, but it was clear that the project was to become a reality (SCT/DGT BIN No.19 October 1980 p.1 and 12). Mexico in fact, had acquired the hardware, and only then, uses/users were being considered. We have 44 different bandwith transponders in the C and Ku band; the question which is for which ends? Only 12 channels are being partly utilized.

According to interviews, it is clear the SCT secretariat did not consult other government agencies like the education and health ministries, or the space studies institutions, like UNAM's Geophysics Institute or the National Polytechnical Institute's Electric Engineering Department. There was lack of coordination and information of the project. This was confirmed in the different interviews conducted in Mexico. There is no evidence anywhere that satellite technology has changed the interests of economic, political and cultural forces that set basic government priorities. The promise of "social applications" was populist rhetoric used to sell the satellite to the public.

In June 1986, a year after Morelos I was launched, the spacecraft was being used at 15% of its capacity. The only time Morelos I was used at full capacity was when Mexico played host to the 1986 World Soccer Championship: television, radio and data transmissions took place from differente stadiums to Mexico City, and via INTELSAT to the whole world. After this event, which is compared in magnitude to the Olympics, Morelos I reverted to underutilization.

The present status of Morelos after two years in operation is: 32% of Morelos I's capacity was being used in 12 semi-occupied transponders, mainly for state and private television services, telephony, radio networks and some data transmission (Munoz, September 1987). In its third year of operations Morelos I reached 56% capacity utilization, with 40% for television, 10% for telephony, and 6% for data transmission. The reality may be somewhat different because SCT feels the pressure to fill transponder capacity (Angeles Munoz, 1988).

Morelos II, launched in November 1985, was placed in a special "storage orbit" until it is required by the expansion of telecommunication services; it is planned to commence operations later in 1988 (Landeros, 1987).

The Morelos programme has also suffered from administrative setbacks. The "Subdireccion de Explotacion de Satelites Nacionales", the department created to administer, promote and operate the system, is centralized in the huge bureaucratic ministry "Secretaria de Comunicaciones y Transportes" (SCT), where this department comes under several "Subsecretarias" (undersecretaries) and "Direcciones" (directorates) like the Directorate General of Telecommunications. An official expressed that the problem with the system's underutilization is an economic one, there being an inadequate promotional budget; this area has two managers, who have laboured under this shortfall (Munoz, 1987).

SCT's service policies have not promoted the satellite services. The potential users identified in the last study of demand conducted in 1985 are listed as follows: the Federal government, state governments, private and State corporations (500 largest corporations), banks (nationalized in 1982), broadcasting corporations, news agencies and newspapers. SCT's lack of a marketing strategy in the initial services promotional campaign failed to capture the market. SCT used INTELSAT as a basis for its tariff policy. Potential users have expressed that with the high cost of equipment and the high cost of services, it is just not cost-effective for many corporations to use domestic satellite links at the oil boom rates they could afford. Only those major corporations like banks, Oil Company PEMEX, Chrysler de Mexico and Ford de Mexico can afford it.

For purpose of illustration, tables on the annual circuit and transponder demand (1985-1988) are presented in the following page:

Table 1

ANNUAL CIRCUIT DEMAND-MSS

SERVICE	YEAR 1985	1986	1987	1988	SUBTOTAL
AUDIO	862	965	137	83	2047
DATA	1454	442	195	381	2472
VOICE/DATA	654	228	233	140	1255
TELEGRAPHY	124	19	5	2	150
TELEPHONY/TELEGRAPHY	92	95	124	----	31
	----	----	----	-----	-----
SUBTOTALS	3186	1749	694	606	6235
BROADCASTING					
TELEVISION	14	10	8	----	32
RADIO	23	1	7	----	31

The equivalent in number of transponder is presented in table 2.

For table 2, the number of voice grade circuits per transponder is estimated at 500 circuits per transponder. For radio networking it is estimated at 20 circuits per transponder (Sanchez Ruiz, 1987).

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in linking thousands of offices, clinics and schools, in the remote areas, but are unable to use Morelos because of budget constraints. Three of the potential users, the Electricity Company (CFE), Telephony Company (TELMEX) and the Oil Company (PEMEX) are expanding microwave systems to avoid dealing with SCT and their high rates (Ortigoza, 1988).

The transmission of a tele-medicine course from "Hospital Infantil" was at the initiative of the director of this hospital, an individual interest, and not that of the health sector (SSA) which was not interested at all (Munoz, 1987).

Rivalries between different engineering schools were identified: National Polytechnical Institute (IPN) and Universidad Nacional Autonoma de Mexico (UNAM). The ruling elite in Mexico usually are graduates from UNAM. SCT has been traditionally managed by graduate engineers from IPN. As a result of political maneuvers and power plays, UNAM's engineers in the rival institution now control Morelos in SCT/DGT, while MSS's Iztapalapa operation center is controled by IPN graduates. Here, we see how political frictions in the surrounding context significantly affect the performance of the technology. It seems that Morelos present status as an underutilized technology, is the reflection of Mexico's social-economical-political system, rather than its technological status. An additional observation is that Morelos is mainly managed by technical personnel who have completed the technology implementation. Now, administrators, and specialists in the marketing of telecommunications are required. What is necessary is a a decentralization of the Morelos's department from the SCT to avoid budgeting and understaffing problems. Further, there is an urgent need to change policies on tariffs and ownership of earth station equipment. SCT, as is the case with government agencies, is feeling the pressures of "deregulation" and "privatization" trends in the new emerging international arena. With the recent Aeromexico's bankruptcy (one of the two major national airlines) under SCT, the government is denationalizing. According to an official from the Telephone company, TELMEX may become private, and in the long term, MSS may do the same, at least decentralize the MSS. (Federico Ortiz M. "Analiza la SCT la situacion de Telefonos de Mexico para su venta", Excelsior, January 21, 1988 5-A; Munoz, Heller, 1988).

The foregoing answer has been presented to illustrate the lack of systematic planning for Morelos. Now, I proceed to research question two:

RQ2:

The adoption of Morelos was not based on a national assessment of the needs of Mexican society. It was proposed and promoted by specific government and private interest groups.

For research question two, by national assessment of needs of Mexican society I refer to the participation of the Congress, where a special committee could have reviewed the project, in cooperation with the National Council of Science and Technology (CONACYT), UNAM's Space Studies Department, the Polytechnic Institute, and different agencies to give inputs on the best conditions to acquire this technology.

The initiative towards acquiring a satellite came from the two special interest groups (SCT and Televisa). It was proposed by the Director General of Telecommunication, Mr. Clemente Perez Correa and the Minister of Transportation and Communications, Mr. Emilio Mujica Montoya to the President, Mr. Jose Lopez Portillo. The decision was taken without consulting the Congress, who represent the Mexican public, who after all are the tax payers. Interviews conducted in September 1987 established the good relationship between Mr. Clemente Perez Correa and Televisa families. The role of Televisa in the "Ilhuicahaua" programme clearly indicates the interest of Televisa in the quick implementation of the satellite.

A bureaucratic (SCT/DGT) and a private corporate (Televisa) interest group rather than the concerned interested ministries determined its adoption. The engineers in SCT/DGT were mainly concerned with the growing telecommunication demand. Televisa's interest in the technology was dictated by their need for corporate expansion and profit maximization through audiences covered by satellite. 93% of Televisa's revenue comes from advertising.

Televisa's involvement in the "Ilhuicahua" project is legitimate in Mexico's "mixed economy". The corporation represented the interest of the private sector for economic reasons. SCT represented the interest of the state for the "common good and public interest". This alliance is the result of the social-economic-political system. The "mixed economy" in Mexico is one where the state control is strong, but where powerful private economic groups also play an important role in the decision-making process in the socio-political system.

Research question three asks:

RQ3:

The applications of the Morelos Satellite System reflect the special interest groups and forces that created Morelos. These applications are more revenue oriented and private, as opposed to pro-social and public, as is reflected in transponder assignment and plans.

These are telephony, commercial television and radio, cable TV and data transmission, and not pro-social e.g. tele-education. agricultural extension and tele-medicine to rural areas.

Table 3 (see, page 101) shows present and planned transponder assignments. Table 4 (page 103) shows present users in the transponder assignment. Economic circumstances in the market (among other factors) have changed due to a severe recession in Mexico.

For purposes of illustration, (see table 4), the transponder assignment as of September 1987, shows three main users: Televisa with two TV channels and one for cable TV. TELMEX is using almost one transponder, but has reserved four of them for short term utilization. Instituto Mexicano de la Television (IMEVISION-State TV network) is transmitting two channels, one commercial and another as a public TV station. The radio networks OIR, RASA, RIP and

El Heraldo, among others are revenue-oriented groups. The table shows all other small users as Instituto Tecnologico de Estudios Superiores de Monterrey (major private high level educational institution financed by the Monterrey industrial group), Chrysler de Mexico, Seguros de Mexico, CARNET, Banco Nacional de Mexico, Banco de Comercio. These among others also are revenue-oriented. Except for capacity reserved for rural telephony, occasional services (the tele-medicine project), ISSSTE (State workers social security), social applications are being neglected. SCT's plan for 1988 is to start the Education sector (SEP) "Telesecundaria program" to rural areas.

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Table 3

Morelos I Transponder Assignment

22 Transponders

C Narrowband 36MHz Transponder		C Wideband 72MHz	Ku Band 108 MHz
1	IMEVISION Channel 7 100%	INFOSAT 1/6 % SCT's telephony (*) 5/6 %	Chrysler de Mexico ITESM (1/50 &2/10)
2	-PEMEX telephony 1/10 -Radio: OIR, RASA, RIP, El Heraldo, Radio Centro- 4/10 -Reserved for: El Heraldo de Mty., ACIR, Radio Educa-cion, Radio Central, Radiorama, Radio Mil, Infojal-5/10	Reserve 1/2 SCT/SSA, Channel 4 and Occasional-1/2	Rural Telephony SENEAM, ISSSTE, Televisa, CFE, Seguros de Mexico, CARNET-1/15 -Reserved for: Rural Telephony, Diconsa, Banca Cremi, IBM-1/5 -Reserved for: Tele-education, SEP-6/15
3-	Reserved for: Channel 11 IPN-1/2 and Channel 22 IMEVISION -1/2	Reserve-2/3 Reserved for: Natl. Chamber of CATV-1/3 Reserved for: 2 CATV channels	Reserved -Data: El Nacional -1/3
4-	IMEVISION Channel 13- 100%	of Nuevo Laredo, Tam. Mexico-2/3 Reserve-1/3	-Digicom-1/50 -BANAMEX-1/10 -BANCOMER-2/25 -Reserve-2/25
5-	Televisa-Chan. 5-1/2 Televisa CATV-1/2	Occasional Video -1/2 Reserved for: States television Reserved for:	

6-	Occasional Services 100%	States television -1/2 Reserve-1/2	
7-	Televisa Channel 2 100%		
8-	Reserve-1/2 Reserved for: Telefonos de Mexico (TELMEX) La Paz-1/2 TELMEX Tijuana y		
9-	Hermosillo-1/3 Reserved: TELMEX Tijuana y Hermosillo -1/3 and additional 1/3 of transponder		
10-	TELMEX Monterrey-1/5 Reserved for: TELMEX Monterrey-2/5 TELMEX Monterrey-2/5		
11-	TELMEX Guadalajara-2/5 Reserved for: TELMEX Guadalajara-2/5 TELMEX Guadalajara-2/5		
12-	TELMEX Mexico-1/5 Reserved for: TELMEX Mexico-2/5 TELMEX Mexico-2/5		

Transponder assignment as of September 1987.
Angeles Munoz, Morelos Programme Service Promotion

*Morelos II will start operation in the end of 1988.

**Projections for 1987 were that 55% of Morelos I's capacity would be used.
***For 1988, the projection is 75-80% capacity utilization.

Table 4
Morelos I Transponder Assignment
22 Transponders

C Narrowband 36MHz Transponder		C Wideband 72MHz	Ku Band 108 MHz
1	IMEVISION Channel 7 100%	INFOSAT 1/6 %	Crysler de Mexico ITESM (1/50 &2/10)
2	-PEMEX telephony 1/10 -Radio: OIR, RASA, RIP, El Heraldo, Radio Centro- 4/10		Rural Telephony SENEAM, ISSSTE, Televisa, CFE, Seguros de Mexico, CARNET-1/15
3-			
4-	IMEVISION Channel 13-100%		-Data: El Nacional -1/3 -Digicom-1/50 -BANAMEX-1/10 -BANCOMER-2/25 -Reserve-2/25
5-	Televisa-Chan. 5-1/2 Televisa CATV-1/2	Occasional Video -1/2	

6-	Occasional Services 100%		
7-	Televisa Channel 2 100%		
8-			
9-	Telmex Tijuana y Hermosillo-1/3		
10-	TELMEX Monterrey-1/5		
11-	TELMEX Guadalajara-2/5		
12-	Telmex Mexico-1/5		

Transponder assignment as of September 1987.
Angeles Munoz, Morelos Programme Service Promotion

*Morelos II will start operation in the end of 1988.

**Projections for 1987 were that 55% of Morelos I's capacity would be used.
***For 1988, the projection is 75-80% capacity utilization.

RQ4:

The adoption of the Morelos Satellite System, fosters technological dependence on the transnational manufacturers and foreign institutions.

Here, I refer to the unfavorable technology transfer conditions when acquiring the satellite system. SCT's engineers learned just operational and maintenance skills, unlike Brazilian and Indian engineers who learned to design and build satellite subsystems, so that by the next generation a major satellite component would be developed indigenously. These dependence relationships on a foreign satellite manufacturer, are not waning, because of the motivation of the elite behind the country's socio-economic and political system. The lack of a national consensus when adopting new technologies, and the special interest of two lobbies in the country hastened the adoption process, rather than led to a-step-by-step gradual absorption attempt.

In interviews conducted in Mexico, Dr. Rodolfo Neri Vela harshly criticized the Morelos program as reflecting the attitude of space researchers in Mexico, the lack of research and development (R&D) in space technology, and the limited terms of the transfer of technology with Hughes.

The Morelos system has been acquired in a "packaged turn key" fashion, which is the less desirable option for a developing country when acquiring a technology, unless it includes in the contract a program of transfer of technology, training at all stages of planning, design, production, implementation of hardware/software and associated aspects. At the same time parallel to this an "in house" program of research and development in this area must be created to adapt, redesign and gradually develop locally subsystems of the "packaged technology" to avoid the vicious cycle of buying "off the shelf" technology, which depletes the scarce hard currency reserves.

Systematic and extensive planning, before, during and after implementation, along with scientific and technical expertise in hardware and software to adapt the technology to the local context, will determine if and how Mexico will" domesticate" this sophisticated information technology.

Dr. Rodolfo Neri Vela in UNAM confirmed the unfavorable terms of Transfer of Technology (TT); there were no deliberations on this subject. Morelos's TT included a two year training of 40 Mexican engineers for the operation and maintenance of systems. For purposes of comparison, Brazil's TT conditions were favorable, because it included training and participation of Brazilian engineers from "scratch" in all the stages of antenna design, satellite design, assembling of subsystems, among other things in addition to the training for operation and maintenance of systems. Brazilian TT covered earth segment hardware, and also the launch vehicle (Albernaz, 1984; SPAR's Brazilsat summary, 1987). Brazil has three separate "in house" R&D programs: INPE for experimental satellites, IAE for launch service and Telebras R&D center for the earth segment hardware.

The major dependence on foreign technologists in design and delivery of the hardware is a unique characteristic of the hasty 5-year development Mexico chose. French and American engineers were hired as consultants on the "feasibility study" which led to the development of specifications. The suppliers were foreign, building Mexico's system to specifications set by foreigners. Hughes which manufactured the satellite and its telemetry, COMSAT which supervised all stages (engineering, assembly, integration, test and launch), McDonnel Douglas which delivered the Payload Assist Module, and NASA's Space Shuttle which launched the satellite. This stands out distinctly from the longer time periods, (20 years), involved in the efforts at indigenized adoption made by India and Brazil. Additionally, Mexico relied entirely on foreign expertise from one country, instead of diversifying dependence in the technology. Given that it was U.S. cultural dominance of its border areas, and U.S. dominance of the geostationary orbit, it is interesting to note Mexico's reliance on the U.S. to defend itself, against the U.S!

The main advantage of the "total system" implementation was its low cost (US $150 million), compared to $211 million in the case of Brazilsat, and around $300 million invested by India in its INSAT multipurpose system. Another advantage was technical: the hybrid C and Ku band system allows a greater flexibility to provide a variety of services.

The critical area in this lack of vision for TT in the program was in the earth segment hardware. The requirements in the near future is for 1600 to 2000 earth stations. Most of the equipment must now be imported. The only components Mexico manufactures are the dish, the mechanical parts, some modems and their assembly (of parts). Most of the sophisticated Very Large Integrated Circuit (VLIC) equipment is being imported (LN amplifiers, receivers, multiplexors, etc). Dr. Rodolfo Neri Vela pointed out that the capability to develop a local earth station equipment industry has not been accomplished, because of the lack of information about the system, since the inception of the project, which did not include those national industries that could have developed the expertise to manufacture these main components. During the five years it took to implement Morelos, Mexican industries could have partially developed this production capability. Brazilians corporations accomplished this task through their own R&D, (Telebras). When Mexican entrepreneurs wanted to do so, it was too late to compete against companies like Scientific-Atlanta and NEC, Japan, who established their subsidiaries in Mexico in the early 1980's, and who have had better information about MSS project, export and marketing strategies than national entrepreneurs (Neri Vela, 1987).

* * *

The presentation of Mexico as a case study in adopting high technology in telecommunications shows how different factors interact and influence the adoption of technology. The socio-economic/political Mexican system, (within which this technology functions) dictates the extent of its technological dependence on foreign transnational corporations and institutions. To circumvent contextual forces requires concerted action over a long period: perhaps this is why it took India and Brazil 20 years to assimilate this technology.

Satellite communication policy makers must necessarily consider technological, economic and socio-political conditions for the optimal utilization of technology. Decision makers must choose between a long-term policy that favors technology transfer for indigenization and self-reliant national development on the one hand, and speedy adoption by purchasing off-the-shelf technology from a First World country on the other. The latter option may be a preferred option for some TWCs at some points in time. The first option represents a preference for self-reliant national development while the second implies acceptance of dependence on foreign services.

Technological dependence is not inevitable for Third World countries with large pools of trained scientists such as Mexico, India and Brazil. By creating "in-house" research and development programs for the hardware and software, prior to and parallel with the adoption of new information and communication technologies, policy makers could prevent further dependence on foreign manufacturers, while nurturing the domestic industrial production of new products stimulated by such technology implementation. Broad-based planning in all stages of the project, and pilot programs will help a country successfully indigenize foreign technologies.

In addition to this, holistic societal-level forecasting of technology impacts must be undertaken to understand consequences in a total socio-economic and political context. If satellite technology is to be technically feasible in a developing country, careful prior studies must be undertaken to lessen the contingencies that new technology brings when development in one area is accelerated at the expense of other basic development projects, i.e. a bridge or a road (basic infrastructure construction).

Satellite technology, theoretically, can help expand telecommunication services, improve productivity in a society and enhance development in education and health and other spheres, but the actual prevailing conditions under which the system is accepted greatly affect its success.

An urgent national policy is essential in the adoption of new technologies. Mexico should create an organization similar to Brazil's Special Secretariat for Informatics (SEI), that oversees every condition in a contract when acquiring sophisticated technology, as well as coordinating "in house" R&D programs accompanying its implementation.

Mexico's case serves an example to other developing countries seeking to adopt new communication technologies to accelerate independent development, because instead of the latter, a dependent relationship is reinforced, not by the technology, but by the country's socio-economic and political environment.

This study of the adoption of satellite communication technology in Mexico shows how different forces interacted to produce Morelos. The action/inaction of these forces determined the limited social applications during the first half of Morelos I's lifetime, and influenced/re-inforced macro-level contextual relationships such as Mexican technological dependence on a U.S. satellite builder. Early versions of dependency theory saw the dominance of the center (the industrialized West/North) as the explanatory variable in dependency relationships between developed and developing countries. This case study demonstrates how the domestic social, economic and political context within Mexico dictated a dependent technological relationship with this trasnational corporate satellite manufacturer. It is conceivable that such dependency in one sector may be planned as part of a larger industrial policy to benefit other crucial sectors where independent initiatives are foreseen.

In the next five years, the Morelos project organization in SCT needs to:

a. commission sophisticated research on marketing Morelos capacity under a range of domestic economic scenarios;

b. nurture and demonstrate social applications in the public interest;

c. commission R&D to reduce dependence on foreign suppliers in the new internal Institute for Communication and Transportation and in the GIAE-UNAM on the lines of Brazil's Special Secretariat for Informatics (SEI) that oversees the conditions under which relevant technologies are acquired,

d. stimulate technology transfer to Mexican industry in locally manageable items such as Ku band earth stations for rural telephony and television.

e. involve all user agencies and research universities in planning for Morelos III, starting inmediately;

f. and finally, as in all other countries, conduct in-depth analysis of the institutional structures that are most likely to serve efficiency and public service objectives under prevailing contextual conditions (Melody, 1987).

A deterministic perspective on the force of the context would indicate very little hope. However, the contradictions and conflicts between the different forces in the Mexican power structure are the locations where hopeful interventions are conceivable.

A traditional study of the effects of Morelos on individuals in Mexico would have yielded no insights for Third World policy makers. This contextual analysis might profitably serve Mexico and similarly constrained Third World countries as an illustration of how sophisticated communication technologies can be adopted without a larger national vision or policy. The villain of this piece however, is not the technology, or the foreign sales person, but the domestic power structure in the adopting nation that perpetuates the dependency relationship, due to a combination of haste, short-sighted/short term (e.g. SCT) policy, and corporate self-interest (e.g. Televisa-Digisat-Scientific Atlanta).

As Mr. Landeros, director of Morelos (one of the main promoters for R&D in this area) said: "We are learning with the Morelos mistakes. The next time the conditions will be different" (Landeros, Sep. 1987).

APPENDICES

APPENDIX A

APPENDIX A

MORELOS SATELLITE SYSTEM I&II

Orbital Assignments: Longitude	113.5o and 116.5o West
Launch Vehicle:	NASA Space Shuttle
Design Life:	10 Years
<u>Communication Payload:</u>	
Frequency Bands:	Receive 14.000-14.500 GHz 5.925-6.425 GHz Transmit 11.700-12.200 GHz 3.700-4.200GHz
Channels	C Band: 12 Narrow Band and 6 Wideband with Horizontal and Vertical Polarization Ku Band: 4 Wideband channels with Circular Polarization.
Channel Bandwith:	C Band: 36MHz and 72MHz Ku Band: 108 MHz
Antenna Coverage:	Mexico and Central America
Signal Power:	C Band: 36dBW Mexico and South-western USA. Ku Band: 44dBW in Mexico.
TWTA Power:	C Band 7 and 10.5 Watts
Capacity:	36 Color TV Channels
<u>Spacecraft:</u>	
Satellite Type:	Hughes HS 376 Spin-Stabilized
Electrical Power:	940 Watts at the beginning of life

*Mark Long, 1985 World Satellite Almanac.

APPENDIX B

APPENDIX B

BRAZILIAN SATELLITE TELECOMMUNICATION SYSTEM-SBTS I & II

Orbital Assignments:	65o and 70o West Longitude
Launch Vehicle:	Arianespace
Design Life:	8 Years
Communication Payload:	
Frequency Bands:	Receive: 5.925-6.425 GHz Transmit: 3.700-4.200 GHz
Channels Polarization	C Band: 24 with Horizontal and Vertical
Channel Bandwith:	C Band: 36MHz
Antenna Coverage:	Brazil and neighboring countries
Signal Power:	36dBW within Brazil
TWTA Power:	10 watts
Capacity:	12,000 simultaneous conversations or 24 color TV channels
Spacecraft:	
Satellite Type:	Hughes HS 376 Spin-Stabilized
Electrical Power:	940 Watts at the beginning of life

*Mark Long, 1985 World Satellite Almanac

APPENDIX C

APPENDIX C

Mexico's Basic Telecommunication Statistics

Number of Radio Broadcast Stations (AM):	676*
Number of Radio Broadcast Stations (FM):	196*
Number of Television Stations:	424*
Networks:	IMEVISION channels 7, 11, 13, 22 (State TV) TELEVISA channels 2, 4, 5, 9
Television Standard:	System M, NTSC color
Number of Telephone Lines:	3,985,000 **
Number of Telephones:	7,827,000 **
Annual Growth of Telephony (1962-1985)	14.8%***

Microwave Network: 16,100 kilometers (10,006.15 miles). 110 terminal and 224 repeaters

- Coverage: It serves 110 cities
- Capacity: Four color television channels or 3600 telephone conferences.

Domestic Satellite Communication Network:

- Earth Segment: 243 earth stations, 15 of them are transmitte/receive dishes. Telemetry and Telecommand Centre Iztapalapa, Mexico City
- Space Segment: Two Hughes HS-376 communication satellites. Each with four Ku Band 108MHz; six C wideband 72MHz; and twelve C narrowband 36MHz transponders.
- Coverage: Southern U.S., Mexico and Central America
- Capacity: 36 color television channels

International Communications:

- Via Satellite: They are routed through three earth stations (Tulancingo I, II and III). SCT uses 365 circuits linking 20 countries.
- Terrestrial: They are routed via the microwave network to neighboring countries.

*SPP/IGEI, 1986
**El Excelsior and SCT 1987
***Sanchez Ruiz, 1987

APPENDIX D

APPENDIX D

DGT's telecommunication services

SCT/DGT provides three services:

I) Those under SCT's direct control
1) Transmission of broadcasting signals (Radio and TV).
2) Telegraphy
3) Data
4) Telex

II) Those under a license, issued to individuals or institutions (Servicios Concesionados).
1) Telephony
2) Community Antenna Television (CATV)
3) Radio paging
4) Broadcasting
5) Restricted TV signals
6) Cellular telephone

III) Private operators, with permission from SCT. (Servicios Permisionados).
1) Maritime mobil
2) Citizen band
3) FM radio
4) Shortwave
5) Mobile broadcasting transmissions
6) Private data networks
7) Private radiophone
8) Aeronautic mobile
9) Broadcasting
10) Private Branch Exchanges (PABX) (SCT, 1987)

APPENDIX E

RED NACIONAL DE ESTACIONES TERRENAS

SCT, 1985

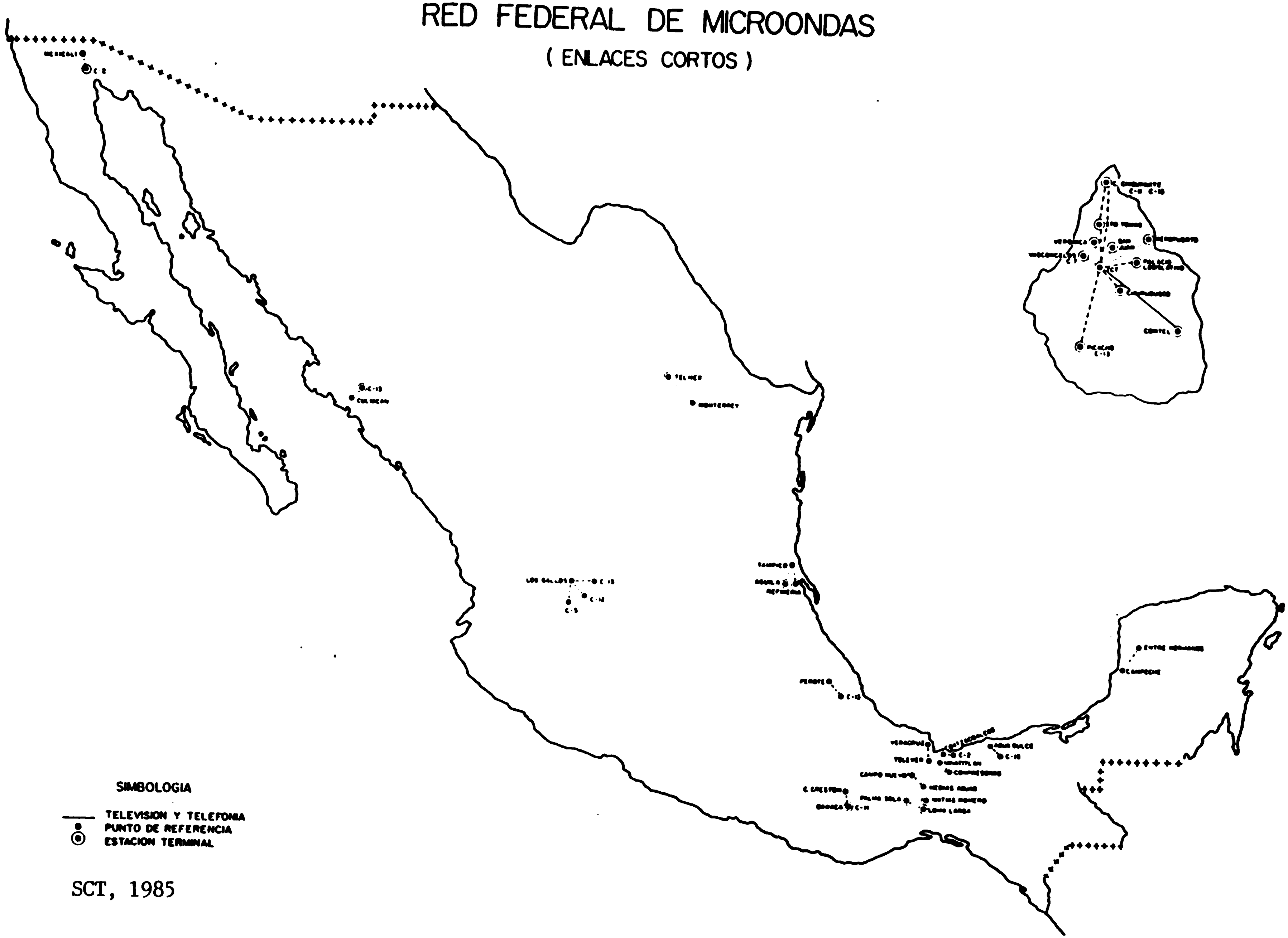
APPENDIX F

RED FEDERAL DE MICROONDAS

SCT, 1985

RED FEDERAL DE MICROONDAS

(ENLACES CORTOS)

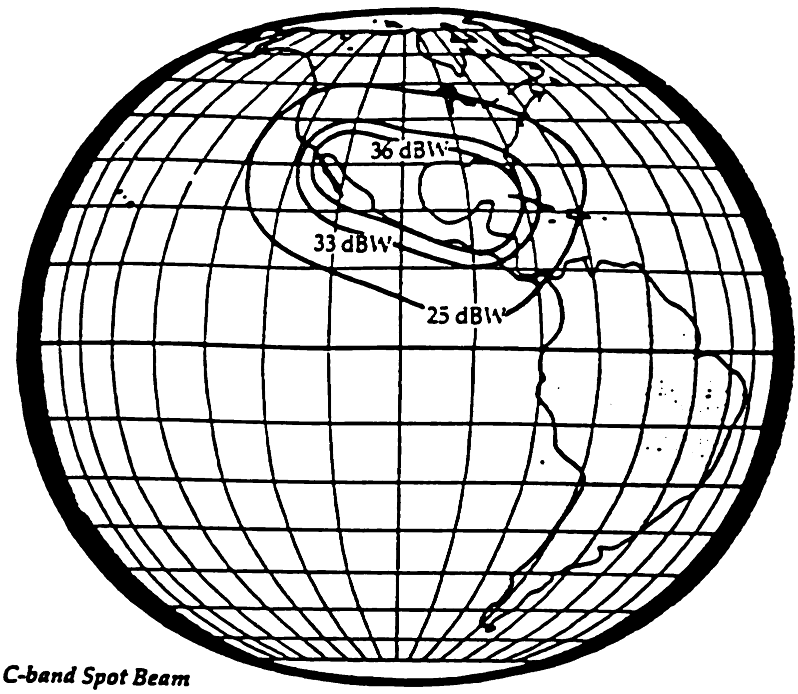


SCT, 1985

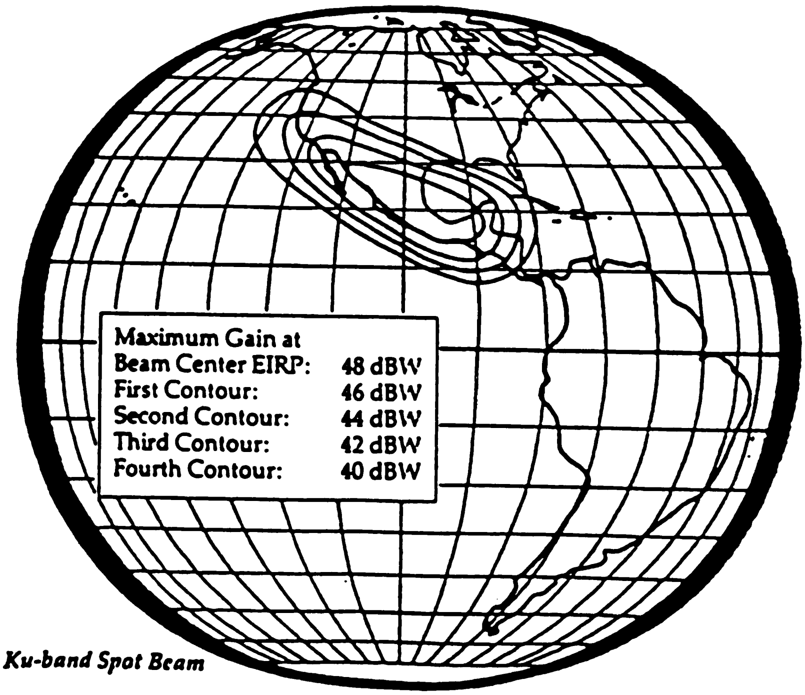
APPENDIX G

113.5° & 116.5° West

ITU REGION 2



C-band Spot Beam



Ku-band Spot Beam

Long, 1985

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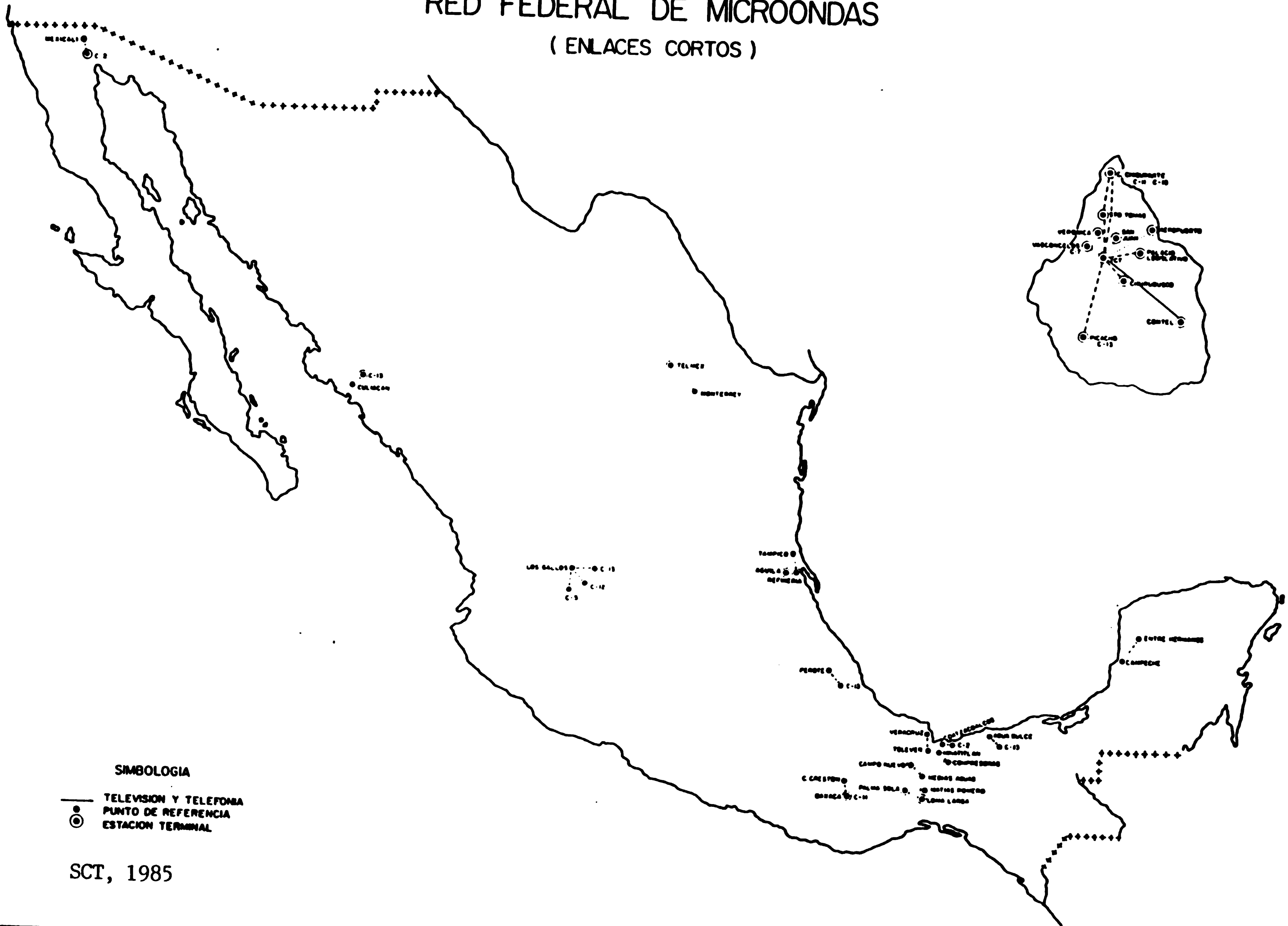
RED FEDERAL DE MICROONDAS

SCT, 1985

RED FEDERAL DE MICROONDAS

(ENLACES CORTOS)

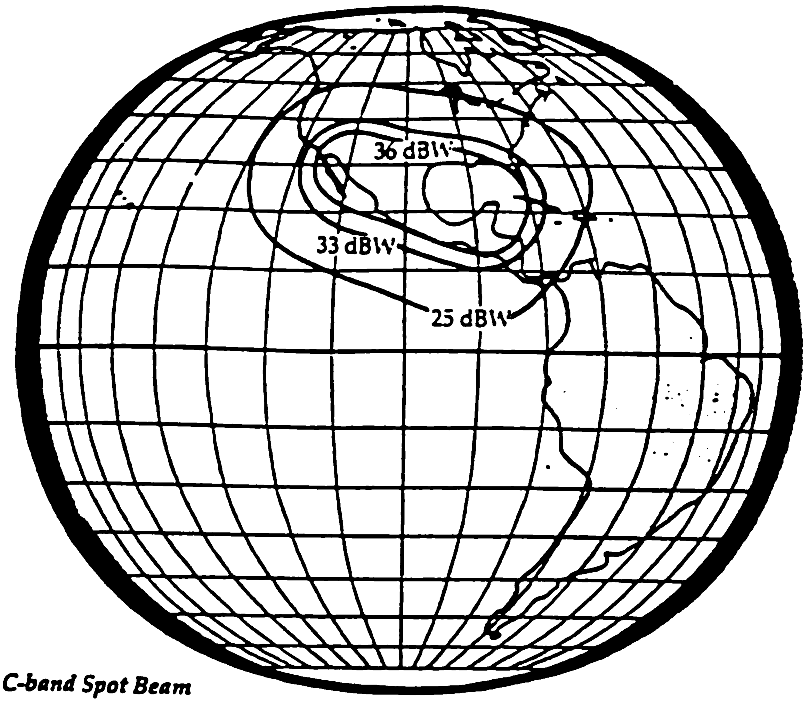


SCT, 1985

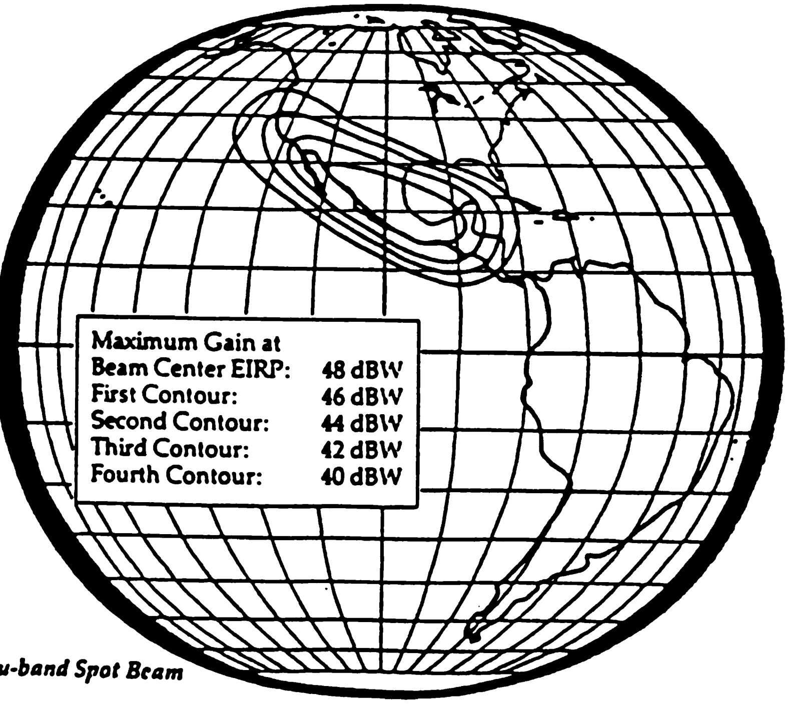
APPENDIX G

113.5° & 116.5° West

ITU REGION 2



C-band Spot Beam



Ku-band Spot Beam

Long, 1985

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