INPE-300-LAFE

PROJECT: SACI

TITLE: THE SYSTEMS ANALYSIS APPROACH TO SATELLITE EDUCATION IN BRAZIL

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SEAMO CONFERENCE, SINGAPORE, FEBRUARY 1973

THE SYSTEMS ANALYSIS APPROACH TO SATELLITE EDUCATION IN BRAZIL

This report contains the results of data compiled as well as the actual plans of the SACI Project, publication of which has been authorized by the undersigned.

Fdo Mendonça

Fernando de Mendonça

General Director

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SEAMO CONFERENCE, SINGAPORE, FEBRUARY 1973

THE SYSTEMS ANALYSIS APPROACH TO SATELLITE EDUCATION IN BRAZIL

I - INTRODUCTION

It is generally acknowledge that Brazil's educational system is both quantitatively and qualitatively inadequate to meet the social and economic development requirements for the country as a whole in the 1970's.

Dependence on conventional processes of capital investment to expand the existing system is not only financially impossible, but could hardly be expected to place Brazil in a desirable position within the next ten years. The gravest aspects of the problem are:

(1) The protracted training period required to obtain good teachers, and

(2) The futility of attempting to extend the same quality of education to all parts of the country.

The solution proposed is not a complete one, nor can it be easily implemented. However, it is fully compatible with Brazil's economic and technological capacities. It might be regarded as almost the sole solution for developing nations of continental scale, such as Brazil.

TABLE 1

(Latest Data Available)

Country	Estimated Population (millions of inhabitants)	Elementary, Secondary and Vocational Education			Higher Education			Percentage of Illiterates over 14 years of age
		Teachers	Pupils		Teachers	Pupils		
			Total	Ob. I		Total	Ob. I	
Brazil	85	440,000	11,246,000	132	28,000	142,000	2	40%
Argentina	22	217,000	3,138,000	142	14,000	216,000	10	8.6%
Japan	98	755,000	21,286,000	220	68,000	964,000	10	Ob. II
U.S.A	198	2,024,000	59,703,000	250	326,000	4,265,000	22	2.4%
U.S.S.R.	231	2,571,000	49,926,000	216	206,000	3,608,000	16	1.5%

Ob. I: Rounded number of pupils per thousand inhabitants, based on the total population.

Ob.II: Figures unavailable.

The educational panorama in Brazil is even poorer than might be estimated from the data shown on Table I, since for the most part, the population is very young.

Starting from the assumption that the application of technological systems and processes in the educational field may - in less time and with less cost than the traditional system - solve some of the most serious educational problems existing in the country, the SACI Project was started to introduce advanced technological resources into the Brazilian educational system.

Studies concerning the feasibility of such a project were started in 1967. One of them, the Rio Grande do Norte Educational Experiment (SACI / Segment 02) will utilize new educational resources via ground system and via satellite. It is located in Northeastern Brazil, where the differences existing in the environment represent the characteristics of almost all Brazilian regions. Therefore, it is an excellent area in which to locate an experiment for later extrapolation to a national system.

In as much as there are limitations in technical and economic resources, as well as time and personnel available, it is not possible to have all the various educational levels involved in this experiment. We established an operational plan which makes maximum use of the systems analysis approach in order to reach our objectives as directly as possible.

The above chronogram covering all activities was designed as a Master plan at the beginning of the project.

The INPE program is on target, as indicated by our most recent Progress Report, February, 1973.

II - DESCRIPTION OF SACI PROJECT

In outline form, the following are essential components in our program:

Main targets:

1. Primary level - 1st 4 years
2. Qualifying primary teachers

Bottlenecks in current system:

1. High % drop-outs
2. High % of repeaters

Work Hypothesis:

1. Education technology approach presents better results in terms of student achievement than the traditional system.
2. Qualification of lay-teachers more cost/effective through technology than the traditional system.
3. Reach a greater number of primary school age population with greater efficiency than the traditional system.

Educational Objectives:

1. To test efficiency of educational program for 1st

4 years of primary using audio visual media including TV, radio and slow-scan.

2. Develop techniques for the production of TV programs for different subject areas, grade levels and evaluation techniques.
3. Train teachers in the utilization of audio visual media equipment and provide them with up-grading.
4. Offer better education opportunities to a considerable portion of school population.
5. Through formative evaluation, develop and improve school curriculum.
6. Analyze the results in terms of cost/benefits and cost/effectiveness, comparing them with data from the conventional system.
7. Verify the "degree of acceptance" of technology in the school system.

Chronogram of Activities

The experiment will cover the priorities already mentioned during the period of 4 years, 1972 - 1976.

The following presents a chronogram of the activities to be developed in Rio Grande do Norte.

PROJECT SACI - SEGMENT 02

EDUCATIONAL EXPERIMENT IN RIO GRANDE DO NORTE

CHRONOGRAM OF ACTIVITIES

MISSION I for TEACHERS	1. Supervisor and teacher training 2. Up-grading course covering the first four grades, pedagogic notions and didactic notions.
MISSION II for STUDENTS	1. Material of 1st grade by TV. 2. Material of 2nd grade by radio.
MISSION III for TEACHERS	1. Supervisor and teacher training 2. Up-grading course covering grades 5 through 8, pedagogic notions and didactic notions.
MISSION IV for STUDENTS	Material of first four grades.
MISSION V for TEACHERS	1. Supervisor and teacher training 2. Up-grading course covering high school level for elementary teachers.
MISSION VI for STUDENTS	Material for first four grades.
MISSION VII for TEACHERS	1. Supervisor and teacher training 2. Up-dating course for elementary teachers.
MISSION VIII for STUDENTS	Material for first four grades.

TABLE 3

The experiment will be carried out in eight phases or missions. During each mission, radio and TV will be used to transmit classes. Programs will be broadcast to about 500 schools spread out all over the state, which is about 400 by 250 kilometers. Broadcasting was initiated in 1972, utilizing three AM radio broadcasting stations, and one VHF TV broadcasting station, channel 5, with two retransmitting stations, also VHF channels (2 and 9). The experiment reaches about 3,000 teachers and 25,000 children. Of the 500 schools, 100 are in urban zones and 400 in rural zones.

Criteria for Delimitation of the Area of the Experiment

The geographical area to be involved encompasses 150 of Rio Grande do Norte counties, and contains 2,053 of the 3,439 public schools existing in the state. During the selection of these counties the following criteria were observed:

1. Involvement of the greatest concentration of counties within a geographical area.
2. Inclusion of both rural and urban population in the coastal area, the "agreste" and the "sertão".
3. Inclusion of the greatest number of SEEC centers.
4. Inclusion of the economic poles of the State to coincide with the study underway of economically viable communities.
5. Availability of the greatest possible number of schools in order to select the best for experimentation and control.
6. Technical restrictions on the coverage of TV and radio signals.

Criteria for Selection of Schools

In order to validate and generalize the results, the schools were chosen according to the following criteria:

1. All schools must belong to the public school system, state or municipal.
2. Inclusion of the 3 categories of public schools: "Grupo Escolar" (GE), "Escola Reunida" (ER) and "Escola Isolada" (EI) from rural and urban zones. *
3. Use of a random selection process for the 3 categories of schools.
4. A sampling which was not less than 25% of the school population of the Experiment area.

Since a primary objective is to test the effectiveness of technologies applied to education, it was necessary to make a comparative analysis between the technological system and the traditional.

The schools involved in the experiment were therefore divided into the following 3 groups:

---

* GE - A school with a separate classroom for each class, a teacher for each class, a principal, a secretary, etc.

ER - A school with several classrooms and teachers but without any administrative staff.

EI - A school with one room and one teacher.

1. Experiment Group (Exp. G) - composed of 500 schools chosen at random from among those already selected. All "lay" teachers must take part in the up-grading course. The students of both morning and afternoon shifts of these schools receive their classes through the technological system (TV and/or radio). This program started in December, 1972.
2. Control Group I (CG-I) - composed of 50 schools chosen at random. These teachers take part in the training and in the up-grading course in accordance with the criterion established for the Experiment. Classes will be taught under the traditional system, however, and will not receive TV or radio.
3. Control Group II (CG-II) - composed of 50 schools also selected at random. Teachers and students will continue with the traditional system, and do not receive any of the benefits offered to Exp. G /CG-I.

Study of the Area Involved

In order to adapt the proposed technology system to the real needs of the region, and to obtain the support of the communities involved, our research embraced the following 4 types of surveys:

1. Teacher characteristics - to obtain detailed information

on their needs, values, areas of interest, educational background, professional experience and personal aspirations, involving the 3 categories of elementary teachers existing in the public school system.

2. Student characteristics - to obtain information on their needs, values, learning difficulties and personal aspirations.
3. School characteristics - to obtain information concerning location, administrative dependence, category, construction type, installations, quantity and quality of permanent school material.
4. Community leadership - to identify the communities leadership in order to get their support for the Experiment, considering that the participation of people and/or community agencies which exert influence on the community is of vital importance when introducing a technological innovation in the education field.

The characteristics of teachers and students were determined by means of a representative sampling method. The survey of the characteristics of the schools covered the universe of schools involved. The community leaders were identified by a crisscrossing study of the opinions collected in a questionnaire applied to each county.

The data-collecting tool utilized has been the questionnaire

of directed answers which makes easy the interpretation and the statistical analysis. After the electronic processing of the data an analysis was performed and a report of the results presented the conclusions reached.

Operational Structure

In developing the experiment, the existing organizations in the area were used as fully as possible, as represented in Tables 4-5.

Observations

1. Ministerial, state and county agencies are providing material and technical assistance to INPE, according to their specializations.
2. INPE is in charge of the coordination of the experiment.
3. Local working groups comprise the following:
   - Training team: which prepared supervisors and teachers to carry out their functions.
   - Transmission team
   - Logistic team: for transportation, communication and maintenance.
4. System A of supervision includes state and municipal supervisors who were selected by the Secretariat of Education and Culture of Rio Grande do Norte. Their principal function is to supervise and assess the

	ADOPTED ABBREVIATURES
MC	Ministry of Communications
MEC	Ministry of Education and Culture
DEF	Department of Fundamental Training
PRONTEL	National Program for Teleducation
INEP	National Institute of Pedagogical Studies
CNPq	National Research Council
INPE	Institute of Space Research
MPCG	Ministry of Planning and General Coordination
IPEA	Institute of Applied Social/Economical Research
SEEC	State Secretariat of Education and Culture
UFRN	Federal University of Rio Grande do Norte

TABLE 4

Organzational structure of Segment 02

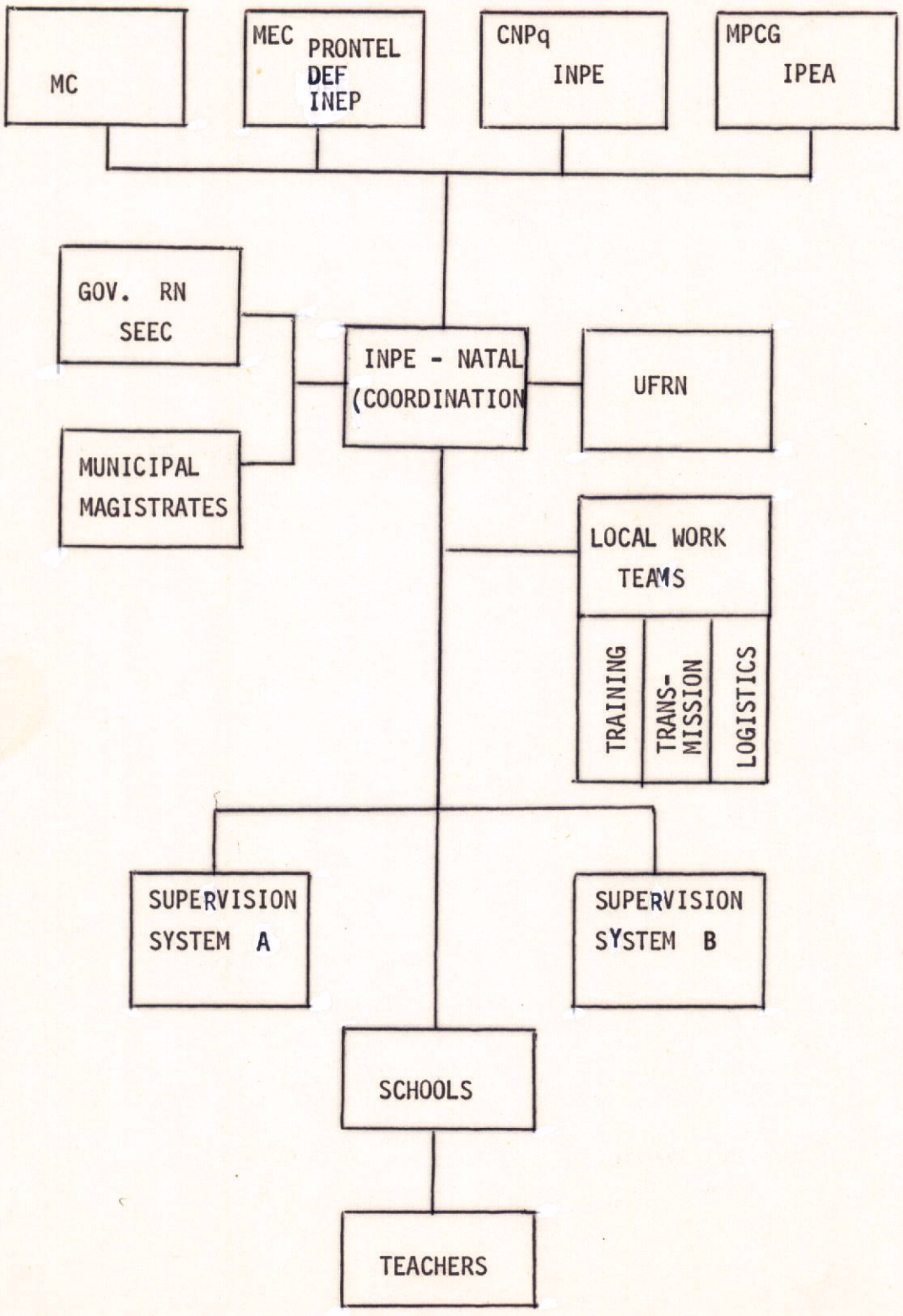


TABLE 5

teachers participating in the up-grading course.

5. System B of supervision includes approximately 10% of the total of the schools in the Experiment and includes personnel from INPE and SEEC/RN. The objective of this system is to obtain more systematic data on the program.

The following page contains a chronogram of training and courses for the total period of the Experiment.

Audio Visual Aids and Forms of Utilization

To meet the objectives of the experiment, we utilize the following technological resources:

Television - TV - via ground system and satellite
Radio - Ra - via ground system and satellite
Slow-scan - (SS) - via satellite
Fac-Simile (FS)-- via satellite

In order to optimize the future use of these media on a national scale, several alternatives are being tested during the SACI Experiment stressing pedagogical activities and the technical restrictions of engineering.

INPE/PROJETO SACI

DESCRIÇÃO DAS FUNÇÕES E ATIVIDADES DO GRUPO DE _____

RESPONSÁVEL _____

DATA ____/____/____

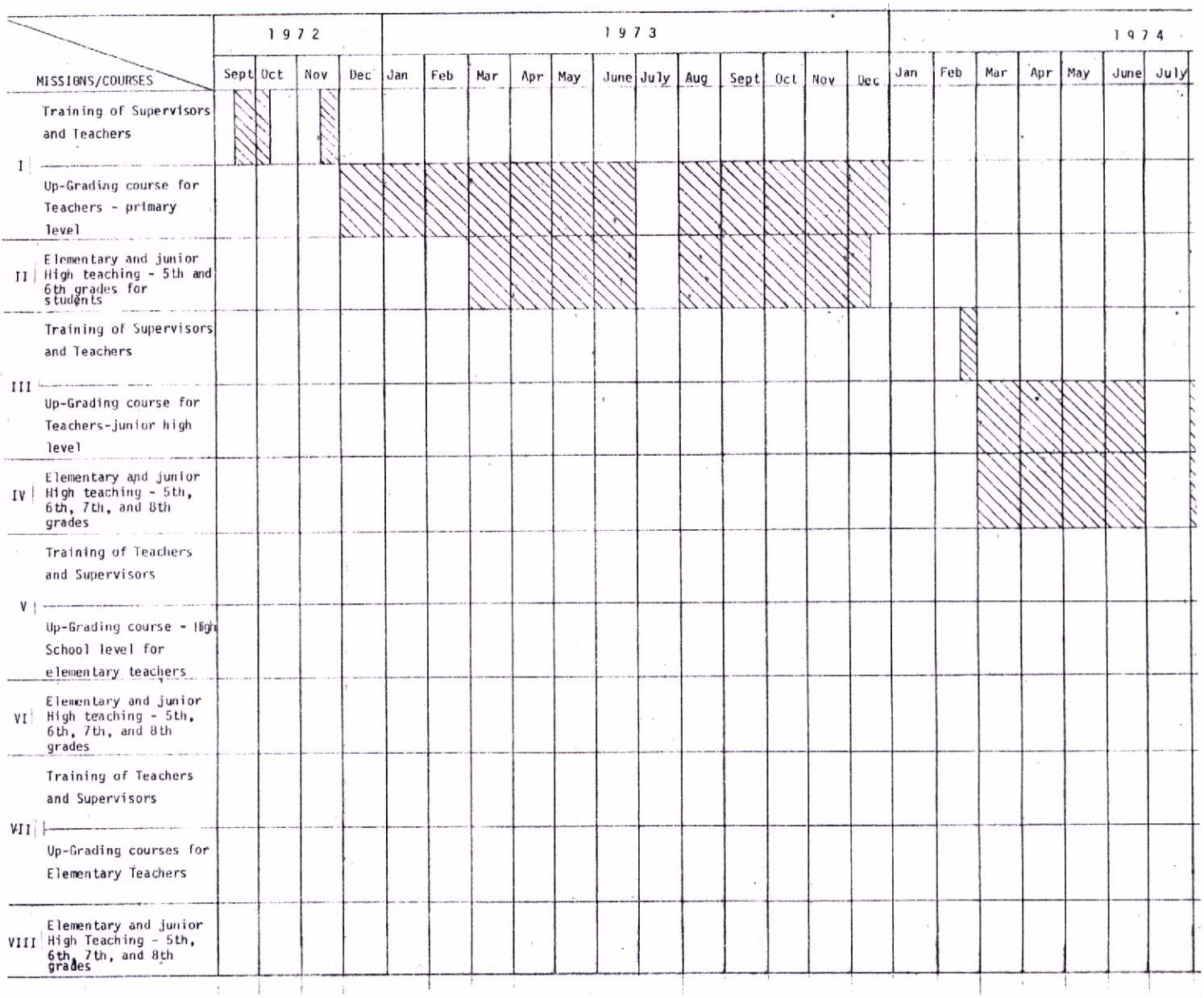
FUNÇÃO (D.F.T)			ATIVIDADE OU TAREFA					
CÓDIGO	TÍTULO	DESCRIÇÃO	CÓDIGO	TÍTULO	DURAÇÃO	INÍCIO PREVISTO	TÉRMINO PREVISTO

QUADRO III

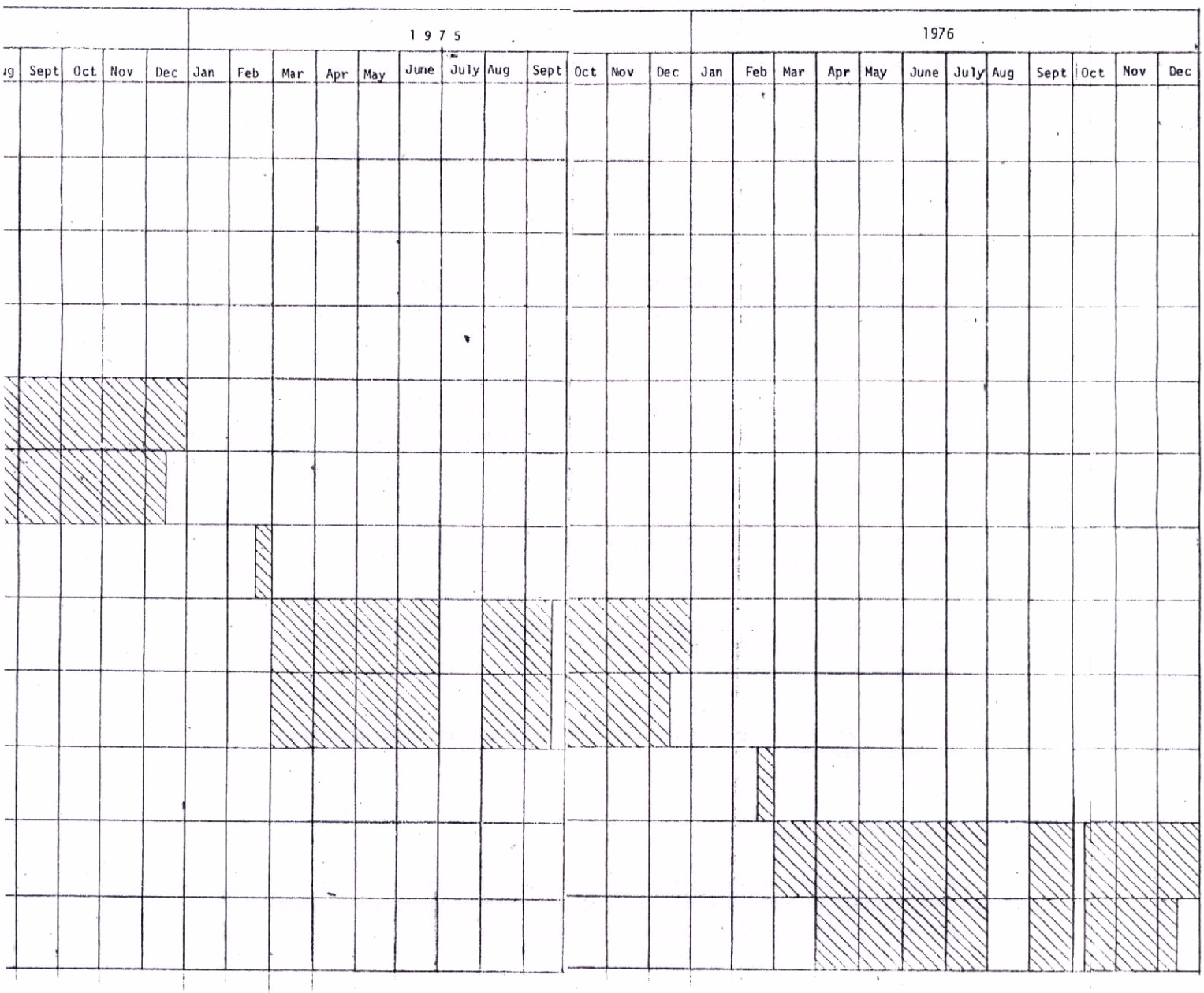
CRONOGRAMA DE TREINAMENTOS E CURSOS (PREVISÃO)

	MISSÕES / CURSOS	1972				1973												1974												1975											
		Set.	Out.	Nov.	Dez.	Jan.	Fev.	Mar.	Abr.	Maio	Jun.	Jul.	Ago.	Set.	Out.	Nov.	Dez.	Jan.	Fev.	Mar.	Abr.	Maio	Jun.	Jul.	Ago.	Set.	Out.	Nov.	Dez.	Jan.	Fev.	Mar.	Abr.	Maio	Jun.	Jul.	Ago.	Set.	Out.	Nov.	Dez.
I	Treinamento de Supervisores e Professores																																								
	Curso de Capacitação para Professores - nível primário.																																								
II	Ensino de 1º Grau 1ª e 2ª séries para alunos.																																								
III	Treinamento de Professores e Supervisores																																								
	Curso de Capacitação para Professores - nível ginasial.																																								
IV	Ensino de 1º Grau 1ª, 2ª 3ª, 4ª séries.																																								
V	Treinamento de Professores e Supervisores.																																								
	Curso de Capacitação - nível normal colegial.																																								
VI	Ensino de 1º Grau 1ª, 2ª, 3ª, 4ª séries.																																								
VII	Treinamento de Professores e Supervisores.																																								
	Curso de Atualização do Magistério Primário.																																								
VIII	Ensino de 1º Grau 1ª, 2ª, 3ª, 4ª séries.																																								

CHRONOGRAM OF TRAINING A



D COURSES (FORECAST)



Instruction for the First 4 Grades of Primary School

Radio

During the experiment two different radio formats will be used: simple or conventional (Ra), and programmed instruction (RP).

Conventional Radio

The conventional radio format will be utilized for transmission of 10 minute classes in the basic disciplines of the curriculum via ground system in 1973 and via satellite in 1975 and 1976.

Accompanying material will be used to provide the visual aspects necessary during the radio class, and during the exploration period after the reception.

For the transmission, one voice channel will be utilized (via ground system and satellite).

Radio will be tested in isolation and in combination with television.

Programmed Radio

This is an experimental project in programmed radio. Its

application in the Rio Grande do Norte project will depend on the results of the tests now taking place in our laboratories.

Television

Television classes will also be 10-15 minutes in duration in the basic disciplines of the official curriculum, via ground system in 1973 and 1974 and via satellite in 1975 and 1976.

Television will be utilized in isolation, with conventional radio and with programmed radio via satellite.

For transmission of these classes, one channel of TV will be available, via ground system and via satellite.

Slow-Scan

The potential of slow scan to education programming has been recognized for some time.

The advantage of slow scan is the narrow band width of the signal necessary for communication, and the possibility of utilizing telephone channels for the transmission of the images.

The slow scan that we use presently with the ATS-3

satellite is characterized by the transmission of static images.

Slow scan will be utilized only in 1975, via satellite, for the transmission of 10 minute classes in the basic disciplines. This utilization will probably be restricted to 10 schools of the G Experiment.

Distribution of Media

After testing the various systems of transmission/reception in isolation and in combination, the methods to be used in the experiment will be distributed according to the following diagram.

In 1973 and 1974, we will have two sub-groups of radio and two of TV. In 1975, with the utilization of more technological resources via satellite, we will have sub-groups in almost identical proportions.

Class Schedules

The class schedules are appropriate for all of the sub-groups of Ra, TV, TV and Ra and SS.

The model was prepared for a classroom schedule with two shifts.

1st shift - 07:00 to 11:00 hrs.

2nd shift - 13:00 to 17:00 hrs.

DISTRIBUTION OF AUDIO VISUAL MEDIA

PROJECT SACI

Sub-Groups	Nº of Schools	%	Sub-Groups	Nº of Schools	%	Sub-Groups	Nº of Schools	%	Sub-Groups	Nº of Schools	%
Ra	100	20	Ra	100	20	Ra	100	20	Ra	100	20
Ra	100	20	Ra	100	20	RP	100	20	RP	100	20
TV	100	20	TV	100	20	TV	100	20	TV	100	20
TV	100	20	TV	100	20	TV+RP	95	19	TV+RP	95	19
						SS	10	2	SS	10	2
TV+Ra	100	20	TV+Ra	100	20	TV+Ra	95	19	TV+Ra	95	19
OTAL	500	100	-	500	100	-	500	100	-	500	100

TABLE 7

Activities: a period of 10 minutes for the student to enter class, for attendance, and delivery of the material for the classes.

Preparation for the class: period of five minutes before the reception of each program.

Reception of the Program: period of 10 minutes for each program.

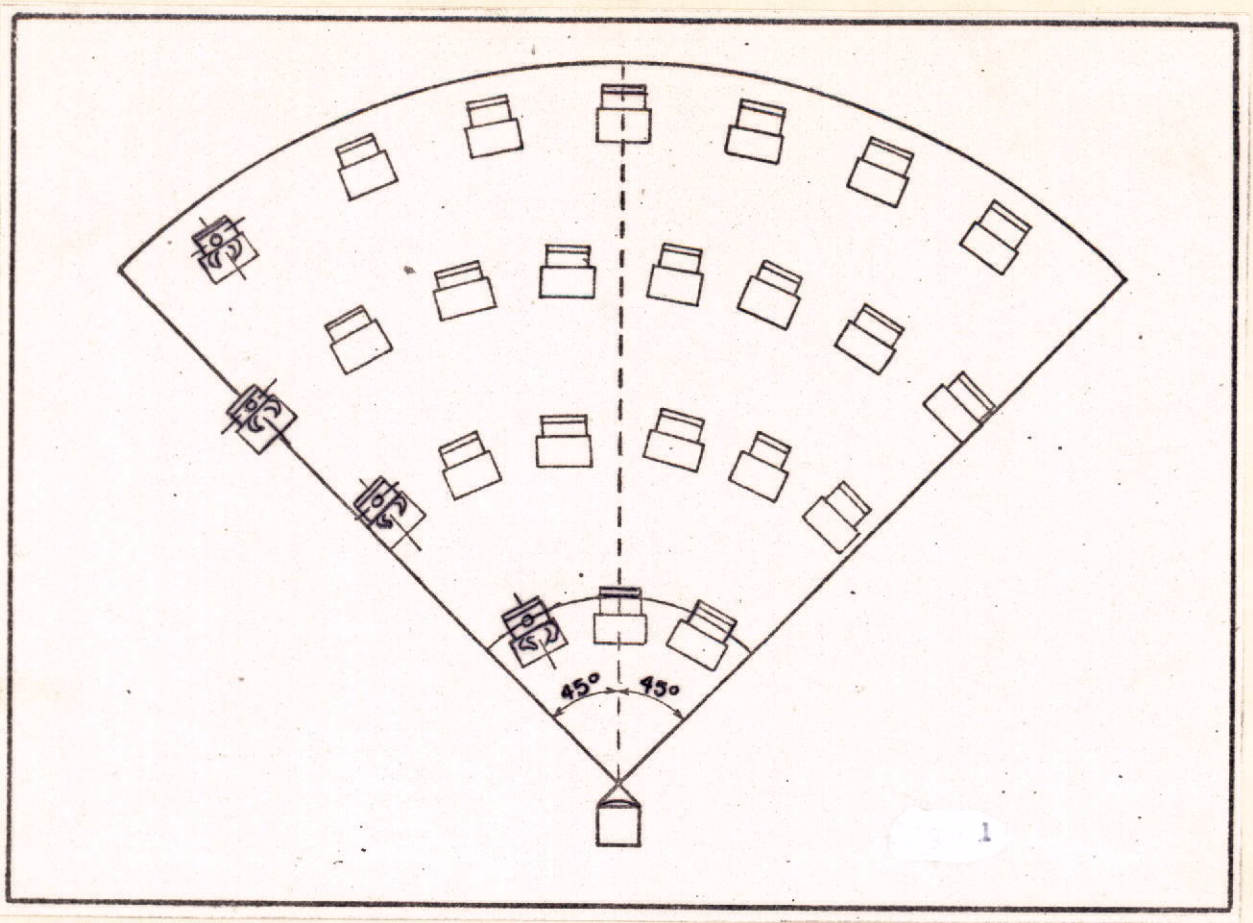
1st Exploration: periods of 25 minutes for Portuguese language, and mathematics and 20 minutes for the other disciplines, immediately after the reception of each program.

Intervalo: physical education.

2nd Exploration: a period of one hour and forty minutes for additional review and exercises concerning the subject under study.

Configuration of the Classrooms

The necessity of turning the head in the direction of the television set makes one tired. A simple way of eliminating this problem is to arrange all the seats facing the direction of the television, as shown in Figure 1.



The problem in a normal classroom (below) of having to move the head in the direction of the television can be overcome with the above seating solution.

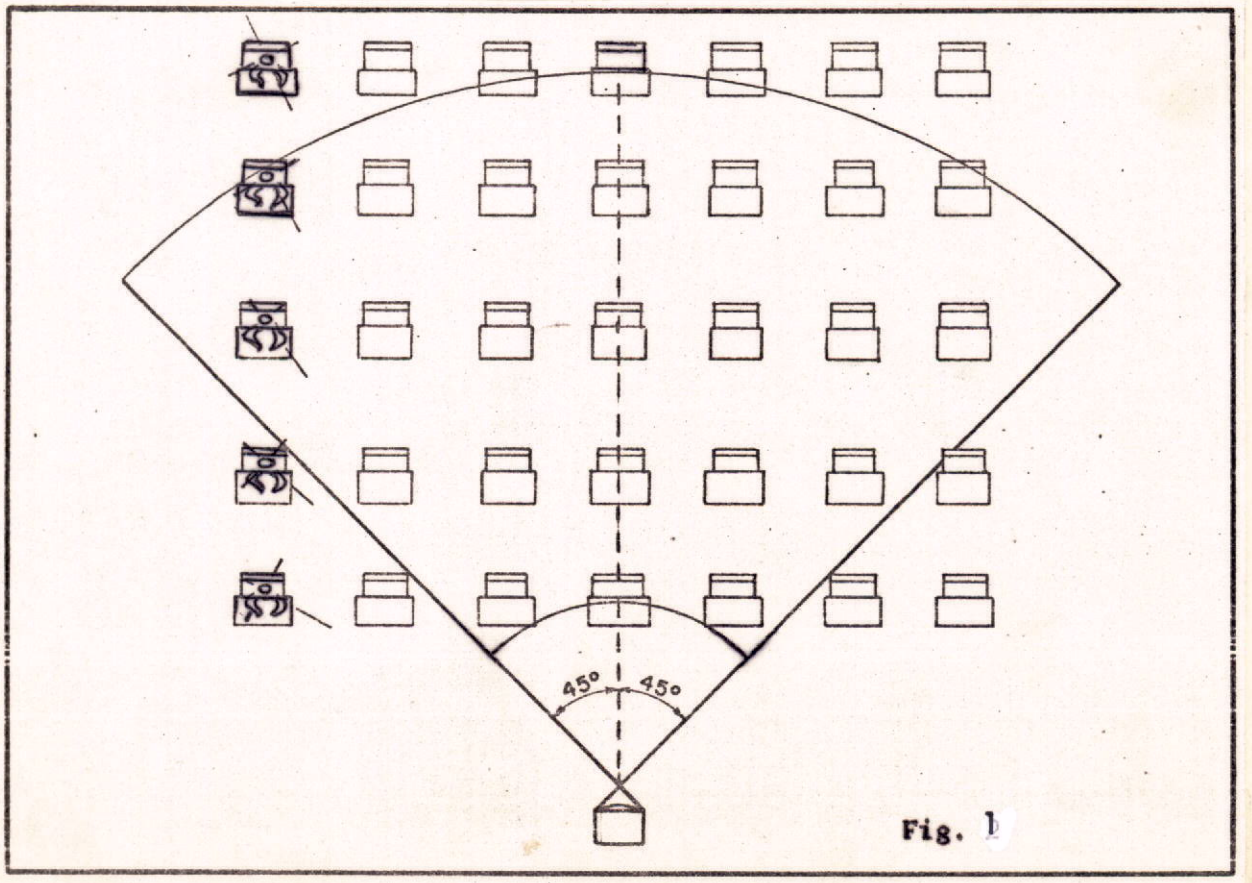


Fig. 1

System of Evaluation

In the evaluation system of Project SACI, we use two types of evaluation (1) formative, consisting of a detailed analysis of the results obtained in each unit of the program cycle and (2) summative, consisting of the measurement of the system through its global results.

The evaluation of the educational experiment in Rio Grande do Norte constitutes an essential part of Project SACI, and therefore is being carried out with all the scientific rigor possible. The data is handled with maximum precision and independence in order to present an impartial judgement. Preliminary data will be available late February 1973, during the yearly progress review meeting.

Methods and Procedures of Evaluation

In order to reach our educational objectives, a sampling of 30% of the population of the schools in the area of the Experiment was used, about 500 of the 2,053 public primary schools. These schools were selected at random, observing the existing proportion between the three categories of schools: Grupo Escolar, Escola Reunida and Escola Isolada.

In 1973 and 1974 we will have two sub-groups with TV and 2 with radio so that in 1975 with the use of the satellite and other technology resources we will have sub-groups of each type of school in almost identical proportions.

SCHOOLS IN THE AREA OF THE EDUCATIONAL EXPERIMENT
IN RIO GRANDE DO NORTE

CATEGORIES	TOTAL	
	Nº	%
Grupo Escolar	65	11.0
Escola Reunida	58	9.0
Escola Isolada	477	79.0

	Nº	%
General	600	29.0

TABLE 8

DISTRIBUTION OF SCHOOLS INVOLVED
IN THE EDUCATIONAL EXPERIMENT IN
RIO GRANDE DO NORTE

GROUPS	Nº OF SCHOOLS
Experimental	500
Control I	50
Control II	50
TOTAL	600

TABLE 9

Studio in Natal

The studios in São José dos Campos are producing 3 - 4 TV and 5 - 10 radio programs daily. Our TV studio at the area of experimentation (Natal) will soon be operational in order to help with the production of the classes for the 1st grade students.

III - THE SYSTEMS ANALYSIS APPROACH TO SACI

In order to reach its objectives as efficiently as possible, INPE utilizes the systems approach in planning, implementation, training and evaluation for the SACI Project.

Each of the 8 missions is divided into 6 phases:

1. Planning
2. Development
3. Production
4. Pre-operation
5. Operation
6. Evaluation

These activities are carried out by highly specialized groups:

PROJECT SACI

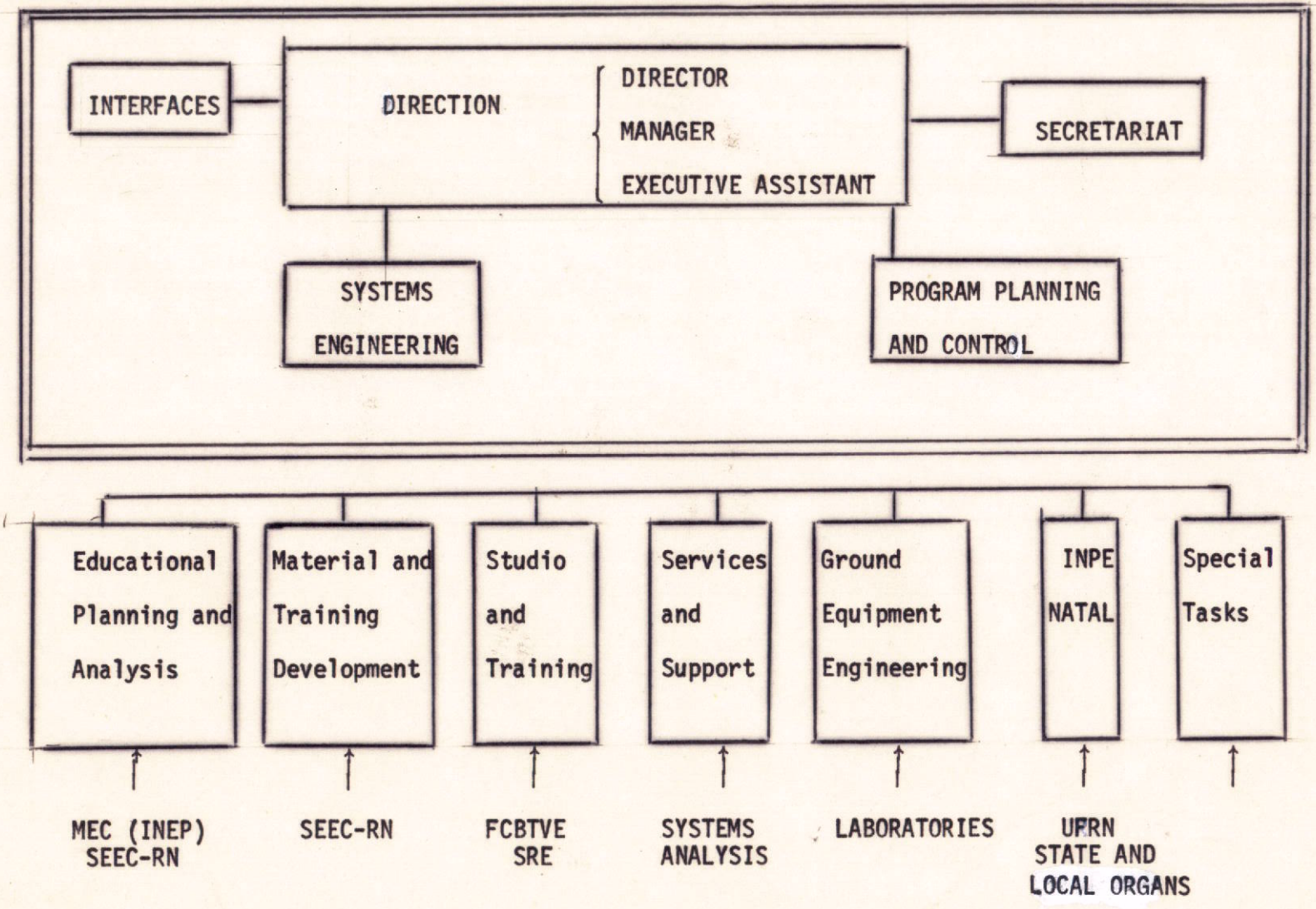


TABLE 10

1. Educational planning and analysis
2. Development of material and training
3. Studio and training
4. Engineering and ground equipment
5. Service and assistance
6. INPE NATAL
7. Special assignments

IV NATIONAL SATELLITE PROGRAM

Project SACI is composed of three segments:

Segment 01 - Experiment ATS-3

Segment 02 - Educational Experiment of Rio Grande do Norte.

Segment 03 - National Coverage System

Segment 01 - Experiment ATS-3

This phase linked INPE with Stanford University (U.S.A.) through the ATS-3 satellite. Three kinds of tests have already been made in our experiments utilizing part of the time of the satellite ATS-III:

. Transmission of simplex voice channels between INPE and

Stanford University and Mojave Space Center, in the U.S.

. Transmission of video signals compressed to a bandwidth of 0.5 KHz, using slow scan equipment, from INPE to Stanford University and back to INPE. (120 sec for 1 image).

. Transmission of documents scanned by a xerox telecopier equipment. An electrocardiogram taken from a man with heart problems was sent from INPE to Seattle, via ATS-3, which was located between Colombia and the Equator ($71^{o}W$). The electrocardiogram was then immediately sent from Seattle to the University of Alaska, via the satellite ATS-I, which was located on the Pacific Ocean ($150^{o}W$). The information received at the University of Alaska, after recorded on a special paper in the telecopier, was transmitted back to Seattle via ATS-I, and then retransmitted to INPE via ATS-3. We had, in this case, a link with four hops.

Only one antenna was used at INPE: a four helix array. Our up-link frequency is 149.22 MHz, and our down-link frequency is 135.6 MHz.

This experiment will become routine by the beginning of the year.

Segment 02 - Educational Experiment of Rio Grande do Norte

INPE originally planned to use the ATS-F NASA satellite as per description below, but now also plans to use its own domestic satellite in 1976. Meanwhile an effective ground system using radio, TV and slow scan is being established in Rio Grande do Norte.

One year ago, in December 1971, INPE submitted to NASA a supplement to the May 1970 proposal, proposing participation in the experiments to be held with the ATS-F satellite.

The first proposal, dated May 1970, was related to the UHF transponders, in 850 MHz. The last one, of December 1971, takes into account now, the utilization of the 2.5 GHz transponders on the ATS-F.

The 10 meter dish, at the satellite, will produce a 0.9 degree half-power beamwidth. The state of Rio Grande do Norte, and also a great part of Northeast region is covered.

An FM receiver is being designed at INPE, tuned to one of the ATS-F transponders carrier frequencies at 2569.2 MHz.

The design philosophy is based upon the study and development made at Stanford University.

The antenna is a 2.14 meters (7 ft.) parabolloid, and the

Schottky diode balanced mixer, the local oscillator and the IF pre-amplifier are antenna mounted.

A cable having up to 5 dB losses is used to connect the antenna mounted part to the rest of the receiver.

At the output of the IF filter, the half-power bandwidth is equ 1 to 33 MHz. The output of the receiver presents a baseband with 5.3 MHz and 2 V p-p.

The total system noise figure is about 6.0 dB, which corresponds to an effective noise temperature of 960^{o}K, taking into account about 100^{o}K for the antenna temperature.

The tests are now being performed and the next step is to develop a mass producible receiver, in conjunction with national industries.

Segment 03 - National Coverage System

This refers to diffusion of education and information throughout the country by means of a national satellite. These activities will be directly related to the results of the experiment in Rio Grande do Norte, and will in fact be an extrapolation of the INPE experiment in the Northeast.

A distribution satellite for countrywide coverage can be

built and put into orbit in less time than microwave links can be set up all over Brazil.

The saving in time and money is crucial to a developing country, because of present explosive evolution in advanced countries.

Sparsely settled, the vast interior of Brazil presents to terrestrial links, not only serious installation and operational difficulties, but also costs that steeply increase with distance.

Satellite costs and difficulties are independent of distances, having practically uniform long-distance rates, because any two stations are always some 73,000 km apart.

The Brazilian Government set up in June 1972, a high level commission, formed by the key personnel of Brazilian agencies interested and related to the Domestic System, to analyze the general concepts of such a system, along lines proposed by INPE in 1967.

A first satellite should be launched in the geostationary satellite orbit about 1976. Its probable configuration will encompass one TV channel, with educational purposes, in 2.5 GHz band allocated to the Broadcasting Satellite Service in WARC, and a large number of telephony transponders, for telecommunication purposes, in the 6-4 GHz band.

Its probable location, taking into account several criteria,

is from about 72 to about 83 degrees west longitude.

Summing up, the advantages of satellite communications for Brazil are:

1. Augments national telecommunication network
   a. Cost benefits for long distance
   b. Facility diversity for service restoration
   c. Rapid response to unanticipated traffic
   d. Instantaneous network for National Television Broadcast.

2. Provides unique services
   a. Television for remote areas
   b. Telephony to isolated communities
   c. Low cost instructional television distribution
   d. National security communication network.

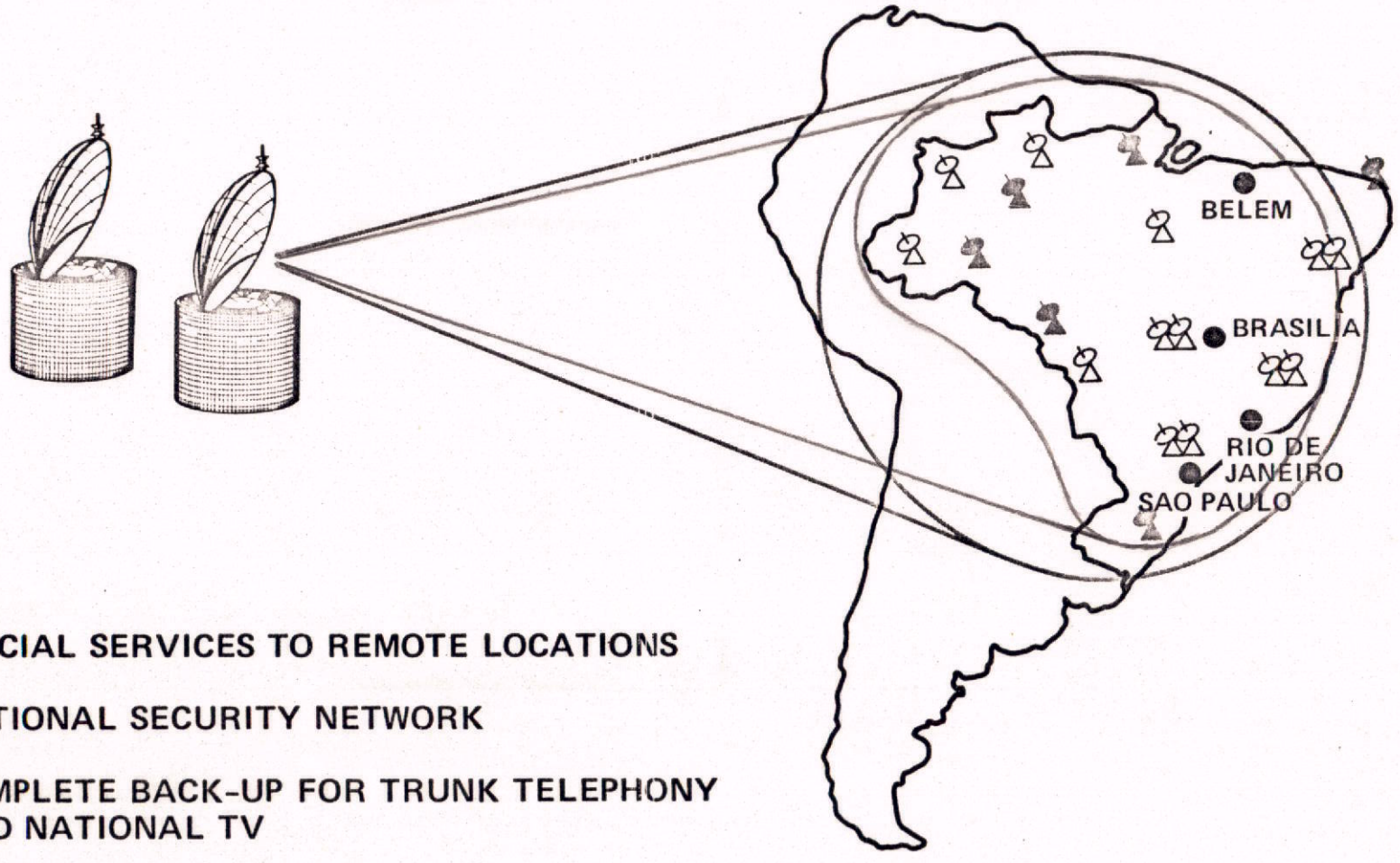
A satellite system is the least costly of the means of reaching any point within the country, such as the frontier villages. In certain cases, it is the sole means of communicating very confidential matters. This method involves the shortest installation period required by any nation-wide communications system. In addition, that portion of the satellite used for communications purposes could well provide a reasonable source of income.

The following (graphics) are illustrative of Brazil's plans for a domestic communications satellite to be used for educational programs.

LAUNCH VEHICLE	
TYPE	NASA Thor Delta 2914
PAYLOAD	700 Kg

TABLE 11

BRAZIL SATELLITE SYSTEM



SPECIAL SERVICES TO REMOTE LOCATIONS

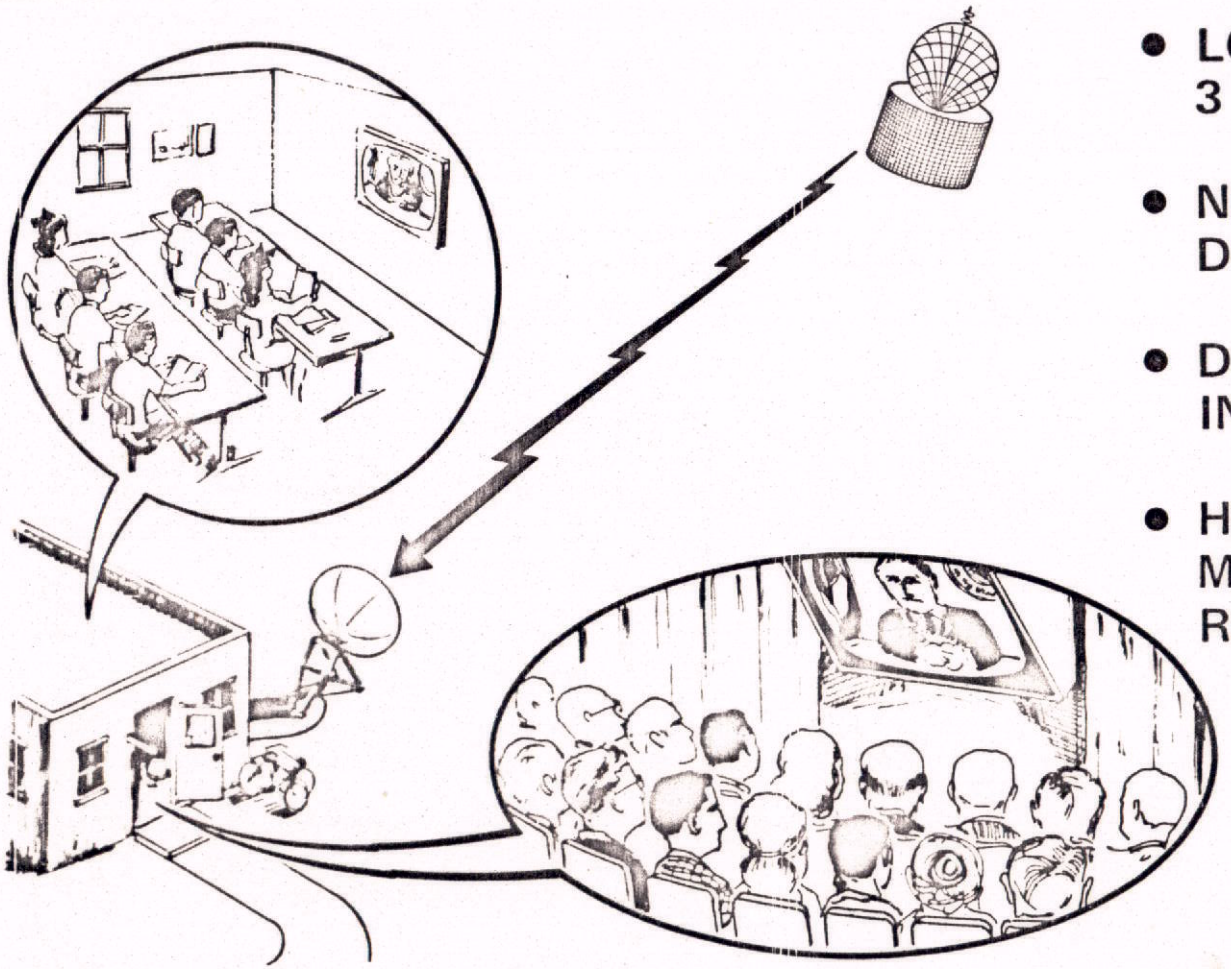
NATIONAL SECURITY NETWORK

COMPLETE BACK-UP FOR TRUNK TELEPHONY AND NATIONAL TV

36010-66

FIGURE 2

COMMUNITY AND INSTRUCTIONAL TELEVISION



- LOW COST 2.5 GHz 3 METER TERMINALS
- NATIONAL TV DISTRIBUTION
- DEVELOPING INSTRUCTIONAL TV
- HIGH RELIABILITY– MINIMAL MAINTENANCE REQUIREMENTS

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FIGURE 3

BOOSTER PAYLOAD CAPABILITIES

BOOSTER/AVAILABILITY	COST, $M	MASS INTO TRANSFER ORBIT, KG	SPACECRAFT	COMMUNICATION PAYLOAD (TRANSPONDERS)
THOR DELTA				
• 1914/CURRENT	8.2	590	CANADIAN SATELLITE (HS333)	12 AT 6/4 GHz
• 2914/1974	8.5	700	BRAZIL SATELLITE (HS339)	12 AT 6/4 GHz 1 HIGH POWER AT 2.5 GHz
ATLAS CENTAUR				
• ATLAS-3C CENTAUR-D /CURRENT	17	1550	INTELSAT IV A AT&T DOMESTIC	24 AT 6/4 GHz WITH SPATIAL OR POLARIZATION ISOLATION
• ATLAS-3D CENTAUR-DIA/1975	20	1770	FOLLOW-ON U.S. DOMESTIC SYSTEMS	MULTIPLE FREQUENCIES, FREQUENCY REUSE

TABLE 12

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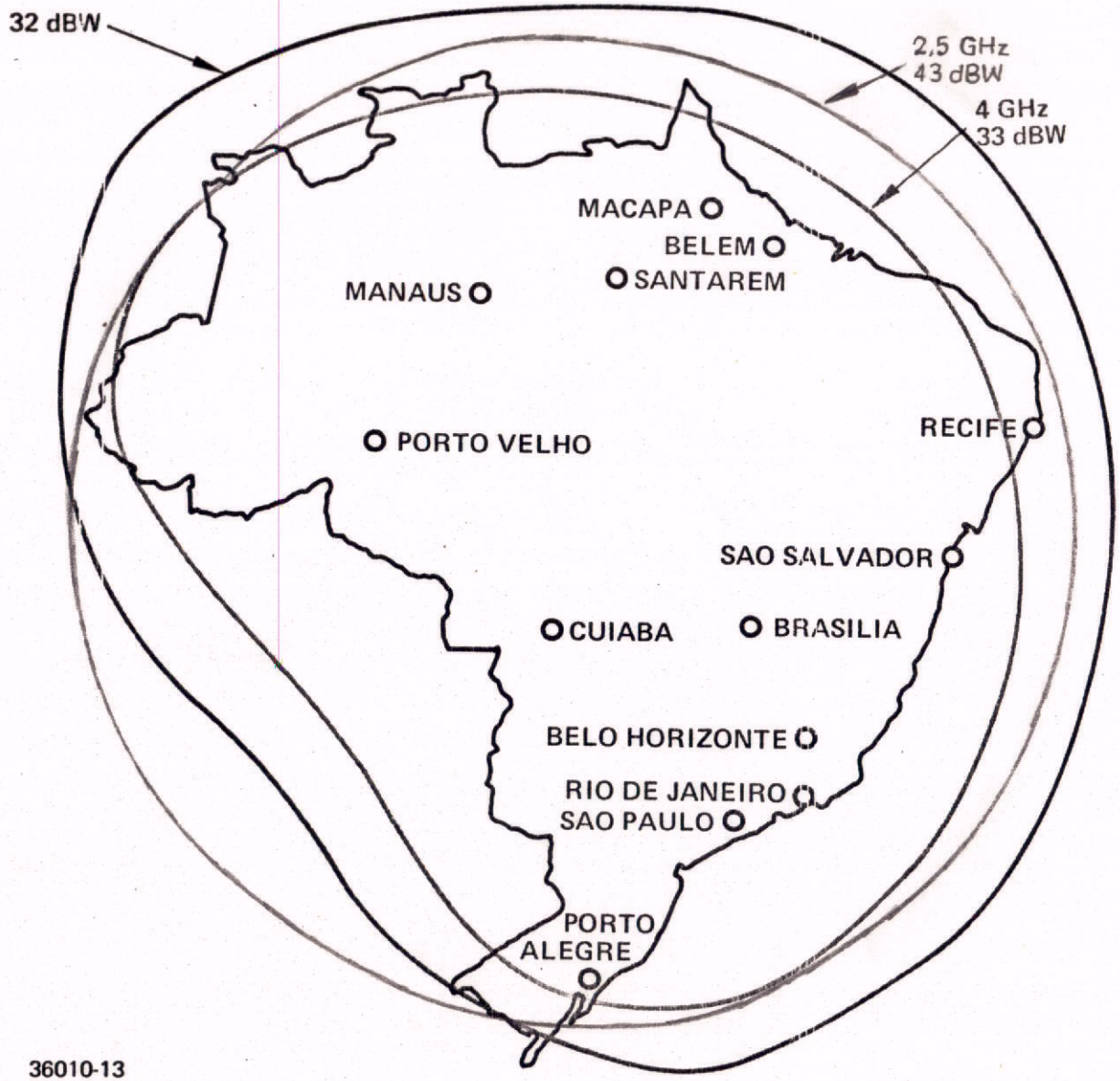

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FIGURE 4

ANTENNA COVERAGE PATTERN

IN-ORBIT OPERATIONS

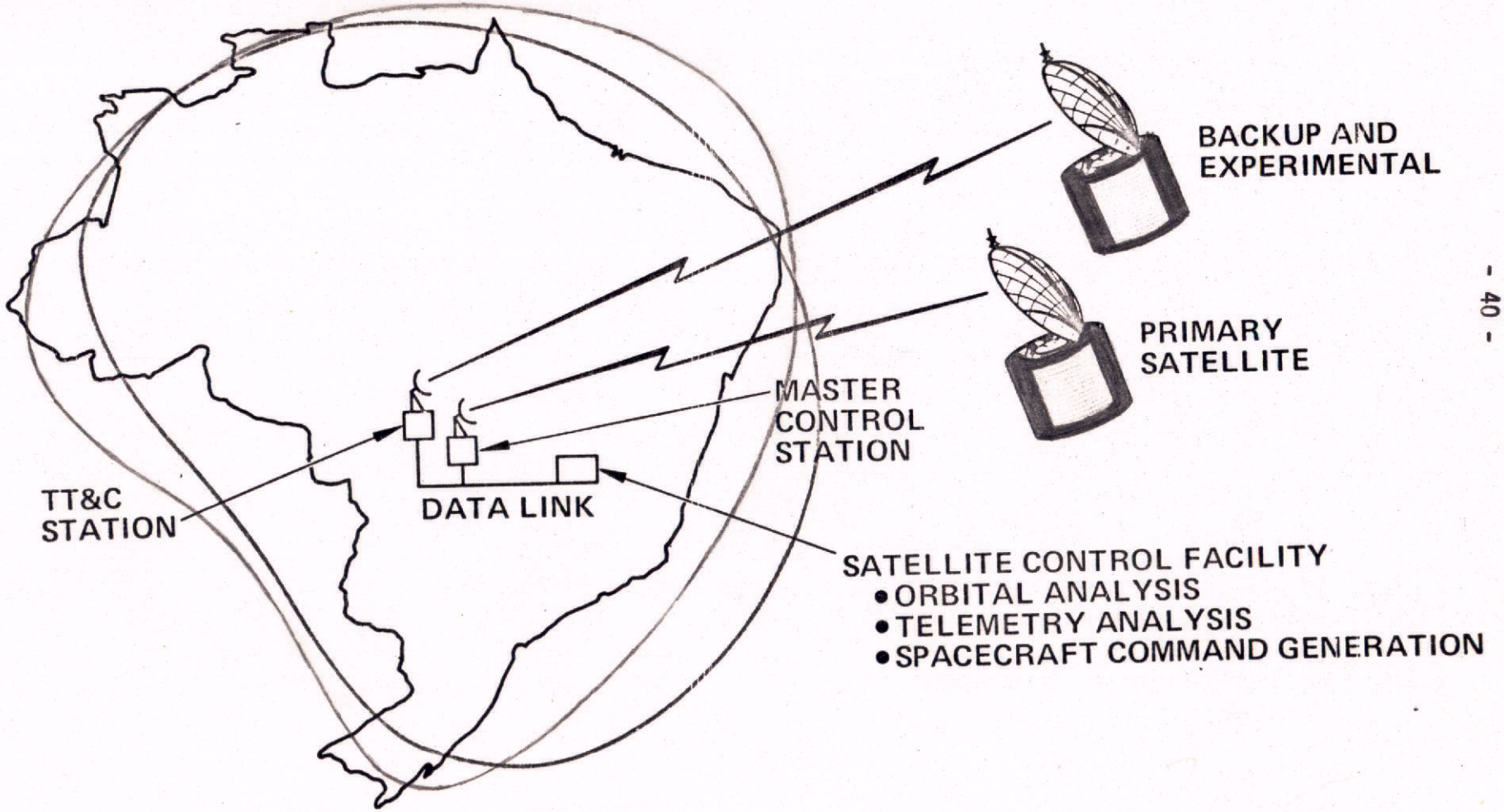

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FIGURE 5

V - FUTURE DIRECTIONS

Future activities at INPE will focus on extending the Rio Grande do Norte Educational Experiment by 10%, into the neighboring states in the Northeast, such as Ceara and Paraiba. By 1976 this modern, validated instructional system will be broadcast via ground system and satellite to some 24.0 million students in primary schools in order to attain one of Brazil's most highly prized goals: universal education.

Training

The next years will be decisive in establishing Brazil among the nations developing scientific activities linked to space.

It is obvious that the scientific and technological aspects of Brazil's space problems will only be resolved when it has a significant corps of scientists in terms of quality and quantity.

It is urgent that a group of high-level scientists, capable of administering projects, directing laboratories and orienting engineers, be selected and trained as a first step for the formation of a Masters' degree program. Given the lack of Brazilian educational centers to develop these students, INPE is concentrating all its resources in order to build up the potential for good engineers, physicists, meteorologists, economists, geologists, sociologists, physchologists, educators and administrators.

Our Post-Graduate Program envisages granting Masters and Doctoral degrees in these essential areas. The structure of this program conforms with the directives for granting graduate degrees established by the Federal Council of the Federal Ministry of Education and Culture.

At present we are offering graduate degrees in the following areas:

1. Systems Analysis and Applications
2. Space and Atmospheric Science
3. Electronics and Telecommunications
4. Computer Science
5. Remote Sensor Applications
6. Technology of Education

The newest program is Technology of Education. Its introduction to the curriculum is essential because of INPE's responsibilities in developing a national education program by satellite.

Educational Technology is defined broadly as the systems engineering approach to designing, implementing, and evaluating learning systems.

All graduates of the program will be profficient in the areas of: educational research, measurements, statistics, experimental design, educational psychology in systems analysis, and communications media.

The program is primarily designed to equip students to manage or participate in educational technology programs where they will carry out educational research and development activities in international settings, public school systems, the community, government or military agencies and in private industry.

A student's program may include courses in other departments of the Institute as well, in order to achieve an inter-disciplinary approach.

Requirements for the degree include demonstrated mastery of the concentration areas through practical application of learned skills and performance testing.

The program concentrations will be Instructional Systems Development and Educational Research and Evaluation.

The concentration programs include:

1. Basic and applied research methodology
2. Statistic and experimental design
3. Education test development
4. Human learning
5. Development and use of technology in education
6. Computer applications

7. A behavioral approach to instructional design

8. An analysis of variables in the learning environment.

A second phase of the program will be the design of validated course notes for presentation through media and programmed instruction format, in order to provide independent study programs at INPE and other regions of Brazil.

We are also planning to invite a representative number of students from all regions of Brazil as well as from other countries to participate in our graduate program next year. Scholarships will be provided for this unique work/study program.

Dr. Fernando de Mendonça, General Director of INPE, would like to take this opportunity to invite two students to be nominated by SEAMO to study and work with us next year in our graduate program, and in exchange we would plan to send two Brazilians to Innotech. We believe such an exchange of ideas, and experience, a sharing of skills and resources would be equally stimulating and advantageous to our people and to yours.

I would like to thank you very much for the opportunity to present the current status of Brazilian efforts to develop a viable system of satellite education.

We are greatly interested in the development of innovative programs in the SEAMO conference countries, and hope this will be the beginning of a fruitful sharing of information.