JPRS L/9906

12 August 1981

Worldwide Report

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

(FOUO 11/81)

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BRIEFS

APPLE IN ORBIT--The Indian experimental telecommunications satellite, Apple, launched on 18 June 1981 by the third Ariane rocket (see AIR & COSMOS No 866) is now in geosynchronous orbit. A trajectory correction was effected by Indian technicians on 27 June. The Apple satellite should reach its geostationary emplacement (102° East) about 20 July. But one of the two solar panels is still jammed. The Apple is the fifth satellite launched by India. The first Indian satellite, Aryabhata, was launched in 1975 by the USSR, which also placed the second Indian satellite, Bhaskara 1 (remote sensing) into orbit. India itself next launched two small experimental satellites with its own SLV3 rocket: the Rohini 1, successfully, in July 1980 and the Rohini 2 on 31 May 1981. But the satellite fell prematurely on 9 June after only 9 days in orbit (instead of 300) because of an orbit which was too low as a result of improper functioning of the launcher. Five other satellites are contemplated within the scope of the Indian space program. The Bhaskara 2 satellite is to be launched by the USSR at the end of the year. Then, two telecommunications and meteorology satellites, Insat 1A and 1B will be launched by the United States in the beginning of 1982 and the end of 1983 respectively. Next, starting in 1986 India plans to launch two telecommunications satellites, IRS 1 and 2 with its own facilities. [Text] [Paris AIR & COSMOS in French 4 Jul 81 p 35] [COPYRIGHT: A. & C. 1980] 11706

CSO: 5500/2261

JAPAN

SMALL RADIO UNIT FOR LAND MOBILE TELEPHONE SYSTEM DESCRIBED

Tokyo TECHNOCRAT in English Vol 14, No 5, May 81 p 73

[Text] *NTT has completed trial production of a new land mobile telephone radio unit which is as compact as 1500cc in volume and 2.4kg in weight. Compared with a conventional mobile unit, the size of the new unit is reduced to less than 1/4, the weight to about 1/3, and the DC power consumption to about 2/3 for transmission and less than 1/2 for stand-by.*

NTT has also developed some unique items of technology to miniaturize and reduce the weight of the machine. The major efforts made by the corporation during the manufacture of the machine are as follows:

In a local oscillator which must generate accurate and stable radio channels for steadier communication, microwave planer-circuit technology has been employed to simplify the circuit structure. A variable frequency local oscillator capable of direct oscillation of 800MHz frequency has been developed to be built into the machine. This is based on thick-film planer-hybrid IC technology. The combination of bipolar semiconductor and CMOS technologies has enabled miniatuarization of a prescaler and a variable divider conducting high-speed control of frequency into LSI's.

In the transmitting section, a 145MHz FM modulator for voice and data has been required. But because an oscillation frequency of 145MHz is too high to be caught by a crystal oscillator, a new device called SAW has replaced it as the oscillation source of the modulator. An up-converter provides an 800MHz band output by mixing the 145MHz modulated carrier with the output of a local oscillator. Although application of thick-film technology to higher frequencies has conventionally been very difficult due to large transmission losses, NTT has successfully completed the circuit using a thick film hybrid IC by applying low-loss technology developed by the corporation.

In the receiving section, a thick film hybrid IC has been used for a receiving mixer which mixes received signals and the output of the local oscillator to produce an intermediate frequency (IF) carrier of 90MHz. Newly developed monolithic crystal filter fabrication technology has also helped in the manufacture of a 90MHz IF filter.

HIC's used for the transmitting section have reduced a great number of adjustment points. A uniquely structured and compact low loss duplexer using high dielectric materials has also been incorporated.

The logic unit performs logic operations required for call processing, channel control etc. The circuits are composed mainly of general purpose LSI's, so that functions of the logic unit can be performed on a digital basis.

Also, transmitter power amplifier efficiency has been improved mainly by 30% to 40%, resulting in a decrease in power consumption.

Table 1 shows the main features of the new mobile radio unit.

Table 1. Specifications of the New Mobile Radio Unit.

Size		214mmx140mm x50mm
Volume		1500cc
Weight		2.4kg
Transmission power		5W
Frequency		800 MHz band
Consumption power	Transmitting	35W
	Receiving	7W

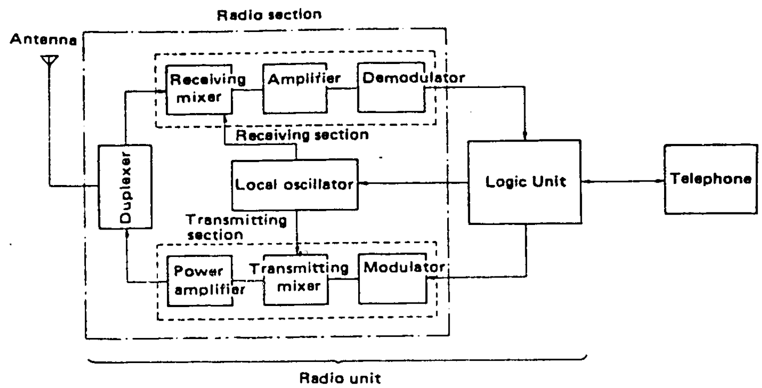


Fig. 1. Block Diagram of a New Radio Unit

CSO: 5500/4586

JAPAN

TEST OF TELEPHONE EXCHANGES IN STRICKEN AREAS, GROUND TELEPHONE NETWORK

Tokyo TECHNOCRAT in English Vol 14, No 5, May 81 p 73

[Text] *A satellite communications circuit, which is most unlikely to be affected by ground disasters, may be the most effective means for the rapid reassignment into a telephone network of a region isolated from the network by disasters. NTT has succeeded in a circuit installment connection test in which a ground telephone network and the telephone exchanges of a stricken area are linked via an experimental, medium capacity, stationary communications satellite (CS).*

When a trunk line between telephone exchanges or telephone offices is damaged by a disaster, it is necessary to organize quickly an earth station for satellite communication for immediate use by installing a satellite circuit. To cope with these emergency cases, on the assumption of traffic interruption, a test was conducted in which a helicopter carried a quasi-millimeter wave mobile station which communicates with a CS. Next, in the Karasuyama Telephone Office of Tokyo, the mobile station was linked with an emergency telephone exchange substituting for the damaged telephone office. A circuit covering the route of an exchange → mobile station → CS → base station → ground telephone network was established after an hour-long attempt.

A transmission test via the above-mentioned circuit was also conducted to check the influence of dial pulse delay caused by transmission delay time inherent in a communications circuit through the operation of a telephone exchange. However, no trouble was recorded.

On the other hand, when a large part of the trunk line between telephone offices is damaged, the required work is not only to change the route of the circuit, but also to build the structure of a satellite communications circuit mainly for communications with the stricken areas. The former will be conducted by the route alteration function of an exchange, and the latter by the time sharing multiple connection function. In the test, using these methods, circuit structure change required only a very short time.

These tests have proved that public telecommunications with stricken areas can be quickly secured even if exchanges and trunk lines in those areas are damaged.

CSO: 5500/4586

JAPAN

TELEX TELETYPE SWITCHING SYSTEM ANNOUNCED

Tokyo TECHNOCRAT in English Vol 14, No 5, May 81 p 72

[Text] • Toyo Insatsu Denshinki Co. has announced that it has developed a "Message switching system VIT 1100" which allows considerable reduction of manpower and great improvement of efficiency in telex•teletype communications, both domestic and international.

The system comprises a main body and terminals, such as a multi functional CRT. The main body incorporates a 14.9 Mbyte magnetic disc, 1 Mbyte floppy disc and a system controlling microcomputer, DEC•LSI 11/2. The maximum number of input/output ports is 22. Telegraphic messages input is stored on magnetic disc of variable length.

These features allow the following: (1) automatic allocation of telegraphic messages input from each port. (2) storage of messages in magnetic and floppy disks, the latter being also used, especially for long-term preservation of messages. (3) simple retrieval of messages from the discs and transmission of them to any desired port including a CRT, paper tape printer, printer and circuits. (4) fixed message registration, repeated use of the registered messages and correction at terminals. (5) output of messages to a journal printer (6) relay of messages for international (5 unit) and domestic (6 unit) uses. (7) transfer of faulty messages back to the input terminal after highly accurate checking of the messages.

As mentioned, this system uses magnetic and floppy discs, excluding any kind of tapes used in the storage and retrieval of messages from telex and teletypes, which normally have been performed by paper punch tapes and monitor copies. It is reported to be most suited to companies with channel capacity of about 10 circuits.

CSO: 5500/4586

JAPAN

PILOT PLANT FOR ISDN TO BE INSTALLED

Tokyo TECHNOCRAT in English Vol 14, No 5, May 81 p 72

[Text] • NTT will start in FY1982 to establish a pilot plant for a digital communication network so that the analogue communication network currently used mainly for telephone calls can be replaced by the integrated system digital network (ISDN), which is used by various kinds of communication systems.

The telecommunication network used at present is made up of an analogue system which permits only transmission/reception of oral signals by telephone. Analogue-based telecommunications, however, which transmit voice wave-form as it is in order to conrey natural voice, are accompanied by defects such as distortion and noise.

Recent development of digital technology has enlivened the transmission/reception of digital information using data terminals and facsimiles. However, transmission of digital information using the analogue network requires specially designed signal conversion equipment. Most urgently needed, therefore, is a digital network which unifies various kinds of signals from all kinds of telecommunication networks into pulses.

There may be many technical problems to be overcome involved in the conversion of the present analogue system into the digital one. Technical interface of both systems, maintenance of the digital network, training of the staff, and introduction of digital electronic exchanges are some of them.

To clarify these technical problems, a pilot plant will be established in a few years in a practical stage following the theoretical study. In the plan, some of the electronic exchange of the present telephone offices will be digitalized and be connected to digital devices such as data terminals, facsimiles, and data telephones. Selected offices and telephone subscribers will have a monitor for the digital devices, and telephone offices and these terminals are also expected to be linked by an optical fiber instead of a copper calbe. The number of monitors expected to be subscribed for will reach about 2000.

CSO: 5500/4586

JAPAN

BRIEFS

COMPUTER NETWORK USING SATELLITE--The Agency of Industrial Science and Technology of MITI has started a study for a computer network program in which the Information Center of Tsukuba Science City and seven local research institutions of the Agency are linked via a communication satellite. A network using optical fibers has already been established between nine major research institutions of Science City. Furthermore, a new work for a wider area covering local institutions will use a communication satellite as well. The Agency also expects that the progress of this program will clarify technical problems underlying a computer network formation using a satellite, and find other areas of application for the same kind of technology. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 5, May 81 p 72] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

OPTICAL FIBER FOR PRACTICAL USE--NTT will use on a practical basis an optical fiber method for inter-office transmission lines with a total length of 110km in respect of 12 sections of Tokyo, Osaka and other areas. It will use 32Mb/s and 100Mb/s medium capacity methods, in which new aspects of technology, such as long wave length elements of about 1.3μm, as well as optical fiber manufactured by the VAD method, will be employed. NTT is expected to start construction in March, 1981 and complete it at the end of the year for service commencement. [Text] [Tokyo TECHNOCRAT in English Vol 14, No 5, May 81 p 72] [COPYRIGHT: 1981 Fuji Marketing Research Co., Ltd.]

CSO: 5500/4586

CZECHOSLOVAKIA

UDC 621.396.43:621.396.946

CSSR'S INTERKOSMOS SPACE COMMUNICATIONS RESEARCH DESCRIBED

Prague SLABOPROUDY OBZOR in Czech No 4, Apr 81 pp 177-182q

[Article by Eng Anton Kuchar, CSc, Institute of Radio Engineering and Electronics, CSAV, Prague: "Some Information on Space Communications Research Conducted in Czechoslovakia Within the Interkosmos Program"]

[Text] This article describes the scope and direction of work done in Czechoslovakia in the context of the Permanent Working Group on Space Communications, Interkosmos. Specific results achieved in space communications by Czechoslovak organizations are presented and the prospects for development of this field in Czechoslovakia are described.

1. Introduction

Practically every manmade object launched into space is provided with equipment for one-way or two-way communications with the earth. In terms of their missions we distinguish two types of satellites: reconnaissance satellites and communications satellites.

In the case of satellites of the first type, radio communication is used for transmission of telemetric signals and is generally conducted in the meter or decimeter wavelength region, the throughput capacity is generally small, and the energy balance is generally quite critical on deep-space probes, requiring the use of special modulating methods, extremely sensitive receivers and large antennas at the ground stations.

The primary mission of communications satellites is transmission of signals between different points on the surface of the earth. The throughput capacity of modern communications satellites is generally many thousands of telephone channels. Geostationary satellites, synchronously orbiting the earth in the equatorial plane at a distance of about 36,000 kilometers, are the type most often used. The design of thesc satellites is geared to the service which they perform. They are used to transmit huge streams of information between communications centers or for communications with moving objects (aircraft, ships), and in the near future they will be used for broadcasting radio and television programs, data transmission and small-channel telephone communications between small ground stations, precise time and frequency broadcasting, determination of spatial position and the like.

Because of the uniqueness and importance of the problem of communications with or via satellites, the Permanent Working Group for Space Communications (SPSKS) was created within the Interkosmos program. By agreement with the Czechoslovak Academy of Sciences [CSAV], which manages Interkosmos program research done in Czechoslovakia, management of Czechoslovak participation in the work of SPSKS was undertaken by the Federal Ministry of Communications. Joint assignments on several subejcts are carried out in accordance with a work plan. Work on individual subjects is coordinated by the countries which can make the greatest contribution to solving the problem in question. Information on results achieved is exchanged through regular or special conferences and scientific symposia, and experimental equipment which has been developed is made available to the cooperating countries through bilateral or multilateral agreements. The operation of the satellite communications system developed in the Interkosmos program is managed by the Intersputnik organization.

2. The Nature of the Research Done in Satellite Communications

While physical phenomena are the primary subject of study in the other areas of space research conducted in the Interkosmos program, the main objective of satellite communications research is the development of methods for the optimal use of satellites for communications purposes. The culmination of this work is the development of a plan for a satellite communications system which is at a qualitatively higher level than previous systems. Communications networks are extensive systems whose effects reach far beyond the boundaries of individual countries. Immense sums are invested in them and their operation is subject to international regulations. The applicability of the results of space communications research depends on these factors. New principles are utilized only after thorough testing, and accordingly innovations are introduced slowly in this field. Research and development work must be thoroughly coordinated. The conditions must be created for transferring research results obtained in the Interkosmos program to the Intersputnik operating organization and to producers of satellite communications equipment.

3. Areas of Satellite Communications Research

Satellite communications research in the Interkosmos program is conducted in accordance with the Permanent Working Group on Space Communications plan, which includes several subject areas. Below we present information and comment on the following selected subject areas:

1. Opening up new frequency bands for satellite communications.

2. Organizing the operation of satellite communications, methods of signal transmission via satellite, and direct broadcast and reception of signals from satellites.

3. Methods of processing signals intended for transmission by satellite: modulation and coding methods.

4. Questions of the electromagnetic coexistence of ground and satellite systems.

3.1 The Use of Higher Frequency Bands for Satellite Communications

Currently the frequency band from 3.7 to 4.2 GHz is the one most heavily used for satellite-to-ground communications and that from 5.925 to 6.425 GHz for earth-to-satellite communications. These bands are particularly well suited for use because there are only very minor atmospheric effects on signal propagation in them. However, they are also used for ground communications and are almost filled by satellite communications. Accordingly most new satellite communications systems will operate in frequency bands above 10 GHz.

Bands in the vicinity of 12, 14, 20 and 30 GHz, among others, have been reserved for satellite communications. Signal propagation at these frequencies is subject to extremely unfavorable atmospheric effects, especially from precipitation. Attenuation is increased and it becomes necessary to adjust the carrier wave plane of polarization. These phenomena are of a statistical nature and must be specially measured for each region. For this purpose SOSKS has designed an experimental satellite system which will make possible:

--the study of signal propagation at frequencies in the vicinity of 12 GHz, and

--experiments with the transmission of television, telephone and other signals in this frequency band.

Opening up higher frequency bands also entails mastering the technology for producing microwave circuits (especially integrated circuits), such as low-noise and power amplifiers, generators, mixers and filters, as well as antennas.

The experimental satellite system consists of:

--geostationary satellites of the Luc I and Luc II types, each of which will allow the transmission of one high-frequency channel in the 12 and 14 GHz bands;

--class I and class II ground stations;

--ground sections of measurement links in the 12 and 14 GHz bands;

--radiometers.

Class I ground stations are equipped with transmitters and receivers and can transmit a television signal or 200 to 400 telephone channels when operating with another class I station, or 20 channels when operating with a class II station. These stations have antennas with a reflector diameter of 12 meters.

Class II stations have both a receiver and a transmitter or only a receiver. The antenna diameter does not exceed 4 meters. These stations will be used for research, for experimental reception of television signals from satellites, and for small-capacity communications.

The measuring stations of the ground links have equipment for monitoring meteorological conditions in the vicinity.

We now present the main specifications of the Interkosmos experimental satellite system.

Signals transmitted	1 television channel with audio, 1 telephone trunk, measurement signals
Modulation	frequency-modulated television signal, audio on 6.4 MHz subcarrier with double frequency modulation; FM/FDMA/SCPC or ΔM/DPSK/FDMA/SCPC for telephone trunks*
Bandwidth of high-frequency channel	40 MHz
Frequency channels	
uplink	14 GHz
downlink	12 GHz
Satellite position	14° W(Luc I), 53° E (Luc II)
Radiated power (EIRP) of satellite	40 dBW
Polarization	circular
Class I ground station	
EIRP	92 dBW
transmitting antenna gain	63 dB
transmitter power	3 kW
receiver quality G/T	33 dB/K
noise temperature of receiver	250° K
receiving antenna gain	60 dB
Class II ground station	
EIRP	71 dBW
transmitter antenna gain	G = 51 dB
transmitter power	23 dBW
receiver quality	23 dB/K
noise temperature of receiver	300° K
receiver antenna gain	49 dB

*[FDMA: frequency division multiple access; SCPC: separate carrier pulse coding; ΔM : delta modulation; DPSK:

FM modulation with a carrier swing of ± 15 MHz is proposed for transmission of a television signal between class I stations, which would give a signal-to-noise ratio of 55 dB; a smaller swing will be used in communications with class II stations, assuring that the FM demodulator operates above threshold by decreasing the signal-to-noise ratio at the detector output to less than 50 dB. The audio frequency is modulated onto the 6.5 MHz subcarrier with a swing of 50 kHz, which in turn is frequency-modulated onto the principal carrier with a swing of 5 to 7 MHz. Digital transmission of the audio signal in the blanking pulses of the television signal is also being investigated. The complete television signal, including the audio, takes up a 27 MHz band.

Two modes of voice telephone transmission will be investigated:

1. Each signal will be subjected to delta modulation with a speed of 32K bps on a separate carrier (SCPC system). This will make it possible to combine up to 400 channels into a telephone trunk with a carrier spacing of 45 KHz.

2. Each voice signal will be digitized by PCM [pulse code modulation] with a speed of 64K bps. In the ground station several channels will be combined by time division multiplexing into a connected sequence of bit pulses with frequencies up to 1,540 Mbps, which will be used to phase-modulate a single high-frequency carrier (PSK modulation).

Questions of organizing communications via satellite and of modulation methods are the subjects of other research being carried out by SOSKS Interkosmos.

As part of the work on the opening up of higher ferquency bands, ,the problem of designing small receivers for direct reception of television signals from satellites in the 12 GHz band is also being solved; this will be discussed in the next section.

3.2 Methods of Satellite Transmission of Signals

In terms of the width of the band taken up by the signals transmitted we distinguish narrow-band and wide-band signals. The former group includes primarily telephone and data signals, while we assign to the other television signals and telephone trunks produced by multiplexing many telephone signals together in the ground station.

The main problem arising in the transmission of narrow-band signals is that of choosing a suitable operating procedure for the satellite system so that the capacity of the transponder installed on the satellite will be optimally used, even when a large number of transmissions are passing through the satellite. Under SPSKS, two basic methods of multiple access to the satellite have been developed, the first based on frequency division (FDMA) and the second on time division (TDMA). Currently work is under way on a third method based on signal switching in the satellite and the use of controlled-beam antennas, which is extremely promising. The data can be transmitted on television channels if suitable modems are used. But work is proceeding on special methods of data transmission via satellite which take account of the characteristics of the data signals, such as intermittent transmission in short bursts, the requirement for nearly error-free transmission and the like.

Today, wideband signals are generally transmitted via satellite between large communication centers which are the interface points between ground and satellite communications systems. But satellites allow continuous coverage of a large territory by a signal which may be simultaneously received by an unlimited number of suitably equipped stations. These advantages of communications satellites will be utilized in so-called satellite broadcast service (RDS), or direct broadcast of radio and television signals from satellites.

Development of the RDS concept has an important place in the SPSKS program. Since the World Administrative Radio Conference (Warc BS 77) reserved a frequency band in the vicinity of 12 GHz for RDS, solution of the problems associated with the introduction of RDS has been proceeding in close connection with the experiments with the satellite system described in section 3.1. Here we present certain basic information on the RDS concept developed in the Interkosmos program.

In addition to reception by the industry, using stations with a G/T ratio of 16 to 20 dB/K connected to a cable or radio distribution system, plans are also being made for group reception (G/T - 10 to 14 dB/K, distribution by residential cable), and, in the future, for individual reception (G/T = 4 to 8 dB/K). The high-frequency signal will take up a band 27 MHz wide, the video signal will be frequency modulated, and the wideband audio portion will be used to modulate a 6.5 MHz subcarrier with a 50 kHz swing, which in turn will be used to modulate a 70 MHz carrier, which will then be transponded into the microwave region. A signal-to-noise ratio of 48 to 50 dB for the video and 52 to 55 dB for the audio is expected. The satellite transponder and its transmitting antenna will be so dimensioned that for receiving stations with these G/T values the signal-to-noise ratio at the input of the FM detector will not fall below the threshold voltage of 10 dB for more than 1 percent of the time.

Czechoslovakia has been assigned the same position for placement of communications satellites in the geostationary orbit as the other socialist countries of central and eastern Europe and has had reserved for it a frequency band which will make it possible to establish five high-frequency channels 27 MHz wide.

3.3 Methods of Processing Signals Intended for Satellite Transmission

Questions of source coding and channel coding are addressed under this heading.

Source coding consists primarily of converting a signal produced by a certain source (audio, video and the like) into a digital signal and processing it, with the aim of minimizing the bandwidth required for transmitting the information which the signal contains, i.e. suppressing as much as possible of its redundancy. Audio and video signals are the main subjects of interest. In both cases several different modulation methods (different variants of delta modulation or differential pulse code modulation) or transformation methods are available. Methods coming under the first category have been developed for real time transmission of audio and video and their use is planned in the Interkosmos system and later in the Intersputnik system.

The notion of "channel coding" refers to protection of a (digital) signal against errors and modulation of the signal onto a carrier frequency.

Protective coding is of critical importance in the transmission of signals with suppressed or zero redundancy, e.g. in data transmission. It allows the transmission error to be decreased by widening the transmission band used.

Selection of a suitable modulation method will allow optimal use of the transmission capacity of a given type of communications through a compormise between power and bandwidth which is required to achieve certain transmission qualities which in analog signals are characterized by the signal-to-noise ratio at the detector output and in digital signals by the transmission error rate.

SPSKS is doing both theoretical and experimental work on this problem. The theoretical work is based primarily on computer simulation of the characteristics of satellite communications. The formulas developed are used for experiments with signal transmission via the Intersputnik organization's existing satellite system.

3.4 Questions of Electromagnetic Coexistence of Ground and Satellite Communications

Since many signals modulated onto carrier waves arrive in a given space at the same time, the frequencies or polarization of these carrier waves must differ from one another so that there will not be greater-than-permissible mutual interference between individual communications links. The frequency spectrum which can be used to transmit signals through space must therefore be used according to a specific plan. Certain frequency bands below 10 GHz are used by both ground and satellite communications. One measure which is expected to decrease the possibility for interference between ground and satellite communications is the establishment of a maximum power density for signals on the earth's surface transmitted from satellites in these bands.

At the World Administrative Conference held in Geneva in 1977, a frequency band was reserved for direct radio and television broadcasting from satellites. The benefits of long-term cooperation between the socialist countries in the Interkosmos organization manifested themselves at the conference in their advocacy of their interests.

An inseparable part of the planning of satellite systems is the solution of the problem of optimal use of the geostationary orbit, which is unique and in which only a limited number of communications satellites can be placed.

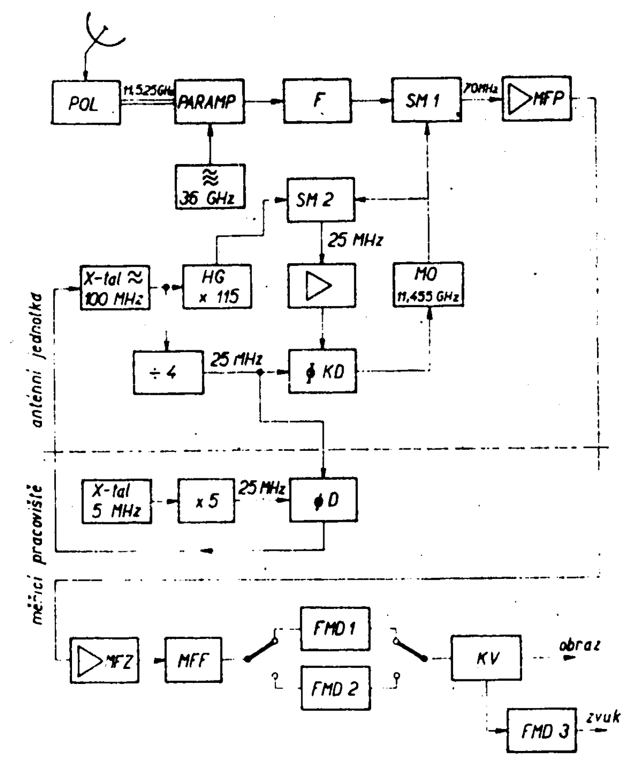
4. Satellite Communications Work in Czechoslovakia

Czechoslovakia has taken part in the accomplishment of subtasks in practically all of the subject areas, based on its capabilities and interests. Important factors have been the industrial applicability of the findings and long-term approaches to the introduction of satellite communications into the national communications net.

4.1 Implementation Work

An important aspect of implementation which documents Czechoslovak industry's ability and interest in involving itself in the satellite communications field is the experimental class II ground station for receiving signals from satellites in the 12 GHz band. The station was developed by TESLA-VUST [A.S. Popov Research Institute of Communications Engineering] on the basis of a request by the Communications Research Institute. URE [Institute of Radio Engineering and Electronics] CSAV and the Nuclear and Physical Engineering Faculty (FJFI) of CVUT [Czech Institute of Technology] in Prague also took part in developing the station. Below we give a brief description of the main capabilities of the station (Fig. 1).

12 GHz. Stanice byla realizována v TESLA-VÚST A. S. Popova na základě zadání Výzkumného ústavu spojů. Na realizaci stanice se podílely též ÚRE ČSAV a Fakulta jaderná a fyzikálně inženýrská (FJFI) ČVUT v Praze.



Obr. 1. Blokové schéma pozemní stanice II. třídy pro příjem signálů z družic v pásmu 12 GHz.

POL - převodník kruhové polarizace na lineární, PARAMP - parametrický zesilovač, F - filtr, SM1, 2 - směšovače, MFP - mezifrekvenční předzesilovač, X-tal - krystalový oscilátor, HG - hřebínkový generátor, MO - místní oscilátor, ΦKD - fázově kmitočtový detektor, ΦD - fázový detektor, MFZ - mezifrekvenční zesilovač, MFF - mezifrekvenční filtr, FMD1, 2, 3 - kmitočtové demodulátory, KV - kmitočtová výhybka.

Fig. 1. Block diagram of the class II ground station for reception of signals from satellites in the 12 GHz band.

Key:
POL--converter from circular to linear polarization
PARAMP--parametric amplifier
F--filter
SM1, 2--mixers
MFP--intermediate frequency preamplifier
Xtal--crystal oscillator
HG--spike generator
MO--local oscillator
ØKD--phase-frequency detector
ØD--phase detector
MFZ--intermediate frequency amplifier
MFF--intermediate frequency filter
FMD1, 2, 3--frequency demodulators
KV--frequency shift filter
1. Antenna unit
2. Measuring station
3. Video
4. Audio

The station is designed for reception of television and measurement signals transmitted from a geostationary satellite. It is so designed that a transmitter can be added. It is equipped with an antenna 3 meters in diameter (a 4-meter antenna will be installed later), which will be able to track the satellite to a limited degree. The antenna is a Cassegrainian type with a gain of about 48 dB. A circularly polarized signal received by the antenna is converted to linear polarization and fed through a flexible waveguide to a non-cooled two-stage parametric amplifier. The amplifier noise temperature is about 250°K, the gain is 20 dB, and bandwidth is 150 MHz. The frequency shift filtering signal source, which was designed and fabricated at FJFI CVUT in Prague, consists of a pair of mutually synchronized Gunn oscillators operating at 36 GHz.

Following the parametric amplifier is an integrated-circuit balanced mixer which converts the microwave signal to the intermediate frequency of 70 MHz. To assure extreme frequency stability and low noise close to the carrier required for experimental purposes, the Gunn oscillator is phase-suspended to a 100 MHz crystal oscillator (frequency instability 10^{-7}), which is phase synchronized by a 5 MHz precise subnormal crystal oscillator (frequency instability 10^{-9}) produced by the Hradec Kralove national enterprise. The local osicllator was designed and fabricated by URE CSAV in Prague. The ACES equipment, also produced by URE, makes it possible to produce phase synchronization to the national frequency standard, e.g. by means of station OMA.

The intermediate frequency signal is fed from the antenna unit to the measuring station, which is located in a housing module. This contains an intermediate frequency filter, an intermediate frequency amplifier, two sets of FMD modulators and a 5 MHz temperature-stabilized crystal oscillator. The first FMD modulator, using conventional circuitry, is a proven development of the Hloubetin national enterprise, while the second, operating on the phase suspension principle, has a low threshold and was developed and fabricated in East Germany, also as part of the Interkosmos program. By means of frequency shift filtering, the 6.5-MHz audio subcarrier is separated out and demodulated. The ground station is shown in Fig. 2.

This station will be installed in 1981 on an international research range in the Soviet Union. Czechoslovak communications specialists will take part in measurements on this range.

The Communications Research Institute has built with its own resources a second small station, which will also allow experimentation with the reception of television signals from satellites in the 12 GHz band. The station was built in an area in Czechoslovakia which also has a ground link for the 12 and 18 GHz bands, a set of rain gages and its own radiometer.

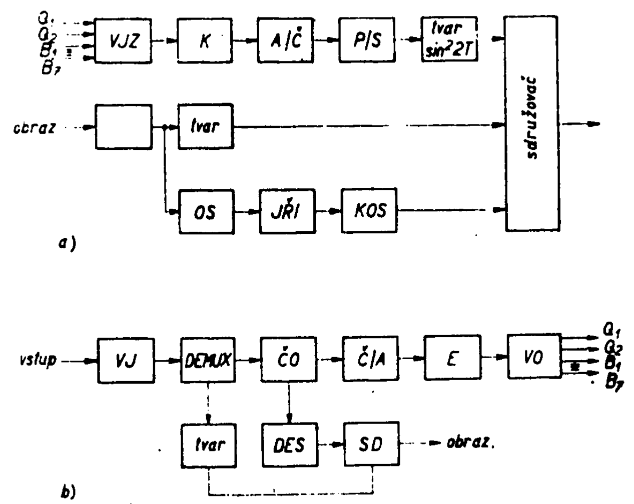
In connection with the Interkosmos program, TESLA-VUST has developed equipment allowing conversion of several TV audio signals without requirements for additional bandwidth and transmitted power. This equipment operates on the principle of time division multiplexing of an analog television signal and of digital signals which transmit the audio in the intervals resulting from shortening the line blanking pulses. The sound signals are converted into binary-ternary code, in which each word consists of seven least significant binary bits and an eighth most significant bit expressed by the level of the entire group of seven bits. The line synchronization pulse is suitably shortened and the intervals of the blanking pulses are used for transmitting various types of auxiliary information.

Fig. 3. is a block diagram of the coder. In the input unit of the audio channel and the compressors the individual audio channels are subjected to analog processing in the baseband. There follow analog-digital converters and a parallel-serial converter, in which the individual digital audio signals are serialized. The audio channel ends in a pulse shaper in which pulses representing digital signals are shaped in accordance with the function $\sin^2 2T$. The digital audio signals are then fed to the multiplexer. A standard TV signal in the baseband is fed into the video channel unit. After removal of the synchronization pulses and shaping, the color video signal is fed to the other input of the multiplexer. The necessary synchronization pulses are produced in the synchronization channel and fed into a third input of the multiplexer. The time-multiplexed signal containing the digital audio signals, the analog video signal, and the coded synchronization signal appears at the multiplexer output.

Fig. 3b is a block diagram of the decoder, in which the signal is subjected to a process which is the reverse of that taking place in the coder.

Popsaná stanice bude během roku 1981 instalována na mezinárodním výzkumném polygonu v SSSR. Měření na tomto polygonu se zúčastní také odborníci čs. spojů.

Výzkumný ústav spojů si vlastními silami vybudoval druhou malou stanici, která rovněž umožňuje experimen-



Obr. 3. Zařízení pro přenos několikajazyčných zvukových doprovodů televizního signálu; *Q* - zvukové doprovody vysoké kvality s mezním kmitočtem do 15 kHz, *B* - komentátorské zvukové doprovody s mezním kmitočtem do 6,4 kHz.

a) Kodér.

VJZ - vstupní jednotka zvuku, K - kompresory, A/Č - analogově číslicové převodníky, P/S - paralelně sériové převodníky, TVAR - tvarovač, OS - oddělovač synchronizačních impulsů, JŘI - jednotka řídicích impulsů, KOS - kódovací obvod synchronizačních impulsů, VJO - vstupní jednotka obrazu.

b) Dekodér.

VJ - vstupní jednotka, DEMUX - demultiplexor, ČO - čtecí obvod číslicové složky, Č/A - číslicově analogový převodník, E - expandor, VO - výstupní obvod, DES - dekodér synchronizačních impulsů, SD - sdružovač.

Fig. 3. Device for transmission of multilingual audio portions of television signal. Q denotes the high-quality audio portions with limiting frequencies up to 15 kHz and B denotes the commentator's audio signals with limiting frequencies up to 6.4 kHz.

Key: a. Coder.
VJZ--audio input unit
K--compressors
A/C--analog-digital converters
P/S--parallel-serial converters
TVAR--shaper
OS--synchronization pulse remover
JRI--control pulse unit
KOS--synchronization pulse coding circuit
VJO--video input unit

b. Decoder
VJ--input unit
DEMUX--demultiplexer
CO--digital component counter circuit
C/A--digital-analog converter
E--expander
VO--output circuit
DES--synchronization pulse decoder
SD--coupler

The equipment shown in Fig. 4 has undergone laboratory testing and has also been tested in satellite television transmission. In principle it may also be used in ground communications. The conditions for industrial production of this unit are being developed.

The Electrical Engineering Faculty of CVUT in Prague has worked out an original design for a system for transmission of a television signal in digital form, which would also allow transmission of digitized audio, radio signals and data. In addition to scientific and technical staff members, students also took part in the design as part of their diploma work. The system uses adaptive delta modulation for source coding, applying it to the color television component signals. A suitable prediction algorithm is used to reduce the transmission speed required for transmission of each component to 13.5 Mbps, and 8-state phase modulation makes it possible to transmit a complete 40 Mbps television signal on a frequency band of less than 27 MHz. Since the adaptive delta modulators are relatively simple, this system might be applicable in the future in some simplified form for group reception of television signals from satellites, and possible in the more distant future even for individual reception.

URE CSAV has developed a modem for continuous transmission of 4-state phase-modulated signals with a speed of up to 20 Mbps. It uses the principle of coherent demodulation; the coherent carrier is renewed by remodulating and phase suspension filtering and the timing frequency is removed with a crystal filter. The modem can also be used in radio relay communications.

In addition, URE CSAV has developed some of the equipment for the ground station at Panska Ves belonging to the Institute of Geophysics, CSAV, which is intended for receiving telemetric signals from reconnaissance satellites of the KOSMOS series, and a precise 150 and 400 MHz frequency generator synchronized with Czechoslovak station OMA, which is used for the satellite investigation of the properties of the ionosphere which is being conducted as part of the Interkosmos program by the Institute of Astronomy, CSAV.

4.2 Theoretical and Research Work

The Research Institute of Communications and the Computer Laboratory of VAKUS [Communications Computation and Control Center] have developed a frequency layout for satellite broadcast service in the 12 GHz band using a computer. In addition to transmission channel frequencies, the program package also makes it possible to determine the transmitter powers on the satellites, the positions of the satellites in the geostationary orbit, the polarization of the carrier waves and the geometric parameters of the beans in the area covered by radic signals transmitted from the satellites. The result of the computation is a frequency layout which guarantees that the mutual interference between individual channels will not exceed established limits. This was used as the socialist countries' point of departure in discussions at the World Administrative Conference on planning of the 12 GHz frequency band.

URE CSAV has been studying digital modulation methods which are suitable for use in satellite communications, methods of multiple access to satellites, questions of system synchronization of digital satellite communications, and the use of satellite communications for data transmission and for precision time and frequency broadcasting.

The Research Institute of Communications and URE CSAV are studying the transmission properties of the satellite communications channel by computer simulation. VUS [Research Institute of Communications] is conducting a simulation in the frequency domain, which is most suitable for investigation transmission of analog signals, while URE CSAV is simulating signal passage through the transmission channel in the time domain. The advantages of the latter approach are being used in the simulation of digital satellite systems containing nonlinear functional blocks.

5. Prospects for Utilization of Satellite Communications in Czechoslovakia

On the global scale, satellite communications were earliest put into use in intercontinental transmission of television and telephone signals and data and in assuring full coverage of extensive, sparsely settled territories with a sparse ground communications network. In Czechoslovakia, as in other small countries with a relatively dense ground communications network, there has been a certain delay in commercial utilization of satellite communications. It will be governed by the need to introduce new types of services with the economic advantages of satellite communications over ground communications for transmission over ranges on the order of hundreds of kilometers.

Owing primarily to progress in microwave engineering and rocketry, the construction of communications systems with powerful satellites and small, cheap ground stations is feasible today. In this situation, the use of satellite communications is becoming attractive even for small countries such as Czechoslovakia. The use of satellite communications for broadcasting the third television program, radio programs, the transmission of small-channel telephony and the like is being contemplated in Czechoslovakia, which has the prerequisites for producing the equipment for the ground section, i.e. small ground stations. Only the Soviet Union can provide the communication satellites, including putting them into orbit, in the context of international cooperation with the other countries in the socialist camp.

6. Conclusion

Czechoslovakia's participation in solving the problem of satellite communications in the Interkosmos program is preparing the conditions for the introduction of satellite communications in Czechoslovakia on a large scale and creating the conditions for introduction of the products of the Czechoslovak electronics industry to foreign markets. Czechoslovak specialists are obtaining valuable experience in this new, progressive field of communications engineering. Satellite communications is of great significance for Czechoslovakia in terms of international operations as well.

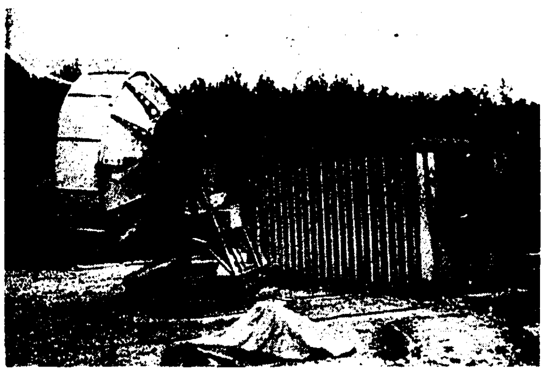


Fig. 2a. Class II ground station

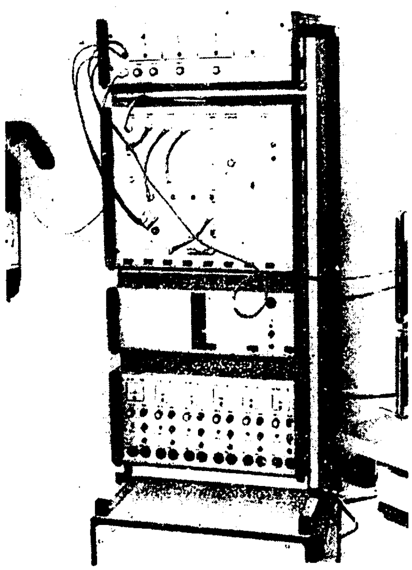


Fig. 2b. Part of the equipment of the class II ground station's measuring station

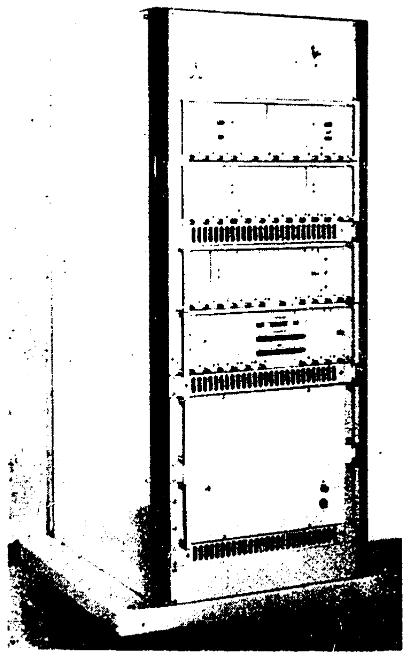


Fig. 4a. Encoder for the transmission of a multiplexed audio track for TV signals

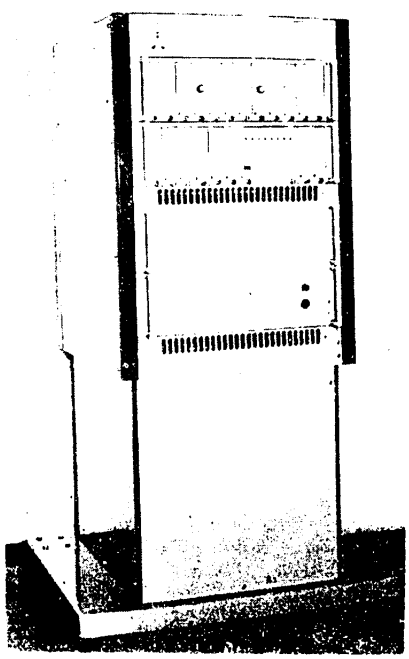


Fig 4b. Decoder for the transmission of a multiplexed audio track for TV signals

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COMORO ISLANDS

BRIEFS

KUWAITI LOAN--The Kuwaiti Fund for Arab Economic Development granted the Comoro Islands on 7 July an approximately 3.5 million dollar loan for financing a telecommunications project. The loan is repayable in 40 years, with a 10 year grace period, at an annual interest of 1 percent. [Paris MARCHES TROPICAUX ET MEDITERRANEENS in French No 1862, 17 Jul 81 p 1897] [COPYRIGHT: Rene Moreux et Cie Paris 1981]

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NIGERIA

BRIEFS

AIR SPACE COVERAGE BY RADAR--The Nigerian federal minister of civil aviation, Mr Samuel Mafuyai, has announced that complete radar coverage of the Nigerian air space would be established within the fourth development plan. Mr Mafuyai stated he was impressed by the first phase of installation of the radar system at the Kaduna, Kano, Port Harcourt, and Enugu airports. [Text] [Paris MARCHES TROPICAUX ET MEDITERRANNEENS in French No 1857 12 Jun 81 p 1598] [COPYRIGHT: Rene Moreux et Cie Paris 1981.) 6445

AEROSTAT SYSTEM ABANDONED--The American transmitting balloon project which was planned to be developed by the ministry of communications and the NTA (Nigerian Television Authority) at a cost of 152 million naira has been rejected by the Federal House of Representatives. The system, which would have allowed simultaneous transmission of television programs and communications channels was not considered sufficiently useful considering its increasing cost. [Text] [Paris MARCHES TROPICAUX ET MEDITERRANNEENS in French No 1857 12 Jun 81 p 1598] [COPYRIGHT: Rene Moreux et Cie 1981.] 6445

JAPANESE CONTRACT FOR PROJECT--Three Japanese firms (Marubeni Corp., Nippon Electric, and Sumitomo Electric Industries) have received an order worth 16 billion yen for the construction of an ultra-short-wave communications network at Ibadan. The Japanese firms will provide the equipment and will carry out the network installation which will be completed in 2 years. The order has been placed by the Nigerian Ministry of Communications within the scope of the 5-year development plan started last year. [Text] [Paris MARCHES TROPICAUX ET MEDITERRANNEENS in French No 1860 3 Jul 81 p 1773] [COPYRIGHT: Rene Moreux et Cie Paris 1981.] 6445

NEW VON TRANSMITTER--The Nigerian chief of state, Alhaji Shehu Shagari, approved late in June a new short-wave transmitter for the Voice of Nigeria at Ikorodu, near Lagos. This transmitter is intended to improve reception of the Nigerian national radio abroad and to give better assistance, among other things, to the liberation movements in Namibia and South Africa. As the chief of state also remarked, while newspapers and magazines are subject to various restrictions on circulation, short-wave broadcasts probably escape any control. [Text] [Paris MARCHES TROPICAUX ET MEDITERRANEENS in French No 1861, 10 Jul 81 p 1829] [COPYRIGHT: Rene Moreux et Cie Paris 1981] 9516

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SUDAN

BRIEFS

TECHNICAL ACCORD--A technical agreement has been concluded between the Sudanese Ministry of Telecommunications and the firms Thomson-CSF and Siemens for execution of the telecommunications development program. In the first phase, to last 3 years, the two companies, which will share in the work equally, will set up a national automatic telephone system made up of 100,000 lines, extend telex services to 7,000 subscribers (instead of the 500 at present), modernize the telegraph system and increase the power of the radio-television stations. The estimated cost of the first phase will be 300 million French francs. Financing offers for the project are now being studied. However, it is emphasized in Khartoum that the American ITT and the Dutch Philips are under careful consideration for the major project which, over a period of 9 years, should cost over $625 million. [Text] [Paris MARCHES TROPICAUX ET MEDITERRANEENS in French No 1857, 12 Jun 81 p 1588] [COPYRIGHT: Rene Moreux et Cie., Paris, 1981.] 11,464

SUDAN-ETHIOPIA LINK--Sudan and Ethiopia will join together in approaching the EEC in an attempt to persuade that organization to finance, as a regional project, the construction of a telephone line connecting al-Qadarif in Sudan and Gondar in Ethiopia. The line, costing an estimated $4 million, is an important link in the Pan African Telecommunications Network (PANAFTEL). Its economic importance is considerable since it would connect Sudan with East Africa via Ethiopia and East Africa with the Gulf countries via Sudan. An initial study was completed by experts from the International Telecommunications Association. [Text] [Paris MARCHES TROPICAUX ET MEDITERRANEENS in French No 1857, 12 Jun 81 p 1588] [COPYRIGHT: Rene Moreux et Cie., Paris, 1981.] 11,464

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