電波研究所
ニュース
1979. 3 No. 36

Millimeter-wave charged wave propagation experiment plan

Microwave

Postcard

The potential importance of new frequency band development is increasing in order to cope with the recent increase in communication demand due to social development, diversification of communication forms, application to measurement technology, and energy utilization. ..

At the World Radio Administration Administration Conference on Space Communications (WARC-ST) in 1971, the upper limit of frequency distribution was raised from 40 GHz to 275 GHz, and distribution of this frequency band mainly to satellite communication, space research, radio astronomy, etc. Was broken. At the World Radio Administration Administration Conference (WARC-G) on general radio communications that will be held this fall, a major revision of frequency distribution has been made for the first time in 20 years, and it is expected that radio waves of 40 GHz or more will be distributed to ground communication. ..

In light of this background, a special research “Research and development of frequency resources” was established by the Ministry of Posts and Telecommunications from 1975. As one of the items, “Research on radio wave propagation characteristics above 40 GHz” was taken up, some revisions were made to the initial plan, and the project “Research on radio wave usage above 40 GHz” was carried out in our laboratory. The purpose of this project is to elucidate the relationship between these underlying atmospheric propagation characteristics and meteorological conditions for the development and utilization of new frequency bands. In addition, through these research activities, we also aim to develop into a project related to the specific use of this frequency band.

The following is an overview of the characteristics of millimeter-wave charged waves in the atmosphere, and the outline of the propagation experiment plan that we are promoting.

Overview of atmospheric propagation characteristics

When using millimeter-wave charged waves (radio waves with a wavelength of millimeter (1 to 1 mm), which corresponds to radio waves of 30 to 300 GHz in the frequency band) in the atmosphere, it is important to note that radio waves due to atmospheric molecules The absorption and scattering of radio waves by precipitation particles such as rain. The millimeter wave charged wave suffers strong attenuation due to these absorption and scattering phenomena, and its use is severely restricted. Even in the quasi-millimeter-wave band whose wavelength is longer (or lower in frequency) than the millimeter-wave charged wave, the effect of rainfall is a serious problem, but it is even greater in the millimeter-wave band.

1 Absorption by atmospheric molecules

About 20% of the atmospheric composition near the ground is oxygen, and as shown in Fig. 1, oxygen molecules have strong absorption bands (or absorption lines) near the 60 GHz band and 118 GHz. In addition, water vapor is contained in the atmosphere, and water vapor molecules have strong absorption lines near 22 GHz, 183 GHz, and 325 GHz. These oxygen molecules and water vapor molecules are mainly responsible for the atmospheric absorption of millimeter-wave charged waves. In addition to these, absorption lines due to trace gas components in the atmosphere such as ozone, carbon monoxide, nitrous oxide, and chlorine oxide. Is also in the millimeter wave band. Absorption by these trace gas components is negligible and is not a big problem, but from the standpoint of remote sensing or radio astronomy, these absorption lines have important meanings.

In general, considering the absorption characteristics as shown in Fig. 1, it is desirable to select a frequency band in which absorption by atmospheric molecules is small, that is, a frequency range of a so-called atmospheric window, for transmission such as communication. Conversely, when using the interaction between the atmosphere and radio waves, such as remote sensing of the atmosphere, it is desirable to select each absorption band (or line). Radio waves in the absorption band (60 GHz band) may be used for intersatellite communication because no interference occurs even if the same frequency is used in the terrestrial system and the space system. Further, in the absorption band, the propagation distance of radio waves becomes short, so there is a possibility of short-distance high-density communication without interference even at the same frequency.

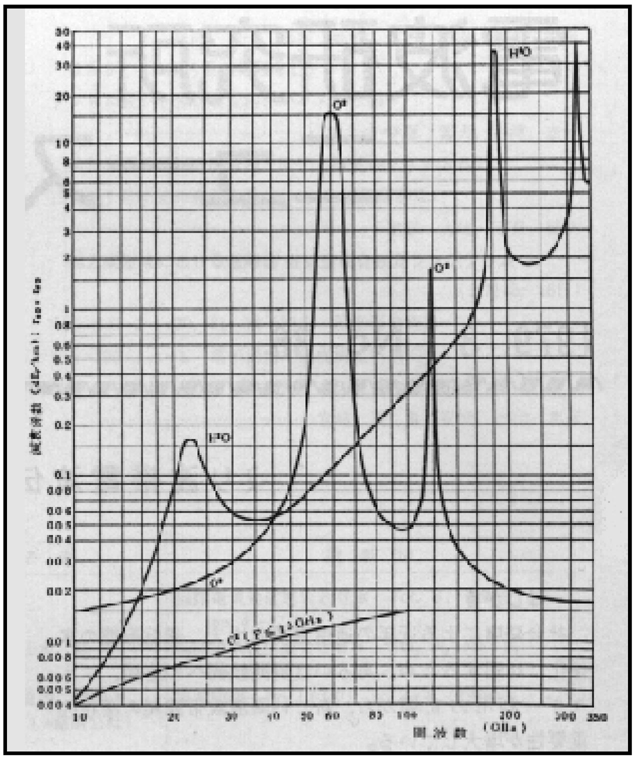


Fig. 1 Attenuation characteristics due to absorption of water vapor and oxygen molecules (pressure: 760 mmHg, temperature: 20°C, water vapor: 7.5 g/m^3)

2 Effect of rainfall

Millimeter-wave charged waves are affected by the precipitation, such as rain, snow, and hail, in their amplitude, phase, and polarization. Among them, the effect of rainfall is the largest. Figure 2 shows the frequency dependence of the attenuation coefficient for rainfall intensity. The damping coefficient increases dramatically with increasing frequency. In the frequency band above 30 GHz, even if the rainfall has the same rainfall intensity, the attenuation will be different if the number distribution of raindrops (rainfall grain size distribution) differs. This is because the millimeter wave electrification wave has a short wavelength, and the scattering attenuation due to small raindrops that make little contribution to rainfall intensity is significantly increased.

The rainfall attenuation of millimeter-wave charged waves changes depending on the rainfall intensity, and the attenuation is generally much larger than in the microwave band. The above-mentioned attenuation of radio waves due to atmospheric gas absorption can be mitigated by selecting the frequency band of the atmospheric window, and the amount of attenuation can be predicted to be almost constant (absorption attenuation due to water vapor depends on the amount of water vapor). Although it fluctuates, the amount of water vapor in the atmosphere fluctuates slowly and can be easily predicted). On the other hand, millimeter-wave attenuation due to rainfall cannot be avoided at any frequency, and it differs significantly depending on the type of rainfall (drizzle, thunderstorm, typhoon rainfall, etc.) and cannot be easily predicted. Rainfall varies in nature by region and also by season or year. Therefore, in order to understand the millimeter-wave band rainfall attenuation, it is necessary to elucidate the statistical correspondence between radio waves and rainfall. As can be seen from Fig. 2, the amount of rainfall attenuation in this frequency band is large, and the range of radio waves is significantly limited. Therefore, in order to use this frequency band for communication and maintain the same line quality as in the microwave band, the relay distance must be made extremely short. This is a major limitation on the use of millimeter wave.

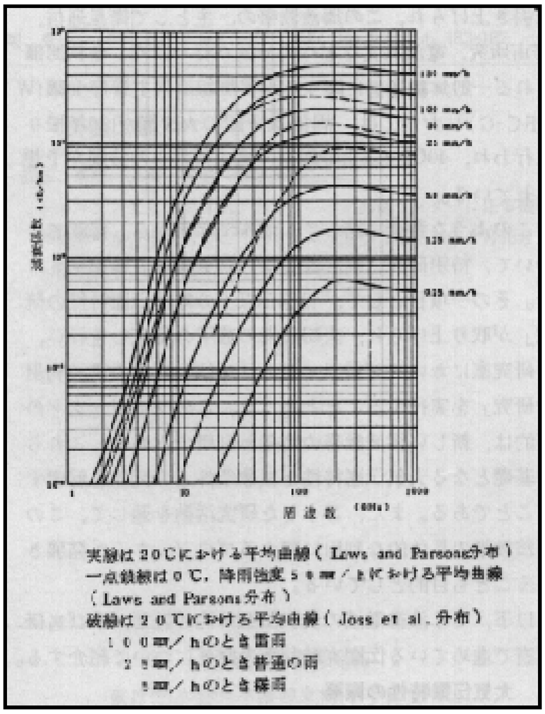


Figure 2 Frequency characteristics of rain attenuation

Outline of Millimeter-Wave Propagation Experiment Plan

Due to the revision of the mechanism in June 1972, the "research on millimeter-wave atmospheric propagation" that was being carried out at the former ultra-high frequency laboratory was canceled. Since then, horizontal propagation experiments in this frequency band have stopped. During this period, a study was conducted on rainfall attenuation prediction in oblique propagation paths using a millimeter wave radiometer. Also, as is well known, measurement of rainfall attenuation in oblique propagation paths is currently being performed using radio waves from actual satellites. Therefore, when resuming the millimeter wave propagation experiment, we will follow the propagation experiment plan for the 35 GHz, 70 GHz, and 140 GHz bands that was conducted or planned 10 years ago, and also relate it to the ETS-II ground and satellite propagation experiment plan. With this in mind, we selected frequencies and organized a transmission/reception system for propagation experiments.

As shown in Fig. 2, the relationship between rainfall attenuation of millimeter-wave charged waves and rainfall is qualitatively well known. The problem is that we do not understand the quantitative relationship between the two. For this reason, the relationship between millimeter wave rainfall attenuation and rainfall is observed throughout the year, the statistical relationship between the two is clarified, and the millimeter wave rainfall attenuation is predicted from the statistical characteristics of rainfall such as rainfall intensity and rainfall particle size distribution. We aim to develop law.

1 Frequency selection

There are two standpoints in clarifying the atmospheric propagation characteristics of millimeter wave charged waves. The first is to elucidate the propagation characteristics during rainfall in the frequency range corresponding to the so-called atmospheric window in order to perform communication or remote sensing using the frequency band that is less affected by atmospheric gas. The other is to clarify the absorption and emission characteristics of these atmospheric gases in order to perform remote sensing of these atmospheric gases in the frequency range where they are strongly absorbed. In this project, the frequency band corresponding to the atmospheric window is selected as a starting point in order to clarify the propagation characteristics during rainfall, which is the most serious problem in the use of millimeter-wave radio waves.

As can be seen from Fig. 2, the rainfall attenuation in the millimeter wave band increases monotonically with frequency up to around 150 GHz. Therefore, in each frequency band of 25 to 50 GHz and 70 to 100 GHz, which corresponds to the window of the atmosphere, if one wave is selected as a representative and simultaneously tested, the attenuation characteristics during rain over these frequency bands can be grasped. From the latter frequency range (70 to 100 GHz), select the 80 GHz band located in the center of the latter and relatively easy to manufacture experimental equipment. Also, from the former frequency range (25 to 50

GHz), in order to have a relationship with conventional horizontal propagation experiments and oblique propagation experiments (radiometer experiments and ETS-II millimeter wave propagation experiments), etc. From the standpoint of effective use, select 34.5 GHz using the ETS-II millimeter-wave propagation experimental device.

In addition, 11.5 GHz and 1.7 GHz are also used in the ETS-II millimeter-wave propagation experiment. In this project, the propagation characteristics at these frequencies are also acquired for comparison with the millimeter-wave band propagation characteristics. ..

2 Outline of experimental system

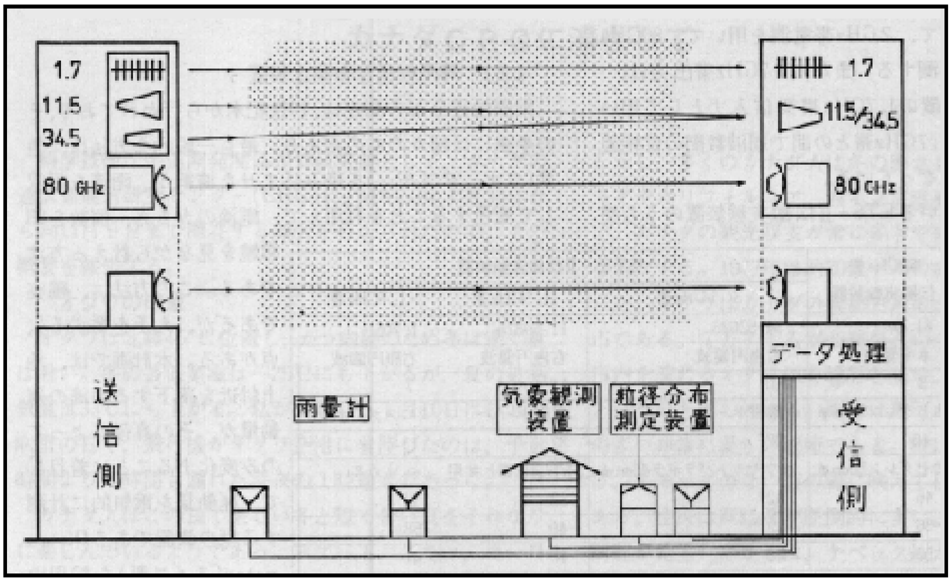


Figure 3 Conceptual diagram of radio wave propagation experiment system

In this project, in order to quantitatively elucidate the relationship between millimeter wave rainfall attenuation and rainfall using an experimental system as shown in Fig. 3, an experiment will be conducted from April this year on a 24-hour day basis for a year. .. This experimental system consists of five subsystems: radio wave propagation experimental equipment, rain gauge network, rainfall particle size distribution measurement equipment, meteorological observation equipment and data processing equipment.

Among the radio wave propagation test equipment, the transmitter is installed on the roof of the Central Research Laboratory of Hitachi, Ltd. (about 48m above ground), and the receiver is on the 5th floor of the 3rd Research Building (about 20m above ground). It is installed. The propagation distance is about 1.3 km. A large number of rain gauges will be installed in the area within a few kilometers of this propagation path. Currently, we are preparing to install two locations in the main office, one each in the premises of the Kokubunji Telegraph and Telephone Office of the Electric Power Company, JNR Central Railway Academy, and Tokyo Keizai University. Since the locations will be maintained, a total of 7 rain gauge networks will be created. Data from other than the main office is transmitted using the company's dedicated line. All of these are prompt response type rain gauges and will be compared with a tumble-drop type rain gauge. This rain gauge is incorporated as one sensor in the meteorological observation device. In addition to rainfall, this device has the function of continuously measuring wind direction, wind speed, temperature, humidity, and atmospheric pressure, and recording them in self-record. In addition, a Distrometer is available to measure the rainfall particle size distribution. All of these data are recorded on magnetic tape by the data processor (OKITAC-4300C system) installed in the reception room. This tape is processed by our large-scale computer. Table 1 shows the main measurement items. Below, the radio wave propagation experimental device and the rainfall particle size distribution measuring device are described.

電波伝搬実験装置	1	81.84GHz	主偏波レベル
	2	34.5 GHz	〃
	3	〃	交差偏波レベル
	4	〃	主偏波交差偏波間位相差
	5	11.5 GHz	主偏波レベル
	6	〃	交差偏波レベル
	7	〃	主偏波交差偏波間位相差
	8	1.7 GHz	主偏波レベル
	9	34.5/11.5 GHz	周波数間位相差
	10	1.7/11.5 GHz	〃
	11	81.84/11.5 GHz	〃
雨量計	12	雨量 No.1(本所)	(即応型雨量計)
	13	〃 No.2(本所)	〃
	14	〃 No.3(国分寺電報電話局)	〃
	15	〃 No.4(国鉄中央鉄道学園)	〃
	16	〃 No.5(東京経済大学)	〃
	17	〃 No.6	〃
	18	〃 No.7	〃
降雨粒径分布測定装置	19	降雨粒径分布	
気象観測装置	20	風向	
	21	風速	
	22	気温	
	23	温度	
	24	雨量	(転倒枡型雨量計)
	25	気圧	

Table 1 Main observation items

(1) Radio wave propagation test equipment

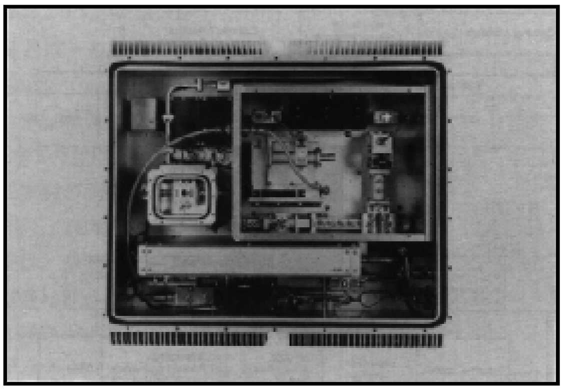
This equipment is composed of a newly installed 80 GHz band propagation test equipment and an ETS-II propagation test equipment that is partially modified or added to the receiving antenna section, etc., and its main specifications Is shown in Table 2.

諸元 \ 装置名		80GHz帯伝搬実験装置	ETS-II伝搬実験装置		
			34.5GHz帯	11.5GHz帯	1.7GHz帯
使用周波数(GHz)		81.84	34.52625	11.50875	1.705
送信偏波		水平偏波	右旋円偏波	右旋円偏波	右旋円偏波
送信出力(dBm)		3	10	12	7
送信アンテナ	型式	カセグレン50cmφ	電磁ホーン	電磁ホーン	クロスダイポール
	利得(dB)	46	22	22	13
受信アンテナ	型式	カセグレン50cmφ	オフセットパラボラ45cmφ	34.5GHz帯と共用	ヘリカル
	利得(dB)	46	42	33	11
晴天時受信電力(dBm)		−36	−52	−49	68
降雨マージン		50	40	40	40

Table 2 Main specifications of transmission/reception system

The features of the 80GHz band transceiver are as follows. (1) Both the transmitter and receiver are completely solidified and have improved reliability such as temperature stability and weather resistance. (2) The same frequency (106.5625MHz) as the ETS-II propagation experimental device is used as the original oscillation frequency of the transmitter/receiver, and it can be driven by an external local oscillator. (3) Since the method in which the transmission frequency is 768 times the original oscillation frequency is used, frequency stability is improved and a wide measurement range can be secured. (4) The receiver shall be of a type similar to a frequency converter that obtains two second intermediate frequency outputs of 1.7 GHz band and 2.1 GHz band from 80 GHz band input. Therefore, the level fluctuation in the 80 GHz band is measured using the 2 GHz electrification measurement. In addition, the 1.7 GHz band output is used as the 1.7 GHz band receiving input of the ETS-II propagation experimental device, and the phase difference between frequencies with the 11.7 GHz band can be measured.

The receiving part of the ETS-II propagation experimental equipment used in this project was partially modified from the ground receiving facility used for the ETS-II millimeter-wave propagation experiment, except for a part of the antenna and feeding system. It was prepared. Moreover, the beacon oscillator for calibrating the 10 mφ millimeter-wave antenna is used as it is for the transmitter.



Inside of 80GHz band receiver

(2) Rainfall particle size distribution measuring device The measurement of

raindrop particle size distribution has been performed since the end of the 19th century, and there are various methods. The most common method is to count the size and number of raindrops while observing with a microscope by utilizing the fact that a filter paper impregnated with a dye (water blue) absorbs raindrops and changes color. Although this method is reliable, it has the drawback of requiring manpower. In this project, focusing on the fact that the momentum of raindrops that fall near the ground changes only with its diameter, we decided to use Distrometer (made in Switzerland), which is a device that electrically measures momentum. This device divides raindrops with a diameter range of 0.3 mm to 5 mm into 20 channels and can count the number of raindrops in each channel every unit time (for example, 1 minute). Accuracy of measurement of raindrop diameter is ±5%. This device is expected to play a major role in elucidating the rainfall particle size distribution and millimeter wave rainfall attenuation characteristics.

Postscript For the

time being, we will proceed with experiments centering on two millimeter-wave bands, but from 1979, the study of radio wave propagation characteristics above 40 GHz was extended to a seven-year plan, and from July this year, our laboratory Since the name will be changed to the Ultra High Frequency Propagation Laboratory, we are currently studying propagation experiments in the 150 GHz and 250 GHz bands as the next step. From the viewpoint of manufacturing the device, it is expected that the propagation experiments at these high frequencies will be very difficult. However, if the propagation experiments in these frequency bands can be performed and quantitative data can be obtained, this kind of experimental plan will be completed. It is thought that.

In this experiment plan, the emphasis is on elucidation of atmospheric propagation characteristics of millimeter-wave charged waves, especially rain attenuation characteristics, and it is intended to obtain objective data. These results can be greatly contributed to CCIR, etc., as they are globally useful as basic data for communication line design or frequency distribution. Regarding general use of millimeter-wave radio waves, we would like to continue the trend research.

We have been preparing for about two years to restart the millimeter wave propagation experiment, but the experiment has finally begun in FY54. In the meantime, we would like to thank the Radio Control Bureau and all the parties concerned for their great guidance and support for the start and development of this project. We would like to thank Hitachi kk Central Research Laboratory, Kokubunji Telegram Telephone Station, JNR Central Railway Academy, and Tokyo Keizai University for their cooperation in installing the transmitter and rain gauge. As we continue to carry out propagation experiments over the next few years, we ask for the continued support of our stakeholders, as well as our efforts.

(Yoji Furuhama, Director, Radio Meteorology Laboratory)

Stay in Canada CRC

Hiroshi Kojima

As an overseas researcher for space development related to the Science and Technology Agency, I was given the opportunity to stay at the Communications Research Center (CRC) of the Ministry of Communications of Canada from January 10 to November 9, 1978, so I will report the outline. ..

Impressions of

Ottawa Ottawa is located at a latitude of 45° north and is inland, so it is cold in winter and hot in summer. The lowest temperature in winter drops to -25℃, but the highest temperature in summer rises to 33℃. January 10th, when I arrived, was a terrible snowstorm, and the plane landed at Ottawa Airport at 1:00 am, which was four hours behind the scheduled time.

Canadians seem to enjoy this long, harsh winter and short, hot summer for some reason. Winter sports such as skating, skiing and car-risig are very popular. In summer, enjoy swimming, canoeing, sailing, camping, etc. However, many Canadians dislike the cold winter and spend vacations in southern Florida, California, the West Indies, etc., so I feel that Canada's tourism balance is always in the red. In 1977 it was about $2 billion in deficit. Ottawa is the capital of Canada but a small city with a population of 310,000. It is also the town of officials, with 77,000 civil servants. It borders the town of Hull in Quebec with the Ottawa River flowing through the city as a boundary. It is a very beautiful city with many canals, parks and green areas. Especially, the green of spring and the colored leaves of autumn shine against the blue of the sky without smog. The majority of residents are English speakers. Since the independence problem in Quebec, the number of English Canadians migrating from Quebec to Ontario has increased, which indirectly boosted Ottawa's price index. The main reason why Ottawa's prices are high may be due to the economic situation in which imported goods, which account for a considerable portion of everyday goods, have gone up in value as the value of the Canadian dollar has declined.

Canadian Space Development

The structure of space development in Canada is shown in Figure 1. Interdepartmental Committee on Space (ICS), which was established in 1969, coordinates the ministries. The ICS is an organization responsible for the Minister of Communications, and the current Chairman of ICS is also Dr. JH Chapman, Assistant Secretary for Space Affairs of the Ministry of Communications. The ICS has three subcommittees, each of which examines the industrial, international, and scientific aspects of space policy.

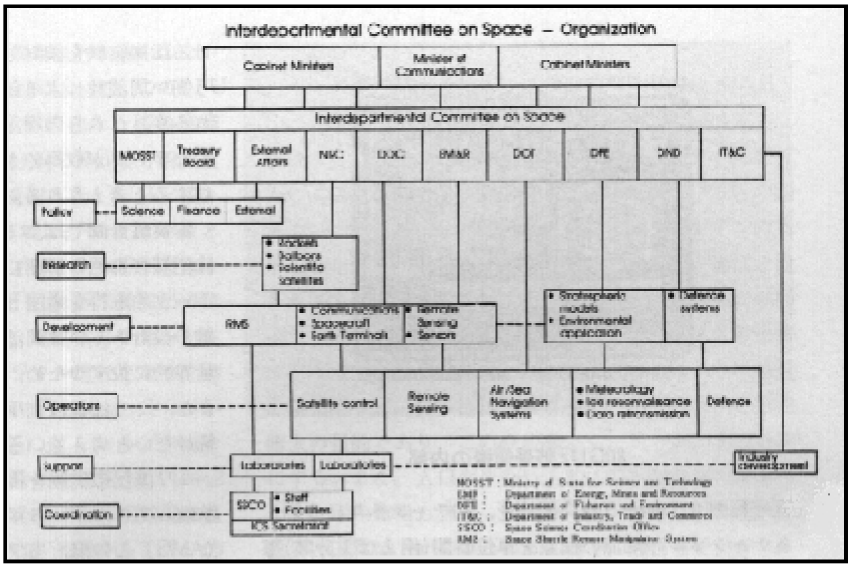


Figure 1 Canadian Space Development System

The government's space budgets for both 1977 and 1978 fiscal years are shown in the table. The total expenditure in fiscal 1978 was about 100 million dollars (20 billion yen), of which the Ministry of Communications (D0C) and NRC (National Research Council) accounted for the majority, each of which was about 40 million. It is a dollar (8 billion yen).

Total government space expenditures (million dollars)
(by department)

	1977/78 A	B	C	Total	1978/1979 A	B	C	Total
Communications	14.4	4.6	3.4	15.4	33.5	6.0	0.4	39.9
National Research Council	31.7	—	1.3	33.0	35.4	—	1.3	36.7
National Defence	0.1	2.6	3.6	3.3	0.1	5.5	1.9	7.5
Energy, Mines & Resources	—	1.5	3.1	4.6	—	1.7	2.9	4.6
Industry, Trade & Commerce	0.8	9.8	—	1.0	1.7	4.7	—	6.4
Fisheries & Environment	—	0.5	2.0	2.5	—	0.6	2.0	2.6
Transport	0.1	0.6	0.1	0.8	.05	0.2	0.2	1.0
Total	47.2	10.6	7.4	65.2	71.4	15.8	8.6	95.8

A: Space systems
B: Ground stations & earth terminals
C: Data processing & analysis

Table Canadian Government Space Relations Budget

DOC's main spending was on ANIK-B (successful launch on December 14, 1978 with Delta rocket), and NRC's main spending was on RMS (Remote Manipulator System) for space shuttle. It is a thing.

Outline of research at

CRC CRC is located about 25 km west of downtown Ottawa, in a very quiet area near the Ottawa River. Officially, the name of the place where the research facility is located (Shirley Bay) is taken by the Shirley Bay Research Center. It is called. There are about 500 employees, of which about 100 are JDOC, a manufacturer's employee who contracts with DOC, was reorganized in November 1974, and the structure is as shown in Figure 2.

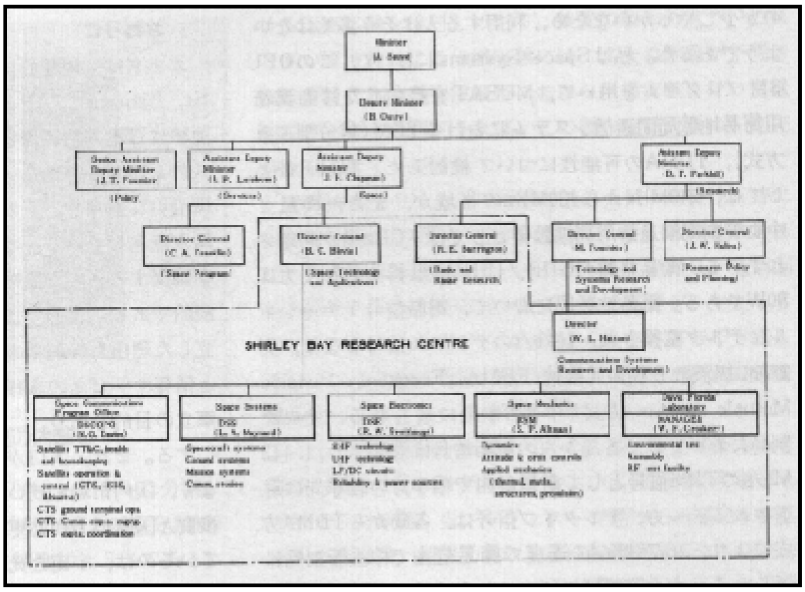


Figure 2 Organization of DOC (Communications Canada)

In space, there is Director General of Space Technology and Applications, where there are 4 Directors and 1 Manager. The David Florida Laboratory is a facility for various satellite tests and assembling, and is equipped with four thermal vacuum chambers, vibration test equipment, a radio wave non-reflective room, and a satellite assembly clean room. The largest space chamber has a diameter of 3 m, a height of 9 m, and a test temperature range of -195°C to +150°C. The size of the non-reflective chamber is 7m x 7m x 7m, and the reflection coefficient is -50dB or less in the frequency range from 1GHz to 20GHz. The size of the satellite assembly room is 30m x 12m x 10m. Currently, in the space chamber, an RMS engineering model developed by NRC and manufactured by SPAR Technology is being tested. The detailed design examination was completed in 1978, and the first flight model was to be handed over to NASA in July 1979. Space Mechanics is engaged in the development of high-power solar panels of 2kW to 10kW, research and development of satellite antenna pointing/control technology, and satellite orbit/attitude control dynamics. Space Electronics is developing communication equipment for satellites and power supplies, and developing small earth stations in the SHF and UHF bands. Above all, we are particularly focusing on improving the performance and reliability of GaAs FET devices. In addition, analysis of Electrostatic charging of triaxial satellites is also being conducted. Space Communications Program The office is usually called SCOPO, and there are 21 earth stations in total, which are used for the CTS experiments, where CTS operations and CTS and ANIK-B experiments are coordinated. The antenna diameters are 9m, 3m, There are 4 types, 2m and 1m. All of these earth stations are procured and owned by the DOC and will be moved to the test site and installed according to the test items. In the ANIK-B experiment, he wanted to increase the number of earth stations to around 30. Space Systems, to which I belong, has conducted CTS (1976 In addition to the implementation on January 17th), he is in charge of MUSAT (Multipurpose UHF Satellite) and SARSAT (Search And Rescue Satellite). MUSAT intends to provide services such as telephone and telex in the UHF band to aircraft, ships and land stations using satellites, and has already completed feasibility studies and various types of final specifications. Research studies and experiments are being conducted. SARSAT is a joint project with the Department of Defense (DND) and is used to determine the location of distressed aircraft and ships faster and more accurately. This project is a joint project of the United States (NASA), Canada (DOC), France (CNES), and the Soviet Union, and Canada is in charge of developing a satellite-based repeater. We are also prototyping an ELT (Emergency Locator Transmitter). MUSAT is expected to be launched in 1982, and SARSAT will be demonstrated in 1981. OFUSM (Orbit There is a simulation program for space communication systems called Frequency Utilization Simulation for Mobile Service), which is built into the CRC computer system. This is a model that quantitatively calculates the line design and the amount of interference in the space communication system from 200MHz to 20GHz according to the type of baseband. It is very effective as a tool. However, it seems that there are not many people who use it because it is a little too huge and it is a little difficult to handle. At Space Systems, using this OFUSM program, I examined the possibility of TDM (Time Division Multiplexing) and TDMA in a simple inter-earth communication system for mobile services via MUSAT. The UHF band is expected to be in the range of 240 MHz to 400 MHz, and the frequency band for communication between the satellite and the central control station is the 7 GHz band. The saturated output of the SHF/UHF repeater onboard the satellite is 80W. At the simple earth station, one channel of the telephone signal is delta-converted into a digital signal of 16 kb/s, which is then modulated and sent to the central control station by the frequency division multiple access (FDMA) method. At the central control station, the telephone signals from each station are demodulated and transmitted as 1.442 Mb/s TDM signals via satellite to the other earth station. On the other hand, teletype signals are sent from each station to the central control station via satellite at a rate of 16.75 kb/s by the TDMA method. At the central control station, these teletype signals are demodulated, combined with the telephone signal and then 1. It is sent as a 442 Mb/s TDM signal to the other earth station. The transmission power of the earth station is 25 W, and the antenna gain is expected to fluctuate from 13 dB to 0 dB, but 13 dB was used in the calculation. The telephone signal threshold was set to 10^-3 and the teletype signal threshold was set to 10^-5. Signal quality depends greatly on the earth station antenna gain and propagation conditions.

CRC panoramic view

The 4th ICDS (Internationl Conference on Digital Satellite Communicatons)

was held at the Queen Elizabeth Hotel in Montreal, Canada, from October 23 to 25, 1978, and from more than 27 countries around the world, 449 First name attended. The breakdown is Canada (179 people), United States (166 people), France (28 people), Japan (13 people), Italy (9 people), England (7 people), Germany (7 people), other countries (40 people).

The author also read one report on the CS digital transmission experiment. At the award of the best papers from the previous meeting that started from this meeting, papers on NEC kk's band compression digital TV (NETEC) were selected and introduced at the dinner on the first day of the event. What is noteworthy about this conference was that nine Chinese representatives participated as observers, so simultaneous interpretation in Chinese was provided in addition to English and French. They were enthusiastic about every occasion such as receptions, coffee breaks, maker's exhibitions, and excursions, which was enough to make them feel their extraordinary motivation.

in conclusion

Geographically, Canada has five characteristics: Mountain, Prairie, Shield, St. Laurence, and Atlantic. With an area of about 27 times the size of Japan, there are only 22.4 million people. It is a country with only a population. The cities are scattered along the border with the United States, and are also dotted with Eskimo and Indian communities. In such countries, satellite communication is extremely effective and economical in terms of securing communication means. We can understand why we established the first practical satellite communication system in the world. In Japan, the purpose of establishing a satellite communication system is to diversify communication means and information services, and to improve reliability. In this respect, the situation is different from Canada. Also, because of the small population, the number of technologists is small and the domestic market is narrow. Therefore, selective investment and international cooperation are inevitable. Currently, the Ministry of Communications is focusing on space, optical fibers and lasers. Regarding space, DOC is in charge of electronic communication and NRC is in charge of mechanical. In order to strengthen international competitiveness, these two are integrated to form a new National Development Agency. There is a debate that there should be an immediate establishment. In terms of international cooperation, it is natural that the cooperative relationship with the neighboring United States is the closest. This is clear if you look at the production and experiment of CTS and the development method of the space shuttle RMS. However, recently, it seems that they are expecting partnerships with ESA (European Space Agency) and Japan. As an example, we are negotiating with ESA on a plan for Canada to manufacture H-SAT transponders and antennas.

This is the end of the return report. Although it was a short period of time, it was very meaningful to be able to have a family relationship with people from different cultures. We would like to thank you for giving us the opportunity to be dispatched as an overseas researcher, and we would like to express our sincere gratitude to all those who have taken care of us.

(Researcher, Communications Satellite Laboratory, Satellite Research Department)

About type verification of transmitters for mini satellite stations

Communication Equipment Department

Introduction

Due to the amendment of the wireless equipment type certification rules by the Ministry of Posts and Telecommunications Ordinance No. 15 dated July 7, 1978, a transmitter for mini satellite stations was newly added to the models subject to type certification, and came into effect in August of the same year. Along with this, we started accepting application for inspection in September last year, and four companies currently manufacturing with NHK specifications have applied for inspection of the M-01 type mini saté device, and passed on December 26 of the same year. I will take this opportunity to outline it.

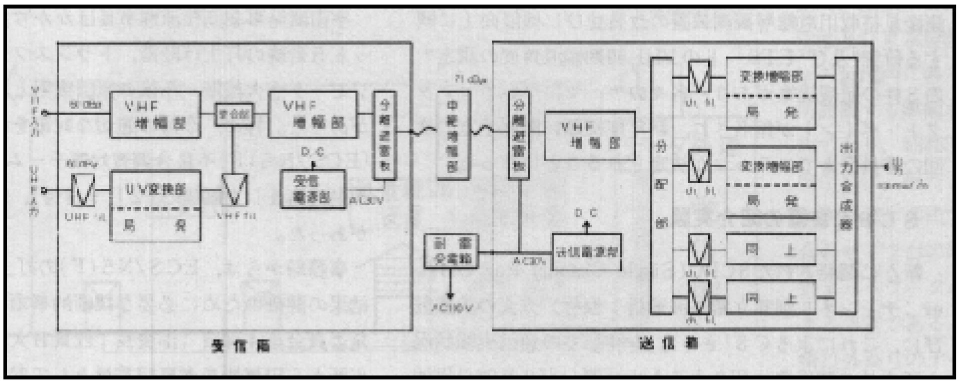
Background to the implementation of the type certification The

mini-sat device is the name of the relay device of the extremely low power television broadcasting station of 100 mW or less, which is assigned the frequency band of 590 MHz to 770 MHz. This time, the target of the type verification is the part corresponding to the transmitter of this device. Minisate stations are very simple relay stations that are set up as a solution to the difficult-to-view areas of less than 300 households, which are in closed areas due to radio wave propagation, such as mountainous areas, and cannot receive sufficient TV viewing services. It is a broadcasting station. In December 1975, the Ministry of Posts and Telecommunications revised the relevant ministerial ordinance and introduced a minisate station as a measure to eliminate difficult-to-view areas. On the other hand, the broadcasting station also made diligent efforts to reduce the cost of the mini-sat device, but due to the increase in required costs, etc., it was not possible to meet the demand for early installation from many areas. Under such circumstances, the problem of eliminating difficult-to-view areas was taken up in the Diet in October 1976 and the following March

1977, and the Radio Control Bureau decided to introduce a type certification for the mini-sat device. Have asked for cooperation. In this way, we examined the test method of this equipment, proceeded with the preparation of the necessary test equipment, and revised the related regulations at the Radio Control Bureau and conducted the type verification.

Outline of transmitter for mini satellite station

The mini-satellite device has (1) a receiver installed on the top of the mountain in order to receive TV radio waves from the parent station (satellite station, etc.) in a high electric field, and the transmitter that performs frequency conversion and amplification avoids interference with others. For this purpose, there are two methods: a transmission/reception separated type installed in the lowlands in the service area, and (2) a transmission/reception non-separated type that performs transmission/reception at the summit, and the former is the main body. This section gives an overview of the transmission/reception separation type that is widely used. (See schematic diagram)



Transmission/Reception Separation Mini Sat

In addition to the frequency conversion method described above, there is also a booster method that receives the TV radio wave from the master station and only amplifies and transmits it as is in the minisat device, but this method is subject to type verification. Was removed.

VHF or UHF TV radio waves are received at the summit where a required level (receiver input 60 dBμV) is secured, UHF TV radio waves are converted to VHF and then amplified, and VHF TV radio waves are usually It is amplified as it is and transmitted to the transmission point with a cable. The transmitted TV signal is once amplified to the required level, and then split into arbitrary channels by the distributor and channel filter. The demultiplexed signals are sent to each VU converter/amplifier, converted to the required UHF band frequency, then combined into four waves by the output combiner, and sent from one antenna.

Technical standards and test results

The type verification test targeted non-separated and separated transmitters of the frequency conversion method, and the test items were also limited to the minimum required for radio wave supervision. Regarding electrical performance, a test was conducted to determine whether or not the following conditions specified in Ministry of Posts and Telecommunications Notification No. 502 were satisfied. 20 minutes after starting, (1) Frequency deviation shall be within 10kHz in the range of ambient temperature change from -10℃ to +40℃. (2) Spurious emission intensity shall be 1 mW or less. (3) Deviation of antenna power shall be +50% upper limit and -50% lower limit for video transmitter, and 4% or more and 50% or less of the specified antenna power of video transmitter for audio transmitter. Environmental tests (temperature -10℃ to +40℃, relative humidity 95% at +35℃), power supply voltage fluctuation test (reference voltage ±10%), and performance test in continuous operation for 8 hours were performed for these three items. As a result, the frequency deviation was sufficiently below ±3kHz. The spurious emission intensity was designed to be -55 dB or less within the specified channel and -23 dB or less for the other, relative to the rated output, and the test result was a maximum of several μW compared to the standard of 1 mW or less. The antenna power of the video transmitter was about ±30% with respect to 100 mW at high and low temperatures, but most of the antenna power was within ±10%, and the antenna power of the audio transmitter was lower than that of the video transmitter. On the other hand, it was 20 to 30%.

Since

the conclusion of the conclusion test was that each company had already gained manufacturing experience, it was pleased that they satisfied the criteria sufficiently. In the future, the type verification will eliminate the problem of out-of-the-range hearing and improve the performance of the mini-sat device evenly. I hope it helps. At the time of this type approval, with the cooperation of NHK, we started a field survey of the minisate bureau and noted that the fact that we had a sufficient preliminary survey was extremely effective in examining the test method and proficiency, and we appreciate your cooperation. We would like to express our deep gratitude for the guidance and support of the various organizations and related parties.

Short message

Holding a joint research committee with the Japan Space Agency

The Joint Research Committee for the above was held on February 22nd at the headquarters of the corporation, and 23 persons from the corporation to the deputy director Suzuki and below, and 18 persons from the office to director Tao and below attended the introduction of both budgets for 1979. After that, the progress of joint research in 1978 (for the theme, see this News No. 30 brief report) and the planned theme for 1979 were discussed.

Research themes for 1979 are "Research on communication satellite repeaters", "Research on tracking and control and data relay satellites (TDRS) using intersatellite communication technology" and "Research on satellite attitude detection method using laser". Was approved by continuing the three cases. In addition, the business group requested a continuation of "Research on test evaluation methods for microwave radiometers", and from this institute "Research on active remote sensing", "Research on improvement and function enhancement of ionospheric observation equipment for observation satellites" There are three new proposals, "and measurement of VHF initial polarization angle of ETS-II", contact points are appointed for each theme, and the theme will be decided by the next committee scheduled to be held at the beginning of the new year. It was decided.

SCPC device introduction experiment

An event to introduce the newly developed SCPC (Single Channel Per Carrier: device independent carrier communication: tentative name) system and the communication experiment status via the CS "Sakura" to related parties inside and outside the facility. Was held at the Radio Research Laboratory headquarters on February 23. On the day of the experiment, an antenna with a diameter of 2 m including a transmitter/receiver was installed in the south yard of Building No. 3, an indoor device was installed on the first floor, and a CS quasi-millimeter wave band (30 GHz/20 GHz) repeater was used to counter Kashima main station and return satellite In the form of Eru-Lube, it was mainly used for telephone calls, faxes, and still image transmission. The event was open to the public in the morning, and in the afternoon, it was a study group color inviting some people from internal and external related organizations who are deeply involved in the CS experiment. In addition to the SCPC experiment, the TV reception experiment situation by BS "Yuri" was also introduced.

On the day of the event, light rain fell from the morning, and it was feared that there would be an outbound visitor, but the number of participants was close to 100, and the meeting ended with a lively discussion.

Deliberation of the Space Development Commission regarding the "Ayame" defect

Regarding the title, the 4th Space Development Committee (temporary meeting) was held on February 10, 1979.

Chairman Matsuura and others of the Space Development Agency reported on the launch stage, transfer orbit stage, apogee motor ignition stage, future cause investigation and countermeasures for ECS/N-I rocket No. 5. In particular, in order to consider appropriate future measures, we will form an “ECS/N5(F) defect investigation measures team” (general manager: Vice Chairman Suzuki) (February 9), and report on the measures to be taken. was there.

From the secretariat, regarding the technical matters necessary for the launch of ECS/N5(F) and the evaluation of tracking and control results, the Space Development Commission 4th Section (Chairman: Sanuki Nihon Univ. It was decided that there was a proposal to refer the deliberation by the end of mid-March to Director Tao (participating as a technical committee member).

In addition, the Ministry of Posts and Telecommunications requested that the spare aircraft be launched as soon as possible.

Technical assistance to the Kingdom of Jordan

In promoting the plan to establish the Electronics Service Center of the Royal Academy of Sciences of Jordan, Japan requested a request from the Kingdom of Jordan, and in February 1977, a report of a study team headed by Shozo Hayami, a radio wave supervision station dispatched to the Kingdom. Based on the above, various kinds of assistance such as provision of necessary electronic measuring instruments, acceptance of technical trainees, and technical guidance by dispatching experts from Japan will be provided. Thus, in November of the same year, an implementation consultation team headed by Mr. Hayami was sent to the Kingdom again, and a concrete way to proceed as a three-year plan was agreed, and at the end of last year, various measuring instruments etc. of the first year plan were already announced. Shipped to the Kingdom.

In order to provide technical guidance necessary for operation and maintenance of equipment at the training center of the above center, Watanabe and Ueda, Senior Research Investigators of the Equipment Division, Communications Equipment Department, will conduct on-site confirmation of shipped equipment and provide guidance on operation methods. ， As a specialist based on the agreement between the two countries, I was dispatched to the Kingdom from February 13 for 45 days.

The Japan International Cooperation Agency will be responsible for the compilation and promotion of this plan.