Use of Satellite Telecommunications for Telemedicine

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DEAR COLLEAGUES,

The use of space telecommunications facilities in the interests of medicine (in a broad sense) should establish a reliable and timely connection between the specialists involved and access—for each of them—to information sources they need.

Since a certain global-scale program should be implemented for this goal to be achieved, one of the top-priority tasks is to determine appropriate orbital facilities for telecommunications as well as appropriate areas and countries for them, outlining the territories where portable data receive/transport records can be placed and stations that are cheap and simple enough to operate can be stored.

Naturally this work should begin only after an appropriate conception is developed, as well as the technological optimization of the exchange procedure, of hardware compatibility, and after demonstration experiments are conducted, mainly by the U.S.A. and the U.S.S.R. Along with confirming—in practice—the possibility of implementing the scheme developed, the above experiments would also be of political significance: this would be an illustration of a joint humane work between the East and the West on the peaceful use of outer space and in the interests of all other states, which could be an impetus to other developed countries to join the program.

Eventually the satellite telecommunications system should encourage health workers to unite in a world community on the basis of a regular and efficient information exchange with the goal of protecting the health of man and the peace of Earth. This long-term goal could only be achieved by gradually removing differences in the domain of medical education and information in different regions over the globe, by providing a possibility of rapid and coordinated access to the information on medical problems of interest on the global scale, as well as by coordinating the discussion and solution of all problems associated with the development and progress of the satellite telecommunications system.

The satellite telecommunications system under development should obviously be global in terms of its coverage, with opportunities to involve users from any region; it should be a sufficiently flexible system, permitting the necessary information to be obtained in time to allow

decisions to be taken without impeding the solution of a problem; it should also be easily accessible, cheap, and simple from the viewpoint of a wide involvement of potential users.

Since the system should be developed with its prospects and growing number of potential users in view, then, in our opinion, all approved and implemented technical solutions should obey the priority development concept, which will help considerably to increase the life cycle of the system and also improve the system with minimal expenditures. We believe that the system should operate in two modes: 1) information servicing; 2) urgent medical consultation and assistance.

Besides, if the information servicing mode mainly implies the absence of stringent requirements on how prompt the system servicing is, the urgent consultation and assistance mode should be insured by the system's functioning, at least in certain types of operations, in real time. It goes without saying, of course, that normal consultation can be provided without specific requirements for prompt servicing.

In the context of the tragic events that have occurred in recent years on the planet, in particular in the U.S.S.R., especially the tragedy in Armenia, primary emphasis should be given to the mode of urgent international medical aid and consultation.

In our view, the analysis of events in Armenia, especially the analysis of the first stage of providing international medical assistance and the removal of aftereffects, makes the world community face the special problem of extraordinary calamities in any region of the globe, to be more exact, the problem of joint eradication of the aftereffects of these tragedies.

Unfortunately, by now the scientific foundations of organized rescue (especially international rescue) have not been developed enough for extreme situations; there has never been an organizationally well-developed engineering system relying upon advanced international expertise and incorporating at the more recent scientific and technological achievements, in particular those in the sphere of data acquisition and processing systems, and preparation of respective decisions.

The tragic events in our country (Georgia, Tadjikistan, Bashkirtostan) have confirmed the necessity of developing such a system: simple enough with a high factor of readiness for use; sufficiently versatile and adaptive to a wide range of possible extreme situations; applying a developed system of telecommunications, including space communication.

At present, different countries have different approaches to problems associated with providing international assistance in extreme calamities and eradicating the aftereffects of such calamities.

Obviously, the top-priority problem here is the exchange of results and the systematization of joint, coordinated, international actions in similar situations. We think that these activities should undoubtedly be associated with the results of similar trends of activities within such international organizations as the World Health Organization and the International Red Cross.

In all the cases mentioned above, a global system of satellite telecommunications is, in our opinion, a *sine qua non* means for informational interaction having an urgent assistance mode which still has no alternative.

There are still some problems along this road, but from the viewpoint of today's situation, all of them can be solved. The first necessity is a decision of coordinated activities approved by the U.S.S.R. and the U.S.A., which can remove all problematic questions of a juridical, organizational and financial nature.

An optimal structure of a dynamic organization is needed which could use in its operation—at the initial stage—the instruments now under development at least for some countries.

The foundations of the satellite telecommunications system under development should be scientifically analyzed in terms of systems approach, taking into account the component, structural, functional, integration and communication aspects. Here comprehensive consideration should also be given to all kinds of support: hardware, algorithms, software, information, organization, etc.

In our case, special attention could be given to the aspect of the system's evolutionary development, since individual fragments that can be used have been developed independently and autonomously, whereas they could acquire a new quality within the system discussed.

At the initial stage of the activity in the U.S.S.R. and U.S.A. the possibilities exist for efficiently using the systems developed earlier for other purposes, which still have some reserve. In particular, the use of the capabilities of the INTER-SPUTNIK and INTELSAT systems should make it possible to organize in the agreed time the regular exchange (for example, once per week) of news in medicine employing the principle of TV news exchange, to conduct planned or, if required, special TV bridges between the leaders of a program, or to do other procedures. In this case there are no technical problems, but it is necessary to solve organizational problems. The experience gained during operations with the INTELSAT ground-based station installed in Yerevan and used for performing joint consultations and TV bridges between the U.S.S.R. and U.S.A. conclusively confirmed the above considerations.

The designed mode of teleconferences using the Soviet space segment (GORIZONT spacecraft), the NAUKA Soviet ground-based station, and the U.S.A.-made compressed video permits TV bridges to be conducted regularly in the interests of the U.S.S.R. and the U.S.A. In principle, there is a possibility of using the COSPAS system in the interest of the program "Space for Health." This program envisions that the staff of medical offices in the potentially hazardous regions (in the sense of epidemic) should be supplied with emergency transmitters with information of the type "character and type of accident, hazard, epidemic, the size of calamity (the number of defeated people, the size of territory)" and so on.

Such transmitters could be used in medical offices of provincial towns in hazardous regions, which, if required, should be given to physicians sent to a region affected by calamity.

In the case of the agreement with the administration of the COSPAS system and, possibly, with the COSPAS-SARSAT system, emergency information of a medical nature could be quickly (within hours) transmitted to the appropriate medical centers for analysis and the organization of required efforts.

In the opinion of specialists at the initial stage about 500 modified portable personal transmitters could be put into operation with a keyboard to type an appropriate code that could work with 50 transmitters, not higher, in a zone with a radius of 2500 km.

If the user of the transmitter has the receiver/processor of signals installed which can operate at an AES transmitter frequency, used to receive and decode a digital flow with a rate of 2.4 Kbit/s, it is possible to organize the duplex exchange of information with the center using the principle of the packet-switched data communication with free access. For this option, however, it is necessary to develop and install on board the artificial Earth satellite an additional transmitter and appropriate antenna.

At present, it is planned to make the exchange by digital data flows, voice information, the organization of TV reporting and TV conferencing in the mode of compressed video using the NAUKA small portable modular station and its modifications designed in the U.S.S.R.

It is, however, only single problems, a certain backlog on the problem which can be solved using a multifunctional satellite telecommunication system whose base can be illustrated by the interesting presentation of Academician M. F. Reshetnev.

Proceeding from the conceptual viewpoint to certain problems of using satellite telecommunication systems in the interest of emergency medicine to particular applications, we would like to inform the conference about the experience in the design of the transcontinental satellite communication system with the compression TV mode in the interests of teleconferences over a mid-rate channel.

A possible technical base for the development of such a system is the presence of Soviet GORIZONTs on a stationary orbit, the NAUKA ground-based station, and American sets of compression TV for their use in the mode of teleconferences (appropriate slides are demonstrated). The GORIZONT spacecraft at the point of sight 14° W (STATSIONAR-4) ensures the coverage zone from the East Coast of North America to the Urals in our country.

So, the dialogue mode of a TV-bridge over the mid-rate channel with a rate of 384 Kbit/s is provided with the use of two NAUKA stations conjugate to the equipment of compression TV studies, one of which is located at Brown University (Providence) and the second is placed at the Space Research Institute (Moscow), U.S.S.R. Academy of Sciences, during operations over the ninth trunk (TV) of the space segment. According to the preliminary estimate the cost of service should be essentially lower (by several times) than that of the traditional TV-bridge with the help of analog television. At present more than 10 TV conferences were performed as experiments

between Brown University and the Space Research Institute. Scientists in space physics, medicine, students, university students, and other specialists participated in these conferences.

We accepted the responsibility of demonstrating the system discussed above at this conference. For this purpose a TV-conference session through Brown University was planned to be carried out today. In this case Brown University should have played the role of relay station. Unfortunately, this experiment was not approved at this conference.

The next stage planned for implementation during 6 months of 1992 envisages the switch-on of one to three studios in the U.S.A. and the same number of studios in Russia. After this, it will be possible to use the systems for different tasks as well as for medicine, according to the conditions which will be adopted in the next week.

We suggest that the tariff for the system's use in the interest of medicine be reduced.

Thus, except for letters, telefax, fax, and telephone we will have a new means of telecommunication servicing video conferences. As to medicine, it could increase the efficiency of education, consultations, medical advice, prompt conferences in emergency situations, and so on.

An interactive video conference with the use of satellite channels is the novel technology that is most promising for many fields of science, medicine, engineering, and business.

The participants in the project I have the honor to present here, would be very pleased if on a top-priority basis representatives of medicine—and space medicine as well—one of the most humane sciences, could use the results of their effort.