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Worldwide Report

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

(FOUO 14/82)

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USSR

ASSIGNMENTS FOR ELECTRICAL COMMUNICATIONS WORKERS, 1980-1985

Moscow ELEKTROSVYAZ' in Russian No 4, Apr 82 pp 1-6

[Unsigned article]

[Text] During 1981, the workers of the Soviet Union, in accordance with the resolutions of the 26th CPSU Congress, achieved further growth in the production and scientific-technical potential of the country, strengthening of its might and defense capability and multiplication of material and spiritual values.

The November 1981 Plenary Session of the CPSU Central Committee made specific plans for establishing a congress for the first half of the 1980s and indicated the ways to increase the economic potential of the country, improve the efficiency of the national economy and provide dynamic development on the basis of intensive factors. Particular emphasis was given the requirement of concentrating capital investments; further mastery of Siberia and the Far East; development of the economy of each republic; and observation of strict conservation of all types of resources.

This phase has put forth new requirements which can be met only through an energetic restructuring of management style, planning methods and the control system. In his speech to the November Plenary Session, comrade L.I. Brezhnev called upon the State Committee on Science and Technology, the USSR Academy of Sciences, Ministries and departments to carry out the resolutions of the 26th Party Congress to accelerate the utilization of the achievments of science and technology more energetically. He called the slow reduction in manual labor in the present demographic situation the root of all evil. An increasingly important condition for economic effectiveness in the light of more complicated inter-branch and intra-branch communications is coordinated work of all branches of the economy.

The social program is also extremely important today, including supply of foodstuffs and industrial goods, improvement of wages, residential construction, for which 93 billion rubles have been allocated, and satisfaction of the cultural and domestic requirements of the population.

It is from precisely these high positions that we must evaluate the results of the work of the communications branch during 1981 and determine prospects for further developments.

The main result of the first year of the 11th Five-Year Plan is the fulfillment of the basic planned assignments: communications production volume -- 100.9 percent, tariff revenues -- 100.7 percent, labor productivity, 101.2 percent (85 percent of the increase in communications production volume was achieved due to increased labor productivity.

Communications enterprises have accomplished a significant amount of work: over 0.5 billion telegrams were transmitted, about 1.5 billion long distance conversations were held, city telephone exchanges served 16.5 million subscribers, while rural exchanges served 3.6 million, 85 million wired-radio outlets were operating, 87 percent of the population was able to receive one broadcast television program, and 67 percent - two or more programs.

The assignment to increase the length of long distance telephone channels was fulfilled by 103.2 percent. As during the 10th Five-Year Plan, more than 70 percent of this increase was achieved by rehabilitating and reequipping existing trunks. The collectives of TTsUMS-7, 8, 14, 16, 17, the TsMTS, and the Kazakhstan Ministry of Communications worked well in this area.

Automation of long distance telephone communications is the basic way to improve the quality of services, to save labor resources and to create the Unified Automated Communications System. By the beginning of 1982, 44 percent of long distance exchanges were automated, which corresponds to the plan assignment. The level of automation in Latvia, Lithuania, Moldavia, the Kirgiz and the Ukraine exceeds the national level. The introduction of automation must be accelerated in Turkmeniya, Azerbaijan and Georgia.

Enterprises of the telegraph subbranch have been reequipped purposefully in order to reduce labor consumption, improve the quality of communications and improve working conditions for service personnel. The growth plan for the capacity of channel switching centers in the Nationwide Data Transmission System and telegraph network was fulfilled by 102.2 percent. Fifteen cities have put automatic direct-connection telegraph and subscriber telegraphy exchanges into operation, including Dnepropetrovsk, Krasnoyarsk, Tyumen' and Yaroslavl'. TsKS-T message switching centers have been built in Novosibirsk, Khabarovsk and at TTsUMS-21. The five existing message switching centers are already processing over 600,000 telegrams per day. The problem of how to find the means and capabilities to introduce high efficiency telegraph facilities is now urgent for specialists in all republics. Telegram processing still takes many stages. Because of the lack of channel capacity, the direct connection system is not working efficiently enough at exchanges in Irkutsk, Tbilisi, Vladivostok, Magadan, Sverdlovsk, Barnaul, Kemerovo, and others.

The newspaper transmission network, which is of great political and economical importance, includes 41 receiving locations. A group of projects involving construction of locations for receiving newspaper columns over communications channels has been completed in Izhevsk, Cheboksary, Astrakhan', Arkhangel'sk and Tyumen'. Newspaper columns have been transmitted experimentally to Alma-Ata over the advanced "Orbita-RV" satellite communications system.

The growth plan for city and rural telephone exchanges was fulfilled by 100.4 percent.

Over 1.2 million telephones were installed in local systems, over 70 percent of which were for private service, in accordance with the resolutions of the 26th CPSU Congress. Private branch facilities were constructed, expanded and rehabilitated at 2180 sovkhozes and kolkhozes. Experience continued to build up in operating telephone systems using automatic message accounting equipment. The required decisions have been made, and must be affirmed organizationally and technically in order to accelerate the switchover of large urban systems (Moscow, the capitals of the union republics, etc.), to length-of-call payment. A great deal has been spent on developing local systems, and increasing their profitability is an important task facing the subbranch.

The Moscow, Leningrad and Tashkent city telephone systems are operating technical operating centers equipped with computers, diagnostic and test equipment, which has made it possible to improve the performance of communications and reduce the amount of labor involved in network service. The team method of servicing city exchange line and cable structures and subscriber centers (in Chelyabinsk, inter alia) has made it possible to increase the volume of preventive maintenance on lines, to increase revenue production from coin operated phones and to prevent damage to cables by other organizations.

The problem of satisfying the demand for local telephone services continues to be an urgent one. The enterprises of the subbranch must actively implement existing reserves, accelerate the activation of existing capacities and continue expansion of the construction of automatic private branch exchanges.

The "Orbita", "Moskva" and "Ekran" communications satellite systems were developed further (especially in the RSFSR and Kazakhstan). By the beginning of 1982 the total number of earth stations serving these systems exceeded 2000. Relay of the second television program has been organized at 12 operating TV stations. In conjunction with traditional terrestrial television facilities, the satellite systems have made it possible to organize five-zone broadcast of the first national program, and three-zone broadcasting of the second program.

The capacities of radio broadcast transmitters continued to increase in 1981, mainly at existing radio enterprises. Synchronous radio broadcast networks expanded, and radio communications equipment has been updated. Improving the operating reliability of equipment is an essential task, and is the main prerequisite for reducing the amount of personnel on duty and to eliminate night shifts. Problems of capital repair and operation of metal antenna supports at TV and radio stations must be resolved optimally.

The wired-radio broadcast network, which is of great significance given the present international situation, increased by three million outlets. Half of the wired-radio facilities carry three programs. Over 500 rural radio centers were automated in 1981.

Industrial communications enterprises fulfilled the plan for volume of production by 100.4 percent, and the labor productivity plan by 101.4 percent. All plants except for Barabinsk, Taldomsk and Tashkent completed work in 1981 on introducing an integrated product quality control system. Production was up by 6.8 percent over 1980, and 87 items of experimental prototypes of new equipment were fabricated. Implementation of the assignments of the five-year plan requires strengthening of the production base, improving product quality and reducing the amount of manual labor.

The plan for the introduction of new equipment has been fulfilled, with an important contribution from scientific-research institutes. Among the work done by the latter, the following should be pointed out: bringing the "Ekran" on line, and putting the "Moskva" system into experimental operation; completing development of the "Orbita-RV" system for transmitting newspaper columns and a large number of radio broadcast programs over communications channels to radio broadcast centers far away from Moscow; work on automating control of groups of shortwave receivers of the "Molniya" type; bringing message-switching centers on line; development of quasi-electronic and electronic telegraph and telephone exchanges (although the established deadlines have not been met); expansion of introduction of computers in technological processes - message accounting, centralized city exchange servicing systems, etc., which is important from the viewpoint of reducing service personnel and improving network performance. Fundamental research on digital transmission methods and optical cable systems is continuing. The branch scientific organizations must accelerate the rates of development and improvement of new equipment - this is absolutely necessary for accelerating the development of the branch. It is no less important to study system problems of constructing communications networks, technical-economic aspects, and to plan development straight through from research to assimilation with the goal of accelerating the introduction of new equipment.

In 1981, communications training institutions trained 7400 engineers and 17000 technicians. More than one million communicators improved their qualifications by attending various courses and on the job. Each enterprise must make efficient use of existing engineering and technical cadres and provide all possible support to young specialists, which is especially important in light of the scarcity of personnel.

One good result from 1981 in the area of construction was fulfillment of assignments concerning the activation of basic funds. This is the result of intensive labor on the part of all participants in the construction chain, and their ability to concentrate labor, material and financial resources on facilities which are being brought on line (more than 70% of the allocated construction and installation work was aimed in this direction). The mainline RRL-800, rehabilitated K-3600 mainlines, radio broadcast facilities and automatic telephone exchanges handling 1.4 million numbers were put into operation. The "Mezhgorsvyaz'stroy" trust completed the installation, wiring and adjustment of a 2500-KM coaxial line along an ammonia pipeline; all of the participants in this work have received the gratitude of L.I. Brezhnev, Secretary General of the CC CPSU.

The proportion of allocations directed toward technical reequipping rehabilitation of existing enterprises increased. The number of new construction starts for the USSR Ministry of Communications was reduced by 4.6 percent.

Design institutes fulfilled the planned scope of work.

Technical cooperation with foreign countries continued. In 1981 a USSR-India troposcatter link was put into operation.

The level of organizational and economic work in the branch was increased. Unified integrated programs were developed for the most urgent problems of technical progress, the development of communications facilities and social and economic matters. The Shchekinskiy method received wider employment.

A number of organizations achieved superior results in 1981, including collectives of the Novosibirsk, Rovno, Volgograd and Zaporozh'ye PTUS, the Order of Lenin Central Telegraph Exchange of the USSR Ministry of Communications, the Vil'nyus Telegraph Exchange, TTsUMS-4, 12, 21, the Moscow and Tallinn Post Offices, the MGRS, SUR-5, 11, the Leningrad city television exchange, the "Mostelefonstroy" trust, the Moscow city telephone system, as well as others.

Communicators are participating directly in fulfilling the urgent political and economic task reflected in the resolutions of the 26th CPSU Congress and the November (1981) Plenary Session of the CC CPSU - to increase the material potential of each republic and utilize it maximally for harmonic development of the entire country. All of the union republics contributed to fulfilling the tasks of the first year of the 11th Five-Year Plan for the development of communications facilities. Experience in integrated development of communications facilities was accumulated in Latvia, Lithuania, Estonia and Armenia; in improving the network of communications enterprises in the RSFSR, Kazakhstan and Georgia; in development of long distance communications in the Ukraine, in Belorussia and in Azerbaijan. Turkmen communicators are implementing plans under difficult conditions.

One task for the next few years is to eliminate the territorial disproportion in the development of communications facilities, especially city, rural and long distance telephone systems. In building cable lines and other structures it is necessary to overcome the local approach and be guided by both regional interests and, primarily, social and state requirements.

What must be done as a first priority in order to resolve the key question in the economy of the branch - switching over to a primarily intensive path of development?

In 1981, like during the 10th Five-Year Plan, it was not possible to achieve growth and stabilization of capital productivity, although the reserves and capabilities for doing this are certainly available. For example, the failure to integrate the development of automatic long distance exchanges and communications channels reduced significantly the level of activation of exchanges, especially for zone communications. The subbranches must provide a clearer connection between newly constructed automatic long distance exchanges and their future use, and must make wider use of AVTS [Automatic Intraoblast Telephone System] equipment and two-frequency semi-automatic equipment. The degree of utilization of city telephone exchanges is low. As much as 20 percent of all rural exchange capacity remains unused, in both RSFSR and Ukraine. A task has been established to increase the level of city exchange utilization to 92-93 percent, and rural exchange to 83-85 percent. Other specific directions have also been formulated. By overcoming the force of inertia and obsolete traditions, communicators will certainly be able to handle these urgent assignments.

Another path for intensification of work involves conservation of labor resources. In 1981 the rates of growth of labor productivity exceeded the growth rate of wages. In order to achieve the labor productivity indicators established for the five-year plan, the plans for introduction and efficient utilization of new equipment, for measures in the area of organization and standardization of labor must be followed scrupulously; automation of equipment must be accelerated and wider use must be made of payment for end results of collective labor. Personnel turnover is still high at communications enterprises. Keeping personnel and rallying of labor collectives are closely associated with creating normal production and living conditions for workers. These questions require specific immediate solution everywhere.

The requirement that "economics must be economical" has placed major tasks before the branch in terms of rational utilization of all material resources. The USSR and union republic ministries of communications have already done definite work in this direction. Measures have been authorized to conserve resources during the 11th Five-Year Plan. There are provisions to reduce heat and fuel utilization by 3 percent and electricity by 4 percent of the calculated funds. Nonetheless, conservation is not being observed everywhere by any means. Nonproductive losses are great, especially at enterprises in the RSFSR, Georgia, Uzbekistan and Azerbaijan. Some enterprises are submitting increased expenditure requests and reduced efficiency reports. The assignments to accelerate the turnover of floating funds are not being fully met.

An important component element of the work is to improve the quality of communications services and service culture. According to the 1981 results, an improvement was achieved for 13 and 20 of the quality indicators considered. However, the number of complaints concerning the work of long distance and local telephone organs, as well as telegraph communications, increased. The mean time to eliminate one malfunction increased on both long distance lines and in rural systems.

The problem of improving production quality is a complex one which touches all aspects of the activity of an enterprise. The introduction of an integrated quality control system is a powerful means to solve it. An example of this is the positive experience of the Ministries of Communications of the Ukraine, Belorussia, Lithuania, as well as a number of PTUS in the RSFSR. It is now time to disseminate this experience and to issue normative documents for the introduction of integrated quality control systems throughout communications management as a whole.

Management reform is still being introduced slowly within the communications branch. A number of methodological documents have been prepared recently on improving the management mechanism, but there is still no extensive introduction of measures which should have a significant influence on economy. It is necessary to increase the economic independence of enterprises, to achieve closer ties between the end results of their activity and the benefits obtained by labor collectives, and to create a mechanism under which the enterprises themselves would strive to undertake intensive plans.

Special attention must be devoted to a fulfillment of assignments associated with large nationwide programs such as the conversion of Nechernozem'ye, the construction of main gas pipelines, the petroleum complex at Tyumen', etc.

In executing the resolutions of the 26th CPSU Congress and November (1981) Plenary Session of the CC CPSU during the 11th Five-Year Plan, including 1982, the efforts of communicators are aimed at unconditional fulfillment of the planned assignments, intensification of production, improvement of communications service quality, better satisfaction of the demands for services on the part of the economy and the people, and creation of work to carry over into the 12th Five-Year Plan.

The Unified Automated Communications Network is continuing to be developed on the basis of the latest transmission and switching systems, and the extensive use of satellites for multiprogram television and radio broadcast, telephone communications with remote regions and transmitting central newspaper columns by facsimile are going forward.

In accordance with the resolutions of the 26th CPSU Congress, the total extent of long distance telephone channels will increase by a factor of 1.8, and the number of telephones in city and rural areas by a factor of 1.3, including residential sets by a factor of 1.4. Color television and stereo radio broadcasting will be developed further. Communications production will increase by 24 percent over 1980, and the labor productivity of communications workers involved in basic activity will increase by 19.6 percent.

A group of steps will be taken to improve planning and management of the economy of the communications branch, to improve the management style and methods, to ensure rational utilization of metal, fuel, electricity, raw materials, financial and labor resources, to ensure fuller utilization of basic production funds and acceleration of deadlines for assimilating new capacities, to create a reliable personnel reserve and to expand the network of training courses.

Capital investments and funds for materials and equipment for starting and priority construction projects and technical reequipping and rehabilitation of existing enterprises are being allocated on a priority basis. Thanks to the use of new efficient materials, improvement of organization and management, improving the degree of prefabrication of construction, etc., labor productivity and construction will increase by 14 percent over the five-year plan.

At least 20 items of construction equipment are to be introduced in 1982, and new quasi-electronic "Istok" switching exchanges, as well as IKM-120, K-1920P and other transmission equipment, are to be mastered.

The technical level of plans must be improved, and conservation of resources must be provided on this basis. Preference is given to plans to reconstruct and modernize existing structures; a decision to go ahead with new construction is made only when it is impossible to achieve the required indicators by rehabilitating existing facilities.

Urgent problems include fulfillment of plans to introduce advanced technology, automate and mechanize production processes, computer technology, the plan to create new equipment which is provided for in integrated scientific-technical programs and decrees of directive organs and the USSR Ministry of Communications.

Work is continuing to create third-generation "Elektronika-Svyaz'" standardized radio relay communications systems. State testing is being completed, and experimental operation begun, of the "Elektronika-Svyaz'-11Ts" equipment, as well as a prototype of the "Dozhd'4" four-program radio broadcast station. Tests are under way on a message switching center in Leningrad and on an experimental model of a central station serving the GDR-produced YeSS ATs unified analog-digital switching communications systems.

The scientific potential of the communications VUZ must be utilized more effectively in scientific research and experimental design work done in the interests of the branch.

Long distance telephone communications will be developed further; the level of automation will be increased to 55 percent by the end of the five-year plan, and to 47 by the end of 1982. There are plans to construct and expand coordinate automatic long distance exchanges in Yerevan, Kiev, Baku, Kurgan, Saratov and Vladimir in 1982, to begin construction on three automatic switching centers and to install at least 3000 long distance pay telephones. Overall, coordinate, quasi-electronic and electronic exchanges will be established in 90 cities. Work is underway to create automated operational management and technical servicing systems. It remains to reduce accidents on communications links, to ensure that line damage is taken care of within established deadlines and to reduce communications channel downtime in 1982 by 5 percent. The level of mechanization of line service and repair work is to be doubled during the five-year plan.

In order to improve the quality of service received by long distance telephone subscribers, call waiting time will be reduced and the work of ordering and information services will be improved.

New equipment will be introduced in the telegraph network during 1982-1985 which will make it possible to automate labor intensive processes and to increase labor productivity; this includes the AVK automatic call concentrator, the ATK hardware-software complex, OUKS-T, TAKT, RITM, ELIT-T and other equipment. Introduction of the direct connection system will be completed. Subscriber telegraph and low speed data transmission networks will be developed substantially. The capacity of telegraph exchanges will be increased significantly. Telegraph switching exchanges will be constructed and rehabilitated in 30 cities (including 8 in 1982), and TsKS-T message switching centers will be built in 12 cities. Receiving locations for newspaper columns via communications channels will be built in Ashkhabad and Kemerovo in 1982.

There are provisions to accelerate the growth rate of local telephone networks. Automation of telephone exchanges in cities and rural areas will be completed, which will involve the replacement of manual exchanges serving more than 190,000 numbers in cities, and 150,000 numbers in rural areas. At least 45,000 coin-operated telephones will be installed, including 9,000 in 1982, primarily in regions of new construction. The network of private branch exchanges is to be developed at accelerated rates, which will make it possible to intensify the work of city networks.

In order to do this, 10 percent of the city exchange capacity brought on line annually is set aside for the construction of switching centers.

There are plans to introduce the test-correction operation method at all existing automatic coordinate exchanges and automatic private branch coordinate exchanges in 1982: this will make it possible to increase the profitability of the networks and to improve labor productivity in the subbranch.

The following plans exist in the area of radio broadcasting, television, radio communications and satellite communications. The capacity of radio broadcast stations will be increased, primarily due to upgrading and rehabilitating existing enterprises and installing additional equipment in available spaces. The synchronous radio broadcast network in the long- and medium-wave bands will be expanded, and organization of zone radio broadcast of the third program with allowance for time zones will begin. Multi-program radio broadcast stations will be installed in 70 cities during the five-year plan, and stereo broadcasts will be organized in 50 cities.

The availability of television broadcasting to the population will increase as follows: first national program - 92 percent, second program - 72 percent. This will be done by bringing 60 powerful TV stations, 2500 low-power relays, 3000 "Ekran" stations and 400 "Moskva" stations on line. A five-zone TV broadcast distributing network carrying two national programs will be organized during 1982-1985, and four-zone broadcast of the second program will be introduced.

The number of radio relay points will increase by a factor of 1.2 during the five-year plan. In addition, multiprogram wired-radio broadcasting will be introduced in 1500 populated areas, including rayon centers.

There are plans to improve the operating reliability and throughput capacity of the backbone radio communications network. Single-sideband transmitters, receivers and radio channel control equipment will be installed. Automation of mainline transmitter and receiver groups will make it possible to free service personnel.

The industrial enterprises of the USSR Ministry of Communications must provide a growth in the volume of production of 44.7 percent and in labor productivity of 34.1 percent during the five-year plan. Series production of the K-1020S line equipment is to begin in 1982, and series production of type VUT thyristor rectifiers and other articles is to be prepared.

The year 1982 is filled with major political events. December marks the 60th anniversary of the USSR. Trade union and komsomol congresses will be held. Elections will be held in local Councils of Peoples' Deputies. A new powerful impetus to the creative activity of the masses is natural. Socialist competition has become widespread among communications workers: this is aimed toward successful fulfillment of the tasks of the five-year plan, acceleration of scientific-technical progress, increased labor productivity, improved work performance and better service to the population and economy, as well as conservation of all resources.

Communications workers have undertaken increased socialist obligations for 1982 and the 11th Five-Year Plan. For example, these provide overfulfilling the plan for communications management profit by 25 million rubles in 1982, overfulfilling the labor productivity plan, which will provide at least an 85 percent increase in communications production. Automatic exchanges serving no fewer than 68,000 numbers should be put into operation ahead of schedule. Two coaxial mainlines will be put into operation a year ahead of schedule. Rehabilitation of a cable line, replacing K-1920 equipment with K-3600, should be completed ahead of schedule, by 1 December 1982. Broadcasting of the second television program will be organized in 14 cities ahead of schedule. Thanks to the introduction of new equipment, scientific organization of labor, automation and mechanization of production processes, communications have obligated themselves to save the labor of 22,000 workers during the 11th Five-Year Plan.

It is important in each labor collective that the planned assignments and socialist obligations undertaken be supported by economic and organizational measures which will guarantee their fulfillment.

Only in this way can the key problems involved in the development of the branch be resolved in the light of the requirements of the 26th CPSU Congress and November (1981) Plenary Session of the CC CPSU, the state plan filled and overfulfilled, and a good base created for the 12th Five-Year Plan.

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USSR

METHOD FOR INCREASING CAPACITY OF SATELLITE COMMUNICATIONS LINKS

Moscow ELEKTROSVYAZ' in Russian No 4, Apr 82 pp 12-15

[Article by G.M. Vayzburg and M.S. Raber]

[Text] The high efficiency of communications systems using satellites, especially geostationary satellites [1], has facilitated their extensive utilization. Serious discussions are now underway on the problem of estimating the maximum throughput capacity and the most rational ways to utilize the geostationary orbit [2]. Some methods which make possible multiple utilization of the frequency bands allocated for satellite communications have already been implemented in certain systems, and others are in the development stage. The former of these include economizing bandwidth by using polarization and direction separation [3], while the latter includes methods of compensating for crosstalk from adjacent systems [4], as well as conserving the uplink spectrum through on-board signal processing in which it becomes possible to change the type of modulation [5].

On-board signal processing also makes it possible to implement the idea of doubling the downlink capacity for communications between two stations exchanging digital information using TDM [6]. In this case, the pulse streams from both stations can be demodulated aboard the transponder, combined in time and multiplied Modulo 2 bit by bit. Then each earth station subtracts its own stream, delayed by the signal propagation time over the channel, from the total stream.

The present article examines a method which can be used to double the amount of analog information transmitted over a frequency-multiplexed relay trunk by combining the spectra of the signals of the two stations which are working with one another [7]. The bandwidth which is freed can then be used either for communications between an additional pair of stations, or to increase the amount of traffic exchanged between the same two stations.

There are two specific ways to implement this method - with and without signal processing aboard the satellites. Both of these versions are analyzed below.

Method not employing on-board signal processing. The transponder operates in the same mode as in a multiple-access FDM system in which signals are multiplexed without overlapping of their spectra.

Let us examine the interoperation of two stations. Let station A emit the signal $U_1\cos[\omega_1 t + \Delta\omega_1 S_1(t)]$ and let part of that signal be diverted to a delay line DL (figure 1a). Station B emits and diverts the signal $U_2\cos[\omega'_1 t + \Delta\omega_2 S_2(t)]$, where $\omega_1 \approx \omega'_1$; $\omega_1 - \omega'_1 = d\omega$ is the detuning which always exists between different transmitters operating at the same frequency; $\Delta\omega$ - frequency deviation;

$$S_1(t) = \int_{-T_1}^{t} u_1(t)\,dt \text{ и } S_2(t) = \int_{-T_2}^{t} u_2(t)\,dt,$$

where T_1 and T_2 are the times at which the modulation is activated; $U_1(t)$ and $U_2(t)$ are the modulating processes at stations A and B, respectively.

When the amplitude response of the transponder is linear (an analysis of the influence of nonlinearity will be given below), the following identical signal arrives at the input of the receiver at each earth station:

$$U_1' \cos[(\omega_2 + d\omega_2)(t-\tau) + \Delta\omega_1 S_1(t-\tau) + \psi_1] + U_2' \cos[(\omega_2' + d\omega_2')(t-\tau) + \Delta\omega_2 S_2(t-\tau) + \psi_2], \qquad (1)$$

where $d\omega_2$ and $d\omega'_2$ - fluctuations in carrier frequency caused by Doppler effect during orbital movement of the satellite; τ - signal propagation time over the channels; Ψ_1 and Ψ_2 - phases of signals at receiver inputs. In order to extract the correspondent's signal at any of the stations it is necessary to compensate for any of the components corresponding to the signal belonging to that station: this problem can be simplified significantly since the source of the interfering signal is located in the same station. The problem can be resolved as follows.

The transmitter signal which is diverted and delayed for the propagation time over the link is input to mixer Mi (figure 1a), which translates it to the input frequency range of the receiver. Then adaptive noise compensator ANC, the operating principles of which are examined in sufficient detail in [4], suppresses the local interfering signal. The operating algorithm of the compensator is such that it produces a signal which controls the frequency, the phase of the mixer oscillator and the signal delay in the delay line.

This version is close to the case of suppressing noise from an adjacent system operating in the same frequency range. The difference is that a special antenna which is aimed at the noise source is used there to obtain the noise copy which is then subtracted from the input signal mixture, while the noise copy in the present case is present at the station itself.

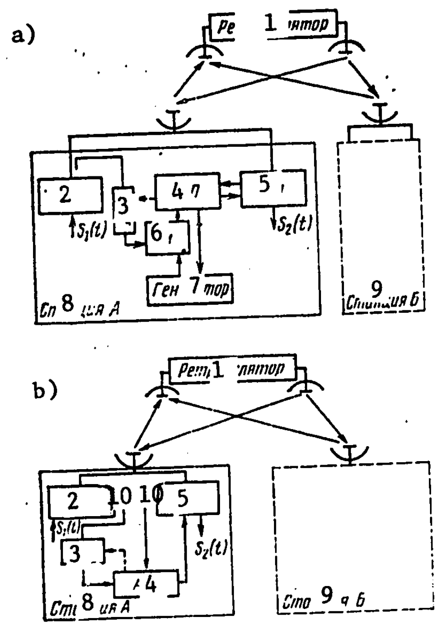

Figure 1

Key: 1--transponder; 2--transmitter; 3--delay line; 4--adaptive noise compensator; 5--receiver; 6--mixer; 7--oscillator; 8--station A; 9--station B; 10--intermediate frequency.

The frequency and phase of the receive signal can also be adjusted with the help of a phased-locked loop system, for which it is fairly simple to obtain control voltage by comparing the transmit and receive signals in a channel set aside specially for this.

The compensation circuit can also be implemented in the i.f. range (figure 1b): when this is done the mixer is not needed, but instabilities in the oscillators of the transmitter and receiver at the station have an additional influence which, however, can be compensated in the manner described above.

The required degree of suppression of the local signal and the received mixture which provides a tolerable noise level can be determined using the familiar formula [8]

$$P_n = 10^{0,1\, p_{\kappa}\, r^2} \frac{\Delta F_\kappa K_n^2 10^9}{F_\Sigma B^2(\Omega)} \left(\frac{F}{\Delta f_\kappa}\right)^2 \times \times \frac{[g_\Sigma(\delta - b) + g_\Sigma(\delta + b)]}{2} \quad (2)$$

(notation corresponds to that used in [8]). Given an acceptable value of P_n, the ratio between the valid and interfering components r should be calculated. For example, when the modulation is being done by 60-channel group messages with effective modulation indexes $M_{es}^2 = M_{ep}^2 = 0.65$, and assuming that the noise level must not increase by more than 2000 pW, the noise component of the local signal must be suppressed by more than 34 dB ($r^2 \approx 3 \cdot 10^6$). It should be noted that theoretical and experimental investigations of noise compensation systems (in which the noise copy can be extracted using an additional antenna) are now making it possible to obtain 40-50 dB suppression [9]. Unfortunately, the operation of such devices has not been evaluated under dynamic conditions allowing for variations in the channel parameters over time. Nonetheless, examination of this matter is of independent interest, and is beyond the scope of the present article.

The received signal mixture can also be processed using the scheme shown in figure 2. In this case, a copy of the modulating message $S_1(t)$ is delayed by the propagation time and is then input to frequency-modulated oscillator FMO and to correlator Cor where it is compared with the output signal of the receiver. Since the correspondents' messages are uncorrelated, when the receiver completely suppresses the local signal, there will be no control voltage at the output of the correlator. If a residue of the message $S_1(t)$ is present at the receiver output, a proportional residual control signal will be input to the FMO and delay line, changing their responses accordingly.

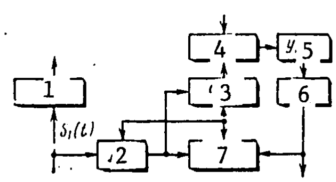

Figure 2

Key: 1--transmitter; 2--delay line; 3--frequency modulated oscillator; 4--mixer; 5--IF amplifier; 6--frequency detector; 7--correlator

The mixer translates the spectra of the input signals to the intermediate frequency and simultaneously suppresses the frequency modulation corresponding to message S (t). In this case only the carrier frequency of the interfering signal remains uncompensated. Interference of this sort can be controlled using ordinary or adaptive band-rejection filters [4].

In order to estimate the degree of suppression of interference and to control the operation of the FMO and delay line, it seems best to use a special test channel for each station at the high-frequency end of the message spectrum. By loading it with a sinusoidal signal, after the sinusoid is extracted it is possible to use its residue at the receiver output to control the operation of the circuit, and also to measure any additional noise which has been introduced.

When the amplitude response of the transponder is nonlinear, distortions are formed which can be calculated using the method in [8]. It should be kept in mind that in this case the number of signals passing through the common section of the transponder is n = 2; their frequencies are practically the same ($f_k \approx f_1$); the third-order distortion products are formed only from combination frequencies of the form $2f_k - f_1$; the number of these products $N_n(k) = 2$; the power of this type of distortion products is 6 dB lower than the power of a distortion product of the form $f_m + f_k - f_1$. Both signals are modulated by independent multichannel messages with effective frequency deviation Δf_{es} and effective modulation index M_{es}; the effective frequency deviation and noise index is

$$\Delta f_{э.п} = \sqrt{5}\,\Delta f_{э.с};\; M_{э.п} = \sqrt{5}\,M_{э.с},\ \text{а}\ \Delta f_{э\Sigma} = \sqrt{\Delta f^2_{э.с} + \Delta f^2_{э.п}} = \sqrt{6}\,\Delta f_{э.с},$$
$$M_{э\Sigma} = \sqrt{6}\,M_{э.с}.$$

Considering the above, and on the basis of [8], the formula used to calculate the power of the transient noise occurring when the transponder has a nonlinear amplitude response is written as

$$P_{nnp} = \frac{2}{(P_c/P_3)_4}\,\frac{\Delta f_к K_п^2\, 10^9}{\sqrt{6}\,\Delta f_{э.с}\sqrt{2\pi}\,B^2(\Omega)} \times \left(\frac{F_к}{\Delta F_к}\right)^2, \tag{3}$$

where ΔF_k - channel bandwidth; F_k - center frequency of channel; K_p^2 - psophometric coefficient; $B^2(\Omega)$ - pre-emphasis coefficient; $(P_s/P_3)_4$ - ratio of power of one signal to power of one third-order distortion product with four input signals.

For example, let each of two signals be modulated by a 60-channel message with frequency deviation Δf_k = 400 KHz. The nonlinear properties of the amplifier are characterized by the relationship by $(P_s/P_3)_4$ and P_{in} shown in figure 5.11 in [8]. Let us find the ratio P_{in}/P_0 for which the transient noise power in the voice grade channels does not exceed 2000 pW at the relative null level, where P_{in} is the summary signal power at the amplifier input; P_0 is the power at the saturation point; $K_p = 0.75$; $B^2(\Omega) = 2.5$; $\Delta f_k \approx 400$ KHz; Δf_{es} = 800 KHz; ΔF_k = 3 KHz; F_k = 250 KHz.

Substituting these quantities in formula (3), we obtain $P_{n.n.p.} = \frac{10^5}{(P_s/P_3)_4}$, and when $P_{n.n.p.}$ = 2000 pW $(P_s/P_3)_4$ = 17 dB. It is apparent from the graph in figure 5.11 [8] that the quantity $(P_s/P_3)_4$ corresponds to the ratio of the summary power of the signals at the input to the power at the saturation point (P_{in}/P_0) = +0.5 dB, i.e., with given parameters of the transmitted signals there is no need, in order to provide $P_{n.n.p.}$ = 2000 pW, to reduce the power of the transmitter of the transponder in order to create a linear amplifier operating mode.

Method employing signal processing on board. Bandwidth is saved on the downlink by combining the messages from different stations in the transponder. This is done as follows. The signals from stations A and B, respectively

$$U_1 \cos\left[\omega_1 t + \Delta\omega_1 \int_{-T_1}^{t} u_1(t)\,dt\right] \text{ and } U_2 \cos\left[\omega_2 t + \Delta\omega_2 \int_{-T_2}^{t} u_2(t)\,dt\right] \quad (4)$$

are input to the transponder, demodulated separately, combined with the common signal input to the transponder modulator, which emits the following signal toward the earth stations:

$$U \cos\left\{\omega_3 (t-\tau) + \Delta\omega_\Sigma \int_{-T_3-\tau}^{t-\tau} [u_1(t-\tau) + u_2(t-\tau)]\,dt\right\}. \quad (5)$$

After demodulation, the sum of the messages will be extracted at each earth station; the component corresponding to the message belonging to the station in question must be subtracted from this sum:

$$u_1(t-\tau) + u_2(t-\tau) - u_1(t-\tau_d) = u_2(t-\tau) + \delta u_1(t-\tau).$$

where τ_d is the delay of the copy of the message from the station in question, which is equal to the signal propagation time over the uplink and back.

The subtraction can be done in practice using various technical approaches, both with and without test signals in special channels to regulate τ_d.

Let us determine the accuracy requirements for the delay in the line for a given acceptable channel noise increase. The correlation function of the noise $\delta U_1(t - \tau)$ is

$$R_\delta(\tau) = 2R_1(\tau) - R_1(\tau - \Delta t) - R_1(\tau + \Delta t),$$

where $R_1(\tau)$ is the correlation function of the original message $U_1(t)$ and $\Delta t = \tau - \tau_d$. The spectral noise density

$$G_\delta(\Omega) = 4G(\Omega)\sin^2\frac{\Omega\Delta t}{2},$$

where $G(\Omega)$ is the spectral density of the original message, which is the same for $U_1(t)$ and $U_2(t)$. When $\Delta t << 1$, which must be the case in the system in question, we have

$$G_\delta(\Omega) \approx G(\Omega)(\Omega\Delta t)^2 \text{ и } (P_n/P_s) = = (\Omega\Delta t)^2.$$

Thus, given the acceptable degradation in the signal/noise ratio, we can find the required precision of the delay of the message over the link.

As indicated above, the second version saves bandwidth on the downlink; therefore, in order to realize a positive effect it is necessary to arrange the transmission of additional information to the transponder over the uplink. This problem was solved in [5] for transmitting programs in the broadcast satellite service. The same methods can be used in the present case, namely, using the additional frequency band (if there is any margin in the frequency band), polarization and direction separation on the uplink, etc. For communications systems with large modulation indexes $M >> 1$ it is most rational to cut the frequency deviation of the signals on the uplink in half, which cuts the frequency band occupied by these signals in half; the increase in the channel noise may be insignificant, since the noise contribution of these links is relatively small.

One version of independent interest is that which employs signal processing aboard the satellite when the communications system is constructed so that the voice grade channels in one direction correspond exactly to the voice grade channels in the other direction, i.e., a subscriber occupying, e.g., the first channel on the link from station A to station B talks with a subscriber who also occupies the first channel on the link from station B to station A, etc. In this case, the conversation is only going one way in the channel, since one of the subscribers is listening to the talking party. If we assume that effective echo suppressors are used on satellite links which disconnect a particular receiving circuit from the channel during transmission, it obviously becomes unnecessary to suppress the local signal further in the earth station receivers.

Conclusion. Let us define the relative gain to be achieved from employing the proposed transponder trunk multiplexing method over the traditional multiple access FDM method without overlapping spectra.

Let us assume that the transponder trunk was fully occupied by a single carrier which is frequency modulated by the group channel spectrum. Let the modulation index be high, and the spectrum width be determined approximately by the frequency deviation. In order for the trunk to handle two carriers, each modulated by the group spectrum of the same number of channels n, it is necessary to employ a frequency deviation which is no more than half as large, and to cut the power of each carrier at least in half. The total energy losses in this case amount to 9 dB.

In the proposed method, when the HF spectra of the two signals are combined (without on-board signal processing), the power of each carrier must also be reduced by at least 3 dB; however, the frequency deviation remains unchanged. If the LF spectra are combined (with signal processing aboard the transponder), the effective carrier deviation of both messages must be reduced by 3 dB, but the carrier power need not be reduced. With this method of doubling the volume of data transmitted, the energy losses thus amount to 3 dB. Accordingly, the gain over multiple access FDM is approximately 6 dB.

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USSR

'MOSKVA' NEWSPAPER TRANSMISSION SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 4, Apr 82 p 15

[Unsigned article]

[Text] In October 1981 the Scientific-Technical Council of the USSR Ministry of Communications discussed the NIIR [Scientific Research Institute of Radio] report entitled "Satellite Transmission of Newspaper Columns Utilizing Simple Receiving Stations Installed Directly at Printing Facilities". The receiving stations in the "Moskva" satellite communications system were the subject of discussion here. Small receiving antennas are installed directly on the building housing the printing facility, while the receiving equipment is installed inside the building.

Analog transmission makes it possible to employ the existing technical treatments for transmitting newspaper columns over an "Orbita" television trunk in order to organize the transmission of newspaper columns in a timely fashion to printing locations over channels in the "Moskva" system. The Scientific-Technical Council proposed the following: acceleration of research on digital methods for transmitting newspapers, as well as creation of remote control and remote signalling equipment to support normal operation of terminal equipment during circular transmission of newspaper columns to printing locations; employ the remote signalling and remote control equipment used to transmit newspapers over the "Orbita" system for the time being; developed coordinated principles for constructing newspaper transmission systems employing both analog and digital methods. The "Moskva" system will make it possible to expand significantly the capabilities of transmitting central newspapers from Moscow to printing locations.

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USSR

'SVYAZ'-81 INTERNATIONAL EXHIBITION EXHIBITORS NOTED

Moscow ELEKTROSVYAZ' in Russian No 4, Apr 82 pp 47-48

[Unsigned article]

[Text] The success with specialists and the public of the International Exhibition "Communications Systems and Facilities" - "Svyaz'-81" (Moscow, Sokol'nika, 2-16 September 1981) resulted from the variety and high degree of sophistication of the exhibits, which provide a clear idea of the rates of development of communications which have become avalanche-like in recent years, as well as the increasing universal importance of communications facilities in the social life of our country. The concept of "electrical communications" has been expanded significantly as a result of the increased scope of production of its numerous subbranches, as well as the appearance of new types of transmission and data application.

Communications equipment makes full use of the latest achievements of physics, crystallography and chemistry to master increasingly wider frequency bands and to develop high speed elements including LSI, electronic microcircuits and processors. Communications theory and technology, in turn, enrich adjacent branches of knowledge with new principles of transmitting, extracting and recognizing signals, and provide a wide assortment of sensitive devices for experiments and specific research.

Considering the above, we must recognize as fully justified, the display at the exhibition of numerous sound and picture reproduction devices, special purpose testing and measuring instruments, control devices, production line equipment, systems for automating large-series production of printed circuits and domestic radio equipment along with various communications, broadcast and television systems. The word "Svyaz'" (communications) in the title of the exhibition should be understood in its broadest sense, as a combination of facilities for transmitting information along with the required electronic, computing and technical radio devices.

Industrial enterprises and associations from seven socialist countries were included among the participants at the exhibition: the Peoples' Republic of Bulgaria, the Hungarian Peoples' Republic, the German Democratic Republic, the Polish Peoples' Republic, the USSR, the Czechoslovakian Socialist Republic and the Socialist Federative Republic of Yugoslavia, in addition to companies and organizations from Austria, Great Britain, Denmark, Spain, Italy, The Netherlands, Norway, the US, Finland, France, The Federal Republic of Germany, Switzerland, Sweden, Japan and West Berlin.

The television and radio broadcasting equipment and apparatus in the largest display at "Svyaz'-81" - that of the Soviet Union - occupied over 10,000 square meters in the Main Pavilion of the exhibition complex. Production associations and industrial enterprises of 17 USSR ministries and departments demonstrated over 3,000 exhibits, most of them working.

The exhibition was visited by more than 400,000 people, including 200,000 specialists. Visitors included a group of management workers from the USSR Council of Ministers headed by comrade N.A. Tikhonov, member of the CC CPSU Politburo and Chairman of the USSR Council of Ministers, as well as a group of executives of the CC CPSU apparatus. Foreign specialists present included management personnel from most of the communications administrations of the socialist countries, headed by ministers, including Rudolf Shultze, Deputy Chairman of the GDR Council of Ministers and Minister of Postal and Electrical Communications of the DGR, Pando Vanchev, NRB Minister of Communications, Vlastimir Chalupa, Minister of the Czechoslovakian SSR Federal Ministry of Communications, and others.

Repeated visits to the pavilions at the exhibition were organized so that workers of operational and production enterprises, scientific-research, design and training institutes and design organizations could become thoroughly familiar with the exhibits. A great number of catalogs, prospectuses and descriptions of domestic and foreign apparatus equipment were disseminated.

During the exhibition a symposium was held at which more than 60 lectures and reports were read. About 5,000 specialists took part in creative discussions.

Study of the exhibits at the exhibition and the technical and advertising literature, plus exchanging information and experience during meetings and encounters and attendance at lectures and reports made it possible to obtain a great deal of information in the area of the development of communications facilities and to make an objective evaluation and comparison between the level of development here and abroad and of the developmental trends of the communications equipment subbranch.

The basic directions in the development of communications systems for the near future can be defined very briefly as the introduction of digital systems for transmitting all possible types of information over cables, radio relay links and satellite links; the introduction of quasi-electronic and electronic systems for switching single and group channels using electronic controllers and microprocessors, and the use of optical cables as a transmission medium.

Nonetheless, analog systems are not being taken out of production. The same is the case for obsolescent coordinate switching systems: regardless of the employment of new systems, these will still be in use for the foreseeable future.

Five communications enterprises and organizations participating at the "Svyaz'-81" International Exhibition - the State Scientific-Research Institute of Radio (NIIR), the Moscow Department of the Central Scientific-Research Communications Institute (MO-NIIS), the Minsk "Promsvyaz'" experimental plant and the Moscow and Leningrad city telephone systems - were awarded Diplomas of the USSR Trade and Industrial

Board, and 28 communications enterprises and organizations were awarded Exhibition Organizational Committee Diplomas.

The journal ELEKTROSVYAZ' has published descriptions of many of the type of domestic gear, equipment and devices which were exhibited at "Svyaz'- 1". These include the "Orbita", "Moskva" and "Ekran-ChM" satellite communications systems, the K-3600, K-1920P, K-1020S, IKM-120, I,M-30, KURS, "Oblast'", and "Elektronika-Svyaz'-11Ts" transmission systems, ATsV digital broadcasting equipment, the "Istok" YeSS ATs switching system, the DUMKA telegraph channel formation equipment, the ELIT-T display-type telegraph terminal, the city telephone system technical operating center (TsTE) equipment, and many others.

The editors also intend to present the features of domestic apparatus and equipment, to which special articles will be devoted (under the rubrics "Technology of the Five-Year Plan", ""Svyaz'-81" International Exhibition", etc.). For example, descriptions are now being prepared for publication on the "Orbita-RV" satellite broadcast system, the IKM-480 digital transmission system, the "Kvarts" quasi-electronic automatic long distance telephone exchange, equipment for time-of-call billing for local toll calls, etc.

Published below are reviews of mainly foreign communications equipment which was presented at the exhibition. These descriptions are based on studying the exhibits, the handout literature and information obtained from the lectures and conversations with specialists. The articles written only from materials available at the exhibition, of course, do not pretend to exhaustive thoroughness or universality. However, each review gives an idea about the characteristic features of the current status of a particular communications subbranch and the typical trends in its improvement.

Articles devoted to the "Svyaz'-81" International Exhibition will continue to be published in subsequent issues.

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USSR

LONG-DISTANCE COMMUNICATIONS CABLES AND CABLE FITTINGS

Moscow ELEKTROSVYAZ' in Russian No 4 Apr 82, pp 55-60

[Article by A.S. Vorontsov, K.G. Levinov and S.Kh. Miftyakhetdinov]

[Text] General developmental trends. The main factors which determine improvement in traditional communications cable equipment using metal conductors are the constantly growing demand for data exchange, increased requirements for transmission quality, reliability and economy, and the appearance of new, more sophisticated technology.

The "Svyaz'-81" International Exhibition demonstrated that the scientific and technical thinking of specialists in the area of cable equipment during the period which elapsed since the "Svyaz'-75" exhibition followed these paths:
a) improving cable utilization efficiency by expanding the frequency range which can be handled and using digital transmission systems;
b) developing a list of cables for various purposes using large numbers of construction elements;
c) developing and using cable components which are standardized in terms of both construction and electrical characteristics;
d) improvement of existing cable designs of all types in order to improve their economy, reliability and stability of electrical characteristics in the spectrum of wideband analog and digital transmission systems. This is achieved by reducing the use of, or completely replacing, such expensive, scarce materials as copper and lead, used respectively to make conductors and jackets, with aluminum, steel and new, improved plastics; increasing the mechanical strength of cable elements; using new manufacturing technology;
e) finding new installation methods and improving existing ones; improving the quality and reliability of connections; reducing the cost of installation operations and the amount of labor consumed therein;
f) theoretical and experimental investigation of the electrical characteristics of cables in the wideband analog and digital transmission system spectrum, primarily questions of the effect of nonuniformities in the wave impedance and cross-effects on the quality the data transmitted, and standardizing them on the international scale.

Coaxial communications cables were exhibited by the SAT and LTT companies (France), Nokia (Finland), NKF (The Netherlands), as well as the KWO combine (GDR). The exhibits and handout literature indicate that, as before, the basic types of coaxial cables used in the long distance systems in these countries employ standard 2.6/9.5 and 1.2/4.4 pairs.

The construction of these pairs is standard, and their elements differ little from one another. For example, the internal conductors are made of signal-conductor copper wire with a nominal diameter of 2.6-2.65 mm (for 2.6/9.5 pairs) and 1.18-1.2 mm (for 1.2/4.4 pairs). The outside conductors consist of a cylinder made of copper band 0.25 mm thick (for 2.6/9.5 pairs) and 0.15 or 0.18 mm (for 1.2/4.4 pairs) with a single longitudinal "corregation"-type seam and with nominal inside diameters of 9.5-9.75 mm (for 2.6/9.5 pairs) and 4.4 mm (for 1.2/4.4 pairs).

The insignificant differences in the diameters of the conductors used in the cables in a number of countries while employing various types of insulation result from the attempt to obtain a 75-ohm wave impedance (for 2.6/9.5 pairs at 2.5 MHz and 1.4/4.4 pairs at 1 MHz) and to maintain nominal attenuation at 10°C at 18±0.3 dB at 60 MHz (for 2.6/9.5 pairs) and 5.3 dB at 1 MHz (for 1.2/4.4 pairs) for a given frequency dependence.

The shielding is made of two steel bands, except for the French cables containing 1.2/4.4 pairs, where bimetal bands (copper-plated steel) are used.

The polyethylene washers are the main type of insulation used in 2.6/9.5 pairs. 1.2/4.4 pairs use several types of insulation: polyethylene bladders (France), polyethylene sleeves (GDR); polystyrene cord (Finland), polyethylene washers with a plastic tube around them (The Netherlands).

The outside insulation on the coaxial pairs usually consists of plastic strips (1.2/4.4), paper strips (2.6/9.5) as well as plastic tubes, in order to increase electrical strength.

The electrical characteristics of the pair constructions (cf. table), regardless of some slight differences, meet the requirements of CCITT Recommendations G.623 and G.622.

These cables are produced with the following capacities: 2.6/9.5 - from 1 to 22 pairs, and 1.2/4.4 from 1 to 48 pairs, or in combination configurations such as 8 2.6/9.5 pairs and 6 1.2/4.4 pairs. Coaxial cables of varying capacity produced by the NKF Company are shown in figure 1.

The dynamics involved in increasing the number of pairs can be seen using the example of French cables employing 1.2/4.4 pairs used in the networks in that country. The cables made between 1968 and 1970 had an average capacity of 6.5 pairs, increasing to 16 pairs during 1976-1980. The production of cables with capacity of up to four pairs practically ceased in 1975 due to the lack of orders for them. Eighteen-coaxial cable was first produced in 1970, and 24-coaxial in 1972. The 48-coaxial cable displayed by the SAT Company at the exhibition was first produced in 1976. It is used in small amounts in the network, and on short links.

Table

Characteristic	Unit of Measurement	Coaxial cable characteristics							
		The Netherlands	Finland	GDR	CCITT (G.622)	The Netherlands	Finland	GDR	CCITT (G.623)
Wave impedance	Ohms	75±1.0 per MHz	75±0.6 (100%) 75±0.4 (95%) per MHz	75± 1.0	75±1.5 per MHz	75±1.0 per 2.5 MHz	75±0.3 (100%) 75±0.2 (90%) per 2.5 MHz	75± 0.3 per 2.5 MHz	75±1.0 per 2.5 MHz
Corrected echo attenuation (A_{echo})	dB	50(100%) 54(95%) for τ_{imp} = 50 nsec	48(100%) 54(80%) for τ_{imp} = 50 nsec	50(100%) 54(95%)	45(100%) for τ_{imp} = 100nsec 44-48* for τ_{imp} = 50nsec	50 (100%) 56 (95%) for τ_{imp}=50nsec		50 (100%) 56 (95%) for τ_{imp} =40 nsec	50 (100%) 56 (95%) for τ_{imp} =50 nsec
Input reflection factor	dB	35, up to 60 MHz	-	-	under study	40, up to 60 MHz	-	41 between 40-70 MHz	35 (100%) 38 (95%) in 4-62 MHz band, 30* in 20-100 MHz band; 20* in 62-500 MHz band
Attenuation at 10°C at	dB/km								
1 MHz		5.22	5.21	5.23	5.3	2.33	2.29	2.31	2.32
12 MHz		18.05	17.9	-	-	8.08	7.97	7.99	8.01
16 MHz		40.46	-	-	-	18.25	18.0	17.96	18.0±0.3

[Table continued]

Near-end cross-talk attenuation A_0, far-end attenuation A_1 or protection at far end A_p	dB	110(0.6-60 MHz) 500 m	A_p=120 (0.06-12 MHz) 440 m	115(0.06 MHz) 600 m	A_p = 87/8 km; 89/6 km; 93/4 km and 95/3 km-without inversion	130(0.06-60 MHz) 500 m	A_p = 140 (4-60 MHz) 400m	140 (4-60 MHz) 1500m	A_p= 140 A_p= 130 (4-62 MHz) 1500m

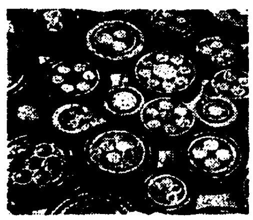

Figure 1

All of the coaxial cables contain balanced pairs, either quadded, or pairs and quads combined with 0.5-1.4 mm copper conductors in conjunction with 1.2/4.4 coaxial pairs, and from 0.6 to 1.3 mm in conjunction with 2.6/9.5 pairs.

These companies have mainly switched over to the use of aluminum jackets, either smooth or corregated, in their coaxial cables. Nonetheless, according to the prospectus from the NKF Company, there is another direction as well - the use of aluminum polyethylene laminate. Lead jackets are also still in use. Cables with lead jackets were displayed, for example, by the Nokia Company.

A promising direction is the use of aluminum for the outside conductors of coaxial pairs. This makes it possible to conserve scarce copper and to increase the mechanical strength of the pairs and the cables as a whole, and their reliability as a consequence.

Multi-pair coaxial cables employing 2.8/10.2 pairs with the outside conductor made of aluminum were displayed by the SAT and LTT companies. These cables are already being used extensively in the French system. The use of aluminum for the outside conductor provides copper savings of approximately 60% as compared with a standard 2.6/9.5 pair, and has identical electrical characteristics. In conversations, the company representatives expresed the opinion that the 2.8/10.2 pair will become basic and will fully replace the earlier 2.6/9.5 pairs, as well as the 3.7/13.5 with aluminum outside conductor. The CCITT is considering the question of standardizing the 2.8/10.2 pair on the international scale, with the following conductor design dimensions proposed: inside - solid copper with nominal 2.8 mm diameter; outside - aluminum strips 0.7 mm thick with a longitudinal welded seam and nominal diameter of 10.2 mm.

As follows from the prospectuses, technology exists to manufacture cables with 2.8/10.2 pairs and an outside aluminum conductor with capacity of 1-22 pairs. Figure 2 shows a 12-pair 2.8/10.2 cable produced by the LTT Company.

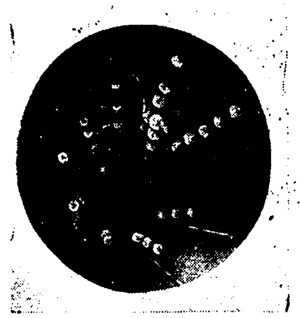

Figure 2

French and Finnish companies exhibited single-coaxial cables with familiar constructions in underground and overhead versions which are analogous to the VKPAP single-coaxial cables produced in the USSR.

It should be noted that overhead cables, not only single-coaxial, are used widely in these countries. For example, Finland uses four-coaxial overhead cables with 1.2/4.4 pairs. In the opinion of company representatives, the operation of overhead cables produces no problems.

Microcoaxial cables using 0.7/2.9 mm pairs were not exhibited this time at the exhibition by even one country. However, recommendation G.621 was adopted in 1976, in which their basic design and electrical characteristics were defined: internal conductor of copper wire with nominal 0.7-mm diameter; 2.9-mm inside diameter of outside conductor made of 0.1-mm copper strip; shield made of 0.1-mm steel strip; 75 ± 2.5 ohm wave impedance and 1 MHz; -36 dB (100%) corrected attenuation of echos from internal heterogeneities measured by 100-nsec sine-squared pulse;

-8.9 dB/km attenuation at 1 MHz at 10°C; -135 dB near- and crosstalk attenuation in 0.5-20 MHz band.

It is considered technically and economically most advisable today to use 1.2/4.4 pairs for analog transmission systems operating at frequencies of up to 12 MHz and for digital systems operating at speeds of up to 140 mbps, and 2.6/9.5 pairs for up to 60 MHz and up to 140 mbps and higher, respectively. A trend has recently been noted toward increasing use of digital transmission systems on the coaxial cables which provide the basis for the long distance communications system in many foreign countries. For example, there are plans to use digital transmission on 90% of all long distance lines in France by 1990.

The use of wideband analog transmission systems and high speed digital systems has forced many companies to improve their technology for manufacturing coaxial cables in order to ensure stability of the electrical characteristics of the pairs in the spectrum of these systems.

Instead of press-fitting cut washers, technology has been developed to cast them directly on the inside conductor, which increases the uniformity, electrical strength and mechanical stability of coaxial pairs.

New technology is being used to twist the coaxial pairs to form the conductor, in which the pitch of the twist constantly changes along the length of the cable. This makes it possible to avoid repeating heterogeneities having the same period as the pitch of the twist, thus eliminating their strong effect on transmission characteristics in the high frequency range. Technology has also been improved in terms of increasing the surface quality of the conductors employed in the coaxial pairs.

The use of modern technology for manufacturing coaxial cables and the availability of special instrumentation for testing and evaluating electrical characteristics of pairs during production allow the companies to guarantee stability, and ensure precise knowledge of the transmission parameters of the coaxial pairs throughout the entire spectrum of the analog and digital transmission systems employing them.

Balanced high frequency communications cables. No new types of balanced HF cables were presented at the exhibition. The Nokia Company and KWO combine exhibited familiar constructions of long-distance balanced HF cables analogous to the MKSA cables produced in the USSR. It follows from the prospectuses of the GDR that the star-twisted cables with an aluminum jacket produced by the KWO combine are suitable for use in analog transmission systems with a maximum line spectrum frequency of 522 KHz, and in digital transmission systems operating at up to 8488 mbps.

Analysis of the prospectuses of the French companies indicated that, for example, the LTT Company is producing cable of this type with a maximum capacity of 12 star-wound quads with conducting cores 0.9, 1.2 and 1.3 mm in diameter with paper or porous polyethylene (except for cables with 0.9-mm conductors) insulation. These cables are designed for use at frequencies of up to 552 KHz.

Balanced HF cables with star-twisted quads are also used in a broad frequency range in the USSR. For example, the K-1020S and IKM-120 equipment exhibited in the Soviet division operate over these cables (up to 4896 MHz and 8448 mbps, respectively).

Cable fittings. Sections on cable fittings were presented at the exhibition by Nokia (Finland), Philips, ECC-Europa and NKF (The Netherlands), Raychem (French division), CIT-Alcatel (France) and NITTO (Japan). The Nokia Company demonstrated a method for joining a 2.6/9.5 coaxial pair which provides uniform wave impedance at the junction. This method consists of butting the inside connector together and connecting the outside connector with shaped half-couplings without changing the inside diameter of the inside conductor. During the installation, the polyethylene discs are replaced with fluoroplastic, and the shield is restored by winding on pre-straightened seal shielding strips. Both the inside and outside conductors are joined using high-temperature self-fluxing solder. The inside conductors are soldered using solder in the form of a sleeve, while the outside conductors are soldered with strips placed on the edge of the inner surfaces of the half-couplings. The inside and outside conductors are soldered by means of universal electrical soldering tongs with copper-graphite electrodes.

The Nokia Company also displayed cylindrical unattended repeater containers for the IKM-30 system, with 54 repeaters for installation in cable channeling wells and with 2 and 8 repeaters for installation on towers. The unattended repeater container for man-hole installation (figure 3) has a removable sealing cover which is bolted to the housing through a rubber insert, and can be put under autonomous positive gas pressure. The tower-mounted containers (figure 4) have removable cap-like covers which are also sealed with rubber inserts. The flanges of the trapezoidal cross-section of the cover and container base are joined by a sleeve having the same shape. These containers have an anti-corrosion coating and are provided with cable stubs approximately six meters long with a factory sealed end piece.

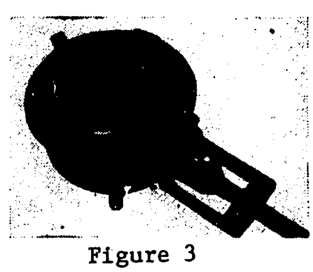

Figure 3

Figure 4

The CIT-Alcatel Company displayed a cylindrical unattended repeater container for oil and gas pipeline communications systems (figure 5). This container is designed to employ single-coaxial cable. The cable inputs are designed as a pressed polyethylene feed-through from the line cable to the station cable, which is terminated by a connector. The cable input devices are connected to the container with the help of rubber inserts with additional special sealing agent poured around the inlet tube. One design feature of this container is the use of a protective cap which uses the principle of a diving bell, which prevents water from entering the container even if it is fully submerged.

Figure 5

The NKF Company showed a method of installing cable connectors and terminating devices for 2.6/9.5 cables. The pairs are joined in the traditional way, by low-temperature soldering employing sleeves to join the inside conductor and cylindrical inserts and sleeves for the outside conductor (figure 6). The installation of the terminating device is singular in that the 2.6/9.5 coaxial pairs are first connected directly to its small connectors, after which these connectors are secured to the plate of the termination device (figure 7).

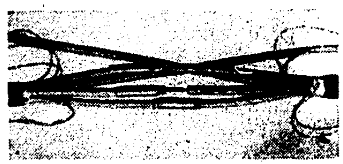

Figure 6

Figure 7

The Philips Company displayed a container which accommodates unattended repeater equipment for analog systems and one for digital systems operating over coaxial cable. The container (figure 8) is made of aluminum alloy with a protective anti-corrosion coating. The design of the container allows connection of cables with either lead, aluminum or steel jackets. The mainline cable is connected to the container by joining it with the flexible station cables of the cable input device using standard mounting parts. The container is sealed by means of a U-shaped rubber gasket. The air space between the walls of the insert is used for quick checking of the seal when the lid of the container is closed.

The Raychem, ECC-Europa and NITTO companies displayed a number of heat-seating articles: tubes, cable guards, split couplers for cable mounting made of various materials - polyolefins, polyvinyl chloride, fluorine-containing elastomer, fluoroplastic, etc. The shrinkage factor of the heat-seating articles produced by these companies is between 1.25 and 6.0. Heat-seating articles with relatively small diameters - up to 120 mm - are made by extrusion or pressure casting. The NITTO Company also produces large-diameter heat-shrink tubing - up to 1.200 mm - using a

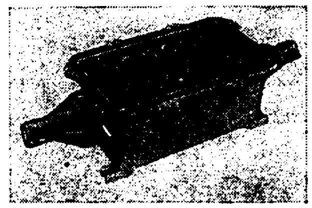

Figure 8

new technology: welding heat-shrink film on special forms.

The "Hada 200" heat-shrink cable guard produced by Raychem (figure 9), with a shrinkage factor of about five, is of interest. The coupling includes the heat-shrink cable guard, a flexible support tie made of stainless steel which fixes the seam of the guard; a support casing; solvent-impregnated wipers to remove grease from the cable; a piece of emery paper for cleaning the cable; silica gel to be placed in the coupling; aluminum foil for repairing the cable shield; clamps for installing the split coupler guard; and installation instructions. The guard is coated with temperature-sensitive paint which allows visual monitoring of the optimal seating temperature. The attachment of wedge clamps makes it possible to seal several (two or three) cables.

Figure 9

Cable guards used to repair cable jackets with a plastic clamp and a shrinkage factor of three are also produced by the ECC-Europa Company. These guards use two types of glued substrates - one to seal the guard to the cable and the other to seal the guard around the clamping connection. Tesla (Czechoslovakia), SITEL (France) and Sedlbauer (FRG) displayed overvoltage protection devices - spark gaps and isolation transformers. The spark gaps produced by the SITEL Company are glass articles containing radioactive gas employing tungsten leads which are designed for ignition voltage of 240 V d.c. and nominal shock current load of up to 20 kA. The inherent capacitance of the spark gaps does not exceed 5 pf. The Tesla spark gaps are of glass-and-metal construction and are also designed for pulsed currents of up to 20 kA. These spark gaps are distinguished by their small dimensions.

The isolation transformers produced by the Sedlbauer Company are designed for protection against overvoltages occurring in communications cables running in the same channeling as power cables. The transformers are produced with output impedance of 600 ohms (for 0.3-6 KHz range) and 150 ohms (for 6-252 and 6-552 KHz range).

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USSR

CITY TELEPHONE CABLES

Moscow ELEKTROSVYAZ' in Russian No 4 Apr 82, pp 60-63

[Article by D.L. Sharle]

[Text] City telephone cables were exhibited at the "Svyaz'-81" exhibition by the foreign companies NKF (The Netherlands), Nokia (Finland), LTT and SAT (France) and the KWO combine (GDR). These have in common, as before, the employment in series-produced cables of current conducting copper cores 0.4-1.0 mm in diameter, primarily 0.4-0.6 mm, although we know from the literature that a number of countries are working on replacing copper conductors with conductors made of aluminum alloy or copper aluminum. In particular, a large portion of the distribution and mainline telephone system in Great Britain has been switched over to cable with aluminum conductors in cities.

As before, there are two types of conductor insulation: air-paper (tubular paper in the countries named above) and polyethylene - solid and porous (except for the GDR, where polyethylene-insulated cables are produced almost exclusively).

Some of the countries (for example, The Netherlands) continue to use paired twisting of conductors into groups, while other countries use quadded twisting (GDR, Finland, France). The overall structure of the cables is primarily bundled, with individual color-coding of all 10 pairs in an elementary bundle, and with each cable pair a and b clearly distinguished.

The maximum number of pairs in the cables ranges from 2 to 2700 (as we know, the maximum numbers in the US and Japan are 3300-3600). Table 1 gives an idea of the ranges of pair numbers which the participating countries use in cables designed for installation in cable conduits (i.e., unshielded) or directly in the ground (shielded), as a function of the diameter of the current conductors.

Characteristic tendencies in the development of city telephone cables include the following: a continuing attempt to replace lead shields in cables with air-paper insulating jackets of other metals (steel, e.g., in the FRG, and aluminum in Finland) and even plastic (in The Netherlands); increasing employment of cables with polyethylene insulation - sealed, i.e., with the empty space in the core filled with a hydrophobic compound; searches for improved methods of cable sealing - completely filling the conductor with petrolatum (petroleum jelly), partial sealing with

Table 1

Exhibitor country	Conductor insulation	Cable type	Number of cable pairs with copper conductors with diameter, mm					
			0.4	0.5	0.6	0.7	0.8	1.0
The Netherlands	Air-paper	With and without armor	100-2400	100-1200	100-900*	-	-	-
Finland	Air-paper	Without armor	100-2400	100-1200	100-400	-	-	-
		With armor	100-1600	10-1200	10-400	-	10	-
	Polyethylene	With and without armor	-	3-200	10-100	-	10-50	-
France	Air-paper	Without armor	224-2688	8-896	28-896	-	28-672	224;448
		With armor	-	2-448	28-448	-	28-224	224
	Polyethylene	Without armor	8-2688	8-896	8-896	-	8-672	-
GDR	Polyethylene	Without armor	-	6-1000	-	6-600	-	

*0.63-mm conductor diameter

waterproof plugs (The Netherlands), as well as hydrophylic dry powders (France); universal manufacture of self-supporting cables with built-in support cables carrying 10-100 pairs (and even 200 in Finland); production of special cables with group shields for digital transmission systems (FRG, Finland); replacement of shielding in cables with polyethylene insulation with special uninsulated protective conductors.

Cables with air-paper insulation. Cables with air-paper insulation are produced in The Netherlands carrying 100 or more pairs. All of the cables are bundle-twisted: the 100-pair cables are twisted from 10-pair elementary bundles, (200-400)x2 cables are twisted from 50x2 main bundles, and (600-2400)x2 cables are twisted from 100x2 main bundles. Seven colors are used for color-coding of the pairs in each elementary 10-pair bundle (table 2).

Table 2

Number of pairs in bundle	Color of conductor insulation		Number of pairs in bundle	Color of conductor insulation	
	a	b		a	b
1	white	blue	6	red	blue
2	white	orange	7	red	orange
3	white	green	8	red	green
4	white	brown	9	red	brown
5	white	gray	10	red	gray

The primary and most important feature of NKF cables is the combination of air-paper insulation with an aluminum polyethylene jacket (when necessary the cables can be produced with a lead jacket). A polyethylene-coated shield made of aluminum strip is laid lengthwise along the desiccated cable core, with a polyethylene jacket welded in place during extrusion. A barrier is thus formed which prevents moisture from penetrating the cable. The weight of the cable is slightly more than half the weight of cables with lead jackets.

There is no difference in the numbers of pairs carried in armored and unarmored cables used in The Netherlands. The maximum outside diameter of non-armored cables, which is limited by the conduit diameter, is 75 mm, while armored cables up to 87 mm in diameter are produced.

The thickness of the polyethylene-aluminum jacket is from 1.6 to 2.6 mm (in cables with strip insulation diameter of 15-70 mm). The thickness of the armor strip is 0.5, 0.8 and 1.0 mm. The thickness of the protective polyethylene tubing in shielded cables is 1.8-1.0 mm. The minimum radius of curvature of cables during installation at temperatures above +5°C is 15 D, where D is the outside diameter of the cable.

There is a wider range of nominal number of pairs, namely 10-2400, in Finnish cables. Spiral twisting of the conductors is used with up to and including 150 quads, while bundle twisting is used for 200 or more quads. Cables containing 400-2400 pairs are twisted from 50x4 spiral-wound bundles; no elementary bundles are used. The construction of the conductors in, e.g., a 1600 and 2400-pair cable are thus (1 + 5 + 10)x50x4 and (4 + 8 + 12)x50x4.

One distinguishing feature of the Finnish cables is the use, in addition to the traditional lead, of a smooth aluminum jacket 0.9-1.2 mm thick with a core diameter of the strip insulation of approximately 22 mm and corregated aluminum 0.8-1.4 mm with larger diameters. An anticorrosive layer and polyethylene protective tubing surrounds the aluminum jacket. The number of pairs in cables with aluminum and lead jackets is practically the same. The maximum outside cable diameter is 78 mm.

Cables with aluminum jackets are unarmored. Cables with lead jackets are armored using steel strips 0.5, 0.8 and 1 mm thick. Cables for river crossings which are laid at depths of up to 25 meters are produced with conductors 0.5, 0.6 and 0.8 mm in diameter, with 10-100 pairs, using a lead shield with round steel wire armor 0.3 mm in diameter, and bituminous-fiber impregnated protective sheathing (paper, jute).

Cables produced in France differ from those produced in other West European countries in that the number of pairs they carry are usually multiples of 14 rather than 10 (1x4x0.5 and 4x4x0.5 cables are an exception). High capacity cables carrying 448 pairs or more are twisted from 112-pair main bundles, each formed of four 28-pair elementary bundles. The construction of the latter is (4+ 10)x4. Cables carrying up to 56 pairs use spiral winding by regulation, while 244x2 (i.e., 112x4) cable is twisted using the 4x[4x(7x4)] system.

If we line up the number of pairs of Dutch, Finnish and French cables and domestically-produced cables and compare them, it turns out (table 3) that the row of domestic cables is most heavily concentrated in the 100-1600-pair range - 14°; The Netherlands row contains 10°, while the most uniform rows - those of the Finnish and French (8° each) are closest to the rational dimensional series of preferred numbers.

The cable jackets are made of lead with 0.7% antimony added. The maximum outside diameter of a cable carrying 2688 pairs is 70 mm, i.e., slightly smaller than the 2400-pair Finnish (78 mm) and Dutch (75 mm) cables.

<u>Polyethylene-insulated cables</u>. This type of cable is produced in Finland with up to 400 pairs (i.e., 100x4); cables designed for conduit and trench installation use the same construction. The core insulation is porous polyethylene, and the center is petrolatum-filled. 10x4 cables consist of two spirals (2 + 8), cables with 15, 25 and 50 quads are twisted from elementary five-quad bundles, while 100x4 cables are twisted from 25-quad main bundles using the 4x[5x(5x4)] system. The strip insulation is surrounded by an inside polyethylene jacket, and a shield made of aluminum strip coated with a plastic film; the outside conductor is made of photostabled polyethylene. The following are the nominal inside jacket thicknesses: 1.0 mm in cables with diameter of up to 25 mm inside the jacket, and 1.2 mm in cables with diameters of 25-30 mm inside the jacket. The nominal thickness of the outside jacket are between 1.4 and 2.4 mm. The maximum outside diameter of the cable is 37 mm.

Table 3

Number of cable pairs

USSR	The Netherlands	Finland	France
100	100	100	112
150	-	-	-
200	200	200	224
300	300	300	336
400	400	400	448
500	-	-	-
600	600	600	672
700	-	-	-
800	800	800	896
900	900	-	-
1000	1000	-	-
1200	1200	1200	1344
1400	-	-	-
1600	1600	1600	-
-	1800	-	1792
-	2000	-	-
-	2400	2400	2688

Cables for underwater installation and certain conditions of direct burial in the ground are protected, respectively, with armor made of zinc-coated steel wire: round, with 1.4-mm diameter, and 0.8x3.0 mm flat. The cushion beneath the armor is made of bitumen and impregnated paper, while the outside tube is polyethylene.

A color-coding system helps to distinguish all five quads in each elementary bundle. Conductor a uses blue, orange, green, brown and gray; conductors b, c and d in all quads are colored white, yellow and red, respectively. Each elementary bundle in a main 25x4 bundle has a distinctive identifying winding in blue, orange, green, brown and gray.

French cables use solid polyethylene insulation and an aluminum-polyethylene jacket (called "Alupe" in French). The system by which the cores are twisted and the nominal series of pair numbers are basically the same as in cables using air-paper insulation. The outside diameters of polyethylene-insulated cables are 5-8 percent larger on the average than cables using air-paper insulation.

In addition, high frequency city telephone cables with 0.5-mm conductors and porous polyethylene insulation are produced with a working capacity of 25-27 nf/km. Quad-twisted cables with up to 140 star quads are used for 12-channel transmission systems in the frequency spectrum up to 120 KHz, or 120-channel in the spectrum up to 552 KHz. The distance between repeaters is 8 and 4 km, respectively. Pair-twisted cables with up to 36 pairs are designed for videotelephone systems in the frequency spectrum up to 1 MHz.

Conductors with diameters of up to 0.5 mm in GDR-produced cables use solid insulation, while 0.7-mm conductors use porous polyethylene. There are constructions with an aluminum shield and single polyethylene jacket, and with a lengthwise corregated copper shield placed between two jackets, the inside of polyethylene and the outside of polyethylene or polyvinylchloride. Cables using the most recent construction employ uninsulated protective conductors instead of the shield ("Reductionsadern") located in the outside spiral of the core and providing the same protective factor on the average as a shield. The standard for the electrical resistance of the protective conductors is 7.0 ohms/km for distribution cables carrying 3-100 pairs. These cables, carrying conductors 0.5 and 0.7 mm in diameter, contain, respectively, two protective cores 1.26 mm in diameter and one 1.8 mm in diameter. The standard for the electrical resistance of the protective cores in cables with 100 or more pairs is 2.4 ohms/km. The number and diameter of these are 6x1.26 and 3x1.8 mm in cables with 0.5- and 0.7-mm conductors.

Polyethylene-jacketed cables can be laid at temperatures ranging from -20 to +50°C; these cables can be held at temperatures between -40 and +60° before and after installation.

Sealed cables employing an original construction were demonstrated by The Netherlands. Instead of filling the entire length of the empty space in the center of the cable with petroleum jelly, a compound based on silicoorganic rubber is placed periodically in the core. The compound has low viscosity while being injected, but the viscosity increases upon injection, so that the compound does not spread along the cable but rather stays in place and vulcanizes at room temperature. This results in the formation of waterproof plugs placed at regular intervals along the cable. These plugs are $\Delta \simeq 20$ cm long, and are placed every L = 4 m.

The method for forming plugs is suitable for both solid and porous polyethylene insulation. The interval between the strip insulation and aluminum-polyethylene jacket can also be sealed by using narrow rings of waterproof material outside the strip insulation placed in the same locations as the plugs.

The company name of cables using these waterproof plugs is "Aqua Block Cable". We know that for a given operating capacity, the outside diameters of solid filled sealed cables is approximately 20 percent larger than unsealed cables, and they weigh 45-50 percent more. This can be avoided completely or partially by increasing the acceptable operating capacity or by employing porous polyethylene insulation instead of solid. When plugs are used, the outside diameters D and weight M of the cables is less than filled cables with D and M taken as 100 percent (figure 1).

Cables with plugs have practically the same outside diameters as unfilled cables, and weigh no more than 10-15 percent more. As a result, savings are achieved in the filling agent as well as polyethylene and steel (in shielded cables). Thanks to the low degree of filling of the cable (5 percent), the influence of the plugs on the transmission and noise protection parameters is insignificant. The lengthwise sealing integrity of the cable is retained even after stretching and bending and temperature fluctuations. These cables have successfully undergone aging tests at +60°C for 300 days.

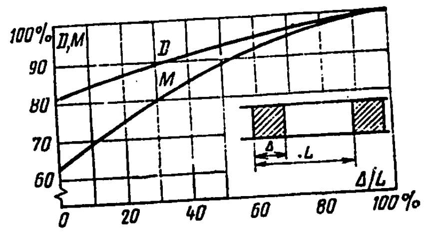

Figure 1

Table 4

Parameter	Unit of measurement	Parameter value in cables: The Netherlands	Finland	France	GDR
Electrical resistance at 20°C, not over:	ohms/km				
cores		93	-	-	-
stub		-	186	186.2	190
Attenuation at 20°C at 800 Hz	dB/km	1.35	1.2	1.35	1.19
Insulation resistance, at least	MΩ x km	5000	2000	5000	10000
Working capacitance at 800 Hz, not over	nf/km	52	45	50	44
Test voltage:	V				
between conductors		500	-	600	500
between conductors and jacket (shield)		2000	-	2250	2000
Capacitive coupling coefficient:	pf				
average		70/500m	500/500m	100/300m	-
maximum		500/500m	1000/500m	300/300m	-

In the opinion of the representatives of the French SAT Company, the employment of cellulose-based powders applied to insulated conductors by spraying in an electrostatic field holds promise for core sealing. If moisture should enter the cable, the hygroscopic powder swells up, fills the empty space in the core and thus prevents the moisture from moving along the cable.

Table 4 compares the electrical parameters which are standardized in different countries for city telephone cables carrying the common 0.5-mm conductors.

The Felten und Guilleaume Company (FRG) is producing special cables for secondary digital transmission systems (8 mbps). The pairs in both directions in the 2x(34x2x0.65) cable are separated by a Z-shaped shield (figure 2). The 34-pair main bundles consist of four elementary bundles (8x2 + 8x2 + 9x2 + 9x2). In the 4x(34x2x0.65) cable, each main bundle has a separate D-shaped shield of aluminum foil (figure 3). The cables are filled with petrolatum.

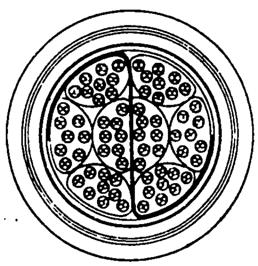

Figure 2

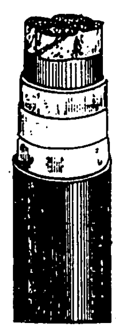

Figure 3

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USSR

'SVYAZ'-81' INTERNATIONAL EXHIBITION

Moscow ELEKTROSVYAZ' in Russian No 4 Apr 82 p 64 plus inside back cover.

[Unsigned article]

[Text] Exhibits Displayed in Soviet Division of Exhibition.

1. "Kvant" quasi-electronic automatic private branch end office designed for operation as part of national unified automated communications network and in departmental systems. Supports automatic long distance communications and provides 28 additional types of services. Maximum capacity 2048 numbers; maximum number of one-way intertoll trunks - 384; number of outside lines - 32.

2. ELIT-T display-type telegraph terminal designed for data-processing work stations at terminals on the nationwide telegraph networks; can be installed at tape-punching positions, telegram format conversion positions, indexing them at the message switching center, and at locations where telegrams are received by telephone.

3. PPR regenerator tester, designed for certifying regenerators and digital transmission systems with respect to three parameters: error coefficient, output signal amplitude and noise tolerance; and for measuring the error coefficient in digital transmission systems themselves at the third and fourth level of the hierarchy. The system consists of a code generator, error detector and mainline cable attenuation simulator.

4. "Luga" receiving facsimile equipment.

5. Moscow city telephone system technical operations center, serving 300-500,000 numbers. Designed for gathering and processing data regarding performance of technical equipment in city telephone system; provides centralized data acquisition and status monitoring and analysis of automatic exchange equipment, line equipment room transmission systems, power supplies and line structures. Also has provisions for transmitting control instructions to facilities based on the analysis. The data received is processed on the basis of a standardized SM-4 minicomputer.

6. Domestic radio equipment.

7. OUKS-T terminal telegraph installation designed for automating basic technological processes involved in processing telegrams at telegraph terminals and ex-

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changes hard-wired to message-switching center.

8. ASV time-service equipment used to provide time information in verbal form upon request to subscribers of large city telephone systems.

9. "Izotop-1" transmitting and receiving facsimile equipment designed to transmit black and white and color images in the form of color-separation signals over voice-grade and physical lines; the signals are reproduced on photographic film which is then used to print the pictures lithographically.

10. "Otel'" equipment for message accounting for all types of telephone conversations direct-dialed from hotel telephones; also used to produce documentation and provide accounting of conversations held between the hotel guests and administration and between the hotel administration and communications enterprises.

11. KIT pulse-code telegraphy equipment, consisting of multiplexer, intermediate regenerator set KRP and subscriber trunk equipment.

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FRANCE

FIRM WANTS TO PENETRATE AMERICAN FIBER OPTICS, INFRARED MARKET

Paris L'EXPRESS in French 14-20 May 82 pp 112-113

[Article by Francoise Chirot: "SAT Is Ambitious"]

[Text] Who has heard of Telecommunications Corporation [SAT]? In high technology, it is nevertheless a leader, which despite serious labor problems is trying to pierce the American market.

Telecommunications Corporation--SAT--A mysterious acronym, a little known corporate name for this 50 year old firm specializing in high technology. Nevertheless, it is one of those leaders from which the French economy expects a fresh boost.

A lengthy labor dispute and the purchase of another firm have recently twice brought this firm, whose legendary discretion has given it the title of "the most anonymous telecommunications corporation," into the limelight.

With the public purchase offer it made in order to takeover Silec, it extended its hold on the telephone cable market. At the same time, it strengthened the G3S group of which it is a member.

Telecommunications, information systems, aeronautics and space are SAT's areas of activity. The firm designs complex and sophisticated instruments intended for specialists. It does not make mass-marketing products. Its clients are powerful and rich, but rather discreet: 40 percent of its production goes to the PTT, 35 percent to National Defense. Large companies and banks purchase the remainder.

SAT employs 7,000 people in eight factories; 3,000 engineers, executives, technicians, employees, and workers labor in the research departments and production workshops of its Paris establishment. It occupies 50,000 m^2 of floor space in the 13th ward of the capital, in a picturesque district next to the immense depots of the Austerlitz train station, the tall towers of the renewed areas near the Italian Gate, and the narrow and winding streets of Old Paris.

With total sales of 2.3 billion francs, SAT is only one piece of a financial arrangement which resembles a Chinese puzzle. Together with SAGEM [Company for General Applications of Electricity & Mechanics] and the Signals Company, which are similarly specialized in aeronautical and maritime equipment, signaling systems, electronics, and information systems, SAT forms the G3S group: 19,700 employees in thirty establishments in France and abroad. Total sales figures: 6.5 billion francs in 1981. The Signals Company holds 40 percent of SAGEM's capital. SAGEM in turn controls 41 percent of SAT...The whole operation is under the control of 3S Executives, an unusual aspect of this group.

Formed by the executives of the three firms, 3S Executives, which owns 40 percent of the Signals Company, is the real master of G3S. To achieve this, some 800 executives broke their piggybanks. In 1978, the minimal capital subscription was 40,000 francs, payable in 4 years. "Thanks to this system, we had direct access to information and participated in the life of the group," explains Jacques Dockes, president of 3S Executives and technical planning director at SAT.

They thus had front-row seats to watch the evolution of their firm. They had some shaky moments, because to get out of the trouble it was in in 1978, SAT had to make a double effort to diversify and export.

In the 70's, it had grown rapidly, thanks to the telephone market. In those days to get a phoneline, one had to scheme, use ones' connections, and claim professional need. Between 1972 and 1977, the PTT decided to catch up and equip the country with new telephone centers. SAT profitted from this. Total sales climbed 15 percent per year. The firm invested, built six factories, and hired workers.

However, once the re-equipping was completed, SAT's growth abruptly halted: "It is never good to depend on a single sector," admits Georges Plantier, commercial director. On the spot, SAT invested up to 20 percent of its total budget in research. It has thus fine-tuned two processes which will allow it to re-establish its reputation as an industry leader: fiber optics and infra-red technology.

Infra-red rays offer the possibility of longer-range detection and are used in missiles or airplanes: SAT delivers to Dassault and Aerospatiale.

Optical fibers have more peaceful uses. Lighter and more flexible than the traditional copper wires used for making cables, they allow transmissions of 10 to 20 times more information. Mastery of this technique allowed SAT to capture the test market of Biarritz. Five thousands inhabitants of this city will be the first Frenchmen to enjoy "visiophone," the new telephone which allows one to see the party with whom one is speaking. At the same time, thanks to a cable network they can receive foreign television, several radio programs, consult data banks or directly inspect their electrical meters. The work which has just started will keep SAT busy until the middle of 1983.

The 39 Hour Detonator

SAT has also pierced the export market. In Cairo, Qatar, Abidjan, and Budapest, it has installed multiplex networks or microwave equipment. Located in more than 50 countries, its export sales figures have reached 500 million francs. Sure of its competitiveness and of its technology it is now trying to pierce the American market. To achieve this, it is collaborating with General Optronics and Interconnect Planning Corporation.

Diversification, high technology, and executive participation in capital investment haven't guaranteed freedom from labor disputes. In fact, SAT has just passed through a more turbulent period than any it had known before. For two months, work stoppages multiplied in its Paris establishment. The application of the 39 hour work week was the detonator. In February 1982 management, as in other firms, tried to gain time and "sweep away" certain acquired rights. Rather than quickly negotiate with personnel representatives, it preferred to wait for the signing of an agreement with the metallurgical industries and mines branch on which it depends. Next, playing with a system of flexible schedules which it had applied for a long time, it proposed to its employees a 39 hour 45 minute workweek, anticipating the recovery of holidays expected during the year, which recovery had until then been optional. The strike took off from that point.

In truth, things would have worked out if the workers hadn't used the conflict to settle an old quarrel. "It's a fight for our dignity," explained one of the employees, who had come with at least a hundred others to demonstrate in front of the company's stand at the Components Exhibition on April 2.

Because, on the side of team play, SAT is not a leader. "They don't consult us on anything," protested the CGT, CFDT, FO and CGC unions, which seem to practice within those walls an unbroken unity. In fact, it seems that lawsuits are more common than collective agreements. Thus, for having posted solidarity tracts with the Polish movement Solidarity, as it did in many firms last winter, SAT's CFDT saw itself cited in front of an arbitration tribunal.

The judges will also have to decide, on appeal, the case brought by SAT's management against its unions, complaining that they disseminated and sold tracts and newspapers in the firm's canteen. Beyond these skirmishes, however, it's the salary policy which causes SAT's workers to grumble. In truth, there is no agreement linking wage increases to price increases. For several years, management has favored individual increases rather than indexed increases, resulting in disparate salary changes. The unions estimate that "For some, it has lead to a loss of buying power of 2.6 percent compared to the cost of living."

According to them, this change in labor policy dates back to 1972. At that time, the firm's founders reached the age limit and were replaced by executives who were already members of the hierarchy. The chief executive officer, 58 year old Jacques Boulin, is a polytech grad more interested in technological prowess than in public or labor relations.

"It's true that we have favored industrial development over labor policy," says Georges Plantier.

The reorientation of the firm's activities was necessary to insure its future. Now SAT should maintain its new direction. One small cloud remains: in the electronics sector, it is the only large firm to remain in private hands. If, for its own purchases, the state does not respect the principle of competition, and decides to favor the firms it has just nationalized, SAT could pay the piper. Even if they only murmur about it, the unions and management of SAT have at least that one worry in common.

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