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No 3

ECONOMIC INTELLIGENCE REPORT

STATUS OF HIGH-CAPACITY COMMUNICATIONS IN THE SOVIET BLOC

EIC SR-6

October 1962

ECONOMIC INTELLIGENCE COMMITTEE

Subcommittee on Electronics and Telecommunications

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Approved For Release 1999/09/21 : CIA-RDP79S01100A000100110007-1

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FOREWORD

This report has been prepared by the members of the Subcommittee on Electronics and Telecommunications of the Economic Intelligence Committee (EIC). Departments and agencies represented on the subcommittee are the Departments of State, Defense, and Commerce; the United States Information Agency; the National Security Agency; and the Central Intelligence Agency.

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STATUS OF HIGH-CAPACITY COMMUNICATIONS IN THE SOVIET BLOC

I. Introduction

Two aspects of high-capacity communications in the Soviet Bloc are assessed in this report: (1) production of high-capacity communications equipment and (2) the planned expansion of main-line high-capacity communications facilities during the current Seven Year Plan (1959-65) of the USSR. For the purposes of the report, high-capacity communications equipment is defined as equipment having a capacity of 1 or more television channels or 24 or more telephone channels and includes microwave radio relay, tropospheric scatter, and multiconductor and coaxial cable and associated multiplexing equipment.

Microwave radio relay equipment provides a high-capacity, multi-relay communications system capable of operating over great distances via relay stations regardless of terrain. This technique is especially suited to spanning mountains, forests, and the bleak tundras of Siberia. The number of simultaneous telephone and telegraph channels that can be transmitted over a microwave system far exceeds the capability of open wire or multiconductor cable. The system also has the following other major advantages: (1) shortness of installation time, (2) economy of construction and maintenance, (3) no requirement for physical connections between transmitting and receiving stations, and (4) suitability to subsequent increase in capacity at less cost than other systems.

Coaxial cable also can provide a high-capacity communications system. Four-tube coaxial cable, for instance, when multiplexed with appropriate equipment can provide 2,000 or more telephone channels. Compared with microwave relay systems, "hardened" (underground) cable networks are more expensive to install and maintain but are much less vulnerable to blast damage -- a strategic advantage well known to Soviet planners.

The USSR, East Germany, and Hungary are the principal Bloc countries producing high-capacity equipment. Poland and Czechoslovakia produce special types of high-capacity equipment in limited quantities. Although production capacity in the Bloc is being increased, output of microwave radio relay equipment, multiplexing equipment, and coaxial cable has not been adequate as yet to take the place of imports.

The USSR has delayed development and quantity production of high-capacity communications equipment, probably because of the lower

priority afforded to development work on civil communications equipment rather than because of the technological complexities inherent in the development and subsequent series production of this equipment. In the USSR, first priority for research, development, and production of any kind of electronic equipment has always been given to military requirements. Even so, the pressing need for high-capacity civil communications (which now include the needs of the military services for ready access to high-capacity civil systems) is resulting in an expanded effort to develop and produce high-capacity equipment for civil use.

For the first time in Soviet history, the current Seven Year Plan gives high priority and allocates large sums of money to the expansion of the Soviet high-capacity civil communications system. The plan calls for the installation of about 13,500 miles of microwave radio relay lines and about 20,000 miles of multiconductor and coaxial cable lines. Thus all major Soviet cities would be linked together in a vast communications network, and high-capacity systems would be pushed further eastward into Siberia. This plan not only would help provide the large numbers of telephone channels long needed for automatic intercity telephone communications but also would substantially assist in meeting the persistent demands of government, military, industrial, and civilian subscribers for various types of communications channels.

At present it appears that the goals of the Seven Year Plan for 1965, in terms of length of lines, will be met and possibly exceeded, but, because of shortages of multiplexing equipment, it is doubtful that the maximum capacity of these lines will be fully realized by the end of 1965. These shortages, however, are expected to ease toward 1965.

Since 1959, the first year of the Soviet Seven Year Plan, the European Satellites have made steady progress in their efforts to establish an integrated, Bloc-wide, arterial high-capacity communications network. Several main lines that will connect the European Satellites and the USSR are under construction and will feature microwave radio relay and four-tube coaxial cable facilities. Prospects are good for the installation of a significant portion of the network by the end of 1965. Nevertheless, as in the USSR, shortages of multiplexing equipment will hinder fulfillment of the plan by that time.

II. Production of High-Capacity Communications Equipment

A. Microwave Radio Relay Equipment

1. USSR

The Strela M, a 24-telephone-channel system operating in the 1,700-to-2,000-megacycle (mc) band, was the first microwave radio

relay equipment produced by the USSR. Production was begun in 1955 at the Pushkino Experimental Plant of Scientific Research Institute (NII) 100 of the Ministry of Communications but later was turned over to enterprises of the Ministry of the Radiotechnical Industry. The Strela T, which was developed during 1955 and was in production in 1956, is a system similar to the Strela M and provides one broad-band channel for television transmissions. The Strela M when supplemented with the Strela T is capable of transmitting 24 telephone channels and 1 television signal over distances of 175 to 250 miles.

By 1957 the USSR had experimentally produced a R-60/120, which provides telephone and television transmissions simultaneously. The R-60/120 equipment was placed in series production some time in 1958. The standard R-60/120 operates in the 1,600-to-2,000-mc band and provides three radio frequency (two telephone and one television) trunks. With proper multiplexing equipment, each telephone trunk provides 120 simplex* telephone channels, one service channel, and one remote signaling or telecontrol channel. The television trunk can provide a reversible television channel.

The R-600, or Vesna, is the latest microwave radio relay equipment developed by the USSR. Present Soviet plans indicate that this equipment will be the primary facility used on major trunk lines. The Vesna, which operates in the 3,400-to-3,900-mc band, is designed for television and telephone transmissions at distances up to 3,000 miles. The construction and electronic characteristics of this system allow for a gradual increase in the number of trunk channels as multiplexing equipment becomes available. The advantage is similar to that of the US TD-2 system, which has been in service for more than a decade.

The Vesna has two methods of operation, with three trunks and with six trunks. Each trunk can provide either a duplex television transmission, including sound, or a maximum of 600 telephone channels. Three-trunk operation can provide one reversible simplex television transmission and up to 1,200 telephone channels with automatic switchover standby equipment. Six-trunk operation probably will be used as follows: two trunks for television relaying, three for a maximum of 1,800 voice channels, and the sixth as a standby.

One of the first models of the Vesna was produced in 1957 at the NII 100, and the zero series reportedly was manufactured in 1959 at an unidentified plant near Mytishchi. The Vesna is believed

* Simplex is a method of communication between two stations in one direction at a time; duplex involves communication between two stations in both directions simultaneously.

to have been in regular series production since January 1960. Although production of this equipment has been going on for several years and a few lines are in operation, there are no known routes on which the full 600-voice channel capacity per trunk is in use.

Estimates of production of Strela M, Strela T, R-60/120, and Vesna equipment are shown in the table. Quantities produced as

Table

Estimated Production of Microwave Radio Relay Equipment in the USSR, East Germany, and Hungary 1955-65

Units a/

	1955	1956	1957	1958	1959	1960	1961	1962-65 b/
USSR								
Strela M	10	20	50	50	50	50	50	100
Strela T	0	10	30	30	40	40	40	60
R-60/120	0	0	10	25	40	50	50	200
R-600, Vesna	0	0	5	10	50	80	100	1,000
East Germany								
RVG-903	200	100	50	50	20	20	0	0
RVG-904	40 to 50	30	20	0	0	0	0	0
RVG-908	0	0	0	5	10	10	10	10
RVG-934	0	0	0	0	10	50	50	100
RVG-935	0	0	0	0	0	0	0	50 to 70
RVG-958	0	0	0	0	0	0	0	100
Hungary								
PM-24	0	0	10 to 20	40	125 to 150	125 to 150	50 to 75	0
PM-28	0	0	0	0	0	10	50 to 75	300
GTT/4000	0	0	0	0	0	0	25 to 50	1,000

a. A unit of microwave radio relay equipment is considered to be one transmitter and one receiver.
b. Estimates of production for 1962-65 are highly tenuous, having as their principal base the estimates of line facilities to be installed during the period.

well as the starting dates of production are based primarily on the estimated and/or observed installation of equipment. These estimates represent minimum production: the operation of only one broad-band channel for existing lines is assumed except where available information indicates otherwise. Production of specific items of equipment cannot be related to specific plants. The Pushkino Experimental Plant, however,

has produced a large portion of existing high-capacity radio relay equipment; also, a plant in Odessa is believed to be producing this equipment.

The low level of Soviet production of R-60/120 and Vesna equipment is not attributed to inherent production difficulties. Although tube reliability and service life still present some problems, the USSR has demonstrated the capability to produce the critical components needed in microwave radio relay equipment such as traveling wave tubes, klystrons, metal-ceramic triodes, and waveguides. The USSR, however, has not allocated sufficient production resources to provide these components in quantities adequate for both military and civilian needs. Also, military priorities probably have delayed the procurement of adequate factory space for the series production of the Vesna.

2. East Germany

East Germany has been producing microwave radio relay equipment (the RVG series) at the Rafena plant in Radeberg since 1950. The RVG-903, used for relaying up to 24 telephone channels, has been produced since 1952. Production of television relay equipment was started in 1954 with the RVG-904 television video transmitter and the RVG-905 audio signal relay. Further improvements on television relay equipment were completed by 1958, when the RVG-908 video relay system went into series production along with the RVG-955 audio relay equipment. No new 24-channel microwave radio relay equipment was brought into production until 1959, when the RVG-934, designed for pulse position modulation, reached the production stage. The RVG-935, a 28-channel partly transistorized set, is scheduled to replace the RVG-934 in production in 1963. Series production of the RVG-958, comparable to the Soviet Vesna, probably will be started in 1963. Defection to the West of experienced scientists and technicians has been responsible to a great degree for the delay in East German production of high-capacity radio relay and multiplexing equipment. The estimated production of microwave radio relay equipment in East Germany is shown in the table.*

3. Hungary

Early in the 1950's, Hungary began designing and producing prototypes of a series of mobile military microwave radio relays. Later, development began on the PM-24,** a 24-telephone channel fixed set designed for civilian use and patterned after a Swiss Brown Boveri unit. The PM-24 has been produced since 1957 at the Beloiannisz Plant

* P. 4, above.

** The PM-24 series includes three models: the A, the C, and the L.

in Budapest. Further refinements of the PM-24 resulted in the PM-28, a 28-channel system, which was placed in production in 1960.

As a result of the Hungarian experience in development and production of radio relay equipment, an agreement was reached in 1959 with the USSR under which Hungary was to develop a more modern, broadband type of microwave radio relay equipment. Designated the GTT/4000,* the equipment has a capacity similar to the Vesna (Soviet) and the RVG-958 (East German). The GTT/4000, first produced in 1961, is entirely of original Hungarian design but meets operating standards established by the USSR for the Vesna. The GTT/4000 was developed by and was originally produced at the Beloiannisz Plant. The Fine Mechanics Plant (FMV) in Budapest now produces GTT/4000 equipment. Estimates of Hungarian production of microwave equipment are shown in the table.**

In Hungary, as in East Germany, production of 4,000-mc radio relay equipment has been delayed to a great extent by developmental problems and to a lesser extent by dependence on the USSR for specialized components. Delays in production of the GTT/4000 probably are not caused by manufacturing difficulties, for Hungary has had long experience in production of telecommunications equipment. Production facilities at the FMV Plant have been expanded in recent years and should permit quantity production of the GTT/4000.

4. Czechoslovakia

Microwave radio relay equipment for the transmission of both telephone and television video signals is produced by plants of the Tesla enterprise in Czechoslovakia. The volume is believed to be sufficient to provide for some exports. Items in current production include the MT-11, a mobile television relay equipment of 8,100 to 8,500 mc that is capable of transmitting video and audio signals up to a maximum of 35 miles and is used for on-the-spot coverage of outdoor events and for the transmission of signals between studio and transmitter; the DT-21, a radio relay equipment capable of carrying 60 telephone channels at distances up to 310 miles; and the DT-22, which is similar to the DT-21 but is designed for the transmission of television signals. Newly developed equipment that is capable of carrying 6, 12, 24, and 120 channels and is designated the MKG series is expected to be in series production in 1963.

* There are two models of GTT/4000: the GTT/4000/600 for transmitting telephone and television signals and the GTT/4000/A for transmitting television signals only.
** P. 4, above.

5. Poland

At least one type of broad-band microwave relay equipment, a transportable television link equipment called the Korab, was produced in 1959 at the Gdansk (Danzig) Radio Factory T-18. The Korab is similar to the West German FM TV-7000, which operates in the range of 6,575 to 6,875 mc with 1 watt of power output. Ten Korab sets were produced in 1959, and 12 were to have been produced in 1960. It was reported in 1960 that, in addition to the Korab, Vesna-type equipment was being assembled at the T-18 Plant. The report, however, has not been corroborated.

B. Multiplexing Equipment

The USSR and East Germany are the only producers of multiplexing equipment for high-capacity communications systems in the Bloc. The USSR has been slow to initiate large-scale production of high-capacity multiplexing equipment. The USSR has produced the KRR 30/60 and the K-60 frequency-division multiplexing equipment for use with the R-60/120 system as well as with multiconductor cable, to permit the simultaneous handling of up to 60 telephone channels. In 1959 the K-60 multiplexer was undergoing tests to eliminate operational defects, and in 1960 full production is believed to have begun. The USSR has developed the K-1920 with a capacity of 1,920 channels for use with coaxial cable. The K-1920 was installed on cables for operational testing in 1960 and probably was placed in production in 1961. The K-300, a 300-channel system for use with miniature coaxial cable, is presently under development and probably will be placed in production during 1962-65.

In East Germany the V-60/120, a 60-channel set, is the highest capacity multiplexing unit thus far developed. Two sets of the V-60/120 can be connected in parallel to give 120 channels. A limited number of experimental units were produced at the VEB Fernmeldewerk Plant in Bautzen. Although operating quality of these units has been satisfactory, further development was undertaken. East Germany is now producing the V-60/120 for installation on domestic cable lines, and also the V-60-S, a transistorized variant, for delivery to the USSR. V-60-S equipment is designed to handle traffic at feeder lines of radio relay connections and also can be used on balanced cable lines. Production of the V-60-S probably began in late 1960 or early 1961. It is assumed that production has continued at Bautzen, but the Fernmeldewerk in Leipzig also may be associated with the V-60 production program. The VEB Werk fuer Fernmeldewesen in Berlin/Oberschoeneweide is an important supplier of component parts and is engaged in developmental work in connection with the V-60. A fully transistorized version of the V-60/120 is now under development at the Institute for Postal and Telecommunications Techniques in East Berlin. Production of multiplexing equipment for the RVG-958

probably will present major problems, although such a set is reported to be under laboratory development.

C. Coaxial Cable

Although coaxial cable is produced in the USSR, Poland, East Germany, and Czechoslovakia, limited data prevent the quantification of its production. The USSR has attempted to import coaxial cable from the West. This action may indicate that domestic production has not been adequate to satisfy requirements; but it could also reflect to some extent the problem of priority allocations. Major producers of coaxial cable in the USSR are the Electric Cable Plant 330 in Moscow and the Northern Cable Plant in Leningrad. These two plants account for 50 percent of the total Soviet output.

East Germany has produced coaxial cable type 17a, having 1 tube and 16 balanced multiconductor pairs. Production was to have been discontinued in 1957 because of high manufacturing costs, but this type of coaxial cable was being produced as late as 1959. Kabelwerk Oberspree (KWO), the principal East German producer of coaxial cable, has recently been reequipped with modern machinery, and production of 4-tube coaxial cable probably began during 1961.

Poland has initiated production of 4-tube coaxial cable at the Krakow and Ozarow Cable Factories. Although the quantity being produced is not clear, Poland probably will become the major Satellite producer of 4-tube coaxial cable.

Plants of the Kablo enterprise in Czechoslovakia produce coaxial feeder cable for short-distance transmissions of video and other broad-band signals. This solid dielectric cable is not suitable for long-distance, high-capacity transmissions.

III. Progress and Plans for Operational High-Capacity Communications Systems

The Soviet Bloc is making significant progress in enlarging and improving its main-line high-capacity communications facilities. The need for this buildup has been recognized and is reflected in the economic development plans of individual Bloc countries and also in plans set forth by the Organization for Cooperation Among the Socialist Countries in the Fields of Post and Communications (OSS). Attention is focused in these plans on the construction of internal high-capacity systems that will emphasize compatible techniques, services, and equipments. In turn, these internal systems are to form the nucleus of a flexible, integrated, Bloc-wide arterial network that will provide for

increased volumes of conventional telephone, telegraph, and broadcasting services as well as specialized services to meet economic and strategic needs.

As shown on the maps, Figures 1 and 2,* the integrated Bloc-wide network is rapidly taking form. It features a balanced installation of "soft" (aboveground) microwave radio relay lines and "hardened" coaxial and multiconductor cable lines. On most main routes, "hardened" cable facilities are to parallel "soft" microwave facilities. To enhance flexibility and reliability, the network is to include bypass rings around major urban areas and is to be centered on two connected rings -- the Warsaw ring and the Prague ring. Thus, should any part of the network become inoperative, traffic would be able to flow over alternate routes or alternate facilities. Equipment to be installed would adhere to international standards and would consist mainly of Vesna-type microwave radio relay, 1-tube and 4-tube coaxial cable, and styroflex multiconductor cable.

Although extensive use of this network is not expected until 1963-64, limited use (principally for the passage of television broadcasts) is envisaged during 1962. The intra-Bloc television network (Intervision), which is scheduled to connect all capital cities in the Soviet Bloc by the end of 1962, will utilize these facilities. The exchange of television broadcasts has already begun between several Bloc capitals, although at present they are being passed over transportable microwave radio relay facilities and the quality of service is poor.

The most serious problem foreseen for the establishment of an integrated Bloc-wide network of high-capacity communications systems is the shortage of multiplexing equipment to bring capacities to desired levels. Although it appears that most line facilities will be installed by the end of 1965, the installation of associated multiplex equipment will lag from 1 to 2 years.

A. USSR

By the end of 1965, all republic capitals and most major industrial centers of the USSR are planned to be connected with Moscow by microwave radio relay lines having potential capacities of 120 or more telephone channels. To effect this accomplishment and to provide feeder lines of lower capacities, the installation of 13,500 miles of microwave radio relay lines has been planned. As of 1 January 1962, as shown on the map, Figure 1, 6,500 miles of operational microwave lines were installed: 2,400 miles being Vesna; 1,000 miles, R60/120; and 3,100 miles, Strela M or Strela T, with 7,400 additional miles under construction,

* Inside back cover.

2,900 of which are Vesna; 4,200, R60/120; and 300, Strela M or Strela T. In spite of the publicity given to the transmission of television programs over operational Vesna lines, however, none is known to be operating at its designed telephone trunk capacity, and only a few R60/120 lines are equipped to provide even 60 telephone channels, because of current shortages not only of multiplex equipment but of experienced engineers and technicians for installing, operating, and maintaining microwave equipment -- a situation that should improve to some degree toward the end of the plan period.

The routes and the known capacities of 1,100 miles of coaxial cable lines in operation, nearly 1,000 miles under construction, and 3,000 miles planned as of 1 January 1962 are shown in Figure 2. Four-tube coaxial cable, multiplexed with K-1920 apparatus, is planned for routes having the greatest traffic density. Not all of the planned lines are believed to be scheduled for completion by the end of 1965. In the latter part of the Seven Year Plan an unspecified quantity of miniature coaxial cable multiplexed with K-300 apparatus is expected to be laid on routes of less than 500 miles.

Main multiconductor cable routes are to use balanced styroflex cable multiplexed with K-60 apparatus. On secondary routes, multiconductor cable lines are to be multiplexed with K-24 apparatus. Certain details on the progress of laying multiconductor cable lines include the completion of the Trans-Siberian multiconductor cable line to Irkutsk, the completion of the Petropavlovsk (Kazkhstan) - Alma-Ata line, the possible reequipment of the Moscow-Brest and Moscow-Khar'kov lines with K-60 apparatus, and the initiation of work on the Moscow-Arkhangel line. Demonstrated progress to date indicates that a substantial portion of the planned cable lines will be in operation by the end of 1965.

Tropospheric scatter is ideally suited to meet Soviet requirements for reliable telecommunications service in remote areas of the north and east. Experimental links were reported as early as 1957, but there are no known operational tropospheric scatter links having a capacity of 24 or more telephone channels. Although plan announcements for the use of scatter communications are vague, a limited number of scatter links with a capacity of 24 or more telephone channels are expected to be operational by the end of 1965.

B. European Satellites

Since 1959 the European Satellites have made steady progress in establishing an integrated Bloc-wide arterial telecommunications network. The indecision in the choice of equipment and routing of main lines, evident in the early stages of the network's development, has given way to

resolute installation of facilities. Already under construction are several main lines that will connect the European Satellites and the USSR and feature modern Vesna-type microwave radio relay and 4-tube coaxial cable facilities. Installation of a significant portion of the network is expected by 1965, although desired capacities are not expected to be fulfilled because of shortages of multiplex equipment.

As shown on the map, Figure 2, there were about 2,200 miles of microwave radio relay lines in operation in the European Satellites by the end of 1961, nearly all of which are using equipment with a capacity of 24 telephone channels or 1 television channel. Only the recently installed 300-mile line between Prague and Bratislava (Czechoslovakia) is using Vesna-type equipment. Construction of about 1,000 miles of Vesna-type lines is currently underway mainly in East Germany, Czechoslovakia, Hungary, and Rumania, and 2,500 miles in addition are planned for installation in those countries by the end of 1965.

On the basis of the known compatibility of the East German RVG-958, the Hungarian GTT/4000, and Soviet Vesna equipment, all three types are expected to be used on the main microwave radio relay lines. During 1961-64, many new main lines are to use either the Vesna or the GTT/4000. The RVG-958 should be available for operational use by late 1963, at which time it is to be introduced on East German main lines and subsequently on some of the main lines in other Satellite countries.

East Germany, Poland, and Czechoslovakia also have accelerated the construction of "hardened" coaxial cable lines since early 1959. As shown in Figure 2, about 230 miles of coaxial cable line had been installed, 1,000 were under construction, and 1,100 additional miles were planned by the end of 1961. Of the 2,300 miles expected to be completed by the end of 1965, 2,000 miles will consist of 4-tube coaxial cable, installed mainly in Poland and Czechoslovakia, and the remaining 300 miles will consist of 1-tube coaxial cable installed entirely in East Germany. The new coaxial cable lines will parallel the new microwave radio relay routes generally and will conform to standards associated with "hardened" telecommunications facilities. The lines will be buried at depths of 3 to 5 feet and will bypass major industrial and strategic areas. Spur lines will connect these areas with the main lines.

In tropospheric radio scatter communications, East Germany now is conducting feasibility studies on five experimental links operating between Kolberg (near East Berlin) and Gross Inselsberg, Fichtelberg, Dresden, Prague (Czechoslovakia), and Poznan (Poland). If these investigations prove to be fruitful, it is likely that this medium will be introduced to supplement main line intra-Bloc facilities and to provide service to more inaccessible regions and, same time after 1965, to introduce service in the other European Satellites.

Figure 1

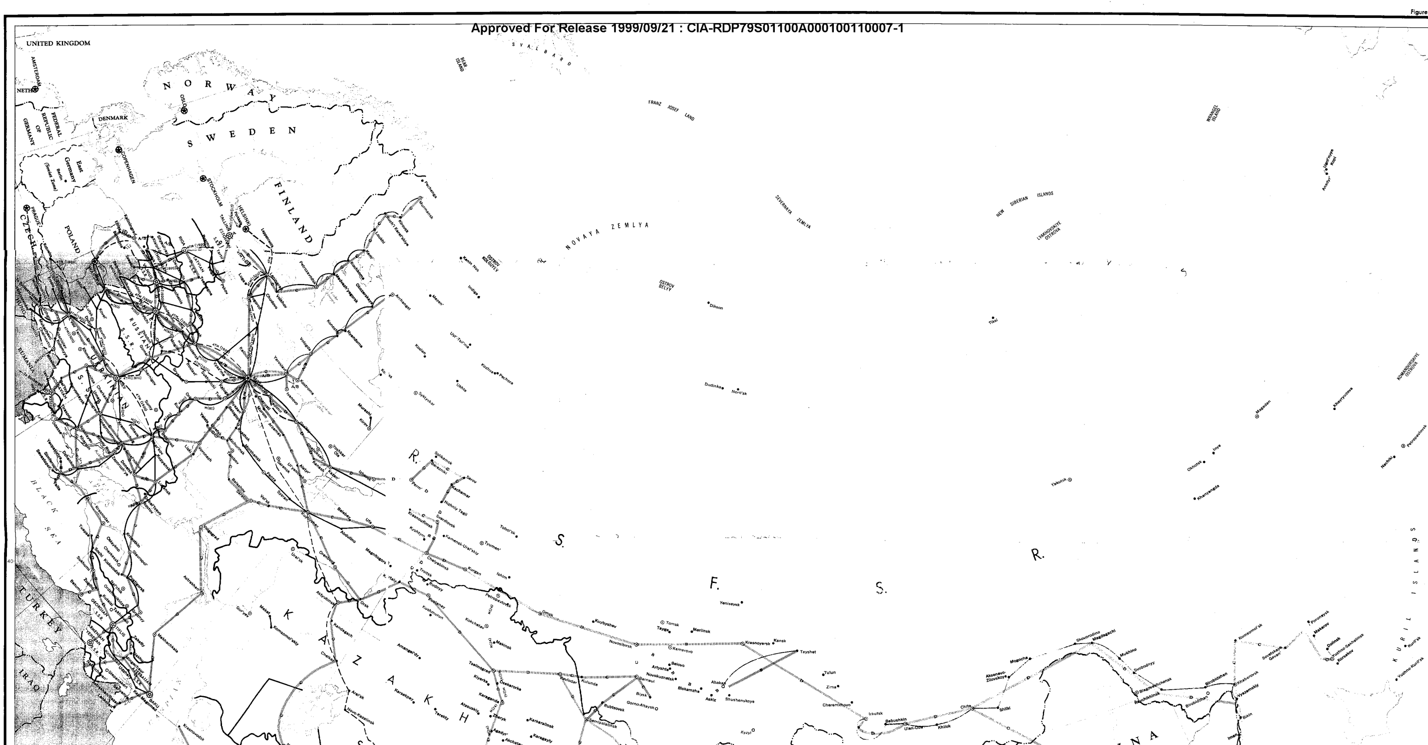

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Figure 2