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Prospects for Soviet Commercial Exploitation of Space Systems and Related Services [redacted] 25X1

An Intelligence Assessment

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December 1983

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Prospects for Soviet Commercial Exploitation of Space Systems and Related Services

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An Intelligence Assessment

This paper was prepared by Office of Soviet Analysis and Office of Scientific and Weapons Research.

Comments and queries are welcome and may be directed to the Chief, Policy Analysis Division, SOVA, or to the Chief, Space Systems Division, OSWR,

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Key Judgments

Information available as of 25 October 1983 was used in this report.

Moscow has clearly indicated its intention to compete for a share of the growing international market for space systems and related services and is increasing its capability to do so. It is concentrating its marketing efforts on the launching of satellites and the sale of communication services, where its goals are to supplement its hard currency earnings, gain access to customer-supplied technology, open up markets for other products, and increase Soviet prestige.

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The Soviets have said they will enter the launch service market with the SL-12/13 Proton, a booster that has maintained about a 90-percent reliability rate over the past 10 years and that has a payload capacity about 65 percent as large as that of the US shuttle.

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We believe they will have a sufficient number of Proton boosters—between four and six annually—to use for commercial launches and could probably maintain a reliable launch schedule

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Moscow has already succeeded in having the Proton included on a list of candidate launch vehicles for the International Maritime Satellite Organization (INMARSAT) and is underpricing Western competitors. The Soviets are also developing a heavy-lift launch vehicle and a shuttle orbiter that will greatly enhance their ability to compete with the United States, the European Space Agency (ESA), and Japan. We believe this system will become fully operational during the period 1990-91. Successful development of a Soviet space tug with capabilities to retrieve satellites for repair and refurbishing would also increase the attractiveness of a Soviet contract.

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The Soviet-sponsored INTERSPUTNIK organization has attempted to compete with the US-sponsored International Telecommunications Organization (INTELSAT) in marketing international communication services in the Third World since the late 1970s. INTERSPUTNIK, which has primarily served the needs of Soviet Bloc members, remains a much smaller organization than INTELSAT, which currently provides services to more than 120 countries. INTERSPUTNIK has, however, succeeded in attracting new users among pro-Soviet Third World countries, including

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Algeria, Angola, Grenada, Iraq, Libya, and Nicaragua and has been willing to offer financial and other incentives to attract new customers for its international services. We believe its fees for domestic services may be well below those charged by INTELSAT for similar services.

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Although there is no evidence of Soviet intentions to manufacture communications satellites for foreign countries or firms, the USSR is capable of doing so. To succeed in such an effort, however, the Soviets would have to either increase the service life of their satellites or price them low enough to offset the increased replacement costs that the customer would incur because current Soviet communication satellites have a shorter lifespan than Western equipment.

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In 1977 the Soviet Union publicly offered to provide photographic services and remote-sensing data from outer space to other countries. Although the Soviets have given no subsequent public indication that they intend to develop a market for such data, Moscow may be waiting until the end of this decade, when we expect it will have an operational remote-sensing system competitive with a US system and a projected French system. The Soviet policy of requiring prior consent from the target country before disseminating data with potential military or economic significance to third parties will probably aid in marketing remote-sensing data to Third World countries. The only profitable market to develop, however, may be for value-added computer-processed data, an area in which the Soviet Union is not expected to become competitive for some time.

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As the world's leader in experimental research in material processing in space, the USSR would enjoy a considerable advantage over potential Western competitors should it decide to market products manufactured in space. It has conducted extensive experiments in materials processing on board the Salyut 6 and 7 space stations. Officials associated with the Soviet space program have indicated that Cosmos 1443, which docked to Salyut 7 in early 1983, is a prototype module of a future multimodular space station that will be used for a variety of missions, including materials processing. Although most of the materials that the Soviets are experimenting with—semiconductors, optical materials, and metal alloys—have military applications, materials for commercial purposes, such as pharmaceuticals, could also be produced.

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Overall, the launch service market is the area in which the Soviets probably will enjoy their greatest success during the next 10 years. Although unlikely to be able to take scheduled customers away from the US shuttle in the 1980s, the Soviets, by virtue of their long experience with expendable launch vehicles, are in a good position to compete with ESA and private US firms for a portion of the international launch service market that the US shuttle cannot accommodate. Success in the expendable launcher field could pave the way for broader Soviet efforts to make commercial use of space in the 1990s, when the USSR's own space shuttle and its other space programs with extensive economic applications mature.

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Introduction

This paper assesses the prospects for Soviet commercial exploitation of space systems and related services during the next 10 years. It examines Moscow's incentives and disincentives to compete for a share of the international market for space systems and services, reviews the available evidence on Soviet intentions and capabilities, and estimates the probable focus, extent, and success of Moscow's future efforts to make commercial use of its space-related assets.

Soviet Incentives and Disincentives To Compete

Moscow has both financial and political incentives to make commercial use of its space systems and capabilities. Although there is great uncertainty about the eventual size of the market for space-related services and products, Western space and industry analysts estimate that the manufacturing and launching of communication satellites alone will yield billions of dollars in revenues annually by the late 1980s. Capturing a share of this market would provide the USSR with an important supplement to its hard currency earnings.

Moscow would also view participation in the market for supplying launch services for Western communication satellites as an opportunity to acquire advanced technology, particularly electronic systems. Soviet operating procedures call for the mating of a satellite to its launch vehicle and the performance of checkout procedures to be carried out in a horizontal position inside a building. During this period Soviet scientists, engineers, and technicians would have an opportunity to inspect Western communication satellites, particularly if the agreement between Moscow and the customer did not call for the presence of Western engineers, technicians, or observers.

Moscow would probably also perceive activity in this high-technology export trade as a foot in the door for other Soviet high-technology products and might be prepared to offer space-related services to Third World countries on inexpensive terms to encourage their purchase of other Soviet equipment or services.

In addition, the Soviets would view commercial exploitation of space as a means of increasing their national prestige and influence.

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Entry into the market, however, will require some changes in Soviet operating procedures. At a minimum, customers will need to know satellite capabilities and launch vehicle reliability and will require access to satellite assembly and checkout facilities, launch sites, and support facilities. Even when involved in joint space ventures, the Soviets have often refused to provide information requested by the other participating country. They have never released data on the reliability of their launch vehicles or their command and control systems and have generally not maintained separate civilian and military space facilities or allowed foreign access to military space complexes.[1]

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Soviet Intentions and Capabilities

Notwithstanding these drawbacks, the Soviets have indicated their intention to market space-based services and are increasing their capabilities to do so. Moscow's marketing efforts and its prospects for success vary greatly with the type of space-related service or product.

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Launch Services. The US Government virtually monopolizes the current commercial satellite launch market, using the Atlas-Centaur and the Delta expendable launch vehicles and the reusable shuttle

[1] Moscow has allowed limited access to previously denied areas by selected Western officials, beginning with President Charles de Gaulle in the late 1960s and including American, French, and Swedish scientists and astronauts. Such access has been granted for political reasons and to allow for Western participation in cooperative programs. Indian space officials have also reportedly been allowed to visit Soviet launch sites. In the 1970s, for the Apollo-Soyuz project, the Soviets constructed a separate flight control center and an addition to the booster and spacecraft assembly building.

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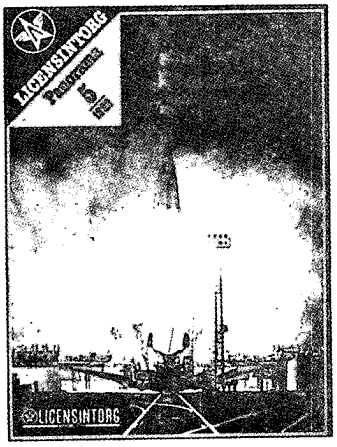
Figure 1
Soviet Publicity for Satellite Launch Service

LICENSINTORG Panorama

No. 5 • 1982

A quarterly publication
of V/O LICENSINTORG, Moscow, USSR.

Appears in English, Russian, Finnish, French, German and Spanish.



Cover Picture: **The achievements of Soviet scientists and designers in space research are universally known. Licenstransmash is ready to assist foreign firms in launching their artificial earth satellites by Soviet carrier rockets.**

From a Soviet foreign trade magazine disseminated in Western Europe and the United States.

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system. The Atlas-Centaur and Delta systems, however, are scheduled to be phased out by the US Government by 1985, and US space and industrial analysts estimate that the increasing demand for commercial and government launch services will exceed what the shuttle can provide during the period 1986-94 by about 25 percent. In 1983 the US Government decided to allow private US firms to continue producing current expendable launchers and to rent US launching pads. These firms, however, will need to prove their capability to launch and position satellites before large segments of the commercial market will be willing to book launches with them. They also will have to compete with at least one foreign organization, the European Space Agency (ESA), that is subsidized by the governments of the member states.

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Commercial shuttle payloads also have the lowest priority, behind military and other US Government payloads. They could be bumped from scheduled launches on short notice, and the current tight shuttle schedule will make it difficult to accommodate rescheduling. Because the loss in revenue resulting from such cancellations or delays would amount to millions of dollars,[2] commercial firms are likely to schedule alternate launch vehicles.

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The shuttle's main Western competitor is the French Ariane booster sponsored by ESA. Two of the seven Arianes launched thus far, however, have failed to reach orbit. Only in June 1983 did the Ariane deliver its first commercial satellite into geosychronous orbit, and the first fully successful commercial launch did not occur until October 1983. Moreover, the fact that one of the two satellites launched in June was damaged by the Ariane booster during launching and stranded in an orbit of limited usefulness will probably cause potential customers additional concern.[3] As a result of its poor launch record, ESA has been experiencing difficulties in marketing its launch vehicles and could still lose some previously scheduled launches.

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Recent US press reports indicate that the Japanese Space Development Council plans to develop a new space launcher with a payload capability similar to that of the US Titan III. This launcher eventually could be used to compete with the United States and other countries in the launch service market. The Japanese already have expendable boosters based on US technology that could enable them to provide commercial customers with an alternative to the US

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[2] Revenues for a Western commercial communication satellite can amount to as much as $300 million per year. A one-month delay in launching a satellite, therefore, could result in a loss of $25 million in revenues.

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shuttle. An agreement exists between Japan and the United States, however, that these boosters will not be used for third-party launches without US permission.

Since 1980, there have been several indications that the Soviet Union intends to use its Proton (SL-12/13) launch vehicle to compete directly with the French Ariane space vehicle and possibly with the US space shuttle for launching civilian commercial communication satellites:

- In 1981 and again in 1983, the Soviets offered to supply launch vehicles for INMARSAT satellites during the period 1988-89 for $24 million per launch. According to Western press reports, they are offering the Proton launch vehicle as a booster for the satellites and are offering to commit themselves to a replacement mission at one-half that fee if a satellite is lost because of launch failure. They also have apparently prepared a handbook of specifications for potential users of the Proton.

- In mid-1982, Vladimir D. Shibaev, director of the Soviet export-import firm for transport machine building, reported in a journal article that his firm had a new capability to provide satellite launch services, indicated that his firm was "talking" with ESA with hopes for positive results, and stated that contacts had been made with other companies.

- Shibaev subsequently reported a Soviet commercial agreement for launching an Indian remote-sensing satellite in 1986, and an "arrangement" to launch the ESA MAREC-C satellite. He expressed the USSR's interest in a large number of orders for launch services now and for the next 10 years.

the Soviets intend to undercut Western prices, provide financing with flexible terms and low interest rates with the Soviet Bank for Foreign Trade, and guarantee short delivery schedules for launch vehicles. the Soviets will have a multiple-satellite launch capability, will be able to accommodate any Western satellite regardless of weight, and will be able to retrieve disabled satellites for repair.

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The Soviets have developed a family of space launch vehicles that have proved to be highly reliable. They currently have eight expendable vehicles with payload capabilities for low-Earth orbit (185 kilometers) ranging from 1,600 to 19,000 kilograms. The booster with which the Soviets claim they will enter the market, the SL-12/13 Proton, has maintained about a 90-percent reliability rate over the past 10 years. It is the largest operational Soviet space booster and has a payload capacity about 65 percent as large as that of the US shuttle (see figure 2).

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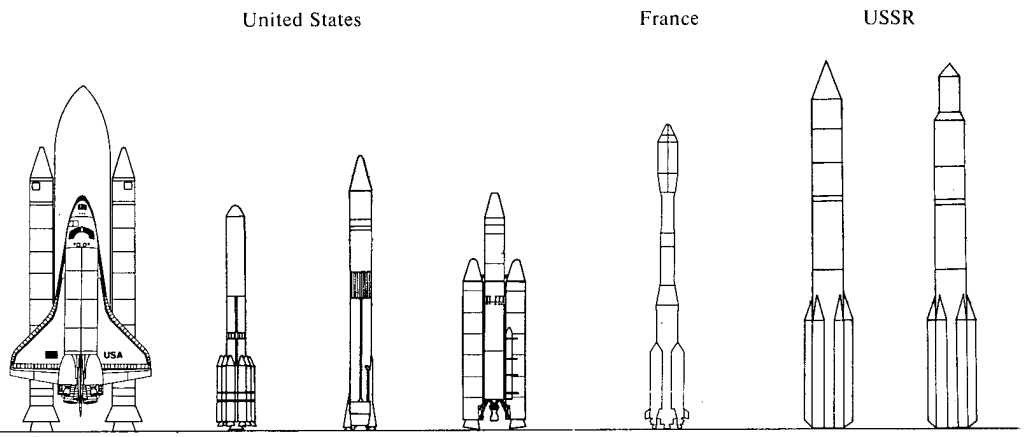
Figure 2
Payload Capabilities of Selected US, French, and Soviet Launch Vehicles



Vehicle	Space Transportation System	Delta 2914	Atlas/ Centaur	Titan III C	Ariane	(SL-12) Proton	(SL-13) Proton
Payload (kg) (Low Earth orbit)	29,500	2,000	5,135	12,275	4,700	Not used	19,000
Payload (kg) (Geostationary orbit)	——	335	955	1,455	950	2,700	Not used
Height (m)	56	35	43	38	47	58	58

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- Retrieve satellites for repair or refurbishing, thereby extending satellite service life and practically eliminating unsuccessful payloads.
- Facilitate construction of refueling, repair, and orbital launch complexes.[4]

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Unclassified Soviet technical journals indicate that Moscow's program to develop a reusable space transport system includes the development of a reusable space tug. According to several Soviet authors, the tug will be used to:

- Place satellites in their final orbit, thereby increasing the shuttle's utility.

[4] US plans include the use of an orbital transfer vehicle that will perform similar functions.

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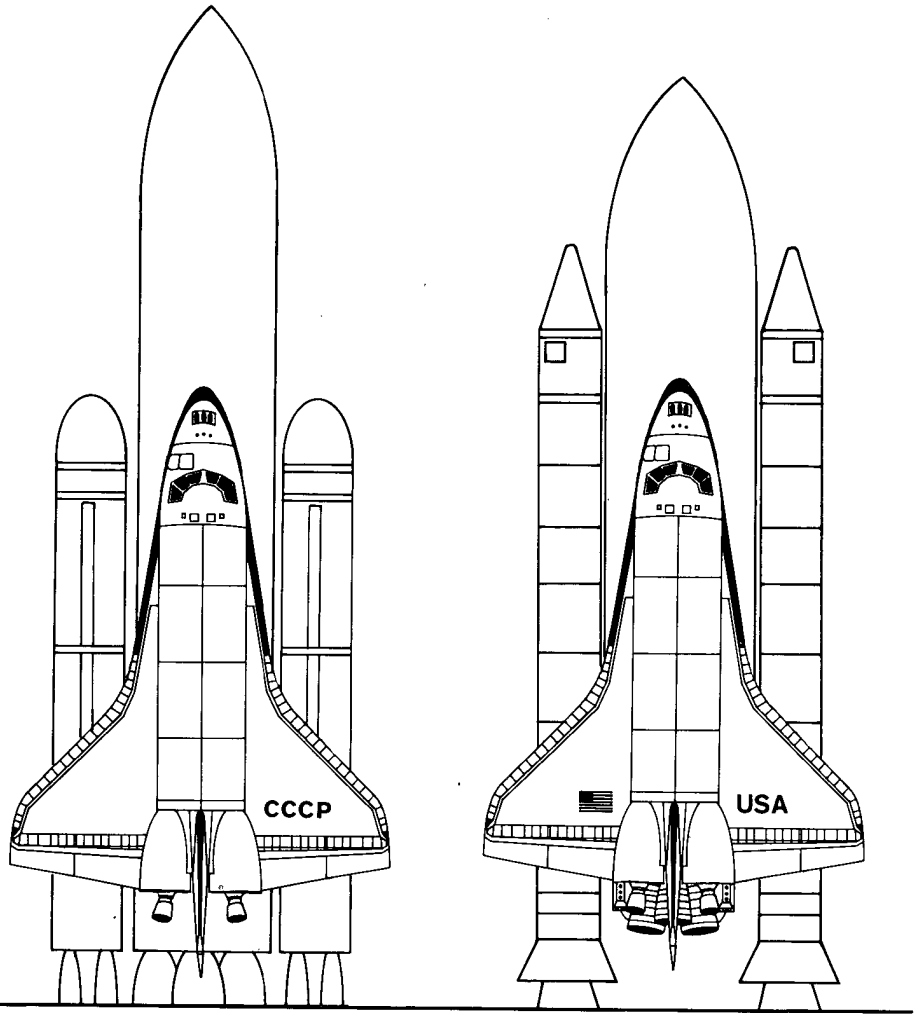
Figure 3
Soviet and US Space Transportation Systems



Height (m)	59	56
Lift-off weight (kg)	1,700,000	2,026,000
Lift-off thrust (lbs)	5,600,000	6,860,000
In-orbit weight (kg)	75,400	97,700
Payload to 185 kilometers (kg)	27,300	29,500

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The Soviets have plans for a permanent space station for both military and civilian uses. One of its many uses may be the refurbishing of satellites. Refurbishing satellites at a space station would be more economical than returning them to Earth, because a smaller boost vehicle using less fuel is needed for reboosts to operational orbit. Moreover, it may be easier and faster to refurbish satellites at a space station because this would eliminate transfers to Earth and relaunch schedule problems. Servicing at a space station would also free launch vehicles for other missions.

As part of the effort to market launch services, the Soviets may decide to separate commercial space activities from their existing, largely military facilities to eliminate access problems.

There are also two launch sites with two pads each for the SL-12 Proton at the Tyuratam space launch complex. Instead of building a new complex for commercial launches, the Soviets could use one of these sites and shield the other (military) site from the view of visitors.[5]

The Soviets may also be willing to offer insurance to non-Bloc countries using Soviet launch vehicles. Indeed, their reported willingness to offer INMARSAT a replacement mission at one half of the $24 million launch fee if a satellite is lost because of launch failure may indicate that such concerns are already being considered in Soviet planning. The Soviet Union owns three insurance companies in the West—one in Vienna, one in Hamburg, and one in London—that cover export credit risks as well as other risks for Western firms engaged in trade with the USSR.

[5] Western press reports indicate that Soviet officials have said that the Proton for INMARSAT missions would be launched from the facility at Tyuratam.

Reinsurance arrangements with major Western insurance companies permit the Soviet companies to underwrite East-West trade risks without limitation as to the amount of liability or length of credit maturities involved. Most West European banks provide financing on the basis of guarantees provided by the Soviet-owned insurance companies. 25X1

Leasing Communication Services. Since the late 1970s, the Soviet-sponsored INTERSPUTNIK organization has begun to compete with the International Telecommunications Organization (INTELSAT) in marketing international communication services in the Third World. INTERSPUTNIK, which has primarily served the needs of Soviet Bloc members (see figure 4), is smaller than INTELSAT, which currently provides service to more than 120 countries. It has, however, attracted new users among pro-Soviet Third World countries including Algeria, Angola, Grenada, Iraq, Libya, and Nicaragua and others are said to be interested or have been invited to join. It has offered attractive financing and other inducements to gain new users for its international services. For example, in August 1982 Grenadian Prime Minister Maurice Bishop announced that the Soviet Union had offered a 3-percent loan to finance Grenada's INTERSPUTNIK earth station. We also believe its yearly fees for leasing communication services may be well below those charged by INTELSAT for similar services. Earlier, in 1979, the earth station installed in Algeria to work with the INTERSPUTNIK satellite system included mostly Western equipment. The use of Western equipment made the station more compact, efficient, easily serviced, and reliable.

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From a variety of open sources we know that at the present time the Soviets have two types of geostationary satellites available for two-way civil and commercial communications—the Raduga and Gorizont systems. Another satellite communication system, known as Luch, is currently being tested. Both operational types have communication transponders [6]

[6] A transponder is a device that receives a radio signal and retransmits it to another point.

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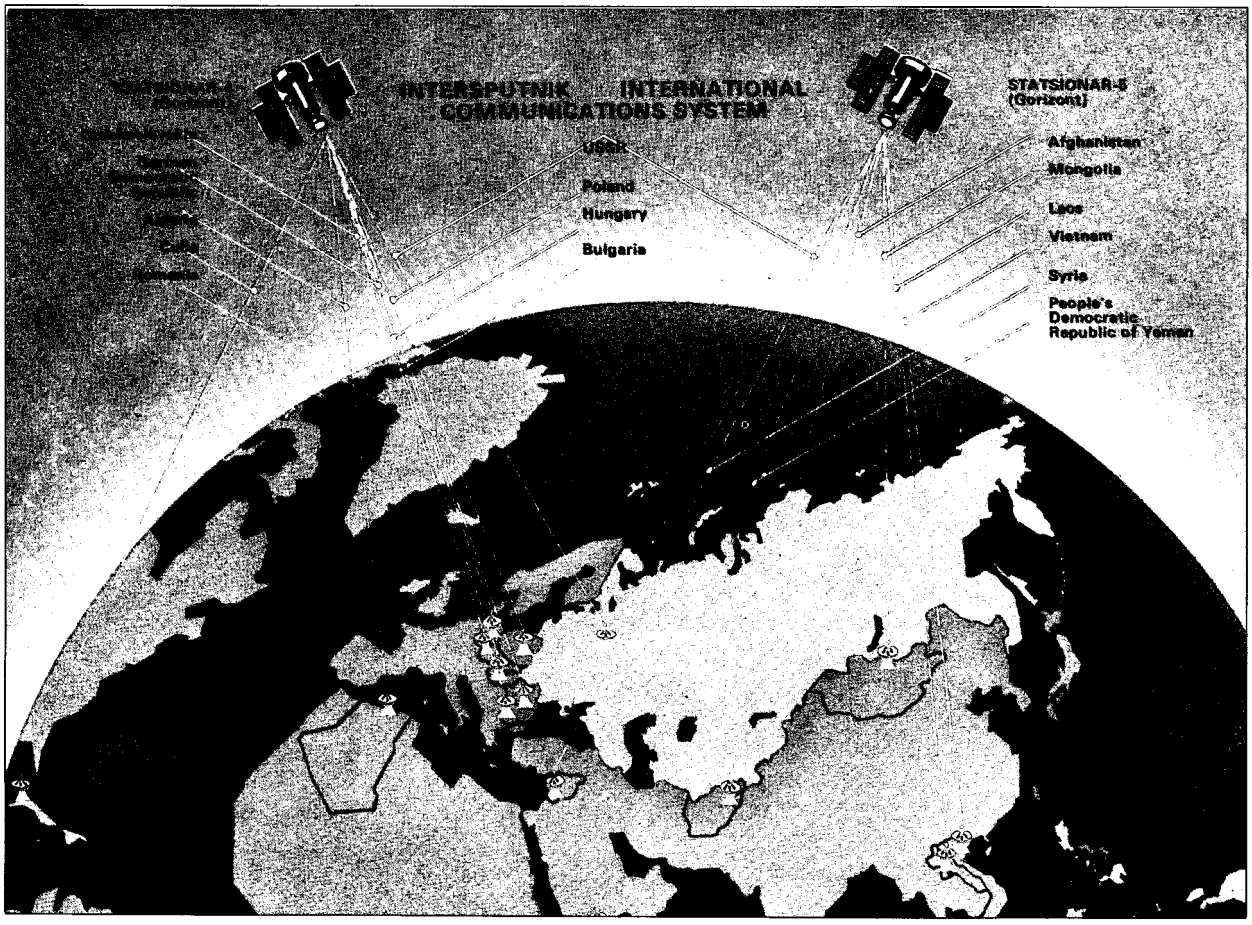
Figure 4
INTERSPUTNIK Members



This 1983 Novosti Press Agency map shows the 14 INTERSPUTNIK members, some of which do not have operating ground stations, and one nonmember user, Algeria. In addition, other Third World nations are planning to use the system in the future; some have ground stations under construction.

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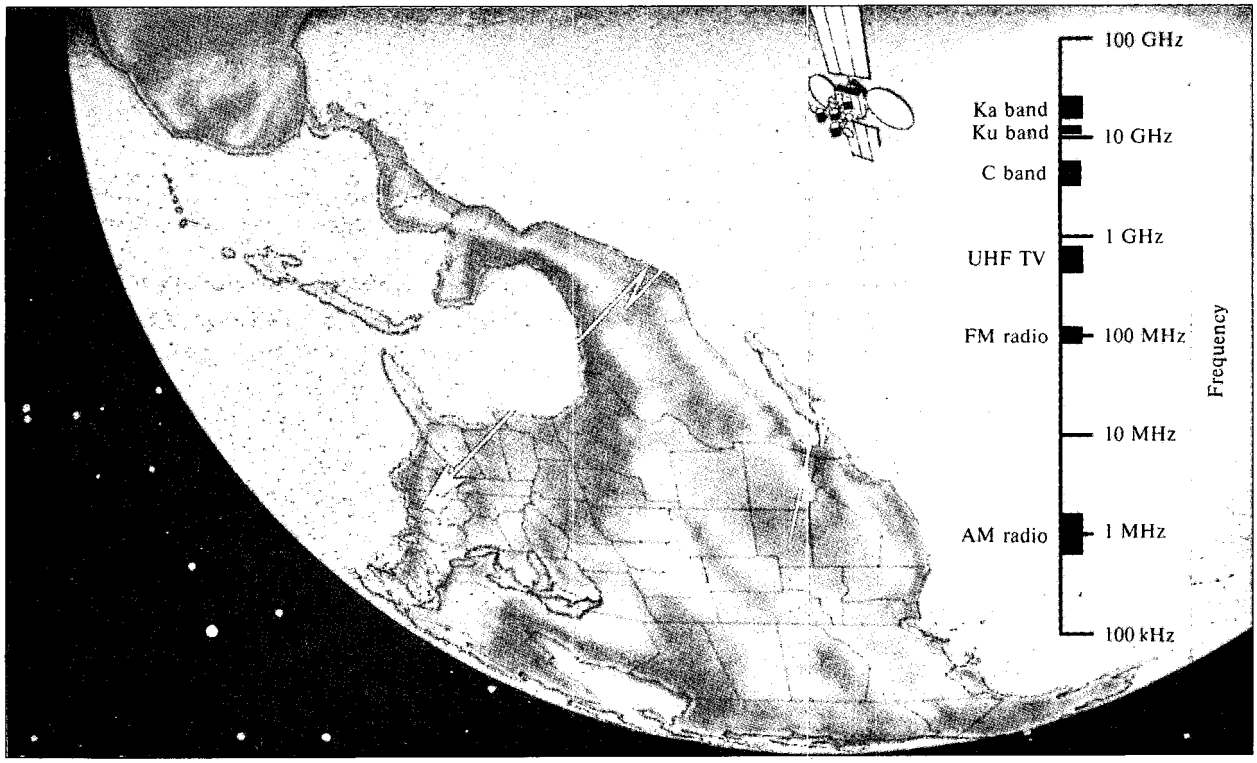
Figure 5
Satellite Frequencies



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aboard that operate in the 4 to 6 gigahertz or C-band portion of the radiofrequency spectrum currently used worldwide for satellite communications. (See figure 5 for a depiction of the frequency spectrum.) Commercial satellite communication demands, however, are expected to outpace the capacity of satellites using the 4 to 6 gigahertz frequency range. The Luch system being tested by the Soviets operates with communication transponders in the 11 to 14 gigahertz or Ku-band portion of the frequency spectrum. This frequency range can be used to help alleviate overcrowding of the 4 to 6 gigahertz spectrum and is used for such purposes by several Western nations.

Soviet requests to the International Frequency Registration Board (IFRB) for satellite positions and radiofrequencies, plus open-source data, suggest that Moscow is planning to have space platforms in geostationary positions with several communications systems on board using different frequency ranges. Some of these systems will be dedicated solely to military subscribers and others to civil uses. These systems will enhance the Soviets' ability to provide commercial services to a variety of non-Soviet civil users if they choose to do so.

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The Soviets will probably provide the ground terminals for their customers either by themselves or, as they have done in two agreements since 1979, through subcontracts to the Japanese. We know from Soviet press reports that Japanese ground terminals have been used in conjunction with the INTERSPUTNIK station in service in Algeria. The terminals would be the only hardware involved in the relay service transactions.

Manufacturing and Selling Communication Satellites. On the basis of surveys of aerospace industry personnel, system operators, and likely customers, US space and industry analysts estimate that (excluding the requirements of Japan and of Soviet-aligned nations) the total world demand for new and replacement commercial communication satellites will be more than 200 during the period 1983-95. This figure could increase as new technologies and uses requiring additional satellites are developed and introduced in the late 1980s. For example, satellites will be needed for direct broadcast, data transfer, banking, electronic mail, and broadcasting in the microwave portion of the radio spectrum. In addition to the Soviet and US firms, companies in at least six Western countries and Japan can manufacture communication satellites or the associated ground stations.

The Soviet Union has a capability to produce satellites for commercial sale and might, if it chooses to use this capability, have an advantage over Western competitors in marketing satellites in the Third World. We believe they are probably less difficult to manufacture and less expensive than Western versions, and may therefore be attractive to many Third World nations. On the other hand, the lifetime of Soviet communications satellites has been about two years; whereas the average for Western satellites is six to seven years. To capture any market, the Soviets would have to either increase the lifetime of their communication satellites or price them low enough to offset the increased costs incurred from frequent replacements and the accompanying launch fees

Entry into the commercial spacecraft production market would entail selling the command and control and telemetry systems as well as satellites and ground stations. Moscow, however, probably considers access to the command and control systems sensitive. Thus, if the Soviets decide to produce satellites for sale abroad, they will also have to develop a new command and control system as part of the package.

Remote Sensing. Both industrial and developing countries are looking to data collected by remote-sensing satellites to locate mineral and energy resources, to identify potential problems in such areas as agriculture and forestry management, for land use studies, and for cartographic work. The export of remote-sensing data or associated equipment and services is currently not a financially profitable business. The market for the data, however, is potentially huge and is growing because of an international awareness of the need to better manage resources.

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Thus far, the US Landsat program has provided most of the remote-sensing data to consumers. There are currently 13 stations throughout the world receiving data from the US system. Customers can either buy data in the form of a picture or a tape or own a ground receiving station and pay a fee to the US Government for access to all imagery taken within line of sight of the station. Countries concerned about timeliness and possibly about national autonomy and industrial espionage are leaning toward national ownership of ground receiving stations. Industry analysts believe that the most lucrative remote-sensing market will be for data that have been computer processed and analyzed to provide particular information tailored to the needs of users such as oil companies and agriculture firms. The US commitment to maintain an operational system and to provide the data to both domestic and foreign users, however, does not extend beyond the mid-1980s.

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French and Japanese programs, scheduled for completion in the later 1980s, will meet some of the need for remote-sensing services. Even though the first French remote-sensing satellite will not be launched until January 1985 at the earliest, the commercial organization of the French system, Spot-Image, is already aggressively marketing ground system hardware and

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US and Soviet Civil Unmanned Remote-Sensing Systems

	US Landsat-4	USSR Meteor-Priroda [a]
Ground segment	13 receiving stations.	Three receiving stations.
Space segment	Multispectral scanner;[b] thematic mapper;[c] record and playback capability.	High-, medium-, and low-resolution electro-optical multispectral scanners.[b]
Geographic coverage	Worldwide.	Worldwide in 1990s with use of data-relay satellite and a record and playback capability.
Timeliness	Near-real time.	Near-real time.
Ground resolution	30- to 80-meter picture element size.	30- to 1,000-meter picture [d] element size.
Swath width	185 kilometers.	30 to 1,900 km, depending on resolution.[d]

[a] This is the USSR's developmental system. Capabilities listed are those for a system that could be operational in the middle-to-late 1980s.
[b] A multispectral scanner uses a mirror to scan the scene on the ground and reflect the light onto a series of photoelectric cells sensitive to different spectral regions.
[c] The thematic mapper is a remote sensor with seven spectral bands covering the visible, near-infrared, and thermal infrared portions of the spectrum.
[d] Demonstrated to date.

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data processing equipment compatible with both Spot and Landsat-4. The French have reportedly sold equipment to at least three nations and are talking with additional countries that already own Landsat receiving stations. Canada is also developing a radar-imaging remote-sensing system, but it is not expected to become operational until the early 1990s.

In 1977, at a session of the UN Committee on the Peaceful Uses of Outer Space, the Soviet Union officially offered to provide photographic services and data from outer space to other countries and claimed that photographs taken with up-to-date equipment on board Soviet spaceships would satisfy the most exacting customers. A member of the Soviet delegation subsequently explained that to obtain such data the requester would have to pay an unspecified charge and allow Soviet personnel to assist in mapping the data.

Since 1977, the Soviets have given no public indication that they intend to develop either a cooperative or a commercial market for remote-sensing data. We believe they may be waiting until they have an operational remote-sensing system competitive with the US Landsat or the soon-to-be-operational French Spot system.

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the Soviet Union has been actively pursuing the development of a space-based land remote-sensing capability since the mid-1970s. The Soviets currently have one fully operational satellite system dedicated to land remote-sensing and another system that is still in the developmental stage. Technical analysis indicates that the operational system, the Earth Resources Photographic (ERPHO) satellite, is a military-operated system that is used to gather economic data including surveillance of Soviet crops. Its data, however, are not timely, because it is a film system that can only return film in capsules at the end of a mission that normally lasts 13 days. Its data are not disseminated outside the Soviet Union, and it is not even referred to in Soviet remote-sensing literature. The developmental system, the Meteor-Priroda, is dedicated to civil land remote sensing. When fully operational it will be similar in many respects to the US Landsat (see table). The Soviets are expected to launch the first fully operational Meteor-Priroda satellite in 1985.

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According to Soviet technical journals and Soviet information submitted to the Second UN Conference on the Exploration and Peaceful Uses of Outer Space in 1982, the Meteor-Priroda satellite will carry both high-resolution and medium-resolution multispectral scanners. Its data will be transmitted in real time to three existing ground stations (see figure 6) and will be processed, recorded, and disseminated at additional centers. These descriptions and current Soviet practices suggest that, even when Meteor-Priroda is fully operational, the Soviets probably will have problems with processing and dissemination of the data and will need to expand their current processing capabilities, including computer hardware and software. Through the 1980s they will continue to have limitations in geographic coverage because they do not have a data-relay system. The satellite now can collect and transmit data only when it is within reception range of one of the three ground terminals. We expect the system to be upgraded by the 1990s to allow greater data-handling capability, larger amounts of timely imagery, and, with the use of a Soviet data-relay satellite system, near-real-time coverage of all areas of the world except North and South America. If a record and playback capability is added to the system, these areas could also be covered to a limited extent.

There are indications that Moscow's development of remote-sensing equipment and techniques will be a Soviet-led Council for Mutual Economic Assistance (CEMA) venture. For example, a March 1983 *Economic Gazette* article describes CEMA efforts to develop the technical equipment for the space segment of a remote-sensing system and for the processing, copying, and use of the data. The East Germans and Bulgarians have developed multispectral scanners which have been flown on developmental remote-sensing satellites. The East Germans are already marketing image-processing equipment and probably could not have made the decision to do so without Soviet agreement.

The Soviet Union is a strong supporter of regulating the dissemination of remote-sensing data, largely because of its concern over the military significance of the data[7] for countries that do not have a photoreconnaissance capability and because of the adverse effects release of such data could have on world markets for agricultural, energy, and other products (figure 7 illustrates the coverage of Soviet territory that is possible from Landsat ground stations in countries surrounding the USSR). These concerns are reflected in Soviet negotiating positions at the UN Committee on the Peaceful Uses of Outer Space[8] and in the Soviets' handling of remote-sensing data from their program.

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Moscow has proposed several formulas to control dissemination at the UN Committee on the Peaceful Uses of Outer Space where principles to regulate remote-sensing systems are being negotiated. One Soviet proposal would require the consent of the target state for the release of unanalyzed, unprocessed data that come directly from the satellite to third countries. Another would classify the data as global, regional, and local and would permit the release of only global and regional data without consent. A third proposal would limit dissemination of data without prior consent to that with a resolution no better than 50 meters.

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Moscow's policy of restricting access to remote-sensing data could be both a handicap and an aid to any future Soviet marketing efforts. Customers interested in using remote-sensing data for management of renewable resources will need current data. If a Soviet proposal requiring prior consent is adopted, it could result in long delays in satisfying customer requests, particularly if targeted states are allowed to review data prior to release to a third party. Controls over dissemination of data, however, will continue to appeal to those Third World countries that are concerned about exploitation of their natural resources by

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[7] A recent illustration of the type of information available and the intelligence value of remote-sensing data appeared in the 21 March 1983 *Aviation Week*. US Landsat-4 imagery with a resolution of about 40 meters shows new construction at the Soviet Union's Tyuratam Missile Test Range, including a runway comparable in size to the US space shuttle runway at Kennedy Space Center.

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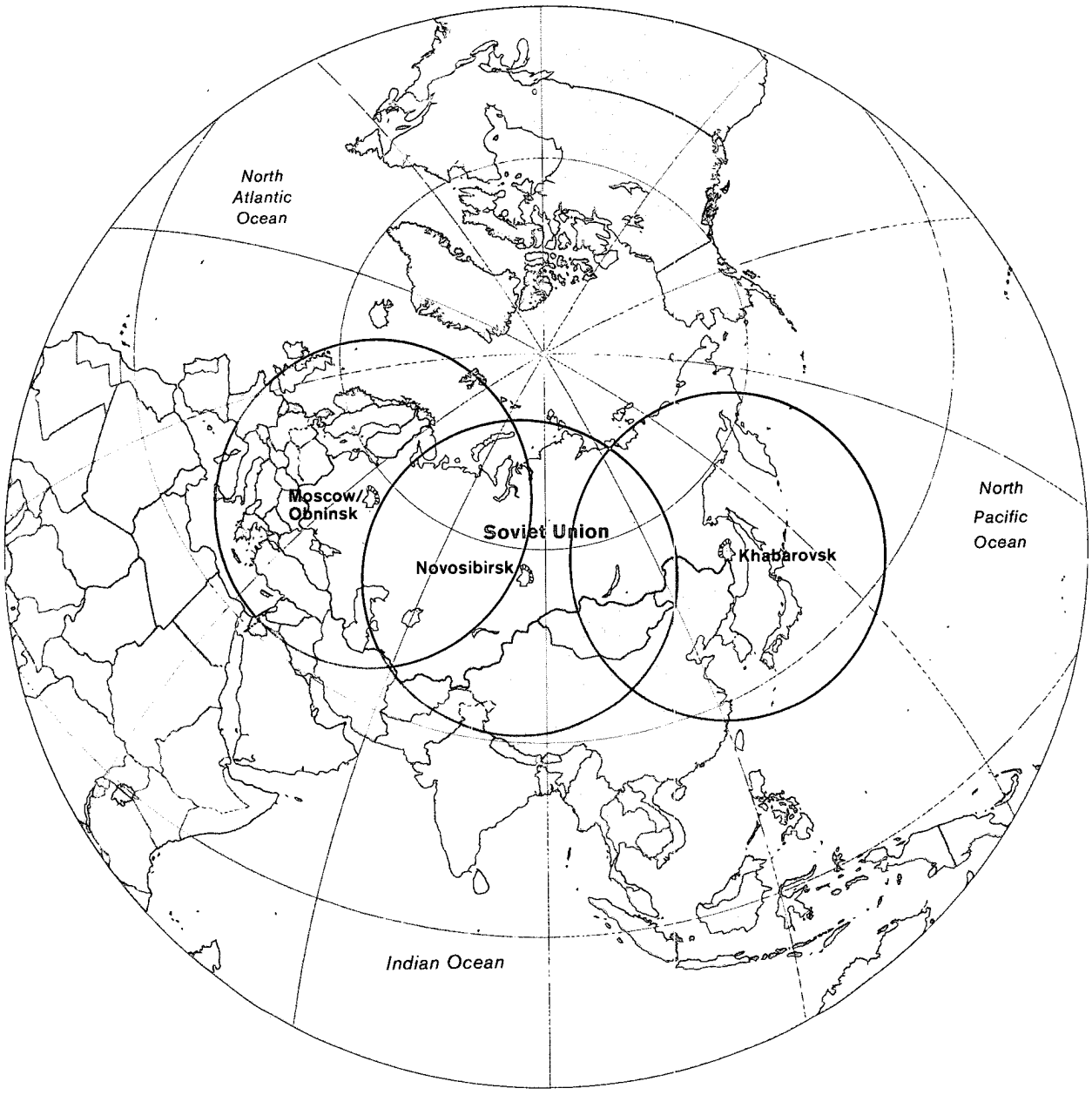
Figure 6
Soviet Receiving Stations for Remote Sensing Satellites



Rings represent the approximate ground coverage that each ground station could receive in direct transmission from Meteor-Priroda satellites. Radius of each ring is 2,700 kilometers.

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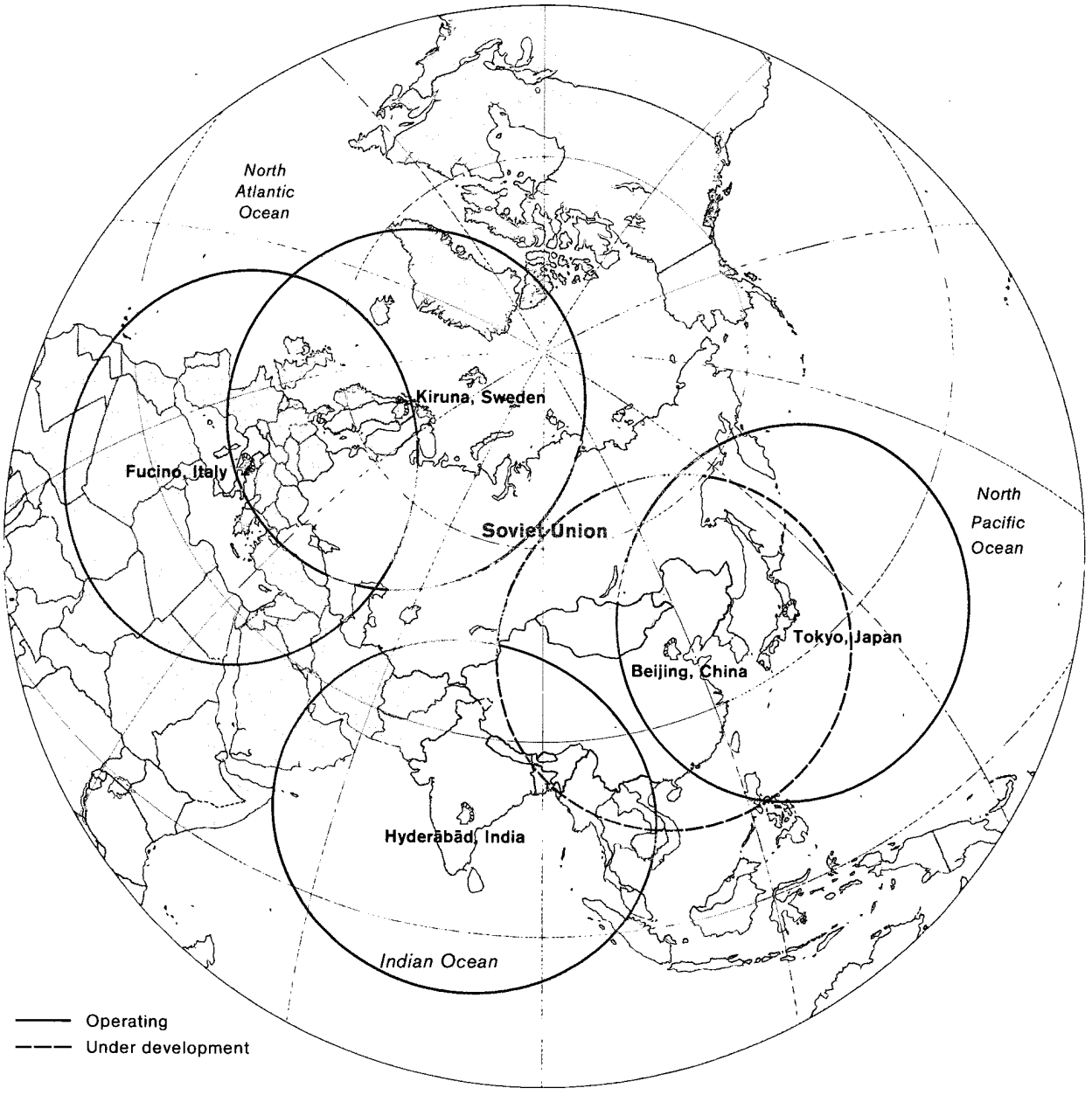
Figure 7
Select Landsat Ground Stations



Rings represent the approximate ground coverage that each ground station could receive in direct transmission from the satellite. Radius of each ring is 3,000 kilometers.

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the industrialized nations and multinational corporations and about the possible release of strategic information to hostile neighbors.

Materials Processing. Experiments show that the zero gravity of the space environment facilitates the manufacture of high-value, low-volume products that are difficult or impossible to produce on Earth. Molten metals and glasses, solutions, and gases that are impossible to mix on Earth can be combined in space to produce new materials. Materials also can be melted in a weightless environment with less risk of contamination by contact with a crucible or container. The products that look most promising are pharmaceuticals, electronic devices, optical-sensing equipment, and metal alloys. Many of these products will have important military as well as commercial applications. Until permanent manufacturing facilities that can produce materials of sufficient quantity are established in space, however, an accurate estimate of the potential capability cannot be made.

The United States, France, West Germany, and Japan are looking at the feasibility of space manufacturing. In the United States, private firms have plans for manufacturing pharmaceuticals on board the shuttle by 1985, but the US Government has no current plans for a permanent space processing facility for the remainder of the decade. The Europeans are committing considerable resources to their projects. Still, although some West European materials processing experiments have been conducted, extensive experimenting will not begin until the ESA-built Spacelab is orbited for a week of experimenting in the fourth quarter of 1983. In Japan, space manufacturing has been made a national priority, but the Japanese have no current capabilites for permanent facilities. They do, however, plan to conduct extensive experiments on upcoming Spacelab missions.

The Soviet Union has experience in processing materials in space that could be translated into an advantage over potential competitors should it decide to commercialize its space-processed products. In terms of the numbers and types of experiments, the Soviet effort in materials processing is outpacing that of the West and is more extensive than that planned for early shuttle work. The Soviets have experimented with more materials than the West; most of their work has dealt with substances that have significant applications; and their studies appear to have been carefully planned and well thought out. 25X1 25X1

We know, for example, from Soviet technical articles, that the USSR's space-based experiments in semiconductors have included at least 12 different combinations of elements, all of which could have applications in both civil and military technology for electronic components, radiation detectors, and solar cells. The Soviets have also conducted experiments with several different superconductor combinations. In the field of metal alloys, the Soviets seem to be concentrating on strong, lightweight materials that could have applications in the construction of aircraft and spacecraft. They are experimenting with fiber optics and attempting to produce glass fibers without impurities and irregularities for use in laser communication systems. Other experiments have been aimed at producing large crystals from fragile materials that are difficult to grow on Earth and would have numerous applications. 25X1 25X1

The USSR's most extensive experiments in space-based materials processing have been conducted on board the Salyut 6 and 7 space stations. The Soviet press has claimed:

- Such experiments will lead to the creation of space-based manufacturing facilities to produce pharmaceuticals, semiconductors, alloys, and special glasses for use in the electronics, machine-building, construction, and consumer goods industries.
- The amounts of certain materials produced on board Salyut 6 have already equaled the production of these materials by several facilities on Earth.
- The USSR is now bridging the gap between experimenting in orbit and actual production. 25X1
- In 20 to 25 years the marketing of goods produced in space "shops" of orbital stations "will yield an income of about $50 billion." 25X1

Soviet space officials indicate that they are now ready to move beyond the research and development phase of materials processing in space. A likely step would be to include a special materials processing module as part of a modular space station (see figure 8). The docking of Cosmos 1443 to Salyut 7 in early 1983 was a step in this direction. A *Pravda* article of 2 July 1983 stated that Cosmos 1443 is, among other things, a prototype of units to house space-based laboratories.

Although most of the products they are experimenting with have important military applications, the Soviets evidently also plan to produce for their civilian economy and could also produce materials for export. Soviet press articles and interviews with officials associated with the programs, however, have given no hint of Soviet intentions to market the space-processed products outside the USSR, except possibly in Soviet Bloc countries. Still, Moscow might view production and sale of even small amounts of new and unique products manufactured in space as an important means of increasing its national prestige.

Soviet Prospects and Implications for US Interests

During the next 10 years, the Soviets probably will continue to focus their involvement in the commercialization of space on the sale of launch services. In the near term—that is, for three or four years—they are likely to step up their efforts to obtain commercial contracts for the Proton launch vehicle.

Prospects for the Soviets succeeding in introducing the Proton vehicle to the commercial market have been enhanced by INMARSAT's decision to include the Proton on its list of candidate launch vehicles [9] that could be used to orbit its second-generation maritime communication satellites beginning in 1988.

[9] The other INMARSAT designated launch vehicles are the US shuttle, Atlas-Centaur, Delta, Titan, and the ESA Ariane.

INMARSAT also intends to require the manufacturers bidding to build its second-generation satellites:

- To make their satellite design compatible with more than one of the six potential launch vehicles.
- To select the US shuttle, the Ariane, or the Proton as one of the primary launch vehicles.
- To add the fee for the selected launch vehicle to the price of the satellite when considering the proposals for the INMARSAT contract—a requirement that could benefit the presumably less expensive Soviet launch vehicle.

Soviet prospects for entry into the launch service market in the near term would be enhanced by the US shuttle's inability to meet the anticipated worldwide demand for launch services, delays in scheduled US shuttle launches, another Ariane launch failure, and any difficulty experienced by the new US private launch firms in demonstrating their capability with the expendable US launchers. Moreover, Moscow's willingness to subsidize its launch service will make its fees more competitive than those that the US private firms will need to charge.

Success in obtaining commercial contracts for the Proton launcher will enhance Soviet prospects for competing for a share of the market targeted by the US shuttle when Moscow's own shuttle becomes operational during the period 1990-91. Successful development of the Soviet space tug with capabilities to retrieve satellites for repair and refurbishing would also increase the attractiveness of a Soviet contract. Moscow, nevertheless, will probably experience difficulty in obtaining contracts to launch US communication satellites that have been produced for Third World nations, because US firms will not want to transfer sophisticated satellite technology to the USSR.

We also expect the Soviets to step up efforts to lease communications services both through the INTERSPUTNIK organization and to individual nonmember countries. Moscow has communication

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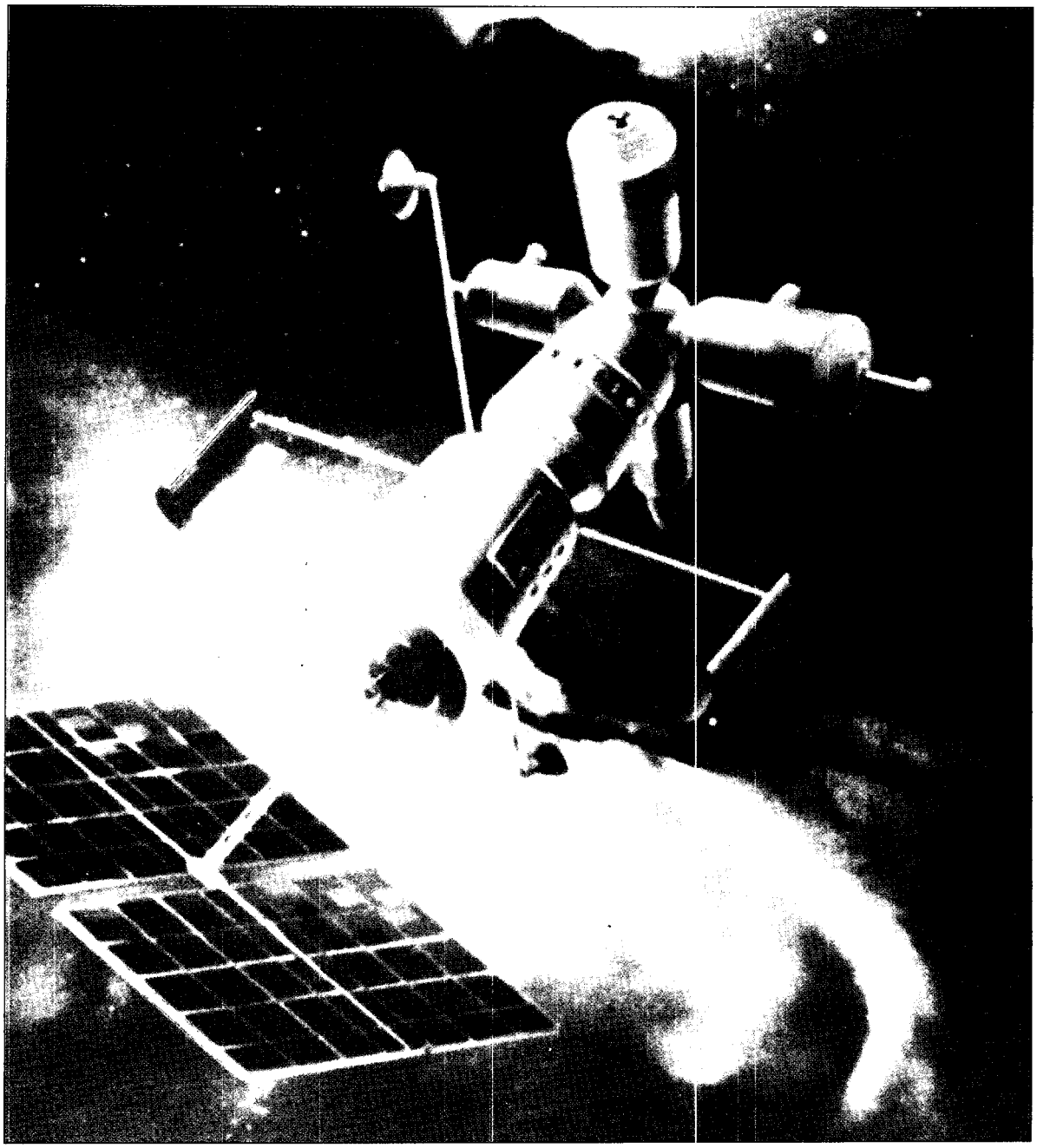
Figure 8
Soviet Concept for Modular Space Station



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circuits available now for lease and apparently plans such use for some of its future communication satellites. It has filed with the IFRB for 16 geostationary positions for satellites using the 4 to 6 gigahertz frequency band and has filled only eight of the positions. Four of the remaining eight unfilled positions have the designation "for international cooperation," which was attached to at least one other Soviet satellite currently used for INTERSPUTNIK traffic, the US-USSR hotline, and worldwide transmission of the 1980 Moscow Olympics. At the INTERSPUTNIK council meeting in November 1982 held in Sofia, Bulgaria, expansion plans were discussed and a protocol was accepted that provides for transition to commercial exploitation of the space communication system.

We believe the Soviets may be already undercutting INTELSAT's fees for communication services by a considerable amount—a practice that may enable them to acquire some customers who might otherwise use INTELSAT. Moreover, INTELSAT's fees could rise if it loses customers to competing regional and national systems, making the Soviet offer attractive to even more Third World nations that are seeking domestic communications services

Largely because Soviet satellites currently have shorter service lives and use less advanced technology than Western equipment, Moscow is unlikely to try to compete with the West in selling communication satellites or high-technology satellite communication applications. If Western manufacturers are unwilling to supply less complex satellites to Third World nations, however, the USSR might eventually enter the market with communication satellites designed to meet those nations' domestic communication needs.

At present, the Soviet Union is not competitive in supplying remote-sensing data, and we do not expect it to be so in the near term. Moreover, it is possible that the only profitable market to develop will be for value-added computer-processed data,[10] an area in which the Soviet Union is not expected to become competitive for some time. Moscow may view its remote-sensing data as a political tool or a means of enhancing—at little or no cost—the attractiveness of other Soviet products and supply remote-sensing data to nations in the Third World where it has political, strategic, or economic interests. 25X1

Notwithstanding Soviet press claims that the USSR is already moving beyond the R&D stage in space-based materials processing, Moscow is almost certainly not about to launch a major effort to market materials produced in space to foreign organizations and firms in the next few years. Instead, Soviet defense industries and other domestic consumers will continue to have priority claim on these products. Moscow might, 25X1
however, attempt to make use of its materials processing effort as a means of enhancing its image as a supplier of space-related products and services or other high-technology output. Similarly, as in the case of remote-sensing data, the Soviets might be willing to provide at least some materials processed in space—for example, in quantities sufficient for research purposes—to their clients in "package deals" that would be contingent upon the purchase of other Soviet equipment. The Soviets might also make some limited 25X1
efforts to market materials produced in space in an effort to determine the demand for such goods. 25X1

Overall, the launch service market is the area in which the Soviets probably will enjoy their greatest success during the next 10 years. Although unlikely to be able to take scheduled customers away from the US shuttle in the 1980s, the Soviets, by virtue of their long experience with expendable launch vehicles, are in a good position to compete with ESA and private US firms in capturing a portion of the international launch service market that the US shuttle cannot 25X1
accommodate. Success in the expendable launcher field could pave the way for broader Soviet efforts to make commercial use of space in the 1990s, when Moscow's own space shuttle and its other space programs with extensive economic applications mature. 25X1

[10] Value-added products are those derived from standard remote-sensing data that have been manipulated by computers and/or interpreted in various ways to provide information tailored to the needs of the particular user about the surface of the Earth. 25X1