Satellites in the Middle East

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The recent report of the Steinitz committee[1] on Israeli intelligence in advance of the war in Iraq mentioned the contribution of satellites to intelligence, and included a recommendation "to expedite Israel's espionage satellite development as a long-term visual intelligence infrastructure." The committee further recommended that "this system be constructed with the capability of addressing the threats, both near and distant, to Israel."

This essay reviews the current situation regarding satellites in the Middle East in order to evaluate the role of space activity in the regional strategic balance. The review will focus on three types of satellites: intelligence satellites, which are designed to provide visual images; telecommunications satellites; and research satellites. An important related field, though not addressed here, is satellite launchers, which in many cases in the world are similar and even identical to the ground-to-ground missiles used for strategic-military purposes.

Intelligence Satellites

The two superpowers began operating reconnaissance satellites in the mid-1960s, and for many years, intelligence satellites were available to them only. The first generations of reconnaissance satellites used photographic film, and the satellite had to land after a relatively short period for the photographs to be retrieved. Later, advanced reconnaissance satellites were capable of broadcasting the images more or less in real time. This technological capability was jealously guarded by the superpowers, and the true capabilities of reconnaissance satellites were kept secret for many years. There were even exaggerated reports that the satellites were capable of reading cars' license plate numbers.

The superpowers operated intelligence satellites especially to obtain high-quality images, but they also operated satellites to collect intelligence information of other kinds. Examples are the American Vela satellite, which was designed to identify nuclear explosions, and a system of Defense Satellite Program (DSP) satellites, which was designed to provide real time warning of missile launches from anywhere on earth. Less developed countries benefited from the intelligence output of the satellites, although only as a result of agreements with one of the superpowers. Images from satellites were marketed commercially in the mid-1970s, but the images were mostly from Landsat satellites with 20-40 meter resolution (depending on the spectral band). Such photographs have many uses,[2] but are of little value for purely military purposes.

The breakthrough in commercial satellite photographs took place in February 1986 with the launching of SPOT (Systeme Pour l'Observation de la Terre) French satellite. This satellite broadcast images with a resolution of ten meters, and the images were marketed freely. Ten meter resolution was the outer limit for use of photographs for intelligence, even if in circumscribed ways only. For example, such photographs cannot be used to view small objects, like vehicles or small buildings, but they can be used to monitor changes in the infrastructure, such as the construction of new buildings in known installations, the construction of runways and hangars in airports, and so forth.

With the end of the Cold War, the satellite market began to expand. Satellites such as Ikonos provided images with increasingly sharper resolution to any buyer. Competition in the global market grew when Russia began releasing photographs taken by satellites during the Cold War. Today, photographs with resolution of less than one meter are commercially available. Restrictions still exist, however, and not every desired photograph can be obtained. For example, the United States does not allow American companies to sell satellite photographs of Israel at the maximum resolution available.

There are also a number of levels of cooperation in the use of commercial satellites for intelligence purposes. At the lowest level, a country purchases photographs according to need. At higher levels of cooperation, a receiving station is set up in a country's territory for the photographs taken by a particular satellite. The receiving station makes it possible to obtain satellite photographs in real time, decode them rapidly, and distribute the intelligence information to the consumer immediately. At the highest level of cooperation, the receiving station has the capacity to control the satellite itself, enabling it to photograph the desired sites at the desired time.

Intelligence satellites are designed to procure intelligence images capable of producing high-resolution photographs. It may still not be possible to read the license plate on a vehicle, as was once claimed, but it can certainly be possible to obtain other details, for example, to distinguish between different types of vehicles. The following important limitations of intelligence satellites, however, should be kept in mind:

- High resolution is possible only under good lighting conditions, only during the day, and in the absence of clouds and fog. Satellites do exist that are capable of providing images at night and in cloudy conditions (through radar photography), but at a much poorer resolution.
- Intelligence satellites cover the earth from relatively low orbits (600-900 kilometers), and an orbit period takes 90-100 minutes. The length of time that the satellite remains above a given region for purposes of obtaining an image is short – usually a few minutes. Due to the earth's rotation, a number of days pass before a repeat "visit" to a given site is possible
- The quantity of photographs that can be obtained during any passage above a given region is limited, due to both the short time available and the quantity of information to be broadcast. This means that it is impossible to "cover" an entire country constantly. Satellite operators must consider well what to photograph in the target countries, and when.
- Intelligence images are by their nature limited. Land contours, buildings, and the deployment of military forces are visible.

Israel stands out with its technological capabilities in the field of intelligence satellites, as it does in telecommunications satellites.

Intelligence Satellites in the Middle East

Since the Yom Kippur War, both Israel and a number of Arab countries have benefited from a degree of cooperation with a superpower – the United States in the case of Israel, and the Soviet Union in the case of Syria. American DSP intelligence satellites provided Israel with advance warning of the launchings of ground-to-ground missiles during the Gulf War.

It is reasonable to assume that all the countries of the region purchase satellite photographs of the neighboring countries for intelligence purposes. A separate issue is the degree to which each country relies on these photographs in its intelligence collection. The relevant questions asked in this context are how many photographs per year on the average each country buys, what areas it focuses on, and how capable its intelligence agencies are of interpreting the photographs and extracting real value from them.

Israel stands out with its technological capabilities in the field of intelligence satellites, as it does in telecommunications satellites, compared with other countries in the region. Israel launched the **Ofeq** 1 satellite in 1988, and the Ofeq 2 satellite in 1990. These satellites were actually research satellites, which examined various features of intelligence satellites. Israel's first intelligence satellite was the Ofeq 3, launched in April 1995 by the Israeli-made Shavit-1 satellite launcher. While official technical details of the satellite's capability were not published, foreign sources reported a capability of producing photographs of approximately one meter resolution. Ofeq was exceptional among photoreconnaissance satellites in several aspects. Only 189 kilograms, it weighed much less than other photoreconnaissance satellites with similar capabilities. Due to Israel's geographic, security, and safety limitations, it was launched towards the west, in contrast to all other satellites, which are launched towards the east, in order to benefit from the earth's rotation. The Ofeq 4 was launched in January 1998, but the launch was unsuccessful. The Ofeq 5 satellite, designed to replace the Ofeq 3, was successfully launched in May 2002.

Israel Aircraft Industries (IAI) also undertook the **Eros** project – a series of civilian photoreconnaissance satellites, which used technology taken from the Ofeq satellites. The first in the series, the Eros A1, was launched in December 2000, this time from a Russian Start launcher. The Eros A1 is capable of providing photographs with 1.8 meter resolution; these photographs are marketed by a commercial company, though it was reported that the Israel Ministry of Defense has acquired exclusive rights to the satellite's photographs of Middle Eastern countries.

The launching of the Ofeq 6 is scheduled for 2004 or 2005, to be followed by the Ofeq 7 in 2007 or 2008. More Eros satellites, of the Eros B series, are also planned. These will provide photographs with resolution of less than one meter. The development of a Techstar satellite, a radar photoreconnaissance satellite, has also been reported. This satellite will benefit from synthetic aperture radar (SAR) technology, which can photograph images with a good resolution even at night and in cloudy weather.

> Satellite intelligence information is believed to have a stabilizing influence on strategic balances: it increases transparency, reduces the chance of a surprise attack, and enhances the feeling of security. This strategic factor has become more powerful as the quality of the information has improved, enabling countries to obtain information about both infrastructures and military deployment.

Strategic Implications

Intelligence from satellite photographs provides countries in the Middle East with a great deal of valuable intelligence information, particularly in the coverage of strategic military and civilian infrastructures. Such intelligence information is believed to have a stabilizing influence on strategic balances, because it increases transparency between neighboring countries, reduces the chance that a country will be surprised by an enemy, and enhances the feeling of security on all sides. This strategic factor has become more powerful as the quality of the information has improved, enabling countries to obtain information about both infrastructures and military deployment.

Israel's satellite capabilities also provide a basis for strategic cooperation with other countries, for example, proposed cooperation with Turkey, which involves information from the Ofeq satellite that Turkey has requested and the possibility that Turkey will buy its own photoreconnaissance satellite from IAI.

Of all the countries in the region, Israel is the only one with its own intelligence satellite, and the only one with the capability of independently launching a satellite into space. The question therefore is what advantage such a satellite provides, given that the information can be purchased on the free market, and whether the heavy financial costs involved in developing the satellite were necessary. The Ofeq project provides Israel with the following important advantages:

- **Independence**. Information from the Ofeq satellites is not dependent on an external party. As noted above, even in the era of commercial intelligence satellites, countries with these satellites retain the ability to control the information from them and prevent the dissemination of information should they so choose.

■ **Exposure of fields of interest.** The Ofeq project has enabled Israel to avoid exposing its particular fields of interest, in contrast to countries that acquire information from a commercial concern.

■ **Frequency of coverage**. The latitude covered by the Ofeq satellite's orbit is limited, but its advantage is that it passes more frequently above regions of interest to Israel.

■ **Technological advantage**. The Ofeq project is a technological challenge in a wide variety of fields, and makes an important contribution to the establishment and expansion of Israel's advanced technological capacity.

Telecommunications Satellites

Telecommunications purposes were among the first satellite applications to penetrate the civilian market, and today many countries and commercial entities operate telecommunications satellites. From a technological standpoint, telecommunications satellites are nothing more than relay stations: they receive broadcasts from a ground station, and relay them to other stations at a great distance from the first station.

Most telecommunications satellites are large, weighing several tons, and are stationed in space in geo-synchronous orbits. They are located above the equator, at an altitude of 35,900 kilometers. This means that they are "suspended" above a fixed point on the earth, because in this orbit, it takes them exactly twenty-four hours to circle the globe. The combination of a large satellite mass and a high orbit requires a large, heavy satellite launch vehicle (SLV), which is not available to most interested countries. The sophistication of the special payloads – the communications systems carried by the satellite – has prevented many countries from independently producing and launching such satellites. Instead, different parties on the global market have combined to develop the satellite communications field for purely commercial activity. In this way, the market has been opened to countries and commercial companies, which offer both the satellites, the special payloads, and the launching systems on a commercial basis.

Telecommunications is considered of more civilian interest than other satellite applications. This does not mean that telecommunications satellites have no military uses. Compared with imagery satellites, however, telecommunications satellites are considered free of security risk, and the developed countries have accordingly allowed the technology to be released to any buyer. Many of the vehicles required to launch telecommunications satellites are based on technology considered unsuitable for most military uses. These launchers are mostly cryogenic, operating on liquid oxygen and liquid hydrogen. The end of the Cold War allowed the release on the global market of launch vehicles originally constructed for the intercontinental ballistic missiles possessed by superpowers (primarily the USSR and China). The release of these technologies to the civilian market spurred global competition in the satellite market, and created additional opportunities for underdeveloped countries to purchase launchers.

Telecommunications Satellites in the Middle East

Arab countries were among the first to exploit the opening of the telecommunications satellite market, which provided a unique opportunity for them to enjoy the benefits of advanced technology, business opportunities, and the prestige of possessing the technology without having the technological capabilities and infrastructure required to develop and launch such satellites.

The first agency established in the Middle East for satellite telecommunications was **ARABSAT**, the Arab Satellite Communications Organization, which was founded in 1976 as the satellite telecommunications organization of the Arab League. The organization currently operates from Saudi Arabia as a purely commercial company. ARABSAT bought and operates telecommunications satellites from three generations. The first generation of satellites, the Spacebus-1000 model, was purchased from the French company Aerospatial. Two of these satellites were launched in 1985 and 1992. Two other first-generation satellites were of the HS-376 model, made by Hughes (now Boeing). ARABSAT is currently operating its second and third generation satellites. Four second generation satellites were launched in 1996-1998. The first two were of the Spacebus-3000 model (also by Aerospatial), and were launched from an Ariane launcher. The third satellite, on the Hughes HS-601HP model, was launched from a Russian Proton launcher. The fourth satellite, of the Eurostar 2000 model, was launched from an Atlas launcher. The first third generation satellite, of the Spacebus-3000 model, was launched in 1999, also from an Ariane launcher.

ARABSAT satellites lie on the 26° east and 30.5° east longitudes, which gives them good coverage of both Arab countries and Western Europe. ARABSAT services are marketed commercially.

Projects in the Middle East similar to ARABSAT are Turkey's **Turksat** satellites (three in a series), and Egypt's **Nilesat** – two Eurostar 2000 model satellites manufactured by the European Astrium consortium, and launched using Ariane launchers. One unique project in Arab countries is the **Thuraya** project in the United Arab Emirates (UAE). Boeing Satellite Systems developed these advanced satellites at the special request of the UAE, at a cost of approximately $1 billion. The first satellite was launched in October 2000, and the second in June 2003. These satellites provide users with a "single hop" link between mobile handheld devices (similar to cellular devices). From a technical standpoint, this involves the capability to create dynamically between 250 and 300 spot beams, as needed.

The **Zohreh** telecommunications satellite project was commissioned by Iran. This ambitious endeavor was originally planned to include six satellites, but was later scaled down to two, for which sites in outer space were allocated. The satellites were ordered from Aviaexport, a Russian company, and some of their special telecommunications equipment was due to come from European manufacturers. The project was apparently canceled in early 2003 before the contract with the manufacturer was signed, following a dispute between Iran and the manufacturer, and the fate of this project is still unclear. It appears that Iran has not abandoned its ambition to obtain its own telecommunications satellite, but in the absence of a signed contract with a manufacturer, the ambition is little more than a vision. The Iranian media have presented a satellite called the Mesbah as an alternative to the Zohreh, but the Mesbah is a small research satellite, and does not resemble the canceled Zohreh.

Israel's **Amos** telecommunications satellite stands out as unusual among the telecommunications satellites in the Middle East. The satellite was planned and built completely by IAI. Two satellites in the Amos series have been launched to date. Even though Israel has independent satellite launching capacity, it is unable to launch a satellite the size of Amos into orbit. Satellite launchers were therefore purchased: the Amos 1 was launched by an Ariane launcher in May 1996, and the Amos 2 was launched by a Russian Soyuz launcher from Baykonur, Kazakhstan in December 2003. The satellites were operated by Spacecom Satellite Communications, a commercial company, which markets their services.

Cost-Benefit Analysis and Strategic Significance

The purchase of a telecommunications satellite affords both prestige from the image of technological achievement, and profit from selling the use of telecommunications channels to other countries, as well as the political power the provider of the service gains with respect to its customers. The benefit derived from maintaining and operating the telecommunications satellite must be measured in terms of telecommunications technology. The purchase of a telecommunications satellite gives the operating country the freedom to determine how the satellite will be used, and the ability to adapt the satellite to the country's needs. The purchaser does not need to deal with problems involved in planning and maintaining the satellite, such as stabilization, durability at various temperatures, and related issues.

The Amos, however, is different. Its launch demonstrated extremely high technological capability, but involved large development costs and a full range of problems involved in operating the satellite. Even a commercial project like the Amos involves considerable government investment in the development process, and invites the question whether the investment was justified, or whether it would have been preferable to buy the necessary telecommunications capacity from foreign suppliers.

In contrast to the Ofeq, which is used solely for military purposes, the Amos is designed mainly for civilian and commercial use. At the same time, it is reasonable to assume that some of the technology used in the development of the Amos was developed for military needs in the Ofeq project, thereby saving a large proportion of the development costs. It should also be kept in mind that Spacecom is a joint venture, in which foreign companies (the Eurocom group, the Mer Services group, and the General Satellite Services group) are partners, in addition to IAI. Such a degree of international cooperation necessarily imposes limitations on the independent operation of the satellite, because it gives the other partners rights in determining how the satellite is operated.

Despite the civilian ownership of most telecommunications satellites, concern always exists that, in times of war, countries might oblige the civilian providers of telecommunications channels to close telecommunications channels to and from Israel. National ownership of a telecommunications satellite removes this cause of concern.

Development of the Amos has given industry another advanced technological tool that can be commercially marketed. This marketing has strategic significance, derived from the satellite's status as an asset in international strategic cooperation. One example is the report of a possible sale of two telecommunications satellites to China as a means of strengthening defense cooperation with that country, following the damage to relations caused by the canceled sale of the Phalcon airborne reconnaissance aircraft. Another project under consideration is the launching of a telecommunications satellite for use by the Israel Defense Forces.

Research Satellites

The term "research satellites" covers an extremely wide variety of satellites designed for diverse purposes, from miniature satellites weighing a few kilograms and used for simple tasks, to a satellite like the Hubble Space Telescope, which is a multibillion dollar project.

Many Middle Eastern countries take pride in operating research satellites. Other countries besides Israel that have launched such satellites include Saudi Arabia, Turkey, Egypt, Algeria, and Morocco. The satellites in all of these cases are small, and their declared purpose is educational. It is assumed that undertaking the development of the satellite itself contributes to the expanding of technological capabilities and the furthering of know-how in the field. The projects are usually civilian, without any military applications. Some of the countries in the region have developed these satellites with external aid, and in all cases, the satellites are launched by an external commercial concern.

■ **Algeria** launched the ALSAT-1 research satellite, weighing ninety kilograms. This satellite was designed at the Surrey Satellite Technology Ltd. (SSTL) space center in Surrey, England, in cooperation with the Algerian Space Agency. The satellite was launched in December 2002 from Kazakhstan using a Cosmos launcher. This satellite is part of a large project for establishing an array of satellites for monitoring natural disasters. Additional satellites will be launched by this center, in cooperation with Nigeria and Turkey.

■ **Iran** initiated the Mesbah research satellites project in 1998. The original plan called for the design and construction of the satellite to be carried out in Iran, but a satellite platform was eventually ordered from the Italian company Carlo Gavazzi. The satellite will carry photography equipment, probably with low resolution, and elements of an electronic messaging system. The declared purpose of the satellite is educational; development and launching it will enable technological concerns in Iran to gain experience. The satellite is scheduled for launching in 2005. Who will launch the satellite is still unknown, but it is reasonable to assume that a commercial launcher will be used.

■ **Israel** – In Israel, the universities deal with research satellites. The Technion launched the TechSAT-Gurwin-1 in 1995 and the TechSAT-Gurwin-2 in 1998, both from Russian launchers. This satellite, which weighs forty-eight kilograms, was designed to remain in space for only one year, but continued to conduct experiments for five years after its launch. Another project of this category is the David, a joint satellite project of the Israel Space Agency and companies in Israel and Germany. This project involves the development of a remote sensing satellite carrying a unique camera with five-meter resolution and twelve spectral channels for scientific uses. The project was initiated in 1995, but Germany withdrew its support of the project in 2003, and its status is currently unclear.

- **Egypt** is developing the EgyptSat satellite. The EgyptSat will weigh about 100 kilograms, will be developed in cooperation with the Ukraine, and will be launched with the Ukranian Dnieper launcher. The satellite is officially designed to monitor natural resources.
- **Morocco** launched a research satellite named Zarkaa al Yamama in 2001. This satellite, weighing forty-two kilograms, was developed as part of a University of Berlin project called TUBSAT. The Moroccan satellite is of a series of satellites developed in cooperation with various countries.
- **Saudi Arabia** – The Riyadh Space Research Institute has planned and launched three satellites in the SaudiSat series. These are miniature satellites weighing approximately ten kilograms. The two first satellites were launched in September 2000, and the third in December 2002. The satellites were launched using a Start-1 Russian launcher.
- **Turkey** launched the BILSAT satellite of the SSTL series, similar to the Moroccan satellite. The Turkish version of the satellite carries two special payloads, designed and jointly constructed by the Turkish Scientific and Technical Research Council (TUBITAK), the Communication Systems and Computer Networks Group (ODTU), and Information Technologies and Electronics Research Institute (BILTEN). These payloads included a nine-band low-resolution multi-spectral imager, and an image-processing module.

Strategic Significance

The strategic contribution of research satellites lies in the opportunity to train technological cadres and solve problems in designing, launching, and operating satellites, along with building a technological and industrial infrastructure. Being engaged in the satellite industry boosts the prestige of a country and its rulers. It appears that for this reason, even countries with limited technological capabilities try to obtain a satellite to bear the national name. These countries purchase a satellite from a commercial concern in the framework of a project for international cooperation. In such cases, it appears that the contribution of the investment in a satellite to the development of technological and industrial infrastructure is small.

Even countries with limited technological capabilities try to obtain a satellite to bear the national name, largely to boost the prestige of the country and its rulers.

Conclusion

In the mid-1970s, the Middle East entered the space age. The countries in the region began buying space assets and products derived from satellite telecommunications and intelligence information. The civilianizing and commercialization of most satellite technologies – capabilities formerly the exclusive province of the superpowers – enabled many countries in the region to benefit from these technological advantages. The principal use of satellite products is in the field of international telecommunications, but the important strategic aspects stem from intelligence satellites and their products. A reality of virtually open skies has gradually emerged.

While only changes in infrastructure could be viewed using satellite images in the early 1980s, countries are now able to use satellite images to monitor changes in military deployments. In the case of satellite images, however, owning a satellite is much more important than owning a telecommunications satellite. While photographs taken by foreign satellites can be purchased, this capability is limited and subject to supervision by foreign governments. Israel's advantage in this field over other countries in the region is therefore much more significant than in the field of telecommunications satellites.

Israel is the only country in the region capable of designing and constructing telecommunications, photoreconnaissance, and radar satellites. The technological level of its intelligence satellites is on the cutting edge of global technology. The Ofeq satellites are lighter and smaller than the satellites made by the superpowers, but provide similar results. Israel is also the only country in the Middle East capable of launching satellites. It consequently enjoys the advantages of full ownership of telecommunications and intelligence satellites, in addition to the strategic benefit achieved through its ability to use both the products and the technology itself as bargaining chips, and as a means of creating strategic links and obtaining influence.

Notes

1 The Committee to Investigate the Intelligence Agencies Following the War in Iraq, Knesset Foreign Affairs and Defense Committee Report, Volume A, the declassified section, March 2004.

2 There are uses in agriculture, environmental planning, monitoring ecological developments, locating mineral deposits, and other fields. For military uses, photographs are needed that can identify at a minimum large strategic installations (airports, factories, military camps, munitions storage dumps, etc.). Resolution of at least 5-10 meters is necessary for these purposes. At higher resolution, smaller details can be distinguished. Vehicles can be identified, and details making it possible to determine the function of buildings within installations. Only at this level of resolution can military preparations be monitored.