COMMERCIAL OBSERVATION SATELLITES IN THE MIDDLE EAST AND THE PERSIAN GULF

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OVERVIEW:

The Middle East and Persian Gulf will be among the regions most directly affected by the proliferation of commercial high-resolution satellite imaging. In these areas, which continue to be characterized by high levels of conflict and tension, the dual-use nature of this technology and the data it provides, are most pronounced.

Militarily, the instability in the region, particularly among revisionist and pariah states, such as Iraq, Iran, Libya, and Syria, and the terrorist groups, such as Hamas, Hizbollah, and the Bin Laden network, highlight the potential strategic impacts of the widespread availability of high-resolution images and data. Satellite imaging is generally seen as a means for obtaining military intelligence, and depending on the format, (resolution, spectral details, and timing) is likely to have major influences on regional stability and balance of power.

In this chapter, we will consider the implications of increased transparency resulting from the commercial availability of timely high-resolution satellite imaging for the Middle East. On this basis, the chapter will describe and analyze the activities and capabilities of the countries in the region with respect to imaging satellite launch, operation, data analysis, and distribution.

THE DOUBLE-EDGED SWORD OF TRANSPARENCY

In discussions and analysis of high-resolution commercial satellite imaging, beyond the economic benefits,

advocates frequently point to the increased transparency provided by this technology. Through space imaging, it will be much easier to identify and respond to unusual troop movements, preparations for surprise attacks, or tests of missiles. Verification of arms control agreements will also become more reliable, thereby increasing their potential role. With wide access to high-resolution satellite images, non-governmental organizations and journalists will also be able to provide independent checks on governments, making it harder for states to hide their activities from the public.[2]

However, in the high-conflict environment of the Middle East, the potential advantages of transparency are open to question, and in some ways, the costs may be greater than the benefits. With the legacy of overlapping conflict zones (Arab-Israeli, Persian Gulf, Turkey-Syria, North Africa, etc.) and the resulting wars and terrorism, this is aregion characterized by a high level of instability.

Under these circumstances, the increased availability of timely information to be provided by high-resolution satellite imaging will, first and foremost, be used for military intelligence. In the Middle East, efforts to negotiate arms control agreements and various confidence-and-security-building measures (CSBMs) to increase stability have not made significant progress. The meetings of the Multilateral Working Group on Arms Control and Regional Security between 1992-1994 ended in an impasse without any accomplishments. In the Middle East, the United Nations Arms Registry has made little headway, with most states either ignoring this voluntary measure towards transparency in conventional weapons, or only providing information that has been made available from other

sources. Thus, for the foreseeable future, the use of satellites for verification of formal regional arms control agreements is likely to be limited.[3]

This environment highlights the dual-use nature of high-resolution satellites, with both military and civil applications. During the Cold War, satellite imaging was a major tool for military intelligence[4], and now, this technology is becoming available in regional contexts, through both dedicated military programs and commercial systems.[5] (Similarly, the images provided by the French SPOT system, as well as Russian and Indian high resolution imaging satellites, are also frequently used for military purposes.[6]) There are indications that Iraq and Iran used SPOT images during their eight year war.[7] SPOT has also been used to obtain information regarding the Dimona nuclear reactor complex in Israel (which is closed to all but essential personnel with the highest level security clearances), sites in Iran and Iraq, and in the areas of Serbia and Bosnia.[8]

Among the states in the region, Israel is probably the most sensitive to the dual-use impact of high-resolution commercial imaging satellites. This sensitivity was expressed in the early 1990s, when the U.S. government's decision to remove the limitations on high-resolution commercial imaging led to concern among Israeli defense officials regarding the impact on national security. Israel's very small territorial extent, which allows for detailed and repeated coverage with a relatively limited number of images, makes itvulnerable to attacks based on data accessible through commercial high-resolution imaging satellites. Its deterrence posture and strategy is based on maintaining a high degree of uncertainty in the eyes of potential enemies, particularly with respect tothe nuclear and

ballistic missile potential. Israeli policy makers feared that Arab states, and Iran, as well as terrorist groups, would be able to exploit these high-resolution images to obtain very detailed intelligence of Israeli capabilities and deployments. Their ability to target Israeli sites with a high degree of precision would alter the balance of power fundamentally, particularly if these images were combined with GPS data to target cruise or ballistic missiles. [9]

The military applications of commercial satellite imaging, and the potential destabilizing impact is not confined to the Middle East. Indeed, the emergence of capabilities for receiving detailed images from the battlefield, and distributing them(or analyses based on this data) directly and immediately to the commanders in the theater, is increasingly recognized as one of the major innovations in conventional warfare. In 1995, US Secretary of Defense William Perry noted the central role that space forces play, stemming from their “exceptional capabilities” for collecting, processing and distributing data. Similarly, Russian military analysts note that “The collection processing, storage, transmission and display of information in them ... has been made the basis of operation. It permitted formalizing the process of assessing events that are occurring and coming up with preferable decisions. …”[10]

If regional powers, rogue states, and terrorist groups have access to this data and capability, they will be able to exploit it for the same purposes. Eliot Cohen noted that "A military cliche has it that what can be seen on the modern battlefield can be hit, and what can be hit will be destroyed. Whereas at the beginning of this century this applied with deadly certainty only to front line infantrymen, it now holds not only for machines on the front lines but for

supporting forces in the rear. … As all countries gain accessto the new forms of airpower [space based reconnaissance and unmanned aerial vehicles], hiding large scale armored movements or building up safe rear areas chock-a-block with ammunition dumps and truck convoys will gradually become impossible."[11]

U.S. government officials have increasingly recognized the potential impact of the proliferation of this technology. Keith Hall, Director of the U.S. National Reconnaissance Office, has stated that "Real-time imagery capabilities provided by E-O and other technologies is causing a revolution in warfare."[12] In analyzing the 1991 Gulf War, he noted that "Satellite reconnaissance was a major factor in the rapid US victory." However, his public statements do not address the impact on U.S. interests, allies or on regional stability in areas such as the Middle East.

In contrast, other analysts emphasize the destabilizing impact of these capabilities on a global basis. For example, "Islamic Jihad could get its hands on a one-meter resolution picture of .. a US Air Force General's headquarters in Turkey, convert the shot to a precise three-dimensional image, combine it with data from a GPS device.. and transmit it to Baghdad, where a primitive cruise missile, purchased secretly from China could await its targeting coordinates."[13]

Gupta notes that the impact "depends on how the new remote sensing services will be distributed through the political landscape, how belligerent states will use the high-resolution images, and how observed states will respond to routine overhead imaging by their neighbors."[14] He warns that unlimited sales of high-resolution imaging could

disrupt “delicate balances of power”, complicate the containment of international crises, and fuel developments in offensive weapons capability.[15] Similarly, former CIA director James Woolsey concludes, “This very comfortable world people have been living in where fixed target installations on land are safe” will vanish with the proliferation of high-resolution commercial imaging.[16]

As noted above, the Middle East is characterized by a high level of conflict, and instability is increased by a number of revisionist powers (Iraq, Iran, Syria, Libya), as well as numerous terrorist groups with access to funds and advanced technology, includingthe Bin Laden network. As a result, high-resolution satellite imaging whether dedicated military platforms or commercial systems, are viewed primarily in the context of their dual-use nature. As will be seen in the following discussion, security concernsare the foundation for Israel’s efforts to limit the distribution of high-resolution images.

COMMERCIAL IMAGING CAPABILITIES IN THE MIDDLE EAST

Israel has the most active and advanced space program in the region, including a dedicated military imaging system (Ofeq), and a the commercial EROS program. The military establishments of other countries which do not have the resources for dedicated reconnaissance satellites, such as Egypt, Syria, Iraq, and Iran are likely to be major customers for commercial imaging products, while applying the data to military intelligence applications.

However, the market for civil applications of high-resolution satellite imaging systems in the Middle East and Persian Gulf is also significant. As in other regions, space-basedimaging has long been used for urban planning,

location and identification of natural resources, including water, (particularly in large and remote deserts), agriculture, and environmental monitoring. In some of these applications, commercial high-resolution imaging can be used to improve the efficiency. Egypt and Saudi Arabia have developed an advanced infrastructure in civil applications of remote-sensing, and the UAE has created a commercial center to provide remote sensing services (both military and civil) to the Arab and Islamic world (all states in the region except Israel).

The Israeli Program

Israel has had an active and growing space program for two decades. As in the case of the U.S. and USSR during the Cold War, the environment of conflict led Israel to develop imaging satellites capable of real-time intelligence for reconnaissance purposes.

The centrality of intelligence and early warning was emphasized as the countries in the region began to acquire ballistic missiles and weapons of mass destruction. On occasion, the U.S. shared strategic and space-based intelligence information with Israel. However, despite the close defense cooperation with the American government, Israel did not have routine access to real-time satellite intelligence data. A Defense Ministry official was quoted saying "For years we have been begging the Americans for more detailed pictures from their satellites and often got refusals -- even when Iraqi Scud missiles were falling on Tel Aviv...."[17] At times, the IDF has turned to other sources, including Russia, which reportedly sold hundreds of satellite pictures of Syria, Iran and Iraq for about $1 million, as part of a secret cooperation agreement.[18]

The Middle East peace process and the transfer of territory to Egypt and the Palestinian Authority has reduced Israel's ability to rely on ground-based early warning and intelligence installations, increasing the reliance on space-based systems. This dependence will increase if Israel relinquishes the Golan Heights to Syrian control, including the intelligence gathering station on Mt. Hermon. Following an agreement with Syria, Israel will need systems to provide early warning of any Syrian military activity. As for former U.S. DOD official Dov Zakheim has noted, "space-based support could buttress Israel's employment of unmanned stations that could be placed on the Golan to monitor Syrian military activity."[19]

Ofeq:

As a result of these factors, in 1988, Israel launched the Ofeq-1 (Horizon) test satellite, using the three-stage Israeli-designed and manufactured Shavit launcher.The launch site is located on the Mediterranean Coast, and in order to avoid flying over hostile countries, a highly unusual flight path was used (northwest over the Mediterranean) placing the satellite into a retrograde orbit at an inclination of 143 degrees.[20] Ofeq-1 was reported to be a test vehicle designed to lead to the development of an orbital reconnaissance capability, and it reentered the earth's atmosphere in January 1989. Ofeq-2 was launched in April 1990, similar in weight and technical characteristics to Ofeq-1, and had an orbital lifetime of 3 months.[21]

Ofeq-3, launched in April 5 1995, was apparently the first operational reconnaissance system, with a payload containing ultraviolet and high-resolution imaging sensors.[22] Its higher perigee (369 km) and orbital maneuvering

capability allows for a longer lifetime. (According to reports in the Israeli press, this version of the Shavit launcher included a small new IAI third-stage rocket engine with 674 lbs of thrust.[23]) Its orbit takes it over sites in the Middle East, including Iraq.

On January 22 1998, the attempted launch of Ofeq-4 (reportedly equipped with an advanced imaging system) ended in failure when the booster malfunctioned.[24] Had the last launch been successful, it would have provided Israel with two operating imaging systems operating simultaneously, significantly enhancing capability. As a result of the launch failure, the Israeli military now hopes to attempt another launch in early 2000 before Ofek 3 reenters or is no longer operational.[25]

EROS

As in the case of the U.S. (where the firms and individuals involved in the military reconnaissance satellite program are centrally involved in the commercial efforts), the Israeli military and commercial high-resolution imaging satellite programs are closely interrelated. Based on the technology developed for dedicated military reconnaissance systems, Israel Aircraft Industry (IAI) has been planning commercial space ventures since the early 1980s. The establishment of the Space Technology Division at IAI in 1984 marked a major step towards developing this capability.

Although a government-owned firm formally under the control of the Ministry of Defense, IAI enjoys a significant amount of autonomy, particularly with respect to new commercial ventures. As direct government

subsidies are reduced, the firm's directors are responsible for independent resources for research and development, and for insuring employment to Israel's largest industrial firm. In the past two decades, the efforts to increase exports and joint ventures with foreign firms have accelerated.[26]

IAI's first proposal for the EROS program was submitted in 1993. Reflecting the limits on government funds, and the high costs of development, outside investors were sought. (The major Israeli defense technology firms, including IAI, have often sought external partners in the private sector, particularly in the U.S., as a means of expanding both marketing opportunities and access to development capital. Thus, the effort to find foreign partners or investors in this case was not particularly unusual.) In order to remain the senior partner, and insure control over technology, operations, and data, joint programs with the major commercial firms in the U.S., such as Space Imaging (Lockheed-Martin and Raytheon), OrbImage, Earthwatch, or the French SPOTIMAGE, were rejected.

In 1996, IAI agreed to work with Core Software Technology, (CST)[27], based in Pasadena, California, in the development of the EROS (Earth Remote Observation System) satellite system. Core reportedly invested $150 million in the program to provide real-time imaging to ground stations around the world.[28]

Although press reports claimed that the first EROS launch was scheduled for 1997, this date was never realistic,in part because the Israeli MOD refused to approve the license (see discussion below). However, planning continued, and by 1998, a program for a constellation of eight commercial light LEO high-resolution imaging satellites was completed. This system is designed to provide potential customers, including the Israeli military, with

very frequent coverage of any point on the globe, compared to the more sporadic coverage that would be available from a system of one or two satellites.

For this very ambitious program, IAI, CST, and ELOP Electro Optical Industries, Ltd. (Israel) created West Indian Space (WIS), incorporated in the Cayman Islands[29], to manage development, launch and operations for the EROS project. Following the failure of the Ofeq-4 launch, the Israeli government's interest in EROS as a means of lowering the cost of a satellite observation system, increased.[30]

EROS is advertised as a low-weight "light-sat" incorporating breakthroughs in systems concepts that allow a 200kg satellite to match the performance characteristics of satellites weighing several tons. (Similarly, IAI's Amos Communications satellite was the lightest communications satellite built at the time of launch, in 1996.) Customers can purchase "turn-key" Earth observation systems, based on "vertical Integration of IAI's satellite technology and CST's archiving, distribution, image management and exploitation technology." West Indian Space is offering to retrofit existing ground stations, used for accessing SPOT and LANDSAT images, at a cost of $10 million.[31]

Israeli launch capacity is currently insufficient for the orbital altitude and weight of the EROS payload, and as a result, the first satellites are scheduled to be placed into orbit using Russian launchers (in itself, a major source of controversy).[32] The first stage of the program consists of two enhanced EROS A+ satellites, to be launched in 2000 and 2001, followed by the EROS B satellites. By 2004, the full system of 8 satellites is scheduled to be fully operational. This constellation will provide data to customers and Satellite Operating Partners (SOPs) in GIS-ready

form. The satellites will be launched into low earth orbits, at altitudes of between 480 and 600 kilometers.

EROS A+ will deliver imagery at a resolution of 1.8 meters, and using the “pushbroom sweep method” of imaging, will cover a 12.5 km swathe with panchromatic imagery, providedto customer at near-real-time. EROS B1 will deliver 0.82-meter resolution from an altitude of 600 km, covering swaths of 16.5 square kilometers, followed by EROS B2 through B6 (five satellites), with 0.82 panchromatic imagery and 3.68 meter multi-spectralimagery. The EROS A+ sensors will consist of 10,000 detector elements in arrays that provide day-only or day/night performance, with time delay integration. The EROS-B series will incorporate 15,000-element modules on a single focal plane, to provide for different sources such as an IR layer over conventional (visible light) images.[33]

The Satellite Operating Partners in the EROS network will receive worldwide access to high-resolution imaging, archiving and distribution, based on existing remote sensing ground infrastructure, as well as additional installations, as necessary. TheSOPs will receive “a dedicated regional satellite with local customer tasking to meet national and civilian satellite program requirements.” In 1999, WIS and the Israeli government reportedly signed an agreement providing exclusive access to images of the Middle East region obtained by the first three EROS satellites for eight years.[34]

Customers can also purchase Priority Acquisition Service (PAS) programs to provide priority tasking of EROS satellites worldwide. Daily coverage (at least one revisit per day) will be provided for North and South America, Europe, Asia, the Middle East, Africa and Australia. WIS is offering imaging services for use in civilian

mapping,infrastructure management, and military intelligence via long-term contracts at $10-20 million annually. Company officials are basing their marketing plans on the expectation that states will opt for a system that is less expensive than the development of their own military surveillance programs, which could cost five to 10 times more.[35]

In addition to selling a range of services to investors and customers, WIS is also planning to issue bonds via a private placement to help finance the $250 million needed to launch and operate their first three satellites. The full cost of the eight satellite system is estimated at $750 million, and WIS is seeking to raise most of this sum through private investors.[36]

Details regarding possible SOPs and customers have not been published, but there has been some speculation in press reports, particularly with respect to Turkey[37] and India[38]. Asian nations that lack their own satellite capability, but with a need for high-resolution intelligence and other data, are considered to be likely customers. WIS officials declared that they will "respect the wishes of the U.S. and Israeli governments" by not providing data to states that are subject to export restrictions, such as Libya, Iraq, and Iran.[39] There are also reports that Israel rejected requests from other states to purchase EROS and Ofeq-type platforms.[40]

US-Israeli Negotiations

As noted above, Israel is particularly vulnerable to intelligence data that can be made widely accessible through commercial high-resolution imaging satellites.[41] In the early 1990s, the changes in the U.S. policy in this

area (PDD 23, in particular), disturbed and surprised Israeli military planners, and they sought to reduce its impact with respect to Israeli security concerns. In addition, the close strategic relationship between Jerusalem and Washington, and the degree to which the peace process and Israeli concessions have been dependent on US security guarantees and pledges to prevent the degradation of Israel's qualitative edge, were also important factors in the Israeli efforts to limit the damage caused by what was seen as a radical unilateral change in U.S. policy.

The Israeli government first raised this issue in 1992, shortly after the US adopted the Land Remote Sensing Policy Act (P.L.102-555), and the United Arab Emirates (UAE) submitted an application to purchase an imaging satellite from Litton/Itek. Israeli officials protested, charging that the U.S. was planning "to supply the Arab countries with binoculars that will enable them to see every military movement here."[42] The application was ultimately blocked by the US State Department (in part, in response to Israeli objections).

Israeli concerns increased after a Saudi company known as EIRAD, owned by Prince Fahd Bin Salman Bin Abdulaziz, sought to acquire a major interest in Eyeglass (now OrbImage), in return for an agreement to build a ground station in Riyadh and exclusive rights of coverage in the Middle East. The main customer was said to have been the Saudi Defense Ministry.[43] In response, the Israeli government expressed concern that this would give the Arab States, including Iraq, access to highly accurate intelligence information and threaten Israeli security and vital interests. The Clinton Administration asked Israel not to object to the Orbview agreement with Saudi Arabia. However, Israel cited the Saudi's negative role in regional instability, potential contribution to conflict, and support for

radical Islamic groups.[44] The issue was also taken up by the Congress, and OrbImage subsequently announced that it would"exclude the territory of Israel from its viewing area and to put a technical fix on the satellite that would prevent such viewing."[45]

The Israeli development of the commercial EROS system added a complicating factor in these discussions. As noted above, IAI's plans for EROS were largely motivated by commercial factors, and were not coordinated with the Ministry of Defense. This created the appearance of a sharp contradiction in Israel policy, with political and defense officials seeking to prevent commercial satellite imaging of Israel, while the defense industries were planning their own high-resolution commercial imaging system.[46]

This contradiction was cited by American government and industry officials, who argued that while the U.S.was limiting its own programs to satisfy Israeli demands, and at considerable costs, Israel was preparing to establish a major market presence before the American firms were able to launch their first commercial satellites. Had the initial schedule, aimed at a launch in 1997, been met, EROS would have been in orbit 18 months before the first US commercial system.[47] (U.S. industry officials also argued that Israeli commercial imaging was unfairly subsidized by the military, although the US government also effectively subsidized the development of US commercial imaging systems.[48])

In contrast, some Israeli industry officials complained that the MOD's (Ministry of Defense) policy of negotiating limits with the US, while refusing to license the EROS program, would result in the loss of an opportunity

to establish a major presence in the market before it was dominated by the US. They argued that the Americans were using the negotiations to delay the EROS program until US firms are able to launch their own commercial imaging satellites.[49]

In 1995, after considerable negotiations, the Israeli and American governments agreed to coordinate policies. Washington denied the Saudis control of the satellite track from the ground, and also placed limits on the sale of state-of-the-art software for image enhancement. On 4 March 1996, the Israeli Ministry of Defense issued the first formal public statement of Israeli policy, which included a ban on the use of Ofeq-3 images for commercial purposes, and maintenance of the division between security related technologies. “Any possible future commercial track” would require licensing from the MOD.[50]

In June 1996, the US Senate passed an amendment to the 1997 Defense Authorization Act entitled, “Prohibition on Collection and Release of Detailed Satellite Imagery Relating to Israel and Other Countries and Areas.” The amendment would have prohibited any agency or department of the US government from licensing the collection or dissemination, declassification or release by any non-Federal entity of satellite imagery with respect to Israel, or any other designated area, unless the imagery is no more detailed or precise than imagery produced by that country's indigenous satellites.[51]

The final version of the amendment prohibited the sale of imaging data over Israel with a resolution below that provided by other “commercially available” sources. The precise definition and implementation of this language was unclear, and the Israelis agreed to a 2 meter limit, based on the availability of Russian KVR-1000 images, (although there are questions regarding the degree to which these can be called "commercially available”.) In 1998, the U.S.

placed the limit at one meter. Israel protested, and in July 1998, an agreement was reached blacking-out Israel at resolutions below 2 meters. Israel also accepted this limit on the sale of EROS images, and the MOD agreed to licensethis program. [52]

During the negotiations, the positions and policies of the two governments began to converge. U.S. government officials gradually began to understand and accept the Israeli concerns regarding the security implications of the proliferation of high-resolution commercial imaging systems, not only for Israel, but primarily for U.S. security interests. At the same time, the Israelis understand the difficulties inherent in blackouts of specific areas, shutter control and other limitations[1]. Officials from both countries have adopted a more flexible and pragmatic approach, seeking to balance their security and commercial interests.

Israel's Data Policy

As the EROS program progressed, the Israeli government began to develop a licensing policy for a commercial imaging system. After considerable pressure for a definitive policy statement, the Ministry of Defense issued a shortdocument, which began with the straight-forward acknowledgement that "The State of Israel is developing national remote sensing capabilities". At the same time, "The MOD prohibits the use of its remote sensing [i.e., Ofeq] defense capabilities for commercial purposes. It is the policy of the MOD to strictly differentiate between the national defense technological projects and any possible future commercial track." Thus, like the U.S., and France, Israel has created a clear partition between dedicated military reconnaissance satellites and

commercial ventures, even though, at some point, the commercial systems, such as EROS may be used for national security objectives. Regarding licensing, the announcement proclaimed that “Any industry that will express aninterest in entering into the commercial remote sensing field will have to receive appropriate permits. Any industry in Israel, including IAI, wishing to enter the track of commercial remote sensing, will have to receive final approval of the MOD after a careful and thorough review of all aspects.”[53]

This statement acknowledges that Israel faces the same combination of military and commercial incentives that exist in the U.S. and other countries. In the spirit of “if you can’t beat them, join them”, Israeli policy had shifted, and the MOD agreed to provide operating licenses and initial contractual commitments for the EROS program. Thus, although the military factors are still dominant, commercial factors have become increasingly important. In Israel, as in the U.S., France, Russia, India, and other states, sales of high-resolution imaging services are increasingly viewed as a means of offsetting the cost of developing and operating a vital military capability.

THE ARAB STATES AND IRAN

SAUDI ARABIA

Saudi Arabia has invested considerable resources in creating a remote-sensing infrastructure, including an advanced center, located in Riyadh. In late 1994, a Saudi company known as EIRAD, owned by Prince Fahd Bin Salman, sought to acquire a major interest in Eyeglass (now OrbImage), in return for an agreement to build a ground station in Riyadh and exclusive rights to receive and distribute OrbView satellite images in the Middle East. (EIRAD

acquired a 20% interest in the company.) The main customer is expected to be the Saudi Defense Ministry.[54] As noted above, this involvement raised fears in Israel regarding the use of this system to gather military intelligence information that would be used by various Arab states and terrorist groups against Israel.

In addition, the Saudi Center for Remote Sensing (SDRS), located in Riyadh, was established in 1983, and is developing an advanced capabilityfor data analysis. In 1999, SDRS signed an agreement with RADARSAT International (Canada) for exclusive ordering, scheduling, reception, and product generation of RADARSAT I (7 meter resolution) data for the Middle East.

Other Saudi investors have alsoinvested heavily in different space based commercial technologies. Prince Alwaleed Bin Talal invested $200 million in Teledesic, which is seeking to manufacture and operate a global, broadband space-based internet communications system. Another Saudi investor has reportedly agreed to finance the development of a commercial launch system.[55] Thus, Saudi involvement and access to data in costly commercial ventures, including high-resolution satellite imaging, is part of the pattern.

UAE

As noted, in 1992, the United Arab Emirates sought to purchase an imaging satellite from an American manufacturer on a commercial basis. Although the rules had not yet been changed, thisoffer was seriously considered and favored by the Commerce Department, before being rejected on political and military grounds.

In 1997, Dubai signed an agreement for the establishment of an imagery receiving station, operated of DSI-

Dubai Space Imaging, a joint venture formed by Space Imaging EOSAT (U.S.) with a group of UAE investors. This station will provide customers with realtime (within 20 minutes of collection) access to detailed imagery in an area within a 2,300km radius (including all of Iraq and Iran) from the receiving station.[56] In the first stage,the Dubai receiving station will use a ground imagery processing system leased from US company Datron World Communications, and receive data from the 5m Indian Remote Sensing (IRS) earth imaging satellites IRS-1C and IRS-1D. After the launch of the IKONOS satellites, the Dubai station will be upgraded with Raytheon/E-Systems technology, to receive and distribute 1m-resolution imagery. Company officials and sales material explicitly noted that this system "is easily capable of detecting and identifying individual vehicle movements, mobile missile launchers and other military activities under clear weather conditions."[57] DSI will sell information products and services as well as imagery, and will provide training in imagery analysis and geographic information systems tools and applications. The contract with DSI is not exclusive, and EOSAT officials have stated that "we are already talking to several other countries in this region who have an interest in establishing a national ground station to exploit our imagery." [58]

EGYPT

Although Egypt is not known to be investing in development or purchase of a dedicated imaging satellite (civil or military), in terms of remote sensing applications, Egypt has broad and advanced capabilities. Egyptian analysts,both civil and military, have significant experience in processing and interpreting high-altitude aerial and

satellite-based imaging data. As a result, Egyptian technicians and analysts are likely to be centrally involved in many of the application programs based on the use of commercial high-resolution satellite imaging in the Middle East.

IRAQ

In December 1989, a few months before the invasion of Kuwait, Iraq launched a three-stage missile (the Al-Abid), and the Iraqi government declared that this was a test of an independent space launching capability.[59] During the 1980s, Iraq was also involved in the CBERS satellite imaging development project, with Brazil and China.

After the Gulf War, and the imposition of UN sanctions, these projects were frozen. However, with the availability of commercial systems, the Iraqi regime will have the same access as other entities to the data and images that are produced. In late 1999, a Russian firm (NPO Mashinostroyenia) reportedly delivered the first 70 (out of a total of 220) digital high and medium-resolution images satellite images of the Gulf region to Iraq. News reports noted that "Defense analysts believe the photographs will greatly improve the ability of the Iraqi armed forces to target neighboring countries."[60]

The Iraqis may be barred from directly entering into contractual arrangements for receipt of data from American and perhaps European or Japanese firms. However, as in the case of other dual-use technologies, agents and contractors will be able to purchase the data via third-party transactions. Coupled with the missile and WMD capability that Saddam Hussein retains, and ability to launch terror operations throughout the world, the

availability of the intelligence information providedby real-time commercial imaging systems will mark a major increase in the level of Iraqi capabilities.

IRAN

Following Israel, Iran is the most active country in the Middle East with respect to indigenous space and satellite development and launch capabilities. In 1998, Iran announced plans to build a telecommunications satellite, to be launched in 2001 using a Shehab-4 rocket. (Iranian Defense Minister, Admiral Ali Shamkhani announced that Shehab 4 is now in production as a space launcher. "Shehab 4 is not for military purposes but for launching a satellite."[61]) Although there have been no official announcements, Israeli intelligence analysts believe that Iran is seeking to acquire a reconnaissance satellite.[62] Iran is also a participant in a $20 million multinational project to develop and launch a satellite for use in telecommunications and monitoring. Other participants include China, Pakistan, Mongolia, Thailand, South Korea, with the target launch date of 2001. (The official press release did not provide details on the potential monitoring activities of the satellite.[63]) However, given the involvement of South Korea and Thailand, whose interests are primarily economic and technological,rather than military-strategic, this could also provide the basis for a commercial imaging satellite program.

RULES OF THE GAME?

The dual-use nature of commercial satellite imaging systems, and the data that these systems can supply, remain primary factors in future military scenarios involving the Middle East. Concerns regarding their potential

destabilizing impacts were central in the Israeli government's efforts to prevent the sale or release of high-resolution commercial imaging of its territory.In addition to the legislation in the U.S. Congress, Israeli officials also held talks with policy-makers in other states, including Russia and France, in order to persuade them to impose limits or prevent the release of images that would compromise vital Israeli security interests.

However, as the number of satellites with high-resolution imaging capabilities increases (including the successful launch of IKONOS in September 1999), Israeli officials are also increasingly aware of the difficulties of maintaining the blackout of high-resolution images over its territory. Although the commercial American technology will provide the most advanced, and therefore, most militarily significant sources of intelligence, satellites operated by Russian, French, Canadian, Indian, and other firms, as well as consortia, will also provide such data. Under current political conditions, the obstacles to the negotiation of agreed "rules of the game" and a satellite imaging regime to prevent proliferation of destabilizing systems and information, remain formidable.

TABLE 1: ISRAELI MILITARY SATELLITE IMAGING SYSTEMS

PAYLOAD	LAUNCH DATE	DESCRIPTION	TECHNICAL DETAILS
CLASSIFIED PAYLOADS			
Ofeq 1	September 1988	Test and proof of	156 kg package;

		concept	spin-stabilized. Re-entered after 4 months
Ofeq 2	April 1990	Advanced test	156 kg package; spin-stabilized. Re-entered after 3 months.
Ofeq 3	April 5 1995	Dedicated reconnaissance satellite	Thruster based three-axis stabilization; 255 kg package. Still orbiting as of January 2000
Ofeq 4 -- launch failed	January 22 1998	Dedicated reconnaissance satellite (?)	

Note: All Ofeq payloads were launched by the Israeli Shavit launcher.

TABLE 2: ISRAELI COMMERCIAL SATELLITE IMAGING SYSTEMS

Satellite Designation	**LAUNCH DATE**	**DESCRIPTION**	**ALTITUDE**
EROS A+1	2000	1.8 m GSD	480 km
EROS A+2	2000	1.8m GSD	480 km
EROS B1	2001	.82 m GSD	600 km
EROS B2	2001	0.82 m panchromatic, 3.68 m multi-spectral	

EROS B3	2002 (est.)	0.82 m panchromatic, 3.68 m multi-spectral	600 km
EROS B4	2002 (est.)	0.82 m panchromatic, 3.68 m multi-spectral	600 km
EROS B5	2004	0.82 m panchromatic, 3.68 m multi-spectral	600 km
EROS B6	2004	0.82 m panchromatic, 3.68 m multi-spectral	

Note: The first EROS satellite is scheduled to be launched by the Russian START booster. No decisions have been made regarding subsequent launches.

REFERENCES AND END NOTES:

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[1] The U.S. decision to license high resolution commercial imagery (PDD 23, March 9 1994) was based on a trade-off between commercial interests, which sought minimal limitations, and national security and foreign policy interests, which argued for greater intervention controls. This resulted in the establishment of shutter controls, to allow the U.S. government, at the Cabinet level, to limit the collection or distribution of data "in the event of a diplomatic or military emergency". See John C. Baker, "Trading Away Security?: The Clinton Administration's 1994 Decision on Satellite Export Imaging Exports", Pew Case Studies in International Affairs No. 222, Institute for the Study of Diplomacy, School of Foreign Service, Georgetown University, Washington DC, 1997, pp. 6-7. This definition was widened subsequently in the licenses issued by the U.S. National Oceanographic and Atmospheric Administration (NOAA) include the provision that "During periods when national security or international obligations and/or foreign policies may be compromised, as defined by the secretary of defense or the secretary of state, respectively, the secretary of commerce may, after consultation with the appropriate agency(ies), require the licensee to limit data collection and/or distribution by the system to the extent necessary by the given situation." See Ann M. Florini and Yahya Dehqanzada, "Commercial Satellite Imagery Comes of Age", *Issues in Science and Technology*, Fall 1999

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[1] I would like to thank Aharon Entengoff for providing research assistance in the preparation of this paper.

[2] See, for example, Vipin Gupta, "New Satellite Images for Sale: The Opportunities and Risks Ahead," *International Security* 20, Summer 1995; Ann M. Florini and Yahya Dehqanzada, "Commercial Satellite Imagery Comes of Age", *Issues in Science and Technology*, Fall 1999

[3] In the context of bilateral arms control, it is possible that a change in the political environment could lead to a peace treaty between Israel and Syria. Such an agreement would include Israel withdrawal from the Golan Heights, accompanied by demilitarized and limited conventional deploymentzones on both sides of the border. In this context, high-resolution satellite imaging might be able to supplement on-site, airborne and other forms of verification, but the use of commercial systems, as opposed to dedicated national technical means, forthis purpose will be limited.

[4] See Gerald M. Steinberg, *Satellite Reconnaissance: The Role of Informal Bargaining* (New York: Praeger, 1983); John Lewis Gaddis, "The Evolution of a Reconnaissance Satellite Regime," in *US-Soviet Security Cooperation*, George Farley Dallin, ed. (New York: Oxford University Press: 1988), pp. 353-363

[5] Ann Florini, "The End of Secrecy", *Foreign Policy*, No. 111, Summer 1998; George J. Tahu, John C. Baker, Kevin O'Connell, "Expanding global access to civilian and commercial remote sensing data: implications and policy issues", *Space Policy*,14 (1998) 179-188

[6] Michael Krepon, "The New Hierarchy in Space," in Michael Krepon, Peter Zimmerman, Leonard Spector, and Mary Umberger, eds., *Commercial Observation Satellites and International Security* (New York: St. Martin's Press, 1990), p. 21; Jeffrey Richelson,"Implications for Nations Without Space-Based Intelligence Collection Capabilities," in Krepon et al., *Commercial Observation Satellites*, p. 55

[7] Krepon in Krepon et al., op. cit., p. 23.

[8] Peter Zimmerman, "From the SPOT Files: Evidence of Spying," *Bulletin of Atomic Scientists*, Vol. 45, No. 7 (July 1989), pp. 24 25.

[9] Gerald M. Steinberg, "Middle East Space Race Gathers Pace", *International Defence Review*, October 1995; Gerald M. Steinberg, Dual Use Aspects of Commercial High-Resolution Imaging Satellites, Security and Policy Series Paper No. 17, BESA Center for Strategic Studies, Bar Ilan University, 1998

[10] Major General Valeriy Menshikov and Colonel Boris Rodionov, "Opinion on the Subject," Russian National Information Service, Moscow Armeyskiy Sbornik (in Russian), No. 10 (October 1996), pp. 88-90 (reprinted in FBIS Daily Report, 30 January 1997, UMA-97-018-S, US Government World News Connection, Washington DC (http://wnc.fedworld.gov/).

[11] Eliot A. Cohen, "A Revolution in Warfare", *Foreign Affairs*, 75:2 March/April 1996, pp. 37-54

[12] Keith Hall, Director of the National Reconnaissance Office, Remarks to the National Network of Electro-Optical Manufacturing Technologies Conference, February 9, 1998, http://www.nro.odci.gov/

[13] Charles Lane, "The Satellite Revolution," *The New Republic*, August 12, 1996, p. 24

[14] Gupta, 1995, p. 115.

[15] Ibid. p. 117.

[16] R. James Wollsey, cited by Charles Lane, "The Satellite Revolution," *The New Republic*, August 12, 1996

[17] Michael Rotem, "Spy Satellite for Arab Emirates 'Serious Threat'," *Jerusalem Post,* November 19, 1992; Sergey Koulik and Richard

Kokoski, “Verification Lessons of the Persian Gulf War,” *Conventional Arms Control* (New York: Oxford University Press, 1994), p. 199

[18] Yossi Melman, “Russia sold Israel hundreds of satellite pictures” *Haartez*, March 30, 1998

[19] Dov S. Zakheim, “Hi-tech eyes and ears”, *Jerusalem Post*, July 30, 1999

[20] ‘‘Space Activities of the United States, Soviet Union and Other Launching Countries/Organizations: 1957-1993,” Congressional Research Report to Committee on Science, Space Technology, House of Representatives, 103rd Congress (Washington: US Government Printing Office, 1994), p. 161; Since additional thrust was needed to achieve the extra 1200 mph of velocity required to escape into orbit from a westward launch, this restricted the size of the payload (John Simpson, Phillip Acton, and Simon Crowe,“The Israeli Satellite Launch,” *Space Policy*, May 1989)

[21] “Space Activities of the United States, Soviet Union and Other Launching Countries /Organizations: 1957-1993,” *Congressional Research Report toCommittee on Science, Space Technology,* House of Representatives, 103rd Congress (Washington: US Government Printing Office, 1994), p.161.

[22] Rafael, the Israeli Arms Development Authority, has developed a sophisticated system of gauges inside the fuel tank to measure the movement of gas. When small satellite thrusters are fired, the fuel tends to slosh, which has an impact on the satellite’s attitude and orbit. The Rafael system dampens the impact of this sloshing. Amnon Barzilai, “Israel to cooperate with European Space Agency on new Dutch satellite”, *Haaretz*, September 10, 1998

[23] *Aviation Week and Space Technology*, October 17, 1994.

[24] Israel to launch new satellite before old one expires, Reuters, July 7, 1998; Steve Rodan, “Ofek satellite budget approved”, *Jerusalem Post*, June 26, 1998

[25] Ze'ev Schiff, “A serious satellite situation”, *Haaretz*, January 25, 1998

[26] Gerald M. Steinberg, “Defence Procurement Decision Making in Israel”, Arms Procurement Decision Making, Vol. 1, Oxford University Press and SIPRI, Ravi Singh, editor, 1998; Aharon Klieman and Reuven Pedatzur Rearming Israel: Israeli Defence Procurement Through the 1990s, Jerusalem Post Publication, Jerusalem, 1991

[27] Core Software Technology (CST) is headed by Steve Wilson. Founded in 1991, Core developed a global on-line visual indexing and distribution infrastructure, known as ImageNet, for users of geospatial information products (i.e. satellite and aerial imagery, computer cartographic and demographic products). ImageNet claims to be “the single largest on-line source of electronically indexed satellite imagery archives” with “over 20,000 registered subscribers through franchised Primary Service and Data Providers in North America, Europe, Russia, the Middle East, Australia and the Southern Pacific Rim.” See also Core Software Technology Homepage http://www.coresw.com/

[28] Jeff Cole and Amy Docker Marcus, “Israeli-Led Venture in Satellite Imaging Poses Challenge to US Aerospace Firms,” *Wall Street Journal*, 28 February 1996; Steve Rodan, “Space Wars,” *Jerusalem Post Magazine*, 10 March 1995; Christian Lardier, “Proliferation of Remote Sensing Satellites as Market Expands,” *Air & Cosmos/Aviation International*, April 4, 1997, pp. 34-35.. See also press release, “Israel Aircraft Industries and Core Software Technology Announce Formation of a Joint Venture Company to Enter High-Resolution Satellite Imagery Market,” IAI Electronics Group and Core Software Technologies, Tel Aviv, February 28, 1996; West Indian Space Homepage: http://westindianspace.com/home.html

[29] The establishment of an offshore corporation for a joint venture is unusual and probably unique in the case of IAI. The Cayman Islands

was apparently chosen as a result of its unique tax status with respect to Israel and the U.S.

[30] Ze'ev Schiff, “A serious satellite situation”, *Haaretz*, January 25, 1998

[31] Peter B. deSelding, “U.S.-Israeli Venture Plans Bold Offer”, *Space News*, March 15 1999

[32] Israel has been very supportive of American efforts to use sanctions against Russian firmsand research centers involved in the sale of missile technology to Iran. If Israel were to contract for Russian sales of launch services, it would be undermining its policy with respect to Iran. See Gerald M. Steinberg, “News Analysis -- Israel to use Russian launcher”, *Jerusalem Post*, 6 December 1999, and Ze’ev Schiff, “Israeli military satellite to ride Russian rocket“ *Ha’aretz*, 3 December 1999. Israeli industry (Modular Space Transportation and IAI) is attempting to develop a heavier launch capability, known as the Star-460, but its prospects are uncertain. Amnon Barzilai, “Launcher Experts say Israeli super-rocket possible”, *Haaretz* , March 11, 1999

[33] Tamir Esche, “El-Op Aims High for Space Business”; “U.S.-Israeli Venture Plans to Launch Eight High-Resolution Satellites”, *Imaging Notes*, May/June 1999, Vol. 14, No. 3, p. 6

[34] Peter B. deSelding, “U.S.-Israeli Venture Plans Bold Offer”, *Space News*, March 15 1999

[35] El-Op is also participating in the DAVID program, funded by the European Community's R&D Fifth Program. The group comprises Israeli and German participants including German satellite maker OHB and GAF, an image processing company who will also partner in a joint venture for the commercialization of the technology. The service will be based on an array of small satellites, each weighing only 180 kg. It will provide 5-meterresolution earth resources imagery, viewed at specific narrow-band wavelengths. The service will also be able to conduct automatic monitoring of land use, issue alerts when detectable hazards are spotted, and assist national or municipal authorities in the enforcement of licensing and regulation. The group is negotiating with investors for private investment that will enable full-scale development and a commitment for a launch window.

[36] David Rosenberg, U.S.-Israel Satellite-Imaging Firm Plans Bond Issue, Reuters, February 28, 1999

[37] Douglas Davis and David Rudge, “Turkey wants Israeli intelligence on Syria”, *Jerusalem Post*, October 8, 1998

[38] Douglas Davis, 'Foreign Report': Israel giving satellite data to India, *Jerusalem Post*, June 11, 1998

[39] Peter B. deSelding, “U.S.-Israeli Venture Plans Bold Offer”, *Space News*, March 15 1999

[40] Sharone Parnes, “Israeli Officials Decline to Discuss Role of Latest Ofeq,” *Space News*, April 10-16,1995.

[41] Gupta has noted that states with long-range weapons may be able to create highly accurate maps of enemy territory and will thus be encouraged to “develop or import new guidance systems capable of directing weapons to the designated point at a comparably high accuracy” (Gupta, 1995, p. 117).

[42] Michael Rotem, ”Spy Satellite for Arab Emirates ‘Serious Threat’,” *Jerusalem Post,* November 19, 1992**;** Sergey Koulik and Richard Kokoski, “Verification Lessons of the Persian Gulf War,” *Conventional Arms Control* (New York: Oxford University Press, 1994), p. 199

[43] Charles Lane, “The Satellite Revolution,” *The New Republic*, August 12, 1996, p. 24.

[44] *Aviation Week and Space Technology*, 2 August 1994. On August 8 the *New York Times* reported that Muhammed Hilawi, the Saudi diplomat who defected in May of 1993, claimed that the Saudis were interested in nuclear weapons. Paul Lewis, “Defector says Saudis sought nuclear arms,” *New York Times*, 7 August 1994

[45] Statement of Senator Bingaman, *Congressional Record,* Hearings on National Defense Authorization Act For Fiscal Year 1997,

Amendment No. 4321, “Purpose: To Prohibit the Collection and Release of Detailed Satellite Imagery with Respect to Israel and Other Countries and Areas,” US Senate, Washington DC, 26 June 1996, p. S6924-5 (http://www.fas.org/eye/1 _01.htm). See also Warren Ferster, “Eyeglass to Refrain from Photographing Israel,” *Space News,* No. 7, November 13, 1994.

[46] Gerald M. Steinberg, Dual Use Aspects of Commercial High-Resolution Imaging Satellites, Security and Policy Series Paper No. 17, BESA Center for Strategic Studies, Bar Ilan University, 1998

[47] Testimony of Brian Dailey, Vice President of Space and Strategic Missiles Sector, Lockheed Martin Corporation, before the House Subcommittee on Space and Aeronautics, US Congress, Washington DC, 31 July 1996 (http://www.fas.org/spp/civil/congress/1996 _h/h960731_spac_com_wit.htm).

[48] William J. Broad, “Commercial Use of Spy Satellites to Begin; Private Ventures Hope for Profits,” *New York Times*, 10 February 1997, p. 1; Cole and Marcus, “Israeli Led Venture,” op. cit.

[49] Statement from the Israeli Ministry of Defense, Tel Aviv, March 4,1996.

[50] Lane argues that it is in America’s interest to continue to lead the regulation in remote sensing, and claims that the loss of US international leadership in launches has contributed to lower disincentives for missile proliferation. (Lane, “The Satellite Revolution,”).

[51] Statement of Senator Bingman, *Congressional Record*, p. S6924-S6925.

[52] U.S. bans some satellite images of Israel, AP, July 25, 1998; Ze'ev Schiff, “U.S. bans high-resolution satellite sales in bow to Israeli pressure”, *Ha'aretz*, August 17, 1998

[53] Statement from the Israeli Ministry of Defense, (Tel Aviv), 4 March, 1996

[54] Lane, “The Satellite Revolution,” p. 24.

[55] “Kistler receives Saudi investment” *Aviation Week Space Business Online*, July 28, 1999

[56] “Space Imaging EOSAT Forms United Arab Emirates Partnership”, *Florida Space Today Online*, November 18 1999; http://www.flatoday.com/space/explore/stories/1997b/111897c.htm; “Middle East customers to obtain detailed space imagery”, *Jane's International Defense Review*, January 1, 1998, Vol. 31:1, p. 8

[57] “Middle East customers to obtain detailed space imagery”, *Jane's International Defense Review*, January 1, 1998, Vol. 31:1, p. 8

[58] “Middle East customers to obtain detailed space imagery”, *Jane's International Defense Review*, January 1, 1998, Vol. 31:1, p. 8

[59] “Space Activities of the US, USSR and Other Launching Countries/Organizations: 1957-1993,” p. 135.

[60] Con Coughlin, “Russian space pictures enable Saddam to target Gulf states”, *Sunday Telegraph*, October 10 1999; Reuters, “Russia Sells Iraq Satellite Photos”, October 12 1999

[61] Clifford Beal, “Iran's Shehab 4 is Soviet SS-4, says US intelligence”, *Jane's Defence Weekly*, Special Volume/Issue: Vol. 031, Issue: 007, February 17, 1999

[62] “Israeli intelligence suspects developing spy satellite”, AP, September 5, 1998

[63] Iran to build $20 million satellite with Asian states, Reuters, August 4, 1998