INTERNATIONAL PEACE THROUGH THE FREE MARKET. THE EFFECT OF COMMERCIAL REMOTE SENSING SATELLITES ON INTERNATIONAL PEACE

Tim Brown
Alexandria,Virginia

Abstract

This paper will examine national, international, and private space-based remote sensing efforts and their effects on international peace. This paper will argue that as long as a few governments control remote sensing technology the peacekeeping abilities of remote sensing satellites will be severely limited. Improvements in spatial resolution, timely data retrieval, coupled with low cost computer hardware and software will increase international access to remote sensing. The paper warns of the dangerous effects that limited access to remote sensing imagery and technology could have on international stability. True information symmetry will be achieved through the marketplace, not through export controls or restrictions. Because of their impartial nature, commercial enterprises that offer imagery on a non-discriminatory basis are better suited for conflict resolution, arms proliferation monitoring and treaty monitoring.

"Up to 30 nations may have remote sensing satellites by the year 2000."

-- Gen. Merril A. McPeak , USAF

A Brief History of Space-Based Remote Sensing

The United States has spent over three decades photographing the earth from space, beginning with the recovery of the first Discoverer capsule in 1960, right up to the present with advanced KH-11reconnaissance satellite images being transmitted digitally in near real-time from orbit to mobile command posts in the field. The Soviets also developed their own systems for spying in space, and until recently it was very closely held.

The general public got its first look at what were then high-quality images of Earth in 1972 when the US made Landsat images commercially available.[1] In 1986, the French launched their own commercial remote sensing satellite, known as SPOT, and were the first to sell imagery with a spatial resolution of ten meters on the open market.[2] China, India, and Israel soon followed with their own reconnaissance satellites, and now a dozen other countries are pursuing their own indigenous space reconnaissance capabilities.

The End of an Era: Shrinking Defense Budgets, Foreign Competition, and the Threat of Transparency

National security concerns delayed, but did not prevent the development of a domestic commercial satellite market here in the United States. The Soviets began selling 5-meter imagery on the open market in 1988. With the collapse of the Soviet Union, the very satellites that were used to wage the Cold War, were being used to gain much needed hard currency for the struggling Russian government. Ironically, the demise of the "evil empire," once thought to be both equally impossible and desirable, became both a reality and a growing worry to US policymakers. Instead of rejoicing, defense and intelligence officials pondered the implications, and worried that less developed nations, regional powers, potential US adversaries, terrorists and sub-national groups could buy Russian 5-meters satellite imagery.[3]

Several factors converged to shape the current context for space remote sensing. The end of the Cold War brought rapidly shrinking defense budgets and fewer contracts for the defense industry. With "defense conversion" in mind, contractors were looking to the private sector as a new market. Foreign competition was taking its toll as Russian RESOURS-F1 satellite imagery boasting an unprecedented 2-meter resolution capability was made available. The French SPOT satellite continued to dominate the world satellite imagery market. Its 10-meter resolution, short data retrieval time and low price attracted much of the market. But the very US defense contractors that had pioneered new technology that gave the military its high resolution KH-11 satellites, were not allowed to

exploit that know-how to launch a commercial version, let alone to export the data and to compete with the Russians and theFrench on the world market.[4]

At the same time the future of the US Landsat program was in question as a result of program delays and cost overruns that threatened to kill the government's only commercial satellite. It was in this context that defense contractors argued in favor of lifting restrictions that kept them from constructing higher quality imagery satellites and from making the data available to the domestic and the international remote sensing market.

The Clinton Administration added space-based environmental monitoring and job creation to the list of reasons for lifting restrictions, and over the past summer gave three commercial firms the approval to launch satellites capable of 1-meter resolution. Space Imaging Corporation, and Eyeglass International will each launch a 1-meter satellite in 1997. Worldview Imaging Corporation will launch a 3-meter systems in 1995. These firms will have the ability to export the data, allowing them to compete in an increasingly bullish international satellite imagery market. In addition, the three firms will be able to export complete "turn-key" satellites to selected US allies and client states, on a case by case basis, allowing them direct access to imagery.

Techno-pessimists and Techno-optimists

As of yet, there is no consensus between scholars, experts, government officials, the news media, the military , and the international community, as to whether the proliferation of remote sensing satellites will have positive or negative consequences for regional stability, trans-national border conflict, arms control, and world peace in general. But a clear split has emerged.

Techno-pessimists

There are several arguments in favor of containing the proliferation of space reconnaissance. Among these are the increased likelihood of regional arms races and conflict. The proliferation of space reconnaissance could create information asymmetries with only the wealthiest nations able to afford the imagery. Critics argue that this could have a potentially de-stabilizing effect on trans-national border disputes in the developing world. There is also a possibility that the imagery technology may weaken US national security, international obligations, and/or foreign policies, by its use in the hands of potential adversaries against US forces or their allies.

In spite of the dominant position that the United States holds as the only remaining superpower in the world, there is considerable concern within the national security establishment, that the proliferation of military quality-imaging satellites could have a de- stabilizing effect on international security and peace. This rather pessimistic view holds that in the future, remote sensing satellites, if allowed to proliferate, will only increase the ability of rival nations to spy, target, and destroy each other's military and defenses. Improvements in spatial resolution, data delivery, and cost, will increase the ability of nations to more accurately target other nations, to hide military forces for an invasion, or to hide clandestine nuclear, biological, or chemical production facilities.

Counter-terrorist experts fear that terrorists and sub-national groups will be able to use remote sensing imagery to target critical facilities for sabotage, seizure or destruction. Coupled with readily available light aircraft and using a hand-held Global Positioning Satellite receiver (GPS), a terrorist could pilot an aircraft loaded with explosives to some critical facility. Pentagon planners and strategists argue, that with increased global instability, it is more likely that US military forces or their allies will be targeted and attacked, by potential adversaries using imagery gained from remote sensing satellites.

Techno-pessimists concede the benefits of remote sensing technology when it is used for the "right reasons," by the "right people" i.e.., US military force application, perception management, public diplomacy, nuclear non-proliferation monitoring, arms control verification, UN cease-fire monitoring, counter-narcotics interdiction, and environmental research. But, they fear that other nations or groups (not under their control) cannot be trusted to use the technology wisely. Therefore, techno-pessimists call for tighter control of the technology. They see remote sensing satellites as de-stabilizing as nuclear, biological, or chemical weapons, and therefore should be treated with the same restrictions.

Techno-optimists

On the other hand there are a growing number of reasons why techno-optimists see mostly beneficial effects of the proliferation of remote sensing technology, and the growth of an international remote sensing market. Increased spatial resolution, timely data delivery, a growing variety of sensors, and the increased performance and reduced cost of computers, all point to wider availability of remote sensing data. These improvements will have profound effects on international conflict and regional stability. While techno-pessimists argue that these will only further arms races, and create instability and conflict, the evidence indicates otherwise.

Clear Commercial Benefit

The list of commercial applications and uses of satellite imagery continues to grow and now includes, agriculture, forestry, fish and wildlife, environmental management, water resources, geological mapping, mineral exploration, disaster planning, emergency services, public safety, land use planning, air-sea-land rescue, news-gathering and reporting, and of course defense applications. There are a variety of estimates of the market potential of space remote sensing industry, each of which varies, but all predict rapid growth in the next ten years.

The US Commerce Department estimates that by 1997, the international commercial remote sensing market will generate between $7.2 and $9 billion annually. Of that, $0.7 to $1.5 billion will go to non-enhanced data, and $6.5 to $7.5 billion for value-added services. [5] Currently the worldwide market for satellite imagery products is estimated at $1 to $2 billion a year.[6]

Other estimates place the realizable remote sensing revenues at about $15 billion and the potential earth resources market at $30 billion a year by the year 2000 (See Figure 1). [7] [8] There are clear economic benefits from an expanding global satellite imagery market, and those benefits are directly linked and necessitated by the proliferation of commercial satellite imagery and nondiscriminatory data access to all potential users. Efforts to limit access will have tangible negative economic impact for the US remote sensing industry. John McMahon, CEO of Lockheed, remarked in testimony before the Senate Intelligence Committee that:

> The question for the future is not whether there will be one-meter satellite imagery available, -- it will happen -- but rather will it be provided by US companies or foreign sources?[9]

Proliferation Will Decrease Information Asymmetry

One of the criticisms of the proliferation of space remote sensing, is that less developed nations with smaller armies may not be able to afford to invest in remote sensing, thus larger bordering or regional nations, with larger defense forces, and more money will be able to exploit space reconnaissance and launch surprise attacks. As Susan B. Chodakewitz and Louis J. Levy point out:

> The commercialization of Landsat, the resultant price-increase of multi-spectral imagery and the need for users to purchase new-data processing equipment have made it difficult for some developing countries to afford satellite imagery.[10]

Secondly they argue that:

> Some [countries] will find it difficult merely to purchase the images and have them enhanced by 'value-added' firms. These asymmetries among developing states -- in basic financial resources, technical capabilities and personnel -- will only grow more severe in a commercial environment where the bottom line is profit margin and not equitable product distribution.[11]

Additionally critics point out that even if less developed nations can afford to use space remote sensing on a limited basis, they may not be able to use the highest resolution imagery or the more sophisticated value-added services, and thus will still be at a disadvantage. This "asymmetry in information" as it is known, would have a de-stabilizing effect on regional and trans-border stability--if it were happening, but fortunately it is not.

Free-market style competition is only increasing space remote sensing proliferation and will actually lessen information asymmetry. For example, the price of unenhanced satellite imagery has dropped considerably in the last few years, and with more satellites that will be launched in the next decade, the prices will drop even further. Spot Image Corp. actually has a "sale" on imagery and is offering 60 percent off the list price for a limited time.[12] There are two reasons for this. First, the Russians have recently made their 2-meter imagery commercially available. Second, Spot Image Corp. knows that the competition is about to increase as the 3-meter Worldview system comes on line next year, and the 1-meter Space Imaging and Eyeglass systems come on line in the next three years.

Indeed, as the international imagery market expands, competitors will also increase the quality of spatial resolution. By 1997 there will be 1-meter resolution satellites in orbit, providing world-wide coverage, and it is not unreasonable to expect that the resolution will only get better. Within the first 10 to 15 years of the next century, resolution of 6 inches or less will be a reality. Furthermore, the timeliness of data delivery has improved considerably and this trend will continue. When Spot first made its imagery available, in 1986 the revisit time (at nadir) was 27 days, and the minimum revisit period was 5 days. The 1-meter Eyeglass system will reduce revisit time to 16 days (at nadir) , and minimum revisit time to 2 days. Even if spatial resolution was not going to get better, either due to the cost or due to arbitrary government restrictions, 1-meter resolution is more than adequate for the security needs of most nation states. Figure 2 shows the relative resolution needed for various reconnaissance functions. In all but a few examples, 1-

meter resolution fulfills or exceeds most of the requirements.

Finally, the largest cost of using remote sensing is not acquiring the data, but the value-added services. Here again, the falling costs of the hardware, software, and the ease of use are all conspiring to make the technology available to more, not fewer nations.[13] The US Commerce Department put it this way:

> According to industry sources, computing capability is approximately 25 percent faster and 25 percent less expensive than was expected for this point in time. The result is that the powerful computers and associate software required for value-added processing of remote sensing data are much more affordable. This reduction in price has encouraged new entry into the value-added services industry and expansion among established entities.[14]

Meanwhile, critics of space remote sensing proliferation argue,"Thus the basic law of the open market may prevail: those who cannot pay cannot buy."[15]

This is turning out to be flatly wrong. Free-market competition is driving increases in quality, driving prices down, making information more available to more users, and flattening any information asymmetry that may exist. This will have a profound affect on regional stability and world peace--profoundly positive, because it means that even the poorest nations can afford remote sensing to guard their borders, track arms buildups, and verify arms control agreements. They will be able to do this without the help of the United Nations or a superpower for protection.

Improvements in Tactical and Strategic Warning

Once imagery becomes more readily available to all nations, and the quality and timeliness increase, improvements in strategic and tactical warning will make it more difficult for adversaries to launch surprise attacks or invasions. While the loss of the element of surprise may not stop a war that two nations are bent on fighting, denying them the imagery will not prevent a war either. Nations have fought wars throughout history without satellite or other types of imagery, and it is naive to think that they will not go to war if the US or other imagery producers cut off access. Conversely imagery will not prevent all wars, it merely forces both sides to fight it in the open. Increased transparency is a potential limiting factor on international conflict. While 1-meter imagery if fine for daylight reconnaissance, it cannot see at night or through overcast weather. Synthetic Aperture Radar (SAR) technology available now in 10-meter resolution, and even better in the not too distant future, can penetrate through clouds, and haze, and can see in the dark, unlike conventional electro-optical sensors. One other technology that will help reduce the element of surprise is what is known as a MTI or Moving Target Indicator. MTI uses the Doppler radar from SAR to determine if there is any target movement. So if tank columns were driving toward a border at night or in overcast weather, the MTI would know it. In the future there will be no place for tank brigades to hide.

National Leaders Would be Better Informed During Crisis

While it is possible for foreign governments to use space remote sensing for offensive purposes, other nations can use the data to better plan for defense. During periods of increased tensions between bordering nations or regional adversaries, space remote sensing can give each nation unambiguous warning, and can allow national leaders better information from which to make decisions.

Improving transparency can only help in a crisis when otherwise conflicting information could make decision-making more difficult. For example, during the Cuban Missile Crisis, the United States had unambiguous information as to the true Soviet capabilities to launch a nuclear attack from the USSR. The US knew that it had a military advantage over the Soviets in nuclear arms. Had the Soviets known this, they might not have deployed missiles in Cuba in the first place, or perhaps backed down much sooner. What the Soviets did know, was that US forces were on alert, and the conventional forces needed to invade Cuba were in place. In this case satellite intelligence averted a nuclear war. The kinds of conflicts that may arise from nations in the developing world will not likely be nuclear, but will involve border disputes, civil wars and unrest. For nuclear powers such as Pakistan and India, satellite imagery might not only be desirable, but necessary. The idea that either nation's leaders might be making decisions without clear, timely satellite information is troublesome. It would be preferable that each nation is fully aware of the others intentions and capabilities, than for one or both sides to be in the dark.

Treaty Verification

While the technology is not quite up to the task right now, by 1997, 1-meter imagery will make arms control treaty verification easier. One possible drawback is that while it is easier to detect cheating, it may also be easier for a nation to cheat, by knowing the capabilities of the verification satellite. However, as the imaging technology continues to reduce the cost and to improve the timeliness and quality of the satellite

imagery, and with the proliferation of a variety types of sensors -- panchromatic, multispectral, infrared, radar -- the likelihood and scope of successful cheating decreases. It may be possible to hide one tank successfully, but not a tank brigade. Verification and confidence building measures like those found in the Open Skies Treaty can be applied elsewhere, thus easing border tensions.

Closed Societies: The Big Losers

Open societies have the most to gain from increased access to satellite imagery. In areas such as mineral exploration, forestry, agriculture, land use, urban planning, disaster management, and environmental protection, open societies will only benefit from the proliferation of uses of both satellite imagery, and geographic information systems (GIS) applications and technology. One argument that is frequently made against open access, is that corporations or foreign countries can locate and estimate another nation's natural resources and can unfairly "exploit" them. Just the mere knowledge of a country's wheat harvest could hurt its foreign balance of payments, the argument goes. This line of reasoning has two flaws. First, any imagery that Landsat or Spot take of Kazahkstan for instance, is available on a nondiscriminatory basis to all parties. There are no provisions that would prevent the Kazahk government from purchasing such data, except if the United States restricted access to such data for "national security" reasons. Even then, the Kazahks could go to the French-owned Spot satellite for the data. And in the next few years, there would be even more choices of data, as new satellites start to transmit even more images. Again, the proliferation of commercial remote sensing is the best way that access to all users is guaranteed. The more choices, the harder it is to deprive one party of the right to access.

On the other hand individual nations would not be able to restrict access either. If there was a bad wheat harvest in Kazahkstan, everyone who has a need to know it, will. The global market needs timely information in order to constantly adjust prices based on supply and demand. It simply isn't in the cards for countries to keep their natural resources "hidden under a bushel." In most cases, the information will be discoveries of yet undiscovered resources. It is difficult to see how a nation could be hurt by learning that it has $1.2 trillion dollars in newly discovered oil and gas reserves! Everyone benefits from this knowledge. First and foremost the nation in which the discovery was made certainly has a new source of revenue. It will also have a waiting list of oil companies eager to gain contracts to drill for more oil. And the world energy market benefits as prices lower because the global supply just increased. And if the nation chooses not to drill the oil but to keep it in the ground to preserve its "natural ecosystem," the knowledge that the oil is there is not going to harm anyone. Oil companies and nations are not simply going to invade because a new oil discovery was made.

Closed societies that remain isolated, will not be able to reap the benefits of this information, and will remain closed. As it is there are only a handful nations that can be considered closed societies, and there ability to remain separate and apart from the rest of the world is diminishing. Access to the global economy is necessary for continued economic growth. Even in despotic-one-party states, such as Iraq or North Korea, ultimately the real strength of a nation will continue to be determined by its economic viability.

The world measured the Soviet Union's superpower status, by its military strength and number of nuclear weapons, while economically it was a hollow giant. Since its demise, its economic power is seen as more important. And since the commercial benefits of remote sensing are proven and are just beginning to be tapped, it is those factors which will really determine the future of space remote sensing .

Weakening Government Propaganda

One of the most promising benefits of satellite imagery technology, is the openness it affords to citizens of nations, and their ability to detect and counter government-sponsored propaganda. Independently verifiable imagery, will make it more difficult for government officials and politicians to withhold negative information or to mold public opinion. Up to this point the United States government has had a virtual monopoly in the use of overhead imagery for propaganda efforts. It has used French Spot imagery in its military propaganda document *Soviet Military Power.* The Spot images were used to justify inflated US estimates of Soviet military capabilities.

In the 1980's the Reagan Administration had KH-11 imagery of the Nicaraguan military build-up but was reluctant to release it even though it would have made their case against the Sandinistas stronger. SR-71 aircraft were sent to "re-shoot" pictures of the same Nicaraguan defense installations and military hardware which eventually did get published. What the Reagan Administration carefully left out, were photos of the US military hardware given to El Salvador, Guatemala, and Honduras. The military assistance to those nations was used to "buy" their cooperation in the US backed contra-war. With 1-meter resolution, the clandestine airstrips in Costa Rica and Honduras that Contra pilots used to fly resupply missions, as well as the aircraft and equipment would have been readily visible, making this unlawful covert war, more difficult or maybe even impossible. With independent sources of imagery, both or many sides of an issue can be shown, not simply the official government view.

Second Guessing Intelligence Estimates

With increasing imagery quality, it will be possible in the future for independent military analysts to make real military assessments and to independently verify whetheror not there is justification for new defense programs. One potential problem with military experts inside and outside of government, is the built-in assumptions and bias they use when they analyze information, whether it is Soviet GNP figures, or counting Iraqi combat aircraft. A perfect case in point is "Team B" study, conducted in the early 1970's. Back then the US Central Intelligence Agency came under increasing attack from anti-communist hard-liners for "underestimating" Soviet missile deployments. Political Conservatives attacked the CIA's annual National Intelligence Estimates (NIE). In response, then CIA Director George Bush authorized the Team-B effort and "competitive threat assessments" began. The Team-B panel was made up of anti-communist hard-liners, and the conclusions they came to were hardly surprising. For example Team-B reported that the Soviets would produce 500 Backfire bombers, but by 1984 the Soviets had only produced 235. According to Anne Hessing Cahn who wrote about the Team-B studies:

> For more than a third of a century, perceptions about US national security were colored by the view that the Soviet Union was on the road to military superiority over the United States. Neither Team B nor the multibillion dollar intelligence agencies could see that the Soviet Union was dissolving from within.[16]

The problem with the analysis of classified intelligence data by outside experts is not the outside experts, it is the inside data that cannot be released. This allowed the hard liners to in effect say "We know the Soviets are fifty feet tall and have the data to prove it, but it is classified and we can't show you, so you'll just have to trust us." The Team-B example, vividly demonstrates why outside data is vital. Outside data, is open to examination, and can be tested for validity. And that is why outside data from independent space remote sensing satellites is important for estimating the military capabilities of various countries. It can be manipulated for political reasons, but the manipulation has to be done in the open. And it can be countered in the open with hard data.

However there are limits to what space remote sensing can do. It will not be able to detect human rights violations, or military juntas. Imagery analysts will not be able to differentiate between a democracy and a dictatorship, nor determine whether an election was free and fair. There are some things that remote sensing satellites will never be able to do.

Why Efforts To Control The Proliferation Of Remote Sensing Technology will Fail

Both the French and Russian space reconnaissance industries are mature and growing and barring severe arm-twisting by the US, it is unlikely that they will limit the quality or access of their imagery. The United States is trying to "encourage" these nations and others with remote sensing satellite to enter into cooperative agreements to restrict access of the imagery during certain periods, when "national security" might be compromised. The US also wants these nations to voluntarily restrict transfer or export of remote sensing satellites and technology. While France voluntarily restricted access to Spot imagery during the Persian Gulf war, it is widely believed that it did so because of its membership in the US -led coalition, and because its own troops were on the ground. In other conflicts, Spot may continue to provide imagery on a non-discriminatory basis, during other conflicts. In fact, during the US military operations in Somalia, and Haiti, Spot imagery was readily available. Other nations who are just launching their first satellites, may in the future develop more sophisticated versions, and may be more willing to sell data to whomever is willing to pay. The space remote sensing market, is starting to take on the familiar characteristics of a cartel - like OPEC, with each member willing to "cheat" in order to increase revenue.[17] In any cartel, enforcement of output quotas is always difficult. Between nation-states, enforcement boils down to non-proliferation regimes and export controls, both of which have spotted track records.[18]

There are already several national and international mechanisms in place to limit the spread of space-based remote sensing technology, but they have had little effect so far. The United States has the Arms Export Control Act, which is enforced through the State Department's Munitions List. Internationally there is the Missile Technology Control Regime, (MTCR). Remote sensing satellite technology is on both lists, yet proliferation continues. While this body of laws seeks to limit the spread of the this technology, it has failed in several respects. First, the MTCR was already in place and failed to prevent Iraq's missile program, whose violations are legion.

The MTCR could be strengthened, but that is unlikely to have much effect on the indigenous programs that already exist, and it will have a disastrous effect on exports, and world trade, as many technologies would be prohibited for export because they would be considered "dual-use." For example, precision optics, CAD/CAM technology, mid-sized and main-frame computers, aeronautical and space technology, and telecommunications technologies might end up restricted for export. If the nuclear non-proliferation track record is any indication, satellite imaging technology probably cannot be controlled. The

Nuclear non-proliferation Treaty (NPT) effort has been going on much longer, and the technology is much more difficult to develop. In spite of this, several nations, including Israel, Iraq, India, Pakistan, Algeria, South Africa, and North Korea have been able to develop their own nuclear programs. The signatory nuclear powers, such as the United States, France, Germany, Switzerland, and the Soviet Union have been guilty of aiding and abetting, undeclared nuclear weapon states. In some cases these are the very nations that decry nuclear proliferation the most. In any case, enough nations have indigenous capabilities, that even if all technology transfer including beneficial dual-use items were cut off, they would still be able to continue to develop space remote sensing capabilities.

Satellite News Gathering

Since the 1985 Soviet nuclear accident at Chernobyl, satellite news gathering has continued to grow. Satellites images used in television news reporting include; the alleged Libyan chemical weapons factory, the Soviet's Krasnoyarsk ABM radar facility and an Iraqi poison gas factory. In the future, the news media will increasingly use this new tool to highlight and focus attention on issues and incidents that would otherwise go unreported through conventional means. This will of course, include wars and conflicts, especially if US forces are involved. And if "national security" concerns prevent US suppliers of satellite imagery from selling to the news media two things will happen. First the news media will turn to foreign sources for their imagery needs. Second, the old battle over national security and the US first amendment freedom of the press, will resurface, with access to satellite imagery being the new battle ground. The government will argue "national security," and the news media will cry "prior restraint," and the courts will decide.

Turning A Blind Eye: Political Shutter Control And The KH-11

How reliable is the US government in using its classified remote sensing to expose potential regional arms races and potential instabilities? In several cases US intelligence capabilities to detect potential trouble, seem to outweigh the political will to deal with the data once gathered and analyzed. In some cases, revelation of certain data, would have undermined US foreign policy goals and objectives. There are consequences if "national security" concerns are allowed to take precedence over the public's right to know. Some examples:

Iran-Contra

Not only did the US intelligence community know about the covert military assistance to the Nicaraguan "Contras", but in some cases the CIA helped the program, and officials later lied about such aid to Congress.[19] If there were independent space reconnaissance systems with a 1-meter resolution or better, this reckless and illegal operation could have been discovered earlier or maybe even prevented all together. And yet the same intelligence community that had knowledge of Iran-Contra and took part in it, argues that outside remote sensing poses a threat to national security.

The Israeli Nuclear Program

The United States has known about Israel's secret nuclear program since at least 1959. No public diplomacy program was initiated, no U-2 or SR-71 photos of the Dimona Reactor site were ever publicly released by the State Department's office of public diplomacy, and no diplomatic sanctions took place. According to William Burrows,

> Although official correspondence (which is still classified) was exchanged between the White House and the Israeli government, the apparent level of inaction by most succeeding US administrations has led many observers to conclude that the United States turned a blind eye to, or to use another metaphor, winked at, the development of the Israeli atomic weapons program.[20]

And in spite of the Clinton Administration's much touted Counter-proliferation policy, US economic and military assistance to Israel increases year after year.

The Iraqi Nuclear Program

Not only did the United States look the other way while Iraq built up a clandestine nuclear program, but it also approved the questionable sale of military-related equipment and technology. This included satellite tracking equipment, conventional munitions, target detectors for Sidewinder missiles, thermal imaging night-vision components, radar-guided anti-aircraft systems. To help Iraq's nuclear program, the Bush administration gave the go ahead to the Du Pont Company to supply nuclear-grade vacuum pump oil, that was intended for use in Iraq's uranium centrifuge program.[21]

The US Commerce Department approved billions of dollars of agricultural loan guarantees that were used by Iraq, to buy weapons on the international arms market. This all took place well after the US was aware of Iraq's nuclear weapons program.

The US granted scores of licenses,

> commented Gary Milholin, a leading expert on Iraq's nuclear weapons program. The government knew very well that Saddam [Hussein] was running a big missile and nuclear program, and that the exports were almost certainly going to help both. But the State, Commerce and Energy departments acted like the three little monkeys: 'See no evil, hear no evil, and speak no evil.'[22]

According to a State Department memo, the Bush Administration had evidence as early as April of 1989 that Iraq was attempting to procure both "non-nuclear components for weapons, as well as items specific to producing nuclear materials." The memo noted that:

> Manufacture of Iraq(i) nuclear weapons would further de stabilize the Middle East and multiply the chances for a nuclear event when added [deleted], and others' known or suspected nuclear weapons capability.[23]

The US contributed more to the destabilization of the Middle East that any commercial remote sensing satellites would have. The US-led coalition to "liberate Kuwait' might not have been necessary, had the US not loaned the money that armed Iraq in the first place. And yet the national security establishment is concerned about the possible "de-stabilizing" effect commercial remote sensing might have on regional security. The supreme irony is that a 1-meter commercial remote sensing satellite would have shown, what the US intelligence community and its KH-11 satellites already knew; that Iraq was aggressively pursuing a clandestine nuclear weapons program.

These examples cannot be argued to be in the national interest. A commercial satellite not under their control could have exposed these dangers early on. US KH-11 turned a blind eye to all.

SHARINT: Giving Imagery To The Wrong Countries

Iraq

The US provided intelligence data to the Iraqis during the Iran-Iraq war and continued to provide such data right up until weeks before the invasion. It is well documented that KH-11 reconnaissance satellite imagery was passed to Iraq in 1982. A top-secret link between Washington and Baghdad was set up to speed delivery of satellite imagery to Iraq. According to Friedman:

> As the White House took an increasingly active role in secretly helping Saddam [Hussein] direct his armed forces, the United States even built an expensive high-tech annex in Baghdad to provide a direct down-link receiver for the satellite intelligence and better processing of the information.[24]

The imagery was used to repel Iranian "human-wave" assaults, as well as to attack Iranian economic targets, troop concentrations, and to conduct bomb damage assessment. It has also been asserted that the imagery helped the Iraqis hide their nuclear weapons program from the US, but this is unlikely.

Israel

When the Israeli pilots the bombed Iraq's Osirak nuclear reactor in 1981, it was not an unfamiliar sight to them because they studied US-supplied KH-11 satellite imagery of the reactor. While the US shared satellite imagery with allies, it usually degraded the quality of the images so that the satellite's true capabilities remain secret. But according to William Burrows, "The pilots on 'Operation Babylon,' as the mission was called, had gotten the same clear, three-dimensional pictures as the CIA's and Department of Defense own interpreters."[25] After the attack the US restricted Israeli access to the KH-11 imagery of countries that posed immediate threats, or were on Israel's border.[26]

All of the examples above were created not by profit-minded commercial enterprises selling imagery on non discriminatory basis on an open market, but rather were examples of what happens when "national security" concerns monopolize satellite information and try to use it to further misguided foreign policy goals.

Nondiscriminatory Access: The First Casualty Of War

During the invasions of Panama and Haiti, Spot Image's policy of "open skies only access," held true. These conflicts were over in a matter of hours and any imagery Spot may have had would be stale by the time it was received. But during the Persian Gulf War, Spot Image "voluntarily" rescinded its policy and limited access of the Persian Gulf area, to only Western or coalition governments. Had Spot continued its nondiscriminatory access policy, it probably would have been shut down by the US Defense Department. In any case, Spot access to Iraq was cut off. But, there was another source: the Soviets. Kosmos satellite 2108 started its coverage on the 19th of January, just after the US air war had started. Its flight path took it over the Gulf and by the 21st it was able to get good imagery of the conflict below.[27] It is conjecture whether or not the Soviets shared any imagery with Iraq, but one thing is clear. In any future conflicts, potential US adversaries will be denied access to US commercial imagery. Provisions of the Clinton Administration's policy on

foreign access to remote sensing make it clear that:

> During periods when national security or international obligations and/or foreign policies may be compromised, . . . the Secretary of Defense [et al] may . . . require the licensee to limit data collection and/or distribution by the system to the extent necessitated by the given situation.[28]

US Space Policy: Control and Denial

The US. Space Policy begins where the Clinton policy leaves off.
It states:

> We must continue to demand that all our space partners comply with current nonproliferation treaties and norms, and continue to ensure adherence to the Missile Technology Control Regime and other non-proliferation guidelines. [29]

Thus the first effort is a preemptive one, to deny the technology to other nations. The report goes on to state that:

> . . . the proliferation of space systems has changed profoundly the space control equation.... Sixteen nations today have some degree of indigenous capability to employ militarily useful satellites . . .To counter such threat, the nation more than ever needs a comprehensive space control capability, including space surveillance systems that can detect and track hostile objects in space, satellites that are impervious to interference from hostile forces, and a comprehensive anti-satellite capability to deny the military use of space to future enemies.[30]

Thus the United States has a three step plan to achieving space hegemony. The first step is to maintain technological hegemony through export control. Second is the positive control of space by "friendly" forces, and lastly is "space denial," which is a euphemism for shooting down foreign spacecraft. To begin with, an ABM shoot down of a foreign satellite is a threefold violation. It violates provisions of the Anti-Ballistic Missile treaty. Secondly it is an act of war and lastly it would be a violation of international law. Should this happen, this would not be the first time the US violated international law, but it would set a dangerous precedent by being the first nation to initiate a military conflict in outer space.

On its face the US Space Policy rejects any claims to sovereignty by any other nation over outer space, rejects any limitations on its fundamental right to acquire data from space, and claims to be committed to the "peaceful" use of outer space. But, the reality is that the United States is willing to pursue quite different. ends. It is a policy of hegemony, in which only the US. or its allies may use space for reconnaissance or military purposes. No other nation is permitted to use space reconnaissance to the detriment of US national security, international obligations or foreign policy objectives, according to the US Space Policy. This double-standard is in itself de-stabilizing because it sets a bad example for other nations, and through its policy of "information dominance," it ensures other nations will be denied access to technology that has beneficial commercial and security potential. At the same time the US denounces the de-stabilizing effects of remote sensing technological proliferation, it gives data to Iraq, and Israel. At one point they were both getting imagery at the same time.

A UN PeaceSat?

Some space experts have argued in favor of a United Nations controlled satellite that could be used for arms control verification, peacekeeping, and international conflict resolution. One of the purported advantages of a UN Peacesat, would be that it would replace the arms control monitoring of nations which have narrow security goals and should not be trusted to police themselves. A UN Peacesat, it is argued would be objective, above the fray, and able to provide arms control monitoring data on a non-discriminatory basis. Unfortunately this is highly unlikely.

First of all, every permanent member of the United Nations Security Council (except for Britain which has a virtual satellite via its intelligence relationship with the US) already has a reconnaissance satellite, that it can use for "objective" arms control monitory. The United States even has an entire agency dedicated to arms control which has access to high resolution satellite data: The Arms Control and Disarmament Agency. But this agency has no enforcement power and does not stand in the way of any US-sponsored arms sales. In fact some of the most vocal critics of US arms and technology transfers to Iraq came from ACDA, but they were only voices of protest.

The conflict of interest between the permanent members own interests and world peace is too large for the Security Council to objectively administer an international remote sensing agency. Furthermore, there would be no real information sharing between this agency and nations without a remote sensing capability. The agency would be a large black hole in which all remote sensing imagery and technology

would be sucked in, and none shared on a nondiscriminatory basis. Without market mechanisms, the quality may improve but the cost of remote sensing technology will explode as it does for other government programs. In short, a UN Peacesat will not work, mainly because it will not reduce and eliminate information asymmetry. As stated earlier, the open market is probably the only vehicle that can reduce de stabilizing asymmetries, that reduce regional and international security.

Conclusion

As the title of this paper suggests, the way to increase international security, lower regional tensions, reduce regional and international instability, anc improve arms control verification and monitoring is through free and open access to space remote sensing imagery and technology. The best vehicle for achieving this is the free market, which drives down costs and improves quality through innovative competition. Government controls to limit access and data have a long track record of failure, and where successful actually create regional and international instability. The best way to achieve international peace is through the free market.

Endnotes

[1] The Landsat system is operated by the Earth Observation Satellite Co. (EOSAT), a partnership. Under the Landsat Remotes Sensing Commercialization Act of 1984, the US. NOAA awarded EOSAT a ten year contract to operate the system. Landsat has a 30 meter resolution.

[2] Spot now operates three satellites with the launch of Spot 3 in 1994.

[3] More recently, JEBCO Information Services is marketing Russian Satellite Imagery with a resolution of 2-meters for about $4,500 per scene, with a data archive going back to 1978. Source: WorldMap Brochure.

[4] In fact the KH-11 doesn't officially exist. The KeyHole-11 satellite is a part of what is known as a Special Access Program (SAP). Similar to the B-2 Stealth bomber,. It's existence, contractors, and budget are not officially acknowledged.

[5] United States Department of Commerce, Space Commerce: an Industry Assessment, May (1988,) p.70 cited information provided by EOSAT Corporation, Terra Mar, KRS Remote Sensing, and other US. value-added service companies, March (1988).

[6] "High resolution satellite imagery at cheap rates," Saudi Gazette, June 30, 1994

[7] Walklet, Donn C., President and CEO of Terra-Mar Resource Information Services, Inc., Prepared statement before the House Committee On Science, Space & Technology US. House of Representatives February 15, 1990. p.89

[8] Lockheed predicts that one-meter resolution could expand the total image market by $1 billion over the next four years. Source:" Spy satellites go commercial," The San Francisco Chronicle, August 9, 1993, page D1.

[9] Id.

[10] Michael Krepon, Peter D. Zimmerman, Leonard S. Spector, and Mary Umberger, Eds. Commercial Observation Satellites and International Security, Chapter 9, Implications for Cross-Border Conflict: Susan B. Chodakewitz and Louis J. Levy (1990) p. 97

[11] Id.

[12] SPOT cut their prices for multispectral scenes from $2,600 to $995 for new acquisitions, archive imagery in any media. Offers was good for a limited time. Source: SPOT Offers 60% Reduction for Multispectral Imagery: SPOT Image Corporation's flyer. June (1994.)

[13] Also see, Patton, Robert, Electronics, 11 July (1994) p.1, "NEC, SunDisk Target 256-Mbit flash," McLeod, Jonah, Electronics 12,September (1994) p.10, "Sparc's answer to the RISC chip challenge due out in Q4 of 1994"

Semich, J. William, Datamation, November 1, (1993) p.51 "Prices Slashed for UNIX Workbench: Prices for UNIX development station have dropped significantly and some vendors are practically throwing in development environments."

Moad, Jeff, Datamation June 15, (1994) p.49 "Mainframe Vendors Hard Hit: Big Iron is out and Mainframe revenue is falling rapidly as users demand more cost-effective alternatives"

Ricciuti, Mike, Datamation June 15, (1994)p. 52, "Workstation Vendors STUNG by HIGH-END PC Systems"

Carroll, Paul B., The Wall Street Journal, July 24, (1991) p. B1 "Truce is Elusive in Mainframe Price War"

For a detailed study of computer prices, Gordon, Robert J., The Post War Evolution of Computer Prices, Northwestern University, National Bureau of Economic Research, 1987, Cambridge Massachusetts.

[14] Information provided by EOSAT Corporation, Terra Mar, KRS Remote Sensing and other US. value-added service companies, (Mar. 1988) Cited in Space Commerce: an Industry Assessment, United States Department of Commerce, May 1988.

[15] Michael Krepon, Peter D. Zimmerman, Leonard S. Spector, and Mary Umberger, Eds. Commercial Observation Satellites and International Security, Chapter 9, Implications for Cross-Border Conflict: Susan B. Chodakewitz and Louis J. Levy (1990) p. 101

[16] Cahn, Anne Hessing, Team B: The Trillion Dollar Buildup, The Bulletin of the Atomic Scientists.,(1993) p. 22

[17] Economically, cartels are inherently unstable. This is due in part to the difficulty in barring entry of new members, especially in industries that have prices above the level of long-run average cost. According to Economist Edwin Dolan, " Since the whole point of a cartel is to raise prices above the competitive level, a cartel acts as a magnet for entrepreneurs." Dolan argues that cartels also have difficulty enforcing output quotas. Each firm has an incentive to cheat, whether or not the other members play fair. Dolan, Edwin G., Economics, fourth ed., (1986) p.593

[18] An excellent analysis is provided by Jonathan Donald Westreich in Regulatory Controls on United States Exports of Weapons and Weapons Technology: The Failure to Enforce the Arms Export Control Act., The Administrative Law Journal, [Vol. 7:463, 1994

[19] Walsh, Lawrence E., Iran-Contra: The Final Report of Independent Counsel, January 18, (1994) p. xviii

[20] Burrows, William E., Windrem, Robert, Critical Mass: The Dangerous Race for Superweapons in a Fragmenting World, (1994) p. 301

[21] Friedman, Alan, Spider's Web, The secret history of how the White Hose illegally armed Iraq, (1993,) p.116,119,151,180.

[22] Id., at p.151

[23] Id. Appendix B, P.337

[24] Id., at p. 27

[25] Burrows & Windrem, p.279

[26] Woodward, Bob, Veil: The Secret War of the CIA 1981-1987, (1987), p.169

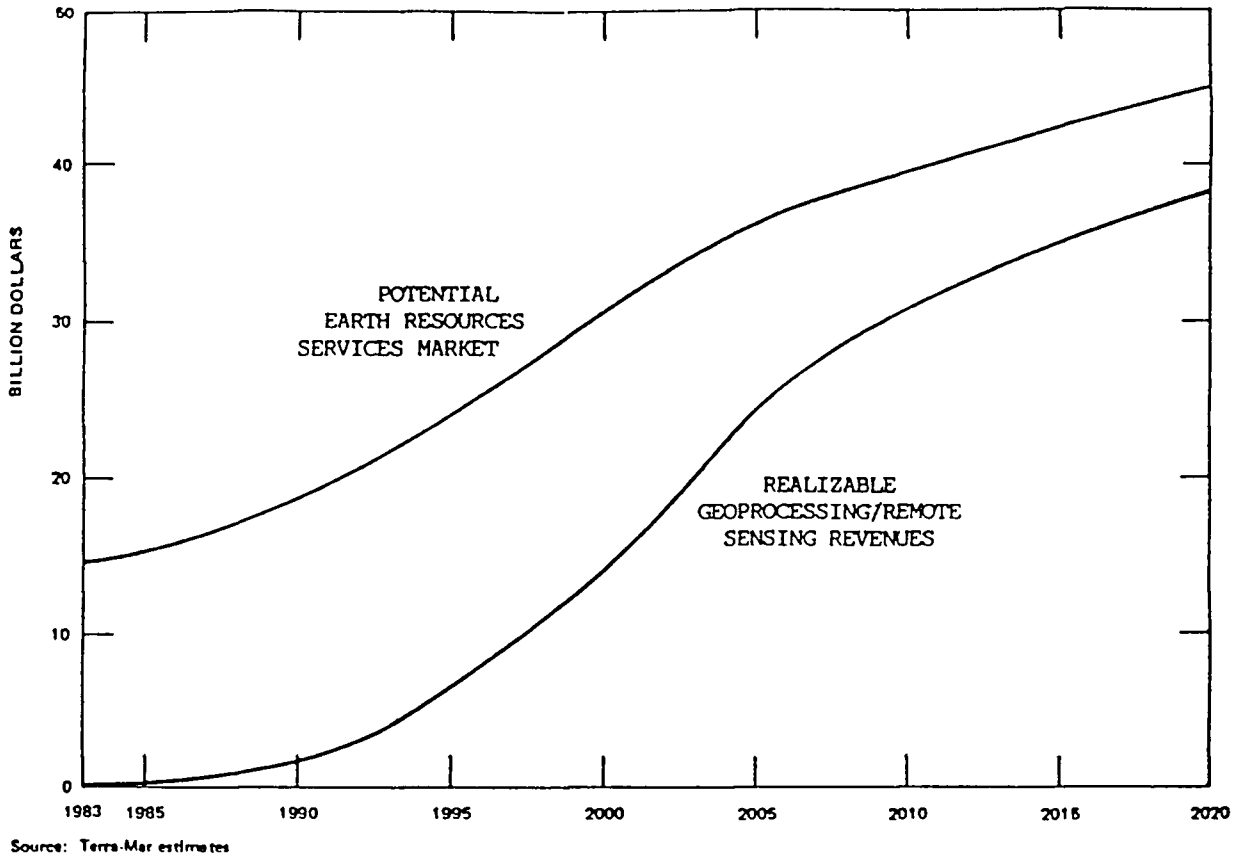
[27] Spot's 'Open Skies' Policy Was Early Casualty of Mideast Conflict, John G. Roos, Armed Forces Journal International, April (1991), p. 32

[28] Foreign Access to Remote Sensing Space Capabilities, White House Fact Sheet, March 10, 1994, p .2

[29] Final Report to the President on the US. Space Program, January 1993, p.10

[30] Id., at p.10

PROJECTED REMOTE SENSING MARKET-POTENTIAL AND REALIZABLE REVENUES



Source: Terra-Mar estimates

Figure 1

Target[a]	Detect'n[b]	General ID[c]	Precise ID[d]	Descr'n[e]	Tech. Analysis[f]
Bridges	6	4.5	1.5	1	0.3
Communications					
Radar	3	1	0.3	0.15	0.015
Radio	3	1.5	0.3	0.15	0.015
Supply Dumps	1.5–3	0.6	0.3	0.03	0.03
Troop Units (in bivouac or on road)	6	2	1.2	0.3	0.15
Airfield Facilities	6	4.5	3	0.3	0.15
Rockets and Artillery	1	0.6	0.15	0.05	0.045
Aircraft	4.5	1.5	1	0.15	0.045
Command and					
Control Headquarters	3	1.5	1	0.15	0.09
Missile Sites (SSM/SAM)	3	1.5	0.6	0.3	0.045
Surface Ships	7.5–15	4.5	0.6	0.3	0.045
Nuclear Weapons					
Components	2.5	1.5	0.3	0.03	0.015
Vehicles	1.5	0.6	0.3	0.06	0.045
Land Minefields	3–9	6	1	0.03	0.09
Ports and Harbors	30	15	6	3	0.3
Coasts, Landing Beaches	15–30	4.5	3	1.5	0.15
Railroad Yards & Shops	15–30	15	6	1.5	0.4
Roads	6–9	6	1.8	0.6	0.4
Urban Areas	60	30	3	3	0.75
Terrain	—	90	4.5	1.5	0.75
Surfaced Submarines	7.5–30	4.5–6	1.5	1	0.03

a. Chart indicates minimum resolution in meters at which target can be detected, identified, described, or analyzed. No source specifies which definition of resolution (pixel-size or white-dot) is used, but the chart is internally consistent.
b. Detection: Location of a class of units, object, or activity of military interest.
c. General Identification: Determination of general target type.
d. Precise Identification: Discrimination within target type of known types.
e. Description: Size/dimension, configuration/layout, components construction, equipment count, etc.
f. Technical analysis: Detailed analysis of specific equipment.

Sources: Senate Committee on Commerce, Science, and Transportation, *NASA Authorization for Fiscal Year 1978*, pp. 1642–1643, and *Reconnaissance Hand Book* (McDonnell-Douglas Corporation, 1982), p. 125.

Figure 2