WHAT IMPACT WILL EMERGING SATELLITE SURVEILLANCE TECHNOLOGY HAVE ON CALIFORNIA LAW ENFORCEMENT BY 2007?

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by

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This Command College project is a FUTURES study of a particular emerging issue in law enforcement. Its purpose is NOT to predict the future, but rather to project a number of possible scenarios for strategic planning considerations.

Defining the future differs from analyzing the past because the future has not yet happened. In this project, useful alternatives have been formulated systematically so that the planner can respond to a range of possible future environments.

Managing the future means influencing the future; creating it, constraining it, adapting to it. A futures study points the way.

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Chapter I – Overview and Research

Introduction

This project addresses satellite surveillance technology in reference to its feasibility and potential application for California law enforcement by the year 2007. Although this project's focus is on what impact this emerging technology will have on California law enforcement, the scope of satellite imaging is so broad that law enforcement agencies throughout the nation would necessarily be affected. For this reason, references in this project are made to law enforcement in general, rather than specifically to California police agencies.

Undoubtedly, satellite imaging technology would offer significant advantages for the control of crime. Crime control in a free society, however, necessitates a tug-of-war between public order interests and concern for civil liberties. The inherent tension between these societal forces gives balance to the criminal justice system in America and in other free nations.[1]

In the United States, because of the constitutional foundation for government, individual freedoms have been codified and held as central tenets by the citizenry for over 200 years. But a practical political system cannot tolerate unrestricted expression of civil liberties. A legitimate, pragmatic government in a free society necessitates that reasonable limitations on civil liberties be implemented so that crime can be controlled and public order maintained. Without such limitations, a free society would devolve into anarchy.

In the United States, the civil liberties of individuals and groups of individuals are often suppressed to a limited degree for the greater good of the

general public. For example, one cannot enter a public airport terminal without consenting to a search of his or her person and items being carried. In this example, the greater good of air travelers to be free from acts of terrorism outweighs the individual freedom of unhampered access to a public airport terminal. Another example of reasonably suppressing civil liberties is apparent at DUI checkpoints operated by many police departments and highway patrol agencies. In these checkpoints, motorists are detained for a short duration without probable cause for the purpose of reducing drunk driving collisions. Repeatedly, courts have held that the greater good of the community to have safe motorways takes legal precedence over a police detention without probable cause for a short duration at a DUI checkpoint.

In contrast to Western democracies, there have been many examples of totalitarian regimes in third world nations, where freedom of speech, assembly and movement have been drastically restricted. The positive side of such a regime for law enforcement is that crime can be controlled much more efficiently than in a society where unnecessary governmental intrusion into citizens' lives is discouraged. As was demonstrated so dramatically in the collapse of the Soviet Union, when a free society emerges from a former totalitarian state, street crime has a tendency to flourish.

But, in a free society, individual civil liberties must sometimes be subjugated to the greater good of the community. The conundrum of deciding when civil rights take precedence over public safety in America is a matter for the judicial branch of government. The appellate courts and supreme court of the state and

federal systems analyze facts of cases and render decisions which result in the setting of precedent for future rulings in lower courts. In some cases, safe streets and neighborhoods are given greater emphasis than being free from governmental oversight. In other cases, fear of governmental intrusion into citizens' privacy is valued above preventing burglars from violating citizens' residences.

It is into this dynamic environment that the subject of this project is introduced - satellite surveillance technology. While Americans are generally cognizant that through judicially authorized search warrants, telephone conversations can be monitored, mail can be opened, and homes and papers can be searched, the idea of a Big Brother eye-in-the-sky that is all-seeing, is an obstacle, even to the most strident law-and-order advocate. Yet, upon further examination, it may be revealed that just as with security screening at airports and DUI checkpoints, the greater good of the community may outweigh the suppression of some civil liberties in regards to law enforcement use of satellite surveillance technology.

Because private sector and law enforcement use of satellite surveillance technology is in its infancy, this project necessarily involves discussion of theoretical applications of this technology as well as pragmatic present-day considerations for use of satellite imaging. In addressing both theoretical and pragmatic issues, this project will consider the following questions:

- Is it possible to launch a network of satellites that will give sub-one meter resolution, real-time surveillance capability above a major population center of the United States?
- If real-time satellite surveillance is possible, can orbits of satellites be designed so that law enforcement agencies in major population centers throughout the world will find it feasible to form consortiums to share the cost of launching and maintaining such networks?
- Is geostationary satellite surveillance of benefit to law enforcement agencies?
- Will law enforcement use of satellite surveillance imagery be driven by increasing availability through commercial providers and broadened application of this technology by the private sector?
- Does the private sector have the ability to archive satellite images as their satellites regularly pass over a given area? If so, can law enforcement routinely access such images to assist in solving crimes which have already occurred?
- Can American law enforcement requisition satellite surveillance images without a court order or other legal process as an adjunct to a criminal investigation?
- Can satellite surveillance imagery be used to assist with emergency preparedness, warrant service planning and other public safety issues?

While American law enforcement use of surveillance satellite images is far-fetched for some, it is a fact that there are now non-governmental, American companies which have lofted high resolution surveillance satellites into orbit. The progress of this technology is beyond critical mass – it is upon us and driven by free market forces. Like stem-cell research and human cloning, the American people will come to terms with the issue of satellite surveillance imaging in the United States – one way or another.

A Satellite Primer

Only 66 years, less than an average lifetime, took us from the Wright brothers' first airplane flight in 1903 to a walk on the Moon in 1969.[2] But, atmospheric flight and space flight are fundamentally different. While propulsion for atmospheric flight can come from spinning propellers or jet engines, to put a satellite or any other spacecraft into orbit, it takes a rocket. And, even in the present day, rockets are risky business.

The ancient Chinese invented gunpowder, which was the genesis of the rocket. They found that when gunpowder was burned in the open, it just burned very rapidly. They also found that when gunpowder was burned in a confined space it exploded. The Chinese then made the discovery that when gunpowder was burned in a confined space that was open on one end, the whole thing "took off like a rocket." As early as 1212, Chinese armies fired rockets carrying flaming materials into Mongol encampments to start fires.[3] Over the next several hundred years, the art of war shaped the development of rockets into powerful

engines which would ultimately lead to putting objects, animals and humankind into space.

On October 4, 1957, the United States was shocked when the Soviet Union launched the first satellite into orbit. Spuntik I was a small sphere carrying a radio transmitter which beeped a signal for all the world to hear of the supremacy of Soviet technology. A month later, on November 3, Sputnik II was orbited carrying the space-faring dog, Laika.[4] Since that time, thousands of satellites have been launched into space. But even though satellites have been launched into space for over 44 years, it still remains a complicated and expensive venture that has been fraught with failures.

Intuitively, it seems like putting an object in orbit would be a simple task. Just put the object on a rocket, aim it toward the heavens and up it goes. But what goes up surely will come down unless the object is launched at sufficient velocity to overcome gravity's pull. But, achieve too much velocity and the object will continue out into space or assume an extremely elliptical orbit, diminishing its value as a useable satellite. So, it appears, the trick to getting an object to orbit the earth is to get just enough velocity to get it up there and then aim it in the right direction to circle the planet.

To understand how satellites get into orbit, it is helpful to imagine the following scenario. A person climbs a very lofty mountain, say 100 kilometers high, and picks up a rock. Assuming, for simplicity, that the Earth is spherical and non-rotating, the person then throws the rock horizontally at a speed of approximately eight kilometers per second – a very fast pitch, indeed. Since

gravity is still almost as strong at this altitude as at sea level, this rock tends to fall at much the same rate as one thrown at sea level. In fact, after being in flight for one second, the rock falls about five meters. Clearly, if the Earth were flat the rock would be five meters nearer the surface. But the Earth is almost spherical, and in a horizontal distance of eight kilometers, one second after release by our hefty rock thrower, the Earth beneath also falls away about five kilometers. So the rock maintains its height above the Earth, and becomes a satellite in a very nearly circular orbit at a height of 100 kilometers.[5]

While this simplified example illustrates how an object must rotate the earth as a satellite, one must understand that the speed necessary to achieve a horizontal path that doesn't intersect the Earth - eight kilometers per second - is over 17,000 miles per hour. It is quite a technological feat to accelerate an object to this speed. And, any object that could achieve this speed in the atmosphere would heat up to the point of disintegrating, melting and vaporizing.

To launch a spacecraft into Earth orbit, it is first necessary to get it up out of the densest part of the atmosphere, then give the spacecraft sufficient horizontal velocity so that its curved path toward Earth does not actually intersect the ground. It is a common misconception that satellites are launched straight up into orbit. The primary reason for launching vertically is to carry the spacecraft through the dense part of the atmosphere at a lower speed to keep it from burning up or breaking up. Then the spacecraft is pitched over nearly horizontally and accelerated to orbital speed. Without sufficient horizontal

velocity it will simply fall back to Earth. It is that motion parallel to the surface of the Earth that keeps a satellite in orbit.[6]

There are three classes of orbits for satellites. Low Earth orbit satellites (LEO) are generally 240-900 kilometers in altitude, although some surveillance satellites dip well below this altitude. Medium Earth orbit satellites (MEO) are generally 5,000-12,000 kilometers in altitude. Geosynchronous orbit satellites (GEO) are approximately 36,000 kilometers in altitude.[7] Whatever the desired altitude of a satellite, depending on payload weight, it takes a solid, liquid or combination fuel staged rocket motor to take the satellite into orbit. Even after 44 years of launching satellites, this is still an expensive proposition and failure of launch vehicles is not uncommon.

Furthermore, a satellite has a lifespan. While it would seem that once a satellite is in a proper orbit receiving solar power, absent a failure of some aspect of the satellite's systems, it should remain functional forever. Sadly, this is not the case. A satellite moving in a nearly circular orbit at a height of 10,000 kilometers or more, if left undisturbed, will remain in orbit for thousands or even millions of years. If we destroy civilization by nuclear, chemical or biological warfare, such satellites would remain circling a devastated planet, relics of the advanced technology that led to our downfall.[8]

Satellites in lower orbits feel the effects of atmospheric drag, which slowly but inexorably reduces their energy. The density of the air falls off rapidly as one goes up, until at an altitude of 200 kilometers the density is ten thousand million times less than at sea level. But the effect of air drag is significant, even at 1,000

kilometers, and it ultimately governs the lifetime of all objects in circular or moderately elliptical orbits. When a satellite's orbit is nearly circular at a height of about 200 kilometers and the orbital period is about 88 minutes, the satellite is ripe for its final fiery plunge through the atmosphere.[9] So, besides the technological obstacles and costs associated with putting up satellites, there is a usable lifespan and technological challenges that must be considered to keep satellites in orbit.

Most surveillance satellites, the Space Shuttle and the International Space Station are in low Earth orbit with a period of approximately 90 minutes. LEO satellites encounter the most air drag so they must be boosted to a higher orbit from time-to-time to keep them from reentering the denser portions of the Earth's atmosphere, where they would encounter even more drag and eventually burn up.

Satellites in geostationary orbit are generally used for communication purposes, broad imaging or for military use in detecting missile launches. These satellites' horizontal speed matches the rotation of the Earth, hence they appear to remain in a fixed position relative to the Earth's surface. A satellite in geostationary orbit can see approximately one third of the Earth's surface at a time. Because GEO satellites must have a very high altitude, approximately 22,400 miles, imaging uses for such satellites has been limited to monitoring weather conditions, ocean conditions and for other resource tracking purposes.

Satellites placed in a polar orbit are very suitable for LEO surveillance as they can orbit at relatively close range yet still see the entire surface of the Earth

in a span of days. This is because every time the satellite orbits on a North-South axis, some rotation of the Earth has occurred. This means that the satellite will trace a path over the entire surface of the Earth in a one or more day period due to the Earth's rotation.

The satellite primer section of this project has provided basic information on the challenges of launching satellites, keeping satellites in orbit, as well as information on different types of satellite orbits. The next segment of this project will discuss matters relevant to satellite surveillance technology.

Satellite Surveillance Technology Review

The history of aerial surveillance goes back to the American Civil War, when Union troops used hot-air balloons to catch glimpses of the Confederate Army over a tree line or a horizon. Most military spying in the First and Second World Wars was done from aircraft flying low, close to the front lines. The era of spy satellites, however, began very soon after the space race started. The first of the U.S. series of Keyhole spy satellites, named Corona, Argon and Lanyard, were built at the height of the Cold War, beginning in 1960. All three snapped thousands of high-resolution photos until 1972. Corona, the world's first spy satellite, was capable of about two meter spatial resolution.[10]

Earth orbit satellites are just extensions of human sensing. They look up at the heavens or down at the Earth, enhancing our ability to observe, in one way or another, things from a distance. Weather forecasting, astronomy, mapping, communications, and examination of the Earth's resources are but a few of the

civilian uses for satellites. Military early warning satellites detect launches of missiles by means of infrared sensors which respond to the heat of a rocket exhaust. Spy satellites, looking and listening from their orbits, keep each side informed in remarkable detail about what the other side is up to.[11]

In 1972, the Landsat Earth scanning satellite, a non-military imaging satellite, was put into orbit. Since that time there have been a series of Landsat satellites placed in orbit as well as a series of highly classified Keyhole military reconnaissance satellites. Until the late 1980s, the United States restricted the resolution capabilities of non-military satellites to keep sensitive images from falling into enemy hands. President Carter issued Presidential Directive 37 restricting Landsat images to ten meter resolution. In 1988 President Reagan removed those restrictions, and in 1993 the Commerce Department issued EarthWatch, a private commercial surveillance satellite company, a license to build a three meter resolution satellite. Resolution, usually expressed in terms of kilometers, meters and centimeters, refers to the smallest objects on Earth that can be discerned by a satellite. A three meter satellite is capable of detecting objects three meters or greater in size. In 1994, President Clinton signed Presidential Directive 23, permitting the Commerce Department to issue the newest round of one meter and sub-meter private satellite images.[12]

The Landsat satellite system is an excellent example of how most LEO surveillance satellites cover the Earth, collecting images. The Landsat orbit is Sunsynchronous, meaning that it returns to the equator at the same local time on every pass. It is also steeply inclined toward a polar orbit. By means of a

movable scanning mirror system, Landsat snaps images of the Earth on a North-to-South swath 185 kilometers wide. This means that by repeated orbits, Landsat photographs virtually the entire surface of the Earth every 16 days.[13]

Visual wavelength photography is only one way a surveillance or mapping satellite may look at the Earth. Infrared, radar or multispectral imaging are other means for a satellite to capture information about objects on the earth. Anything which has a temperature above absolute zero emits electromagnetic radiation. An object of high temperature radiates shorter waves; an object of a lower temperature radiates longer waves. Because almost everything emits some amount of infrared radiation, this segment of the electromagnetic spectrum is a favored region for remote satellite sensing and is not dependant on visual wavelength light sources.

Objects also reflect electromagnetic waves which fall on them from other sources. Radar imaging is accomplished by sending radar waves at the Earth from a satellite and reading the reflections of these waves bounced back to the satellite. Radar waves reflect differently from various surfaces. Interfaces between dissimilar kinds of rock, diverse types of vegetation and paved surfaces, for example, all produce a different radar image. The travel time of the signal is measured, so the distance to objects in the picture can be mapped. Also, because radar can be aimed at an angle to the ground, vertical objects have a three-dimensional look in images.[14]

Multispectral imaging satellites are sensitive to specific wavelength segments, allowing the observer to get quite a different view of the world.[15]

Multispectral imaging is useful for examining certain ground features or for discerning particular types vegetation or land uses. So, besides optical imaging, infrared, radar and other multispectral imaging can be utilized to obtain a picture of what something looks like. Examples of how non-optical imaging has become commonplace are found in night-vision devices on home camcorders and in radar commonly used on small consumer ocean craft. By these examples, one can readily see that surveillance satellites with infrared or radar capability can operate in darkness and through cloud cover with a high degree of success.

It was the military development of heavy-lift nuclear tipped missiles that allowed the first satellites to be launched into space. The military advantage of launching satellites into space was immediately recognized by both the U.S. and the Soviet Union. Communications relay, photoreconnaissance, electronic intelligence gathering, weather observing, navigation and warning of missile launches were the military catalyst for satellite launches. Today, a network of reconnaissance satellites covers the globe. For best resolution, it is necessary, of course, to operate as low as possible, down to 90 miles, which means a rapid decay of the orbit due to air drag.[16] Therefore, spy satellites are equipped with thrusters and fuel to boost them periodically back up to higher altitudes and to maneuver them into different orbits. With more advanced and higher resolution sensors, spy satellites can operate at higher orbits, increasing the lifespan of the spacecraft and improving dwell time over targets.

Currently, the majority of imaging satellites are for military purposes, but there are increasing numbers of private sector satellites orbiting the globe. Most non-military satellites are put into orbit for communications, weather observing, geodetic mapping and monitoring of Earth resources.[17] Due to these increasing uses, near-Earth space is becoming increasingly crowded.

At the end of 1987, there were over 7,000 man-made objects being tracked in their orbits around Earth, only 1,750 of them being useful satellites.[18] The remainder are space junk or inoperable satellites of one type or another. Since Sputnik, nearly 12,000 payloads and pieces of debris have fallen out of orbit. Orbiting man-made objects of sufficient size are cataloged by the North American Aerospace Defense Command (NORAD). NORAD is responsible for checking out the planned trajectories of satellites and comparing them with the orbits of the trackable objects in space to assure there will be no collisions. It is not possible to track all the small pieces of junk, however, and a pea-sized fragment moving at high speed relative to a satellite could easily put the satellite out of commission.[19] And, private-sector market driven satellite launches are only at the genesis of their industry. In the four decades of satellite launches, man has found the monetary resources to put literally thousands of satellites into orbit and is only now turning to near-Earth space as a profit-making venture for private industry. In the following pages, some of the current private providers of space imagery are detailed so that a comprehensive picture of the industry as it stands today can be realized.

The Space Imaging Corporation is a current provider of LEO satellite images. An interesting fact about this private enterprise is that the U.S. government is one of its primary clients. Although the government operates spy satellites, weather satellites and mapping satellites, various government agencies still find it cost-effective to access satellite imagery from commercial satellite image providers. Space Imaging successfully launched the Ikonos satellite on September 24, 1999, the first private one meter resolution photoreconnaissance satellite to orbit the globe. Since its founding in late 1994, Denver, Colorado-based Space Imaging has quickly become a world leader in digital Earth information to help map, measure, monitor, and manage the world.

Space Imaging markets its image products under the company's Carterra brand name. Carterra products provide a global resource for governments, business leaders and private citizens, producing a wealth of information about the Earth's ever-changing cultural and natural features.[20] According to Space Imaging's corporate website, the company feels that access to this growing collection of visual information will allow for a deeper understanding of the environment, international security, and economic change.

The website goes on to postulate that due to the accurate, up-to-date nature of Carterra products, farmers can precisely monitor the health of crops and estimate yields; scientists can look at environmentally sensitive areas and predict trends; government officials can monitor and plan enlightened land use policies; city planners can further the development of new housing communities; and insurance companies can measure and map property damage after natural

disasters. With the map-level detail many Carterra products offer, Space Imaging can also provide definitive and rapid solutions to help planners determine land ownership in nations moving towards private ownership. Real estate brokers might use the imagery to show home buyers potential properties thousands of miles away, and film producers might use it for creating backdrops for the big-screen. What makes Carterra products so unique is that they are complementary in nature and can help respond to a variety of business and consumer needs. The potential uses for Earth imagery and information products are so vast that nobody can predict their ultimate value as we progress into the 21st Century.[21]

Another private sector satellite image provider is Orbimage. Orbimage is a leading global provider of Earth imagery products and services, with a planned constellation of four digital remote sensing satellites complemented by data from other optical, aerial and radar sources.

Orbimage currently operates the OrbView-1 atmospheric imaging satellite (launched in 1995), the OrbView-2 ocean and land imaging satellite (launched in 1997), and an integrated image receiving, processing and distribution system.

Orbimage offers high-resolution imagery through its OrbView Cities program. OrbView Cities is a growing archive of high-resolution one meter panchromatic imagery of major U.S. and non-U.S. urban areas.

Currently under development, Orbimage's OrbView-3 high-resolution satellite will offer one meter panchromatic and four meter multispectral digital imagery. Orbimage is the exclusive United States distributor of imagery from the

planned Canadian Radarsat-2 satellite. In addition, Orbimage distributes satellite imagery from SPOT Image, a French satellite company, Radarsat International and Russia's SPIN-2 two meter satellite program. Orbimage also offers the SeaStar Pro Fisheries Information Service, which provides fish finding maps derived from OrbView-2 Ocean imagery to fishing customers worldwide.[22]

By monitoring military activities in restricted areas from space, Orbimage hopes to help national security agencies manage international relations on a global scale. Real-time OrbView-3 high-resolution imagery is hoped to help the United States government to monitor borders, gather intelligence on potential conflicts, identify and target enemy troops and assets, plan air, ground and naval missions, deploy resources, and assess battle damage.

Today, Orbimage's OrbView-2 satellite provides high fidelity ocean color imagery to the U.S. Navy to support such activities as naval laser-based and Sonar operations. Imagery from Radarsat-2 will enable users to obtain imagery in all weather and illumination conditions, which is useful for national security applications that demand real-time information.[23]

Orbimage is employing an integrated global system of imaging satellites, ground stations and Internet-based sales channels to collect, process and distribute imagery products at a reasonable cost. With satellite systems designed to significantly improve the timely delivery and quality of information, Orbimage intends to break new ground in space-based imagery for land, sea and atmosphere applications.[24]

Another major company which is currently offering commercial satellite images is TerraServer.com. TerraServer.com provides images for commercial or residential real estate, city government, construction or engineering projects via a subscription-based internet website. TerraServer.com allows clients to select and print high-resolution images sized as small as 1.96 square kilometers - a significant advantage over other web-based satellite image services. The ability to choose a much narrower segment of imagery translates into reduced costs. All imagery can be viewed for free - down to eight meters of resolution and TerraServer.com subscribers can view high-resolution images of one or two meters of detail and then purchase the images immediately.

TerraServer.com currently provides imagery from more than 60 countries. Their goal is to offer complete coverage of the earth's surface, so that every search results in an image to view. TerraServer.com’s website allows users to browse through satellite imagery, visit places they've never seen or get a new perspective on places that are seen every day. Images can be purchased of the exact locations and are available in a JPEG file format or in a print form.

The TerraServer.com corporation started as a joint research project between Aerial Images, Inc., Microsoft, the USGS, and Compaq. The TerraServer.com concept grew out of the convergence of two needs. Aerial Images, Inc. wanted to sell imagery online and Microsoft Research needed a large database to demonstrate the capabilities of its new database software. Under their original agreement Microsoft built the TerraServer.com application

and agreed to host the SPIN-2 Russian satellite data and run the site for eighteen months following the formal site initiation.[25]

TerraServer.com is expanding overhead imagery with content from additional satellites. Its corporate strategy is to focus on constantly expanding coverage with the goal of bringing complete coverage of the Earth to market so that anyone with internet access can see the world from overhead.

TerraServer.com currently obtains its satellite imagery from Orbimage, SPIN-2 and UK Perspectives satellites. As stated earlier in this paper, Orbimage is developing a fully-integrated global system of advanced imaging satellites, U.S. and international ground stations, and Internet-based sales channels to collect, process and distribute Earth imagery products. Orbimage provides the TerraServer.com with one meter panchromatic imagery. SPIN-2 is a subsidiary of Aerial Images, Inc. The SPIN-2 marketing effort is the result of a partnership between Aerial Images, Inc. and the Russian Space Agency, Sovinformsputnik. SPIN-2 imagery is film-based 2-meter panchromatic product that is digitized and made compatible with geographic information systems (GIS). SPIN-2 offers two meter and ten meter imagery and digital elevation models of areas throughout the world.

UK Perspectives is a joint venture between Simmons Aerofilms and NRSC (National Remote Sensing Center), the two largest aerial mapping and survey companies in the United Kingdom. The NRSC was formed in 1980 as a government center of excellence for earth observation data and in 1991 became

a private limited company. Today it specializes in the supply of satellite and airborne data and value added mapping services.[26]

A Russian corporation, Sovinformsputnik, is of special interest to Americans who are old enough to have lived through the Cold War. Much of the digital internet-available satellite surveillance pictures of the United States have been taken by Russian satellites. Sovinformsputnik dramatically illustrates the international application of satellite surveillance imagery and reinforces the point that increasing commercial use of high-resolution satellite images cannot be unilaterally regulated by one government or another. It is clear that, due to the far reach of these satellites, if a commercial enterprise is restricted by the government in one country, the enterprise may go to another country to achieve its goals. This has already been evidenced by the use of Russian rockets to launch American satellites on several occasions due to cost and availability problems in the United States.

From the time of its foundation in 1991, Sovinformsputnik has opened new possibilities for customers and users all over the world in the acquisition of Earth surface remote sensing data, not previously allowed for commercial distribution and use. Sovinformsputnik was founded by a number of enterprises of the industry responsible for development, manufacturing and operation of modern remote sensing systems, which until just recently, were used only for defense purposes. The strategic direction of Sovinformsputnik's activity is satellite survey, commercial distribution of the data and provision of added value products and services for peaceful and scientific purposes. Having an archive of satellite

images, Sovinformsputnik is intensively working for civil applications and projects in such fields as land planning and use, urban planning, environmental monitoring, mapping, and GIS creation. Sovinformsputnik's staff includes experienced experts in the field of development and operation of the remote sensing satellite systems, data interpretation and processing. Sovinformsputnik maintains close business and scientific relations with specialized research and manufacturing organizations through a network of agents and representatives all over the world.[27]

A final private corporation that this project will detail is DigitalGlobe. After two previous satellite launching failures, DigitalGlobe successfully placed into orbit a .61 meter resolution satellite in October, 2001. This means that there are now commercially available images with a spatial resolution of approximately two feet. DigitalGlobe hopes to put into orbit a constellation of high-resolution Earth imaging satellites that will offer comprehensive geo-information products. Currently, DigitalGlobe's QuickBird satellite features several technical advantages for providing clear and accurate imagery - highest available resolution; highest collection capacity; highest accuracy; and the largest high-resolution swath width. DigitalGlobe customers can also task QuickBird to collect up-to-date information relevant to their specific requirements.[28]

As evidenced by the aforementioned enterprises, the private sector is diving headlong into the satellite imaging business. The result will be greater and greater use of satellite imaging by local and state governments, corporations and even by private investigators and insurance companies. As more clients emerge,

it will become profitable for more satellites to be put into orbit with increasingly sophisticated imaging potential.

With the growth of satellite imaging to date, the large-scale law enforcement application of this technology is clearly on the horizon. A January 27, 1998, article in the Wall Street Journal chronicled the growing phenomenon of federal and state law enforcement agencies using NASA and Russian spy photos for prosecution of minor offenses, including building backyard porches without construction permits.[29] After Congress repealed a ban on the sale of NASA spy satellite photos in 1994, federal and state agencies began to purchase satellite photos at an alarming rate. The Georgia Department of Revenue photographs all 58,910 acres of the state to look for illegal timber cutting. In 1997, in Arizona, Floyd Dunn was cited by the Arizona Department of Water Resources for growing cotton on his property without a permit. The Department of Water Resources regularly obtains photographs from the French government's SPOT satellites of 750,000 acres of central Arizona farmland. State officials then compare the images with a database of water-use permits to determine which farmers might be exceeding water-use rules.[30]

Environmental law enforcement and building code violations are only a small portion of the potential uses of satellite imagery for law enforcement. Because satellite imagery provides a three-dimensional representation of ground features, and because the digitization of these images allows for computerized modeling and manipulation of these features, emergency preparedness can be greatly enhanced. Impediments to the mobilization of public safety resources

can be anticipated and alternatives developed in advance of a catastrophe. Search and rescue operations can be vastly improved because of the ability to experience topography or cityscape prior to the insertion of rescuers. The application for police tactical operations is also enhanced, especially where tactical teams must move through large open areas that cannot be photographed by aircraft due to a lack of aircraft availability, potential compromise of an investigation or the inability to conduct surveillance flights in a timely manner.

Putting civil liberties concerns aside for a moment, and taking into consideration the increased use of commercially available satellite imagery by the private sector and non-law enforcement government agencies, it appears reasonable to infer that federal, state and local law enforcement agencies will increasingly find productive uses for this technology. Accepting this inference for the sake of further examination of the issue, one must then consider whether it is feasible for these agencies to launch proprietary satellites or to become consumers of images from commercial providers.

Considering proprietary civilian law enforcement satellites as an option, and since most surveillance satellites are low Earth orbit and move quickly relative to the Earth's surface, the international application of this technology becomes apparent. The cost for development, launch and maintenance of law enforcement satellites could be shared by all of the law enforcement agencies in an international consortium of subscribers. As outlined in the Satellite Primer section of this paper, if a satellite were put into a near 90 degree polar orbit, the entire world could be observed within a matter of days and the pattern would

then repeat itself. If more frequent observation of targeted areas was desired, satellite orbits could be designed to pass over several major population centers of the world, and the consortium of law enforcement agencies funding such a project would be limited to these population centers.

A proprietary international law enforcement network of satellites as described would have great value for public safety, as archived images would assist with planned events and with emergency preparedness. However, crime solving would also be enhanced. As the frequency of images derived form these satellites increases, the chances of obtaining images crucial to solving crimes also increases. As an example, one might imagine a different outcome in the O.J. Simpson criminal trial if a satellite image of his white Bronco was obtained as it sat parked near his estranged wife's condominium during the time she and her acquaintance were murdered. So, proprietary satellites in custom tailored orbits could, theoretically, increase the images available to law enforcement agencies.

Another option in considering proprietary law enforcement satellites is the use of geostationary orbit satellites. Currently, civilian GEO satellites are used for communications purposes such as DirecTV and XM Radio. One company, Sea Launch, based in Long Beach CA, is an international company of American, Russian, Ukrainian and Norwegian partners that provides cost-effective, heavy-lift launch service for commercial satellite customers.[31] Sea Launch puts satellites into orbit from a floating launch platform near the equator. A launching position near the equator is particularly suitable for putting up GEO satellites. If

GEO satellites proved useful for law enforcement purposes, a regional, rather than international, consortium of agencies could be formed to bear the associated costs.

Now, returning to civil liberties issues concerning this technology, we must consider whether the American population will find satellite surveillance images palatable and under what legal circumstances could such images be utilized by U.S. law enforcement. While Americans have a long history of being opposed to government surveillance of the general population, there has been a steady creep of electronic surveillance into the lives of everyday citizens. In Great Britain, police surveillance cameras in metropolitan areas are common. Police in Airdrie, Scotland, reported that surveillance cameras cut crime by 75 percent in areas where cameras were installed.[32] Similar declines in crime have caused British authorities to expand utilization of surveillance cameras throughout metropolitan areas and highways.

In America, due to the oppressive English government of colonial times, an independent United States emerged with the Constitution and Bill of Rights as the foundation for government. Because of the American fear of oppressive government that carries over to this day, surveillance camera use by the government has not been widely accepted. Increasingly, though, cameras are being tolerated along freeways, lobbies of public buildings, at traffic intersections and in airports. Americans, as evidenced in the post-September 11, 2001, era, are now willing to accept wider law enforcement surveillance in an effort to keep the country free from terrorism.[33] Given the volatility of world events, Americans'

tolerance for reasonable government intrusion into everyday lives is a matter that will most likely be determined by factors beyond the control of law enforcement officials. But, law enforcement officials must be prepared to provide cost-effective technological solutions to crime problems (including video surveillance) when appropriate and in accordance with industry standards.

As stated earlier in this project, there have been some limited law enforcement uses of satellite surveillance images. At the present time, however, there is no definitive statutory or case law regarding use of satellite surveillance images by law enforcement. It is likely that at some point in the future, a satellite image will be proffered as evidence in a criminal case and that defense counsel will file a motion to exclude such evidence based on an assertion that Fourth Amendment protections against unreasonable search and seizure were violated. Whether or not the motion is granted, an appeal will most certainly follow, resulting in landmark case law concerning satellite surveillance images.

Any ruling on satellite image evidence will undoubtedly be based on extrapolation of existing case law concerning law enforcement use of surveillance images. In terms of legal admissibility as evidence, the law enforcement use of satellite images, by its very nature, is similar to the law enforcement use of images obtained by police aircraft and by covert and overt surveillance cameras placed in public areas to aid investigations or combat street crime. Current case law regarding law enforcement use of audio and video surveillance allows for collection of sounds and images from public areas without

a judicially authorized search warrant where there is no reasonable expectation of privacy.[34]

At present, law enforcement use of aircraft comes closest to the potential use of satellite surveillance images by law enforcement. Currently, if aircraft surveillance is conducted over private property, from legally navigable airspace, even for the specific purpose of detecting evidence of criminal behavior, a search warrant is not necessary to ensure the admissibility of evidence.[35] However, if law enforcement personnel in aircraft use high-magnification devices to view within the curtilage of a dwelling, and such devices do more than merely magnify what has already been detected with the unaided eye, a search warrant may become necessary.[36] The U.S. Supreme Court has ruled that law enforcement use of an infrared imaging device to see heat emanating from a dwelling requires a search warrant for such evidence to be admissible in court.[37] In reasoning this decision, the court held that advancing law enforcement technology cannot be used to erode Fourth Amendment protections. The court went on to say "…just as a thermal imager captures only heat emanating from a house, so also a powerful directional microphone picks up only sound emanating from a house and a satellite capable of scanning from many miles away would pick up only visible light emanating from a house." By this reasoning, it appears that the Supreme Court considers law enforcement use of a high-technology device "…to explore details of a private home that would previously been unknown without physical intrusion…" to be a search, where viewing the same home by the naked eye, even while flying in an aircraft, is not. According to Presiding

Justice Paul Turner, California Court of Appeals, the admissibility of satellite surveillance evidence should be similar in nature to evidence obtained from an airplane or helicopter. Justice Turner added, "It's difficult to know how the Supreme Court will rule, given the high-tech nature of satellite surveillance. It's clear that high-tech surveillance will be looked at differently by the Supreme Court."[38]

According to Joseph F. De Vanon, Judge, Los Angeles County Superior Court, admissibility of satellite images would most likely be weighed as would other types of law enforcement surveillance images. Judge De Vanon expanded his comments by providing the following hypothetical example. If a law enforcement detective investigating a homicide were to obtain archived satellite images for the purpose of identifying persons or vehicles coming or going from the crime scene by means of public streets and areas open to public view, a search warrant would not be necessary. If, in the examination of these images, the detective instead observed activity within the curtilage of a neighbor's home which led to the neighbor's arrest as a suspect in the homicide, the images and subsequent evidence obtained would be admissible in court due to the inadvertent nature in which the detective came upon the neighbor's activities. Conversely, in Judge De Vanon's opinion, if the law enforcement detective procured satellite images for the purpose of viewing within the curtilage of the neighbor's home because the officer suspected that the neighbor had committed the homicide, the detective would need to obtain a search warrant for such

images to ensure their admission in court, and that of any subsequent evidence.[39]

This concludes the first chapter of this project. Chapter I offered a basic satellite primer, provided information about types of surveillance satellites, their orbital variations, and offered an overview of the thriving satellite imaging industry to date. This chapter has also provided information regarding civil rights issues and legal points concerning the admissibility of evidence obtained from surveillance satellites.

The first chapter of this project has put forth the notion that satellite surveillance technology is knocking softly on the door of the American criminal justice system. Due largely to the expansion of satellite imaging in the private sector and the widespread publication of satellite imagery, the interest of criminal investigators, prosecutors and defense attorneys has been piqued. Whether this soft knocking intensifies is a matter of conjecture. But, the technology continues to expand.

In Chapter II, a futures study will be presented using the Nominal Group Technique. Future scenarios regarding satellite surveillance technology will also be provided in an effort to illustrate the potential effects selected trends and events could have on satellite imaging issues.

Chapter II – Futures Study

Research Methodology

In order to examine the issue, “What impact will emerging satellite surveillance technology have on California law enforcement by the year 2007,” a research methodology was utilized that included employment of a nominal group technique panel and alternative scenario development.

The nominal group technique (NGT) is a research method involving a structured workshop. An NGT may be used to elicit potential trends and events which could have an effect on a given issue. To examine trends and events, NGT panelists are provided with an issue statement, and a detailed explanation of all aspects of the issue and related matters that may have bearing on the issue. NGT panelists then independently brainstorm ideas concerning potential trends, which are long-term, incremental changes, and events, which are significant, definitive occurrences. Next, the NGT facilitator conducts a round-robin polling of trends and events, posting responses for the panel’s perusal. The facilitator then engages panelists in a clarification discussion of each trend or event to ensure that all panelists have a common understanding of each item. At the conclusion of the clarification discussion, NGT panelists independently nominate trends and events that each feels has the greatest significance regarding the issue.

Once the most popular trends and events are elicited, survey instruments are completed by each NGT panelist to gain insight into the probability of occurrence of events and significance of impact of trends. Finally, a cross-

impact analysis is completed for trends and events to help forecast their potential impact on the issue being studied.

Nominal Group Technique Panel

The NGT panel for this project was constructed in an effort to reflect diverse opinion, experience and expertise. The ten panelists represented a wide spectrum of knowledge concerning law enforcement practices, civil rights issues, police surveillance techniques and business and community interests (Appendix 1).

Nominal Group Technique Workshop

The NGT panel was convened on November 7, 2001, in Glendale, California. Prior to commencement of the NGT, explanatory flip charts were prepared, handout materials were produced and rating charts were developed. All NGT participants were briefed in advance as to the nature of the panel and the issue to be examined.

The issue statement, in the form of a question - “What impact will emerging satellite surveillance technology have on California law enforcement by the year 2007” - was presented to the panelists both verbally and in writing. An explanatory presentation was made to the panelists to ensure a thorough understanding of the issue and related matters. Panelists were also given an explanation of the distinction between trends and events within the scope of this exercise.

The NGT panel was requested to consider the issue first from a present day perspective then from a perspective of how the issue has changed over the last five years. Finally, the panelists were requested to consider the issue in terms of potential developments over the next five years. The panelists were advised to keep an open mind, to let ideas flow freely and to think creatively.

The NGT panelists were then instructed to individually brainstorm ideas regarding trends and events related to this issue and to record these ideas in list form. Panelists were advised to think independently and to refrain from conversation with other panelists during this period.

After ten minutes, the brainstorming session was concluded and a round-robin polling of trends and events was conducted. This polling elicited 21 trends (Appendix 2) and 21 events (Appendix 3). As each panelist introduced a trend or event idea, a clarification discussion was conducted to ensure that all participants had a common understanding of the idea. Once clarification and understanding had been achieved, the trend or event was recorded on a flip chart and posted in the conference room.

Panelists were then requested to individually nominate five trends and five events from the ideas elucidated in the round robin poll that they felt were most significant to the issue. The panelists were provided with ten stick-on dots for use in nominating their most significant trends and events and were requested to place a dot next to each of their choices on the flip charts posted in the room. Each participant received five dots labeled as trends, numbered one to five, and five dots labeled as events, numbered one to five. The participants were

requested to utilize the following numerical weighting system in nominating their trends and events: five points for the most significant, four points for the next, and so on. Although the panelists were able to see dots placed by fellow panelists, they were cautioned to think independently and not be swayed by any preponderance, or lack of dots posted next to an idea. Panelists were advised that they could only vote once for each trend or event. The panelists' selections were compiled, scored and the top five trends and events were recorded on a flip chart and displayed in the room.

The five trends nominated by the panel were:

1. Development of an entirely new culture due to government satellite surveillance.

This trend was understood by the panelists to mean that pervasive satellite surveillance over all aspects of society may cause American culture to shift significantly due to Big Brother constantly watching all that occurs. While crime might drop significantly due to satellite surveillance, other behaviors might also be impacted such as freedom of unmonitored movement throughout the country. The gist of this trend was understood to be that a whole new society may develop because there would always be a picture of everything that occurs.

2. Level of tolerance for governmental intrusion into citizens' lives.

There was consensus amongst the panelists that this trend referenced the constant tug-of-war between civil liberties advocates and law and order advocates. If law enforcement satellite surveillance became a reality, the level of

tolerance for government surveillance would be affected and might largely be driven by cataclysmic events.

3. Level of local crime impacted by law enforcement satellite surveillance.

The panelists understood this trend to reflect that the level of safety in a local community would be directly affected by pervasive law enforcement satellite surveillance.

4. Supreme court rulings limiting the law enforcement use of satellite surveillance images.

The NGT panel understood this trend to reflect potential search and seizure issues that will be brought to the forefront by increasing use of private or public surveillance satellite images.

5. Level of satellite surveillance use in civil litigation such as workers' compensation, excessive force, etc.

The panel coined the phrase, "the satellite as an independent witness" in clarifying the potential impact of this trend. The panelists understood this trend to reflect the impact pervasive satellite surveillance could have on civil cases of all types.

The five events nominated by the panel were:

1. The Supreme Court issues a ruling interpreting the Fourth Amendment as strictly prohibiting satellite surveillance use by American law enforcement.

The panelists understood this event to effectively block all domestic law enforcement use of commercial or government satellite images in investigations and criminal prosecutions.

2. Implementation of an all-wireless personal communication system infrastructure in the United States.

The NGT panel interpreted this technological breakthrough as being heavily weighted on satellite communications, with GPS capability. Such a system would provide the virtual location of any person at all times while a personal communication device was carried.

3. A second September 11th terrorist attack occurs.

The panelists interpreted this to mean that if another significant terrorist event were to occur, public opinion concerning suspense of certain civil liberties might be greatly shifted.

4. The United States government abuses use of satellite surveillance photos.

The panel interpreted this event to mean that a gross abuse of power by a governmental agency was facilitated through the use of satellite surveillance images.

5. A law is passed mandating the implantation of GPS satellite surveillance tracking chips on all convicted felons.

The NGT panel interpreted this event to mean that satellite surveillance technology coupled with GPS tracking technology makes it possible to permanently implant tracking chips in human beings. These chips allow the surveillance and tracking of all convicted felons, dramatically impacting offender recidivism.

Next, the panel was directed to complete a trend rating instrument which had been distributed to each participant at the beginning of the NGT. This instrument required each panelist to independently rate the direction and level of the five nominated trends over a 15-year period (five years ago, five years in the future and ten years in the future). A value of 100 was arbitrarily assigned as the level of each trend at the present time. From this factor of 100, panelists rated the level of the trend at the specified benchmarks on a scale from 0-infinity.

The panel was then directed to complete an event rating instrument which had also been distributed to the panelists at the beginning of the NGT. This instrument required each panelist to independently rate the probability of occurrence of the five nominated events over the next ten years. Once the probabilities were established, the panelists estimated the potential for positive and/or negative impact on the issue, on a scale from 1-10, for each event if it were, in-fact, to occur.

Upon completion of these rating instruments, the panel was thanked and dismissed. The data contained on the rating instruments were then compiled and summary tables were constructed. Both the trend summary (Table 1) and event summary (Table 2) reflect median values for the data derived from the NGT panel.

The NGT panelists' trend ratings clearly indicate increasing law enforcement and civil litigation use of satellite surveillance technology in the years to come. The panelists ratings also indicate that because of the anticipated pervasiveness of satellite surveillance, American culture will be altered because there will

Table 1

TREND SUMMARY

Trend #	TREND STATEMENT	LEVEL OF THE TREND (Today = 100, Scale = 0-Infinity)				
		5 Years Ago	Today	Five Years From Now	Ten Years From Now	Significance (1-10)
1	Development of an entirely new culture due to government satellite surveillance.	20	100	150	200	10
2	Level of tolerance for governmental intrusion into citizens' lives.	60	100	110	150	8
3	Level of local crime impacted by law enforcement satellite surveillance.	40	100	150	175	9
4	Supreme Court rulings limiting the law enforcement use of satellite surveillance images.	25	100	105	140	9
5	Level of satellite surveillance use in civil litigation (workers' compensation, excessive force, etc.	10	100	110	150	8

Table 2

EVENT SUMMARY

Event #	EVENT STATEMENT	Years Until Probability First Exceeds Zero	PROBABILITY		IMPACT ON THE ISSUE AREA IF THE EVENT OCCURRED	
			Five Years From Now (0-100%)	Ten Years From Now (0-100%)	Positive (0-10 Scale)	Negative (0-10 Scale)
1	The Supreme Court issues a ruling interpreting the Fourth Amendment to strictly prohibit satellite surveillance use by American law enforcement.	5	10	50	4	6
2	Implementation of an all wireless personal communication system infrastructure in the United States.	9	0	80	8	2
3	A second September 11th terrorist attack occurs	4	50	65	9	1
4	The United States government abuses use of satellite surveillance photos.	5	25	75	2	8
5	A law is passed mandating the implantation of GPS satellite surveillance tracking chips on all convicted felons.	8	10	60	7	3

always be an unseen witness orbiting overhead. The increased use of surveillance satellites was rated as having a positive effect on law enforcement efforts to control crime but was also rated as necessitating Supreme Court intervention to limit government application of satellite surveillance technology.

The NGT panelists' event ratings indicated a strong probability of another major terrorist incident in the U.S. within the next five years. This event, while being devastating for our country, was seen as having a positive impact on law enforcement use of satellite surveillance technology. An incident of U.S. government abuse of satellite surveillance images was rated as having a 75% probability of occurring within ten years. The panelists also rated the creation of and all wireless personal communications system as having a strong probability of occurrence within ten years. It is interesting to note that the trends and events elucidated by the NGT panelists represent the dualism of the satellite surveillance technology issue – infringement on civil liberties versus control of crime/terrorism in America.

A cross-impact analysis matrix was constructed by this writer in which the effects of the nominated events on the nominated trends were rated on a scale of –5 to +5. Based on the literature review, expert interviews and NGT panel discussions, values were assigned to the cross-impact matrix (Table 3) representing the impact of events on trends. Through the use of the cross-impact matrix, the interplay of trends and events can be quantified so that a best-case, worst-case and normative future can be readily identified.

Table 3

CROSS IMPACT ANALYSIS					
	TREND				
EVENT	Development of an entirely new culture due to government satellite surveillance.	Level of tolerance for governmental intrusion into citizens' lives.	Level of local crime impacted by law enforcement satellite surveillance.	Supreme Court rulings limiting the law enforcement use of satellite surveillance images.	Level of satellite surveillance use in civil litigation (workers' compensation, excessive force, etc.)
The Supreme Court issues a ruling interpreting the Fourth Amendment to strictly prohibit satellite surveillance use by American law enforcement.	-3	-5	-5	+5	-5
Implementation of an all wireless personal communication system infrastructure in the United States.	+5	+5	+5	-3	+3
A second September 11th terrorist attack occurs.	+5	+5	+5	-5	+5
The United States government abuses use of satellite surveillance photos.	-3	-3	-2	+5	-2
A law is passed mandating the implantation of GPS satellite surveillance tracking chips on all convicted felons.	+4	+3	+5	-3	+2

Based on the cross-impact matrix and opinions obtained from experts and panelists referenced earlier in this paper, the event concerning a second September 11th terrorist attack was determined to have the greatest potential positive impact on the development of law enforcement satellite surveillance capability. The event summary table indicated the highest positive impact score for this event. In the cross impact analysis table, this event had the highest positive and negative impact when referenced against positive and negative

trends. A common thread in opinions was that another September 11th terrorist attack might have a catalyzing effect on the American public toward giving up civil liberties in exchange for freedom from terrorism. Such an event was seen as potentially influencing the Supreme Court to issue more opinions restricting civil liberties in exchange for public order. In other words, increasing terrorism on United States soil was seen as a color by which all other trends and events might be painted.

Through use of the aforementioned process, it was determined that the greatest negative event on the development of law enforcement use of satellite surveillance technology would be a Supreme Court ruling to strictly prohibit the law enforcement use of satellite images. The event summary table indicated the second highest negative impact for this event; government abuse of satellite photos had the greatest negative impact in the event summary. But, when viewed in light of the cross impact analysis, a Supreme Court ruling prohibiting satellite photo use was predicted to have greater overall negative consequences. Government abuse of satellite photos was seen as an event that could be overcome through reforms and public relations campaigns. But, a Supreme Court ruling has force that is nearly impossible to undo in an expedient manner.

Finally, through the same process, it was concluded that the trend concerning public tolerance for governmental intrusion would have the most normative impact on the development of satellite surveillance capability for California law enforcement. This trend had median ratings on the Trend Summary Table as well as on the Cross Impact Analysis Table. Opinions

reflected that the pendular swings from public order to civil liberties has a long-standing basis in American society that satellite surveillance would not significantly alter.

Future Scenarios

The above findings were then used to construct three potential future scenarios to depict situations which might occur in reference to the issue being studied in, 1) a most desirable, optimistic future, 2) a least desired, pessimistic future and, 3) a status quo, normative future.

Scenario One – Most Desired Future

This optimistic scenario assumes that a high-profile fugitive terrorist suspect has been arrested through the use of satellite surveillance technology. As a result of this event, the American public has overwhelmingly embraced the development and deployment of law enforcement surveillance satellites as a means to enhance public safety.

Glendale, California

August 24, 2007

It was a warm evening in Glendale as Officer Vahak Bouzikyan pulled out of the police station parking lot in his marked patrol unit. It was 7:15 p.m. and Vahak was just beginning his 12-hour night-watch patrol shift. As Vahak checked the status of police activity on his mobile computer terminal (MCT), he

saw that the evening was beginning quietly, with no extraordinary police action on the streets of this city of 250,000.

Vahak, a ten-year veteran patrol officer, had seen crime drop dramatically during his career. He recalled how different things were in his first few years of patrolling, before the law enforcement satellite surveillance system had been implemented across the United States. Vahak remembered rushing from roll call to his police car because so many police calls were waiting to be answered. He remembered armed robberies of convenience stores where suspects escaped into the maze of the city without a trace. And, Vahak remembered the high number of unsolved street crimes where justice was never served.

Vahak recalled that when Osama Bin Laden escaped from prison in 2003 and began a nationwide terrorism spree, military surveillance satellites were used to track him down. The use of satellites in this case so effectively demonstrated the public safety value of this technology to the American populace that legislation was almost immediately passed funding the launch of a nationwide law enforcement satellite surveillance system. Now, due to satellite surveillance, street crimes had been reduced dramatically; the ones that still occurred were usually solved, due to the solid investigative leads produced by the satellite images. All across America, violent crime had fallen to levels never thought possible due to widespread use of satellite imaging. Even darkness and cloud cover offered no protection to criminals because of the thermal and radar imaging capability of the satellite network.

As Vahak entered the third hour of his shift, his mobile computer flashed a dispatch to a domestic violence call at a residence in a canyon area of Glendale. As Vahak began driving toward the scene, he received the satellite image over his computer screen showing the call location highlighted in yellow among other houses in the canyon. The dispatch center advised Vahak that the victim's attacker had just fled, driving a red Nissan pickup, with an electronic vehicle identification number (E-VIN) of 7NAC1324. Due to the advanced image analysis software of the satellite surveillance computer, automatic search parameters had been established and an electronic search for the vehicle was already underway. Suddenly, highlighted in flashing red on his mobile computer display, Vahak could see the suspect's vehicle winding down a canyon road toward the intersection of Verdugo Road and Chevy Chase Drive. Vahak could also see, highlighted in flashing blue, other police units converging on the intersection. As usual, the suspect was apprehended shortly thereafter.

Vahak, resumed his normal patrol duties and thought of the fantastic benefits to society that satellite surveillance had yielded. Due to the electronic archiving of random surveillance images, even crimes not immediately detected were being solved at an unprecedented rate. As Vahak saw it, there was only one downside to this technology – boredom for a city police officer.

Scenario Two – Least Desired Future

This pessimistic scenario has assumed that the Supreme Court has issued a ruling interpreting the Fourth Amendment to strictly prohibit the law enforcement use of satellite images.

Glendale, California

August 24, 2007

It was a warm summer evening in Glendale, as Anto Bedikian locked the scissors gates over the front of his convenience store. Although it was only 6:30 p.m., Anto was closing his shop for the evening. Over the years it had become too dangerous, due to increasing convenience store robberies, to stay open into the hours of darkness. As Anto turned off the lights inside his business, he noted the flashing LEDs of the surveillance cameras and motion detector sensors. Although he had been robbed twice within the last year and burglarized four times, Anto still enjoyed running his small market. His regular customers kept him emotionally buoyed, although they didn't come to his store as often since crime had increased so significantly in the area.

Anto entered his PIN into the alarm control panel and waited for the OK to exit. He then walked out of the rear door, locking and dead-bolting the door behind him. The rear parking lot of Anto's store was enclosed by a 10' chain link fence with razor ribbon along the top. Anto had installed a remote controlled driveway gate and motion detector activated lighting since his car was stolen a year ago. As Anto pushed his auto alarm deactivation switch he heard the click of the solenoid operated door locks.

Anto had immigrated to the U.S. from Iran five years previously after a brief stay in London. He had originally planned to live in London near his uncle, Bedros Hanessian, but Anto didn't like the foggy weather and had always dreamed of enjoying the freedom of the United States. After five years of

escalating American street crime, however, Anto was on the verge of moving back to England.

Anto knew that in England the use of police surveillance cameras in metropolitan areas had proven successful for the last two decades. He also knew that British law enforcement had formed a consortium with other European nations to put up a satellite surveillance network. From talking with his Uncle Bedros, Anto had learned how much crime had been reduced in the British Isles through the use of law enforcement surveillance satellites.

Anto wished that the American public could put aside a few cherished civil liberties in exchange for some public order in the form of surveillance satellites. Anto believed that if only American law enforcement used satellites like their British counterparts, he would not have to live in fear of the gangs and criminals who now infested the streets of his adopted homeland.

As Anto pushed the remote control button to open the rear gate of his market parking lot, two gang members approached carrying handguns…

Scenario Three – Normative Future

This scenario assumes that the cost of satellites and launches has not diminished significantly with increased private sector satellite proliferation. Law enforcement use of surveillance satellite images remains limited due to a lack of commercial availability of timely, high-resolution images. Technological breakthroughs to allow greater imaging resolution and longer satellite dwell time over target areas has also failed to materialize. American public sentiment

toward satellite surveillance has also kept law enforcement use of this technology to a minimum.

Glendale, California

August 25, 2007

As Chief Lola Abrahamian arrived at her office and clicked on her computer, it was half-past six in the morning. After the biometric facial recognition system allowed her to access her computer, she immediately opened the watch commander's log file. Lola saw that the previous evening had been typical, except for the gang related kidnap/carjacking of a local convenience store owner. The log indicated that the store owner had been accosted by armed gunmen in the rear parking lot of his store and forced to drive to a nearby ATM. After being made to withdraw $2,000, the store owner was driven to Pacific Park where he was set free. His attackers fled in his car, which was still outstanding. Lola recognized the name of the store owner, Anto Bedikian. She knew he had been previously robbed and that his business had been burglarized on several occasions. Lola had personally spoken with Anto after his last robbery to assure him that the Department was doing all in its power to control crime in Glendale.

By comparison, Glendale was doing quite well in keeping crime down. Many cities had experienced significant jumps in crime, but Glendale, through its community policing and directed patrol efforts, was holding back the tide of street crime. Still, Lola wondered if things could be better.

Lola reflected back to a few years ago. Satellite surveillance technology was allowing a network of satellites to provide real-time high-definition images to

law enforcement in a few European cities. Even more advanced satellites were being employed for military intelligence use. But, the cost of producing and launching satellites had not come down as expected. The anticipated boom of private satellite image providers had also failed to materialize and American public sentiment was still running high against law enforcement use of satellite imaging.

As a result, Glendale, like all other American cities, had found development of consortiums to launch imaging satellites to be impractical. But, Lola thought, if the benefits of crime reduction could only be made tangible to the populace, the money and technology would materialize to make a network of law enforcement imaging satellites a reality. But there were also the civil liberties concerns held so dear by American citizens. Americans, it seemed to Lola, would prefer to be victimized by criminals than to feel Big Brother was always watching over their shoulder.

Lola had taken part in a fact-finding committee to explore forming an international consortium that would launch a network of surveillance satellites. But the technology was too daunting and the costs, both fiscal and in terms of civil liberties, were too great. Although Lola was optimistic about the value of this technology for making safer streets, she was pragmatic in her view that it just wasn't going to happen during the remainder of her police career.

Lola was struck by the realization that in 2007, just like in 1982, when she graduated from the academy, police work was still a matter of patrolling in police

cars and answering calls for service; little had changed. Lola sighed, closed the Watch Commander's Log file and turned her attention to her e-mail.

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In Chapter I, a satellite overview and data to support that there has been rapid growth of the commercial satellite imaging industry was presented. In Chapter II, trends and events were elucidated which may have an effect on employment of satellite imaging by American law enforcement. Also in Chapter II, alternative future scenarios were developed based on trends and events which would have a positive, negative or normative impact on the issue. In Chapter III, strategic planning and transition management strategies will be presented. These strategies will be based on a desired future – that satellite imaging will become a valuable resource for American law enforcement that will lead to improved public safety.

Chapter III – Strategic Planning and Transition Management

Strategic Planning Overview

Development of a strategic plan and transition management strategies for a largely theoretical application of emerging technology is a difficult task at best, much like shooting in the dark. When strategic planning involves an emerging technology, development of such a plan is hampered by inadequate operational data. And, in the case of law enforcement use of satellite surveillance technology, the following issues compound the difficulty in strategic planning.

1. Satellite imaging technology has only had very limited law enforcement use to date. The ability to use this technology for actual crime prevention, crime solving and emergency preparedness has not been tested.
2. Civil liberties advocates have only reacted to faint glimpses of the use of this technology by law enforcement. Satellite imaging has yet to become a major fourth amendment concern for civil rights advocacy organizations.
3. Again, due to only limited law enforcement application of this technology, the courts have not performed extensive review of how satellite evidence may be legally obtained by the authorities and used in criminal and civil trials.

In terms of vision, however, the utilization of imaging satellites by law enforcement, when implemented with constitutional safeguards, represents a technological leap forward for federal, state and local law enforcement. Regardless of whether such satellites are owned and operated by law enforcement, or are private commercial enterprises, these satellites can be tasked to perform a variety of law enforcement activities. The desired future for law enforcement application of this technology is one in which public safety is enhanced while constitutional protections are upheld. If developed within this framework, the outcome of satellite imaging use by American law enforcement would be reduction in crime and an improvement of the overall quality of life in this country.

Despite the theoretical nature of law enforcement use of surveillance satellites, there are present-day applications of this technology for which tangible strategies can be developed. It can also be logically inferred that continued development of this technology will result in greater numbers of imaging satellites, lower cost for development and launching of satellites, more high-resolution images, and more timely availability of imaging products. These aspects, when considered together, lead one to conclude that development of a satellite imaging strategic plan and transition management strategies is, in-fact, viable and desirable.

The following example is presented to illustrate the point that emerging technology, when viable, will overtake law enforcement, regardless of law enforcement's ability to prepare for and participate in such change.

As recently as ten years ago, the most comprehensive investigative databases were maintained by the government. Law enforcement investigators found the best information for finding suspects and for investigating crimes in the DMV databases, criminal history databases, county assessor's databases, or even public utilities and welfare databases. Today, private corporations such as Lexis-Nexis, Auto Track, and Choice Point maintain databases which contain the broadest collection of information that may be useful in solving crimes. Most law enforcement agencies now find it a necessity to subscribe to some or all of the described databases as an investigative adjunct. These databases evolved through computerized access and compilation of information from various private sector and public sector databases by private corporations. Because of the broad collection of information from various sources contained at one point of access, these companies have created a very lucrative industry.

The reason for describing these information companies at this point is to illustrate how through absolutely no participation or cooperation from law enforcement, very comprehensive repositories of sensitive personal data evolved in the private sector. There is a parallel in satellite imaging. Currently, private sector high-resolution satellites are providing images to subscribers and there has been little or no cooperation or participation by law enforcement. It is likely that law enforcement will find itself on the trailing edge of this technology unless foresight begins to translate into vision and strategic planning.

Satellite Imaging Technology Feasibility Assessment

The degree of development of this emerging technology is critical for determining strategies for law enforcement's application of same. For this reason, this project will now discuss two developmental paths that this technology may take. The first developmental path is identified as the deployment of proprietary satellites by a regional or international consortium of law enforcement agencies. The second developmental path is identified as the procurement of commercial satellite imaging as clients of private-sector satellite companies.

LEO satellites currently provide all of the high-resolution satellite imagery. These satellites balance orbital altitude with increased or decreased spatial resolution of objects on Earth. If a satellite orbits at a higher altitude, it has a longer dwell time over a target and will encounter less air drag, giving it a longer lifespan. If a satellite orbits at a lower altitude, it will achieve higher spatial resolution, because it is closer to Earth, but will appear to move across the sky faster relative to the ground. Current classified military imaging satellites reportedly dip down to as low as 90 miles and have a spatial resolution of 2.5 centimeters.[40] But, such satellites can cost up to $2 billion to put into space. The approximate cost of developing, building and deploying a commercial, one meter resolution imaging satellite is approximately $110-150 million.[41]

Because imaging satellites are costly, they are generally placed in polar orbits so that one satellite can view the entire Earth in a matter of days. In this way, timely images of a target can be obtained from a single satellite with a

return time to the target in a matter of days. If two or more satellites are placed in the same orbit, the return time can obviously be shortened commensurately. If a satellite is placed into orbit with sufficient fuel and thrusters, it can be maneuvered over specified targets from a fixed orbit, but this capability is currently the exclusive realm of military satellites and is obviously cost-prohibitive for other applications.

GEO satellites, on the other hand have zero orbital speed relative to the surface of the earth. But to achieve this apparent fixed position in space, GEO satellites must be positioned 36,000 kilometers above the surface of the Earth. At this time, and for the foreseeable future, GEO satellites must be positioned far too high and have far too large a telescopic mirror to offer one meter or less resolution images.[42] Resolution of one meter or less must be achieved for satellite images to be useful for crime solving due to the need to discern the movement of people and vehicles.

This leads to the obvious question as to whether a regional or international consortium of law enforcement agencies could put proprietary satellites into orbit for their mutual benefit. As commercial satellite image providers increasingly penetrate the market with high-resolution images, law enforcement practitioners from throughout the world will begin to appreciate the value of such images. With their collective appetite whetted by frequently obtained satellite images from commercial providers, law enforcement practitioners predictably would be ecstatic if real-time surveillance images were possible from a proprietary group of satellites.

But, at least within the scope of the foreseeable future, absent some technological breakthrough, the cost of putting up sufficient numbers of LEO satellites to offer real-time constant surveillance for law enforcement purposes is not a reality. And, the prospect of putting up a GEO satellite over a region that would offer resolution sufficient for law enforcement purposes is also not within the realm of possibility, absent some technological breakthrough.[43]

The best that could be hoped for is a limited number of proprietary satellites in LEO polar orbits that could be directed by law enforcement practitioners to target certain locations within a matter of days. This capability is currently available from commercial imaging satellites.

Regrettably, the state-of-the-art in satellite technology will not provide law enforcement with the ability to prevent crimes through pervasive satellite imaging or routinely solve crimes by obtaining evidence from a plethora of frequently updated archived satellite images.

Strategic Planning and Transitional Management

There remains a possibility for production and deployment of proprietary law enforcement satellites which would provide some exclusive imaging for an international consortium of law enforcement agencies. And, because such satellites would have worldwide coverage, an international consortium of law enforcement agencies could equally benefit from such a venture and could share costs as well.

With these issues in mind, stakeholders and opponents must be identified to proceed with strategic planning. Obviously, law enforcement practitioners of all strata would embrace satellite surveillance technology if it proved useful in preventing and detecting crime at a reasonable cost. An agency-by-agency cost-benefit analysis would need to be performed to determine if participation in a law enforcement proprietary satellite program would be beneficial. As each agency engaged in this analysis, polarization would develop among those who supported this technology and those who felt the cost for participation would be too high and that funds would be better spent elsewhere. On the other hand, procurement of commercial satellite images could be managed on a case-by-case basis and would not constitute a major budgetary expenditure for most agencies.

The opponents to law enforcement satellite surveillance use would most likely have concerns about the civil liberties implications of this technology. These opponents would predictably arise from outside law enforcement, but, undoubtedly some would also arise from within the ranks. Opposition of this nature would be anticipated for satellites or any other new technology that would extend the reach of law enforcement in unpredictable ways. In the post September 11th world it appears that stakeholders will outweigh opponents of this technology, given the homeland security roles of law enforcement agencies across America.

To form an international consortium, however, involvement of each nation's government at the national level would be required. Working through

professional organizations such as the International Association of Chiefs of Police (IACP) and Interpol, (International Criminal Police Organization), local agencies can be instrumental in bringing the need for such technology to the forefront. However, the final result would involve politicians and high-level nationally appointed officials such as the attorney general and the director of the Federal Bureau of Investigation.

So, the strategic planning required at the state and local level to bring about a consortium of law enforcement agencies is necessarily limited to an educational program for law enforcement leaders regarding the value of satellite imaging technology as an adjunct for investigation, tactical preparation and emergency preparedness. It would then be incumbent on these law enforcement leaders to wield their influence through professional associations and persuasion of elected officials to bring about this change.

Transition management of organizational change caused by use of dedicated law enforcement satellites would not be overwhelming for federal, state or local law enforcement agencies. Increases in individual agency budgets brought about by creation of an international consortium would be for a predetermined amount through international agreements and would have ample lead time so that inclusion as a budgetary line item would be practicable. It would appear likely, due to the international scope of such a consortium, that the entire cost of a nation's share of such a project would be borne nationally and result in little or no fiscal impact for the local or state agency.

As for other transition management concerns for such technology, as an adjunct to traditional investigative, tactical planning and emergency preparedness activities, it is anticipated that there would not be significant work-load impacts, cultural shifts or other major organizational changes that would occur with the ready availability of satellite imagery for law enforcement use. Policy formation for ethical use of such imagery would be one area of concern, however. One can imagine that abuses of this technology by unscrupulous law enforcement personnel could result in images being used for personal gain, to offer unfair advantage to selected individuals or commercial enterprises or for other unintended purposes. Policy development at the international, federal, state and local levels to regulate access and dissemination of such imagery would be a necessary component of any law enforcement satellite imaging consortium.

The most likely mid-range future use of satellite imagery by law enforcement would be as subscribers of commercially available imagery. As detailed in Chapter I of this project, such technology is currently available and has been used in limited law enforcement applications. The most obvious use for this technology would involve enforcement of laws concerning management of resources such as water use, illegal mining operations, farming regulation and in management of ecologically protected areas. Another use would be in building code enforcement where un-permitted structures have been built or existing structures modified. With the proliferation of illicit methamphetamine super-labs in the Southwest desert areas and growing of marijuana crops in the Northwest,

use of this technology could also prove useful in the enforcement of narcotics laws.

Another major use for this technology for law enforcement is for tactical planning and emergency preparedness. While many agencies use aerial photography of one type or another to plan for tactical missions, agencies that do not have this capability could be well-served by satellite imaging technology. Also, imaging satellites have the ability to scan large areas with greater detail than is possible using most law enforcement aircraft. Satellite imaging could become very important for agencies with a large jurisdictional service area.

Satellite imagery is much more effective that two-dimensional mapping because of its three-dimensional properties. In terms of emergency preparedness, having imagery of terrain can help agencies avoid obstacles to movement of logistics and could make the difference between life and death in search and rescue missions.

As the private sector increases use of satellite imaging for profit, the probability that an archived image would assist in the investigation of criminal incident also increases. It is likely that private satellite image providers will routinely make available date, time and location information regarding recently obtained images to federal, state and local law enforcement so that investigators may order images when appropriate for the investigation of unsolved crimes.

Since subscription to satellite imagery providers appears to be the most likely mid-term course of action for law enforcement, a strategic plan for use of this technology is also limited, due to the fact that the technology necessarily

resides outside of the realm of law enforcement. It is likely, however, that as increased use of satellite images by law enforcement occurs, private providers will begin to custom tailor products to meet the needs of law enforcement.

If law enforcement chief executives become increasingly convinced of the value of satellite imaging technology and if use by law enforcement agencies begins to accelerate, it is anticipated that individual agencies will develop strategic plans for incorporation of this technology. An outline for a strategic plan for the incorporation of commercial satellite imagery by law enforcement is provided as follows:

1. Scanning of available imagery providers, products and costs;
2. Development of policy and protocols for use of this technology;
3. Education and training regarding the use of imaging technology;
4. Assessment of effectiveness of satellite imaging technology and fiscal impacts of widespread use;
5. Recommendations for further development and application of this technology for law enforcement use.

It is recommended that a cross-functional departmental team be assembled to investigate and, if desired, develop a strategic plan for the use of satellite imagery. The cross-functional team should contain personnel with expertise in emergency preparedness, tactical operations, criminal investigations including environmental law enforcement, information technology, forensic evidence and budgetary planning. A representative from the agency's criminal prosecutor's office is also recommended.

This cross-functional team should survey availability of image providers and other agencies' practices to develop a cost-benefit analysis for proposed implementation of this technology. If the scanning process reveals that the agency could potentially benefit from use of satellite imaging technology, policy and protocols should be developed to ensure effective use of this technology and that no legal or ethical abuses occur.

A training cadre should then be formed that includes representatives from satellite image providers. Training on the incorporation of this technology into various areas of the agency should then be provided on a department-wide basis. A trial program could then be initiated with strict limitations on cost so that use of this technology could be assessed within acceptable fiscal constraints.

Finally, the cross-functional team should develop a mechanism to evaluate the level of success of the use of satellite imaging technology and contrast the benefits to the fiscal burden encumbered by such use. If necessary, recommendations should be made to adequately increase the agency's budget to continue use of satellite imaging technology.

As for transition management for incorporation of commercially provided satellite imaging into the organization, just as with a proprietary law enforcement satellite system, it is anticipated that there would not be significant work-load impacts, cultural shifts or other major organizational changes that would occur.

In Chapter III, two divergent paths for law enforcement use of satellite imaging were presented. One path involves the creation of a proprietary law enforcement satellite network. The other path involves the use of commercial

satellite imagery for law enforcement purposes. With these paths in mind, strategic plans and transitional management strategies were offered so that leaders in law enforcement might be better able to participate in the creation of a desirable future in which satellite imaging fills a vital niche.

The next chapter will revisit questions presented at the outset of this project and offer concluding remarks.

Chapter IV – Conclusion

Leading Change

In the process of transformation, people and their organizations live with a high degree of ambiguity. Innovation upsets the stability organizations work hard to establish; it throws off the organization's equilibrium. As Meg Wheatley points out in *Leadership and the New* Science, "The things we fear most in organizations – fluctuations, disturbances, imbalances" – are also the primary sources of creativity.[44] As law enforcement agencies move into an age where satellite imaging becomes increasingly available, leadership, rather than bureaucracy, will be required to incorporate this technology into meaningful service for the nation's citizens. One of the most glaring differences between the leader and the bureaucrat is the leader's inclination to encourage risk taking; to encourage others to step out into the unknown rather than play it safe.[45]

For a law enforcement agency to move from the traditional to the innovative, leadership must exist. Leaders in an organization challenge the process, inspire a shared vision, enable others to act, model the way and encourage the heart.[46] In the case of satellite imaging technology, because law enforcement application is so new, the leader advocating use of this technology is likely to be viewed by more traditional practitioners, as a crackpot. But, imagine for a moment if there had been a satellite image available which showed the area around Nicole Brown Simpson's condominium on the night of her murder. That one event might have

changed forever the application of satellite imaging technology by American law enforcement.

As stated earlier in this project, the most likely course of development for law enforcement application of satellite imaging technology will be the use of commercially obtained images on a case-by-case basis. Achieving this level of incorporation in an agency does not require risky beyond-the-nine-dots leadership by law enforcement leaders. But, the course of this emerging technology is all but certain; greater application of satellite imaging technology may be just over the horizon or the fiscal risks may prove too great. Technological breakthroughs, catastrophic events or even failures of commercial satellite ventures could dramatically alter the future of satellite imaging for law enforcement.

If, as a result of these events, law enforcement finds it beneficial to form an international consortium for the development and deployment of proprietary satellites, tremendous opportunities for leadership will result. The local law enforcement advocate of such technology may find himself or herself at the core of an international effort to create a safer society.

Review

In the introduction of this paper, several questions were posed relating to satellite imaging technology. Throughout the text of this paper the answers to these questions have been developed. By way of review, these questions are now posed again with brief summary responses.

- Is it possible to launch a network of satellites that will give sub-one meter resolution, real-time surveillance capability above a major population center of the United States? Yes, but the cost and limitations of current LEO satellites make this impractical for the foreseeable future.
- If real-time satellite surveillance is possible, can orbits of satellites be designed so that law enforcement agencies in major population centers throughout the world will find it feasible to form consortiums to share the cost of launching and maintaining such networks? An international consortium of law enforcement agencies could put a network of proprietary law enforcement satellites into orbit to serve major population centers. However constant, real-time surveillance of major population centers is not feasible at this time.
- Is geostationary satellite surveillance of benefit to law enforcement agencies? Geostationary satellites would offer resource evaluation, weather prediction, mapping and communications benefits to law enforcement. It is not feasible at the present time to provide one meter imaging capability from a geostationary satellite.
- Will the law enforcement use of satellite surveillance images be driven by increasing availability and application of this technology by the private sector? Private-sector satellite companies are increasing high-resolution imaging capability. Marketing their products to various

corporations as well as to governmental entities and law enforcement presents an opportunity for profit. If their products prove useful to law enforcement, increased use will result.

- Does the private sector have the ability to archive satellite images as their satellites regularly pass over a given area? If so, can law enforcement routinely access such images to assist in solving crimes which have already occurred? Archived images are provided by several satellite imagery companies. The timeliness of these archived images will undoubtedly continue to improve as greater imaging capability is achieved. It would appear reasonable that in the near future, law enforcement will be able to routinely search for images from recent timeframes as a crime solving tool. However, image resolution is directly related to the area being observed – the larger the area, the poorer the resolution.
- Can American law enforcement requisition satellite surveillance images without a court order or other legal process as an adjunct to a criminal investigation? While there is not specific case law on this subject, it appears likely that satellite surveillance images will be treated like surveillance images from other sources (aircraft and ground units). Typically if an image is to be obtained for the purpose of seeing into the curtilage of a dwelling that cannot be viewed from a public area, a search warrant may be necessary. If seeing into

private areas is incidental to viewing public areas and open lands, a search warrant would not be necessary.

- Can satellite surveillance imagery be used to assist with emergency preparedness, warrant service planning and other public safety issues? Yes. Probably the most tangible law enforcement use of satellite imagery is for emergency preparedness, search and rescue, and tactical operation planning purposes. The three-dimensional perspective of satellite imaging is far superior to two dimensional maps, charts or drawings.

In conclusion, non-military satellite imaging technology is in a state of rapid progress. Just as with computerization, private databases and less lethal weaponry, the progress of this technology is being driven by the private sector. While fantastic capabilities are available in military satellite technology, real-time constant satellite surveillance is not in the realm of possibility in the near future for American law enforcement.

Despite this fact, police agencies, as consumers of commercial or proprietary satellite imagery, will undoubtedly find myriad applications for this technology. As satellite imaging evolves into new applications, it is only a matter of time before a police agency solves a major crime through the use of satellite imagery.

Appendix 1

Nominal Group Technique Panelists:

- Bill Bennett, Suncrest Trading, Inc. – Mr. Bennett oversees a large international exporting company and is active in local service clubs and philanthropic organizations.
- Walter Calles, Information Specialist, Glendale Police Department –Mr. Calles manages various computer systems for the Department and is an expert in law enforcement information systems.
- David Fortune, Fortune & Associates – Mr. Fortune owns a financial consulting firm and is active in a local service club.
- Rasmik Gregorian, Chair Glendale Human Relations Coalition, Hate Crimes Subcommittee – Mr. Gregorian runs a local real estate business, and is knowledgeable in Armenian-American issues.
- Carmen Merino, Senior Assistant City Attorney, City of Glendale – Ms. Merino is certified to practice before the U.S. Supreme Court and is an expert on law enforcement civil liability issues.
- Lieutenant Gary Montecuollo, Glendale Police Department – Lieutenant Montecuollo is a watch commander and formerly supervised the Department's street gang enforcement unit.
- Captain Michael Post, Glendale Police Department – Captain Post oversees the investigative services division of the Department and is a Command College graduate.

- Leslyn Ray, Manager,Giggles Nightclub – Ms. Ray manages a large restaurant and dance club and is president of the Glendale Downtown Merchants Association.
- Connie Toomey, Glendale Memorial Hospital and Health Center – Ms. Toomey is in charge of community outreach for one of the nation's top 100 hospitals.
- Chuck Wike, Administrator, Glendale Public Library – Mr. Wike is in charge of the special reference section of the Glendale Main Library.

Appendix 2

Trends from NGT panel of November 7, 2001:

- Number of dangerous suspects arrested through the use of satellite photos.
- Successive Supreme Court rulings limiting the use of satellite images.
- Level of tolerance for governmental intrusion into citizens' lives.
- Level of unemployment due to monitoring jobs for satellite surveillance.
- Level of local crime due to implementation of satellite surveillance.
- Level of recruitment numbers due to specialization required by implementation of law enforcement satellite surveillance.
- Level of trickle-down uses of law-enforcement satellites for humanitarian uses such as agriculture and ecology.
- Level of data surveillance as opposed to optical surveillance.
- Level of law enforcement international cooperation and cost-sharing due to satellite surveillance.
- Level of criminal sophistication due to satellite surveillance.
- Level of illegal immigrants due to law enforcement satellite surveillance.
- Level of bioterrorism incidents due to law enforcement satellite surveillance
- Level of preparation by the health care industry due to law enforcement satellite surveillance
- Level of public education effected through the use of surveillance satellites.

- Level of social program sacrifice due to cost of law enforcement satellite surveillance technology.
- Impact on environment due to increasing numbers of satellites.
- Number of persons in prison due to satellite surveillance prisoner tracking capabilities.
- Number of private sector satellite surveillance providers effect on satellite use by the general public
- Level of satellite surveillance use in civil litigation (workers' compensation, excessive force, etc.) The satellite as independent witness.
- Development of an entirely new culture due to constant government satellite surveillance. A whole new society develops because there is "always a picture."
- Level of law enforcement costs due to satellite surveillance.

Appendix 3

Events from NGT panel of November 7, 2001:

- A world-wide consortium of police agencies launches a “real-time” satellite network.
- Immediate response to a criminal act is achieved through satellite surveillance.
- A solar flare destroys 90% of all earth orbit satellites.
- Introduction of nationwide satellite-based tracking of sex offenders.
- Implementation of a nationwide all-wireless personal communications system.
- A criminal group adapts to satellite surveillance, defeating the system of satellites.
- A Supreme Court ruling interpreting the 4th Amendment as strictly prohibiting the law enforcement use of satellite images.
- A technological breakthrough allows for satellite control of automatically driven cars for the handicapped.
- A system is developed that allows for persons (children, spouse, etc.) to be tracked by satellites.
- A major postal strike occurs due to safety issues which has a profound effect on domestic use of satellite surveillance images.
- Satellite surveillance is coupled with less-lethal weapons systems for local law enforcement.

- A law is passed which mandates implantation of satellite tracking chips on all convicted felons.
- A system is developed to track all visa entrants to the U.S. by satellite.
- The U.S. government abuses use of satellite surveillance images.
- Hackers break into the satellite surveillance system, using the images to further criminal interests.
- A system is developed which automatically downloads satellite images to insurance companies whenever a collision occurs.
- A satellite-based system is developed to effect house arrest of convicted offenders.
- The news media launches a satellite surveillance system rendering media helicopters obsolete.
- A second September 11th incident occurs.
- A satellite “virus” infects the law enforcement surveillance network.
- A system is developed which allows for streaming video images from satellites.

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