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ANALYSIS OF THE POSSIBILITY OF MILITARY APPLICATIONS OF CIVILIAN REMOTE SENSING SATELLITE IMAGERY

by

Wang Jingquan

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Analysis of the Possibility of Military Applications of Civilian Remote Sensing Satellite Imagery

Author: Wang Jingquan

With the end of the Cold War and the changing of the world order, the market for civilian remote sensing satellite imagery is taking shape and expanding. More and more civilian remote sensing reconnaissance-grade satellite systems are going into service one after the other. Exchanges of satellite reconnaissance information among nations are increasing daily. There seems to be a trend towards commercialization and internationalization of satellite reconnaissance.

The Possibility of of the Civilian Remote Sensing Satellite Imagery Market Entering Military Applications

The remote sensing satellite imagery the United States originally brought to market was primarily 80-meter and 30-meter resolution Earthsat imagery. The United States government had always prohibited the sale of satellite imagery with resolution better than 10 meters, and the United States and France signed an agreement not to put imagery with resolution better than five meters on the market. However, faced with the grim situation of more and more countries attempting to elbow their way into the future satellite remote sensing market, and under heavy pressure from domestic industries demanding a green light for high-resolution imagery, the Clinton administration issued a new policy on commercial exchange of high-resolution space-based remote sensing imagery. According to this policy, if American companies apply to the Commerce Department and receive a permit, they can manufacture and manage high-resolution remote sensing satellites and sell their imagery domestically and abroad. If they apply to the State Department and receive a permit, they can conditionally provide high-resolution remote sensing satellite systems to foreign countries. The United States government hopes that this new policy will encourage businesses to take the lead in dominating the world's high-resolution remote sensing satellite imagery market. "High resolution" primarily refers to target resolution ability equal to or better than one meter. According to experience from the Gulf War, this kind of imagery data can better fulfill battlefield requirements.

At the end of the 1980s, the former Soviet Union openly sold five-meter resolution satellite photographs. Later, Russia sold two-meter resolution pictures on the international market. Not only did the pictures have the highest resolution, they also had low prices, between U.S. $1000.00 and $5000.00 per picture. The most common unit price was $1250.00, but sales were poor, mostly because the images that were delivered were not timely.

France also plans to change its practice of limiting the highest resolution of its civilian remote sensing satellites to five meters. In the wake of excellent sales on the international market of 10-meter resolution panchromatic images and 20-meter resolution multispectral images from its first-generation SPOT satellites, France will launch its second-generation SPOT-5 satellites in the year 2000. The resolutions of its panchromatic images and multispectral images will be raised to five and 10 meters, respectively.

Japan is developing a high-resolution observation satellite (Hiros) which will have 2.5-meter panchromatic resolution and 10-meter multispectral resolution capabilities. The small 325-kilogram Greensat remote sensing satellite which South Africa plans to launch in 1995 will carry a 1.5-meter resolution CCD [charge coupled device] visible light camera and a 16.25-meter resolution CCD dual spectrum band camera. Germany is also developing an imaging satellite system with resolution between one and two meters. Nations and regions which are developing their own systems or intend to buy foreign satellite pictures include Israel, the United Arab Emirates, Kuwait, Saudi Arabia, [North and South] Korea, India, Turkey, Spain, and Taiwan.

Movement of Civilian Satellite Remote Sensing Into the Military Field

1. The United States

• World Observation Imagery, Inc.: Received approval from the Commerce Department to get a permit for a three-meter resolution panchromatic image and 15-meter resolution multispectral image satellite system at the beginning of 1993. In 1995, this company launched a satellite and began to design a one-meter resolution satellite system.

• Lockheed: Sent in an application on June 10, 1993 and received a permit to build and manage the one-meter resolution Commercial Remote Sensing Satellite System (CRSS) on April 22, 1994. In May 1994, it established Space Imagery, Incorporated (SII) as a subsidiary company to concretely implement this project, and spent between 400 and 500 million dollars

to develop the reconnaissance CRSS. This system can provide one-meter resolution panchromatic images and four-meter resolution multispectral images. A single satellite can revisit any point on earth in a period of one to two days. In 1997, Lockheed will begin to launch satellites, and its goal is to take hold of 20 to 30 percent of the space imagery market within two years after the launches.

• Eyeglass International, Inc.: Made an application in November, 1993 and received a permit on May 6, 1994. Eyeglass global imagery information system satellites weigh 680 kilograms, have a resolution of one meter, can take photographs to the front, back, left, and right at 45 degree inclinations, and can capture stereoscopic images in a single pass. Their on-board recording storage capacity is 60 images, and their repeat observation period for any point on earth is two days. The first satellite will be launched at the beginning of 1997, and following satellites will be equipped with either multispectral imaging instruments with better than 15-meter resolution or synthetic aperture radar.

• Bauer Astronavigation Communication, Inc.: Plans to begin using two small satellites

to set up a system with one-meter resolution panchromatic imagery and five-meter resolution color imagery.

Other companies are also focusing on this kind of system, because they believe that it has good commercial, military, and international market prospects.

2. Russia

In order to capture a larger market share, Russia will take two new actions. It will openly sell satellite images with 0.75-meter resolution and develop a real-time CCD transmission satellite with greater than five-meter resolution, in an attempt to beat SPOT to the market.

3. France

To compete with Russia and the United States, France's Matra Marconi Aerospace Company is preparing to use Helios reconnaissance satellite technology and manufacture new

commercial remote sensing satellites with resolution of one meter. The Pluto X-band synthetic aperture radar satellite in this program has between three- and five-meter resolution.

International Industry Is Trying to Make Civilian Remote Sensing Satellite Systems Fit Military Demands

The declassification of American and Russian reconnaissance satellite imagery is giving rise to large-scale international traffic in satellite remote sensing data, presaging the expanding and shaping of a large international market and implying that future military applications of satellite reconnaissance will make extensive use of resources from the commercial remote sensing satellite market. This is one of the reasons why no plans for new replacement models of reconnaissance imagery satellites have appeared since the Gulf War.

But civilian satellite remote sensing imagery must better conform to military applications, and there are still some major problems that remain to be solved.

There are no special demands for rapid processing and delivery of satellite imagery in scientific and commercial applications of satellite remote sensing, but these are the most important demands for military applications. Short imagery data delivery time coupled with simple processing should be able to satisfy tactical demands on the battlefield. Since the Australia Remote Sensing Center installed a new model supercomputer in the latter half of 1992, it only takes 2.5 minutes to obtain 62-square nautical mile, 20-meter resolution radar images from European Remote Sensing Satellite (ERS) or Japan Earth Remote Sensing Satellite (JERS) data, whereas it used to take eight hours to obtain these results.

Since the Norway Earth Station adopted high-speed processors and distributed structures, it can process ERS-1 data and use ordinary telephone lines to transmit 100-meter resolution imagery to terminal users within two hours of receiving satellite information. If telephone line capacity satisfies requirements, it is no problem to process 20-meter resolution imagery within the same amount of time.

A short repeat observation period is an important indicator of enhanced timeliness of satellites. The ability to obtain an image of the enemy situation every two to three days, rather than every two to three weeks, is of key importance, especially to battlefield commanders. To shorten the repeat observation period, it is necessary to enhance the image swath width of each

pass. By adopting directional reflectors (to cause the satellite remote sensor to oscillate), and giving satellites the side-looking capability that SPOT and ERS have, observation swath width can be widened by a great margin, thus making the repeat observation period only one to four days. This is much shorter than the 16 days required by Earthsat. Solution of these problems can improve the applicability of civilian remote sensing satellites to military affairs.

Moreover, the United States is making major purchases of Russian military satellite remote sensing images. This is an economical, simple method to obtain high-resolution images. The United States has already acquired Russian fifth-generation two-meter resolution images transmitted from reconnaissance satellites. The next step is to purchase Russian fourth-generation (recoverable) satellites, which will be launched by Russia. After recovery, the photographs will be handed over to the United States Air Force. In this way, each satellite will only cost three million dollars. If Russia launches two to three of these satellites per year, the United States will be able to save hundreds of millions of dollars. The United States Air Force is also studying ways to use its Eagle Vision receiving station to directly receive five-meter resolution remote sensing satellite images from new satellites Russia will launch at the end of the 1990s.