II 1.4 Remote Sensing Satellite Systems

Space-based Earth imaging can be divided into two technological categories

- Optical Imaging
- Synthetic Aperture Radar imaging

A remote sensing system is composed of

- A telemetry and control station;
- Several ground receiving stations scattered around the planet;
- A satellite in Low Earth Orbit;
- Data interpretation centre.

The telemetry and control centre is usually located within the national boundaries of the state that licences the operator of the satellite system. At this point there is both an uplink to control the space asset and a downlink to receive data. It is at this point where the satellite tasking occurs, determining what will be sensed. Due to operational contingencies remote sensing satellites have a relatively small capacity to store data, thus the need for several ground stations around the planet. These ground stations typically do not have an uplink capacity and are used exclusively to receive data through a downlink. For example, the North American ground stations for RADARSAT are located in Prince Albert, Saskatchewan, Gatineau, Quebec, and Fairbanks Alaska. Certified RADARSAT foreign stations are located in the United Kingdom, Norway, Singapore, China, Australia, South Korea, Japan, Saudi Arabia, Puerto Rico, and Thailand. The telemetry and control for RADARSAT is located at the Canadian Space Agency in St-Hubert, Quebec. It is important to note that ground-receiving stations need not be fixed. For example, during the Maritime Combined Operational Training (MARCOT) – UNIFIED SPIRIT 1998, a large NATO training exercise, a mobile ground receiving station was used to receive and process RADARSAT data for military use in real time.

Remote sensing satellites are placed in polar Low Earth Orbits. For example, RADARSAT is in a near-polar sun-synchronous orbit at an altitude of 798 km with an orbital plane inclination of 98.6 degrees. RADARSAT completes 14 orbits every 24 hours, each orbit lasting approximately 100.7 minutes. RADARSAT can obtain 28 minutes of data per orbit.

II 1.5 Military Satellite Systems

Military satellites have a similar architecture to that of civilian satellites, namely a ground segment, a space segment and the uplink-downlink segment. The space segment may differ in that the satellite is most probably hardened against electro-magnetic pulse weapons. The applications are the same although the vocabulary may change. Military telecommunications satellites may be also referred to as command and control; remote-sensing satellites may be referred to as reconnaissance, espionage, or intelligence satellites[68]. Examples of military space products include high-resolution earth imagery, target indicators, maps and Digital Terrain Elevation Data (DTED)[69]. It is important to note that the GPS is a military asset, being the property of the USAFA. Furthermore, in the United States, a 1994 Presidential Decision Directive converged existing Air Force, NASA, and NOAA polar orbiting satellites into an integrated national program[70].

II 2. Anti-Satellite Capabilities (ASAT)

There are no reported cases of use of ASAT weapons during international conflict[71]. Nonetheless ASAT technology has been tested. On September 13th 1985, USAF pilot Major Doug Pearson made military history. From his F-15A flying at Mach1.22 200 miles west of Vandenberg AFB, he executed a 3.8 g 65 degree climb to launch a missile, which destroyed a satellite called P78-1[72]. The target satellite

[68] These may also include Signals Intelligence satellites which detect transmissions www.fas SIGINT overview.
[69] See Department of defense Space Technology Guide FY 2000-01 available at http://fas.org/spp/military/myer.pdf, p. 56.
[70] PRESIDENTIAL DECISION DIRECTIVE/NSTC-2. See http://www.ipo.noaa.gov/About/NSTC-2.html
[71] See I.A. Vlasic, "Space Law and the Military Application of Space Technology" in *Perspectives on International Law* (London: Klewer Law International 1995) at 397-98.
[72] www.edwards.af.mil/moments/docs, 'The ASAT missile was nearly 18 feet in length and weighed 2700 lbs.... The delivery aircraft was launched into an area below the path of the oncoming target satellite. Pulling up into a deep climb, the F-15 would release the weapon into a small launch window...the homing vehicle would vector itself directly into the target's path and destroy it by smashing directly into it. At the extremely high closing speed of the two objects, no explosives would be necessary."