large objects reenter the atmosphere quickly due to air drag; the lifetimes of the first three "Big Birds" were 52, 40 and 68 days respectively, while the USSR's equivalent spacecraft lasted an average of two weeks each! Consequently the USSR launched 395 surveillance satellites between 1960 and 1977, while the US launched 227.[2] It was after the July 1966 launch of the KEYHOLE-8 (KH-8) "close-look" inspection satellite, that the US reportedly believed its photographic images were sharp enough to consider the possibility of monitoring arms agreements. In December 1976 the US's first electronic-imaging photo-reconnaissance satellite, KH-11, was launched. It was also the first to transmit its images to earth by digital telemetry and its orbit could be adjusted using an on-board propulsion system. Consequently the satellite's lifetime was dramatically improved, with some KH-11's lasting for over two years.

Throughout the 1970's and up until the recent Shuttle and Titan losses, the US continued launching Big Bird and KH-11 satellites. During the same period the "Rhyolite" and "Chalet" series of geostationary satellites for intercepting communications also became operational.[4] The US may currently be flying spacecraft with high-resolution imaging radars, as part of the "Clipper Bow" programme, which was reported to have begun in 1983[5], although this has not been confirmed.[4] The next generation surveillance satellite is KH-12, which is so large it will fill the entire Space Shuttle. It will have both close-look and area-surveillance capabilities, and it will also carry infrared imaging instruments.[4]

During the 1970's the USSR reportedly used surveillance satellites which returned film to the earth, however they are currently using electronic imaging with signals that are digitally transmitted to earth. In addition, the USSR has two constellations of communications-interception satellites, operating in near-earth orbits.[4]

For civilian applications, the US developed the Earth Resources Technology Satellite (ERTS) in the late 1960's, and in 1972 the first ERTS satellite, renamed "Landsat", was launched.[1,6] This was the beginning of a very successful programme that today provides information to subscribers in many countries. Seasat, launched in 1978, demonstrated the potential for oceanographic imaging radar. The USSR's nuclear powered Kosmos 954, which broke up over Canada in January 1978, was also equipped with an ocean-imaging radar.[5] The most recent remote sensing system is France's "Système Probatoire d'Observation de la Terre" (SPOT) which was launched in February 1986 and is now providing the highest resolution imagery available commercially.[6,7]

CANADIAN SPACE TECHNOLOGY

On 28 September 1962, a US Thor-Agena rocket launched a Canadian satellite from Vandenberg, California. Canada became the third nation into space, after the USSR and the US. The first four Alouette and ISIS satellites were used for scientific research. They featured radar-like instruments called "topside sounders" to study the physics of the radio ionosphere. Canadian capability in space technology subsequently flourished through the 1970's and 80's, within both government and a maturing private sector high-tech industry. Preceded by work under the Department of National Defence (DND), the Department of Communications (DOC) developed communications satellite technology and Canada became a world leader. Telesat Canada began operating the world's first domestic system in January 1973 with the launch of ANIK A. During this same period, Canada's National Research Council (NRC) fostered the development of Canadian space science instruments, the Canadarm, our astronaut programme and our current role in the US Space station.[8] Canadian universities, such as York, Calgary and Saskatchewan developed space science excellence, but, as part of NATO and NORAD, Canada relied on US satellites for surveillance and early warning.

An active Canadian remote sensing community also developed during this time, spawned by the needs of a large land, rich in resources. In May 1971 Canada and the US began a cooperative programme using aircraft, and subsequently spacecraft, for remote sensing. Within government, the Canada Centre for Remote Sensing (CCRS)—part of the Department of Energy, Mines and Resources—fostered the development of remote sensing technology and promoted the growth of the industry in four areas: instrument development, surveying, ground processing of data and application of remote sensing to diverse economic sectors. Today Canadian products, particularly image processing systems, are sold throughout the world and the Canadian Remote Sensing Society is an internationally recognized organization with over 600 members.

There is no inherent difference between national security surveillance technology and remote sensing technology. The types of instruments, the design principles and many of the components are identical. The differences are of degree: surveillance programmes generally require higher resolution, the instruments are often physically larger and they require more electrical power and larger launch vehicles. For surveillance missions the ground processing and data analysis can require more labour and equipment, and the required "turn-around"