four band multispectral scanner covering the visible light regions plus a newer type of MSS instrument, called a "Thematic Mapper" which is specifically designed to highlight particular classes of target, such as crops, forests, etc. Landsat's MSS resolution reportedly could have been better, but the Pentagon imposed restrictions on NASA.[4]

France's SPOT was conceived as a commercial venture from its start, following an initial non-recoverable investment from the government.[7] SPOT provides higher ground resolution than Landsat and its two MSSs are able to pivot to point sideways. SPOT can therefore produce stereoscopic images of targets, but it lacks Landsat-D's spectral range. Planning is underway for improved SPOT satellites, and depending on the commercial success of the venture, these spacecraft should be in orbit in the early 1990's. For verification purposes, it is significant that SPOT and Landsat data are available to anyone in the world.

Table 4 details the characteristics of the instruments on these two satellites:[1,6]

TABLE 4 Satellites with Multispectral Scanners

Mission	*Instrument Characteristics*
EOSAT's Landsat D in a 700 kilometre, circular, near-polar orbit; launched in March 1984 (two instruments)	Four band MSS, covering 0.5 micrometres to 1.1 micrometres, with a ground resolution of 80 metres; and Thematic Mapper, which is a seven-band MSS ranging from 0.45 micrometres to 2.35 micrometres, with a ground resolution of 30 metres
France's SPOT in an 832 kilometre, near-polar orbit; launched in Feb. 1986	Three band instrument covering the visible light regions from 0.51 to 0.89 micrometres, two MSSs, 20 metre resolution for multi-spectral imagery and 10 metre resolution for black/white imagery

Canada has developed a number of airborne scanners. For example, CCRS contracted development of the Multidetector Electro-optical Imaging Scanner (MEIS) which, using 1728 discrete detector elements, each with its own lens, has provided one metre resolution over a range of eight spectral bands.[15] Furthermore, the Department of Fisheries and Oceanography contracted the design and construction of a Fluorescent Line Imager (FLI) which is currently being used to determine plankton concentrations. The airborne FLI is planned to be a forerunner of a space borne version.

Laser Instruments

Lasers are active instruments which produce a narrow beam of coherent light, usually in the visible region, though there are ultraviolet and infrared lasers. One of the advantages is that laser light has minimum dispersion, so an emitted beam remains thin throughout its journey. LIDARs ("Light Detection and Ranging") are laser instruments used for depth profiling and altimetry.[6]

Canadian industry is world class in certain areas, particularly commercial and research CO_2 lasers and airborne Lidars. A Canadian firm developed a laser bathymeter, which is currently being used to map the precise depths of our inland and coastal waters. Laser altimeters have also been developed. Laser research has been done by Canadian government research laboratories such as NRC and the Department of National Defence (DND) laboratories.

Infrared (IR) Region Instruments

Infrared detectors and imagers have wide application in verification. They can be used day or night. The US (and presumably the USSR) use them for military surveillance since, more than any other sensor, they identify a process as well as an object. Thus an aircraft or missile in flight, a moving land vehicle, a moving ship—anything that emits significant heat—may be observed with an infrared sensor. NASA's Heat Capacity Mapping Mission (HCMM) satellite was launched in April 1978, and from a 620 kilometre orbit its (non-imaging) Infrared Mapping Radiometer provided approximately 600 metre resolution, utilizing solely the motion of the spacecraft.[1] Since then spacecraft imaging infrared detectors have been developed which provide much better resolution. One aspect of these instruments is that the detector element has to be maintained at cryogenic temperatures so that it doesn't respond to its own heat instead of the target. Canada has not flown spaceborne infrared instruments, but has used them extensively for airborne surveillance of buildings and processes. Several Canadian firms design and build high quality airborne infrared instruments and one aerospace firm is a major supplier of military infrared sensors for shipboard use.

Ultraviolet (UV) Instruments

These instruments have limited application for a surveillance mission because the shorter UV waves are absorbed by the earth's atmosphere. However certain physical processes emit UV in the longer wavelength "windows" and these can be detected. Canada has built ground based UV instruments, for example at the University of Saskatchewan, and as mentioned Canadian industry developed the highly successful UV cameras for Sweden's Viking spacecraft.