

*Comparison of Spaceborne, Airborne and
Ground-based Surveillance*

The Strengths and Weaknesses of Satellite Surveillance

For the purpose of conducting surveillance of a particular area, large but nevertheless limited, of the earth, such as the territories of and approaches to Canada, a satellite in a highly inclined low-earth orbit has the important attraction of its high speed (about 450 kilometres per minute). Another very significant asset is the enormous field of view available from the great altitude. Of particular importance for reconnaissance activities is the fact that a satellite does not impinge on sovereign airspace.

A satellite also has a number of important limitations. A satellite in a 90° circular polar orbit will spend only 40/180 of its time between latitudes 42°N and 82°N, i.e., about 22 %, and the extreme longitudes of Canada, 54°W and 141°W, occupy only 87/360 of all the latitudes. Thus the satellite spends only $40/180 \times 87/360$, (i.e. less than 5.4 %) of its time within the limits of latitude and longitude occupied by Canadian territory. This fraction can be increased by choosing a slightly different inclination, but will not attain 7% if the orbit is to reach as far north as 82°N. Of course if it is desired to survey large areas covering the approaches to Canada then this useful "duty cycle" will be correspondingly increased, but the satellite cannot spend more than about a quarter of its time at latitudes of interest to Canada, and most of this time will be at uninteresting longitudes.

A fundamental drawback of a satellite is that once launched its equipment cannot be replaced, adjusted, or repaired. (This could be changed if and when the space shuttle becomes fully operational, but the cost is likely to be very high).

Other serious problems for surveillance satellites are the lack of manoeuvrability, the distance from the surface of the earth, the difficulty of providing large amounts of electrical power, and the presence of the atmosphere. There will be no more than two