Chapter 1: Introduction

The problem of arms control and verification for space systems has many unique challenges. Developed nations, notably the superpowers, have come to rely on spaced-based systems for communications, surveillance, navigation, and many other uses. Satellite assets that provide or support strategic military functions are vulnerable to attack; as a consequence, anti-satellite (ASat) technology has been developed and demonstrated, and continues to progress. The real possibility of ASat spacecraft threatening valuable space assets further encourages the development of ASat technology for the purpose of active defense against attack; hence defensive anti-ASats or DSats.

To date, certain international agreements have attempted to limit the proliferation of weapons in space. The *Outer Space Treaty* of 1967 forbids the placing of weapons of mass destruction in space; this outlaws such space weapons as orbiting nuclear bombs. The *Anti-Ballistic Missile Treaty* (ABM Treaty) of 1972 restricts the development by the superpowers of both space-based and ground-based ABM systems — and bans their deployment. As many of the modern ASat technologies are nearly identical to ABM technologies, this treaty has effectively limited ASat development. At this moment, fortunately, space remains relatively weapon-free, due partly to these treaty impediments, and partly to the historical nondeployment of space-based ASat weapons and to their enormous development costs. The present challenge is not to control an arms race in space — it is to avoid one.

This paper is divided into three principle parts. Part I reviews the broad spectrum of space operations in which current satellites are engaged and extrapolates to the much broader spectrum of operations that could conceivably be carried out by satellites of the early twenty-first century. Some of these involve "critical capabilities" that could potentially enable harm to be done to other satellites; others do not. Some of these (conceivable) future operations will, by definition, have harmful intent; others will not. When this multitude of possibilities is examined, it is found that, while certain space operations are clearly "weapon" and others are clearly "nonweapon," there is a substantial number that tend to be ambiguous: they may or may not be weapon operations. Twelve specific examples are given, and suggestions for disambiguating these operations are offered.

Part II contains a rigorous quantitative analysis of the harm that one particular satellite can do to another (at least potentially) once its key parameters and characteristics have been specified. A large number of methods (or "modes") of harm are defined. The potential harm from each is quantified; then, by superposition, the total possible harmfulness for that particular satellite can be calculated.