

Appendix B

Glossary

Glossary of Acronyms and Abbreviations

ABM	—Anti-ballistic Missile	FLOPS	—Floating Point Operations per Second
ALS	—Advanced Launch System	FOC	—Full Operating Capability
AOA	—Airborne Optical Adjunct	FSED	—Full-scale Engineering Development
AOS	—Airborne Optical System	FTV	—Flight Test Vehicle; Functional Technical Validation
ASAT	—Anti-satellite Weapon	g	—Gram
ATA	—Advanced Test Accelerator	GBFEL	—Ground-based Free Electron Laser
ATH	—Above The Horizon (Sensor)	GOPS	—Billion (Giga-) Operations per Second
ATS	—Advanced Test Stand (particle beam accelerator)	GSTS	—Ground-based Surveillance and Tracking System (Pop-up Probe)
BM/C ³	—Battle Management/Command, Control, and Communications	HALO	—High Altitude Large Optics
BMD	—Ballistic Missile Defense	HEDI	—High Endo-atmospheric Defense Interceptor
BMEWS	—Ballistic Missile Early Warning System	HF	—Hydrogen Fluoride (Laser)
BSTS	—Boost Surveillance and Tracking System	HLLV	—Heavy Lift Launch Vehicle
CCD	—Charge-coupled Device	HOE	—Homing Overlay Experiment
CELV	—Complementary Expendable Launch Vehicle	IBC	—Impurity Band Conductor
	—Centimeter	ICBM	—Intercontinental Ballistic Missile
CONUS	—Continental United States	IOC	—Initial Operating Capability
cv	—Carrier Vehicle	ISAR	—Inverse Synthetic Aperture Radar
DANASAT	—Direct Ascent Nuclear Anti-satellite Weapon	J	—Joule
DANNASAT	—Direct Ascent Non-nuclear Anti-satellite Weapon	KEW	—Kinetic Energy Weapon
DARPA	—Defense Advanced Research Projects Agency	kg	—Kilogram
DEW	—Directed-Energy Weapon	kJ	—Kilojoule
DF	—Deuterium Fluoride (Laser)	KKV	—Kinetic Kill Vehicle
DIPS	—Dynamic Isotope Power System	km	—Kilometer
DoD	—Department of Defense	kW	—Kilowatt
DSAT	—Defensive Satellite Weapon	LAMP	—Large Advanced Mirror Program
DSP	—Defense Support Program (U.S. Military Satellite)	LCC	—Life Cycle Cost
DST	—Defense Suppression Threat	LEAP	—Lightweight Exe-atmospheric Advanced Projectiles
EML	—Electromagnetic Launcher	LOC	—Lines of Code
EMP	—Electromagnetic Pulse	LWIR	—Long-wave Infrared
ERINT	—Extended Range Interceptor	m	—Meter
ERIS	—Exe-atmospheric Re-entry Interceptor System	MaRV	—Maneuverable Reentry Vehicle
ETA	—Experimental Test Accelerator	MeV	—Million Electron Volts
eV	—Electron Volt	MHD	—Magnetohydrodynamics
FBB	—Fast-burn Booster	MIPS	—Million Instructions per Second
FEL	—Free Electron Laser	MIRACL	—Mid-infrared Advanced Chemical Laser
FLAGE	—Flexible, Lightweight, Agile, Guided Experiment	MIRV	—Multiple Independently-targetable Reentry Vehicle
FLIR	—Forward Looking Infrared (Sensor)	MOPS	—Million Operations per Second
		MOSFET	—Metallic Oxide Semiconductor Field Effect Transistor

MTBF	—Mean Time Between Failures
MTTR	—Mean Time to Repair
MW	—Megawatt
MW/sr	—Megawatts per Steradian
MWIR	—Medium-wave Infrared
Nd:YAG	—Neodymium Yttrium-Aluminum-Garnet (Laser)
NPB	—Neutral Particle Beam
NTB	—National Test Bed (for computer simulations)
PAR	—Phased-array Radar
PBV	—Post-boost Vehicle
RTG	—Radioisotope Thermal Generator
RV	—Reentry Vehicle
SBHEL	—Space-based High Energy Laser
SBI	—Space-based Interceptor
SBKKV	—Space-based Kinetic Kill Vehicle
SDI	—Strategic Defense Initiative
SDIO	—Strategic Defense Initiative Organization
SDS	—Strategic Defense System
SGEMP	—System-Generated Electromagnetic Pulse
SLBM	—Submarine-launched Ballistic Missile
SS-18, SS-19, SS-24, SS-25	—U.S. designators for various Soviet ICBMS
ss-20	—U.S. designator for a Soviet Medium Range Ballistic Missile
SSME	—Space Shuttle Main Engine
SSTS	—Space Surveillance and Tracking System
STAS	—Space Transportation Architecture Study
SWIR	—Short-wave Infrared
TDI	—Time Delay and Integrate (data processing technique for sensors)
TIR	—Terminal Imaging Radar
TREP	—Thrusted Replica (decoy)
UHF	—Ultra-high Frequency
UV	—Ultra-violet
VHSIC	—Very High Speed Integrated Circuitry
VLSI	—Very Large-Scale Integrated (Circuit)
w	—Watt
W/sr	—Watts per Steradian

Glossary of Terms

Ablative Shield: A shield that evaporates when heated, thereby absorbing energy and protecting the underlying structure from heat damage. Such shields are used to protect reentry vehicles from damage during atmospheric reentry. They could also be used to shield boosters against lasers.

Absentee Ratio: In a constellation of orbiting weapon platforms, the ratio of the number of platforms not in position to participate in a battle to the number that are. Typical absentee ratios for kinetic energy weapons systems are around 10 to 30, depending on details of the satellite orbits and the assumed battle.

Absorption Bands: Frequency ranges in the electromagnetic spectrum that are highly absorbed by the atmosphere, thus restricting transmission between Earth and space. Absorption bands of interest to BMD are found in the ultraviolet, the infrared, and at microwave frequencies.

Accelerator Test Stand (ATS): An accelerator at Los Alamos National Laboratory that is a prototype for a high intensity neutral particle beam accelerator.

Acquisition: The search for, detection of, and maintenance of contact with a potential target by the sensors of a weapon system.

Active Discrimination: The electromagnetic irradiation of a potential target in order to determine from the characteristics of the reflected radiation whether it is a threatening object or a decoy. Radar and laser radar (ladar) are examples of active discrimination tools.

Adaptive Preferential Defense: A BMD tactic designed to increase the value of the defense. The defense determines in the early mid-course phase of ballistic missile trajectories the intended target of each RV that has survived the first defensive layers. Those targets that the defense wishes to protect are defended by preferentially attacking those warheads aimed at these targets. To optimize the number of surviving targets, those that have the fewest warheads aimed at them are defended first.

Advanced Launch System (ALS): A rocket proposed for deployment in the mid-1990s that would have a large payload-to-orbit capacity (50 tonnes or more) and that would be the primary

- launch vehicle for deploying the thousands of tonnes required for an early deployment of the Strategic Defense System (q.v.).
- Advanced Test Accelerator (ATA):** A high-current 50 MeV accelerator at Lawrence Livermore National Laboratory that is being used for free electron laser experimentation and development.
- AEGIS:** The anti-missile system currently in use by the U.S. Navy, designed to defend carrier groups against attack by rockets, aircraft, or air-breathing missiles.
- Agility:** The ability of a pointing system for a sensor or a weapon to shift rapidly and accurately from one target to another.
- Air Defense Initiative (ADI):** A Department of Defense research program that is designed to counter air-breathing threats to the United States, such as aircraft and cruise missiles. Designed to supplement the SDI.
- Airborne Optical Adjunct (AOA):** An experimental aircraft with sensors being prepared for testing in the late 1980s as a part of the development program for the AOS.
- Airborne Optical System (AOS):** A set of optical elements mounted on aircraft and intended to provide tracking information on approaching warheads and decoys and then to hand off this information to the terminal phase of a missile defense system.
- Algorithm:** A precise description of a method for solving a particular problem, using operations or actions from a well-understood repertoire. (Definition by J. Shore)
- Alpha Laser:** A megawatt-class chemical laser being developed by TRW as a prototype for a space-based anti-missile laser weapon.
- Anti-ballistic Missile (ABM):** A missile designed to destroy a ballistic missile.
- Anti-satellite (ASAT) Weapon:** A weapon designed to destroy satellites.
- Anti-simulation:** The tactic of trying to disguise a military asset as a decoy.
- Architecture:** The overall design of a system: its elements, their functions, and their interrelationships.
- ARPA Network:** The computer network set up by the Department of Defense's Advanced Research Projects Agency to facilitate data and information exchange and thus to aid programming and research.
- Artificial Intelligence:** The ability of a computing system to learn from experience and to act in other ways indistinguishably from a sentient being.
- Atmospheric Compensation:** The physical distortion or modification of the components of an optical system for the purpose of compensating for the distortion of light waves as they pass through the atmosphere and the optical system.
- Atmospheric Heave:** Raising a large volume of the upper atmosphere to a substantially higher altitude (hundreds of kilometers) by means of a nuclear detonation within the atmosphere. This could have several different effects on the capability of a missile defense system: for example, nuclear background radiation problems could be substantially worsened for the defense and some directed-energy weapons could be partially neutralized; on the other hand, offensive decoys could become detectable and offensive targeting could become more difficult.
- Atmospheric Turbulence:** Variations in atmospheric density that cause small changes in refractivity of light that passes through the air. In the context of BMD sensors, turbulence causes distortions of plane wavefronts that could, if not compensated for, weaken the coherence and effectiveness of a high power laser beam.
- Ballistic Missile:** A rocket-driven missile that burns out relatively early in its trajectory and then follows a ballistic path in the Earth's gravitational field to its target.
- Ballistic Missile Defense (BMD):** A weapon system designed to destroy ballistic missiles or their warheads at any or all points in their trajectories, from launch until just before target impact.
- Battle Management:** The analysis of data on the state of a battle and decisions regarding weapon aiming and allocation. Subtasks include command and communication, kill assessment, maintaining knowledge of the state and positions of all elements of the defense system and calculation of target track files.
- Beam Control:** The system that maintains the desired pointing, tracking, and quality of a laser or particle beam.
- Beam Director:** A system that focuses and points a laser or particle beam in the desired direction.
- Beam Neutralizer:** Device located at the exit of a particle accelerator that neutralizes the charged

- ion beam in order to produce a neutral particle beam, usually by stripping off extra electrons (charged beams can be accelerated and focused by a particle accelerator while neutral beams cannot). The device may be a gas cell or foil or may utilize an appropriate laser beam.
- Bistatic Radar/Ladar:** Radar or ladar using transmitters and receivers separated by substantial distances. Reasons for separation may include enhanced survivability or the ability to overcome the countermeasure of retroreflectors.
- Blinding:** Destroying elements of an optical sensor by overloading them with radiation.
- Boost Phase:** The part of the trajectory of a ballistic missile during which the rocket booster fires. This phase lasts for about 3 to 5 minutes for current ICBMs.
- Booster:** The rocket that places a ballistic missile in its trajectory towards a target or that launches a satellite or space vehicle into orbit.
- Booster Clustering:** Locating boosters relatively near one another (within hundreds of kilometers) in order to force a space-based BMD to a higher absentee ratio and therefore to increase the required number of space-based interceptors.
- Booster Decoys:** Rockets that would imitate the early phase of booster plume and trajectory in order to draw fire from the defense, but that would not be armed intercontinental missiles and would cost substantially less than ICBMs.
- Bus:** The rocket-propelled final stage of an ICBM that, after booster burn-out, places warheads and, possibly, decoys on ballistic paths towards their targets. Also known as "post-boost vehicle" (PBV).
- Carrier Vehicle (CV):** A vehicle in Earth orbit that carries the space-based interceptors of a BMD. It may also carry some sensors.
- Chaff:** Small, light bits of matter deployed in quantity to confuse radar or ladar by scattering radiation and concealing targets.
- Charge-coupled Devices:** Solid state devices that convert photons of incoming electromagnetic radiation to electric charge, usually in a proportional manner. The charge is then detected by attached electronic circuits and the resulting information is analyzed to provide information about the original photons (direction of the source, wavelength, time distribution, number).
- Chemical Laser:** A laser that uses chemical reactions to pump energy into a lasing medium, thereby creating the inverted state population needed for lasing. An example of a high power chemical laser is the hydrogen fluoride laser, in which a hydrogen-fluorine reaction produces lasing in a hydrogen fluoride medium.
- Coherence:** The maintenance of constant phase relationships between adjacent rays of a beam of electromagnetic radiation. Coherent radiation is able to transfer energy much more efficiently and in a more collimated beam than is incoherent radiation. Laser light is coherent.
- Command Guidance:** The technique of remotely controlling the trajectory of a rocket.
- Complementary Expendable Launch Vehicle (CELV):** The Titan IV; a new U.S. rocket for launch-to-orbit, to become operational in the late 1980s and with a payload, to low-Earth orbits, of about 30,000 to 40,000 pounds.
- Compulsator:** A hollow-core generator able to produce large amounts of electrical energy, but substantially lighter than homopolar generators. It might be used to produce large currents suitable for electromagnetic guns.
- Computer Simulation:** The representation on a computer of a chain of physical events, using physical calculations. In the context of BMD, it will be attempted to reproduce, in computer memory and on screens, all aspects of a large engagement between a BMD system and the opposing offensive force. The behavior of all elements of both systems will presumably be included, as well as effects generated by nuclear explosions in space and in the atmosphere. The results of many such simulations are supposed to show the effectiveness, robustness, and survivability of the BMD system under various sets of assumptions.
- Constellation:** The number and orbital disposition of a set of space-based weapons forming part of a defensive system.
- Cost-effective at the margin:** In the context of BMD effectiveness, the requirement that each additional increment of defensive capability cost the defense less than each corresponding offensive increment deployed by the offense. In the context of survivability, it corresponds to the requirement that the incremental cost of defending one space asset be less expensive than the incremental cost of adding sufficient defense suppression capability to destroy that asset.
- Cost-exchange Ratio:** In the BMD context, the ratio of the cost of an item to the defense to the cost of an equal and opposing item to the offense. For example, the cost-exchange ratio of a terminal defense system would be the cost to the defense of the number of rockets (plus the pro-rated cost of support sensors) needed to kill one incom-

- ing warhead to the cost to the offense of putting that warhead and associated decoys in the terminal phase of flight.
- Countermeasure (Non-destructive and Defense Suppression):** A tactic used by the offense to oppose defensive measures or by the defense to oppose offensive measures. Non-destructive countermeasures are those that are intended to nullify the capability of the opposing system by means other than direct attack. Defense suppression countermeasures include means of attacking defensive system elements.
- Cryogenic cooler:** The equipment used to cool substances to very low temperatures.
- Dazzling:** The temporary blinding of a sensor by hostile incoming radiation (e.g., radiation from lasers, generators, nuclear explosions).
- Debris:** In the BMD context, large quantities of relatively small particles. Debris could be used as an intentional defense suppression measure; debris is also generated when objects in space are destroyed.
- Decoy:** An object intended to fool the adversary's sensors into thinking it is a more expensive and more threatening object. It could be a decoy re-entry vehicle, a decoy ASAT warhead, or a decoy satellite belonging either to the offense or defense.
- Defense Suppression:** Destroying the elements of a defensive system.
- Delta 160:** An experiment in September 1986 that successfully took some radar and infrared measurements in space as well as the coordination among a large number of individual elements in space and on the ground. See text for more detail.
- Detector:** A device that can sense and report on radiation originating from a remote object. Detectors for BMD purposes are usually sensitive to electromagnetic radiation, but some may be particle detectors, able to sense, for example, electrons, neutral beams, or neutrons.
- Deterrence:** The prevention of war or other undesired acts by a military posture threatening unacceptable consequences to an aggressor.
- Dielectric Coating:** On a mirror, a thin (usually fractions of a wavelength) coating of non-conducting materials designed to maximize reflectivity at the operating wavelength.
- Diffraction:** The spreading out over distance of even a perfectly focused beam of electromagnetic radiation. It provides an upper limit on the intensity that can be obtained. A perfectly focused beam will spread out at an angle (in radians) equal to slightly more than the ratio of the wavelength to the diameter of the final focusing element.
- Direct Ascent Non-nuclear Anti-satellite Weapon (DANNASAT):** A ground-based rocket with a homing, non-nuclear warhead designed to destroy satellites.
- Direct Ascent Nuclear Anti-satellite Weapon (DANASAT):** A ground-based rocket with a nuclear warhead designed to destroy satellites.
- Discrimination:** The process of determining which of a set of targets in space (usually reentry vehicles) are real and which are decoys.
- Distributed Architecture:** A system design whose primary functions are dispersed and repeated in numerous nodes at diverse locations. Each node has a large amount of autonomy. This has the effect of increasing the survivability of the system, since the loss of a few nodes will not cause the system to fail catastrophically. It may, however, cause redundant actions, and thus require more system elements than a more efficient architecture.
- Distributed Battle Management:** A battle management system that relies on a distributed architecture with numerous, largely autonomous nodes.
- Doppler Imaging:** The use of radar or lidar to produce reflected doppler-shifted electromagnetic signals from different parts of an object. This technique can provide an image of the object if it is spinning or tumbling. Since the doppler shift depends on the velocity of the object with respect to the observer, reflections from those parts of the object receding from the observer will have different shifts from those moving towards the observer.
- Dynamic Isotope Power System (DIPS):** A device for producing electric power for satellites that utilizes the heat generated by a quantity of a radioactive isotope as a power source and then converts the heat energy to electricity by means of a dynamic heat engine.
- E-beam:** An electron beam.
- Eastport Study Group:** A group of computer software and hardware experts convened by the SDIO in 1986 to provide independent advice on the problems associated with designing and producing a battle management system for BMD and the associated software. The group reached the conclusion that insufficient attention had been thus far paid to software problems and that any BMD system should be designed around battle management software, not vice-versa. It

- also advocated the use of distributed systems and concluded that a successful battle management system for BMD could be designed.
- Electro-optic Countermeasures:** Countermeasures designed to confuse the sensors of one's adversary by jamming, blinding, or dazzling, or by reducing the radiations and reflections produced by one's own assets, or by using decoy targets in conjunction with real targets.
- Electromagnetic Launcher:** A device that can accelerate an object to high velocities using the electromotive force produced by a large current in a transverse magnetic field.
- Electromagnetic Pulse (EMP):** A large pulse of electromagnetic energy, effectively reaching out to distances of hundreds of kilometers or more; induced by the interactions of gamma rays that are produced by a nuclear explosion with atoms in the upper atmosphere.
- Endo-atmospheric Interceptor:** An interceptor rocket that attacks incoming reentry vehicles in their terminal phase within the atmosphere.
- Ephemeris:** The orbital parameters of a satellite or planet.
- Excimer Laser:** A laser that produces the necessary population inversion of molecular energy states by an electric discharge in a lasant consisting of a noble gas and a halogen (e.g. argon and fluorine, xenon and chlorine). The two elements of the lasant form a metastable excited molecular state, and, upon decaying to the ground state and emitting a photon, separate once more into their component atoms.
- Exe-atmospheric Interceptor:** An interceptor rocket that destroys incoming reentry vehicles above the atmosphere during the late midcourse phase.
- Experimental Test Accelerator (ETA):** A 5 MeV accelerator at Livermore Laboratory that produced free electron lasing in the microwave band in 1985.
- Fast-burning Booster (FBB):** A booster for a ballistic missile that burns out more rapidly than the current minimum time of about three minutes. Down to about 80 seconds, there are no anticipated serious technical difficulties in developing such rockets. For shorter times, significant developmental work may be necessary.
- Fault-tolerance:** The ability of hardware or software to continue to function despite the occurrence of failures.
- FLAGE Experiment:** A set of experiments involving a low altitude interceptor rocket for missile defense.
- Fletcher Report:** The report of the Defensive Technologies Study Team, headed by Dr. James Fletcher. This report was requested by President Reagan in 1983 to investigate the technical feasibility of ballistic missile defenses. The report unclassified conclusions were optimistic.
- Fluorescence:** Light or other electromagnetic radiation from excited atoms that have previously been raised to excited states by radiation of a higher frequency.
- Focal Plane Array:** A set of radiation-sensitive devices located at the focal plane of an optical train. The array then provides an image of objects located in front of the optics. The resolution of the array depends on the number of elements in it and on the quality and size of the optics.
- Free Electron Laser:** A laser that takes energy from a transversely-oscillating electron beam and adds it to a coupled beam of electromagnetic radiation. The wavelength of the radiation depends primarily on the distance of oscillation of the electron beam and on its energy.
- Fronnd:** A proposed countermeasure to doppler imaging by radar or ladar: long, thin strips of metal, coated with a material that sublimates in space, are attached to a possible target. The random motion of many of these objects on the same target could confuse attempts to image the target by doppler measurements over its surface.
- Full-scale Engineering Development (FSED):** A stage in the acquisition of a military system that is intended to produce several working prototypes.
- Geostationary Orbit:** A circular orbit about 35,000 kilometers above the Earth's equator with a period of one day; a satellite in this orbit thus remains above one point on the equator.
- "Hard" Kill:** The destruction of an object in a way easily detectable from a distance, usually by fragmenting it or by changing its velocity radically. Distinguished from "soft" kill (q.v.).
- Hard Targets:** Ground targets, such as missile silos or deeply buried command centers, that could survive a nuclear blast unless it were to hit within a few hundred meters.
- Heavy Lift Launch Vehicle (HLLV):** Currently referred to as the Advanced Launch System (q.v.); a projected vehicle capable of lifting tens of tonnes to orbit and ready for use by the mid 1990s. A requirement for placing space-based elements of the Phase One Strategic Defense System into orbit within the timelines planned.
- HF/DF Laser:** A chemical laser, fueled by a hydrogen-(or deuterium-)fluoride reaction, that

- produces lasing at 2.7 (3.8) microns. The most promising candidate for space-based chemical lasers.
- Hierarchical Architecture:** An architecture that has several layers of a hierarchy; an element may take direction from an element in a higher layer but not from one in the same or a lower layer.
- High Endo-atmospheric Interceptor (HEDI):** A proposed interceptor for ballistic missile defense that could be available sometime in the 1990s.
- Hit-to-kill Vehicle:** A kinetic vehicle that destroys its target by hitting it directly and thereby transferring a lethal amount of kinetic energy to it.
- Homing:** In the context of missile defense, the ability of an interceptor to locate its target and to modify its trajectory to insure that it approaches its target close enough to destroy it. May be based on infra-red detectors, radar, or ladar.
- Homing Overlay Experiment (HOE):** An experiment carried out in summer 1984, in which a modified Minuteman I rocket, launched from Kwajalein Atoll in the Pacific, was able to home in on and destroy a simulated reentry vehicle launched from Vandenberg Air Force Base in California.
- Homopolar Generator:** An electric generator that employs a rotating cylinder to store large amounts of electrical energy. Maybe used in conjunction with electromagnetic launchers.
- Imaging Synthetic Aperture Radar (ISAR):** A radar technique that uses the motion of targets to reconstruct an image with high resolution. Resolution is limited by the distance the target moves between successive radar pulses.
- Impulse Tagging:** A possible technique for interactive discrimination. A high-powered laser strikes an object, ablating a small amount of surface material. The object recoils, and the speed of the recoil is inversely proportional to its mass.
- Impurity Band Conductor (IBC):** Recently perfected semiconductors that may be used for charge-coupled devices and have a high degree of radiation resistance.
- Induction Linac:** One of the candidate types of particle accelerator for a free electron laser. The ETA and ATA at Lawrence Livermore Laboratory are induction linacs. The electromagnetic impulse that accelerates the electron beam originates in a changing magnetic field produced by a series of loops that surrounds the beam rather than by a radiofrequency-generated electric potential that is maintained along the beam just ahead of the accelerated particles.
- Inertial Guidance:** Guidance provided from on-board a rocket. Inertial gyros sense acceleration and use that information to alter the rocket's propulsion to maintain a predetermined course.
- Interactive Discrimination:** Techniques for discrimination that involve perturbing a target and observing its reactions to the perturbation. Examples are neutral particle beams (producing electrons or neutrons in the target), impulse tagging with a laser (causing the object to recoil), and laser thermal tagging (heating an object and observing the temperature rise).
- Keep-out Zone:** A volume of space around a satellite that is declared to be forbidden to entry by unauthorized intruders; enforcement of such a zone is intended to protect space assets against attack, particularly by space mines (q.v.).
- Kill Assessment:** Determining with remote sensors whether an attacked target has been destroyed.
- Kinetic Energy Weapons (KEW):** Weapons that kill by transferring a fraction of their kinetic energy to a target.
- Kinetic Kill Vehicle (KKV):** A rocket that homes in on its target and kills it by striking it or by hitting it with a fragmentation device.
- Klystron:** A high-powered vacuum tube used to produce the radio frequency waves that accelerate particles in an rf accelerator.
- Ladar:** Laser radar; a form of radar that uses laser light instead of microwave radiation as a radar signal.
- Lethal Radius:** The maximum distance from an exploding (nuclear or non-nuclear) warhead, within which a target would be destroyed.
- Lethality:** The ability of a weapon to destroy a target.
- Lethality Enhancer:** A device, used by a kinetic kill vehicle, that explodes or expands at the point of closest approach to the target, sending fragments of material into the target and destroying it.
- Life Cycle Costs (LCC):** The total cost of a military system, including operation and maintenance over its anticipated lifetime.
- Limited Test Ban Treaty:** A treaty signed by the US, the UK, and the USSR in 1963, restricting nuclear tests to underground sites. Over one hundred nations have become signatories.
- Lines of Source Code (LOC):** The number of lines in a computer program in the highest (most removed from the computer) level language used.
- Machine Language:** The lowest level of computer language that directly manipulates the bistable

- states in a computer's memory, effectively moving around numbers and performing arithmetic operations upon them.
- Magnetohydrodynamics (MHD):** In the BMD context, a technique for converting a hot plasma to electric energy by passing it through a magnetic field. In space, it might be used to generate electrical energy from a large rocket exhaust.
- Maneuvering Boosters:** Boosters that can change course in a pre-programmed way; they might be used in an effort to avoid attack during the boost phase by space-based interceptors.
- Maneuvering Reentry Vehicle (MaRV):** A reentry vehicle that maneuvers in the late midcourse or terminal phase, either to enhance accuracy or to avoid anti-ballistic missiles. Maneuvers within the atmosphere are usually accomplished by aerodynamic means; maneuvers in space could be accomplished by small rockets.
- Mass Fraction:** The fraction of a rocket stage's mass that is taken up by fuel. The remaining mass is structure and payload.
- Mean Time Between Failures (MTBF):** The average time between element failure in a system, usually composed of many elements.
- Mean Time to Repair (MTTR):** In a multi-element system, the average time required to repair the system in the event of a failure.
- Midcourse Phase:** The phase in a ballistic missile trajectory after the warheads are dispensed from post-boost vehicles and before their reentry into the atmosphere, in which the reentry vehicles (and decoys) coast in ballistic trajectories.
- Milstar:** A U.S. strategic communications satellite under development.
- Mirror System:** In the BMD context, a BMD system that one side builds in response to its adversary that contains similar elements and has similar missions.
- Missile Silo:** A usually hardened protective container, buried in the ground, in which land-based long-range ballistic missiles are placed for launching.
- Monostatic Radar/Ladar:** A radar/ladar in which the transmitter and receiver are located together.
- Multiple Independently-targetable Reentry Vehicle (MIRV):** One of several reentry vehicles carried on the same booster that are sent to diverse targets by a post-boost vehicle (q.v.).
- Mutual Assured Destruction:** The strategic situation now existing in which either superpower could inflict massive nuclear destruction on the other, no matter who struck first.
- Mutual Assured Survival:** The hypothetical strategic situation obtaining wherein each superpower would know that it would survive a nuclear attack launched by the other with only minimal casualties because of the high effectiveness of its defensive systems.
- National Test Bed (NTB):** The nationwide computing network, with a center in Colorado, to be organized by SDIO to test and simulate software and, to a degree, the hardware that might be used in a BMD system.
- Network Topology:** In computing, the elements, lines of communication between the elements, and the hierarchical structure of a computing network.
- Neutral Particle Beam (NPB):** A beam of uncharged atomic particles, produced by a particle accelerator and beam neutralizer, that could be used to strike and destroy an object or to "interrogate" it, ascertaining some information about it from the characteristics of the resulting emitted radiation from the object.
- Noctilucent Clouds:** Naturally occurring clouds in the upper atmosphere (about 60-80 km altitude) resulting from the accumulation of ice crystals about fine particles of meteoric dust. Such clouds may also be susceptible to artificial creation, and thus might be useful for possible countermeasures to ground-or air-based infrared sensors trying to look through the Earth's atmosphere.
- Nuclear Background:** The background of infrared, visible, microwave and nuclear radiation caused by a nuclear explosion in space or in the atmosphere. Such backgrounds could pose significant problems for many proposed sensors of a BMD system.
- Nuclear Precursor:** A nuclear explosion detonated near an adversary's sensors or weapons shortly before the arrival of a number of nuclear warheads on nearby targets. The aim would be to prevent the adversary from launching his own weapons or from using his sensors because of the background or debris produced by the precursor.
- Outer Space Treaty:** A treaty signed by the US, the UK, and the USSR in 1967, and acceded to by many other nations, that bans the stationing of nuclear weapons in space.
- Packet-switched Network:** A computing network in which information and data are distributed and retrieved in "packets"; the size and repetition rate of the packets depend on the computational and communication status of the system at the time of data transfer.
- Particle Accelerator:** A device that accelerates

- charged nuclear and sub-nuclear particles by means of changing electromagnetic fields. Particles are accelerated to energies of millions of electron-volts and much higher. Accelerators for basic research have reached over 10^{12} electron volts of energy. Those useful for BMD missions, such as NPBs or FELs, need only reach between 10^8 and 10^9 electron volts, but generally require higher currents.
- Passive Discrimination:** Discrimination of decoys from real targets by observing infrared, optical, or other emissions from the object. In BMD, passive infrared observations may be used in early versions of a system to attempt to discriminate between reentry vehicles and simple decoys.
- Passive Sensor:** A sensor that passively observes radiation coming from an object at a distance. Usually refers to infrared or visible sensors.
- Payload:** On a rocket, the part of the total mass that is used to accomplish the rocket's mission, apart from the rocket fuel and structure. Examples are a satellite launched to orbit or a nuclear warhead.
- Penetration Aid:** A device, such as a decoy or chaff, that would make it easier for a reentry vehicle to penetrate a BMD system by confusing the system's sensors.
- Phase One:** In the context of missile defense, the first phase of a deployed Strategic Defense System (q.v.), based on space- and ground-based interceptors, and planned for deployment by the mid- to late-1990s.
- Phase Three:** A later phase of missile defense deployment, including directed-energy weapons and interactive discrimination.
- Phase Two:** The phase of missile defense deployment, following Phase One; would possibly include more interceptors, some enhanced discrimination capability and other innovations.
- Phased Deployment:** In the BMD context, the deployment of successively more effective systems as they are developed.
- Pixel:** One unit of image information on a screen, corresponding to the smallest unit of the image; the more pixels, the higher the potential resolution of the system.
- Platform:** In the BMD context, a satellite in space used for weapons, sensors, or both.
- Platform Decoy:** A relatively inexpensive object intended to fool an adversary's sensors into deciding that the object is really a much more valuable platform.
- Plume:** The hot, bright exhaust gases from a rocket.
- Pop-up:** The use of rapidly reacting, ground-launched elements of a ballistic missile defense. These elements may be sensors (e.g. for mid-course tracking and discrimination) or weapons (e.g. X-ray lasers).
- Post-boost Phase:** The phase of a ballistic missile trajectory in which reentry vehicles and associated decoys are independently released on ballistic trajectories towards various ground targets.
- Post-boost Vehicle (PBV):** The rocket-propelled vehicle that dispenses reentry vehicles and associated decoys on independent ballistic trajectories towards various ground targets.
- Preferential Defense:** The defensive tactic of protecting some targets strongly while leaving others less strongly, or not at all defended. This allocation of defense resources is to be hidden from the offense, thus requiring it to waste resources and conferring a strategic advantage on the defense.
- Probe:** In the context of SDS, a ground-based set of sensors that would be rapidly launched into space on warning of attack and then function as tracking and acquisition sensors to support weapon allocation and firing by BMD weapons against enemy ICBMs and RVs.
- Radiation Hardness:** The ability of electronics to function in high fields of nuclear radiation. Techniques for increasing hardness include semiconductors less susceptible to radiation upset, shielding, reduction in size, and redundancy.
- Radio Frequency Linac:** A particle accelerator that uses a traveling electromagnetic wave at radio frequencies to accelerate charged particles. The wave is positioned at a relatively constant phase relative to the particle position as both travel down a tube, providing an electric field that furnishes the accelerating force.
- Radioisotope Thermoelectric Generator (RTG):** An electric generator that uses the heat produced by the decay of intense radioactive sources to produce electricity by the intermediary of thermoelectric devices.
- Railgun:** A device that uses the electromotive force experienced by a moving current in a transverse magnetic field to accelerate small objects rapidly to high velocities. See electromagnetic launcher.
- Range Gate:** An electronic gate placed by a radar system with a timing intended to include expected return signals. The radar would then only look at and analyze those return signals within the gate.

- Reentry Vehicle (RV):** The shielded nuclear warhead of a ballistic missile that reenters the Earth's atmosphere to strike a target on the ground.
- Responsive Threat:** The Soviet ballistic missile force and the Soviet countermeasures to a U.S. ballistic missile defense that could be expected to be deployed by the Soviet Union in an effort to oppose a U.S. missile defense.
- Retargeting:** Re-aiming a directed-energy weapon from one target to another.
- Retroreflector:** A mirror, usually a corner reflector, that returns light or other electromagnetic radiation in the direction from which it comes.
- Robustness:** The ability of a system to fulfill its mission in the face of non-destructive countermeasures or a direct attack.
- Rubber Mirror:** An informal name for mirrors that can be distorted by electromechanical actuators in order to compensate for atmospheric distortions or changes in the geometry of the optical system, and thereby restore a desired wave front.
- SAFEGUARD:** The anti-ballistic missile system deployed in North Dakota in 1975 and then dismantled in 1976 because of low cost-effectiveness.
- Salvage-fused:** In a warhead, a design including a fuse that would detonate the warhead if it were struck or attacked from a distance by another weapon.
- Sensor:** A device that detects electromagnetic radiation or particles emanating from a source at a distance.
- Shoot-back:** The defense tactic of shooting at attacking objects, trying to destroy them before they can destroy the targeted asset.
- Shroud (RV, PBV):** In the BMD context, a thin envelope that would enclose a reentry vehicle, interfering with the infrared radiation that it would emit; also, a loose conical device that would be positioned behind a PBV to conceal the deployment of reentry vehicles and decoys from outside observers.
- Sidelobe:** In radar, a solid angle away from the aiming direction of an antenna, that contains a significant fraction of the energy radiated. The size, shape, and location of sidelobes depend on the wavelength and on the antenna geometry. Energy can also be inserted into the radar receiver through a sidelobe, providing an opportunity for jamming.
- Signal Processing:** The analysis (often rapid and in near-real time) of complex incoming data in order to refine and simplify the information received to a form that is useful to the user. For sensors, signal processing will be needed to separate real signals (e.g. objects and their positions) from spurious and unwanted background information.
- "Soft" Kill:** A kill of an object, usually by a particle beam, against electronics, such that an outside observer cannot detect any physical change in the target from a distance, but in which the target is nevertheless unable to perform its mission.
- Soft Targets:** In nuclear strategy, any target that cannot be hardened in order to survive a nearby nuclear detonation (e.g. people, cities, airfields, factories).
- Software Engineering:** The technology for developing and maintaining software.
- Software Engineering Environment:** Tools for developing software that are mutually compatible, that enable the software engineer to deal in rapid succession with different phases of the software life cycle and that support the entire software life cycle. Such environments are in the development stage.
- Software Security:** The resistance of software to unauthorized use, theft of data, and modification of programs.
- Software Trustworthiness:** The probability that there are no errors in the software that will cause the system to fail catastrophically after it has undergone testing.
- Software Verification:** The development of techniques for mathematically proving the correctness of computer programs.
- Source Code:** A computer program.
- Space Mine:** A satellite with an explosive (either nuclear or non-nuclear) charge that is designed to position itself within lethal range of a target satellite and detonate upon preprogrammed command, remote command or upon being itself attacked.
- Space Transportation Architecture Study:** An interagency (SDIO, USAF, NASA) study undertaken in 1986 to investigate future US space transportation needs for military and civilian missions and to propose methods to meet those needs.
- Space-based Interceptor (SBI):** A kinetic kill rocket based in space.
- Spartan:** Long-range nuclear-tipped missile used as part of the SAFEGUARD missile defense system in 1975.
- Specific Impulse:** A measure of the efficiency of a rocket fuel: the ratio of the thrust produced to the rate of fuel burning. It is measured in sec-

- ends; good liquid fuels today range from 300 to 400 seconds, and solid fuels from about 200 to 300 seconds.
- Sprint:** High acceleration nuclear-tipped short range interceptors used as part of the SAFE-GUARD missile defense system in 1975.
- Stability:** Resistance to rapid and precipitous change in an international situation. Crisis stability refers to the ability of a situation to resist deterioration to war in times of crisis. Arms race stability refers to the ability of the situation to resist deterioration into a spiraling arms race without apparent limits.
- Stable Transition:** In missile defense, refers to a hypothetical transition from today's offense-dominated strategic relationship between the superpowers to a regime based on defense dominance, without passing through a period of crisis instability.
- Stealth:** Means of hiding one's own asset from an adversary's sensors, usually by reducing the radiation emitted or reflected by the asset.
- Steradian:** The solid angle subtending a unit area on a unit sphere.
- Stimulated Raman Scattering (SRS):** A multiphoton interaction between a beam of photons and the molecules of the medium through which the beam passes. If intense enough, the photons can interact with rotational states of the molecules, producing coherent outgoing beams of frequency equal to the sum (and difference) of the frequency initial beam and (from) the equivalent frequency of the rotational state. In practice, regarding BMD, a very intense laser beam might interact with gas molecules in the atmosphere and produce SRS—the result could be a dispersal of the original beam, reducing its weapons potential.
- Strategic Defense:** Defense against long range nuclear weapons.
- Strategic Defense Initiative:** A Department of Defense research program, initiated by President Reagan in 1983, with the purpose of investigating methods of defending against the ballistic missile threat to the United States.
- Strategic Defense System:** The proposed Phase One system for ballistic missile defense, planned for deployment in the mid- to late-1990s.
- Surveillance:** In space, the observation, tracking, and cataloging of objects in Earth orbit and of objects being launched from the Earth.
- Survivability:** The ability of a system to continue to fulfill its mission in the face of a direct attack upon it.
- Survivability Enhancement Option:** One of several methods to help a missile defense system survive a direct attack (e.g., shootback, stealth, maneuver, shielding).
- System-Generated Electromagnetic Pulse (SGEMP):** An electromagnetic pulse in a satellite, generated by gamma rays and x-rays from a nuclear explosion. These rays strike metallic surfaces of the satellite, causing electrons to flow along conductors and inducing large currents in the circuitry within the satellite.
- Terminal Imaging Radar (TIR):** A radar intended for missile defense use in the terminal phase by endo-atmospheric interceptors that need high resolution and discrimination information. The radar may be ready for deployment in the 1990s.
- Terminal Phase:** The final phase of a ballistic trajectory in which the reentry vehicles pass through the atmosphere to their targets. This phase lasts one minute or less.
- Theater Defense:** Defense against nuclear weapons on a regional level (i.e., Europe, Japan, Israel) rather than at the strategic level (globally or the United States and the U.S.S.R.).
- Thermal Blooming:** The dispersion of a high-powered laser beam within the atmosphere, caused by heat transfer from the beam to the atmosphere. The center of the beam will be hotter, resulting in a less dense zone with a lower index of refraction. The beam is then refracted radially outward.
- Thermal Tagging:** A discrimination technique in which a high-powered laser heats up an object; a subsequent measure of its temperature could help indicate whether the object were light (higher temperature) or massive (lower temperature). The higher temperatures could be detected and used as a discriminant by other sensors later in the trajectory.
- Threat Tube:** A narrow geometrical volume of space, usually over the arctic, from Soviet missile fields to U.S. targets, within which there would be a high density of RVs and decoys during a Soviet nuclear attack.
- Thrusted Replica:** A decoy reentry vehicle that has a small rocket which is used upon reentry into the atmosphere. The rocket thrust compensates for atmospheric drag, making it more difficult to discriminate the decoy from a real RV.
- Time Delay and Integrate:** The technique of integrating (essentially, adding) signals from several sensors so that better photon statistics can be obtained, helping the signal processor find a signal above background.

Tracking Denial: Denying an adversary's sensors the ability to detect and keep track of a space asset.

Trajectory: The path followed by a moving object.

Warhead: An explosive used by a missile to destroy its target.

X-band Radar: Radar operating in the frequency band around 10 GHz.

X-ray Laser: A laser that produces radiation in the X-ray band (around a few angstroms). In the BMD context, such lasers would derive their energy from a nearby nuclear explosion, and would function only for microseconds or less.

Z: The number of electrons (or protons) in the atoms of a given element.