Strategic Defense Initiative gains Milestone I approval

Selected SDI concepts and technologies will be entering the demonstration and validation phase. We publish the Defense Department's Sept. 18 announcement.

Secretary of Defense Caspar W. Weinberger approved on Sept. 18 the Defense Acquisition Board (DAB) recommendation that selected Strategic Defense Initiative concepts and technologies, which are candidates for Phase I of the Strategic Defense System, enter the demonstration and validation phase of the defense acquisition process.

The Milestone I demonstration and validation review is prescribed by DoD policy for acquisition of all major programs. The Secretary's approval culminated a thorough review by the DAB and a 30-day period when environmental assessments of the SDI demonstration and validation plan were available for public review.

The purpose of the demonstration and validation phase is to evaluate the feasibility of elements of a potential strategic defense system through analysis, experimentation and simulation. All test and evaluation activities planned for the demonstration and validation phase will comply with all U.S. treaty obligations including the 1972 Anti-Ballistic Missile Treaty.

The Milestone I recommendation was made by the Defense Acquisition Board, chaired by Undersecretary of Defense for Acquisition Richard P. Godwin.

The technology research programs which are candidates for Phase I of the Strategic Defense System include:

- Ground-based Surveillance and Tracking System (GSTS)
- Boost Surveillance and Tracking System (BSTS)
- Space-based Surveillance and Tracking System (SSTS)
- Battle Management/Command and Control, and Communications (BM/C^3)
- Space-based Interceptor (SBI)
- Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS)

The concept of phased deployment

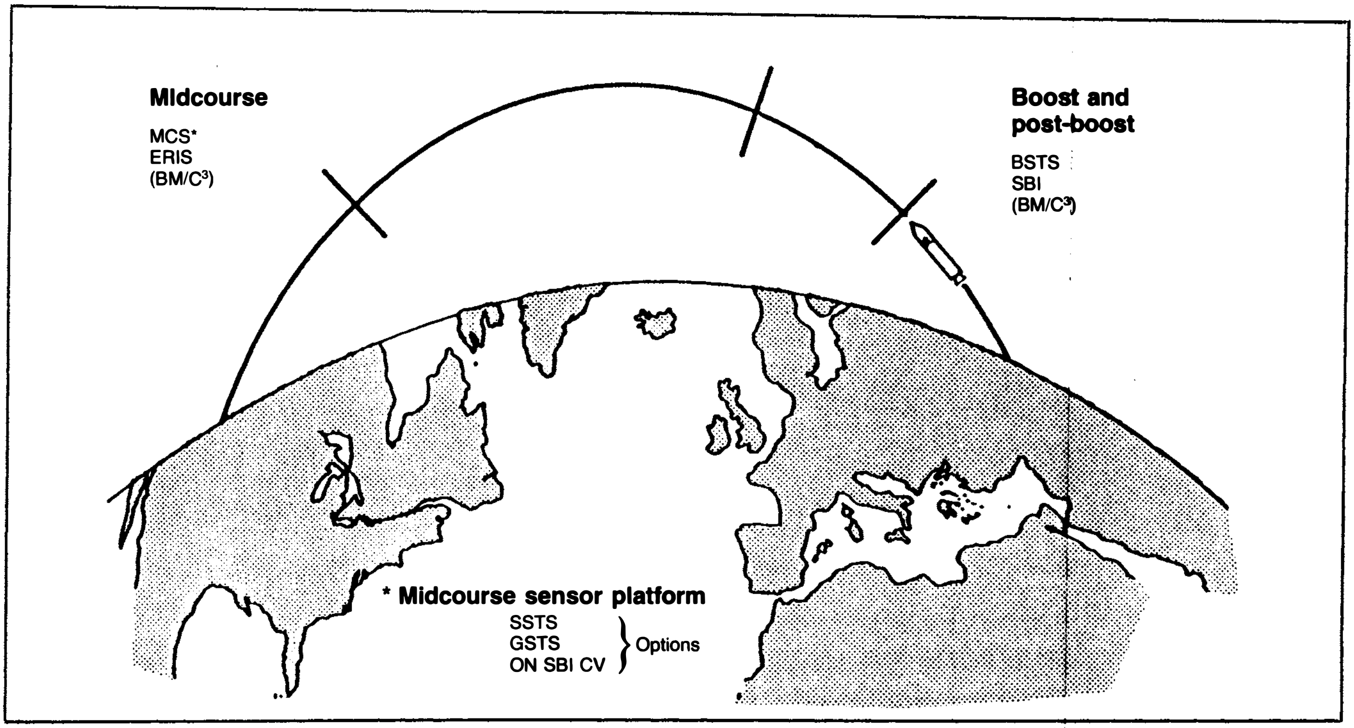
Recognizing that no comprehensive strategic defense system could be deployed all at once, the concept of phased deployment addresses the question of how to deploy strategic defenses in the event a deployment decision is made in the future. It does not constitute a decision to deploy. Since we are talking about an overall system, we would not want to make a decision to develop and deploy an initial phase until we are reasonably confident that more advanced systems will be feasible.

The goals of defense deployments are: (1) Deny the Soviets confidence in the military effectiveness and political utility of a ballistic missile attack; (2) Secure significant military capability for the U.S. and its allies to deter aggression and support their mutual strategy in the event deterrence should fail; and (3) Secure a defense-dominated strategic environment in which the U.S. and its allies can deny to any potential aggressor the military utility of ballistic missile attack. It has become clear that these goals may be reached through the phased deployment of defenses.

We continue to believe that the defense resulting from each of the various increments must be expected to meet our basic criteria. Thus, each phase of deployment would be sized and given sufficient capability to achieve specific military and policy objectives and lay the groundwork for the deployment of subsequent phases. The technologies employed in, and objectives served by, the initial phases of a deployment would be fully compatible with the technologies and objectives of the ultimate strategic defense system. In fact, such early phases would facilitate the achievement of the ultimate system.

In addition, the first phases could serve an intermediate military purpose by denying the predictability of a potential

FIGURE 1
SDS phase I core concept



Soviet attack outcome and by imposing on the Soviets significant costs to restore their attack confidence. These first phases could severely restrict Soviet attack timing by denying them cross-targeting flexibility, imposing launch window constraints, and confounding weapons-to-target assignments, particularly of their hard-target-kill capable weapons. Such results could substantially enhance the deterrence of Soviet aggression.

A first deployment phase could use kinetic energy weapon and sensor system technologies to concentrate on the boost, post-boost, and late midcourse intercept layers. The boost and post-boost layers could consist of space-based kinetic-kill interceptors (SBI) combined with surveillance and tracking satellite sensors in geosynchronous orbit. The late midcourse phase intercept layer could consist of ground-launched interceptors, combined with ground-launched surveillance probes or space-based surveillance platforms, to destroy nuclear weapons that were not destroyed in the boost or post-boost layer defense.

Subsequent phases of deployment could augment and upgrade Phase I assets in the late midcourse and boost tiers with improved sensors, upgraded battle management/command, control and communications (BM/C^3), and increased numbers of kinetic energy weapons. Improved surveillance sensors would provide coverage of the entire missile flight, and could provide an interactive discrimination capability against reentry vehicles and decoys.

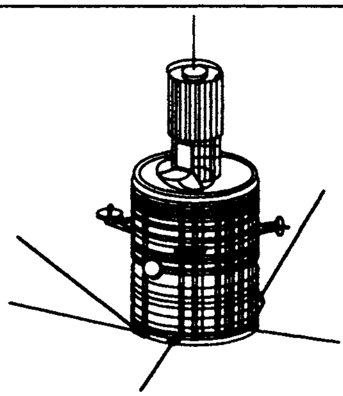
Glossary of terms

ALS: Advanced Launch System
AOS: Airborne Optical Sensor
BM/C^3: Battle Management/Command, Control and Communications
BSTS: Boost Surveillance and Tracking System
BV: Boost Vehicle
CV: Carrier Vehicle
ERIS: Exoatmospheric Reentry Vehicle Interceptor System
GBR: Ground-Based Radar
GBL: Ground-Based Laser
GSTS: Ground-Based Surveillance and Tracking System
HEDI: High Endoatmospheric Defense Interceptor
HVG: Hypervelocity Gun
NPB: Neutral Particle Beam
PBV: Post-Boost Vehicle
RV: Reentry Vehicle
SBI: Space-Based Interceptor
SBL: Space-Based Laser
SDS: Strategic Defense System
SSTS: Space Surveillance and Tracking System

FIGURE 2
Phase I systems

SYSTEM NAME	FUNCTIONS
Boost Surveillance and Tracking System (BSTS)	• Detection of Launches • Acquisition and Tracking of BVs and PBVs • Kill Assessment
Space-based Surveillance and Tracking System (SSTS)	• Acquire and Track PBVs, RVs and ASATs • Discrimination
Ground-based Surveillance and Tracking Systems (GSTS)	• Acquisition • Tracking • Discrimination
Space-based Interceptor (SBI)	• Disabling of Boosters, PBVs, RV and ASATs • Sensors on Carrier Vehicle (CV) Could Provide Enhanced Midcourse Sensor Capability
Exoatmospheric Reentry Vehicle Interceptor System (ERIS)	• Disabling of RVs in Late Midcourse
Battle Management/Command,Control and Communication System (BM/C3)	• Man-in-Loop Control • Engagement Management • Maintaining Track Data • Target Assignment • Communications

FIGURE 3
Phase I—BSTS element



Key requirements

Size:	approx. 36 × 16 ft.
Bands:	multispectral
Sensor:	Scanning or staring
Power:	6-10 kW
Total spacecraft weight:	5,000-7,000 kg

Functions

- Surveillance: continuous global observation of the Earth's surface
- Detection: ICBMs, IRBMs, SLBMs
- Acquisition: initiate tracking of missiles
- Tracking: compute state vectors and predict future positions
- Typing: determine the missile type
- Kill assessment: provide data to weapons to assist in determination of a hit or kill
- Communications: transmit required data to all users
- Battle management: as determined by the SDI architecture

Continued improvements would endow the architecture with full strategic defensive capabilities against ballistic missiles throughout their flight trajectories, using highly advanced technologies developed in parallel with deployment of earlier systems. Suitable advanced elements could include advanced versions of the boost-phase sensors, further improved SBI, advanced Space Surveillance System, Airborne Optical Sensors, High Endoatmospheric Interceptors, improved BM/C^3, and directed energy elements (lasers, neutral particle beams, etc.) for both interactive discrimination and destruction of ballistic missiles in flight.

The extent to which we would choose to follow such a phased deployment approach would depend in large part on Soviet actions. The mere development of the option for phased deployment of strategic defense can help motivate Soviet acceptance of U.S. arms reduction proposals. With such acceptance, phased deployment plans could be modified accordingly. If the Soviets respond favorably, a deployed system could function as an insurance system and would require more limited quantitative upgrading over time. If the Soviets do not respond favorably, we have to take that into account in our own actions.

In summary, although there are many difficult steps to be accomplished along the way and sustained national commitment is required, phased deployment of strategic defenses appears to be feasible. An effective system of space-based and ground-based interceptors can provide a useful deterrent capability and strong motivation for the Soviets to cooperate in a transition from a dependence on nuclear retaliation to a greater reliance on defense.

Boost surveillance and tracking system (BSTS)

The Boost Surveillance Tracking System (BSTS) (see **Figure 3**) would provide the capability to detect and track attacking intercontinental and submarine launched ballistic missiles during their boost phase or powered flight portion of their launches. If the attacking missile can be destroyed in its early boost phase, which is the shortest phase of a missile's flight, the number of warheads destroyed per hit would be greatly increased. (The reentry vehicles and decoys are released during the next phase, the post-boost phase.)

Once the BSTS senses a launch and tracks the attacking missiles, the information would be relayed to the Battle Management/Command, Control and Communications (BM/C^3) system and other elements of the Strategic Defense System. The BM/C^3 would then communicate target assignments to weapon elements such as the Space-Based Interceptor to destroy the incoming missiles. The type of tests, experiments or simulations envisioned during the Demonstration/Validation phase include:

- Performance tests to determine the ability of sensors to detect, identify and track targets would be conducted in a space enviroment chamber.
- Analyses and simulations.
- One limited capability satellite would be launched from Cape Canaveral Air Force Station for space experiments.

The primary contractors for BSTS are Lockheed Missiles and Space Co., Sunnyvale, Calif. and Grumman Corp., Bethpage, N.Y. The U.S. Air Force Systems Command (AFSC) is the executive agent for the program.

Space-based interceptor (SBI)

The Space Based Interceptor (SBI) (see **Figure 4**) would consist of a number of space vehicles, (also referred to as Space-Based Kinetic Kill Vehicles,) that would house multiple rocket-propelled interceptors. These non-nuclear interceptors would be designed to destroy attacking missiles in the boost phase and re-entry vehicles (RV's) in the midcourse phase of their flight. The interceptors would destroy the respective targets by the force of their impact with them at extremely high speed.

Prior to intercept, boost surveillance systems would detect and track the ballistic missiles. This information would be relayed to the Battle Management/Command, Control and Communications (BM/C^3) system, which would process it and communicate target assignments to interceptors such as the SBI. Once the SBI platform received the command to intercept the incoming missiles, it would launch interceptors to destroy the attacking missiles.

Demonstration/Validation phase of SBI would require tests of the SBI homing subsystem and space platform. A system simulator would be used to test the space platform and evaluate the interface between all the subcomponents and to predict overall performance. Individual subcomponent/assembly testing would be conducted in existing facilities.

The primary contractors for SBI are Rockwell International Corp., El Segundo, Calif. and Martin-Marietta Corp., Bethesda, Md. The U.S. Air Force Systems Command (AFSC) is the executive agent for the program.

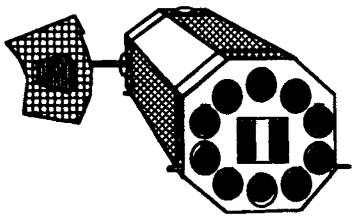
Space-based surveillance and tracking system (SSTS)

The Space-Based Surveillance and Tracking System (SSTS) (see **Figure 5**) would be capable of detecting and tracking ballistic missile buses and warheads in the post-boost and midcourse phases of missile flight. The system would use a series of satellites to track the missiles and to discriminate between reentry vehicles, decoys, and space debris.

This tracking information would be relayed to the Battle Management/Command, Control and Communications (BM/C^3) system and other elements of the Strategic Defense System. The BM/C^3 system would then communicate target assignments to weapon elements such as the Space-Based Interceptor (SBI) and/or the Exoatmospheric Reentry-Vehicle Interceptor subsystem (ERIS) to destroy the incoming warheads.

The Demonstration/Validation phase of SSTS would require fabrication and ground testing of a limited capability

FIGURE 4
Phase I—Space-based interceptor element



Key requirements
Carrier vehicle
- 3,000 kg

Interceptor
- Low cost/long life

Functions
- Intercept boosters, PBVs, RVs, self defense against direct ascent ASATs
- Carrier vehicles
  —Store and launch interceptors
  —Assess kill and report status
- Interceptor
  —Acquire, home on and destroy target

Tech maturity and hardware development supports feasibility

FIGURE 6
Phase I—ERIS element

Key requirements

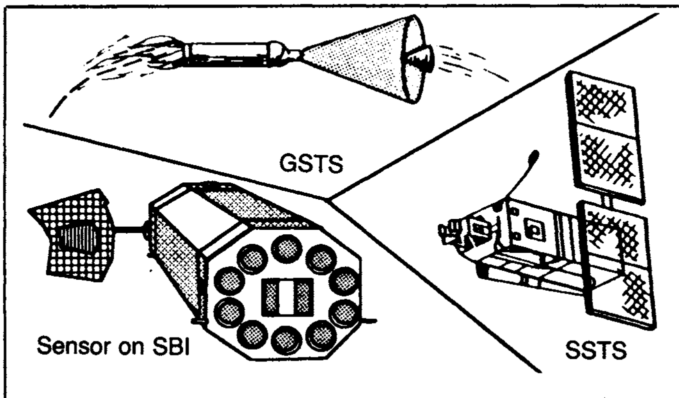
- Low cost per RV kill: ≤$1M
- Lightweight: ~700 kg
- "Dormant" Missile Concept

Functions

- Accept target state vector updates from surveillance sensors (radar, GSTS, SSTS)
- Acquire, home on target, impact RV
- Destroy RVs in late midcourse (exoatmospheric)

Feasibility demonstrated (HOE program): Low cost lightweight is the goal

FIGURE 5
Phase I—Midcourse surveillance element



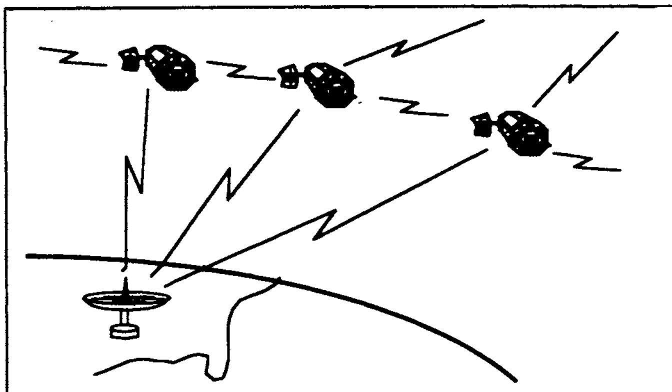
Key parameters

- Aperture: <1.5 meters
- Sensor: Scanning
- No. of detectors: 100s to 1,000s
- Bands: Multispectral

Functions

- Acquire and track cold (non thrusting) PBVs, RVs, Decoys, ASATs
- Track data provided via BM/C^3 to SBI and ERIS
- Discriminate decoys
- Bulk filter debris and keep track of all threatening objects in field of view

FIGURE 7
BM/C^3 systems description



Key requirements

- **Architecture**
  - Minimum coordination
  - Rigorous + complete design
- **BM/C^3 system properties**
  - reliable
  - durable/survivable
  - evolvable
  - testable
  - robust
  - secure
- **Technology requirements**
  - high performance processors
  - validated algorithms
  - jam resistant, secure communications
  - trusted software

Functions

Command and control
- Maintain positive control
- Assess situation
- Manage engagement

Battle management
- Establish and maintain tracks
- Assign weapons to target

Communications
- Manage communications network
- Operate communication links

FIGURE 8
Possible follow-on systems

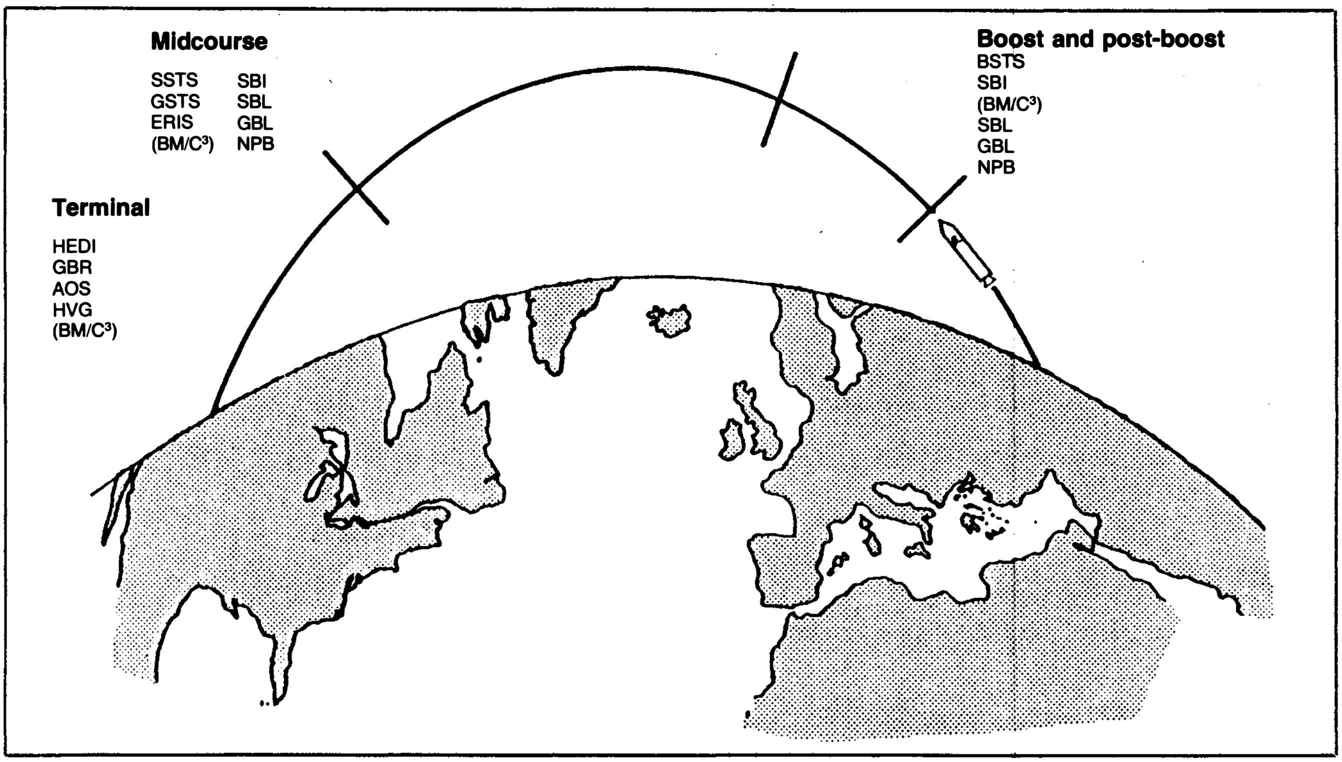


FIGURE 9
Follow-on systems

System name	Functions
Space-based Neutral Particle Beam Weapon (NPB)	• Interactive Discrimination • Disabling of Boosters, PBVs, RV and ASATs
High Endoatmospheric Defense Interceptor (HEDI)	• Disabling of RVs After Reentry
Airborne Optical System (AOS)	• Midcourse and Terminal Acquisition and Tracking
Ground-based Radar (GBR)	• Terminal Acquisition and Tracking • Discrimination
Space-based Laser (SBL)	• Disabling of Boosters and ASATs • Interactive Discrimination
Ground-based Hypervelocity Gun (HVG)	• Disabling RVs in Terminal Phase
Ground-based Laser (GBL)	• Disabling of Boosters

SSTS satellite. Fabriction and ground testing would take place in existing or planned contractor and government facilities. In addition, a satellite may be launched into space for an on-orbit evaluation.

The primary contractors for SSTS are Lockheed Missiles and Space Co., Sunnyvale, Calif. and TRW Inc., Electronics and Defense Sector, Redondo Beach, Calif. The executive agent is the Air Force Systems Command (AFSC).

Ground-based surveillance and tracking system (GSTS)

The Ground-Based Surveillance and Tracking System, (GSTS) (Figure 5), also referred to as the Long Wavelength Infrared (LWIR) Probe, has four basic functions: search, acquisition, track and discrimination. Launched into space upon warning, the GSTS, which represents state-of-the-art exoatmospheric LWIR sensor design, would track an incoming missile's warheads in the missile's midcourse and early terminal trajectory phases. It would also discriminate between reentry vehicles, penetration aids, and debris in space. This information would be relayed to the Battle Management/Command, Control and Communications (BM/C^3) system, which would process it and communicate target assignments to interceptors. The interceptors would then destroy the attacking warheads.

Demonstration/Validation phase of GSTS would require fabrication and ground testing of the sensor, general processor, guidance and control subsystem, and communication subsystem assemblies. It would also include launching sensor-equipped boosters into a ballistic trajectory to provide search, acquisition, tracking, and documentation of potentially hostile ballistic missiles. The fabrication and ground testing of the components would take place in existing or planned contractor and government facilities.

The primary contractors for GSTS have been McDonnell Douglas Astronautics Co., Huntington Beach, Calif. and Science Applications International Corp., San Diego, Calif. The Request for Proposal for the next phase was issued on August 28, 1987, with contract award expected in early 1988. The executive agent is the U.S. Army Strategic Defense Command (USASDC).

Exoatmospheric reentry-vehicle interceptor subsystem (ERIS)

The Exoatmospheric Reentry-Vehicle Interceptor Subsystem (ERIS) (see **Figure 6**) is a ground-based non-nuclear system that would destroy attacking warheads during their midcourse phase of trajectory. Space and ground surveillance systems must first discern between warheads, decoys, penetration aids and debris in space. This information would be relayed to the Battle Management/Command, Control and Communications (BM/C^3) system, which would process it and communicate target assignments to interceptors such as the ERIS. The small ERIS vehicle would destroy the attacking warhead by the force of its impact with it at extremely high speed.

Lockheed Missiles and Space Company, Sunnyvale, Calif., the prime contractor for ERIS, has designed special test facilities for the ERIS. Generally, the types of tests, experiments or simulations envisioned during Demonstration/Validation phase include:

- Laboratory and ground-based research, development, testing, and hardware-in-the-loop evaluation of individual or grouped technology components in or at existing facilities.
- Computer simulation testing and evaluation of technology components by using expanded computer capability at existing facilities.
- Flight testing of individual and grouped technology hardware at existing launch facilities and range areas.
- Survivability testing in or at existing facilities.

The U.S. Army Strategic Defense Command (USASDC) is the executive agent for the ERIS technology.

Battle management/command, control, communications (BM/C^3)

The Battle Management/Command, Control, Communications (BM/C^3) (see **Figure 7**) system would have the responsibility to monitor and control the activities of all the elements of a Strategic Defense System. Information from surveillance satellites, sensors and radars would be relayed to the battle managers. The information then would be processed and target assignments communicated to space and ground-based weapons. This complex communication system must be able rapidly to assess data concerning a ballistic missile attack and provide timely, reliable information to the command structure in a hostile environment. Once a defense response has been determined, the BM/C^3 system must carry out the response, assess its effectiveness, and revise the response if necessary. The BM/C^3 would have to be able to withstand enemy jamming and effects of nuclear radiation.

BM/C^3 Demonstration/Validation phase activities would include analyses, simulation, and subcomponent/assembly testing of the communications, battle management, and command and control computer hardware and software.

Prime contractors conducting various activities in the BM/C^3 research and development program are TRW Inc., Electronics and Defense Sector, Redondo Beach, Calif.; IBM Federal Systems Division, Bethesda, Md.; McDonnell Douglas Astronautics Co., Huntington Beach, Calif.; and Ford Aerospace and Communications Corp., Detroit, Mich. There is no single executive agent of the BM/C^3 program. The Air Force Systems Command executes the space-based BM/C^3 validation program, the U.S. Army Strategic Defense Command (USASDC) executes the ground-based BM/C^3 validation and the Defense Advanced Research Projects Agency (DARPA), Alexandria, Va., executes the communications/processing network experiment, called Cooperating Space System (CSS). Integration of these programs will be a principal function of the Strategic Defense Initiative Organization (SDIO) system engineering and integration activity.