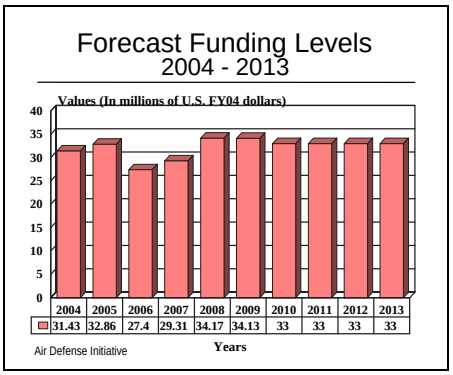
Air Defense Initiative - Archived 12/2005

Outlook

- Forecast International projects the U.S. Defense Advanced Research Projects Agency will spend some US$321.3 million on ADI over the next decade
- In 2005, look for the RF MEMS Improvement subproject to continue demonstration of the ability to fabricate low-cost, low-loss, long life MEMS switches



Orientation

Description. The Air Defense Initiative (ADI) is a research and development program of the U.S. Defense Advanced Research Projects Agency. The ADI program aims to develop technologies that counter the threat posed to North America by stealth bombers, cruise missiles, and cruise missile-capable submarines.

Sponsor

Office of the Secretary of Defense
Defense Advanced Research Projects Agency (DARPA)
Washington, DC

Status. Ongoing research and development.

Total Produced. Not applicable.

Application. Strategic air defense.

Price Range. Not applicable.

Contractors

Contractors Undisclosed, RDT+E (Ongoing RDT&E)

Technical Data

ADI is currently conceptualized as a three-layered defense. In the outer layer, engagement of threats could be carried out by hypersonic interceptors, such as the National Aerospace Plane or boost-glide vehicles, armed with long-range air-to-air missiles and/or space-based weapons. These might be space-based lasers, railguns, or kinetic kill vehicles. This outer layer extends thousands of kilometers from the continental U.S. (CONUS).

In the central layer, supersonic aircraft (e.g., the Advanced Tactical Fighter) armed with long-range air-to-air missiles, space-based DEW/KEW weapons,

and/or long-range surface-to-air missiles, would attempt to intercept remaining threats. The central layer extends hundreds of kilometers from the CONUS.

In the final inner layer, the threats that had penetrated the first two defense layers would be fired on by long-range surface-to-air missiles. Land-based, airborne, and space-based surveillance systems would identify and track threats in all three phases of battle, and transmit target information to survivable land-based and/or airborne battle management centers. The final inner layer is the airspace above the North American land mass.

Major ADI initiatives focus on four areas: battle management, surveillance, target identification, and threat simulation.

An interagency ADI steering committee has been established to ensure that the various DoD components involved in ADI research do not duplicate their efforts. The committee has no budgetary powers and can only provide advice. The panel includes the U.S. Air Force, U.S. Army, U.S. Navy, and U.S. DARPA officials. Overall direction is provided by the Office of the Secretary of Defense.

Variants/Upgrades

The objective of this program is to identify new concepts and bring them through initial development to determine their viability for future application. Consequently, no baseline has been established from which to measure the development of an upgrade or a variant. Rather, the focus is on evolving a series of candidate concepts that will be combined to achieve a viable, cost-effective ADI system architecture.

Program Review

Background. Funding for the Air Defense Initiative is provided under PE#0603762E, Project SGT-03. Project SGT-03 funding encompasses several advanced technologies for use in countering advanced battlefield threats. These technology developments are embodied in the following subprojects of Project SGT-03:

- Low-Cost Cruise Missile Defense (LCCMD),
- Affordable Large Array (ALA),
- Integrated Sensor Is Structure (ISIS),
- RF MEMS Improvement,
- Global Eye

Low-Cost Cruise Missile Defense (LCCMD). The LCCMD subproject focuses on emerging missile seeker technologies that provide cost-effective approaches to the conquest of proliferated asymmetric airborne threats. For the purpose of this report, these types of threats include cruise missiles; unmanned air vehicles; fire control, communications, and navigation systems; and low-flying manned aircraft (i.e., helicopters).

In 2001, the LCCMD subproject finished laboratory characterization testing of the eye-safe laser radar (LADAR) seeker. In 2002, the subproject conducted studies on low-cost surveillance approaches to conveying threat warnings. In 2003, the LCCMD subproject conducted a Critical Design Review of an MEMS (microelectromechanical systems) electronically scanned array (ESA) seeker.

In 2004, the LCCMD subproject worked on building active ESA antenna. In 2005, look for ESA antenna construction to continue with possible testing of the antenna.

Affordable Large Array (ALA). The Affordable Large Array (ALA) subproject is developing ultra-low-cost, lightweight, low-power-density X-band antenna technologies and components for use in large-scale phased-array antennas. MEMS and other alternative low-power module technologies can be used to produce phased-array antenna components that consume a small fraction of the power currently needed by conventional phased arrays, while being considerably lighter in weight. Using these technologies, very large-scale ESAs can be developed for multiple airborne and surface-based surveillance missions, including home-land defense against air threats.

In 2001, the ALA subproject completed the fabrication and evaluation of 100 prototype MEMS two-bit phase shifters from three contractors. Also completed were follow-on MEMS phase shifter design studies.

In 2002 and 2003, the ALA subproject conducted studies and experiments toward the development of alternative array feed technologies applicable to very large arrays. In 2004, power-aperture trade studies were conducted to determine the appropriateness of such technologies for ground-based radars and radars for mid-course cruise missile defense. No work will be conducted under the ALA subproject in 2005.

Integrated Sensor Is Structure (ISIS). The Integrated Sensor Is Structure subproject (previously called "Lightfoot Radar") will develop antenna technologies to enhance the transportability of sensor and communications systems. Program goals include a reduction in total system weight, prime power consumption, fuel requirements, and personnel requirements. The

technology will potentially benefit sensor and communications systems that are space-based, airship-based, ground-based, and hand-held.

In 2004, the ISIS subproject began developing large-scale signal distribution and single chip electronics technologies to enable extremely large low-power active array antennas. In 2005, look for the subproject to continue developing discrete switches or bi-state materials to enable steerable reflect arrays.

RF MEMS Improvement. The RF MEMS Improvement subproject will extend lifetimes, develop inexpensive packaging techniques, and enhance the RF performance of MEMS switches to allow use in devices such as phase shifters, reconfigurable apertures, and tunable filters. This program was previously funded in PE#0603739E, Project MT-12.

In 2003, the RF MEMS Improvement subproject demonstrated the ability to build low-cost, low-loss, and long-life MEMS switches. In 2004, improvements in MEMS fabrication and packaging techniques were developed. In 2005, look for the subproject to continue demonstration of the ability to fabricate low-cost, low-loss, long life MEMS switches meeting DoD requirements.

Global Eye. The Global Eye subproject is developing the critical phased-array antenna technologies and radar mode control concepts essential to the introduction of multi-aperture, multifunction radar systems in UAVs. The key technologies to be used are MEMS filters for simultaneous transmit and receive; polarization diversity, high-efficiency solid-state transmitters; composite lightweight integrated antennas; and advanced mode control/interleaving algorithms.

In 2000, the Global Eye program initiated the design of a prototype antenna as well as the design of MEMS-based filters. In 2001, the risk-reduction phased array began to be fabricated. In 2002, the program demonstrated pseudo-monostatic ESA operation using a 1-square-foot risk-reduction array. In 2003, the Global Eye program completed the development of a demonstration array. The U.S. DARPA did not request funding for the Global Eye program in 2004 or 2005.

Funding

U.S. FUNDING

	FY03		FY04(Req)		FY05(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (DARPA)						
PE#0603762E						
Project SGT-03	-	18.41	-	31.43	-	32.86

	FY06(Req)		FY07(Req)		FY08(Req)		FY09(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (DARPA)								
PE#0603762E								
Project SGT-03	-	27.40	-	29.31	-	34.17	-	34.13

All US$ are in millions.

Source: U.S. Department of Defense FY 2005 RDT&E Descriptive Summary

Recent Contracts

No recent contracts have been identified.

Timetable

Year	Major Development
FY 1986	Release of RFP for ADI Phase 1; ADI Phase 1 contract awards
FY 1987	Start of ADI Phase 2; ADI Management Plan
FY 1988	ADI integration plan
FY 1989	USN initiates development of passive acoustic signal processing and low-frequency active acoustic technologies. USAF establishes a capability to include national assets
FY 1990	Army officially becomes part of ADI effort

Year	Major Development
FY 1991	Draft Requirements Documents; Draft System Threat Assessment Report (STAR); Milestone I
FY 1997	Advanced Signal Processing program completed
FY 1998	Final system components procured, integrated, and tested for the ADSAM program
FY 1999	SAR ECCM algorithms hardware implementation begins
FY 2000	LCCMD subproject upgrades laser radar (LADAR) seeker to eye-safe frequency, redesigns the seeker to increase its acquisition range
FY 2001	LCCMD subproject finishes laboratory characterization testing of the eye-safe LADAR seeker
FY 2002	ALA subproject conducts studies and experiments to develop alternative array feed technologies applicable to very large arrays
FY 2003	RF MEMS Improvement subproject demonstrates the ability to build low-cost, low-loss, and long-life MEMS switches
FY 2004	The ISIS subproject begins developing large-scale signal distribution and single chip electronics technologies to enable extremely large low-power active array antennas
FY 2005	Look for the LCCMD subproject to continue building ESA antenna

Worldwide Distribution

U.S. and **Canada**. The defense departments of the United States and Canada have established the Aerospace Defense Advanced Technology Working Group (ADAT) to ensure total connectivity and interoperability between the two countries in the realm of North American air defense. The Canadian government is looking into two ADI-related space systems, a space radar and military satellite communications.

Forecast Rationale

The Air Defense Initiative (ADI) is a U.S. Defense Advanced Research Projects Agency (DARPA) research and development program. The Air Defense Initiative aims to develop technologies that counter the threat posed to North America by stealth bombers, cruise missiles, and cruise missile-capable submarines.

As indicated by the **Ten-Year Outlook** chart, Forecast International projects the U.S. Defense Advanced Research Projects Agency will spend some US$321.3 million on ADI over the next decade. The U.S. Department of Defense's desire to develop a first-rate missile defense system to protect the United States is driving ADI funding.

The U.S. DoD discloses very little information concerning the specifics of ADI. That said, Forecast International will continue to analyze and report U.S. Air Defense Initiative developments as they are made public.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR FUNDING (US$ in millions)

			High Confidence Level				Good Confidence Level				Speculative			
Designation	Application	Thru 03	04	05	06	07	08	09	10	11	12	13	Total 04-13
AIR DEFENSE INITIATIVE	NEW TECHNOLOGY AERIAL DEFENSE (U.S. DOD)	752.81	31.43	32.86	27.40	29.31	34.17	34.13	33.00	33.00	33.00	33.00	321.30