Electronic Warfare

H.04 Miniature Air-Launched Decoy Program ACTD

Objectives. Develop and demonstrate an affordable ($30,000 average unit flyaway price (FY95 dollars), 3,000 units) air-launched decoy system for applications in the lethal suppression of enemy air defense (SEAD) missions. The Miniature Air-Launched Decoy (MALD) will be employed to enhance the survivability of friendly aircraft by establishing air superiority through stimulating, diluting, and confusing enemy integrated air defense systems.

Payoffs. MALD is an expendable decoy and has a primary military utility in offensive operations against enemy air defense systems by diluting and confusing surface-based and airborne defenses with realistic tactical target characteristics. The MALD program is providing this low-cost, realistic tactical decoy by aggressively leveraging commercial products and processes to develop the high-performance airframe and its advanced payload. Current capability is typified by the Tactical Air-Launched Decoy (TALD)/Improved TALD (ITALD) heavy-glide/-boosted family of decoys. MALD is physically smaller (one-fourth the weight), faster, and less expensive (one-fourth the cost) than the existing family of decoys. At the end of the ACTD, 15 MALD systems will remain with the operational user for continued testing and contingency operations. An expected long-term tertiary payoff is one of MALD expansion into additional roles and missions using the existing basic air vehicle and engine design with other payloads.

Challenges. Critical to the ACTD's success is the tradeoff of affordability of the total MALD package versus its target realism in all mission scenarios (i.e., the minimum set of electronic payload complexity, such as frequency response, antenna form factors, coherent exciter techniques, and amplification technology). The MALD concept involves the integration of previously developed, advanced small-engine technology (4-inch-diameter turbojet) into a missile form factor. Thus, startup and operation of the small turbojet engine over the full flight regime is one of the two major challenges of the MALD ACTD. The second challenge is miniaturization of the complex decoy payload, its integration with the vehicle's avionics system, and the overall life-cycle reliability expected (15-year shelf life “wooden” round concept).

Milestones/Metrics.

FY2000: Continue testing support and interim capability period.

FY2001: Conclude interim capability support.

Customer POC	Service/Agency POC	USD(A&T) POC
Mr. Jim KECK HQ ACC/XRSA	Lt Col Walt PRICE, USAF DARPA/TTO	Lt Col Marty MEYER, USAF DUSD/AS&C

H.04 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0602702E	TT–06	1.9	0.0	0.0	0.0	0.0	0.0
0603750D	P523	0.6	0.0	0.0	0.0	0.0	0.0
	DTO Total	**2.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

H.05 Large-Aircraft Infrared Countermeasures ATD

Objectives. Design, develop, and demonstrate an advanced laser-based infrared countermeasure (IRCM) technology to allow for self-protection of high-IR-signature large Air Force aircraft (e.g., C–17, C–5, C–130, C–141).

Payoffs. The central program to the ATD—the Laser IRCM Flyout Experiment (LIFE)—will demonstrate closed-loop IRCM (CLIRCM) capability for transition to engineering development and preplanned product improvement (P^3I). The coupling of advanced laser source technologies (solid-state, advanced solid-state, or semiconductor) with active aimpoint tracking of inbound threat missiles shows promise of a tenfold increase in jam-to-signal ratio and a significant reduction in missile engagement times. Such figures are necessary to protect large multiengine aircraft throughout their range of mission profiles from the proliferated IR missile threat. This advanced capability can result in a robust IRCM system that will protect large-signature transport and special forces aircraft well into the 21st century. The bottom-line benefit to the warfighter will be increased survivability of those platforms and the ability to successfully prosecute the mission.

Challenges. Currently fielded and developmental IRCM systems are designed to protect lower-signature and suppressed platforms using a combination of coherent or noncoherent sources, and an open-loop IRCM capability against a limited threat list. The increased signature of large aircraft requires that the intensity of the IRCM source(s) be increased and more efficient jam codes be implemented. CLIRCM techniques offer an increased capability by protecting larger-signature aircraft from a wide variety of threats. Technical risks and challenges associated with a CLIRCM system include long-range missile warning in the presence of IR clutter to enable threat engagement at long ranges, pointing and tracking stability consistent with the narrow laser beams used in CLIRCM, development of an all-band laser capability, reduced pointer/tracker size, and demonstration of CM timelines consistent with real-world scenarios (single- and multiple-threat launches) that will protect the full range of large aircraft missions.

Milestones/Metrics.

FY2000: Demonstrate effectiveness during live-fire air-to-air missiles against LIFE testbed. Demonstrate real-time CM effectiveness and 5:1 reduction in engagement timeline. Demonstrate laser-based jamming using CLIRCM technique during live-fire SAM flyouts at White Sands Missile Range (WSMR) cable car. Demonstrate sufficient laser intensity to protect large aircraft IR signature (10–100X greater than suppressed helicopter and SOF aircraft).

FY2001: Conduct airborne tests against captive-carry missiles and seeker test vans.

Customer POC	Service/Agency POC	USD(A&T) POC
Col James RIVARD, USAF HQ AMC/XPR	Maj Deanna WON, USAF SAF/AQRT	Mr. Lou LOME DUSD/S&T/SS

H.05 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603270F	691X	4.0	1.1	0.0	0.0	0.0	0.0
	DTO Total	**4.0**	**1.1**	**0.0**	**0.0**	**0.0**	**0.0**

H.07 Enhanced Situation Awareness Demonstrations

Objectives. Design, develop, and demonstrate hardware and software approaches and techniques to provide aircrews (tactical, strategic, airlift, and special operations) timely, enhanced threat alert (TA) and situation awareness (SA) (defensive), and retargeting and retasking (offensive) capabilities.

Payoffs. The emphasis of this DTO is on evolution and direct application of previously developed, automated decisionmaking algorithms hosted by commercial off-the-shelf, real-time symmetric multiprocessing (RTSMP) computer/open architecture; and integration with onboard sensor and offboard information (data, C^2, imagery) correlation techniques. Enhanced situation awareness (ESA) demonstrations will show automated aircrew defensive TA/SA and real-time retargeting; a hundredfold increase in processor throughput and associated reduction in pilot workload; and a significant acceleration of automatic, enroute correlation of all available offboard and onboard aircraft mission information (e.g., threat emitter laydown, mission tasking, precision targeting, defensive response/EW management). This DTO expands upon initial real-time in- and out-of-the-cockpit (RTIC/RTOC) information capabilities.

Challenges. During mission execution and engagement phases, aircraft survival and successful weapon delivery depend on aircrew SA, which hinges on timely and accurate information. Currently, threat and target information is primarily supported by pre-mission planning functions, yet is often colored by aged or inaccurate intelligence and battle damage assessments. Updates to the cockpit are relayed by voice communications (if and when permitted by mission OPSEC/COMSEC). Aircrew TA/SA is limited by existing onboard sensor ranges and is further constrained by current weapon systems with very limited capabilities for both over-the-horizon targeting and real-time mission updates from offboard information sources. The critical challenge of this DTO is to assimilate onboard sensor reports (both defensive and offensive) with all available in-theater battlespace information, and subsequently, automatically advise the aircrew with the timely defensive situation, response options, and updates to offensive mission posture, profiles, and priorities.

Milestones/Metrics.

FY2000: Demonstrate F–117 RTOC with RTSMP and mission management system using low-probability-of-detection waveform. Integrate upgraded, re-hosted RTSMP with Italian massively parallel “Quadrics” processor for unprecedented avionics computing capability in flightworthy RTSMP form factor.

FY2001: Demonstrate F–15E fusion of onboard SAR/FLIR data with offboard JSTARS imagery via ESA RTSMP. Demonstrate U.S./Italian avionics processor in coalition European theater flight demonstrations. Conduct demonstrations in collaboration with warfighter (USAEF) to provide maximum operational relevance.

FY2002: Ground demonstration of multiple ship, multisource/multisensor (two offboard and two onboard) defensive and offensive ATR data. Demonstrate RTIC and RTOC with AC–130U gunship and A–10.

FY2003: Demonstrate fusion of F–15E onboard SAR/FLIR data with offboard JSTARS and F–15E wingman RTIC products, including imagery via RTSMP in both laboratory and flight test environments. Conduct multiple-ship flight demonstration of internetted RTIC and RTOC capabilities.

FY2004: Conduct internetted multiple-ship RTIC/RTOC flight demonstration in a joint/coalition environment.

Customer POC	**Service/Agency POC**	**USD(A&T) POC**
Lt Col Mike KEMERER, USAF HQ AFSOC/XPQE	Maj Deanna WON, USAF SAF/AQRT	Mr. Lou LOME DUSD/S&T/SS
Mr. Jeff STANLEY AFRL/SNZ		

H.07 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603203F	69DF	1.0	1.4	1.9	1.0	1.0	0.0
	DTO Total	**1.0**	**1.4**	**1.9**	**1.0**	**1.0**	**0.0**

H.07 Non-S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
Nunn	N/A	1.5	0.0	0.0	0.0	0.0	0.0
	DTO Total	**1.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

H.08 Onboard Electronic Countermeasures Upgrade ATD

Objectives. Maximize the defeat of the threat in the acquisition and track phases of target tracking radar engagement prior to missile launch. This ATD focuses on the first of a two-tiered goal to increase survivability of friendly aircraft against an RF-guided missile threat. These goals are to (1) prevent hostile forces from obtaining a valid RF-guided missile firing solution through achievement of track denial or angle breaklock, and (2) counter those missiles that are launched through endgame countermeasures means. The ATD will develop and demonstrate a robust, affordable, monopulse radar angle breaklock technique. This specific high-payoff, single-aircraft, low-effective-radiated-power (ERP) jamming technique is named the "Monopulse Angle Jamming Integrated Countermeasure" (MAJIC).

Payoffs. A robust, self-protection angle breaklock capability against modern monopulse RF weapon systems significantly contributes to aircraft survivability and, thus, mission accomplishment. The major metric to be demonstrated during the ATD flight test is the reduction of missile launch opportunities by 90%. The combination of a 90% reduction in missile launch opportunity and endgame coverage from existing towed decoy self-protection systems against the 10% of missiles actually launched should greatly enhance survivability. MAJIC is potentially applicable to integration with the AN/ALQ–131, –135, –172, and –184 self-protection systems, and the Integrated Defensive Electronic Countermeasure (IDECM) System. The current approach is to conduct critical risk reduction experiments, including digital simulations and ground-to-ground/air-to-air brassboard tests against key radars, followed by the ATD flight test. The flight test is envisioned to take place using an ALQ–172 on a C–130.

Challenges. The main challenge is to develop and demonstrate a wideband architecture that successfully implements the MAJIC technique. The system architecture design must be effective against various implementations of monopulse tracking techniques.

Milestones/Metrics.

FY2000: Demonstrate 90% angle breaklock metric for three radar types in ground-to-ground tests. Demonstrate 90% metric for one radar in ground-to-air test.

FY2001: Digital simulation of aircraft installation effects on MAJIC. Design scaled air-to-air brassboard system.

FY2002: Fabricate air-to-air brassboard system.

FY2003: Conduct air-to-air tests against three ground and one airborne radar systems.

FY2004: Begin ATD. Design brassboard.

FY2005: Fabricate brassboard. Conduct digital simulation.

Customer POC	**Service/Agency POC**	**USD(A&T) POC**
Lt Col Mike KEMERER, USAF HQ AFSOC/XPQE	Maj Deanna WON, USAF SAF/AQRT	Mr. Lou LOME DUSD/S&T/SS

H.08 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603270F	431G	0.5	2.3	3.0	1.2	1.6	0.0
	DTO Total	**0.5**	**2.3**	**3.0**	**1.2**	**1.6**	**0.0**

H.10 Precision EW Situation Awareness, Targeting, and SEAD Demonstrations

Objectives. Provide ground vehicles and rotary-wing, tactical, and special operations aircraft with the precision location of emitters for situation awareness, targeting, and combat ID assistance. A coordinated multiservice program will develop and demonstrate those technologies needed for the uniquely different characteristics and missions of the subject air platforms and ground vehicles.

Payoffs. By increasing the number of electronic support (ES) sensors in the tactical-level battlespace via the networking of platforms equipped with passive detection and accurate space–time reference (STR) systems, the warfighter will be provided with an unambiguous and unified picture of the battlefield with unprecedented targeting fidelity. The Army's Integrated Situation Awareness and Targeting (ISAT) ATD program pursues the modular integration of the RF, IR, and EO spectrums to produce that picture for the "low/slow" movers (rotary-wing and ground vehicles). ISAT will enable reduced decision timelines for defensive/offensive actions, target acquisition and identification, and antifratricide; it is intended for future upgrade programs (ALQ–211, –212, AVR–2A, and VVR–1). From the "high/fast" electronic combat suppression of enemy air defense (EC SEAD) perspective, missions today are accomplished in the face of new electronic order-of-battle and enemy air defender tactics and with a reduced U.S. force structure that has all but eliminated dedicated SEAD aircraft. The AF Precision Location and Identification (PLAID) program capability (unambiguous radar warning/threat geolocation (e.g., ALR–69, –56 C/M)) will feed an advanced SEAD targeting (AST) effort to pursue electronic-support (ES)-based precision targeting. Intended for existing multimission/multirole airframes, AST will specifically enable the use of shoot-to-coordinate precision-guided munitions, thereby negating emitter shutdown tactics. In addition, the PLAID system has entered into an engineering and manufacturing effort for insertion into the ALR–69 Radar Warning Receiver.

Challenges. Detection and discrimination of SAMs and AGMs with terrain maps to geolocate launch sites will be the principal challenge for the multispectral sensor low/slow applications. The sensors must operate under all battlefield atmospheric and environmental conditions (rotary-wing/ground vehicle). Receiver architectures capable of the precision time of arrival (TOA)/time difference of arrival (TDOA) and the required fine frequency measurements stress the limits of sub-nanosecond digital receiver parameter measurement technology. Unconstrained air engagement geometries dictate high-sensitivity approaches in order to conduct missions in emitter sidelobes. STR and precision clock technologies for real-time data alignment are critical to the 7D (time, position, and velocity) registration of the air battlespace. Finally, C^3 datalink techniques are critical to minimizing latencies in distributed ES collection management and coordination of receiver dwells among multiple platforms.

Milestones/Metrics.

FY2000: Demonstrate AST critical component capabilities to resolve high-priority ambiguities greater than or equal to 95%. Conduct real-time ISAT DIS experiments for 10X increase in target location accuracy under operations on the move.

FY2001: AST ground demonstration of hardware and software. System Integration Laboratory/Digital Integrated Laboratory demonstration for off-axis laser detection model and geolocation fusion algorithms for RF, IR, and laser sensors with terrain map.

FY2002: AST flight demonstration of emitter geolocation to 50 m in less than 10 s at 50 nmi. Conduct ISAT rotary flight test and ground vehicle testing. Geolocate radars to 1% range out to 20 km, and missile launches to 10% of range.

Customer POC	**Service/Agency POC**	**USD(A&T) POC**
Mr. Don HUBLER PM–ASE	Mr. Rob SAUNDERS SARD/TT	Mr. Lou LOME DUSD/S&T/SS
Mr. Jim KECK HQ ACC/XRSA	Maj Deanna WON, USAF SAF/AQRT	

H.10 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603270A	K16	7.6	8.3	5.4	0.0	0.0	0.0
0603270F	2432	1.4	2.6	2.0	0.0	0.0	0.0
0603762E	SGT–01	4.1	0.0	0.0	0.0	0.0	0.0
	DTO Total	**13.1**	**10.9**	**7.4**	**0.0**	**0.0**	**0.0**

H.12 Modular Directed Infrared Countermeasures

Objectives. Design, develop, and demonstrate an advanced laser-based infrared countermeasure (IRCM) and missile warning sensors to allow for self-protection of both high-IR-signature (e.g., F–18E/F, AV–8B) and rotary-wing tactical aircraft against surface-to-air and air-to-air missiles (SAMs/AAMs), and of ground vehicles against antitank guided missiles (ATGMs).

Payoffs. The central thrust of this DTO is to demonstrate the capability of existing technologies to protect tactical aircraft (high-performance fast movers) and tactical rotary-wing aircraft against SAMs and AAMs, and ground vehicles against ATGM threats for transition into engineering development and preplanned product improvement (P^3I). The coupling of advanced two-color IR missile warning technology (including integrated laser warning) with a small, aerodynamic laser-based jamming system and advanced expendables offers a tenfold increase in jam-to-signal ratio and a significant reduction in false-alarm rates compared to existing systems. Such figures are necessary to protect fast-moving tactical aircraft throughout their range of mission profiles from the proliferated IR missile threat. This advanced capability can result in a robust IRCM system that will protect high-performance tactical aircraft well into the 21st century. The bottom-line benefit to the warfighter will be increased survivability of those platforms and the ability to successfully prosecute the mission. Additional payoff of this effort is to provide horizontal technology integration for the follow-on Common Air-Ground Electronic System (CAGES) program. CAGES will provide for a common "plug-and-play" capability for EW sensors and countermeasure devices for both aircraft and ground vehicles.

Challenges. Currently fielded and developmental (6.4) missile warning and IRCM systems are designed to protect lower-signature and suppressed platforms against a limited threat list. These systems use a combination of coherent or noncoherent sources that result in a relatively large jammer that protrudes into the airstream. The increased signature and high-velocity nature of tactical aircraft requires that the intensity of the IRCM source(s) be increased and a smaller, more aerodynamic design be implemented. Two-color infrared missile warning systems provide long detection range and low false-alarm rates against a much broader class of threats. Technical risks and challenges associated with an open-loop implementation include pointing and tracking stability consistent with the narrow laser beams used in the system. Further challenges include reduced pointer/tracker and missile warning sensor size, and demonstration of CM timelines consistent with real-world scenarios (single- and multiple-threat launches) that will protect the full range of tactical aircraft missions.

Milestones/Metrics.

FY2000: Demonstrate system effectiveness during live-fire SAM and AAM missiles against QF–4 drone aircraft. Demonstrate real-time CM effectiveness and 2:1 reduction in engagement timeline.

FY2002: Demonstrate greater than 90% effectiveness against both SAMs and ATGMs at White Sands Missile Range live fire.

Customer POC	Service/Agency POC	USD(A&T) POC
Mr. Don HUBLER PM–ASE	CAPT Dan GAHAGAN, USN ONR/EWO	Mr. Lou LOME DUSD/S&T/SS
CDR Joel SEWELL, USN PEO–T, PMA–272	Mr. Rob SAUNDERS SARD/TT	

H.12 S&T Funding ($ millions)

PE	Project	FY00	FY01	FY02	FY03	FY04	FY05
0603270A	K16	1.4	1.7	1.9	0.0	0.0	0.0
0603270N	E2194	4.3	0.0	0.0	0.0	0.0	0.0
	DTO Total	**5.7**	**1.7**	**1.9**	**0.0**	**0.0**	**0.0**