Chapter 4 - Army AMD Initiatives

INTRODUCTION

Work is underway to investigate concepts and potential doctrine, training, leader development, organization, and materiel (DTLOMS) solutions for the AMD force. The AMD force needs leap-ahead innovations and better applications of technologies to successfully face the challenges posed by future air threats and austere friendly force strengths. This chapter addresses some materiel initiatives that could significantly increase the AMD warfighting capability by 2010, and others that could support Full Spectrum Dominance for AMD in the AAN (circa 2025). Discussion focuses on the S&T process and its support to materiel modernization plans; technologies, experiments, and demonstrations under investigation for the near term; and research and development applicable to AMD for the AAN.

PROCESS

Future capabilities are attained through a process of defining requirements and determining solutions across the DTLOMS spectrum. Combat and materiel developers initiate and guide AMD improvements through investigations and experiments with new technologies, tactics, techniques,

Chapter 4 Key Points

- The S&T process supports efficient AMD materiel modernization opportunities.
- The AMD future operational capabilities guide materiel development efforts.
- Experiments and demonstrations, enabling user and developer cooperation, are critical to the materiel development process.
- AMD technological initiatives to support the AAN will emphasize *Protect the Force* from all aerial threats.

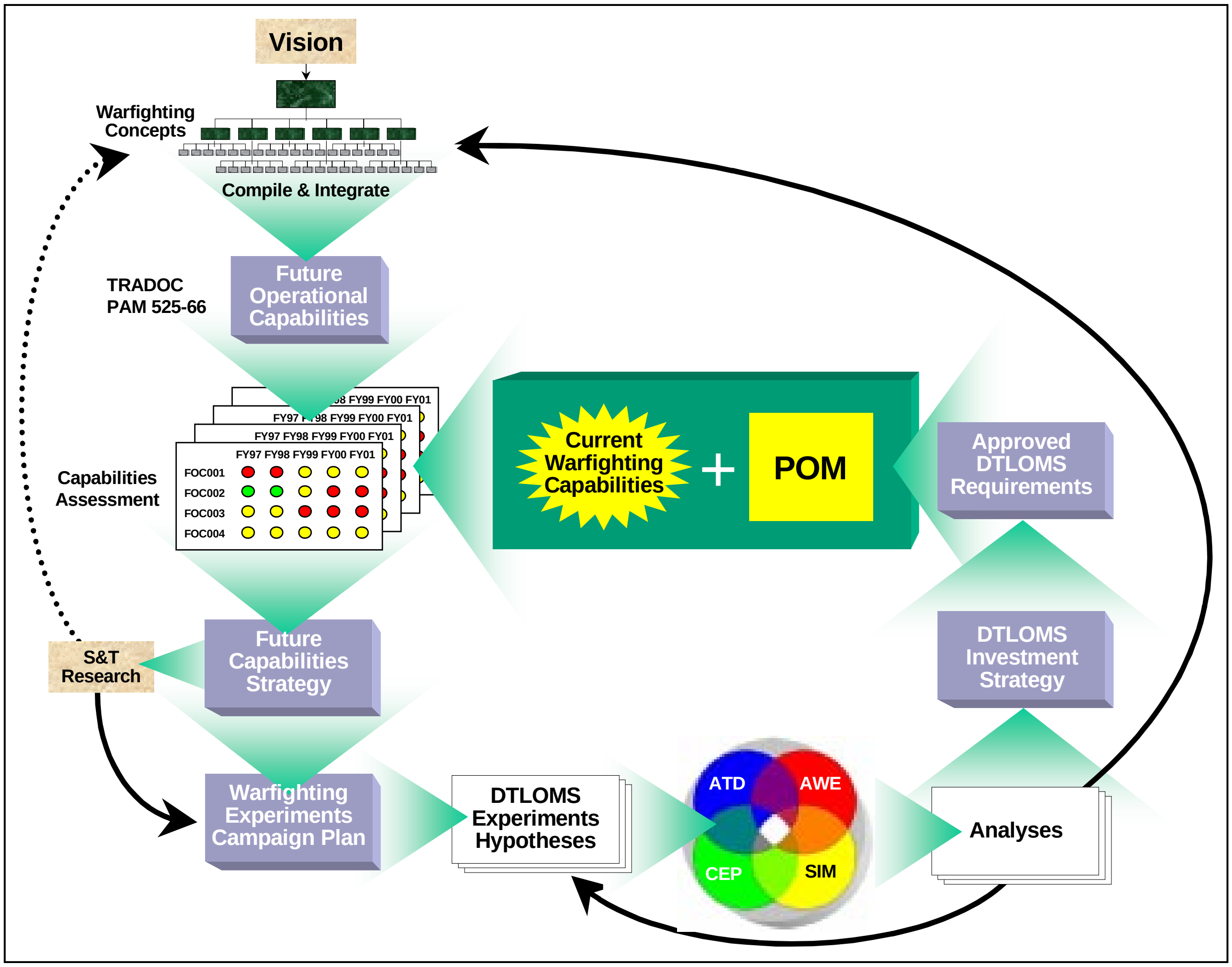

Figure 4-1. Requirements Determination Process

and procedures. Insights learned lead to refined requirements or opportunities for technology application. When promising initiatives surface, developers endeavor to incorporate relatively mature technology into ongoing acquisition programs through product improvements or the warfighter rapid acquisition program (WRAP). Technology requiring more development may warrant future investment in a new program start. The relationship of the requirement determination and acquisition processes appears in Figure 4-1.

The USAADASCH Directorate of Combat Developments (DCD) continuously interfaces with SMDC, the U.S. Army Materiel Command (AMC), the Army Research Laboratory (ARL), the Defense Advanced Research Projects Agency (DARPA), National Labs, and industry to examine new concepts and technologies and to conduct experiments, under the U.S. Army Training and Doctrine Command (TRADOC) S&T process, to stimulate innovative thought and improve future AMD warfighting capabilities. The SMDC Space and Missile Defense Battle Lab similarly develops concepts, examines technologies, and participates in warfighting experiments related to space and missile defense integration. Furthermore, the PEO

AMD incorporates new technologies to improve the capabilities of developing systems. These efforts will determine the most feasible development options and enable the application of capabilities for an effective AMD force in the AAN.

FUTURE OPERATIONAL CAPABILITIES

Future operational capabilities (FOCs), as presented in the TRADOC Pamphlet 525-66, are TRADOC schoolhouse- and battle lab-generated statements of operational capabilities required by the Army to develop the warfighting concepts approved by the TRADOC Commander. FOCs provide the operational reference to guide government and industry research and development efforts. While FOCs address warfighting capabilities across all DTLOMS domains, this chapter emphasizes materiel development.

The AMD FOCs are inextricably linked to the patterns of operation and the required operational capabilities presented in Chapter 3. The patterns provide the operational foundation. The FOCs and required operational capabilities present the desired and necessary mission functions to enable overmatching AMD capabilities. Ideally, FOCs and required operational capabilities are identical. However, the required operational capabilities have, to date, evolved as more discrete requirement statements. The FOCs will steer and challenge the technology communities within government and industry as they anticipate the Army's needs in the next century.

Thirteen AMD FOCs provide the framework for the ensuing discussions. Abbreviated descriptions of these FOCs appear in Figure 4-2. Details of the FOCs, presented in TRADOC Pamphlet 525-66, can be accessed on the TRADOC homepage (**http://www.tradoc.army.mil/tpubs/pamndx.htm**).

FOC	Description
Deployability	Capability for systems to rapidly deploy and employ.
Mobility	Capability for systems to increase their tactical mobility (mobility comparable to the supported systems).
Munitions	Capability for systems to provide overmatching lethality; increase range, kinetic kills; allow for high firepower with low-cost-per-kill intercepts.
Fused and Correlated Situational Awareness	Capability for real-time fusion and correlation of information from all sources (interoperable C^2 systems; timely and near instantaneous decision process).
Decision Support Software and Tactical Planning Aids	Capabilities for technologies to reduce engagement times and enhance the planning process; operate en route and on the move; embedded tools for mission rehearsal and analysis.

FOC	Description
Classification, Discrimination, Identification and Correlation of Information	Capability to classify, discriminate, identify and correlate threat platforms; sharing of information to allow slave-to-cue engagements while ensuring fratricide avoidance.
Sensors	Capability for future sensors to "know more and to know it sooner;" enhancements through signal processing techniques, rapid data exploitation, and auto target recognition.
Air and Missile Defense Systems Survivability	Capability to protect AMD weapons/information systems from electronic warfare, lasers, ARMs, high-power microwaves.
Robotics	Capability for systems to operate through remote control unmanned platforms; more mobile and compact systems, able to survive more intensive environments.
Air and Missile Defense Sustainability	Capability for built-in test equipment and real-time remote diagnostics; use of common parts and maintenance equipment; standard munitions handling items and reduced munition size.
Early Warning	Capability to provide early warning and target data for all threats.
Counter Aerial and Space-Based RSTA Platforms	Capability to deploy day/night and all weather systems countering RSTA platforms; employ high-power microwave, lasers, low-cost kinetic munitions and computer data warfare to conduct information warfare.
Live Virtual Battlefield	Capability to exploit the live and virtual battlefield; use of symbology (virtual display helmet) and sensors to provide target identification and auto-targeting data.

Figure 4-2. AMD FOCs

ARMY VISION 2010 INITIATIVES, EXPERIMENTS, DEMONSTRATIONS

The primary focus of experiments and demonstrations is to showcase the feasibility of a technology to meet military needs (Figure 4-3). Demonstrations are frequently used to validate the maturity of a technology within an operational environment (advanced technology demonstrations [ATDs]), or to integrate maturing advanced technologies into real-time operational scenarios (advanced concept technology demonstrations [ACTDs]). ATDs are risk-reducing, integrated, "proof-of-principle" demonstrations to help near-term system developments satisfy specific operational capabilities. The warfighter uses ACTDs to evaluate the military utility of proposed solutions and to develop appropriate concepts of operation that optimize the effectiveness of the capability. ACTDs provide insights for the generation or refinement of requirements and may provide residual operational capabilities to the sponsoring user. TRADOC and the materiel developer jointly develop ATD and ACTD demonstration plans. Advanced warfighting experiments (AWEs), battle

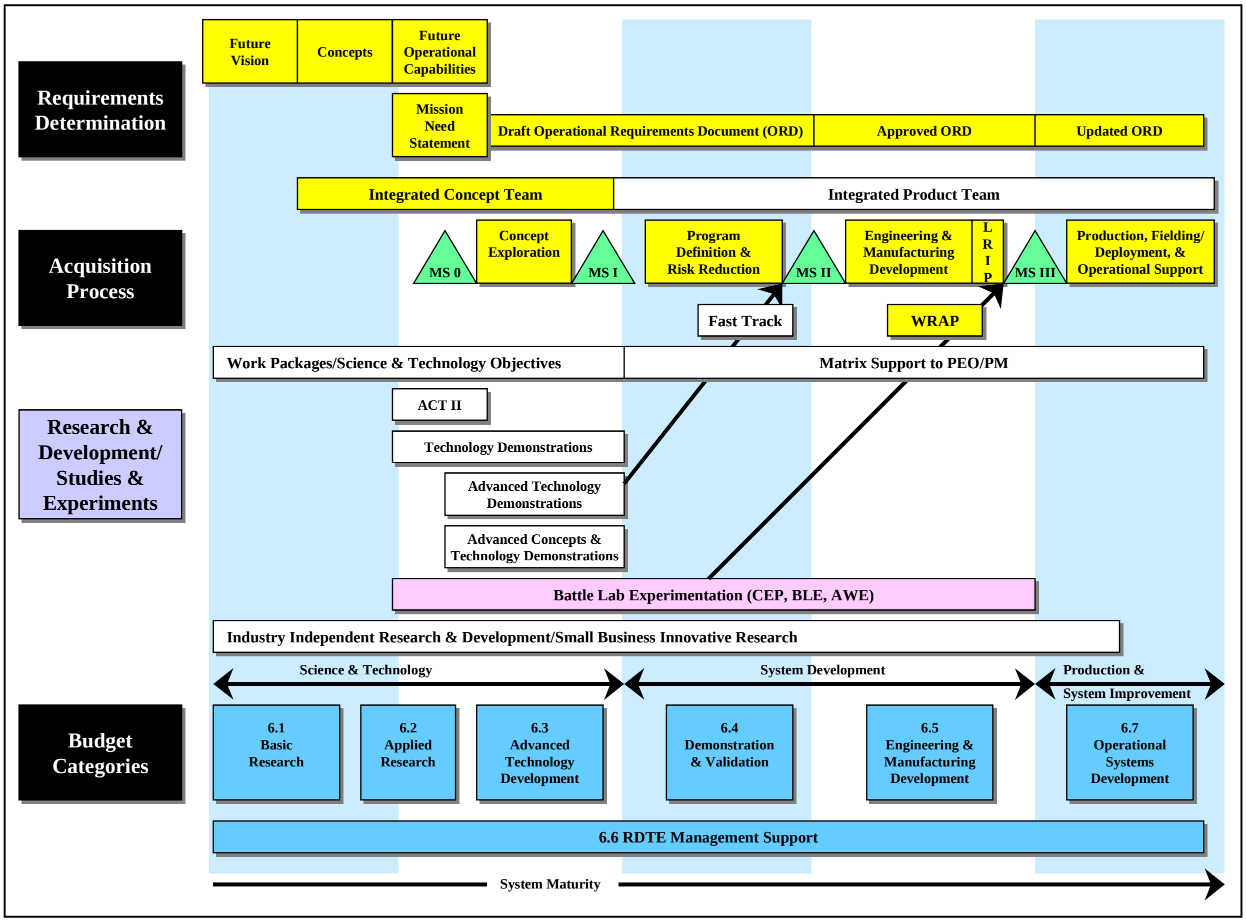

Figure 4-3. Experimentation and Technology Demonstration Relationships

lab warfighting experiments (BLEs), concept evaluation programs (CEPs), and Advanced Concept Technology II programs also provide opportunities to showcase new technologies. The innovations that result from these demonstrations directly support Army Vision 2010 and Joint Vision 2010 operations and the AAN.

The following paragraphs present near-term technology initiatives and their correlation to the AMD FOCs. This summary offers a glimpse of the ongoing research within SMDC, ARL, DARPA, and the AMC Research, Development and Engineering Centers (RDEC) to meet the FOCs. These are just a few examples; they are not presented in any order of priority. More detailed descriptions of AMD and space technology initiatives appear in the "Army Science and Technology Master Plan" and the "SMDC Missile Defense & Space Technology Plan for FY99."

SWORD

Short-Range Missile Defense with Optimized Radar Distribution (SWORD) is an SMDC program that examines the potential to provide a mobile, all-weather, close-in defense against short-range rockets, air-to-ground missiles, CMs, and UAVs. This program leverages interferometric radar and gigahertz signal/data fusion technologies, high-speed processors, and improved kill devices for increased lethality against smart and multiple targets. (Applicable FOCs are Munitions and AMD Systems Survivability.)

Small Low-Cost Interceptor Devices

DARPA is sponsoring an independent industry study to engineer and develop small-scale, kinetic energy (KE), hit-to-kill (HTK) weaponry for the defense of armored vehicles from high-energy anti-tank missiles. Studies show that such a device, at short ranges, could protect critical AMD assets (e.g., radars and operations centers) from ARMs, TASMs, rockets, and indirect artillery fire. Operating in split-second time regimes, Small Low-Cost Interceptor Devices (SLIDs) provide the "final protective fires" to defend against threats that no other system can currently counter. (Applicable FOCs are Munitions and AMD Systems Survivability.)

JLENS

The JLENS Project Manager's mission is to develop a system that provides both over-the-horizon surveillance and precision fire control data for AMD systems performing CM defense. JLENS is a large, unmanned, elevated search and fire control sensor supported by a tethered helium balloon moored to the ground by a cable (Figure 4-4). From its position above the battlefield, JLENS detects and tracks targets normally masked from a ground-based sensor. Tracking incoming CMs allows their engagement by surface-based AMD systems, typically beyond the horizon – well before organic system radars can see the targets. JLENS has several characteristics that make it especially suited to CM defense. It is less expensive to buy and operate than fixed-wing aircraft and has

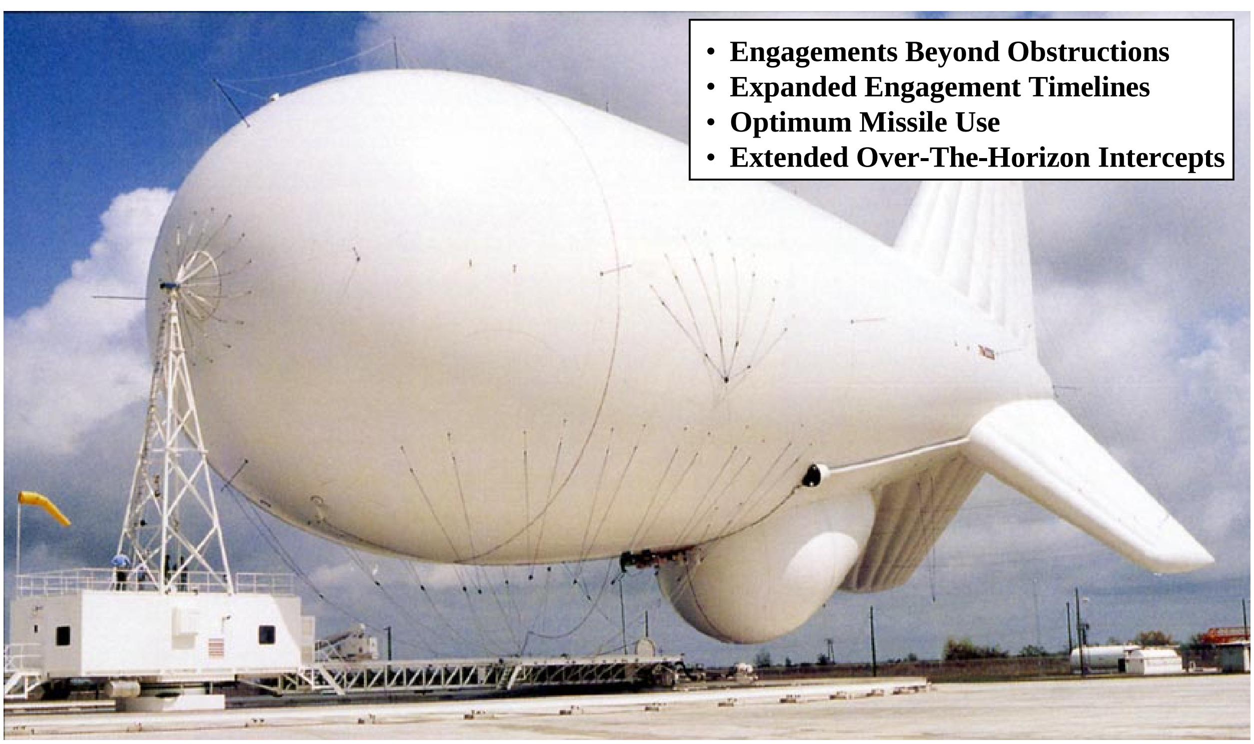

Figure 4-4. JLENS

comparable sensor capabilities. It can stay aloft for up to 30 days, providing 24-hour coverage over extended areas.

JLENS distributes information via the JDN. JLENS will be netted with in-theater sensors, initially via the cooperative engagement capability (CEC) network and objectively with the conceptual JCTN. The CEC will fuse the measurement data from JLENS sensors with other land, sea, air, and space sensors to facilitate development of an SIAP and to provide early warning, cueing, and engagement fire control quality tracks for possible AMD non-line-of-sight engagements. The JLENS sensor classification, discrimination, and identification (CDI) data will also be fused via composite identification processing to support identification determinations in distributed C^2 nodes.

Other JLENS missions could include fire support, battlefield CDI, communications relay, and battlefield situational awareness. (Applicable FOCs are Sensors and CDI and Correlation of Information.)

PATRIOT Engage on Remote of CM Targets

This underway Ballistic Missile Defense Organization (BMDO)-sponsored program will develop an interface between a PATRIOT battery and the CEC system. This interface will provide the PATRIOT system with composite, fire control quality track data to support engagements of low-flying CMs that are non-line-of-sight from the PATRIOT radar but detected, tracked, and identified by other land-, sea-, or air-based CEC-netted sensors.

Prototype CEC-to-PATRIOT interface demonstrations (Mountain Top-96 and All Services Combat Identification Evaluation Team [ASCIET]-97) have shown that CEC composite track data is of sufficient quality to support PATRIOT engagements. The PATRIOT-to-CEC interface will be further tested at the ASCIET field evaluations in March 1999. An engage-on-remote exercise – a PAC-3 missile intercepting a non-line-of-sight CM – is planned for late FY00. (Applicable FOCs are Fused and Correlated Situational Awareness, Sensors, CDI and Correlation of Information, and Early Warning.)

Tactical High-Energy Laser

The United States and Israel initiated the cooperative Tactical High-Energy Laser (THEL) Demonstrator ACTD (Figure 4-5) on 18 July 1996. THEL is a high-energy laser weapon system that uses proven laser-beam generation and beam-pointing technologies, and existing sensors and communication networks to provide a new active defense capability in counterair missions. THEL provides an innovative solution for the acquisition and close-in engagement problems associated with short- to medium-range threats, thereby significantly enhancing coverage of combat forces and theater-level assets. THEL's projected low cost per kill (a few thousand dollars per shot) will also provide an economical defense against a multitude of air threats.

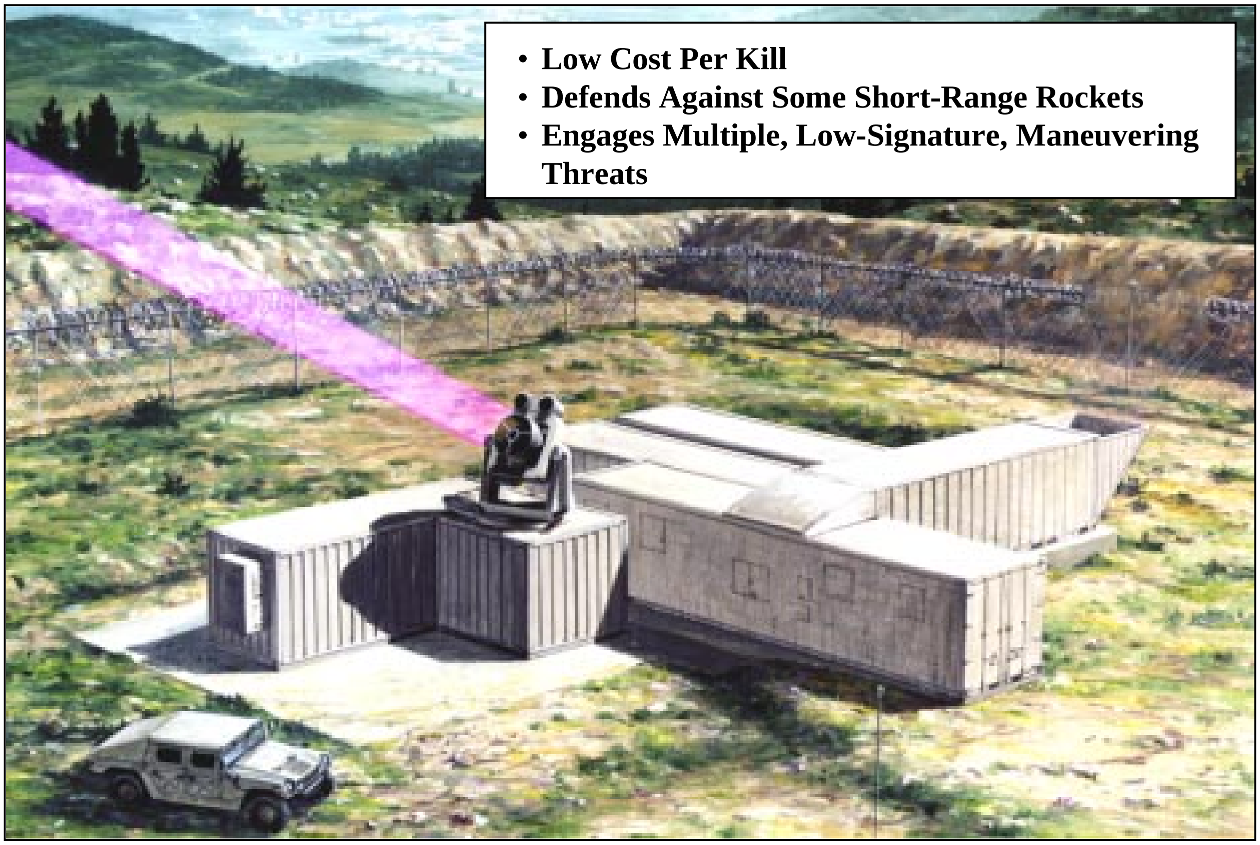

Figure 4-5. Tactical High Energy Laser

A joint U.S.-Israeli program has been initiated to develop a THEL demonstrator using deuterium-fluoride chemical laser technologies. The U.S. and Israeli THEL team members completed a concept design review for the demonstrator in Israel. Designing and building the system requires approximately 21 months, followed by 12 to 18 months of field testing at the High-Energy Laser Systems Test Facility in Israel. As currently scheduled, this program will deliver a THEL demonstrator in early FY99 with a limited operational capability to defend against short-range rockets. (Applicable FOC is Munitions.)

HMMWV-Mounted Medium-Range Air-to-Air Missile

Leveraging efforts being conducted under a combined Marine Corps and DARPA project, this AMCOM RDEC-development mounts an advanced medium-range air-to-air missile (AMRAAM) variant on a high mobility, multipurpose wheeled vehicle (HMMWV) – creating a potentially highly potent surface-to-air weapon system for the division (Figure 4-6). The current HMMWV-Mounted Medium-Range Air-to-Air Missile (HUMRAAM) is a fixed azimuth, fixed (30-degree) elevation firing platform. HUMRAAM is a “plug-in” to any existing sensor network and C^2 architecture. Any sensor that has

Figure 4-6. HUMRAAM

reasonable accuracy and data latencies can cue HUMRAAM to the target.

The USAADASCH Air Defense Battle Lab Support Element executed a live experiment at the SHORAD/McGregor Range on 16 July 1998. The objective of the experiment was to determine if the HUMRAAM could conduct a non-line-of-sight engagement. Sentinel provided the air picture, via the FAAD C^2 network (using EPLRS radios) to the launcher. The data was then translated into the USMC data link that provided the firing commands through the launcher to an off-the-shelf AMRAAM missile. Sentinel was positioned so it could see the target and communicate with the launcher, but the launcher did not have line-of-sight to the target. The experiment was successful; HUMRAAM had a direct hit at a range of about 15 kilometers. (Applicable FOCs are Munitions and Mobility.)

All-Radiation Antimissile System

The All-Radiation Antimissile System (ARAMS) program is a joint venture between the USAADASCH Air Defense Battle Lab Support Element, Technica Incorporated, and the U.S. Air Force Academy to explore the feasibility of radiation and microwave propagation as a directed energy weapon. (Applicable FOC is Munitions.)

JOINT BM/C⁴I INITIATIVES

Battle Management (BM)/C^4I is key to joint force integration and the realization of 2010 warfighting capability objectives. The Joint Theater Air and Missile Defense Organization (JTAMDO) and BMDO have identified critical BM/C^4I enabling capabilities and technologies to achieve the 2010 objectives. Capabilities are grouped under battle management, vertical and horizontal integration of systems (for theater-level defense and for information management), C^4I, and data links. The enabling technologies focus on two primary areas – battle management and integration architectures.

Key technology thrusts include the JPN, JDN, and JCTN. These networks, tailored to respond to the time criticality of the information they are processing or communicating, will accomplish the objective of getting the right information to the right user in time for that user to use it most effectively. In addition, these nets will provide AMD-relevant information to the theater common operational picture (COP) and common tactical picture (CTP) and to develop the theater SIAP (Figure 4-7). Collectively, the COP, CTP, and SIAP provide full situational awareness to commanders and executors at all echelons.

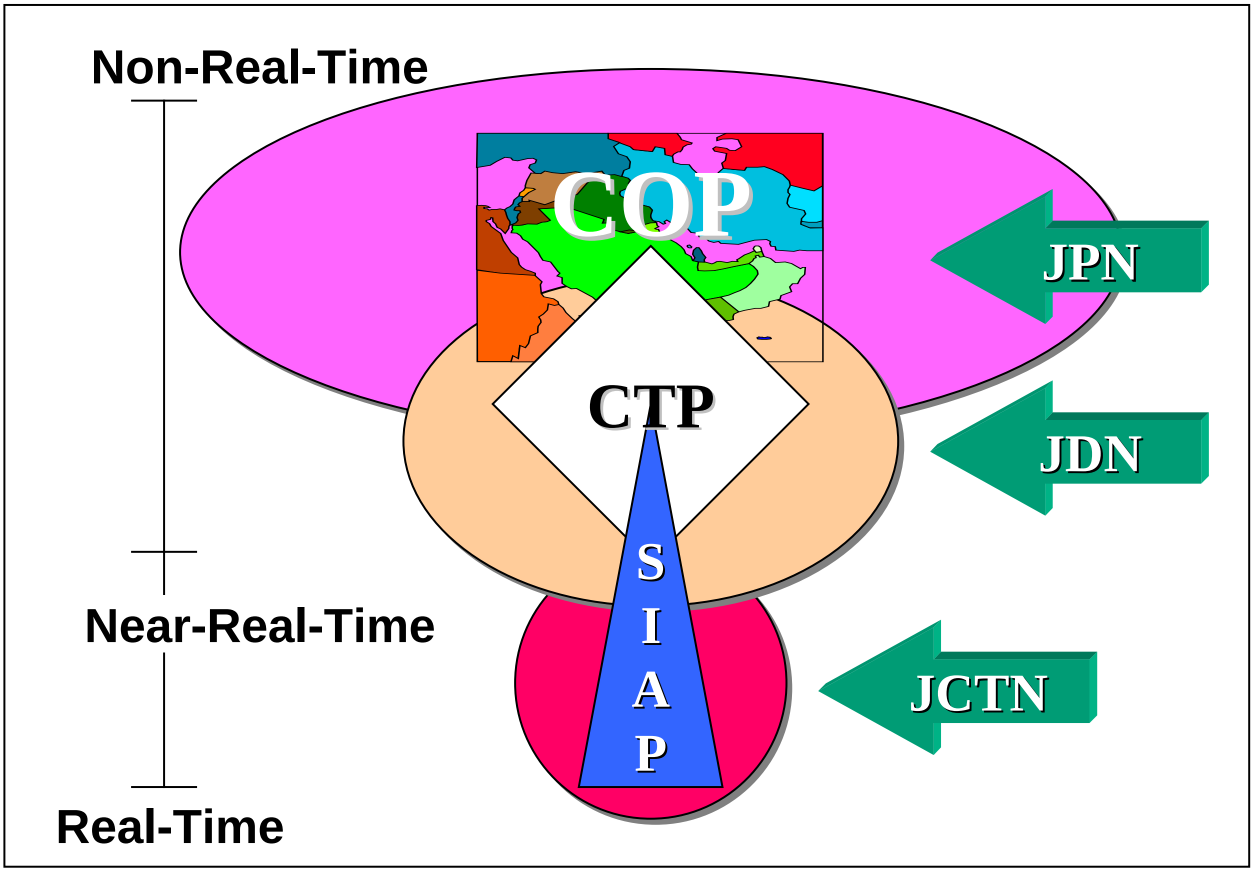

Figure 4-7. Situational Awareness Pictures

JPN is the collection of non-real-time and near-real-time communications and information systems used to execute planning throughout the theater. It provides a distributed collaborative planning capability, automated decision aids, and a means for distributing plans. The core of the JPN is the Global Command and Control System operating in the Defense Information Infrastructure Common Operating Environment (DII COE). The Joint Defensive Planner (JDP), a DII COE-compliant planning tool, will be used by all JTAMD echelons and services for integrating JTAMD planning in theater.

JDN consists of near-real-time communications and information systems used primarily at the coordination and execution level. It provides information exchange necessary to facilitate joint and service battle managers' comprehension of the tactical situation. It also provides the means to exercise C^2 beyond the range of organic sensors. JDN carries near-real-time tracks, unit status information, engagement status and coordination data, and force orders. Link-16, transmitted via JTIDS or Multifunctional Information Distribution System (MIDS) terminals, is the backbone of JDN. However, other data links, such as Tactical Digital Information Link (TADIL) A/B/C and Link-22, will exchange information with the JDN to ensure the inclusion of C^2 nodes without JTIDS or MIDS for JTAMD operations. Satellites will link geographically dispersed users in near-real-time without consuming limited tactical bandwidth.

JCTN is a 2010 time frame, conceptual real-time sensor fusion system, rooted in the Navy's experience with its CEC, that will distribute and fuse sensor data into composite tracks to support development of a high-fidelity air picture. JCTN is envisioned to be a key enabler in the formation of the SIAP and will support advanced employment concepts such as engage-on-remote and forward pass. It will include common software and a communications element that allows participating units to share and fuse sensor data. The envisioned processing architecture will consist of a common kernal function that is the same at all locations and a unique adaptive layer to link the common kernal with the respective host sensor, weapon, or BM system. The envisioned communications structure will include wideband line-of-sight communications, satellite links, and other communications systems. All fire-control sensors will have the ability to share their fire-control quality data via the JCTN. Additionally, a JCTN/JDN gateway will distribute the JCTN-developed composite tracks via the JDN. Collaborative JTAMDO and BMDO-led efforts are underway to define the technical requirements to guide prototyping and experimentation for both JCTN and the JCTN/JDN gateway.

The Army AMD community is a full participant at the joint capability and solution resolution level and at the program level.

AAN INITIATIVES

The AAN possessing Full Spectrum Dominance demands an AMD force that provides near-leakproof defense against all threats from the air. As TBMs, CMs, and UAVs proliferate, the likelihood of their use in standoff attacks grows.

Distributed, remoted, non-dedicated AMD systems governed by comprehensively and redundantly netted C^3I architectures must be capable of providing continuous overmatching lethality against these threats. Non-cooperative, beyond visual range, automatic target recognition, facilitated by elevated sensors with over-the-horizon visibility, is a mandatory tool for all AMD systems. SHORAD systems must possess sensors capable of high-speed, highly accurate CDI and fire control algorithms, enabling them to automatically engage hundreds of MRL- and artillery-delivered targets. Limited in inventory and CONUS-based, AMD systems must be rapidly deployable, highly mobile, and ruggedly reliable. This demands high-strength lightweight materials, highly efficient power sources, and on-board prognostics and self-diagnostics. System processors must enable real-time situational awareness, coupled with information management routines, to preclude operator information overload. Protection of digitization capabilities necessitates electromagnetic pulse hardening and backup C^3I architectures. The responsiveness and agility demanded of weapon effectors is already exceeding the capabilities and affordability of mechanical systems, thus driving consideration of directed energy solutions such as lasers (which have a whole host of other issues that must be overcome). Today's budget must address these needs to enable the AMD force for the AAN.

Tech-base research and development, exploring technologies and systems that will have application to the AMD mission in the AAN, is underway within AMCOM RDEC, SMDC, DARPA, BMDO, and the National Labs. The challenges are constant, and work is often curtailed or distracted by resource shortfalls and competing priorities. Thus, user advocacy and interface with the proponents of these efforts must begin in the very early stages of idea conception and continue throughout the development process. The user can quickly offer realistic commentary on the operational utility of these ideas, considering the impacts of field use. The TRADOC-AMC annual S&T process allows investigations and continuous industry interaction to ensure development and fielding of the best tools for AMD in the next century.

The following paragraphs present only a few of the development efforts underway – technologies with promise for AMD in the AAN. The technologies noted are not in any priority. Industry-sponsored initiatives are proprietary and therefore are not included.

HTK Miniature Interceptor

HTK technology enhancement efforts seek to counter a proliferating submunition threat that, by 2015, may include masking, maneuvering, and active cooling to defeat IR sensors. This program, sponsored by SMDC and BMDO, envisions replacing conventional TMD interceptors with a cluster of HTK miniature interceptors. Hence, when a TBM submunition attack is suspected or detected, interceptors are launched and engagements performed outside the atmosphere. To achieve the postulated capabilities, significant improvements in interceptor maneuverability and guidance, processing speeds, aim-point selection techniques, and decoy-resistant sensing capabilities will be necessary. Weight, size, cost, and high probability of kill will remain major design considerations. (Applicable FOCs are Munitions, CDI and Correlation of Information, and Sensors.)

Exoatmospheric Interceptor Technologies

This SMDC program provides a vehicle to develop and eventually incorporate discrete technologies into a "fire-and-forget" smart interceptor for TBM defense. Two examples of component-level technology being pursued are advanced focal plane arrays (FPAs) and the advanced discriminating laser radar (LADAR). The FPA effort is evaluating concepts for advanced seekers with cooled optics on long-range interceptors (greater than 2000 kilometers). Examples of FPA developments include radiation hardening and rapid recovery from nuclear bursts. The LADAR program, on the other hand, provides a long-range (greater than 200 kilometers), lightweight (less than five kilograms), coherent solid-state sensor producing four-dimensional measurements of long-range targets. It provides a vastly improved discrimination capability and is light enough to be incorporated on-board an exoatmospheric kill vehicle. (Applicable FOCs are CDI and Correlation of Information and Sensors.)

Laser Communications

Laser communications is a line-of-sight, high data rate, anti-jam, low probability of intercept, lightweight communications technology being developed and demonstrated for use between satellites and among TMD and NMD communications networks. Laser communications produce a highly focused beam of energy, enabling more signals than those produced by RF communications to reach the receiver for a given amount of transmitted power. It is particularly suited for those situations that require secure, high-traffic, long-range applications. Current program focus is a layered architecture of networked satellite-to-air-to-ground sensor platforms. The technology uses laser diodes for transmission, tracking, and alignment; low-noise avalanche photodiodes for collecting data transmissions; and charge-coupled device arrays for tracking and alignment. Future efforts will address high bandwidth potential, improved laser output power, and greater link availability. (Applicable FOC is Sensors.)

Overhead Passive Sensor Technology for Battlefield Awareness

This SMDC program is developing a passive optical sensor that uses hyperspectral, polarimetric, and on-FPA processing to support battlefield awareness with wide area, near-real-time target detection, discrimination, identification, and location. This sensor will detect camouflaged and concealed threats, such as tactical vehicles and aircraft, with target location accuracy that is comparable to that obtained from airborne synthetic aperture radars. The sensor and processing technologies will reduce requirements on communications links and ground processing while providing near-real-time targeting data to support warfighters. (Applicable FOCs are CDI and Correlation of Information and Sensors.)

KE ASAT Program

This SMDC program will provide the United States with the capability to interdict hostile satellites, preventing enemy space-based surveillance and targeting of U.S. assets. The KE ASAT consists of missile and weapon control subsystems. To date, two KE ASAT prototype kill vehicles have been integrated, one has been test fired, and two prototype weapon control systems have been built and successfully tested. All demonstration and validation phase exit criteria have been met. (Applicable FOC is Counter Aerial & Space RSTA.)

Innovative Radar Components Research

The SMDC Advanced Technology Directorate has identified various potential improvements to future phased array radar systems that would yield better sensitivities, improved efficiencies, reduced weights, and smaller volumes. The program goal is to ultimately replace current transmit/receive modules with "active radiator technology" components, the fundamental phased array radar building blocks of the future. (Applicable FOCs are Sensors, Deployability, Mobility, and Sustainability.)

Remote Asset Prognostic/Diagnostic System

This AMCOM RDEC program designs and demonstrates technologies to remotely monitor critical electronic and mechanical weapon system components, including complex missile systems. Source data are centrally and remotely analyzed to allow preventive maintenance, services, and "just in time" repairs. It should also ultimately enhance logistics by ensuring the right parts at the right time, thus trimming repair part inventories. This information is provided to commanders and staffs in near-real-time. It is a current candidate science and technology objective (STO). (Applicable FOC is Sustainability.)

Enhanced Counterair Capability

A USAADASCH-led integrated concept team is developing the Enhanced Counterair Capability (ECAC) operational requirement, formerly known as the Combined Arms Directed Energy Capability (CADEC). The team has developed a mission needs statement and a draft concept that describes the AMD operational intent to negate multiple threats employed in near simultaneous and saturation attacks. ECAC will provide protection against unguided rockets, mortar and artillery projectiles, reconnaissance UAVs, CMs, helicopters, and fixed-wing aircraft. Of keen interest are directed energy weapons (e.g. lasers and high-power microwaves) and hypervelocity KE weapons capable of defeating these threats with precision and reliability. Conceptually, the netted, distributed non-dedicated BM/C^4I and remoted weapons will provide the requisite force protection. The ECAC integrated concept team hosts regular meetings to consider technology alternatives and their implications.

SUMMARY

Technology to *Protect the Force* and enable *Full Spectrum Dominance* is implicit in planned and evolving AMD systems. Tremendous advancements in weapon lethality range, sensors, and BM/C4I are continuously achieved by materiel developers. These accomplishments and those enhancing AMD system deployability, mobility, sustainability, and survivability are essential to counter the proliferating air and missile threats. Experiments and demonstrations offer a valuable opportunity to examine the potential military use of an advanced technology. Working together, combat and materiel developers use these forums to exchange ideas and gain insights that optimally lead to better, less expensive, and perhaps more quickly fielded systems.