

2002 Defense Standardization Program (DSP) Annual Awards

CECOM SEC & LRC Advanced Multiplex Test System (AMTS)

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Description of Accomplishment:

The joint team, composed of personnel from CECOM Software Engineering Center (SEC), Logistics & Readiness Center (LRC), and support contractors conceived, designed, developed, and demonstrated all the elements to implement a pilot program for the Apache Longbow helicopter fleet, known as the Advanced Multiplex Test System (AMTS). The AMTS tool standardizes test methods and procedures applicable to all electronics systems utilizing the MIL -STD-1553 (1553) data bus. Other potential applications include US ground vehicles, US Air Force aircraft B-1, B-2, C-17, F-16, etc., US Navy aircraft F-14, F15, F18, EF-111, etc., US Marine aircraft AV-8B, V-22, etc. The AMTS design addresses key standardization goals and maintenance requirements for tomorrow's Army. AMTS will:

- Eliminate the need for several 1553 based test sets at aviation maintenance centers (applicable to all 1553 equipped aircraft including AH-64D, OH-58D, UH-60Q, UH-60M, MH-60K, CH-47D, and CH-47E). The AMTS will increase readiness by providing test capabilities that currently do not exist and enhancing test capabilities beyond current test set (faster and more accurate). AMTS will also reduce capital investment associated with 1553 test equipment and will reduce the logistics footprint concerning aviation assets.
- Be fielded to units on current and projected computer assets. AMTS is a software tool that can be hosted on standardized computer assets.
- Be programmed into Interactive Electronic Technical Manuals (IETM). Mean-Time-To-Repair (MTTR) will be greatly reduced because AMTS permits onboard testing of high-dollar value equipment and permits test to be conducted directly from the IETM (no need for gathering and implementing stand-alone equipment).
- Introduce a process change that enhances maintainer versatility and productivity and increases Unit readiness. This is accomplished by the AMTS display, which instantaneously depicts system health via extremely intuitive graphics.

Standardization of the display and test methodologies allows maintainers to work on different aircraft types.

- Reduce the incidence of extracting misdiagnosed Line Replaceable Units (LRU) (a.k.a. No Evidence of Failure – NEOF). AMTS requires little or no accessories to perform testing.

Background:

In 1992, SEC fielded the AMTS prototype known as the Army Multiplex Avionics Tester (AMAT). AMAT provides a solution for Aviation Intermediate Maintenance (AVIM). AMAT is still used by Army aviation units and DEPOT maintenance facilities, as well as the Air Force C-17 SPO, commercial Original Equipment Manufacturers (OEM), and the Canadian Air Force. AMTS is the evolution of AMAT consistent with current operating systems and to include user defined requirements for Unit-level (on-aircraft monitoring, test and diagnostics), enhanced DEPOT testing, and engineering test functions for simulation and system integration. AMTS is a 1553 environment that leverages the similarities of the LRUs comprising 1553 systems. AMTS will also be fielded to the US Army Aviation Logistics School (USAALS) avionics schoolhouse to be included as part of avionics maintainers curriculum. This will result in standardized 1553 training and several Army avionics maintainer Military Occupation Specialties (MOS's) being trained and qualified on a single test system for 1553 test and diagnostics.

SEC is partnered with the CECOM Logistics and Readiness Center (LRC). The LRC provides the logistics requirements arm of the AMTS effort. The LRC role has been critical in establishing and developing the fielding requirements for AMTS. The LRC also has spearheaded AMTS awareness among the aircraft PM offices. The LRC and SEC co-authored maintenance cost reduction pilot proposal for establishing an AMTS funding line. The LRC was responsible for gathering avionics information regarding LRU supply demands, failure rates, and No-Evidence-Of-Failure (NEOF) information – all of which was used in the proposal economic analysis.

Problem/Opportunity:

Non-standardized 1553 related test equipment, methods, and procedures resulted in the proliferation of stand-alone, single-use 1553-based test systems fielded to aviation units. This increased deployed Units' logistics burden, as more equipment was required to perform maintenance functions. The equipment was less up to the task and did not promote multi-use among different platforms.

As the Army approached transformation, the opportunity existed to put in place a test system that could be used on all 1553 equipped assets, significantly reducing the Units' logistics and maintenance burden while increasing readiness and personnel expertise.

The project offers outstanding standardization benefits. Specifically, AMTS provides a standard testing and maintenance performance approach for all Army (and other DoD) weapons system platforms and commodities that utilize the 1553 bus. Implementation results in improved performance, enhanced readiness, reduced logistical tail/footprint, and reduced capital investment in test equipment. Similarly, there was a standardization impact in connection with training and the utilization of this system across DoD components and, within each service, across skill series.

Discussion:

The CECOM SEC and LRC developed the AMTS concept for testing 1553 cable, LRUs and systems on aircraft, and for intermediate bench testing, as well as establishing the 1553 environment where other 1553 applications can be generated with quick turn-around. This has been followed by the initial (beta) fielding of the AMTS monitor function. The team generated the pilot program proposal for an initial fielding to AH-64D maintenance units, later to be followed with AMTS inclusion for the OH-58D, UH-60Q, UH-60M, MH-60K, CH-47D, and CH-47E. Ultimately, the AMTS team intends to present the standardized AMTS tool to the Air Force, Navy, and Marine Corps encouraging the expansion of the AMTS role to the other DoD services where applicable.

At CECOM, the SEC has developed the solution for 1553 test standardization. Personnel at the SEC have extensive experience in the development of the MIL-STD-1553 itself and chaired Tri-Service committees chartered with the publication of 1553 test methods and procedures. These personnel have the vision and engineering expertise that unifies 1553 test methods, standardizes 1553 test and diagnostic systems, and will consolidate 1553 testing in Advanced Individual Training (AIT).

The 1553 data bus is a very successful multiplex data communications standard evidenced by its proliferation into nearly all DoD aviation platforms, armored vehicles, and weapon systems. Whereas the DoD has been able to standardize several LRUs for use in various 1553 applications, the test and support equipment has not kept pace. This is mostly because there has not been a government organization charged with standardizing 1553 test and support equipment for the broad range of 1553 applications. Typically, Program Managers (PMs) have responsibility to fund and develop 1553 based support equipment focusing on their individual platforms and specific maintenance missions. This approach has been sufficient to “get them through” but has resulted in the fielding of several non-standardized 1553 test and diagnostic systems designed with limited consideration for logistics footprint and MTTR goals.

Nominee Involvement:

Kenneth Capolongo: Project leader and Software Engineer responsible for all AMTS code and integration. Has participated in field experiments and demonstrations.

John Klubnick Sr, Systems Engineer and AMTS architect responsible for the AMTS vision and operational design and compilation of test and user requirements. Has participated in field experiments and demonstrations.

John Lippert, Senior Hardware Specialist has been responsible for hardware and software test and integration. Also, responsible for the development of the open bus test function of AMTS.

Lisa Russo, Systems Support Manager has been responsible for coordinating all aspects of source data used to compile the economic analysis and has contributed to the collection of user data resulting in a requirements list of user likes and dislikes.

Gerard Boyan, Senior Logistician, has been responsible for initial development of the economic analysis supporting the AMTS claim and for assisting with the development of AMTS user and logistics requirements.

Outcome:

The SEC and LRC team has demonstrated that AMTS is a viable solution for standardizing maintenance for 1553 equipped aircraft and vehicles used by all US Services and allies.

The SEC and LRC team have implemented their game plan that identifies the fielding requirements to get AMTS in the hands of the maintainers quickly. Incremental fieldings as AMTS development and releases will follow. The Team also has defined the total target hardware hosting requirements to be a PC (SPORT or equivalent – running Windows 95, 98 and 2000), a simple pair of bus cables (for connection to the aircraft), a 1553 bus interface PCMCIA card (issued in the SPORT computer, or one of five vendor's commercially available cards), a Time Domain Reflectometer (TDR) PCMCIA card, and a bus cable adapter kit. The TDR and bus cable adapter kit are to be fielded at low incidence – at Battalion level. Field experiments and evaluations have yielded all positive results from AMTS first users. Following are comments from identified users:

- CW-4 Alan Ruzicka, USAALS, Ft. Eustis
 - “I believe that getting an Apache back into the fight as quickly as possible could be enhanced using the AMTS...”
 - “The AMTS has the potential to address the significant cost drivers of the Apache...”

- Bob O'Neil, AMCOM LAR, Ft. Drum
–“AMTS is a useful tool for troubleshooting the 1553 Bus on the OH-58D.”
- Mark Simpkins, CECOM LAR, Hunter Army Air Field
–“The requirement to perform more roles in a rapidly evolving world strains the ability of Department of Defense to respond adequately yet economically. Multiple capability systems ... are key to the nations defense in the 21st century. AMTS is exactly such a system in the Electronics arena.”

Payoff:

The 6-year projected economic payoff based on OSMIS data and historical false removal rates exceeds \$10M for the pilot program in which fielding is only to the Apache fleet with an investment of less than \$3M. Fieldings to other platforms will result in greater benefit to cost ratios since most software development tasks are platform independent. These payoff projections are based on the OSMIS database to comply with proposal evaluation requirements and do not include the additional savings produced by increased readiness, operational efficiencies, and program consolidation.

With the production of the Improved Cargo Helicopter and the Black Hawk “M” model, both of which have 1553 data buses, projected savings will multiply significantly and be on the order of \$100M. These savings can be extrapolated to Army ground vehicles (most of which also utilize the 1553 bus) and will again multiply when AMTS is applied across other DoD applications of 1553, ultimately resulting in savings several times greater than that just for Army aviation.

Current Status:

AMTS has been fielded to CECOM Logistics Assistance Representatives (LARS) for evaluation. Left to complete for the AMTS project is the merging of code from the AMAT test tool (which will enable the AVIM test function), completion of the physical bus test function, writing AMTS into IETM applications, the completion of automated LRU testing and graphical display functions, and the addition of LRUs into the database underlining the AMTS system.

Problems in effecting solution:

The most significant problem in effecting the solution is establishing a funding line to complete the AMTS effort. In an effort to get funded, the SEC and LRC are following up on the proposal pilot program submission. Recently the AMTS project was briefed to Army General staff officers at an Army Aviation Association of America (AAAA) symposium held in Eatontown, New Jersey in November 2002. In attendance were LT GEN Cody (Deputy Secretary of the Army G-3), MG Bergantz (PEO Aviation), and MG Russ (Commander CECOM). The General Officers in attendance are the target

audience required to assume sponsorship for the AMTS project since the standardization represented by AMTS exceeds the responsibilities of individual (aircraft) PMs for purposes of funding. Also attending and briefed was Curt Welden (US Congressman from Pennsylvania). All were provided a demonstration of the AMTS monitor and all indicated that AMTS is exactly what the Army needs to standardize 1553 testing and they all showed interest in the project. We are optimistic that this recent event will establish AMTS as the Army's choice system for 1553 systems and LRU testing.