TACTICAL CONTROL SYSTEM (TCS)

Joint ACAT II Program

Total Number of Systems:	114
Total Program Cost (TY$):	$195M (RDT&E)
Average Unit Cost (TY$):	$300KM (Est.)
Full-rate production:	2QFY00

Prime Contractor

Raytheon

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The mission of the Tactical Control System (TCS) is to provide the Warfighter with a command, control, and communications system for the family of tactical unmanned aerial vehicles (UAVs). TCS will provide the tactical commander with ***information superiority***, contributing to the ***full-dimensional protection*** of the forces and supporting ***precision engagement*** of the enemy.

TCS is designed to provide the Warfighter with a scalable, interoperable and modular capability to operate UAVs on existing computer systems and future C4I processing systems. *Scalable* refers to the ability to provide five levels of air vehicle interaction ranging from receipt and transmission of secondary imagery to full functional control of the UAV during takeoff to landing. Modularity allows the use of common hardware. It provides the flexibility to increase or decrease the system's operational capability by adding or removing electronic cards. This allows TCS to be configured to meet the user's deployability or operational limitations. TCS is a software-intensive system required to be compliant

with joint tactical architecture, common imagery ground/surface system, and defense information infrastructure and common operation environment.

TCS is planned to interoperate with the Army Tactical Unmanned Aerial Vehicle (TUAV), Navy/Marine Corps Vertical Take-Off and Landing TUAV (VTUAV), and the Air Force Medium Altitude UAV systems, including Predator UAVs. As a future capability, TCS will also receive and disseminate imagery and data from high altitude endurance UAVs. TCS software operates on current Service hardware [i.e., Sun SPARC (Air Force), Common Hardware and Software-II/SPARC-20 (Army/Marine Corps), and Tactical Air Control Navy (TAC-N)], even when the actual UAV ground station is operating on a different platform. The Air Force will incorporate selected components of TCS software into the existing Predator ground stations. The Army and Marine Corps will use TCS as an integral part of the High Mobility Multi-Purpose Wheeled Vehicle-based ground station. For the Navy, TCS will be the control system for UAV operations from ships and temporary shore sites.

Additionally, TCS is required to interface with 22 different C4I nodes for imagery, data dissemination, and mission planning. TCS, however, does not contain organic communications capability. For those UAV systems that have organic communications, additional C4I interfaces may be provided by TCS.

TCS consists of six subsystems: (1) the line-of-sight antenna assembly, (2) the integrated data terminal, (3) the data link control module, (4) the computer, (5) the synthetic aperture radar sub-system, and (6) the workstation. Various configurations of these pieces have been used in operational exercises and technical demonstrations.

BACKGROUND INFORMATION

The Joint Requirements Oversight Council initially validated the TCS Operational Requirements Document on February 3, 1997 (JROCM 011-97). This Operational Requirements Document identified the urgent need to provide a common tactical control system for current and future family of tactical and medium altitude endurance UAVs. The Joint Requirements Oversight Council is currently revising and revalidating the Operational Requirements Document based on new and different requirements among the programs TCS is to support (i.e., TUAV and VTUAV). The Navy Acquisition Executive is the Milestone Decision Authority for this joint program, and the Navy's Program Executive Office for Cruise Missiles and UAVs is the executing agent and program manager. The Army, Navy, Air Force, and Marine Corps are participating in the program.

The system is being developed utilizing a block approach, and is currently finishing Program Definition and Risk Reduction. During the risk reduction phase, the Government developed both sea-based and land-based prototype TCS systems. These prototype systems participated in proof-of-concept demonstrations to generate early user input and evaluation. The Government will continue with development of a Block 0 configuration, although it awarded a contract to Raytheon and EG&G in November 1998 for system integration in subsequent phases.

A Milestone II decision is proposed for 1QFY00 to enter EMD. During EMD, four low rate initial production TCSs will be delivered for formal developmental and operational testing. TCS will be produced in four different configurations: (1) land-based (High Mobility Multi-Purpose Wheeled Vehicle shelter); (2) ship-based; (3) Predator (ground station retrofit); and (4) Pioneer (ground station retrofit).

TEST & EVALUATION ACTIVITY

DOT&E designated the Navy as the lead test agency for TCS. They also directed the Army, Marine Corps, and Air Force operational test agencies to develop annexes to the test plans with Service-specific test strategies and resources required to evaluate TCS doctrinal issues. The TCS TEMP is currently in coordination; it outlines a program for conduct of TCS testing through IOT&E. The TCS program will first enter developmental testing to ensure that all key performance parameters have been met prior to any operational testing with UAVs. A risk-reduction operational assessment is planned for June 2000 in conjunction with Joint Task Force Exercise (JTFEX) 002. Each Service would then conduct a system-specific IOT&E addressing the TCS requirements in their Operational Requirements Document. A subsequent capstone IOT&E would consist of a combined test with TUAV, Predator, and VTUAV—all operated by the same TCS. FOT&E will be conducted, as required, for any deferred testing or correction of TCS deficiencies.

During FY99, a series of tests and demonstrations were conducted to assess TCS levels of UAV interaction up to Level IV. These demonstrations fell into two categories—those designed to control air vehicles and those designed to demonstrate C4I interconnectivity. Level IV control of the General Atomics Predator UAV was demonstrated at El Mirage in November 1998. This exercise demonstrated flight route waypoint and payload control from TCS. Additionally, Level IV command and control was demonstrated with Outrider at Glasscok, TX, while Level II control was demonstrated with the Bombardier CL-327 in Oklahoma. TCS has demonstrated the capability to control the General Atomics' Predator, GNAT-750, Prowler, Alliant Techsystem's Outrider, and UMV Robo Ski; TCS has received payload data from TRW's Hunter, Bell's Eagle Eye, and Bombardier's CL-327.

In May 1999, TCS participated in an interface demonstration with the Joint STARS Common Ground Station at Motorola in Phoenix, AZ. The objective was to demonstrate various Ethernet, National Imagery Transmission Format and video interface protocols. Several protocols such as Ethernet and analog video were successfully demonstrated, while several other capabilities such as fiber-optic interface and free-text exchanges were unsuccessful. Also, TCS successfully demonstrated receipt of two simultaneous data inputs from dissimilar data control modules from Outrider and Predator via simulation devices.

The UAV program has been certified Y2K compliant in the "standalone" operating mode. TCS will not be certified Y2K compliant in the integrated C4I mode until the operational testing that supports fielding the system is completed.

TEST & EVALUATION ASSESSMENT

The demonstrations have been technical fly-test-fix-fly scenarios in which only limited segments of overall TCS capability have been demonstrated. Realistic operational testing with actual UAVs (vice surrogate) and actual TCS systems (vice original ground control hardware) have not been accomplished and must be conducted to fully evaluate the TCS proof of concept and potential effectiveness/suitability.

During FY99, two additional demonstrations of Level IV control (Outrider and Predator) were accomplished and many of the difficulties encountered during previous air vehicle exercises appeared to be corrected. Level IV and Level II have now been demonstrated with a number of UAV platforms, which serves to validate aspects of the concept. However, no Level V demonstrations have been conducted. TCS control of the actual platforms must await the selection and development of TUAV and VTUAV.

CONCLUSIONS, RECOMMENDATIONS, LESSONS LEARNED

Lessons emerging from the TCS program relate more to acquisition issues than testing issues. The program was started and baselined with a family of UAVs that no longer exists. The newer family it controls has slightly different requirements and schedules that differ with some of the original plans. Many of the challenges the TCS program faces relate to incompatibility of its schedule with TUAV and VTUAV schedules. Since some of the TCS milestones occur before those of the supported programs, it is difficult to conduct some of the required testing with the configurations that must be tested. Until the schedules for TCS and UAV within the Services (Army TUAV is working a MOA) are synchronized, TCS will have to continue piece meal demonstrations of projected capabilities. Final validation of TCS's total capabilities will not occur until after the Milestone III decision of the supported programs. If there are major problems with TCS at that point, there is little leverage to ensure that the individual Services will continue to support the TCS program.