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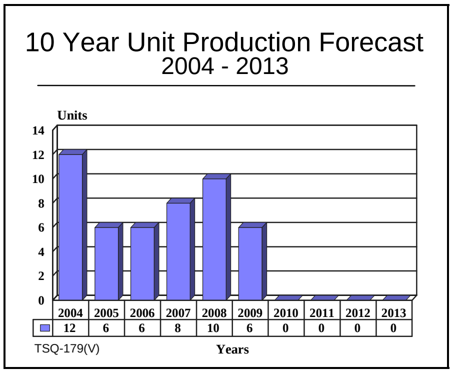
JSTARS (APY-3(V) & TSQ-179(V)) - Archived 1/2005

Outlook

- Ground stations in production, upgrades to E-8C processing systems continue
- Radar production complete
- MP-RTIP development moved to separate, broader program
- Successful in Operation Iraqi Freedom, but aircraft engines a maintenance problem



Orientation

Description. JSTARS is an airborne, multimode advanced synthetic aperture radar system. JSTARS is the acronym for Joint Surveillance Target Attack Radar System, sometimes referred to as Joint STARS. The radar nomenclature is APY-3(V). The Common Ground Station is the TSQ-179(V), with the TSQ-220(V) a transportable version. JSTARS is a primary source of intelligence for military commanders, targeting data for fire control systems, and guidance data for attack aircraft and missile systems.

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(Prime, ground station module)
(Digital display processor & keyboard, power supply)

Raytheon Digital Display Gp
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(CLADDS displays)

Status. In production; ongoing logistics support.

Total Produced. Through the end of 2003, 17 radars and 79 GSM/CSMs had been produced.

Application. Airborne battlefield surveillance system and battle management Command and Control. The Air Force is considering mission expansion, including counter-land and counter-sea missions, with JSTARS a major player in that role.

Price Range. Based on the FY99 budget, the cost of an E-8C is US$289,104,500. Radar cost is estimated at US$14 million. Ground station cost is estimated at US$12.1 million.

A December 1998 Selective Acquisition Report (SAR) changed the overall JSTARS program cost to US$8.7598 billion (base year US$) based on the addition of one more aircraft.

Contractors

Northrop Grumman Airborne Ground Surveillance, http:// www.is.northropgrumman.com, 2000 NASA Blvd, PO Box 9650, Melbourne, FL 32902-9650 United States, Tel: 1 (407) 951-5447, Fax: 1 (407) 951-6876, Prime (JSTARS)

General Dynamics C4 Systems, GD Decision Systems, http:// www.gdc4s.com, 8201 E McDowell Rd, Scottsdale, AZ 85252-3812 United States, Tel: 1 (877) 449-0600, Fax: 1 (877) 449-0599, Email: info@gdc4s.com, Prime (TSQ-79(V) CGS)

Technical Data

	Metric	U.S.
Dimensions		
Boeing 707-300		
Length	463.9 m	152 ft 11 in
Wingspan	11.46 m	145 ft 9 in
Range (un-refueled)		11 hr
Range (in-flight refueled)		20 hr
Speed	.84 Mach	
Service Ceiling	12,810 m	42,000 ft
Radar		
Weight	1,906.8 kg	4,200 lb
Antenna Length	7.32 m	24 ft
Antenna Height	0.61 m	2 ft
Characteristics		
Flight Crew	4 (standard mission) 6 (long duration mission)	
Mission Crew	18 (standard mission) 28 (long duration mission)	
Radar Modes	Wide Area Surveillance Moving Target Indicator (MTI) Synthetic Aperture Radar/Fixed Target Indicator (SAR/FTI) Low Reflectivity Indicator (LFI) Target classification Sector Search (SS) Attack planning/attack guidance capability	
Radar Range	200+ km	124 nm

Coverage	40,000 km^2	24,856 mi^2
Beam Width		
Azimuth	+/- 60°	
Elevation	200°	
Radar MTBF	60 hr specified	75 hr reported
Communications	50 hr specified	90 hr reported
Radar Elements	Pulse Compression Unit Radar Control Unit Radar Transmitter Antenna Special Purpose Processor Receiver A/D Combiner (Power Management) Exciter Antenna Servo Electronics	
Processors	3 load-sharing, programmable signal processors (5 high-speed, fixed-point distributed processors)	
Workstations	17 identical operator workstations 1 navigation/self-defense workstation	
Digital Datalinks	Surveillance & Control Data Link (SCDL) for transmission to mobile ground stations JTIDS for Tactical Air Navigation (TACAN) operation and Tactical Data Information Link-J (TADIL-J) generation and processing	
SATCOM		
Voice Communications	12 encrypted UHF radios Two encrypted HF radios Three encrypted VHF radios (provision for SINCGARS) Multiple intercom nets	
Ground Station Module		
Functions	MTI/WAS Target Correlation Target Tracks SAR SIGINT UAV E-Maps	
Interfaces (CGS)	JSTARS E-8 Guardrail Rivet Joint Army Aviation sensors, including Longbow ASAS AFATDS Predator UAV Outrider UAV Hunter UAV ARL U-2R (ETRAC) Other ground stations Imagery libraries National Sources	
Functions	Real-time surveillance Reconnaissance Situation awareness Target development Theater Missile Defense	

	Battlefield visualization Battle space management
Characteristics (continued)	
Added Functions	SIDS Auto-indexed refs Multimedia databases Real-time video Administration support Weather AI
Data	Moving Target Indicator (MTI) Fixed Target Indicator (FTI) Synthetic Aperture Radar (SAR) EO/IR imagery Video imagery Signal Intelligence (SIGINT) Electronic Intelligence (ELINT)
Human Interface	User-friendly HCI Common Desktop Environment (CDE) Multi-window display Time-based controls Point-and-click operation Easy-to-use toolbars Configurable, custom setup
Communications (CGS)	SATCOM Secure radio MSE CTT/JTT Secure phone/fax AMPS SIPRNET WAN/LAN networks
Communications (JSWS)	The Joint Services Work Station is deployed without its own communications suite

Design Features. The JSTARS airborne system consists of a militarized Boeing 707-300 aircraft carrying an advanced radar, processor, and data display system. Significantly, the aircraft is air-refuelable. It was designed to locate and track moving ground vehicles, discriminating tracked from non-tracked. The system can operate day or night and in most weather conditions. The radar was designed to operate in a robust electronic countermeasures (ECM) environment.

The system architecture accommodates growth to avoid technological obsolescence and to adjust to changing threats and missions. The growth-oriented system design allows JSTARS to take advantage of revolutionary improvements in onboard processing.

Airborne Platform. The airborne platform consists of three major subsystems:

- Radar
- Operations and Control (O&C) System
- Communications

The large size, unique design, and powerful processing of the APY-3(V) enable it to detect slow-moving targets in heavy ground clutter. JSTARS offers low minimum detectable velocity, precise location accuracy, and high probability of detection at long range.

The antenna is located in a 26-foot-long radome mounted under the forward fuselage of the aircraft. It is divided into three eight-foot sections. The system employs a Grumman-patented Clutter Suppression Interferometry (CSI) technique that enables targets buried in clutter to be located and extracted.

The 24-foot-long antenna produces a fairly narrow beam. In Doppler space, however, there is a reasonable spread at the lower end of the clutter return which could restrict the detection capability of the system. In theory, the radar would be able to detect a target in clutter if amplitude return is sufficient. In actual practice, however, being able to locate that target would be impossible without double-processing. Double-processing allows the system to extract low radial velocity targets, which is a distinct advantage.

Achieving the required resolution is complicated by the fact that both stationary and moving objects must be precisely located while the aircraft is moving. The characteristics of JSTARS are such that the antenna produces a narrow azimuth beam and processes a large number of range bins. The platform self-location error rate is virtually nil because of the use of an integrated SNU-84-3 inertial navigation unit with GPS data processed through a 12-state filter. This ensures precise platform self-location with a position error of nearly zero.

Antenna pointing is accurate to within the error limits of equipment available today. Eliminating self-location variables from the location algorithms leaves only range and azimuth resolution as the primary discriminators in target location accuracy. A powerful processing system ensures that these computations are able to produce the results demonstrated in the Persian Gulf.

Detected pulses are processed in turn by each of the three segments so that it is possible to observe what happens between pulses – whether an object blurs or remains stationary. The system uses data from the forward and center segments and performs a clutter cancellation, followed by a center-aft data collection and clutter cancellation. This process makes it possible to resolve phase ambiguities by getting an interferometric baseline on the detections. JSTARS uses a precise phase interferometer that succeeds in pulling low radial velocity targets out of clutter.

In addition to a Moving Target Indicator (MTI) mode of operation, the system is capable of interleaving Synthetic Aperture Radar (SAR) image collection and processing as requested by the 18 onboard operators or ground users via a datalink request.

All radar data are processed on board in real time and displayed on the aircraft consoles in two forms: MTI target reports and SAR images. MIT target reports are essentially produced in real time, while SAR images take several seconds to collect and produce. Both of these data products are displayed in the aircraft and simultaneously data-linked to ground stations. On board the aircraft, radar tracks are developed by integrating MTI reports over several scans. These tracks are displayed on the aircraft's consoles and are also sent to other Air Force nodes via the anti-jam Joint Tactical Information and Distribution System (JTIDS) datalink. These tracks are not sent to Ground Station Modules, but can be developed within the GSMs by subsequent processing of the MTI reports as is done on board the aircraft.

The radar is controlled by the Operations and Control (O&C) subsystem. This consists of a real-time, VAX-based, distributed processor cluster and intelligent operator workstation. The high-power computing architecture, when combined with mass memory access and high-resolution color graphic displays, provides 18 operators with simultaneous access to JSTARS information. A recording system captures data for replay and analysis later. Overall memory has grown from 3 to 60 Gbytes on each aircraft.

Operators at the workstations have overall control of the airborne sensor. Radar imagery and target data can be displayed with digitally stored map databases and terrain features, as well as other tactical information. The consoles can provide onboard training, allowing the operators to become more proficient en route to the actual area of interest.

The main functions of the Operation & Control system are:

- Surveillance and threat analysis
- Attack planning
- Attack support
- Post-attack assessment
- Flight part planning and monitoring
- Communications management
- Technical control of the JSTARS system

Up to 14 databases are used by JSTARS to enhance the tactical value of the radar information. Among these are the cartographic database, area visibility database, and Order of Battle and Weapons database.

The <u>CARTOGRAPHIC</u> database includes primary and secondary roads; foliage; marsh areas; hypsographic and hydrographic features; political boundaries; cities and towns; and railroads. This database provides a basis for recording and monitoring in real time moving target indicators with great accuracy in relation to terrain.

The <u>AREA VISIBILITY</u> database indicates where mountains or other terrain features will interfere with the radar field of view. Obviously, this information changes with the aspect angle that the aircraft generates with respect to the area of view on the ground. Thus, the operator constantly receives an indication of where his targets may disappear from the field of view. This allows the operator to predict when a target should reappear. These data can also be used to provide optimum orbit locations, via the flight path planning function, to minimize radar screening of the area of interest.

<u>Ground Station Modules (GSM)</u>. The TSQ-168(V) was the original GSM and included the following:

Block I Medium was the original Ground Station Module mounted in an S-280 shelter on a 5-ton truck.

Block I Light was a Standard Integrated Command Post System (SICPS) mounted on a HMMWV.

TSQ-179(V) Common Ground Station (CGS). The CGS is now the standard Ground Station that expands the capabilities and range of sensors available to battlefield commanders. It is a real-time, multi-sensor, command, control, communications, computers, and intelligence (C^4I) system. It is a mobile, deployable system that can support a wide variety of global missions, including wartime battlefield management; low-, medium-, and high-intensity crisis management; peacekeeping operations; the war on drugs; and contingency operations.

CGS is a scaleable, open-architecture system that is easily applied to a wide variety of systems requiring real-time interfaces, data processing, data management, geo-critical information processing, and user-friendly human interfaces. The architecture is scaleable and extensible to ensure a simple migration path for system capability upgrades, and has been designed for growth. In this regard, it is equipped with commercial computer servers, workstations, and networking and industry-standard interfaces.

CGS software is based on real-time open system architecture. The system software provides a robust set of core components for C^4I systems. A set of Application Programming Interfaces (APIs) simplify and accelerate software development. There is portability across several Unix platforms.

The CGS provides real-time, sensor-to-shooter C^4I battlefield visualization and battle space management. The system acquires, processes, correlates, and displays in real-time SAR/MTI, SIGINT data, UAV inputs, imagery, and National Sources inputs, providing commanders with information with a fidelity never before possible. Datalinks are line-of-sight, jam-resistant SCDL.

TSQ-122(V) Joint Services Work Station (JSWS). This is a ruggedized version in four transit cases for deployment to fixed command centers, mobile air operations centers, and ships. It can be deployed anywhere quickly, and uses the same software baseline as CGS. It does not have the carry-along communications suite of the CGS. But when opened and set up with the appropriate communications links, JSWS operates like the CGS.

Operational Characteristics. JSTARS is a Corps support sensor which will help assess the hostile force so that combat power can be focused on destroying the enemy's ability to pick and choose when, where, and how close battle will be engaged. Information from JSTARS sensors deployed up to 250 kilometers into the battlespace will help track hostile forces and support the destruction of reserve forces and the logistics tail. The system provides the inputs needed for planning attack and engagement.

The system provides tactical air and ground commanders with near real-time wide area surveillance and deep targeting data on both moving and fixed targets both day and night, and in nearly all weather conditions. The radar will locate, track, classify, and assist in attacking targets beyond the Forward Line of Troops (FLOT). The aircraft typically orbits a (hopefully) safe distance on the friendly side of the FLOT. The radar data are made available to Air Force and Army operators on board the aircraft and to multiple Ground Station Modules at Echelons Above Corps (EAC), Corps, Corps Artillery, Division, and Division Artillery.

The aircraft can deploy quickly to a crisis area, or to an orbit far from the aircraft's base and close to the area selected for surveillance. Once in orbit, the aircraft can maintain altitude and continue surveillance, even in the event of an engine failure. This reduces the likelihood of an orbit not being covered. The E-8C fuel capacity, air refueling capability, and crew rest area permit orbit times up to 20 hours long, enabling large areas to be covered with a small force.

The tremendous capabilities of the radar allow JSTARS to provide high-quality, timely information. The APY-3(V) provides Moving Target Indicator information over a wide area using both radar- and ground-referenced coverage. In the radar-referenced coverage, the radar's field of view progresses along the aircraft's track. In this mode, up to a million square kilometers of terrain can be surveyed in a single pass. In the ground-referenced coverage, the radar is optimized to revisit, according to an established time line, a fixed area on the ground roughly equal to a corps commander's area of interest.

The radar can perform sector searches inside this wide area field of view in either high- or medium-resolution search modes, providing both synthetic aperture radar/fixed target indication imagery and smaller area MTI display.

The radar revisits an area of interest at frequent intervals. During this time, the default mode of the radar is wide-area surveillance, revisiting the entire coverage area periodically unless tasked otherwise by the operator. Within this time line, the radar is capable of interleaving sector search modes, entering attack planning or attack support modes, or providing synthetic aperture radar imaging within a precise scanning plan. Thus, the radar provides excellent wide-area situational awareness, and any of the 18 onboard operators or operators located in GSMs can send requests to the radar. It is possible to simultaneously scan a number of smaller areas inside the primary area of interest.

The JSTARS communications suite carries HF, VHF, and UHF secure/non-secure voice communications. Besides JTIDS, it carries an anti-jam digital datalink, and the Surveillance and Control Data Link (SCDL) for communication with the GSMs.

The ground stations are tactical data processing and evaluation centers that receive sensor data from multiple sources such as radar data from JSTARS, OV-1D Mohawk, and unmanned air vehicle (UAV) platforms. The ground stations are co-located with Corps/Division Artillery Tactical Operations Centers, Multiple Launch Rocket System Tactical Operations Centers, and corps/division/brigade tactical operations centers. They distribute information to other users through the Army Tactical Command and Control System (ATCCS), which includes the All Source Analysis System (ASAS) and the Tactical Fire Direction System/Advanced Field Artillery Tactical Data System (TACFIRE/AFATDS).

JSTARS GSM system capabilities were successfully demonstrated during every major conflict since Desert Storm. JSTARS proved that it is a major force multiplier. It was considered the single most valuable targeting and intelligence system in Desert Storm, Afghanistan, and Iraq.

JSTARS' performance in Bosnia and Kosovo proved that the system has theater perspective, an important requirement for Joint Force commanders in a combat arena. Existing USAF doctrine is being expanded to include land and sea attack missions.

By adding satellite communications to JSTARS, the usefulness and span of control for the asset have been significantly expanded. Radar and operational data can be disseminated beyond the immediate range of GSM downlinks.

The Desert Storm experience led to the development of the multi-data fusion Common Ground Station system. By merging SAR/MTI, SIGINT, UAV, and other data sources, commanders can take the initial inputs, task other sensors (such as a UAV), and clearly identify and locate targets for attack. Datalinks make it possible to link directly to the shooter, improving the effectiveness of operations against difficult targets.

JSTARS is truly a high-demand, low-density asset. From January 13 to May 15, 2003, nine JSTARS flew 193 mission sorties and 2,193 mission hours in support of Operation Iraqi Freedom. There were an added 32 ferry sorties and 270 ferry flight hours. This was the first time JSTARS was used as an ISR asset as well as a Command and Control platform. Initially there were problems at the Combined Air Operations Center (CAOC) until the operators got used to the intelligence generated by the E-8Cs. JSTARS was the key intelligence platform during the severe sandstorms in March 2003.

Operationally, the old engines on the refurbished 707s were the main contributors to a lower than expected mission rate, 70 percent. The Command rate is 75 percent. Nearly half the maintenance required involved the aging and unreliable engines. Supply line problems were another mission-rate problem. Air Force plans are targeting a re-engining effort with JT8D-219s. The improved engines would allow the E-8Cs to operate at a 33 percent higher altitude, increasing line-of-sight distances and allowing them to operate from 8,000 feet runways, vice the 13,000 feet required today. Maintenance costs could be reduced around 10 times, according to officials.

JSTARS

Source: DoD DOTE

Variants/Upgrades

E-8A. This was the prototype system developed for testing; the aircraft was used during the Persian Gulf War.

E-8C. This is the production version of JSTARS which incorporates a variety of enhancements and upgrades. In 1989, the Air Force contracted with Grumman for this enhanced JSTARS version. The Defense Acquisition Board has approved full production.

An ongoing multistage improvement program involves TADIL-J message expansion, communications improvement, and Self-Defense Suite improvements.

Future improvements being considered include:

- Enhanced radar performance
- Enhanced signal processing
- Enhanced Synthetic Aperture Radar (ESAR)
- Terrestrial Inverse Synthetic Aperture Radar (ISAR)
- Automatic Target Recognition (ATR)
- Multi-lateration SAR target location
- Improved cueing and data correlation/fusion

Radar Sensor Producibility Enhancements, Phase II. This effort involved development of the radar sensor reference oscillator, redesign and testing of the radar master oscillator, redesign of the radar sensor printed wiring assemblies, and improving the radar sensor Line Replaceable Units. This work was completed in 1994.

In FY94, engineers investigated linking JSTARS to a satellite as part of the preplanned improvements program, giving JSTARS the ability to communicate with command and control assets more than 500 kilometers from the aircraft orbit. The effort included a NATO attempt to perfect JSTARS communications plans.

In August 1995, the JSTARS program office announced a requirement to augment the basic functional capabilities of the JSTARS E-8C aircraft in three areas: radar sensor and sensor data processing, E-8C interoperability with other elements, and Operations and Control Subsystem capabilities.

Radar Sensor and Sensor Data Processing Requirements. The sensor and sensor data processing needed to be modified, and the signals produced by the E-8C radar refined. Additionally, the quality of the Moving Target Indicator (MTI) and Synthetic Aperture Radar (SAR) imagery data need to be improved. Plans called for adding a maritime surveillance mode to optimize the detection of moving surface targets in a maritime clutter environment, improving sensor Target Location Accuracy (TLA) to increase the effectiveness of directed weapons, improving the resolution of the sensor for identifying stationary targets, and incorporating an Inverse SAR (ISAR) capability for identifying moving targets. The Air Force plans call for adding a capability to automatically identify ground targets and integrating an electronic support measures (ESM) system into the E-8C to aid in cueing the sensor.

Block 20. Commercial off-the-shelf (COTS) high-capacity signal processing equipment is being integrated and the existing E-8C hardware interfaced with new hardware and the existing data processing, signal processing, and radar control. Data display software is being modified. The effort will involve the development and integration of the software that supports the new capabilities. The upgrade includes dual-redundant Mercury RACE computers from Mercury Computer Systems and OpenVMS-based AplhaServer ES40CV systems from Compaq Computer Corporation.

The 14th E-8C was delivered to the 93rd Air Control Wing (active duty) in late 2002. This was the fourth new-build Block 20 aircraft. Future deliveries will be made directly to the Georgia National Guard 116th ACW "blended wing." The Air Force is upgrading the first 10 JSTARS to Block 20 configuration, with the first retrofit completed in February 2002 and the second late in the year.

E-8C Interoperability Requirements. These modifications augment the basic E-8C ability to interoperate with external tactical elements via changes to external communications systems. They include the following: integrating Improved Data Modems (IDM) into the existing E-8C communications subsystem; integrating a basic UHF SATCOM communications capability into the E-8C; providing beyond line-of-sight voice and data communications with UHF-equipped platforms; and replacing the E-8C VHF ARC-186(V) radio with a VHF SINCGARS radio for better voice communications with ground and Army aviation forces.

The JSTARS manufacturer was awarded a contract to develop a computer datalink between the E-8C and the Army AH-64D Apache Longbow helicopter. Target data from JSTARS will enhance the Longbow's radar picture of the close-in battle. The first phase of the effort, estimated at US$5 million, called for developing an improved data modem and installing it on a JSTARS test aircraft. This was to be completed by 2000.

In another data transfer effort, the U.S. Marine Corps is developing software to make it possible to display JSTARS-derived information on the existing Marine tactical data network and command and control equipment. The Marine ground stations collect raw JSTARS data for targeting information, situational awareness, and surveillance. Existing hardware processes pertinent geographical information and forwards it to field commanders both ashore and at sea.

In another data transfer effort, the U.S. Marine Corps is developing software which will make it possible to display JSTARS-derived information on the existing Marine tactical data network and command and control equipment. In FY98, Congress appropriated US$16 million to develop the software and purchase two Common Ground Stations. The Marine ground stations would collect raw JSTARS data for targeting information, situational awareness, and surveillance. Existing hardware would process pertinent geographical information and forward it to field commanders both ashore and at sea. Deliveries were planned for mid-1999. The Marine Corps planned to acquire two ground stations.

Operations and Control (O&C) Subsystem Modifications. O&C subsystem modifications augment the operator's ability to manage the SAR imagery data, to support the Air Tasking Order (ATO), and to exchange graphics data with JSTARS GSMs. As a result of these modifications, redundant sensor tasking for SAR imagery can be eliminated, as SAR imagery requests are compared with previously collected SAR data. In other benefits, operational, map, coordination, and other graphic data will be able to be exchanged with the ground station, as will fire support target parameters; DMA Compressed ARC Digitized Raster Graphic and Hypsographic data can be displayed at Operator Work Stations using slope shading to illustrate terrain features; operators are able to view the overall area of interest while maintaining zoomed-in views of concentrated interest, and to input, store, and display an ATO database; and ATO data will be able to be processed in combination with existing E-8C database information.

Obsolete production processors are being replaced with new COTS general-purpose computers.

Common Large Area Display Set Program (CLADS). In September 1999, the Raytheon Marine Company Digital Display Group was awarded a firm fixed-price contract, with options, to replace the CRT-based crew station monitors with variations of the Raytheon 21-inch Digital Ruggedized (21 DRD). The program was part of the USAF Common Large Area Display Set Program, which was begun in 1995 to address the shortage of manufacturers of the large display systems used aboard AWACS, JSTARS, and Airborne Battlefield Command and Control Center (ABCCC) aircraft. It moves away from cathode ray tube technology toward digital display systems, which should offer greater reliability and image clarity. AWACS, JSTARS, and ABCCC are the initial aircraft to be retrofitted under the CLADS program. A US$29 million contract called for up to 1,071 displays. Deliveries began in 1999.

Radar Technology Insertion Program (RTIP). The U.S. Air Force began a US$1.3 billion Preplanned Product Improvement (P^3I) program under which engineers would design, develop, install, test, and integrate advanced radar systems in JSTARS, taking advantage of advances in radar and signal processing technology to significantly enhance JSTARS' performance and reduce life-cycle costs.

In FY03, the Air Force established a program element for the Multi-sensor Command and Control Aircraft (MC2A). The MC2A is a horizontally integrated architecture of Command and Control (C^2) and Intelligence, Surveillance, and Reconnaissance (ISR) capabilities – those capabilities needed to achieve Global Strike Task Force (GSTF) objectives. MC2C absorbs and maintains the Multi-Platform Radar Technology Insertion Program radar effort. MC2C in addition transitions the 707-based MP-RTIP radar to a 767-based MP-RTIP radar with funding from PE#0207581F.

Common Ground Station (CGS) TSQ-179(V). See **Technical Data** section.

Joint Services Work Station (JSWS) TSQ-122(V). See **Technical Data** section.

Program Review

Background. JSTARS was developed based on two other systems: SOTAS and PAVE MOVER. SOTAS (Stand-Off Target Acquisition System) was an Army helicopter-borne (UH-1) radar system which was field-tested in the Federal Republic of Germany for eight years (beginning in 1977) by Army personnel. SOTAS made use of moving target indication and provided the Army with invaluable operational experience in applying this technology, which can see and track moving targets while ignoring stationary ones.

Meanwhile, the Air Force was developing PAVE MOVER, an airborne radar used to detect ground targets such as tanks and relay the target location to tactical aircraft or ground-based units. The program combined an airborne multimode radar and a wideband datalink with a high-speed digital signal processor, display, and ground control.

Flight tests confirmed the viability of the PAVE MOVER concept of guiding attack aircraft against distant moving and stationary tank formations. Although somewhat crude, the joint Grumman/Norden effort provided a solid basis for the JSTARS concept since it combined target tracking, synthetic aperture radar (SAR) imagery, weapon acquisition tracking in real time, and navigation.

Congress decreed that the Army and Air Force programs merge to reduce R&D costs. In early 1982, SOTAS was canceled, and in May 1982 the Joint STARS office was established at the Electronic Systems Division at Hanscom AFB, Massachusetts.

The original system was to be mounted on Army OV-1 aircraft and Air Force TR-1s. However, in June 1984 it was reported that the Air Force E-8A (a modified Boeing 707-320) would be the only airborne platform used for JSTARS. The first successful test flight with a radar took place in December 1988.

In May 1993, the DoD approved low-rate initial production (LRIP) based on a favorable Defense Acquisition Board Review. The LRIP program is for five aircraft total, Lots 1 to 3. Approval for long-lead items for Lot 4 was also given.

In August 1993, the Army approved LRIP for 12 Medium JSTARS GSMs. Undersecretary of Defense for Acquisition John Deutch deferred a decision on long-term depot support pending further review of the issue. The review also approved a GSM acquisition strategy, the exit criteria for GSM Light LRIP, and Milestone III decisions. LRIP decision authority was delegated to the secretary of the Army.

In a 1993 report, the U.S. Marine Corps announced plans to procure two GSMs in FY96/97 as part of a Corps-wide upgrade of its intelligence systems.

After Iraq invaded Kuwait in August 1990, the Air Force briefed the command structure on the capabilities of JSTARS. On December 17, 1990, General Norman Schwarzkopf requested JSTARS support for Persian Gulf Operations. On December 21, the Joint Chiefs of Staff ordered the deployment of the two prototype JSTARS aircraft from operational testing in Europe (Operation Deep Strike) to the Kuwait theater of operations. The aircraft arrived in theater on January 12, 1991, and flew their first sorties on January 14.

The two test aircraft flew 49 combat sorties, supporting 100 percent of the tasked missions. System availability was over 80 percent, and the mission-capable rate was 84.5 percent. The aircraft logged 535 mission flight-hours.

JSTARS proved capable of tracking convoys, trucks, and armor. The aircraft teamed with F-15E, F-16, and F-111 attack missions to “deny the enemy night sanctuary.” Everyone agreed that JSTARS was a spectacular success, and commanders marveled at all of the contributions JSTARS could make to battlefield operations. Commendations and praise were extensive.

When Coalition leaders discovered that JSTARS could help to counter Iraqi Scud missile attacks, they pressed the aircraft into an active Scud-hunting role. The major complaint was that there were not enough JSTARS aircraft. When engaged in Scud-hunting, the one aircraft available each night was limited in its direct support of ground commanders.

But in spite of the time spent Scud-hunting, JSTARS provided Coalition leaders with excellent situational awareness. Spectacular results were especially noted during the Iraqi attack on Kafji and when Saddam Hussein’s forces fled Kuwait City toward Basrah. Reprints of the JSTARS imaging of the retreat along the “Highway of Death” have become familiar.

In December 1995, JSTARS was deployed during Operation Joint Endeavor, supporting NATO peace-keeping forces in Bosnia. Two JSTARS aircraft flew 50 consecutive sorties, breaking the record set in Operation Desert Storm in 1991. The E-8A and the E-8C developmental aircraft met every assigned mission during the deployment. They flew a total of 95 operational missions and more than 1,000 flight hours. The aircraft and crews returned on March 29, 1996.

JSTARS imagery taken over Bosnia had a great impact on operations as well as the outcome of peacekeeping negotiations. In a speech, the Honorable Sheila Widnall, the former secretary of the Air Force, noted that “The NATO commander enforcing the separation there took to slapping [JSTARS] pictures down in front of the Serbs during their meetings, saying, ‘See, you can’t do anything we don’t know about!” Copies of the photographs reviewed by Forecast International clearly show when vehicles had been moved out of the zone of separation (and when they had not). JSTARS monitoring of the Sava River crossing was key to protecting the Coalition forces building the bridges needed to get U.N. forces across.

The Pentagon sent JSTARS back to Bosnia to monitor the pullout of U.S. troops from Operation Joint Endeavor. In addition to standard JSTARS monitoring operations, the systems were modified to provide links to Predator UAVs flying from the base at Tazar. Operators on JSTARS controlled the UAVs and used them to provide detailed observations (down to 1 foot) of areas screened from the APY-3(V). The UAV data were transmitted directly to ground stations.

The U.S. Air Force accepted the first production E-8C on March 22, 1996. In November 1996, the DoD deployed two JSTARS to Germany a second time to fly missions supporting Operation Joint Endeavor. A second production E-8C was delivered to the Air Force on December 13, 1996.

In October 1997, JSTARS was deployed to Kadena Air Force Base to support Operation Foal Eagle in South Korea. This was the first time JSTARS was deployed to the Pacific area.

The fifth production JSTARS airframe was completed in June 1999. New rework procedures cut the cost of refurbishing the aircraft and made it possible to deliver them 10 weeks ahead of schedule. The radar was installed and delivered to the Air Force in October 1999. A new plan based on the changed rework procedures will make the aircraft delivered in FY02 (#12 and #13) the baseline models for the computer replacement program.

The Pentagon's Defense Acquisition Board approved full-rate production of a planned 19 JSTARS aircraft on September 26, 1996. The Air Force planned to acquire two aircraft per year.

In spite of General Accounting Office (GAO) criticism of production versus test timing, Congress has been very supportive of JSTARS, and added US$210 million to the FY97 Defense Authorization to procure a third aircraft. The FY98 Defense Appropriation fully funded the DoD request and added funds for the Improved Data Modem and other improvements, while at the same time adjusting for funds left over from Engineering Change Orders.

In FY99, the Armed Services committees noted that the Quadrennial Defense Review (QDR) recommended reducing procurement of JSTARS aircraft to 13 based on the assumption that NATO would select it as its ground surveillance aircraft and purchase six aircraft. When NATO did not select JSTARS for its fleet, the DoD did not update the QDR's recommendation, so to address this shortfall, the conferees authorized US$72 million for advance procurement of two JSTARS aircraft.

In 1999, officials began exploring whether or not it would be practical to expand JSTARS' surveillance capabilities by equipping the Global Hawk UAV with a modular JSTARS radar. This would be an offshoot of the RTIP radar upgrade effort. Although there were no plans to replace the existing radar planned for the RQ-4A Global Hawk, officials were open to increasing the synergy between the two platforms by using the same basic sensor in both. The RTIP sensor for the UAV would have a smaller aperture than the original JSTARS, and thus lack some of its capabilities. There are those who say that downsizing the sensor enough to fit the UAV may reduce capabilities to the point that the platform cannot perform the desired mission. The possibility of controlling Global Hawk from JSTARS was also being evaluated.

In other test operations, JSTARS was equipped with an information system to receive sensor data from the Predator UAV. Real-time satellite feed was demonstrated in the Air Force Expeditionary Forces Experiment (EFX 98).

The FY00 Defense Authorization authorized a US$46 million addition to the Air Force budget request for the procurement of one more E-8C (#15). An option to spend the money to shut down the production line was removed in the final conference committee report.

In the FY01 budget, Congress appropriated an additional US$40 million in advance procurement funds for aircraft #16.

In late 2000, the secretary of defense approved Air Force plans to restructure the RTIP program. The Air Force was instructed to budget US$756 million over FY02 through FY07 for R&D of four elements of the RTIP program. US$479 million would be allocated for the development of a modular Radar RTIP sensor for multi-platform applications, with procurement to begin in FY08. US$28 million would fund a multiple-user common datalink to be completed in FY06. US$81 million would go toward developing a sensor for the NATO Trans-Atlantic Advanced Radar (NATAR), to be completed in FY07. US$168 million would fund sensor integration and additional EMD for Global Hawk, with procurement to begin in FY08.

The new effort would be known as the Multi-Platform Radar Technology Insertion Program (MP-RTIP). This was developed into a stand-alone effort, the Multi-sensor Command and Control Aircraft (MC2A) program, the E-10A.

In an October 5, 2000, *Commerce Business Daily,* the Air Force announced that it was awarding a sole-source contract to Northrop Grumman for the design of an MP-RTIP radar that could be integrated on multiple U.S. platforms and would be suitable for use by NATO. For more information, see the Radar Technology Insertion Program (RTIP) section.

In a March 15, 2000, *Commerce Business Daily,* the JSTARS Program Office announced that it was awarding Northrop Grumman a sole-source contract modification to undertake the EMD phase of the RTIP. (See that section for details.)

A September 2, 1999, *Commerce Business Daily* announcement by the U.S. Army CECOM, CECOM Acquisition Center, Fort Monmouth, New Jersey, said that the Army intended to procure up to 120 JSWS. The CGS production contract, awarded under a best-value competition to Motorola Inc in December 1995, will run through October, 30, 2009.

The JSWS will be configured from CGS-based COTS hardware and software components. The JSWS and CGS will have a common software baseline. The JSWS is required to provide the same operational human interface and technical results provided by the CGS. The period of performance will run from October 1999 to October 2004. The contract would be a firm fixed-price delivery order type (indefinite delivery/indefinite quantity).

The contract would contain an initial year order range of 1-17 JSWS units for development and testing of the JSWS hardware and software in laboratory and operational environments. The contract will also include four one-year LRIP options whereby the government can purchase from one to 103 JSWS units. The contract will include the option for the government to lease up to six units from each LRIP production option year for a total of 30 JSWS units. The testing and development units, the LRIP production units, and the leased JSWS units will comprise the total quantity of 120 JSWS called for under this contract. The contract will also contain provisions for the delivery of spares, manuals, training/logistics data, consumables, and commercial type warranty.

On October 1, 2002, the JSTARS mission transitioned to the Air National Guard 116th Air Control Wing (ACW) at Robins AFB, Georgia. This wing is part of the Total Force "blended wing" concept which combines both active duty and Air National Guard personnel in a single unit. It replaced the B-1B mission lost by the wing when the Air Force retired much of the B-1B fleet.

JSTARS/UAV Interoperability Demonstration. In October 2003, at Edwards AFB, California, Northrop Grumman successfully conducted the first communication between the U.S. Air Force's Global Hawk UAV and a manned airborne battle management platform. The company-funded event demonstrated a new architectural concept called the Advanced Information Architecture (AIA), an effort which will result in the ability to rapidly disseminate Global Hawk imagery and other mission-critical data in theater among battle managers, ground troops, and other tactical users. The AIA concept test shared imagery among Global Hawk, a testbed E-8C, and several ground users equipped with tactical manpack radios and laptop computers.

The imagery exchange advances defining communications architectures that integrate the battle operations of manned and unmanned platforms. In July, there was a demonstration of the ability of two UAVs, a U.S. Navy RQ-8A Fire Scout vertical takeoff and landing tactical UAV, and a U.S. Army Hunter tactical UAV, to communicate and safely operate in the same air space at the same time. This is considered the first step in the quest to create an integrated battle space where complete situation awareness is a given, not a goal, for every warfighter. AIA is a faster, simpler alternative to the expensive, bandwidth-intensive process used in recent conflicts, such as Operation Iraqi Freedom, to download Global Hawk image data to U.S.-based ground stations, analyze it, then push it back into theater on demand. It will allow tactical users on the ground or in the air to select and download mission-critical data directly from a network of high-capacity servers on Global Hawk and other in-theater platforms.

The test used narrowband, line-of-sight air-to-air or air-to-ground UHF communications links. Users could elect to receive just the data needed for a specific mission, thereby minimizing bandwidth requirements. If the queried platform did not have the requested data, its server would poll other servers in the network to obtain and deliver the data to the original requester. The AIA concept would effectively extend a user's line of sight to the most geographically distant platform in the network.

To demonstrate the concept, the test team developed and installed on Global Hawk a new 1.4 terabyte (1,500 gigabyte) computer server capable of storing all of the imagery and sensor data recorded during a complete Global Hawk mission. Fifteen hundred gigabytes equals the storage capacity of approximately 50 desktop personal computers. Designers also set up a secure, wireless local area network between Global Hawk and Joint STARS using hardware provided by Harris Corporation, and installed client software that allowed tactical users with UHF radios to query and receive information from Global Hawk.

Global Hawk orbited 64,500 feet above Edwards Air Force Base, and JSTARS patrolled 100 miles away. Battle managers aboard JSTARS queried and received, from Global Hawk, images and navigational data from the UAV's most recent mission. The imagery was also relayed by a satellite communications link to Northrop Grumman's Crew Area Virtual Environment in Melbourne, Florida, a 40-foot-long, company-funded mockup of a Boeing 767-400R fuselage configured as an airborne battle management center. Following the exchange, ground users at Edwards and a Northrop Grumman facility in El Segundo, California, used their tactical, line-of-sight UHF radios to query and receive recently recorded images directly from Global Hawk's server. A tactical radio integrated with Global Hawk's server enabled the proper "handshake" between Global Hawk and the ground users.

This demonstration showed that it is technically feasible to collect, store, and share integrated, decision-quality information among airborne platforms, ground troops, and other disadvantaged tactical users. This network concept could easily be extended to include a full range of current and planned intelligence, surveillance, and reconnaissance sensors. Having information available in an integrated format is considered key to allowing battle commanders to define and carry out decisive, effects-based combat operations.

Company officials noted that the interoperability demonstration advances the credibility of the mixed fleet solution (Airbus midsized jets and high altitude UAVs derived from the Global Hawk) proposed for NATO's Ground Surveillance requirement by the Transatlantic Industrial Proposed Solution (TIPS), an international six-company consortium that includes Northrop Grumman. NATO expects to award a contract for the Alliance Ground Surveillance design and development phase in 2004.

JSTARS RDT&E PE#0207581F (Joint STARS). This program is in Budget Activity 7 – Operational System Development, Research Category 6.6.

This program element funded two related but distinct Air Force efforts: Joint STARS and the Multi-Platform Radar Technology Insertion Program (MP-RTIP). Beginning in FY03, MP-RTIP funding was included in PE#0207449F.

The MP-RTIP program stemmed from the restructuring of the JSTARS Radar Technology Insertion Program (RTIP), formerly a pre-planned product improvement to JSTARS. MP-RTIP would deliver enhanced Wide Area Surveillance System capabilities to the warfighter, provide for a robust Global Hawk reconnaissance capability, and support NATO's Alliance Ground Surveillance (AGS) program. It moved to PE#0207449F.

Through FY02, officials spent US$498.69 million on various JSTARS and MP-RTIP efforts.

FY03 plans budgeted US$60.317 million to continue the various efforts. Plans were to complete the SATCOM EMD effort. Support for the program would be broadly spread. Congressional adds that year included a Joint Services Work Station (JSWS) and Global Air Traffic Management (GATM) system integration.

The FY04 budget would continue to fund these efforts, including Kill Chain/Spiral Development efforts.

Acquisition Strategy. JSTARS LRIP was approved by the Defense Acquisition Board in FY93. Acquisition began with the procurement of two E-8Cs in FY93, followed by the acquisition of two E-8Cs per year through FY97. Procurement funding was allocated for one E-8C in FY98, two E-8Cs in FY99, and one each year in FY00 through FY03.

JSTARS RDT&E PE#0604770A (Army Joint STARS [TIARA]). The long-term objective of this effort is to migrate Common Ground Station with Army ISR Ground Processing capabilities into DCGS-A (Distributed Common Ground Station-A), a modular/scalable network centric design utilizing objective hardware that integrates signal, imagery, and other intelligence processing into a Common Ground Station.

The CGS supports interim DCGS functionality for the Future Combat System (FCS). As part of the Stryker Brigade Combat Team (SBCT), and the Counter Attack Corps, CGS provides a key interface between intelligence and command and control systems by concurrently providing timely intelligence data and receiving the Common Tactical Picture (CTP) via the Tactical Operations Center (TOC) Local Area Network (LAN).

CGS integrates imagery and signals Intelligence, Surveillance and Reconnaissance (ISR) data products into a single visual presentation of the battlefield, providing commanders at Echelons Above Corps (EAC), Corps, Divisions and Brigades with Near Real Time (NRT) situational awareness, enhanced battle management and targeting capabilities.

CGS initially served as the ground station for JSTARS, but has evolved into a multi-sensor ground station that receives, processes, and displays sensor data from Predator, Tactical UAV (TUAV), Airborne Reconnaissance Low (ARL), U2, Guardrail/Common Sensor (GRCS), and Integrated Broadcast Service (IBS) while preserving a small tactical footprint. This system supports the interim transition path and also develops advanced capabilities for incorporation into DCGS-A in support of the Objective Force.

This project provides architecture upgrades facilitating dissemination of CGS products to command and control systems located across multiple echelons and expanding modeling and simulation capabilities in support of unit and staff training. This system supports the Interim transition path of the Transformation Campaign Plan (TCP). FY04 funds Modeling and Simulation (M&S) capabilities to support unit and staff training via a network environment and enhancement of existing CGS tools and applications to support migration to DCGS-A.

Program plans are to conduct/continue/complete enhancement of existing CGS applications to support RTIP, ACS, and other sensors and integrate and enhance CGS collaboration/data sharing with other tactical processing nodes across battlefield echelons to support migration to DCGS-A architecture. This was funded at US$1.786 million in FY02, US$1.040 million in FY03, and US$1.574 million in FY04. There was no funding budgeted in FY05.

Designers will expand Modeling & Simulation (M&S) capabilities to support unit and staff training via network environment. FY02 funding was US$1.805 million, FY03 funding, US$1.571 million, and US$1.881 million in FY04.

Engineering support to migrate CGS functionality into Distributed Common Ground System-Army (DCGS-A) Block I and develop documentation for Objective DCGS architecture was funded at US$3.384 million in FY02 and US$1.3 million in FY03, and budgeted at US$900,000 in FY04.

Coalition Aerial Surveillance and Reconnaissance (CAESAR) Support efforts were funded at US$510,000 in FY02 and US$600,000 in FY03. In FY04, this effort is budgeted at US$350,000.

Acquisition Strategy. The Milestone C approval for the Common Ground Station was granted by the Defense Acquisition Board in August 2000. The baseline CGS is being enhanced via block approach to migrate the CGS functionality into the objective Distributed Common Ground System (DCGS). The enhancements were awarded sole source to General Dynamics.

U.K. ASTOR Program. Following a period of uncertainty and ups and downs, JSTARS became a contender in the GBP800 ASTOR ground surveillance aircraft program. The U.S. pushed a downsized JSTARS in hopes of generating future price benefits for the Air Force when it completes its own fleet and begins a major sensor upgrade effort.

At the 1999 Paris Air Show, it was announced that the Raytheon Company had been selected as the preferred bidder for the U.K.'s military airborne ground surveillance program. The U.K. favored ground-based exploitation datalinked from an airborne sensor, and not a large-scale airborne command and control capability.

NATO Airborne Ground Surveillance (AGS) System. NATO wants to improve its battlefield surveillance capabilities, and is seriously considering procurement of JSTARS for that purpose. An overall capability could include JSTARS, the French Horizon, and the British ASTOR systems. The overall requirement is set at a mixed force of 12 to 18 aircraft, some of which are likely to be JSTARS. The initial purchases were to begin in 1998, and an AGS operational capability was expected by the turn of the century; however, delays have pushed the selection into the 21st century. The decision was being discussed as much on political and business grounds as in terms of defense concerns. Ownership and control of the new aircraft, European involvement in the business side of the program, and individual national concerns would play a role in the decision. The winner of the ASTOR contract is a leading contender for this program.

DOT&E FY2002 Annual Report

The Joint Surveillance Target Attack Radar System (JSTARS) is a surveillance, battle management, and targeting radar system mounted on a Boeing 707 designated the E8-C. The 25-30 year old airframe has been refurbished and equipped with the JSTARS radar system, communications gear, 18 mission workstations, and an air refueling capability. It is a joint Air Force and Army program with the Air Force as the executive service. The system is required to perform surveillance and battle management for air and land component forces and is intended to meet the operational need to locate, classify, and support precision engagement of time-sensitive moving and stationary targets. Four systems combine to perform this mission: the JSTARS radar, E-8C aircraft, Army Common Ground Station (CGS), and data link connection between the two—the Surveillance and Control Data Link (SCDL). The follow-ons to the JSTARS radar, platform and data link are the Multi-Platform Radar Technology Insertion Program (MP-RTIP), Multi-sensor Command and Control Aircraft, and the Multi-Platform Common Data Link respectively. These programs are covered in a separate report.

The JSTARS program office originally planned four E-8C block upgrades. Block 10 provided the Tactical Digital Information Link; Block 20 was the Computer Replacement Program; and Block 30 integrates satellite communications, the Attack Support Upgrade, and Improved Data Modem (IDM). The Block 40 upgrade eventually transitioned to the separate MP-RTIP Block 30 is now broken into separate efforts to upgrade the engines, avionics, and radar modes. In addition, the E-8C will be performing many of the missions previously assigned to the Airborne Battle Command and Control Center (ABCCC), which are being decommissioned.

TEST & EVALUATION ACTIVITIES

- Initial JSTARS IDM testing was conducted from January to April 2002. The IDM provides a sensor-to-shooter data link between the E-8C and Apache AH-64D helicopters. There were three phases of testing. Phases 1 and 2 consisted of laboratory and ground testing, respectively. Phase 3 consisted of two flight test sorties conducted during a 101st Airborne Division exercise at Fort Leonard Wood, Missouri. During the exercise, one E-8C provided threat and targeting data to three companies of Apache helicopters that were conducting deep attack operations.
- The U.S. Army conducted an evaluation of the CGS with the 82nd Airborne Division during a rotation to the Joint Readiness Training Center at Fort Polk, Louisiana in September 2002.

• Test and Evaluation of the Block 30 upgrades is being developed and will be published in a new TEMP. This testing will include Developmental Test and Operational Test of the individual upgrades and will culminate in a dedicated Operational Test and Evaluation (OT&E) of the combined upgrades.

TEST & EVALUATION ASSESSMENT. Although a Multi-Service OT&E had been originally intended for the JSTARS system, it was evaluated instead during Operation Joint Endeavor (OJE) in Bosnia. While the assessment in an operational context was valuable, it presented critical limitations to the scope of the evaluation because of the limited nature of the air tasking and static ground situation of OJE. As a result, only a limited capability in support of target attack and battle management was demonstrated. Because of these shortfalls and unresolved issues in Multi-Service Operational Test and Evaluation, OSD directed an E-8C Follow-on Test and Evaluation (FOT&E).

DOT&E continued to monitor JSTARS during subsequent FOT&Es, operational deployments, and exercises. The system's operational suitability has improved, but it still has not met its requirements. While the radar picture provides information on large-scale movements of ground targets over a corps-sized area and supported commanders feel it gives them a higher level of situational awareness, it is still difficult to find small-scale militarily significant (e.g., company-sized) movements. Also, the Army found the current radar does not have the potential to provide adequate information to support targeting against moving or stationary targets with indirect fire weapons systems such as artillery or Army Tactical Missile System.

Recent IDM testing demonstrated that the required targeting and surveillance messages could be transmitted in a timely and accurate manner between JSTARS E-8C and Apache AH-64D helicopters, sufficient to support target attacks by the Apache. Some operational deficiencies were noted during testing and recommendations were made to resolve these prior to equipment installation. For example, the Apache pilots could not distinguish between moving and stationary targets; those moving were incorrectly seen as stationary.

Because JSTARS was not completely tested during OJE, the future OT&E of the E-8C should be rigorous enough to evaluate the unresolved surveillance, target attack, and battle management issues identified by DOT&E. To be operationally realistic, future testing should include a full range of missions assigned to JSTARS, supporting both Army and Air Force users. The various missions should not be tested one at a time in isolation, but instead should be conducted in concert in order to evaluate workload and capacity issues. This is especially important given that the JSTARS E-8C will pickup the additional responsibility to perform many missions assigned to the Airborne Battlefield Command and Control Center.

Funding

U.S. FUNDING

	FY03		FY04		FY05(Req)		FY06(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USAF)								
PE#0207581F JSTARS								
0003 JSTARS	-	60.3	-	58.4	-	89.5	-	128.8
RDT&E (USA)								
PE#0604770A JSTARS (USA)								
202	-	28.1	-	8.0	-	4.7	-	4.9
Procurement (USAF)								
E-8C	1	268.6	-	0.0	-	0.0	-	0.0
Mods	-	18.6	-	29.0	-	45.6	-	16.3
Spares	-	1.8	-	15.6	-	2.8	-	0.6

	FY03		FY04		FY05(Req)		FY06(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
Procurement (USA)								
BA1080 JSTARS TIARA	-	65.8	-	21.1	-	8.6	-	8.4
JSTARS spares	-	4.8	-	4.3	-	3.3	-	0.3
NATO AGS C35	-	0.5	-	0.0	-	0.5	-	0.5
DCGS (JIMP)	-	7.8	-	72.1	-	15.7	-	15.9
DCGS	-	2.8	-	2.6	-	2.7	-	2.60
TES (TIARA)	-	0.0	-	33.4	-	17.6	-	43.7
Guardrail Mods	-	0.0	-	0.0	-	0.0	-	5.0

	FY07(Req)		FY08(Req)		FY09(Req)		FY10(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USAF)								
0003	-	79.5	-	71.9	-	59.3	-	TBD
RDT&E (USA)								
202	-	6.3	-	6.2	-	5.8	-	-
Procurement (USAF)								
Mods	-	23.5	-	55.4	-	32.6	-	TBD
Spares	-	1.1	-	1.3	-	1.3	-	TBD
Procurement (USA)								
JSTARS spares	-	0.5	-	-	-	-	-	-
NATO AGS C35	-	0.6	-	0.6	-	0.7	-	TBD
DCGS (JIMP)	-	15.6	-	45.1	-	12.9	-	TBD
DCGS	-	2.7	-	1.0	-	64.8	-	TBD
TES (TIARA)	-	18.9	-	6.0	-	7.0	-	TBD
Guardrail Mods	-	5.0	-	5.0	-	1.1	-	-

All US$ are in millions.

Recent Contracts

(Contracts over US$5 million.)

Contractor	Award ($ millions)	Date/Description
Northrop Grumman	38.2	Mar 2001 – Not-to-exceed FPI (firm target)/CPFF contract for advance procurement of one (Lot X) JSTARS. (F19628-19-6-2801)
Northrop Grumman	169.9	Mar 2001 – FPI (Firm Target)/CPFF contract mod for procurement of long-lead items in support of one JSTARS aircraft. (F19628-00-C-0023)
Motorola Inc	11.1	Apr 2001 – Mod to FFP contract to exercise the option to increase to 19 the number of CGS upgrades from TSQ-179(V)1 to (V)2 configuration. To be completed January 2003. (DAAB07-00-C-L006)
Northrop Grumman	26.0	Oct 2001 – Not-to-exceed FPI/CPFF contract mod for advance procurement of one Lot X (P16) aircraft. (F19628-01-C-0015, P0002)
Northrop Grumman	13.0	Dec 2001 – Not-to-exceed FFP contract mod for production of one aircraft for JSTARS Lot X (P16). (F19628-02-C-0015, P00003)
Northrop Grumman	13.4	Feb 2002 – Not-to-exceed FPI (firm target) and CPFF contract mod to increase aircraft production for JSTARS Lot X (P16). (F19628-01-C-0015, P00005)
Northrop Grumman	16.4	Mar 2002 – Not-to-exceed contract mod for increase in long-lead funding for JSTARS Lot X (P16). (F19628-01-C-P00006)
Northrop Grumman	7.9	May 2002 – Undefinitized contract mod for one JSTARS Lot XI aircraft (P17). (F19628-02-C-0022, P00002)
Northrop Grumman	107.0	Jun 2002 – Contract mod to definitize the production effort for JSTARS Lot X aircraft. To be completed March 2004. (F19628-01-C-0015, PZ0004)
Northrop Grumman	223.8	Oct 2002 – FPIF contract mod to maintain funding for production of one JSTARS Lot XI (P17) aircraft. To be completed March 2005. (F19628-02-C-0022, P00005)

Timetable

Month	Year	Major Development
APY-3(V) JSTARS		
1Q	FY99	Production aircraft deliveries
2Q	FY99	Develop Advanced Imagery capability
3Q	FY99	Production aircraft deliveries
4Q	FY99	Follow-on OT&E start; CRP EMD first flight; Indian Springs operational demonstration of CGS
2Q	FY00	RTIP MS II
3Q	FY00	RTIP EMD contract award
	2004	JSTARS full IOC
2Q	FY00	RTIP MS II, Tactical Common Data Link integration
3Q	FY00	RTIP EMD contract award, Milestone III, Block 10 Reliability Growth Test
2Q	FY01	Modeling and simulation
3Q	FY01	MP-RTIP Phase I definitized, MP-RTIP Integrated Baseline Review
1Q	FY02	Radar Requirements Review
2Q	FY02	TCDL retrofit, Radar Functional Review
3Q	FY02	MP-RTIP platform decision, RVSM contract award
1Q	FY03	Support & Training Sys (STS) Phase 1 complete – install Block 20
2Q	FY03	Complete SATCOM development, Flight Crew Training System (FCTS) delivered, ABCCC Award, ASU contract award
2Q	FY04	STS Phase II contract award, develop Block 20 trainer
TSQ-179(V) CGS		
Nov	1985	Preliminary Design Review
Jun	1986	Critical Design Review
	FY86	U.S. and NATO initiate joint airborne radar demonstration program, stemming from Nunn Initiative; Army awarded contract to develop five downsized GSMs
Oct	1995	CGS program approval
1Q	FY96	CGS LRIP contract awarded
3Q	FY97	Full-rate production contract awarded; initial CGS operator training
Dec	1998	IOC, first unit Robins AFB, GA
1Q	FY99	Block 20 P^3I Program initiated
1Q	FY01	CGS Data Link Enhancement Planning initiated
1Q-2Q	FY01-FY02	CGS SCDL risk reduction
1Q-4Q	FY01	Block 20 P^3I
2Q	FY01	Block 10 operational assessment
4Q	FY03	DCGS-A Fielding at III Corps, CGS integration into interim DCGS-A
3Q	FY03	DT/OT for Block 20

Worldwide Distribution

JSTARS is a U.S. program, with Foreign Military Sales certain. **NATO** is considering a procurement. Several countries are interested in a possible procurement, although numbers cannot be fixed until the NATO decision has been made. The British ASTOR decision against JSTARS will impact the possibility of allied acquisition. Cost is a major factor, and many potential users would prefer to acquire ground stations and rely on U.S. airborne assets.

The **United Kingdom** was considering acquiring five aircraft for its ASTOR program, but decided against JSTARS for the effort.

Forecast Rationale

Like AWACS, JSTARS is in great demand for any combat, contingency, and peacekeeping operations where ground surveillance is needed. JSTARS overcomes many of the surveillance weaknesses that plagued commanders in the past, giving ground commanders access to simultaneous, real-time information on opposing ground forces regardless of darkness or weather. The system provides situational awareness of the location and movement of both friendly and hostile forces over a wide area. With the information provided by JSTARS, commanders can get inside the enemy's decision cycle. JSTARS gives them the advantages they need to achieve success with fewer forces and less risk.

Many interim improvements were incorporated into the aircraft on an emergency basis for Desert Storm, and major communications improvements were developed in order to better disseminate JSTARS' data to the battlefield, including direct transmission of data to "shooters" on a mission as well as the establishment of satellite links to distant headquarters.

NATO is interested in acquiring a JSTARS-like capability, the Airborne Ground Surveillance (AGS) system. The alliance has plans to acquire a combination capability, one that could include a JSTARS variant, the U.K.'s ASTOR system, and possibly two helicopter platforms, such as the French Horizon and the Italian CRESO. The U.S. marketed JSTARS heavily in Europe, trying to overcome the barriers created by cost, politics, and technical/operational considerations.

There is an operational need for both large JSTARS aircraft and smaller surveillance platforms in Europe. The exact mix is yet to be determined, as are answers to questions about ownership and control of the assets and a European industry share in the program. The decision hoped for in 1996 has been delayed. ASTOR selection of a different sensor will influence AGS airborne platform selection.

The Pacific Rim is priced out of the market, and many needs can be met with smaller, less technically intense systems designed for maritime surveillance. Some nations do not have the money or maintenance force to buy and support JSTARS.

Middle Eastern forces such as Israel, Saudi Arabia, and Egypt would like to have procured some JSTARS-like aircraft in the late 1990s. Approval of a follow-on version is uncertain because of political factors and would be granted on a case-by-case basis. In late November 2003, Israel announced that it was planning a JSTARS-like capability which would mount a GMTI capability on a smaller bizjet platform.

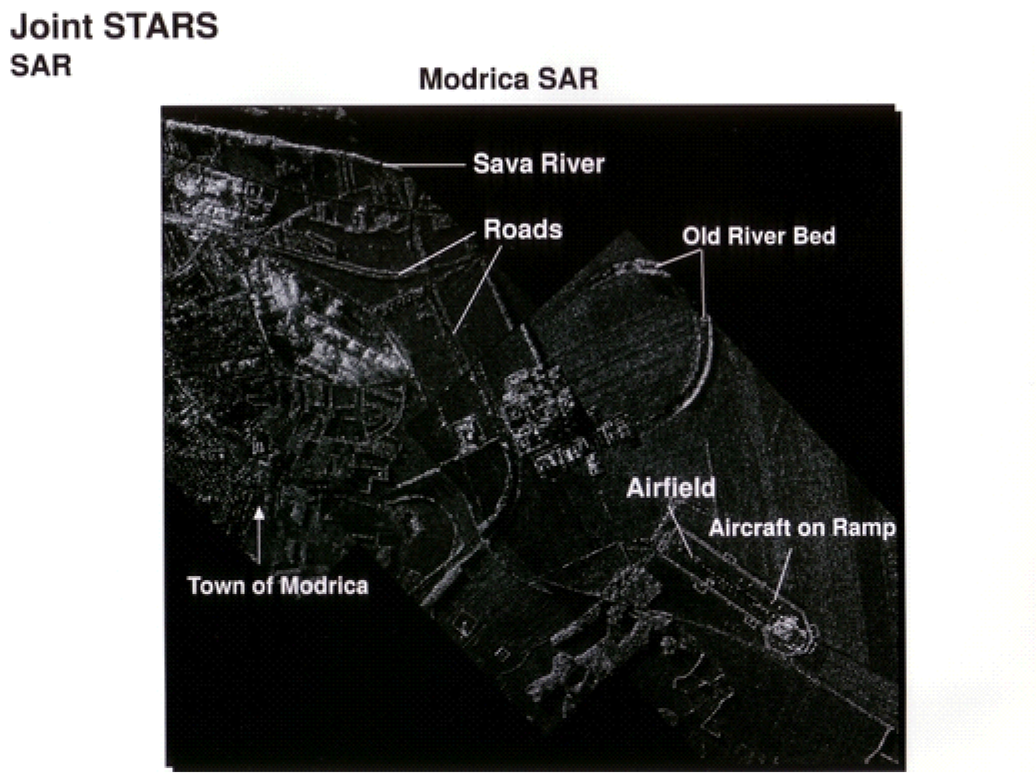
Although significant attention is usually given to the airborne leg of JSTARS, the E-8C, the Ground Station Modules are what make it possible for commanders to use JSTARS data. The Army made an intelligent decision to make the modules a key node in the electronic battlefield of the future. Not only will the Common Ground Station make more effective use of JSTARS data, but it will fuse that information with input from many other sources. This data/information/communications fusion is a must for commanders, as is the ability to make JSTARS data available to users beyond the range of the dedicated aircraft/GSM link.

All of this comes as the Army is transitioning to a faster, more lethal combat organization. The 10-year outlook for ground stations can be expected to change as fielding concepts are revised. It is likely that the number of ground stations will increase, but how many will be CGS and how many will be some other, yet to be developed system is not known.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level		Speculative				
Designation	**Application**	**Thru 03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**Total 04-13**
APY-3(V)	RADAR SENSOR (USAF)	17	0	0	0	0	0	0	0	0	0	0	0
TSQ-179(V)	COMMAND & CONTROL (U.S. ARMY)	62	12	6	6	8	10	6	0	0	0	0	48
		79	12	6	6	8	10	6	0	0	0	0	48



<u>JSTARS SAR Display, Bosnia 1996</u>

Source: Northrop Grumman