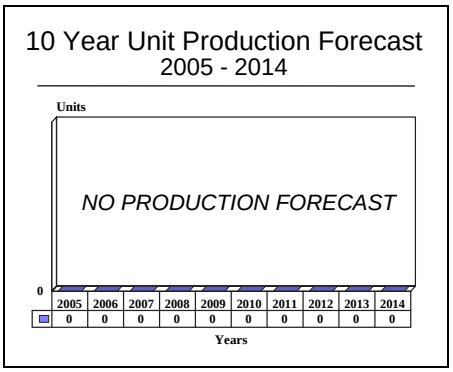
TSQ-179(V) (CGS) - Archived 1/2006

Outlook

- Production/fielding under way
- U.K. ASTOR use planned, NATO AGS use possible
- Joint Services Work Station puts CGS capability in transit configuration



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 (CGS) and the TSQ-179(V) are being fielded, and a transportable version, the TSQ-122(V) Joint Services Work Station, is available.

JSTARS is a primary source of intelligence data for military commanders, target data for fire control systems, and guidance data for attack aircraft and missile systems. The CGS acquires, processes, correlates and displays in real-time SAR/MTI, SIGINT data, UAV inputs, imagery, and National Sources inputs.

Sponsor

U.S. Air Force
AF Systems Command
Aeronautical Systems Center
ASC/PAM
Wright Patterson AFB, Ohio (OH) 45433-6503
USA
Tel: +1 513 255 3767
Web site: http://www.wpafb.af.mil

U.S. Air Force
Electronic Systems Center
ESC/PAM
Joint Program Office
Hanscom AFB, Massachusetts (MA) 01731-5000
USA
Tel: +1 617 377 5191
Web site: http://www.hanscom.af.mil

U.S. Army
Army Communications-Electronics Command (CECOM) AMSEL-IO
Ft. Monmouth, New Jersey (NJ) 07703-5000
USA
Tel: +1 201 532 2534

Status. In production, ongoing logistics support.

Total Produced. Through 2004, an estimated 91 GSM/CGS systems had been produced.

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

Price Range. The Common Ground station is estimated to cost $4.5 to $5.1 million.

Contractors

General Dynamics C4 Systems, (formerly 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

Technical Data

	Metric	**U.S.**
Characteristics		
Radar Modes	Wide Area Surveillance (MTI) Synthetic Aperture Radar/Fixed Target Indicator (SAR/FTI - Mapping) Low Reflectivity Indicator (LFI) Sector Search (SS) Attack planning/attack guidance capability	
Radar Range	200+ km	124 nm
Coverage	40,000 km^2	24,856 mi^2
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 Situational awareness Target development Theater Missile Defense Battlefield visualization Battle space management	
Added Functions	SIDS Auto-indexed refs Multi-media databases Real-time video Administration support Weather AI	

Characteristics (continued)

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. CGS is the Army's premier radar Moving Target Indicator (MTI) ground station, receiving MTI data from Joint STARS, ARL and U2 sensors. It receives, processes, and cross cues data to include SAR, EO/IR, video and Signals Intelligence (SIGINT). CGS disseminates timely targeting and battlefield surveillance data to Army Battle Command System (ABCS) nodes such as the All Source Analysis System (ASAS) and Advanced Field Artillery Tactical Data System (AFATDS). A robust, self-contained communications suite assures connectivity with both sensors and command and control nodes under a wide range of battlefield scenarios and conditions.

CGS contains a robust modeling and simulation capability that supports linkage to sensor simulations, training, and participation in a wide range of exercises on a worldwide basis. The Joint Services Workstation (JSWS) is a single-operator, transportable, reduced-footprint, dismounted workstation variant of the CGS that uses the same hardware and software and provides the same functionality as the CGS. The CGS/JSWS fulfills an urgent air-land battlefield requirement by providing an Army/Air Force sensor and attack control capability to locate, track, classify and assist in attacking moving and stationary targets beyond the Forward Line of Troops (FLOT).

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

The airborne platform consists of three major subsystems:

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

APY-3(V) radar data are processed on board the aircraft in real time and displayed on the aircraft consoles in two forms: MTI target reports and SAR images. MTI target reports are essentially produced in real time, while SAR images take several seconds to collect and produce. Both of these data products are simultaneously datalinked 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 they can be developed within the GSMs by subsequent processing of the MTI reports.

Up to 14 databases are used by JSTARS to enhance the tactical value of the radar information. These databases include cartographic, area visibility, and order of battle and weapons.

Cartographic databases include primary and secondary roads, foliage, marsh areas, hypsographic and hydrographic features, political boundaries, cities and towns, and railroads. These databases provide a basis for real-time recording and monitoring of moving target indicators with great accuracy in relation to terrain.

Area Visibility databases indicate 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 is constantly notified 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.

CGS is the standard Ground Station (TSQ-179(V)). It 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 ensures a simplified migration path for system capability upgrades. The CGS hardware uses commercial computer servers, workstations, and networking, and industry-standard interfaces.

CGS software provides a robust set of core components for C^4I systems (processing engines for interfaces, data, graphics, databases, and Human Computer Interface). A set of Application Programming Interfaces (APIs) simplifies and accelerates software development. There is portability across several Unix platforms.

The CGS acquires, processes, correlates and displays in real time SAR/MTI, SIGINT data, UAV inputs, imagery, and National Sources inputs, providing commanders information with a fidelity never before possible. CGS features Line-of-sight, jam-resistant Surveillance and Control Data Links (SCDLs).

Custom configurations can be developed to meet required specifications. A HMMWV CGS, with full functionality, is highly mobile and deployable for battlefield and on-the-move operations. A transportable version was developed to support the unique needs of Operation Joint Endeavor II. This configuration is rack-mounted and supports all CGS functionality and incorporates all baseline communications systems.

Joint Services Work Station (JSWS) TSQ-220(V). 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 it uses the same software baseline as CGS. It does not, however, have the same carry-along communications suite as CGS. When opened and set up with a table and chair as communications links, JSWS provides the same operability as CGS.

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

JSTARS 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 night and in nearly all weather conditions. The system locates, tracks, classifies, and assists in attacking targets beyond the Forward Line of Troops (FLOT). The aircraft orbits at a 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 high quality, timely information that JSTARS can provide is derived from the tremendous capabilities of the radar. The APY-3(V) provides Moving Target Indicator information over a wide area through both radar- and ground-referenced coverage. Up to a million square kilometers of terrain can be surveyed in a single pass.

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 their deployment to Saudi Arabia in support of Operation Desert Storm in January and February 1991.

By adding satellite communications to JSTARS, its usefulness and span of control 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 to investigate), and clearly identify and locate targets for attack. Datalinks make it possible to link directly to the shooter, improving the effectiveness of operations against previously difficult targets.

JSTARS is truly a high-demand, low-density asset. From January to May 2003, nine JSTARS flew 193 mission sorties – 2,193 mission hours – in support of Operation Iraqi Freedom. This was the first time JSTARS was used as an Intelligence, Surveillance and Reconnaissance (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.

TSQ-179(V) Common Ground Station

Source: General Dynamics Decision Systems

Variants/Upgrades

TSQ-168(V). This was the original version of the JSTARS Ground Station. It was built in limited quantities to support contingency operations.

Common Ground Station (TSQ-179(V)). The Common Ground Station was a Preplanned Product Improvement (P^3I) to the JSTARS Block I Ground Station Module. The Army developed the Common Ground Station as the Block II Ground Station Module and incorporated enhanced operational capabilities and new technology into the GSM functional baseline.

Radar data from the JSTARS aircraft are broadcast to multiple Common Ground Stations via a secure SCDL.

The rapidly deployable CGS is housed in an SICPS and mounted on a HMMWV. The CGS acquisition has been predicated on an aggressive spiral development approach. This approach expanded the number and quality of sensor inputs to the CGS, and the CGS' ability to disseminate information to tactical intelligence and fire support nodes. In addition to receiving Moving Target Indicator (MTI) and Synthetic Aperture Radar (SAR) data, the baseline CGS receives Hunter UAV video, intelligence broadcasts, and National Imagery, and disseminates information to Army intelligence and fire support nodes.

Block 10 CGS provides UHF SATCOM connectivity to the JSTARS aircraft. Block 20 CGS integrates the CGS with the Local Area Network of the Army Battle Command System Tactical Operations Center to improve and expand the dissemination of CGS products. Beyond Block 20, the CGS spiral development will include Tactical Control Data Links (TCDLs) with the Predator UAV and Tactical UAV to reduce reliance on UAV ground stations.

Use of the Tactical Common Data Link provides more timely receipt of MTI and SAR data from Airborne Reconnaissance Low (ARL) and the follow-on Aerial Common Sensor (ACS). Longer term, the CGS will include improved datalinks and processing to exploit the sensor improvements associated with the JSTARS Radar Technology Improvement Program (RTIP).

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 that 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 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 (mounted on an F-111A) and a wide-band datalink with a high-speed digital signal processor, display, and ground control.

Flight-testing of PAVE MOVER confirmed the viability of the concept of guiding attack aircraft in missions 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, and weapon acquisition tracking in real time.

In June 1992, at the direction of the Air Force, Grumman terminated its contract with Motorola for the airborne processor and decided to procure a Raytheon/ Digital processor based on a new Digital 64-bit computer chip.

In August 1993, the Army approved low-rate initial production (LRIP) of 12 medium JSTARS GSMs.

The "Highway of Death" photos of the Iraqi forces streaming out of Kuwait made JSTARS famous and contributed to a belief that the system could see almost anything. Performance in the Persian Gulf was much better than expected, especially since the prototype processing system had only a fraction of the planned capability for production aircraft. In Bosnia, the mountainous terrain presented a problem that did not surprise radar experts; there were screened areas where JSTARS was not all seeing. Targets deep in valleys and behind hills could not always be detected and tracked because of masking and clutter. This, according to an observer, "led to surveillance activity reports that could have been misinterpreted by commanders and staffs, and only partially demonstrated capabilities to support target attack and battle management."

Planned changes included improved satellite communications and deployable ground support stations to enhance dissemination of JSTARS data to ground commanders beyond line-of-sight of the JSTARS SCDL. The Moving Target Indicator software was slated to be changed to reduce the impact of clutter on performance.

A September 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 each JSTARS Joint Services Work Stations (JSWS) and TSQ-220(V)s, direct variants of the TSQ-179(V).

The JSWS would be configured from CGS-based commercial off-the-shelf (COTS) hardware and software components. The JSWS and CGS have a common software baseline. The period of performance is October 1999 to October 2004. The contract is a firm fixed-price delivery order type (indefinite delivery/ indefinite quantity).

The contract had 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 also includes four one-year LRIP options whereby the government can purchase

from 1-103 JSWS units. The contract also includes the option for the government to lease up to six units each LRIP 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 that can be awarded under this contract. The contract will also contain provisions for the delivery of spares, manuals, training/logistics data, consumables, and a commercial-type warranty.

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 upgrade effort. Although there were no plans to replace the 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; therefore, it would lack some of its capabilities.

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

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.

Acquisition Strategy. The baseline CGS capability is being enhanced via block upgrade approach to support other sensors and integrate CGS collaboration/data sharing with other tactical processing nodes across battlefield echelons to support migration to DCGS-A architecture. The enhancements were awarded sole source to General Dynamics.

FY03 and FY04 plans were to complete enhancement of existing CGS applications to integrate and enhance CGS collaboration/data sharing with other tactical processing nodes across battlefield echelons to support migration to DCGS-A architecture. Designers would also complete Modeling & Simulation (M&S) capabilities to support unit and staff training via network environment.

Engineering support would migrate CGS functionality into Distributed Common Ground System-Army (DCGS-A) and develop documentation for DCGS-A architecture. Planners also hoped to complete Coalition Aerial Surveillance and Reconnaissance (CAESAR) Support.

No funding is programmed after FY04.

The Army decided to end production of the Common Ground Station and move to DCGS-A. CGS was considered old hardware, where DCGS-A takes advantage of new software and new hardware. Upgrades to CGS will continue as long as it is fielded.

Details on DCGS are in the Forecast International *Distributed Common Ground System* Market Intelligence Report.

Funding

U.S. FUNDING

	FY04		FY05		FY06(Req)		FY07(Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (USA)								
PE#0604770A JSTARS (USA)								
202	-	4.7	-	0.0	-	0.0	-	0.0
Procurement (USA)								
BA1080 JSTARS TIARA	-	8.4	-	8.2	-	0.0	-	0.0
NATO AGS C35	-	0.5	-	0.6	-	0.6	-	0.7

All $ are in millions.

Recent Contracts

(Contracts over $5 million.)

Contractor	Award ($ millions)	Date/Description
Motorola Inc	11.1	Apr 2001 – Mod to FFP contract to exercise the option to increase the number of upgrades of TSQ-179(V)1 to (V)2 configuration to 19. Completed January 2003. (DAAB07-00-C-L006)

Timetable

Month	Year	Major Development
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 awards contract for development of 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 datalink enhancement planning initiated
1Q-2Q	FY01-FY02	CGS SCDL risk reduction
1Q-4Q	FY01	Block 20 P^3I
2Q	FY01	Block 10 Operational Assessment
1Q	FY02	Demonstrations at Division Capstone Exercises I and II
1Q-4Q	FY02-03	Participation in Desert Pivot Exercises
3Q	FY03	Migration into DCGS-A (FCS UA)
1Q	FY04	Migration into DCGS-A (FCS UE)
2Q	FY04	Field DCGS-A at XVIII Airborne Corps

Worldwide Distribution

JSTARS is a **U.S**. program, with Foreign Military Sales certain. **NATO** is studying a procurement, and several other countries have expressed interest. Numbers cannot be fixed, however, until the NATO decision is made. 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. This decision will, of course, affect allied acquisition.

Forecast Rationale

JSTARS gives ground commanders access to simultaneous, real-time information on ground forces regardless of darkness or weather. It overcomes many of the surveillance weaknesses that plagued commanders in the past, and provides situational awareness of the location and movement of both friendly and hostile forces over a wide area so commanders can get inside the enemy's decision cycle. This lets commanders create the advantages they need to achieve success with fewer forces and less risk.

The idea of developing a ground station that can take inputs from the full gamut of sources was a major step in putting all available information into the hands of field commanders rather than having sensors send their information to a variety of stations which then feed processed information back to the field.

Major communications improvements were implemented in conjunction with the deployment, and better and more effective ways were found to disseminate JSTARS' data to the battlefield, including the direct transmission of data to "shooters" on a mission, as well as satellite links to distant headquarters. The operational integration of JSTARS, AWACS, and the Airborne Battlefield Command and Control Center (ABCCC) has become the tactical standard.

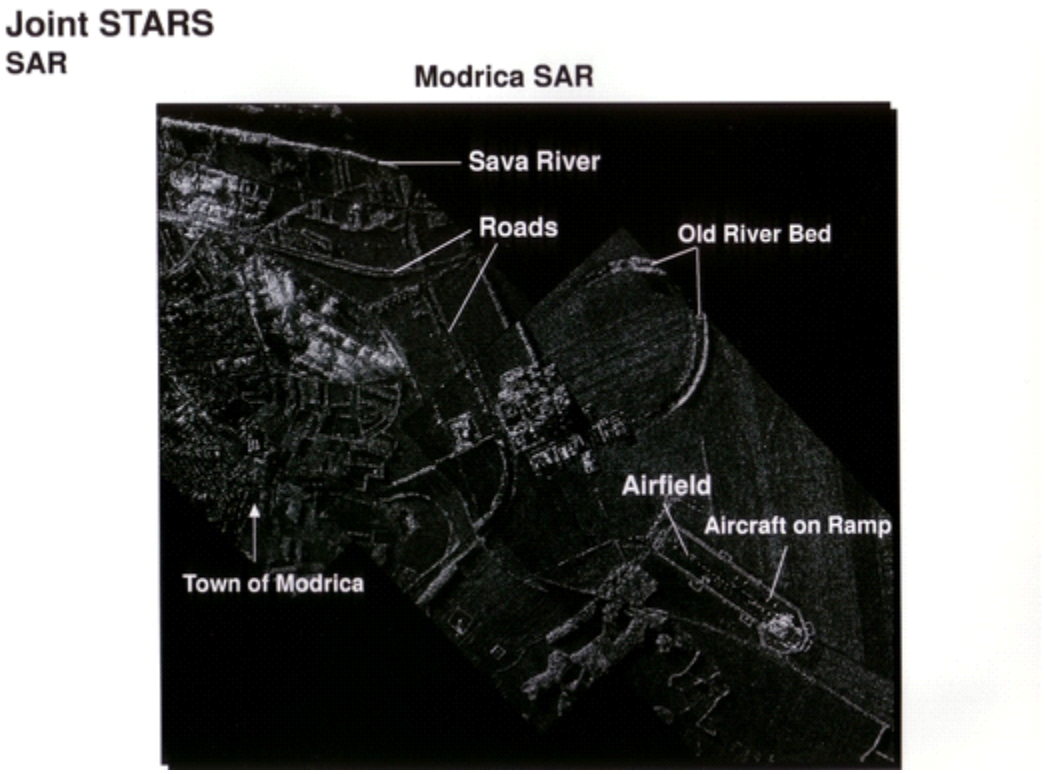
The demonstration of the transmission of information from the Global Hawk UAV to JSTARS to a ground command center was a major milestone in transitioning to the battlefield of the future. It is critical that commanders be able to take full advantage of all the assets available, especially with the rapid maturation of UAVs as valuable information sources.

All of this comes as the Army transitions to a faster, more lethal combat organization. The **Ten-Year Outlook** will 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 unknown.

Ten-Year Outlook

No production is forecast. The Army is going to a newer GCS based on DCGS-A upgrades.

* * *



JSTARS SAR Display, Bosnia 1996

SOURCE: Northrop Grumman