DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE, VIRGINIA 23651

ATCD-C-D

6 April 1979

SUBJECT: Navstar-Global Positioning System (GPS) Army User Equipment (AUE) Required Operational Capability (ROC)

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1. Reference: AR 71-9.

2. Headquarters, Department of the Army, approved subject ROC (Incl) on 22 Mar 79. The following information is applicable to this document:

a. System designation: Major

b. Materiel Developer: USA DARCOM

c. Combat Developer: USATRADOC

d. USER Representative: USATRADOC

e. Trainer: USATRADOC

f. Logistician: USALEA

g. CARDS Reference Number: 0873

h. Operational Test Responsibility: OTEA

i. USATRADOC Proponent Activity: USASIGCEN

3. Subject Requirement Document is forwarded to major Army commands, other services and other DOD agencies for harmonization and to all other addressees for information.

FOR THE COMMANDER:

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Navstar-GLOBAL POSITIONING SYSTEM (GPS)
ARMY USER EQUIPMENT (AUE)
REQUIRED OPERATIONAL CAPABILITY (ROC)

1. Statement of the Need.

a. A capability is needed for selected Army users to determine precise position and to navigate reliably worldwide under adverse weather, during day and night, in all climatic conditions, and in an Electronic Warfare (EW) environment. The desired system must provide instantaneous position location information in Universal Transverse Mercator (UTM)/Universal Polar Stereographic (UPS), Military Grid Reference System (MGRS), grid coordinates and navigation information. The system should also provide a third dimension (altitude in MSL) in certain applications. Map, compass and conventional survey equipment in current use will not provide this location/navigation information to the degree of accuracy and responsiveness required to adequately support the combat user of fielded or emerging tactical systems. Planned systems are intended to provide capabilities to meet this need in general, but not all functional and operational elements can be efficiently supported by those systems being fielded or under development to date. Factors of tactical employment, geographical deployment, degrees of accuracy, and system capacity indicate the need for a mix of systems that can support all positioning and navigation requirements envisioned for the future.

b. CARDS Reference Number:

2. Time Frame. This capability is required to support Army users in the 1985-1995 time frame. (IOC date of 1986.)

3. Threat/Operational Deficiency:

a. Threat. The postulated threat to Positioning and Navigation (POS/NAV) systems at the proposed IOC date is contained in the Threat Appendix to the POS/NAV COEA Final Report. Generally, in central Europe, the threat is characterized by the predominance of rapidly moving armored forces, committed in echelons, with heavy supporting fires, and, in order to maintain momentum, continuous day and night operations.

b. Operational Deficiencies.

(1) Current means of positioning and navigation will not achieve the accuracies and other performance characteristics necessary to satisfy all Army requirements. Systems being developed to meet the requirements are categorized as externally referenced or self-contained with vulnerability to electronic countermeasures being considered as greater for externally referenced and less for self-contained systems. The most effective technological approach to providing a survivability capability under

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all levels of conflict is a combination of an externally referenced system with a self-contained system in those configurations suitable to providing redundancy.

(2) There is a lack of externally referenced systems that offer the instantaneous position and navigation information, desired accuracy and reliability, and the worldwide coverage required by Army users under all battlefield environmental conditions.

4. Operational/Organizational Concept.

a. Operational Concept.

(1) To win the first battle in any future war, Army units must be able to accurately and rapidly determine their location, position their weapons and supporting systems, and navigate on land, in the air or over water. Navstar-GPS and the Position Location Reporting System (PLRS) are the externally referenced systems being developed to enhance these capabilities. PLRS should overcome recognized deficiencies in the current means of providing accurate, timely and reliable position location information within the divisional command, control and communications architecture. Navstar-GPS should meet the needs of the elements outside the PLRS network at division level and at echelons above division. Integrated with the fielded and projected self-contained systems, they should provide the optimum mix of systems to overcome the stated operational deficiencies and counter the postulated threat.

(2) Navstar-GPS is a space-based radio navigation system designed to provide users of all services with worldwide three-dimensional position and navigation information. Potential military users include selected aircraft, surface ships, submarines, land vehicles and ground troops. GPS would be used to enhance such missions as adverse weather weapons delivery, reconnaissance, mapping, and rendezvous. Additionally, GPS may replace many existing navigation aids presently needed for routine point-to-point navigation. The GPS concept includes three major segments:

(a) A space segment consisting of 24 satellites which will broadcast positioning and timing information to users.

(b) A control segment to track the satellites and update position coordinates and timing information daily. It will include four or more monitor stations to track satellites, a master control station to determine signal accuracy, and an upload station to relay data to the satellites.

(c) A user segment consisting of devices to receive and process information from four satellites to obtain accurate position and velocity components for the ground, aircraft, and ship users. The user's position and velocity are established by computing time and range measurements from the known position of GPS satellites.

(3) Navstar-GPS AUE will augment the map and compass and other conventional means of positioning, navigating, and surveying by providing this information to the user with increased accuracies and responsiveness. The AUE will enhance the commanders ability to locate and redeploy his forces, commit his reserves, and bring fire to bear on the threat forces. Small elements (maneuver, supporting, other) detached from parent units for operations such as patrolling, survey, forward area support, or special operations, can utilize the system AUE to obtain their position and to navigate. It can improve the responsiveness of supporting fires, resupply elements, and facilitate rendezvous operations. The vehicular devices will be utilized on combat, combat support, and combat service support vehicles to improve positioning and land navigation. The aircraft set will be used to increase the responsiveness and effectiveness of selected aviation support assets by augmenting the primary (self-contained) tactical navigation systems. GPS will be used to update the primary system in order to maintain desired accuracy performance. It is also envisioned that a GPS vehicular device will be adapted for Army watercraft. In this application, it will be used for ship to shore operations, and on missions requiring navigation through inland waterways and harbors.

b. Organizational Concept.

(1) Specific information on distribution of Navstar-GPS AUE is contained in BOIP I Serial Numbers 78-0260-T and 78-1260-T (Manpack/Vehicular Unit), 78-0263-T and 78-1263-T (Aircraft Unit). Two BOIP I have been developed for each common unit and necessary installation kits. These reflect the user representative philosophy that Navstar-GPS will become an essential part of the Army's positioning/navigation architecture by employment with the Position Location Reporting System (PLRS). In the event that PLRS fails to mature, Navstar-GPS will provide the positioning/navigation function for the force structure. It is necessary, therefore, to present both a low (w/PLRS) and high (w/o PLRS) BOIP I and organizational concepts to reflect the potential utilization of GPS, pending further decisions on the PLRS and GPS development programs.

(2) Low Mix.

(a) Division. AUE will be deployed to elements of the cavalry squadron for reconnaissance, pathfinders of the airmobile division for combat assault operations, Combat Electronic Warfare/Intelligence (CEWI) battalion for surveillance and special missions, signal battalion for control of communications support, aviation elements of the cavalry squadrons and CEWI battalion for reconnaissance, surveillance and special missions, and to NBC defense companies for chemical and radiological reconnaissance.

(b) Echelons Above Division. The distribution of AUE would be in greater numbers than in the divisional organizations. Assignment would include rangers, armored cavalry regiments, and special forces to support their unique functions, CEWI group for employment of radars, sensors and collection devices, air defense control, operations and location of gun and missiles, combat engineer battalions for reconnaissance and mine employment, selected aviation assets (command and control, medical evacuation, special mission), combat service support elements for coordination of logistics and maintenance and conduct of watercraft operations, and NBC defense for reconnaissance of contaminated areas.

(3) High Mix

(a) Division. Typically, AUE will be deployed down to company level in maneuver elements with selected platoons, sections and squads provided devices dependent on their functions (scouts, survey, etc.). Distribution will include elements responsible for maneuver, command and control, intelligence and electronic warfare, field artillery, combat service support, air defense artillery, engineer, and aviation operations.

(b) Echelons Above Division. Typically, deployment of AUE to units will be on a selective functional basis to include armored cavalry, signal, ranger, special forces, pathfinder, Combat Electronic Warfare/ Intelligence (CEWI), field artillery, air defense artillery, engineer, aviation, and marine.

(4) Logistic Support Structure. Direct support for divisional elements will be provided by the Electronic Repair Section of the Division Maintenance Battalion. Direct support for non-divisional elements will be provided by the Direct Support (Forward) and Direct Support (Rear) organizations of the Corps Support Command. General support level of maintenance will be provided by Corps TOE logistic support units/activities that have been organized and structured in accordance with doctrine prescribed for wartime scenario in FM 29-24 or MACOM modified support structure designed to accommodate peacetime austere force structure/ resource constraints. General support level of maintenance for support of operational equipment authorized to non-tactical units organized under TDA structure will be logistically supported by Army area/region GS units/activities structured under TDA support doctrine.

5. Essential Characteristics. The mission essential characteristics are given below by general category.

a. Physical

(1) AUE configurations will consist of a manpack unit, vehicular unit, and an aircraft unit. The manpack units may be carried by any individual in addition to his fighting and subsistence load. The vehicular unit may be installed in selected combat, combat support, and combat service support ground vehicles and adapted for Army watercraft. The aircraft unit may be installed in selected rotary and fixed wing aircraft.

(2) Weight and volume bands are established as:

CONFIGURATION	WEIGHT	TOTAL VOLUME (CU IN)
(a) AUE (Manpack) to include battery	10-12 lbs	500-1000
(b) AUE (Vehicle)	10-20 lbs	500-1000
(c) Aircraft	10-30 lbs	800-1500

(3) Installation requirements are:

(a) Manpack - attack to back pack frame.

(b) Vehicle and aircraft - provisions for mounting and connection to vehicular/aircraft power supply. The vehicular and aircraft units shall be designed to facilitate installation in types of vehicles and aircraft on which they will be used and to provide maximum room for operating personnel. When installed in aircraft to augment a self-contained system, the hybrid system shall minimize size and weight and reduce aviator workload through the use of common displays and controls.

(4) Human engineering will be in accordance with MIL-STD 1472B and user segment specifications. Significant factors include--

(a) Safety of equipment to operate and maintain.

(b) Weight of the manpack within the capability of the soldier to carry in addition to the soldier's fighting and subsistence load.

(c) Operator and maintenance skills limited to the skills (aptitude) expected to be in the Army at the time of fielding.

(d) Operation of the devices will not require a dedicated operator, but will be operated as an additional duty by designated personnel.

(e) All AUE dials, buttons must be easily accessible to the operator, and so designed that an operator wearing standard gloves can manipulate them satisfactorily.

(f) Readout information must be readable in bright ambient light (bright sunlight), under minimum illumination (darkness), and while wearing night vision goggles.

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(g) Antennas that protrude above the head of a man must be flexible and bend on contact with an obstruction.

(5) AUE must be air droppable in manpack and vehicular configurations.

b. Nuclear Survivability: Nuclear survivability is required and the AUE must be designed and constructed to survive the set of nuclear effects levels which will be stated in the user segment specifications.

c. Chemical Biological Protection: The AUE must be designed so that individuals wearing standard chemical/biological protection ensemble can successfully use the device. To facilitate chemical agent decontamination, chemical agent resistant materials will be used to the maximum extent practicable in the fabrication of this item. It will be painted with chemical agent resistant paints to facilitate decontamination. Circuitry will be isolated from the external atmosphere.

d. Climatic Conditions: The AUE must be minimally affected by foliage and capable of enduring all physical conditions defined in paragraph 2-6 and climatic categories 1-8 of paragraph 2-7 of AR 70-38. This system will be impacted less than 5% of the time by atmospheric disturbances (e.g., ionospheric electromagnetic charges, lightning during thunderstorms, or sunspot activity).

e. Performance:

(1) The accuracy requirements are established as:

	Horizontal	Vertical
(a) AUE (Manpack/Vehicular)	10 meters (CEP)	10 meters (PE)
(b) AUE (Aircraft)	25-50 meters (CEP)	25-50 meters (PE)

(2) The AUE must have ECCM capabilities.

(3) The AUE will function in the operational modes of Continuous and Standby. The AUE will warm up from a cold start in five minutes and provide an initial position fix within the accuracy requirements listed above, five minutes after warm up. In the continuous mode, the AUE will provide, in subsequent fixes, an instantaneous digital display of positioning or navigation information. When changed from the Standby mode to the Continuous mode, the AUE will provide output to the operator in 30 seconds to one minute.

(4) The AUE manpack unit will have a battery power source that will support 48 hours of operation on the basis of obtaining an average of 4 fixes/hour from standby during the 48 hour period. The battery must be standard and not require development of a new battery charger.

f. Reliability, Availability, Maintainability (RAM). The AUE Mean Time Between Failures (MTBF) shall be 2,000 hours and the Minimum Acceptable Value (MAV) is 500 hours. The AUE MTTR shall not exceed 15 minutes for organizational maintenance actions and shall not exceed 30 minutes for DS and GS maintenance tasks.

g. The AUE shall withstand conditions of storage and transportation in accordance with AR 70-38. Transportation and handling requirements dictate that the AUE be designed to withstand the shock and vibration normal to movement over adverse terrain such as jungle, mountains, and desert as well as that vibration, noise, and shock normal to the combat vehicle (ground and air) in which it is installed.

h. Service Life. All components of the AUE must provide a 10 year service life without substantial increase in cost or degradation of maintainability or reliability as a function of time.

i. Health/Safety. The AUE design and testing will incorporate adequate measures to identify and control any health or safety hazards to developer or user personnel.

6. Technical Assessment. The capability of GPS to provide accurate navigation information has been demonstrated in the preliminary testing that has taken place. Nuclear hardening poses some technical problems that may require a change in the development technology (medium risk). Achievement of the size and weight requirements are within the state of the art and is considered low technical risk. Cost and schedule risks associated with achieving the manpack 12 lbs. weight requirement are considered medium. Cost and schedule risks associated with achieving the aircraft 30 lbs weight requirement are considered low. Overall development risk is considered low.

7. Logistic Assessment. Because Navstar-GPS is a joint program (see paragraph 8), the logistics management is accomplished by the Integrated Logistics Support (ILS) office which is comprised of Army, Navy, and Air Force personnel. The ILS System Manager for Navstar-GPS will b e located at the prime air logistics center at Warner-Robbins AFB, Item Management Division. User equipment being developed by the Joint Program Office (JPO) will be applied to the requirements of the Army, Air Force, Navy, Marine, and other DOD departments. The Army ILS program will be integrated with that of participating services to the maximum extent possible. The ILS detail in the Joint Service ILS Plan will be prepared to reflect requirements of the Army and other participating users.

a. The baseline logistic concept for the GPS AUE is similar to the concept currently used with FM tactical radios. AR 750-1 will be the baseline guide to the maintenance of the AUE with certain changes as outlined below.

b. It is essential for the AUE to be non-classified when denial of accuracy is not implemented and desirable that the AUE be unclassified when denial of accuracy is implemented. If the AUE is designed with built in or add on COMSEC equipments, the maintenance support plan will have to be revised as well as the training concept for maintenance personnel.

c. The required/desired limit on the need for logistics support elements resources are described below:

(1) Maintenance planning is to be a continuing process throughout the development and testing phases of the AUE life cycle.

(2) Support equipment required to perform maintenance on the AUE should be limited to standard common and special Army Test Measurement Diagnostic Equipment (TMDE). Software programing and post deployment software support for the AUE as well as automatic test equipment (ATE) must be considered as early as possible to insure General Support (GS) maintenance capability upon initial operational capability (IOC).

(3) Repair parts and support to include anticipated maintenance float requirements must be identified, authorized, and responsive to the post IOC support requirements of the AUE.

(4) Personnel and training requirements will be minimal insofar as the MOS's projected to perform maintenance are those existing within CMF-31, CMF-28, and CMF-29. Minimal add-on training should be required to qualify the maintenance personnel.

(5) Equipment publications will be provided IAW Skill Performance Aids Specifications (SPAS).

(6) No additional facilities will be required to provide maintenance or train personnel. The maintenance concept will provide for evacuation of equipment to the next higher echelon of maintenance. Standard mobile maintenance shop vans and/or shelters will be used to provide organizational, DS and GS levels of maintenance in the field.

(7) The Logistics Support Package must be available for test at OT II.

d. Projected changes to current maintenance concepts are to be minimal.

e. The system, to satisfy the requirement, must significantly reduce manpower or increase productivity.

8. Other Service or Allied Nation Interest. Navstar-GPS is a Joint Service Development. The Air Force is the executive service with all DOD agencies represented in the JPO. All Rationalization, Standardization, Interoperability (RSI) actions/implications will be accomplished by the JPO.

9. Training Assessment. The materiel developer and TRADOC proponent will develop a complete training subsystem to support the Global Positioning System AUE. This training subsystem will include a complete SPAS package and all training devices and training materials necessary to provide individual and collective training in both institutions and units.

a. The TRADOC proponent will provide the DARCOM developer with information on the target user populations and will assist the materiel developer in identifying any unusual training requirements inherent in the intended user population.

b. The contractor will produce, and DARCOM and TRADOC will arrive at a signed agreement on, a complete list of operator crew and maintenance tasks through the gneeral support maintenance level. This task list will be generated IAW MIL-M-63035. The list of operator/crew and maintenance tasks should be delivered prior to OT II.

c. The materiel developer will procure a complete SPAS package, to include TM and training materials, for the system. The SPAS package will be developed and funded IAW the DARCOM/TRADOC SPAS Policy Statement.

d. The need for additional training requirments, devices and materials, such as classroom trainers or collective trainers, which were not identified in the demonstration and validation phase, will be investigated. The necessary TRADOC/DARCOM responsibilities and resources to develop these additional training materials will be established and requirement documents will be prepared as appropriate.

e. The TRADOC proponent will prepare/update the Individual and Collective Training Plan (ICTP) which will describe all system training requirements. The ICTP will specify MOS, skill levels, jobs and tasks to be trained using SPAS materials and will also describe the requirement for materiel developer training for service school staff and faculty.

f. The TRADOC proponent will develop training material not included in the SPAS package or developed by the materiel developer as the result of a DARCOM/TRADOC agreement. These products will include the necessary revisions to the ARTEP, SQT, Soldier's Manuals, TEC materials, and audio-visual materials.

g. TMs and training materials developed by the materiel developer NLT 6 months prior to OT II will be made available to the TRADOC proponent school to allow preparation of the Training Test Support Package for OT II (scheduled -- for Jul-Sep 82). The Training Support Package must be available for test at OT II.

h. The draft SPAS package, prototype system training devices and TRADOC developed training materials to support OT II will be delivered to the test site IAW AR 700-127 and AR 71-2 and tested as part of the overall system during OT.

i. The ability of OT test player personnel (representative of the user population trained with the DARCOM/TRADOC training materials) to perform the required tasks to the specified level of proficiency will be a critical issue for test.

j. All elements of the training support package for individual and collective training will be available in final form for system IOC, and in draft form, at least, prior to OT II.

10. Life Cycle Cost Assessment. Projected Life Cycle Cost for development, procurement, operations, and support of Navstar-GPS, AUE,based on a program which develops the Manpack/Vehicular and Airborne sets in tandem, using dual contractors, the low quantity of equipment per BOIP I and a MTBF of 2000 hours can be summarized as follows:

LCCE (FY 79 Constant $M)

Sunk	R&D	Investment	O&S	Cost to Complete
(37.6)	59.5	101.5	24.5	185.5