1.0 ~~(U)~~ Fiscal Year: FY00

2.0 ~~(S/TK)~~ Classification: ~~SECRET/~~ Talent Keyhole/COMINT

3.0 ~~(U)~~ Originator

Army Space Program Office,

(Class FAX)

Financial POC TBD

4.0 ~~(U)~~ MWG Sponsor(s)

5.0 ~~(S/TK)~~ Project Overview

~~(S/TK)~~ This effort implements a subset of the DRAGLINK signal classification algorithms into the Mission 7245 (DARPASAT) payload with the specific goals of improving the classification of existing signals of interest, adding new modulation classification algorithms to the payload, and increasing thruput by up to 50%. This will increase the system's ability to provide critical SIGINT for the tactical commander which increases his battlefield awareness and IPB. In peacetime this improves the capability for access to denied areas and the tactical commander to enter battle better prepared. The system development phase has already been completed on contractor IRAD funds in 1998 in preparation for another program. This effort implements the coding and testing of the algorithms at the contractor facility on the mission 7245 engineering test bed, prior to the software being loaded into the spaceborne payload using the already proven methods. The completion of the development phase means that the implementation of software can be achieved in the 8th month of the effort, to take advantage of the remaining capability of the mission 7245 hardware.

6.0 ~~(S/TK)~~ Background

~~(S/TK)~~ The current Msn 7245 payload was designed as an experiment, with emphasis on the direct downlink to the AEPDS (Advanced Electronic Processing and Dissemination System) vans, the tactically deployable mobile ground stations located at Corps. The experiment also featured on-board processing and report generation, streamlined tasking, CMA (Collection Management Authority) at the tactical military level, and the ability to reload the software to achieve technical upgrades. The on-board processing includes geolocation and signal classification, with a limited number of signals in the on-board library. The signal recognition algorithms were originally given a low priority in the project. The simple classification algorithm uses spectral criteria for identification, rather than initially determining the modulation via demodulation techniques. This has resulted in a large number of signal misidentifications and unknowns. Additionally, the environment has changed since the design occurred in 1992.

~~(S/TK)~~ The current payload supports two broad classes of modulations: Today's environment contains numerous other signals beyond this dual classification approach, including: modulation. While it is desirable to include all modulation types in the present payload, the IRAD project showed that significant improvement would be achieved in the existing hardware if the bauded signals are distinguished as is properly classified even if it contains a bauded signal that skews the spectral characteristics of the FM signal.

~~(S/TK)~~ The significance of Msn 7245 can be seen in recent user comments as to it's utility.

- I Corps…..unique view of the Pacific Rim. Added over 9000 COMINT database items
- III Corps…
- V Corps…..provide Intel beyond range of other Corps assets
- XVIII ABC ….~ 30% of XVIII COMINT worldwide database from Msn 7245
- 12th AF.
- USFK….Best results from direct payload commanding

7.0 ~~(S/TK)~~ Requirements

7.1 ~~(S/TK)~~ Necessity

~~(S/TK)~~ Msn 7245 requirements were formulated for a world wide scenario based on the presence of the USSR. Today's environment is more heavily driven by third world issues and crises, thus the breadth of signals used by the military and others (terrorists) is greatly expanded from the view of the modern tactical commander. For this reason and the advent of digital signals, it is very important to intercept and correctly identify . Additionally, the digital revolution means sets are now using digital modems which alter their spectral content. By including these bauded types into the payload with correct characterization, a more extended set of library reference emitters can be used to expand the list of known signals detected and reported by Msn 7245. This enhances intelligence worth on a worldwide basis.

~~(S/TK)~~ With a higher quality signal classification algorithm, the Msn 7245 reports that are input to the WRANGLER data base can now have the signal identification included. There is a standing requirement for signal identification in this data base that is not being fulfilled today.

7.2 ~~(S/TK)~~ Integration with Overall Program Office Plan

~~(S/TK)~~ Automated identification and classification on board, followed by direct downlinking to field commanders is a tactically proven method for support to military operations. The proposed effort significantly enhances this capability.

~~(S/TK)~~ The IRAD effort was originally focused on a Msn 7245

7.3 ~~(S/TK)~~ Project Impact if not approved

~~(S/TK)~~ The impact on the program if this effort is not approved is that the 7245 system continues to provide intelligence to tactical users with the same degree of identification quality as they presently receive. Also, if not approved, there would be no risk reduction for the

7.4 ~~(U)~~ Impact if not funded

~~(U)~~ The planned software upgrade is not planned at the present time by any other program office, thus a lack of funding from the will place this effort on hold.

8.0 ~~(S/TK)~~ Technical Goals

~~(S/TK)~~ The goals of this effort are as follows:

- Review the existing signal classification software modules to determine the extent of specific modifications necessary to implement new classification and demodulation algorithms. Improve the algorithms to increase the likelihood of a correct classification.
- Convert the simulation code into C code and insure that the converted code operates efficiently within the Msn 7245 multi-tasking system software. Tighten the number of code lines so as to increase the thruput by up to 50%.
- Test the module code for each modified module to insure all paths operate as required.
- Integrate the new modules in the Engineering hardware located at AIL Systems and perform system level test to quantify performance to assure that the new code doesn't cause any problems with the system's operation.
- Load the validated code into Msn 7245 via the proven methodology used for previous on-orbit reloads.

8.1 ~~(U)~~ Technical Objectives

~~(U)~~ This effort will be completed within the FY00. The effort will implement the selected algorithms into "C" code, test the modules written, integrate and test the modules within the overall software and test the total software on the engineering hardware.

9.0 ~~(S/TK~~ Criteria Satisfaction

9.1 ~~(S/TK)~~ Improvement of NRO contributions to military operations

~~(S/TK)~~ The current payload has demonstrated that it is possible to identify and report communication signals in real time. The changes to Msn 7245 will significantly increase the number of correct signal identifications and will add more signal types to the on-board library for eventual identification and reporting via the direct downlink. It will greatly enhanced reports which are input to the WRANGLER database at NSA after processing to combine multiple intercepts of the same emitter by including emitter ID's which are presently not included.

9.2 ~~(S/TK)~~ Joint Service Applicability

~~(S/TK)~~ The payload is currently an Army asset, but the downlinked data is accessible and usable by all services. Currently, tasking of the platform is rotated between the Army and the Air Force. The need for real time intelligence is universal among the services. This compliments collection by air breathing assets for providing real time intelligence. This system also provides frequent worldwide surveillance in areas where air breathing assets are not presently assigned or would otherwise be denied access.

9.3 ~~(S/TK)~~ CINC Thrusts

~~(S/TK)~~ The improved signal identification significantly enhances the intelligence value of intel reports used in developing a worldwide database. This is important for those military units charged with being rapidly deployed anywhere in the world. As an example, the 18th ABC has previously developed as much as 30% of its worldwide database from Msn 7245. This means they can better rely on building an improved SIGINT database prior to deployment of organic assets to the crisis area, resulting in increased battlefield awareness with frequent updates providing change detection based on VHF/UHF communication intercepts. The improved data quality also increases the commander's ability to perform IPB. The same data source can then be direct downlinked into the crisis area for frequent updating of the database. By not deploying organic air-breathers, intelligence can be gathered more frequently in an *unwarned* manner, which offers potential improvement of the intel value. Lastly, this unique overhead asset also provides improved collection in denied areas.

9.4 ~~(U)~~ Significant application to tactical operations

~~(U)~~ The increased list of signal types, plus the fact that any identifications are more likely to be correct, coupled with real time delivery of intelligence reports, provides field commanders with badly needed timely intelligence data. The fact that collection is worldwide provides CONUS based commands with the ability to formulate deployment plans based on real time intelligence from anywhere in the world.

9.5 ~~(S/TK)~~ R&D Prototyping

~~(S/TK)~~ The effort is based on the AIL Systems funded IRAD study which examined algorithms used on other operational overhead systems and determined that they could indeed be used in the Msn 7245 software construct. This effort accomplishes the implementation of the IRAD Project results into code suitable for loading into the operational mission.

9.6 ~~(U)~~ Near term employment of project results

~~(U)~~ The duration of the proposed project is 8 months. At the end of 8 months, within FY00, the upgraded signal characterization becomes operational.

~~(U)~~ Based on previous similar efforts at the contractor facility, it is believed that the software coding and two test levels can be completed in 7 months. This includes verification of the upload on the engineering hardware at the contractor facility. It will take no more than 2 weeks to load and checkout the revised software on orbit. There is also a 2 week test period after the upload is complete to verify operation.

9.7 ~~(U)~~ Transition to operations

~~(U)~~ The operational phase starts after the upload and a 2 week checkout period using known signals to verify the signal characteristic portion of the downlinked reports. The software testing incorporates software module tests (3), software system level tests, integration on the engineering model hardware, and finally the on-orbit checkout.

10.0 ~~(U)~~ Deliverables

DELIVERABLE	DELIVERY DATE
Progress briefings	3 mo ARO, 6mo ARO
Revised software modules	7 mo ARO
Final report discussing signals included in the new library, performance testing and on-orbit results	8 mo ARO

11.0 ~~(S/TK)~~ Transition

~~(S/TK)~~ The revised software is incorporated into Msn 7245 in the same manner accomplished twice before. The system tasking is halted for the period required to upload the entire software which occurs over multiple contacts with the RTS. Upon completion of the upload, tasking will operate test modes designed to recheck the expected operation. Signals will be operated within CONUS containing the desired characteristics to determine that the payload correctly intercepts and identifies the signals.

~~(U)~~ Prior to the software upload, the modules are thoroughly tested as modules to exercise all logic and algorithms. The software is then tested together as a system. Again logic is exercised to insure expected operation and performance. Lastly, the software is loaded into the engineering model hardware at the contractor's facility and exercised completely to check performance. The project will then undergo a scrubbing by a government panel of experts to adjudicate it's status and approve the upload. Essentially, the process used in the two previous reloads is used again.

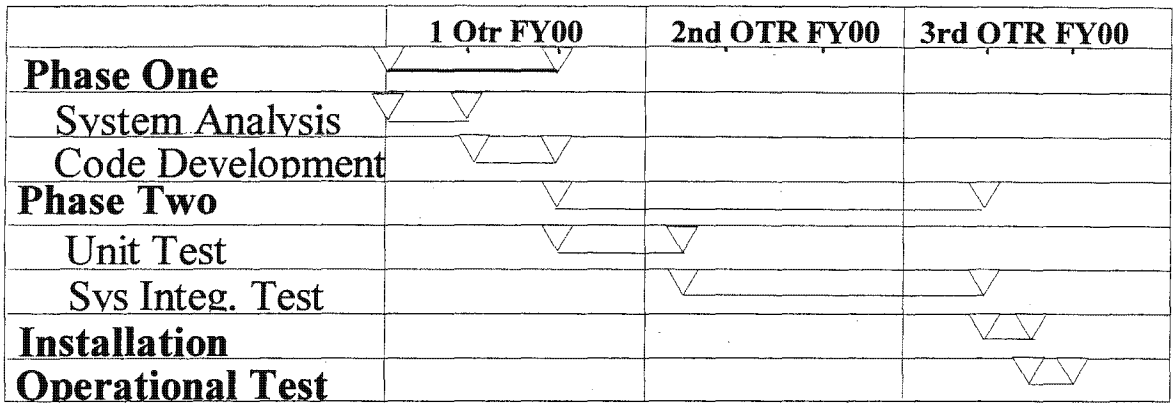
~~(U)~~

12.0 ~~(S/TK)~~ Risk

~~(S/TK)~~ The risk to this effort is minimal. This assessment is based on the completed project which evaluated which algorithms to use. The IRAD project simulated the algorithms and ran performance evaluations. Secondly, this will be the third major software upgrade to the mission. Lastly, the mission batteries, being the most critical item on board, have been evaluated by Aerospace to be able to operate for at least two more years, barring unforseen issues. The project can be completed with the present knowledge base. The only potential out side dependency is the need for the personnel to approve and participate in the software upload.

13.0 ~~(U)~~ Project Milestones

~~(U)~~ The effort is started and completed in FY00. There is no funded FY99 work. The on-orbit testing of the changes will be inserted into the follow-on effort when they are completed in 8 months. Our plan is shown in the following chart.



14.0 ~~(S/TK)~~ Related Technology

~~(S/TK)~~ The payload contractor (AIL), NSA and ASPO have completed a follow-on definition study which determined that new signal classification algorithms can be implemented within the Msn 7245 architecture. The DRAGLINK algorithms They provide the basis for this effort. There is another algorithm being used by NSA systems at present which will only be considered for the follow-on.

15.0 ~~(U)~~ Funding

FY98 IRAD at AIL Systems		$100K
Implementation Phase	FY00	$250K
Total government funding for the project		$250K

16.0 ~~(U)~~ Keyword

~~(U)~~ Signal processing, signal classification, signal identification, battlefield awareness, IPB

17.0 ~~(U)~~ Related POC

18.0 ~~(U)~~ Contractors