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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OAST SPACE THEME WORKSHOP

VOLUME III

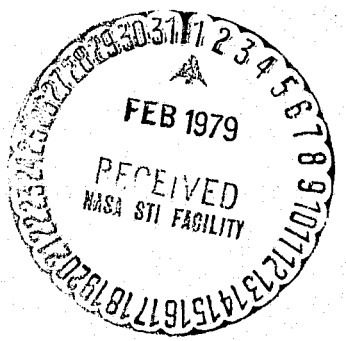
WORKING GROUP SUMMARY

II. DATA HANDLING, COMMUNICATIONS (E-2)

A. STATEMENT

B. TECHNOLOGY NEEDS (FORM I)

C. PRIORITY ASSESSMENT (FORM II)



HELD AT THE
LANGLEY RESEARCH CENTER
APRIL 26-30, 1976

SPONSORED BY NASA-CODE RX

Foreword

The attached material represents the working papers from the OAST Space Theme Workshop held at the Langley Research Center, April 26-30, 1976, and contains a quick-look analysis of the proceedings. The material is unedited and intended for further use by the participants of the workshop and the planning elements of NASA concerned with space mission research and technology. It should be understood that the data do not represent official plans or positions but are part of the process of evolving such plans and positions.

Nearly 100 of the Agency's top technologists and scientists joined with another 35 theme specialists to produce this working document - a document that provides a technical foundation, including research and technology base candidates, for each of the six space themes.

The material in this report is considered essential to the development of Center initiatives in support of these themes. Copies of the report will be made available to the Center Management Board and the individuals at the Centers responsible for the FY'78 program planning cycle. The timing of this planning activity has caused us to distribute this document in this unedited form. Thus, it possibly contains errors, hopefully, more of a typographical rather than a technological nature. Nonetheless, the information contained is of a high professional level, reflecting the efforts of the workshop participants and will be invaluable to the planning and successful execution of the Agency's near- and far-term advanced technology program.

Stanley R. Sadin
OAST Space Theme Workshop
Chairman
NASA Headquarters
Study, Analysis, & Planning Office
Office of Aeronautics and
Space Technology

VOLUME III
II-A STATEMENT

E2 - COMMUNICATIONS AND DATA HANDLING - SUMMARY

I. Data Handling

The technology needs of the seven themes were considered in response to the stated theme objectives and the stated OAST thrust to increase information return by X1000, while reducing costs by a factor of 10.

The most significant driver was observed to be the need for an overall end-to-end data system management technology. Maximum use of LSI component technology and trade-offs between hardware and software were manifest in most all considerations of technology needs.

By far, the greatest need for data handling technology was identified for the Space Exploration and Global Services themes. Major advances are needed in NASA's ability to provide cost-effective mass reduction of space data, and automated assessment of earth looking imagery, with a concomitant reduction in cost per useful bit. A combined approach embodying end-to-end system analysis, with onboard data set selection, onboard data processing, highly parallel image processing (both ground and space), low cost, high capacity memories, and low cost user data distribution systems would be necessary. The needs could be identified with four broad categories:

(1) End-to-End Systems

(2) Maximize Autonomous Operations

(3) High Speed Processing

(4) Performing the Data Processing at the Most Cost Effective Point in the System. (e.g., at the sensor, on-board or on the ground)

END-TO-END SYSTEMS INTEGRATION

A significant contribution to overall technological goals of reducing the flow of unused data while reducing cost can be expected from techniques, simulation tools, and reconfigurable flight experiments to develop and demonstrate cost effective throughput optimization.

AUTONOMOUS OPERATIONS

The concept of autonomous operations will be applied in the technology developments supporting all themes. Total life cycle cost considerations dictate the minimization of operating and maintenance costs for all systems. To achieve cost-per-bit reductions in an inflationary environment implies that the percentage of system costs represented by personnel be reduced through new designs, perhaps using newly developed sensors or new modes of operation, made possible by exploiting technologies identified here.

COST EFFECTIVE DATA PROCESSING

Significant cost reductions in overall data handling cost-effectiveness may be achieved by optimizing the location in the system at which data processing is done. For example, with properly designed computers, automatic classification of earth resources data may be "moved forward" in the system and ultimately performed on board, reducing the "downstream" load or onboard storage, data links, archiving and user distribution networking by perhaps a factor of 100 (if the reduction system is tailored to specific user need characteristics).

HIGH SPEED PROCESSING

Future data handling systems will depend on maintaining real time processing of data followed by immediate delivery of data to users. This will require a new generation of high speed processors ranging from highly parallel digital approaches to analog CCD systems.

II. Communications

A major impact of the themes was increased communications capabilities including higher data rates, increased number of channels, and wideband information.

Requirements for a broader user base including space missions with new categories such as space power, and industrialization of space with their large structures. Requirements for multiple simultaneous links, and increased numbers of both Space-to-Space and Space-to-Ground were evident. Low cost ground terminals were major factors in several Global System missions.

System Technology

System level technology advancement is required in understanding problems of spectrum crowding, RFI-CCIR requirements, multiple access design, systems for mm and um (Laser) bands, and total relay system technology.

Component Technology

Advancement in component technology is required in receivers, transponders, and antennas due to wide bandwidth requirements.

Higher power and higher frequency requirements motivate power amplifier and transponder developments.

A number of systems require very large antennas, with potential for arrays, with both parabolic and planar antennas required. A large multibeam antenna is required for personal communications.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE END-TO-END DATA MANAGEMENT

NO. ALL E2 ( )
THEME / W.G. / TASK

DATE 4 / 26 / 76

2. OBJECTIVE

~~To develop and utilize techniques, simulation tools, and a reconfigurable~~ flight experiment to enable design, analysis and proof of concept with the purpose of allowing & demonstrating cost effective, througput optimization

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [7] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 9/1982]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Various sensor & device (such as CCD's) development, element arrays (such as for information analyses, etc.)

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

A preliminary step to flt. experimentation is an initial analysis to ascertain (in at least a cursory manner) the end-to-end ramifications of ~~proposed configurations. An easily reconfigurable, software-based, end-~~ to-end simulation on a global level is suggested as a tool to accomplish these preliminary analyses. A second phase suggested in this endeavor ~~is the basic flight experiment "shell" which accommodates the end-to-end~~ utility of a system when using (for example) a newly developed sensor, or perhaps a new mode of operation. The "shell" shall contain not only ~~the experimental system but a means of verification (such as a "control"~~ path).

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 1 OF 2

1. TITLE Autonomous, Fault Tolerant Data Handling, Control, and Communication Systems

NO. 7-12 / E-2 / 2 (THEME / W.G. / TASK)

DATE 4 / 29 / 76

2. OBJECTIVE To establish a compreshensive systems technology to permit the development of total spacecraft data management systems which are fault tolerant and permit the long operational lifetimes required.

3. NEED ANALYSIS

a) LEVEL NOW [1], WILL BE LEVEL [1] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: [1983]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [ ] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE 750K through F.Y. 1980

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Computers (multiprocessors, microprocessors) LSI, data busses, fault tolerant hardware/software concepts, data handling techniques.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

To permit achieving the longer life required for this theme, new concepts must be developed for total spacecraft data management systems in these areas: LSI technology, common data busses, computers, memories intercommunication techniques, fault tolerant hardware/software technology end-to-end systems study incorporating tradeoff analysis for graceful degradation, TT&C, power systems, experiment control, propulsion systems, G, N, & C systems. The degree of architectural modularity/centralization must be studied and suitably sized standardized building blocks developed. Self testing and repair technologies must be developed.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE END-TO-END DATA MANAGEMENT

NO. ALL E2 / 1
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Phase 1--Develop end-to-end investigative technique concepts stressing user involvement

Phase 2--Develop reconfigurable simulation tools (to optimize system configs.)

Phase 3--Develop flight core experiment to establish means to allow determination, & proof, of concept (both configuration & mode of operation).

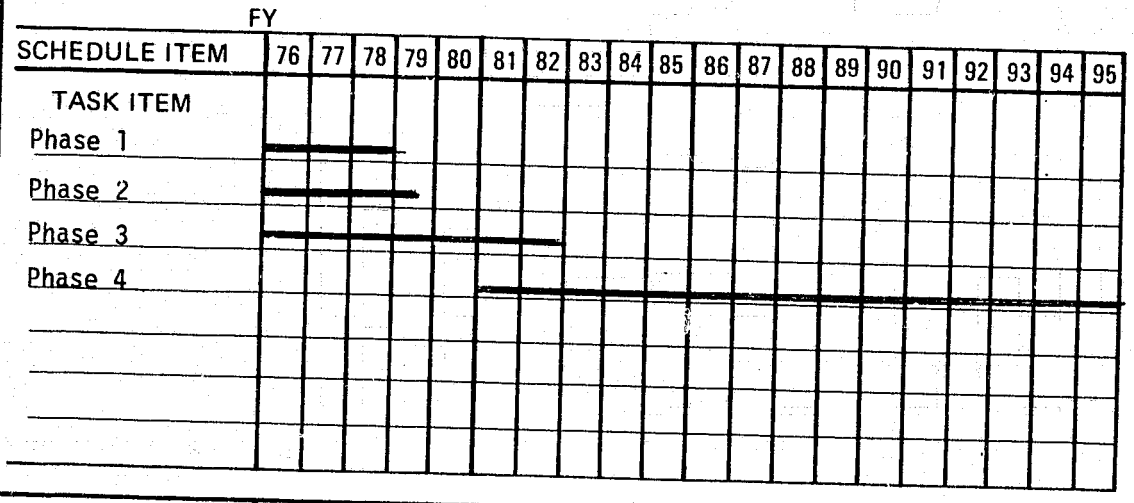
Phase 4--Perform selected experiments to establish utility of core experiment concept

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

656-12-01 (Systems Engr. & Analysis), 750-01-24 (Definition of Space Flight Technology Experiments), & 656-21-01 (Data Technology Assessment & Development)

9. TECHNOLOGY SCHEDULES



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MANPOWER (M-Y) INHOUSE	2	2	2	5																5
CONTRACT	3	3	3	3																3
FUNDING (10^6 $) INHOUSE	.05	.25	.4	.1	.1	.2	.2	.2	.1	.1	.1									.1
CONTRACT				.7	.9	.8	.3	.3	.4	.4	.4									.4

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
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6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE MODULAR ARCHITECTURE FOR DATA PROCESSING AND TRANSFER SYSTEMS

NO 7-12 / E-2 / 3
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Provide a system of modular components and functions to meet the needs of future spacecraft such as lower cost, adaptability, fault tolerance, software simplification

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1982]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE 700K through FY 80

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Higher density LSI, fault tolerant memories, fault tolerant system concepts, module intercommunication technology

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Optimum level of modularity must be determined. Technology, architecture, and representative candidates must be determined. Hardware/software functional distribution must be determined.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE AUTONOMOUS, FAULT TOLERANT DATA HANDLING CONTROL AND COMMUNICATION SYSTEMS

NO. 7,8,9,10,11,12/E2/ 2
THEME / W.G. / TASK

DATE 4 /28 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Survey, track, and select candidate LSI technology
Develop fault tolerant hardware/software concepts
Develop system integration and intercommunication concepts
Breadboard representative systems, test, and verify concepts.
Develop flight-qualified components, integrate, test, and flight tes

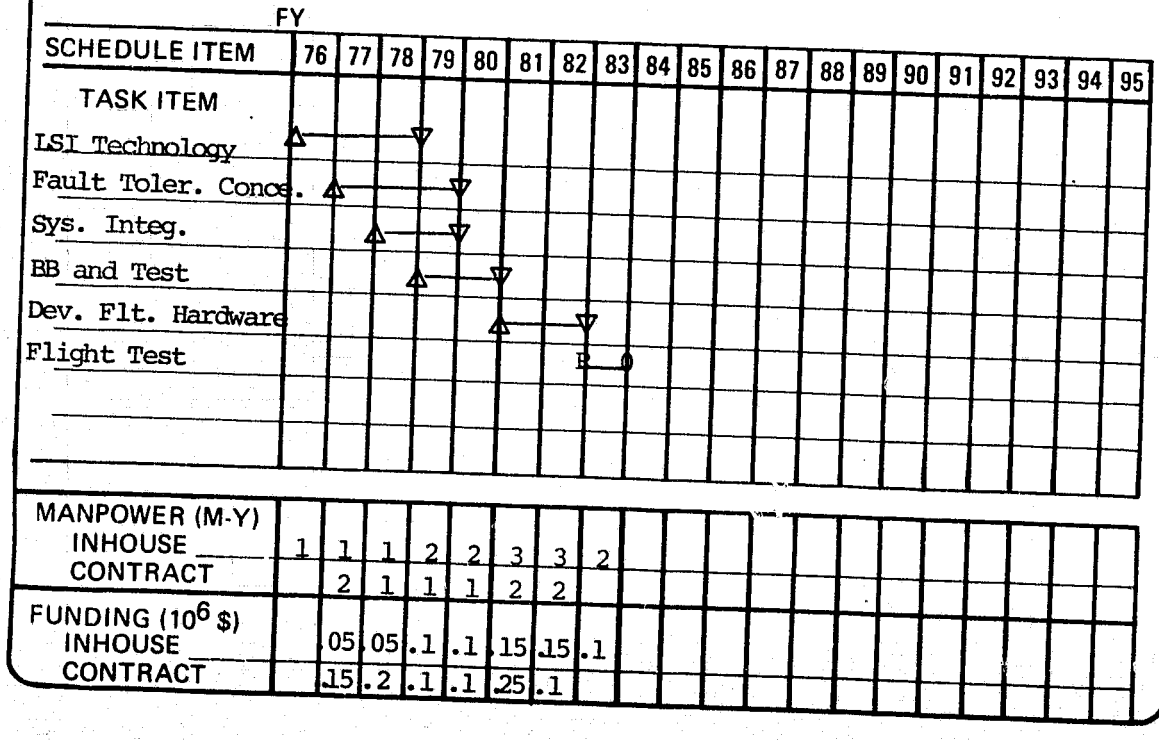
7. ALTERNATIVE APPROACHES/OPTIONS

Pursue variations and alternatives emerging from 6 (above)

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Current prime propulsion system computer control under RTOP 506-22-30 (LeRC). Plans are to initiate efforts to include fault tolerant systems. Planned RTOP 506-20-1X (MSFC) for low-cost fault tolerant random access memory.

9. TECHNOLOGY SCHEDULES



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MANPOWER (M-Y)																				
INHOUSE	1	1	1	2	2	3	3	2												
CONTRACT		2	1	1	1	2	2													
FUNDING (10^6 $)																				
INHOUSE		.05	.05	.1	.1	.15	.15	.1												
CONTRACT		.15	.2	.1	.1	.25	.1													

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE DATA SET SELECTION

NO. 8, 10, 11/E-2 / 4
THEME / W.G. / TASK

DATE 4 /28 /76

2. OBJECTIVE

Develop system concepts/demonstrate feasibility for automated on-board go/no-go data set selection on the basis of such parameters as spatial, spectral characteristics, data thresholds, etc.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [ ] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1990]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Data analysis algorithm development in areas of pattern recognition and multi-spectral classification.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

1. Merging of hardware, firmware, and software technology to implement a selected set of algorithms using imaging sensor data.
2. Evaluation of effectiveness of approach.

Major thrust of this activity will be the development of modular firmware to implement the pattern recognition and go/no-go decision algorithms.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
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SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Modular Architecture For Data Processing and Transfer Systems

NO. 7-12 / E-2 / 3
THEME / W.G. / TASK

DATE 4 / 28/ 75

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Perform trade studies to determine degree of modularity.
2. Investigate and review related space and commercial circuits and techniques for applicability and transferability
3. Select and/or fabricate candidate components and assemble breadboard and test.
4. Assemble suitable end-to-end system for flight test.

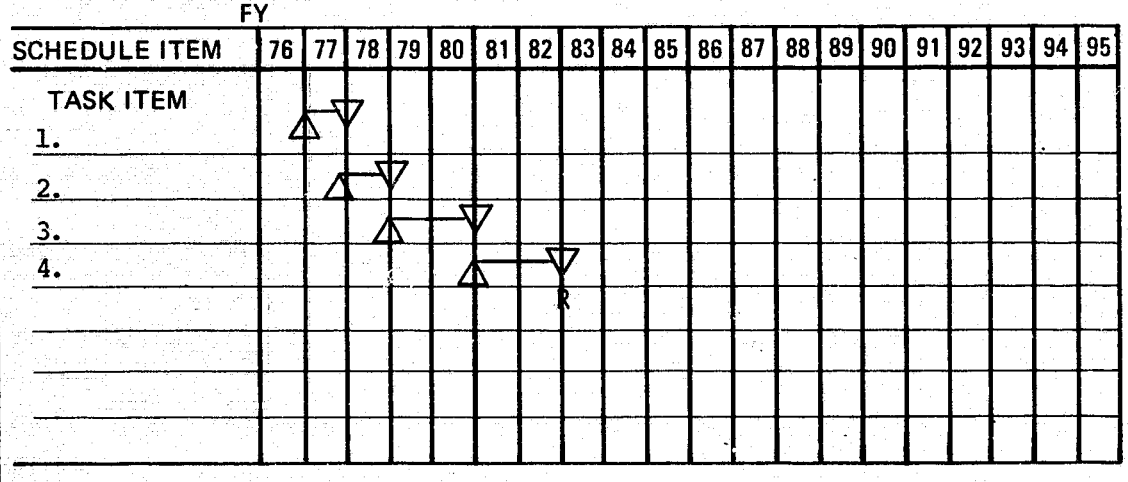
7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Activity started on RTOP 750-01-24-1 (MSFC)

Related activity on RTOP 506-20-11 (JPL) and as a task under RTOP 506-22-30 (LeRC)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE	.1	1	1	2	2	4	4													
CONTRACT		1	1	1	1	2	2													
FUNDING (10^6 $)																				
INHOUSE		.05	.05	.1	.1	.1	.1													
CONTRACT	.05	.05	.1	.1	.1	.5	.5													

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 1 OF 2

1. TITLE HIGH RATE DATA PROCESSOR NO. 10,11 E-2 5
THEME / W.G. / TASK

DATE 4 /29 /76

2. OBJECTIVE Develop a general modular processing capability to handle high rate data from imaging systems, multispectral scanners, and other remote sensing systems for both onboard and ground applications.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: 1980

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [ ] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE $950K (new)

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY High speed, low power, complex IC's: array processing architecture

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

1. Development of multifunction and custom sampled analog CCD's.
2. Dev. system technology to achieve feature extraction, classification, compression, etc., using:
   (1) Multivariant statistics-clustering and ground truth
   (2) Dev. specific processing algorithms
3. Develop parallel array architecture utilizing LSI microprocessor technology.

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 2 OF 2

TITLE DATA SET SELECTION

NO. 8,10,11 E-2 4
THEME / W.G. / TASK

DATE 4 /28 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Review candidate pattern recognition and multispectral classification algorithms for inclusion into system and go/no-go selection criteria; (2) Design prototype system; (3) Fabricate and test the prototype. Only ground testing is required, using typical operational data to evaluate system performance.

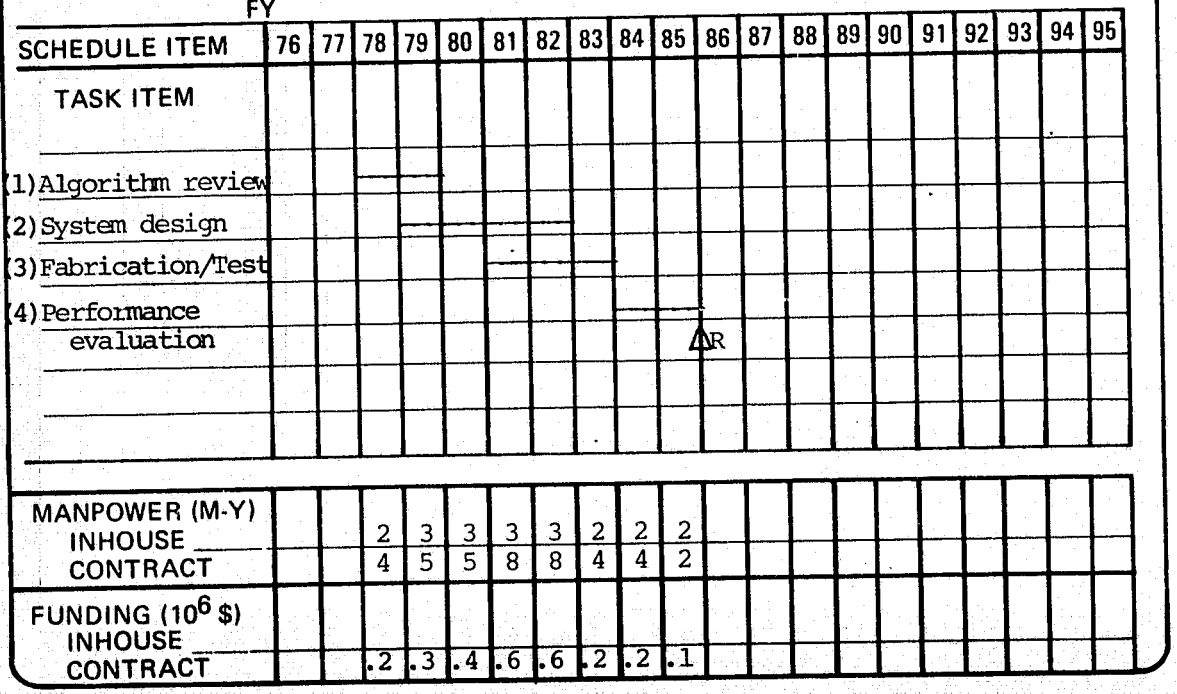
7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Autonomous pattern recognition algorithm development.

Autonomous multispectral classification algorithm development (LACIE, etc.)

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

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6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

1. TITLE Multichannel Spectrum Analyzer (MCSA)
Real-time Pourier Processor (10^9bin) ("FYP")

NO. 09 / E-2 / 06
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE Develop systems that will permit continuous scanning of 2300 MH_z band.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7*] FOR OPERATIONAL SYSTEM USE BY [DATE: 1986]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [X] Ground test at 10^6 bin level at ~~Arecibo; at 10^9 level in dedicated system~~ (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Concomitant development of Battern Recognition Analyzer and Display will be required -- to analyze output of UCSA

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

1. Develop 10^6 bin prototype Pipeline Cordic FFT analyzer by F.Y. 78
2. Develop 600 MH_3 - 1200 MH_3 digitizer (approximately 200 MH, now possible) by F.Y. 79.
3. Develop 10^{12} to 10^{13} bit RAM power spectrum raster memory by F.Y. 80.
4. Develop optimal 10^9 bit Pipeline Cordic FFT analyzer prototype by F.Y. 80.
5. Operation of FTP with Pattern Recognition Analyzer.

*Item will not be flown in space. Will be GSE. Listed at level 7 to represent testing as part of overall space system.

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 2 OF 2

TITLE HIGH RATE DATA PROCESSOR

NO. 10,11 E-2 5
THEME / W.G. / TASK

DATE 4 / 29 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

The approach involves basically three steps: (1) Develop device and systems technology. (2) Ground demonstration of candidate technologies in test bed processors. (3) Selection of technology and implementation into flight/ground processor, including LSI microprocessor for array processors and control.

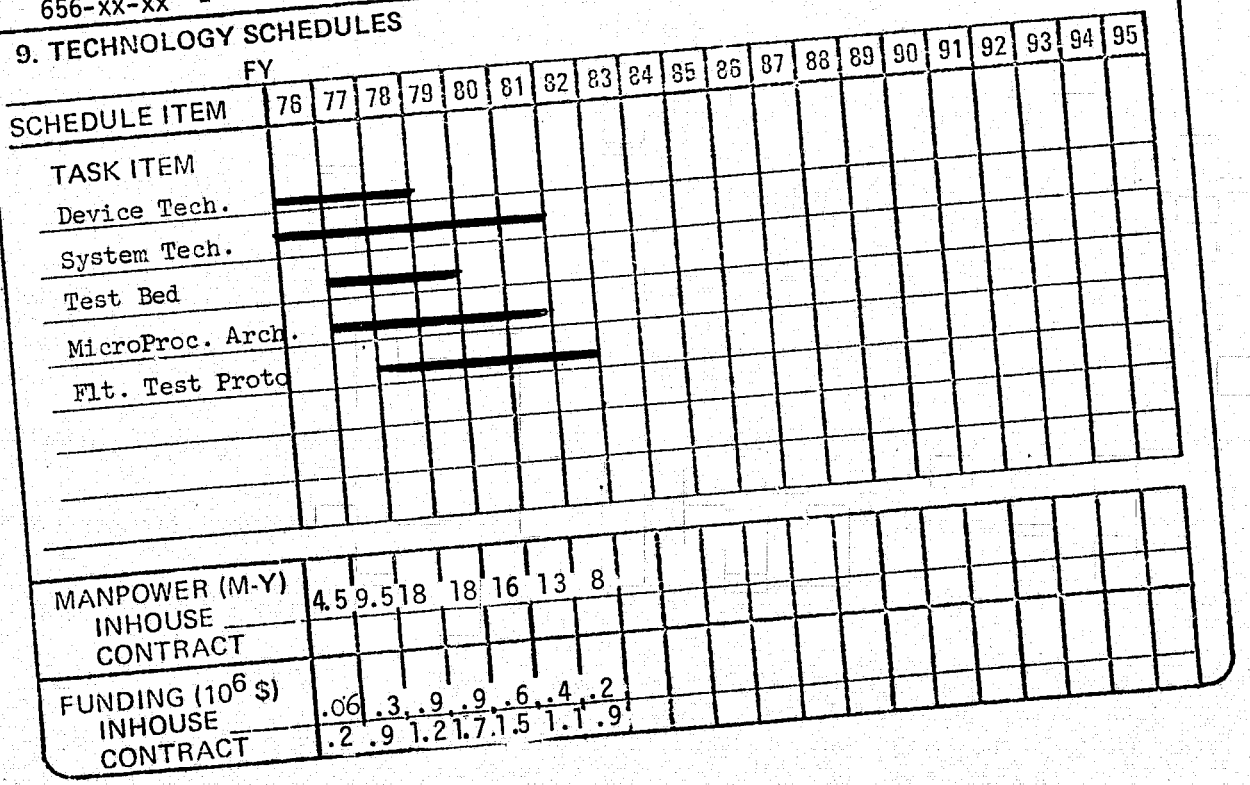
7. ALTERNATIVE APPROACHES/OPTIONS

The alternative is a complex, high power digital approach which is not necessarily practical for onboard application or cost effective or timely for ground systems use.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

506-20-11 - Data Systems Architecture
506-18-21 - Electron Devices
506-20-10 - High Capacity Data Systems
656-xx-xx - ~~Cluster compression Preprocessing for Landsat D.~~

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE Stellar Sensing System Array Processor

NO. 10 E2 7
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

Develop an array processor capable of performing the function of photographic film in astronomical applications, when augmented with proper detector arrays.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [ ] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1991]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE ✓

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Large detector arrays for all wave lengths of interest to astronomy, LSI technology, parallel processing system architecture and software.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

(1) Study of candidate detector array characteristics and image enhancement (digital integration) algorithms.

(2) Development of processor architecture, interfaces and data display techniques.

(3) Development of feasibility demonstration model.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE MULTICHANNEL SPECTRUM ANALYZER (MCSA)
Real-Time Fourier Processor (10^9 Bin) ("FTP")

NO. 09 E2 06
THEME / W.G. / TASK

DATE 4 / 28/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

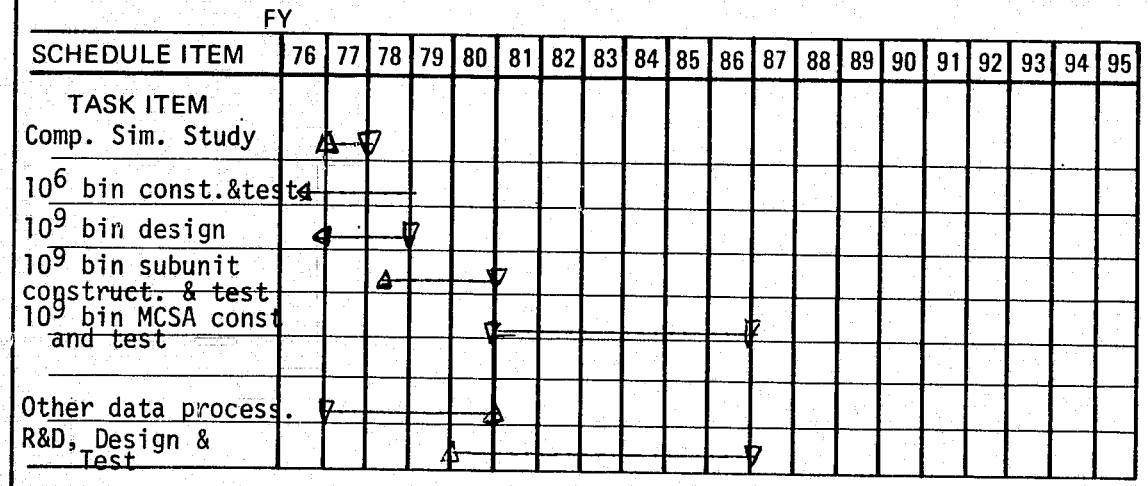
1. Build 10^6 bin analyzer and test over 2.0 year period at Arecibo

3. Develop techniques for synthesizing 10^9 bin anayzer by paralleling 10^6 bin analyzers

7. ALTERNATIVE APPROACHES/OPTIONS The only possible alternative is a hybrid photo-digital technique which is considered to be too expensive and unreliable for the anticipated use

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)
SETI research at ARC and JPL and RFI characterization at JPL

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE	1	8	13	18	10	10	10	15	15	15	15									
CONTRACT	4	30	50	70	20	20	20	25	35	35	35									
FUNDING (10^6 $) INHOUSE	.02	.2	.3	.3	.1	.1	.1	.1	.2	.2	.2									
CONTRACT	.2	1.5	2.6	3.4	1.0	.9	1.0	1.3	1.7	1.7	1.7									

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 3

1. TITLE Large Capacity Onboard Storage Systems

NO. 10,11/ E2 / 8
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
Development of high density data storage technologies for space applications capable of storing 10^9-10^{10} bits and containing no moving parts.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: '83, '90] (A B)

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [B] MEDIUM [ ] LOW [A]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [X] Flt. Design & Dev. (Check one or more)

f) R&T BASE CANDIDATE 200K (for A) plus 300K (for B)

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY None required for A, basic research in memory storage technology (especially in material research).

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

A. Meld NASA concepts for fault tolerance and modular architecture with NASA and DOD components. Supports the Strawman package for exploration of the solar system in the requirement for large capacity solid state storage systems.

B. NASA is currently developing a 10^8 bit bubble memory. A significant improvement in bit storage density, data rates, access time, etc. is required Consideration of alternate approaches, primarily CCD and optical storage should be made since it is not clear that 10^{10} bubble memory can be achieved.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. 1

TITLE A: Low Cost Fault Tolerant Random Access Memory

NO 10,17E2/8
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Combine C-MOS SOS silicon gate RAM technology with the MNOS EAROM and the bubble memory BORAM technologies to provide packaged hybrid memory modules which are low-power rapid-access nonvolatile memories from the user point ov view. Define control logic, design subsystems, layout control chip masks, design package, fabricate prototypes, fabricate and qualify flight versions.

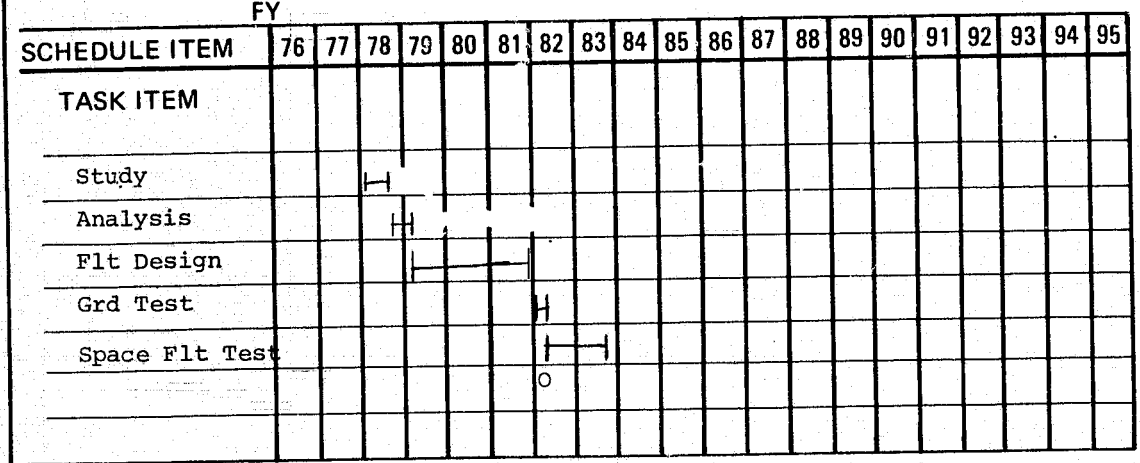
7. ALTERNATIVE APPROACHES/OPTIONS

Endure high cost and low reliability of present memories.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Related activity on SOS under 506-18-31, on bubbles under 520-21-01, plus DOD BORAM programs in bubbles and MNOS.

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE			6	13	13	4	4	4												
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE	.			.1	.1															
CONTRACT			.2	.3	.3	.1	.4	.1												

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 3 OF 3

TITLE LARGE CAPACITY STORAGE SYSTEM

NO. 10,11 E2
THEME / W.G. / TASK

DATE 04 /27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Improve magnetic domain material and process technogy, where required
2. Design and develop storage device
3. Design system
4. Fabricate system
5. Laboratory tests

7. ALTERNATIVE APPROACHES/OPTIONS Optical (holographic or direct) storage

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

RTOP 506-20-13. A 10^8 bit bubble mass memory system is now under development (300K/FY 77)

504-20-1X Low Cost Fault Tolerant Rundown Access Memory (200K/FY 77)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
1.Matls. & Proc.																				
2.Device des. & dev.																				
3.System design																				
4.System fab.																				
5.Laboratory test																R				
MANPOWER (M-Y) INHOUSE			2	2	2	2	2	2	2	2	2	2	2	2	2					
CONTRACT			3	3	4	4	4	6	6	6	6	4	4	2	2					
FUNDING (10^6 $) INHOUSE																				
CONTRACT			.2	.2	.3	.3	.3	.4	.4	.4	.5	.5	.3	.2	.1					

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 2

1. TITLE LOW COST DISTRIBUTION SYSTEM

NO. 11/E2/09
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

Develop the incremental (only) technology for processing, routing and distributing remote sensing and DCP data to user networks on a "fixed order" and interactive basis. Assumes pre-existence of an operational centralized system.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [X] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE X

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Pre-existence of an operational gigabit/sec "centralized" system is required. Assumed this baseline will develop out of existing and planned technology.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

1. Operational low cost system study and analysis
2. Onboard processor/compression development for low cost users (>5:1 compression)
3. Low cost ground system compression scheme (<$10K per station)
4. Regional processor (pattern recognition, etc.) development
5. Develop automatic routing system
6. Low cost user terminal design
7. Low cost user console design (for interaction)
8. Preliminary user needs study

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE STELLAR SENSING SYSTEM ARRAY PROCESSOR

NO. 10 E2 7
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

(1) Review of detector array technology development with special emphasis on feasible array sizes ($10^3 \times 10^3$ to $10^6 \times 10^6$); (2) System design, including trade-off study between array size and object scanning strategy; (3) Prototype system fabrication and test; (4) System performance evaluation, including a flight test

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
(1) Technology Rev.			—	—																
(2) System design				—	—	—	—													
(3) Fab. & test							—	—	—											
(4) Performance eval.										—	—									
											△	R								
(5) Flight test																	0			
MANPOWER (M-Y) INHOUSE			2	2	2	2	2	2	2	2	2									
CONTRACT			2	4	4	4	5	5	2	2	2									
FUNDING (10^6 $) INHOUSE																				
CONTRACT			.1	.2	.2	.3	.4	.3	.2	.2	.2									

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE MICROELECTRONIC TECHNOLOGY

NO. 1,7-12 / E-2/10
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Provide a microelectronic technology for on-board s/c applications with emphasis on reliability and high density LSI devices.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE 506-18-33 (600K) NEW (400K)

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Electron Beam Lithography

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Reliability: Develop diagnostic methods for studying MOS device failure mechanisms; formulate models of the mechanisms, and demonstrate test methods for assuring reliability in the manufacturing process.

High Density LSI: Develop a reliable thin oxide process; apply electron beam lithography to demonstrate devices with 1 micron lateral dimension.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE LOW COST DISTRIBUTION SYSTEM

NO. 11/E2/09
THEME / W.G. / TASK

DATE 4 /27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

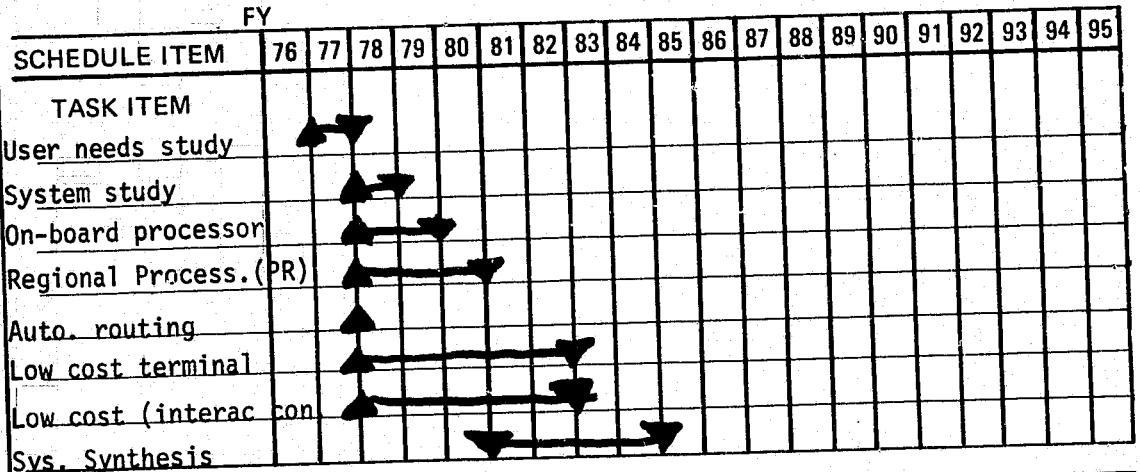
1. Comprehensive sensor-to-user study of low cost operational system
2. Phase low cost distribution system into (by then) pre-existing "centralized" system in mid-1980's
3. Optimize degree of centralization in subsequent system versions

7. ALTERNATIVE APPROACHES/OPTIONS Centralized systems without low cost distribution will be viable during next decade. User studies indicate need for distributed systems subsequently

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Current developments toward Landsat-C and (later) "proto-operational" systems at GSFC/EROS

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)		2	3	3	4	4	4	5	6											
INHOUSE																				
CONTRACT		2	12	12	16	16	16	16	16											
FUNDING (10^6 $)		-	.1	.1	.1	.1	.1	.1	.1											
INHOUSE																				
CONTRACT		.1	.6	.6	.8	.8	.8	.8	.8											

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE RADIATION HARDENED ELECTRONIC COMPONENTS

NO. 10,11 / E-2/11
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

To provide a radiation hardened component technology which will withstand a total integrated dose of 10^6 rads.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1981]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE 186-68-83(1.3M), 506-18-34 (400K)

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

1. Definition of radiation hardened integrated circuit processes for MOS and bipolar linear IC's.
2. Hardness assurance techniques.
   (a) Process monitoring
   (b) Device testing
3. Design criteria.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE MICROELECTRONICS TECHNOLOGY

NO. 1,7-12 / E-2/10
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

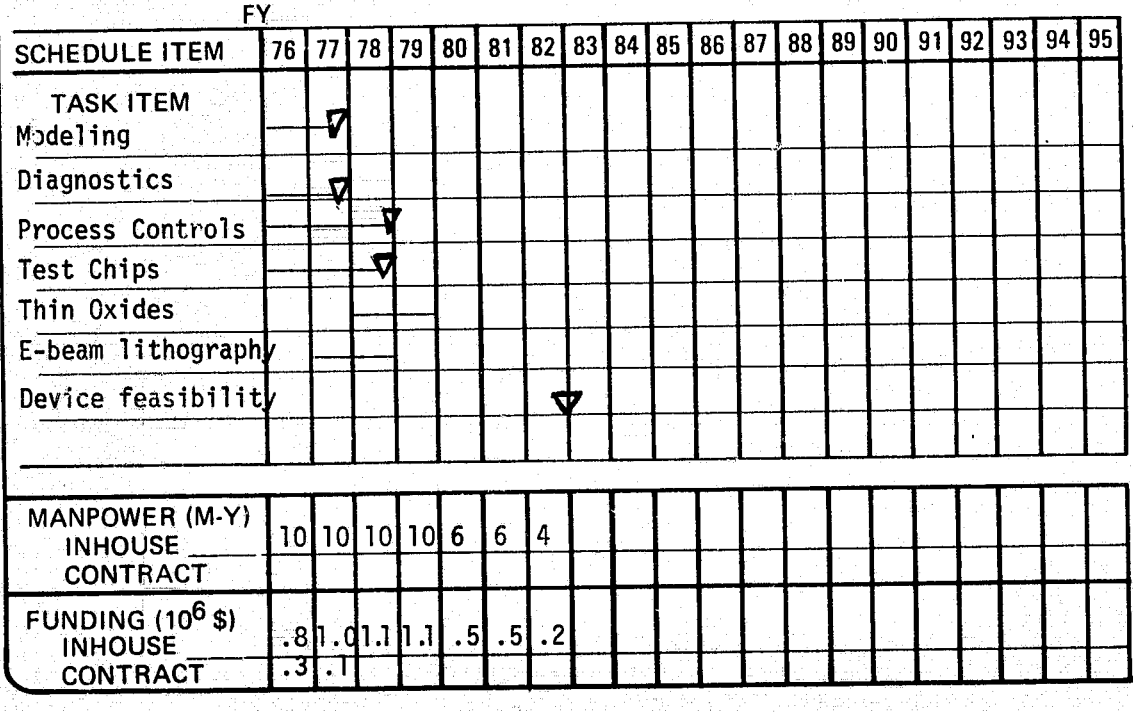
Reliability: The approach is to first understand the physics of failure process in MOS and to develop the necessary diagnostic tools, then to model the failure processes and design wafer test chips. High Density LSI: Develop thin oxide technology on test structures and then extend to devices using E-beam lithography.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

The reliability aspects of this program is being addressed in RTOP 506-18-33. The high density work is a proposed new initiative.

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE PARALLEL IMAGE PROCESSING

NO. 10,11 E-2 12
THEME / W.G. / TASK

DATE 4 /28 /76

2. OBJECTIVE

Develop a photoreceptor array imbedded in a logic matrix on a silicon LSI chip to provide real-time parallel image processing.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [X] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE (New) 500K

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

LSI arrays; high density lithography (electron beam or X-ray)

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

1. Design of custom LSI arrays.
2. Develop pre-processing algorithms for feature extraction from raw data (contour, motion, texture, etc.).

SPACE TECHNOLOGY NEED — **FORM NO. I**

TITLE RADIATION HARDENED ELECTRONIC COMPONENTS

NO. 10,11 / E-2/11
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Identify failure sensitive components/processes through test programs, and physics of failure studies.
2. Identify needed process changes to enhance radiation tolerance, and develop in industry as feasible.
3. Develop screening and hardness assurance techniques for a broad range of technologies.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

186-68-83)
506-18-23) Proposed FY77 RTOP's

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Component Ident.		▽																		
Process Correlation		——	▽																	
Screening & hardness assurance		——	▽																	
MANPOWER (M-Y)																				
INHOUSE		10	8																	
CONTRACT																				
FUNDING (10^6 $)*																				
INHOUSE		.7	.6																	
CONTRACT		1.0	.8																	

*Includes funding from 186-68-83

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. I

1. TITLE PATTERN RECOGNITION ANALYZER AND DISPLAY (PRA) NO. 9/E2/ 13 THEME / W.G. / TASK

DATE 4 / 28/ 76

2. OBJECTIVE (1) Develop visual interactive system for identifying intelligent signals in the massive output file of the Fourier Analyzer (FTP); (2) automated pattern recognition scanner for identifying intelligent signals with high probability and acceptably low false alarm rate.

3. NEED ANALYSIS

a) LEVEL NOW [1], WILL BE LEVEL [1] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [X] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [X] Test as part of overall SETI system (Check one or more)

f) R&T BASE CANDIDATE New. Need $1.1 million in FY 77

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Large memory (11/E2/14) and FTP (9/E2/06), large space antenna (09/E2/30)

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

1. Determine display media/human factors matched to solve display problem.
2. Feasible hardware implementation.
3. Test and evaluate candidate systems on SETI problem.
4. Synthesize and test optimal zoom display (with 10^{12} memory)
5. Survey likely intelligent patterns.
6. Develop suitable P.R. algorithms.
7. Implementation of algorithms with selected hardware.
8. Continuing development of device technology for PRA.
9. Design and test PRA.

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE PARALLEL IMAGE PROCESSOR

NO. 10,11 E-2 12
THEME / W.G. / TASK

DATE 4 /28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

The approach requires the integration of digital logic elements with a photoreceptor array. Feasibility will first be demonstrated on a small array. The concept will then be expanded to handle processing of an entire imaging frame.

7. ALTERNATIVE APPROACHES/OPTIONS A parallel optical approach is being pursued at GSFC (TSE Computer) RTOP #506-20-14.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

(None) This is a new proposal.

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Circuit Design			—	—																
Alog. Dev.			—	—	—															
Feasibility						▽														
Full Frame Processing							▽													
MANPOWER (M-Y) INHOUSE			5	8	10	10	10													
CONTRACT																				
FUNDING (10^6 $) INHOUSE			.4	.6	.8	.8	.8													
CONTRACT			.1	.2	.4	.7	.7													

SPACE TECHNOLOGY NEED

FORM NO. 1

1. TITLE Large Capacity Ground Data Storage System NO. 9.11 E2 14
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE
Develop a high capacity (10^{15} bits), high transfer rate (10^{10} bits/sec), ground data archival storage system. The data cataloguing function will also be considered.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE ✓

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY
Erasable storage materials for optical and electron beam storage systems.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Direct optical storage systems are now under development (502-23-31). Significant improvement in these areas is required: (1) erasable storage media, (2) improvement in storage density, (3) data transfer rates. Studies in system architecture, data access/transfer methods and the cataloging function are required.

The system's data management considerations will include all external as well as internal (cataloging) tasks.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 2 OF 2

TITLE PATTERN RECOGNITION ANALYZER (PRA)

9/E2/13
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Two-phase program starting with (1) development of a "zoom" display for studying intelligent signal characteristics, followed by (2) development of automated pattern recognition techniques to perform the same recognition tasks on identified patterns

7. ALTERNATIVE APPROACHES/OPTIONS

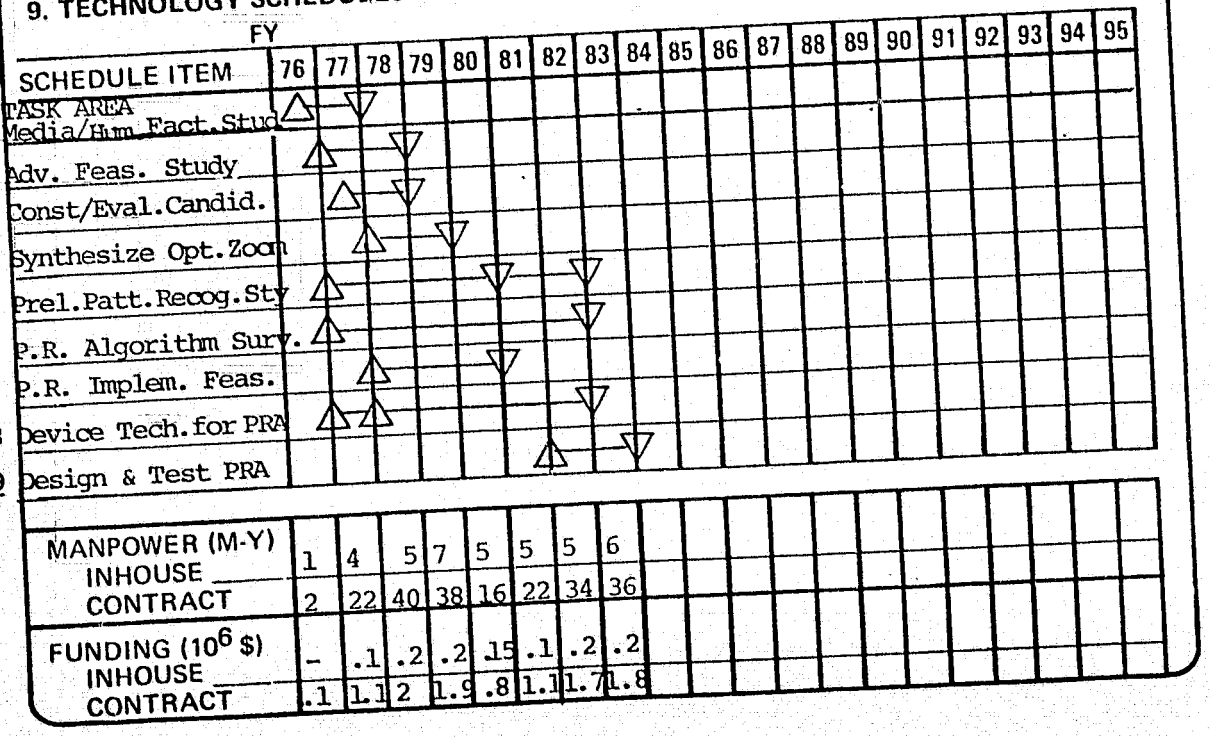
No alternative approach is presently known.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

FTP, LSI & CCD memory development by NASA and industry.

Large memories (11/E2/14)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE	1	4	5	7	5	5	5	6												
CONTRACT	2	22	40	38	16	22	34	36												
FUNDING (10^6 $)																				
INHOUSE	-	.1	.2	.2	.15	.1	.2	.2												
CONTRACT	.1	1.1	2	1.9	.8	1.1	1.7	1.8												

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
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6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 1 OF 2

1. TITLE Safety in the Multipurpose Space Power Platforms

NO. 7 - E2 - 21
THEME / W.G. / TASK

DATE 4 /26 / 76

2. OBJECTIVE
To develop the systems technology to establish and maintain safety aspects in the handling of space power

3. NEED ANALYSIS

a) LEVEL NOW [1], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY None

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Development of general safety guidelines as well as the implementation of these, such as automatic mgt. techniques which establishes additional servomechanism loops within the more traditional power mgt. system, or as bias inputs to traditional control loops. Communications and coding aspects must also be considered. The advancement necessary is probably one of system development, rather than component development. However, a study is necessary to ascertain whether or not component development in (for example) on-board multiprocessors is necessary to accomplish this system function.

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Large Capacity Ground Data Storage System

NO. 9,11 E2 14
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

1. Major activities in the development of high density, erasable storage media for optical or electron bram storage are required. In addition, techniques for high speed (10^{10} bits/sec) data transfer to and from memory need development.
2. System design, including consideration of internal and external data management functions.
3. System implementation.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Development of high density tape recording systems (OA, OTDA funded).

High capacity data systems, 502-23-31 (.2M)

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
1. Storage media			—	—	—															
2. Data transfer			—	—	—															
3. Sys. design				—	—															
4. Sys. fab., test.						—	—	—			R									
MANPOWER (M-Y) INHOUSE			3	3	5	5	3	3												
CONTRACT			6	6	8	8	6	6												
FUNDING (10^6 $) INHOUSE																				
CONTRACT			.4	.4	.8	1.8	1.0	.3												

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 2

1. TITLE RADIO FREQUENCY INTERFERENCE (RFI) ANALYSIS, SETI

NO. 9 E2 22a
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Identify RFI effects on SETI for both Earth based and space systems. For both systems develop frequency allocation procedures. For space based systems determine potential for shielding

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1978]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

SETI antenna system design

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

RFI analysis, and supporting tests, are required to establish the magnitude of potential interference to SETI by unwanted sources. Subsequent analysis shall be performed to provide material for securing CCIR allocation of frequencies. For space based systems, analysis shall also be performed to evaluate potential shielding

Earth based system operates 1.4 to 1.727 GHZ.

Space based system operates 1.4 to antenna limit.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

TITLE Safety in the Multipurpose Space Power Platforms

NO. 7 - E2 - 21 (THEME / W.G. / TASK)

DATE 04 /28 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

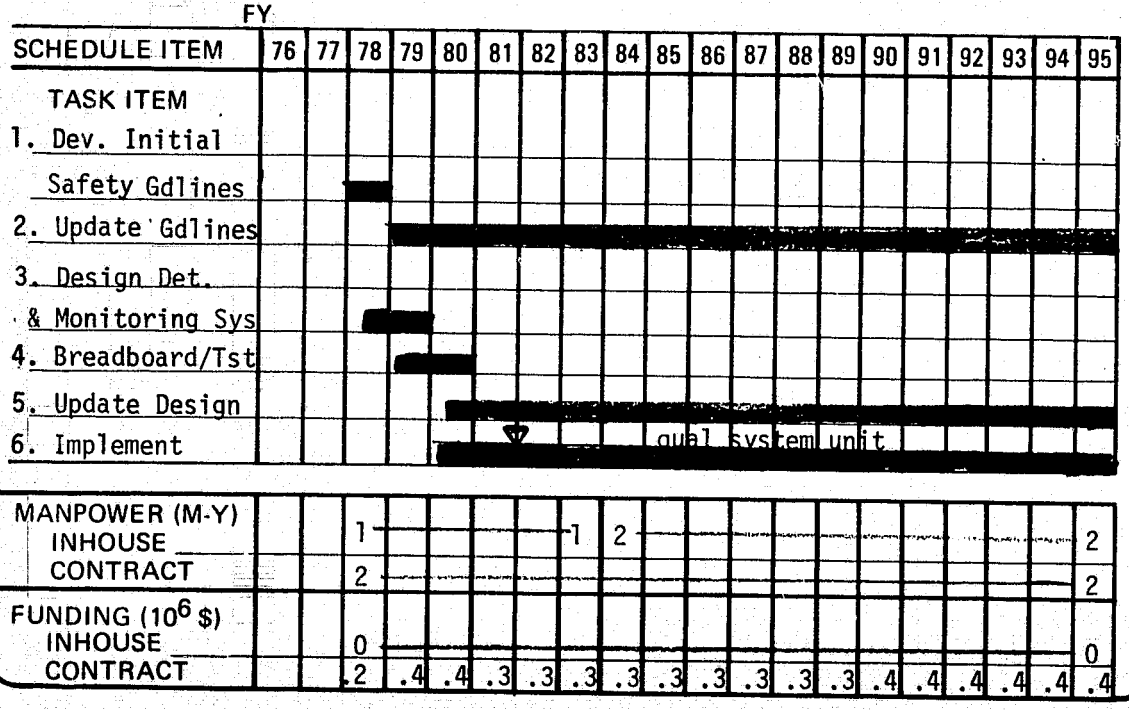
Development phases (block 9) starting with first general and then specific guidelines for detection and monitoring system development. Guidelines will, of necessity, will encompass general high power usage, etc. Study/test phases 3, 4, and 5 will also determine whether or not component development is needed.

7. ALTERNATIVE APPROACHES/OPTIONS None

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

None

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE RADIO FREQUENCY INTERFERENCE (RFI) ANALYSIS, MSPP

NO. 7 /E-2/ 22b
THEME / W.G. / TASK

DATE 4 /28 / 76

2. OBJECTIVE

Perform investigation, analysis and test necessary to select MSPP microwave frequencies and secure CCIR assignments

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1990]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Definition of devices used for DC to RF conversion, from which output spectra can be derived.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Effort will provide full understanding of output spectra of each DC to RF converter candidate when coupled to candidate antenna elements. FCC and ITU regulations will be researched to ascertain requirements. System trade studies will determine impact on other spectrum users, with options for clear or shared channel. National/international agreements for operating frequencies, guard bands, allowable harmonic and spurious levels will be made.

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE RADIO FREQUENCY INTERFERENCE ANALYSIS, SETI

NO. 9/E2/22a
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Investigate potential sources of interference in desired band.

b. Develop plans for CCIR frequency request for Phase 1.

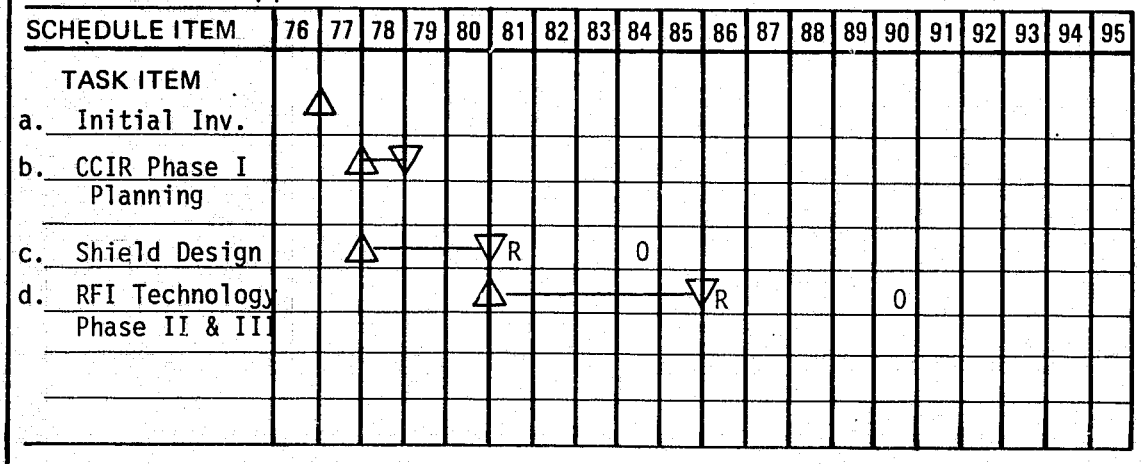
c. Design RFI shield for space system.

d. Follow-on analysis/tests/CCIR interface.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE		1.5	3	3	3	1	1	1	1	1										
CONTRACT																				
FUNDING (10^6 $) INHOUSE		.1	.2	.2	.2	.6	.6	.6	.6	.6										
CONTRACT																				

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE Microwave Power Transmission and Reception NO. 7 - E2- 23
THEME / W.G. / TASK

DATE: 4 / 27 / 1976

2. OBJECTIVE
Establish the technical and economic feasibility of advanced large scale systems to transfer commercially useful amounts of power (5 GW) from synchronous orbit to Earth by means of microwave transmission.

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1990

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [X] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Extremely large space structures; high power amplifier development; control systems; safety systems; RFI; transportation to orbit.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Studies show that high power/efficiency tubes (5 KW at 90%), high gain/efficiency antennas (92 dB at 90%) and extremely accurate pointing (0.005°) will be required to transfer commercially useful amounts of power from space to Earth. These components, integrated into a system must function reliably for several decades. No components exist today. The receiving antenna efficiency must be increased to the 85-90% range while retaining simplicity and low cost of production. Transmitter tube technology (efficiency, losses, spectral purity, output power, weight and noise bandwidth) must be developed to achieve required performance characteristics.

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE RADIO FREQUENCY INTERFERENCE ANALYSIS, MSPP

NO. 7 /E2 /22b
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Determine spectra and performance of each potential DC-RF converter candidate when coupled to antenna.

b. Research ITU and FCC regulations to establish requirements.

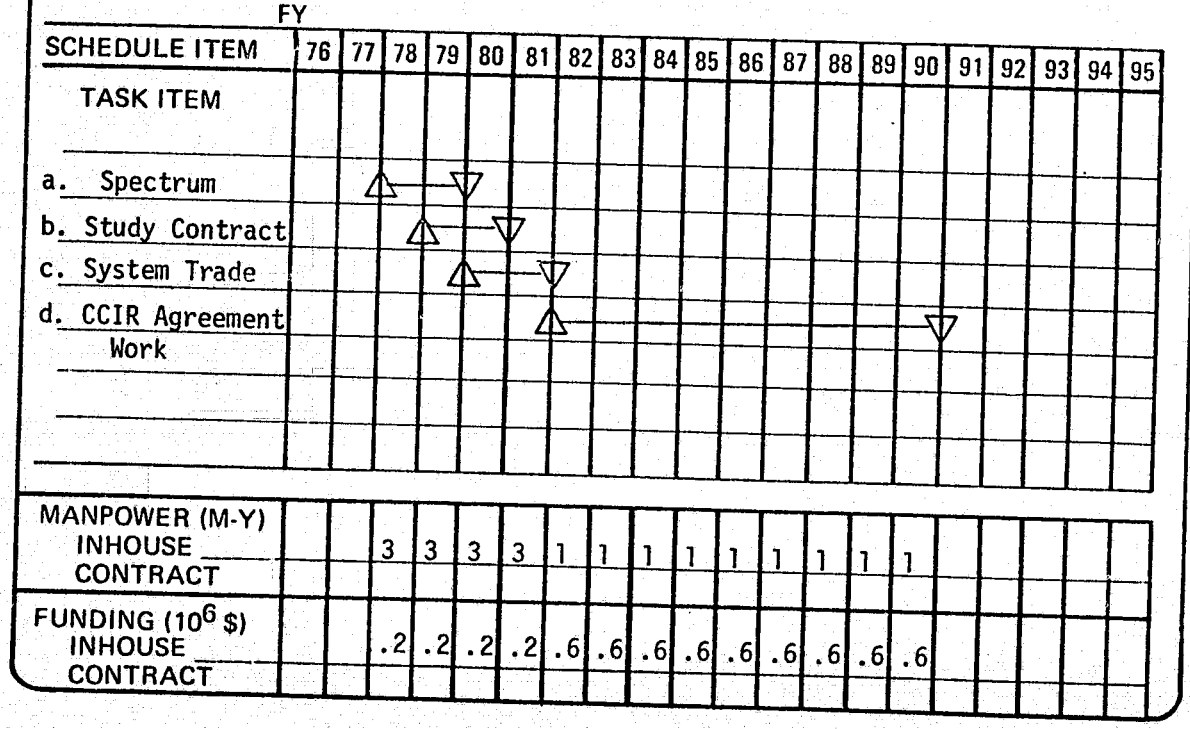
c. Perform system study tradeoffs to determine impacts on SSPG.

d. Obtain national/international agreement for operating frequency, guard bands, and spurious levels.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE Laser Power Transmission

NO. 7/E2/24
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Develop system design and components for space-to-space laser power transmission

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE:1991]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR-CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Transmitting/Receiving system beam directing techniques to improve tracking accuracy;

Lifetime of components which degrade under space environments;

Component/system efficiency

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Microwave Power Transmission and Reception

NO. 7 - E2 - 23
THEME / W.G. / TASK

DATE 4/ 27/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

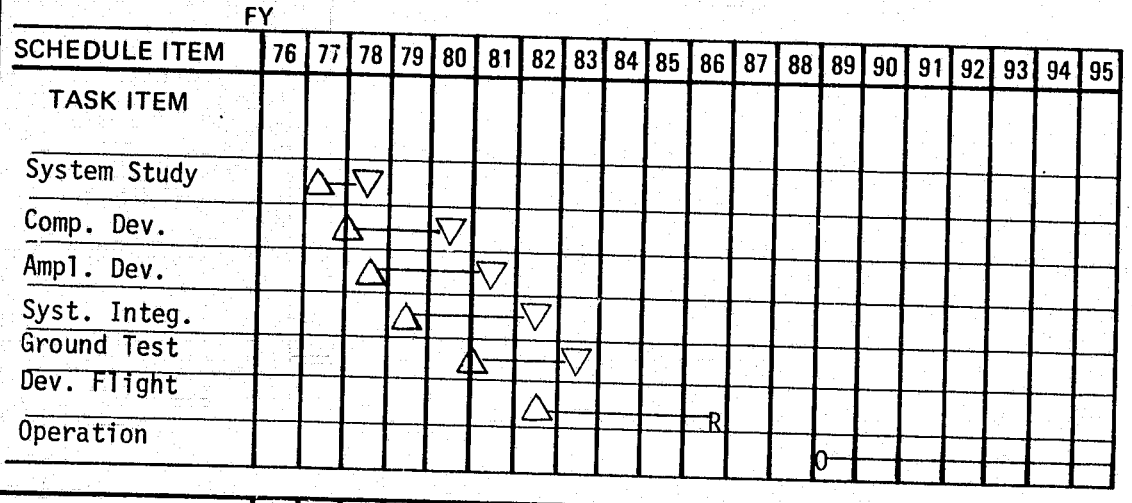
Initiate a systematic program to define microwave energy transmission system concepts and answer fundamental questions determining feasibility. Initiate a program of system engineering studies, technology development and major demonstration tests, Key areas include power sources, interfaces, DC-RF/RF-DC conversion, mechanical systems, phase front control, etc.

7. ALTERNATIVE APPROACHES/OPTIONS A laser system of power transmission has been suggested although substantial increases in raw power and efficiency are required.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Energy transmission by microwaves	RTOP 650-40-10
Receiving antenna technology development	RTOP 650-40-10
DC to RF converter development	RTOP 650-40-10

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		5	5	5	8	10	10	5												
CONTRACT		5	5	5	10	10	10	10												
FUNDING (10^6 $)																				
INHOUSE		.2	.3	.3	.3	.3	.3	.3												
CONTRACT		1.2	1.5	1.5	3.0	3.0	3.0	3.0												

SPACE TECHNOLOGY NEED **FORM NO. I**

1. TITLE Space-to-Space Wide Band Communications NO. 8&12 E2 25
THEME / W.G. / TASK

DATE 4 / 26 / 76

2. OBJECTIVE
Develop communication systems for multiple point-to-point communications in space between Advanced Space Transportation Vehicles and those used in Industrialization of Space.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1988]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Support wide band communications (numerous voice, data, and video channels) using frequencies above K band; i.e., millimeter waves and D&G bands above 100 GHz, and/or laser links. All components of these links including multi-beam antennas for simultaneous transmissions to multiple vehicles. System analysis to optimize frequency and modulation technique selection.

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Laser Power Transmission

NO. 7 E2 24
THEME / W.G. / TASK

DATE 4 / 28 / 76

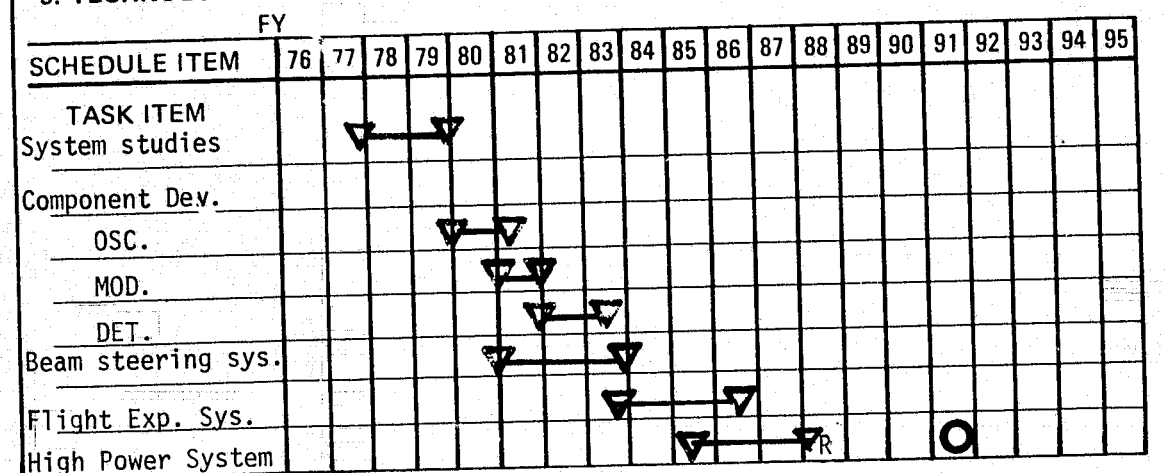
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Systems studies to identify alternatives among LASER types and beam transmitter/receptors optimizing for efficiency and long life. Adaptive optics. A modest power system will be developed for experimental flight test followed by high power system development for long term needs.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



MANPOWER (M-Y)			1	1	1	2	4	1	10	10	8	4	2							
INHOUSE																				
CONTRACT			2	2	2	4	8	2	20	20	16	10	6							
FUNDING (10^6 $)			.05	.05	.05	.1	.2	.1	.5	.5	.4	.2	.1							
INHOUSE																				
CONTRACT			.1	.1	.1	.2	.4	.2	1.0	1.0	.8	.5	.3							

SPACE TECHNOLOGY NEED **FORM NO. I**

PAGE 1 OF 2

1. TITLE On-Board Multi-Loop, Multi-Channel Communications System

NO. 8-12 E-2 26
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE
Develop systems which meet the onboard (internal) voice, video, data and command communications requirements of large multi-man space stations

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE:1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Low cost (probably using expandable standardized module approach), low weight and high reliability (application of fiber optics for transmission and multiplexing), application of tracking and telephony techniques to multiple types of signals (voice, video, commands) in multiple, duplex communication modes. Audio and video terminal devices such as color TV flat panel or projection displays.

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE SPACE-TO-SPACE WIDEBAND COMMUNICATIONS

NO. 8,12/E-2/25
THEME / W.G. / TASK

DATE 4 / 28/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

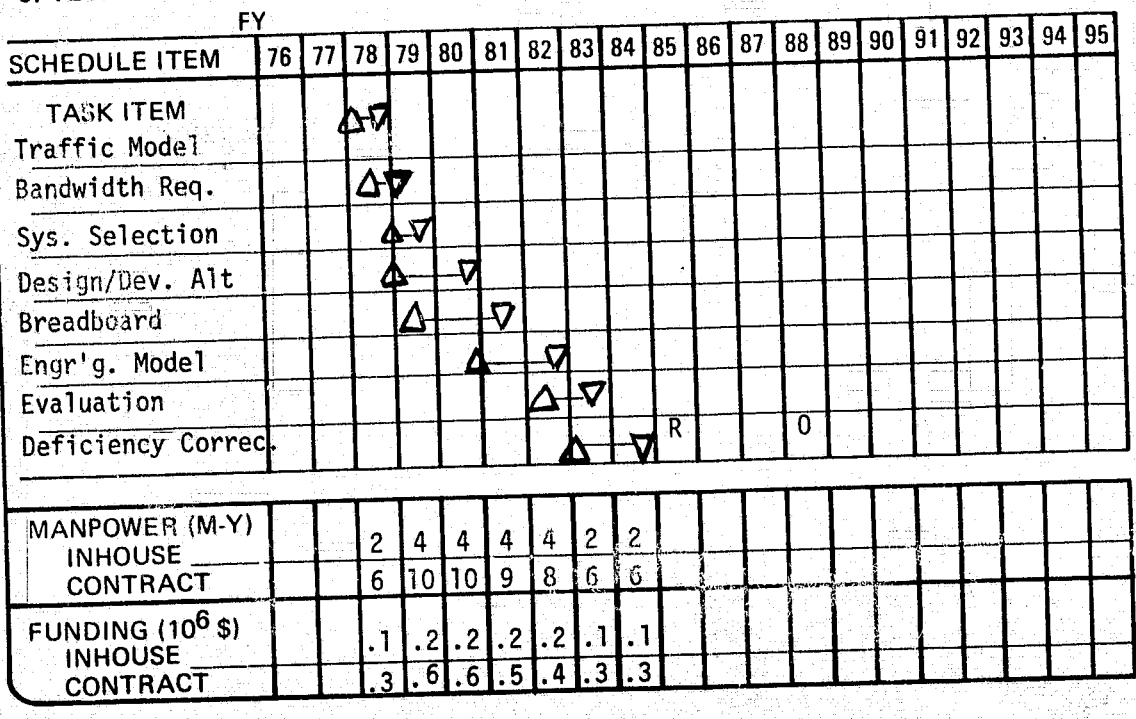
Use of communications frequencies above K Band including lasers to accommodate very wide bandwidths up to 1800 Mhz (SETI). Integrated system approach tc accommodate multiple vehicle communications traffic model.

7. ALTERNATIVE APPROACHES/OPTIONS A family of systems using increasingly higher frequencies: millimeter waves, D & G bands, laser.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Relay communications links proposed for Low Cost Multi-Service Communications.

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

1. TITLE LOW NOISE RECEIVER NO. 9,10/E2/27 (THEME / W.G. / TASK)

DATE 4 / 28 / 76

2. OBJECTIVE

Develop low noise receiver system for SETI, either for Earth or Space-based systems. Similar system required for Orbiting Deep Space Station (ODSRS)

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1984]

c) RISK IN ACHIEVING ADVANCEMENT: HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Antenna design to ascertain max. operating freq.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

a. Receiver noise temperature: less than 3K.

b. Receiver bandwidth: 300 mhz

c. Tunable over 1.4 GHZ to antenna frequency limit using either tunable maser or tunable cooled up converters.

Orbiting Deep Space Station maser will operate at fixed conversion ratio.

SPACE TECHNOLOGY NEED

FORM NO. I

TITLE On-Board, Multi-Channel, Multi-Loop Communications

NO. 8.12 E-2 26
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

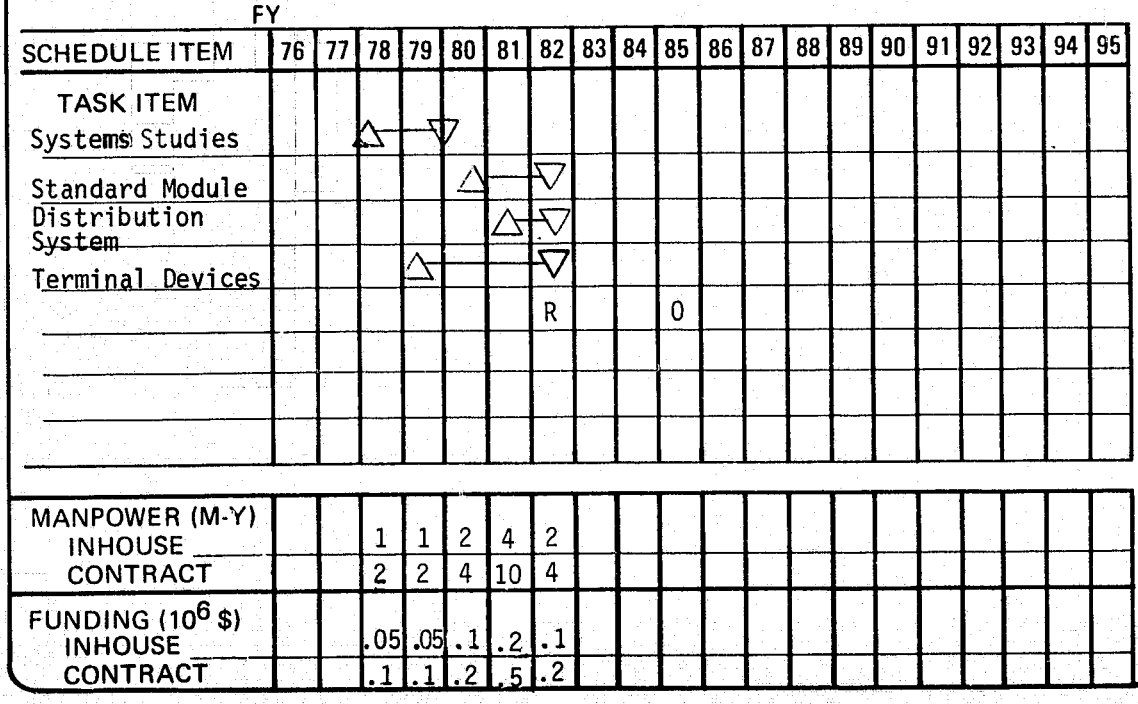
Application of Trunking/Telephony techniques to large, multi-man space station emphasizing low cost standard modules to enable expansion of the system without redevelopment. Application of Fiber Optics. Application of projection devices for color TV display. Development of terminal devices required to display and control teleoperator video, data and commands.

7. ALTERNATIVE APPROACHES/OPTIONS

Flat panel displays

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	78	79	80	81	82
MANPOWER (M-Y) INHOUSE	1	1	2	4	2
CONTRACT	2	2	4	10	4
FUNDING (10^6 $) INHOUSE	.05	.05	.1	.2	.1
CONTRACT	.1	.1	.2	.5	.2

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 2

1. TITLE Antenna Analysis/Design for SETI and ODSRS

NO. 9,10/E2/28
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE Perform trade studies necessary for antenna selection, then provide development thru prototype model test.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE:1984]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Finalize antenna requirements then develop antenna technology to desired level. Current estimate of requirements are:

	Antenna Diameter, M	Operating Freq. GHZ
SETI Phase 1	30	1.4 to 300 GHZ
SETI Phase 2	300	1.4 to 15 GHZ
SETI Phase 3	3000	1.4 to 15 GHZ
ODSRS Phase 1	50	2.3, 8.4
ODSRS Phase 2	100	2.3, 8.4, 13

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE LOW NOISE RECEIVER

NO. 9,10/E2/27
THEME / W.G. / TASK

DATE 4 / 28 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Develop final requirements for SETI and ODSRS.

b. Tradeoff alternate system configurations, including maser (and up-converter,if used) cooling.

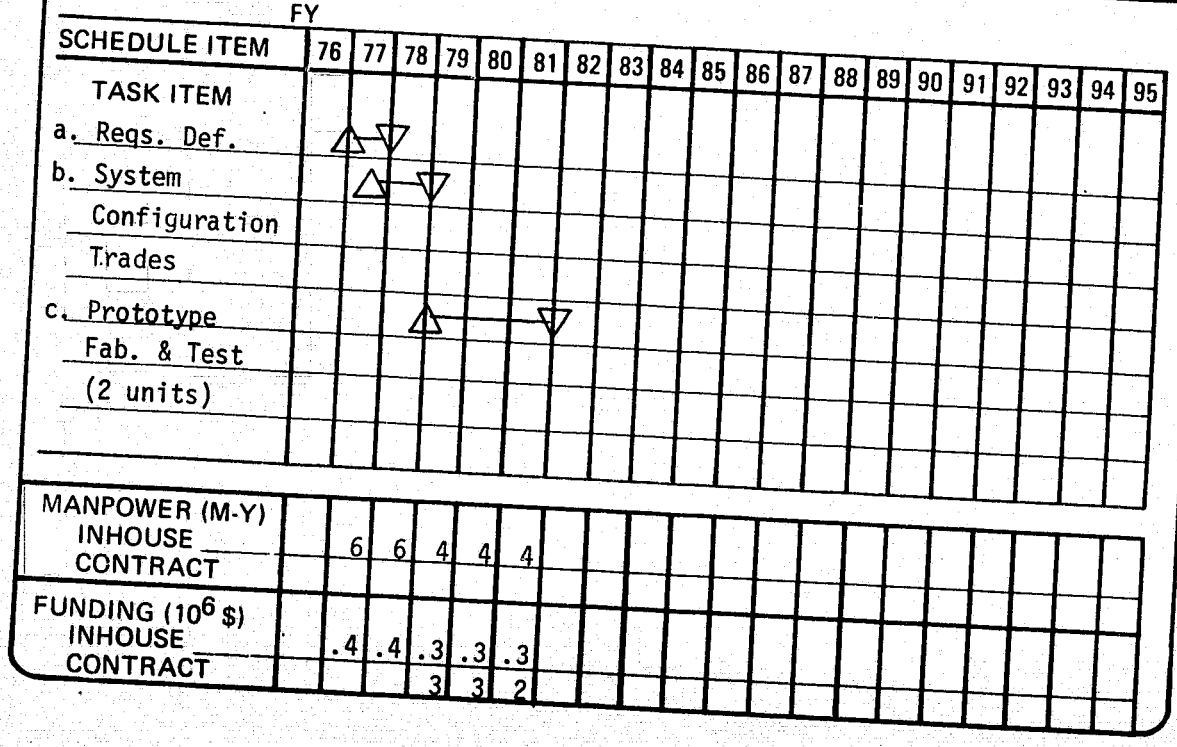
c. Design, fabricate, and test prototype design.

7. ALTERNATIVE APPROACHES/OPTIONS

Tunable maser versus cooled up converter.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE Transponder, Deep Space, X-Band Uplink, S-X or S-K Downlink

NO. 10 / E2 / 29A
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

Develop transponder technology through breadboard test in simulated space environment. Transponder does not include power amplifier.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: 1984

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [XX]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

X- and K-band power amplifiers.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop transponder requirements, design, fabricate and test a breadboard (electrical equivalent to flight unit) in a simulated space environment. This transponder operates at X-Band on the uplink and provides optional downlink operation at S and X band, or S and K band.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Antenna Analysis and Design for SETI and ODSRS

NO. 9,10/E2/28
THEME / W.G. / TASK

DATE 4 /29 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Develop final set of requirements

b. Trade-off potential antenna configurations, estimating costs, feasibility risks.

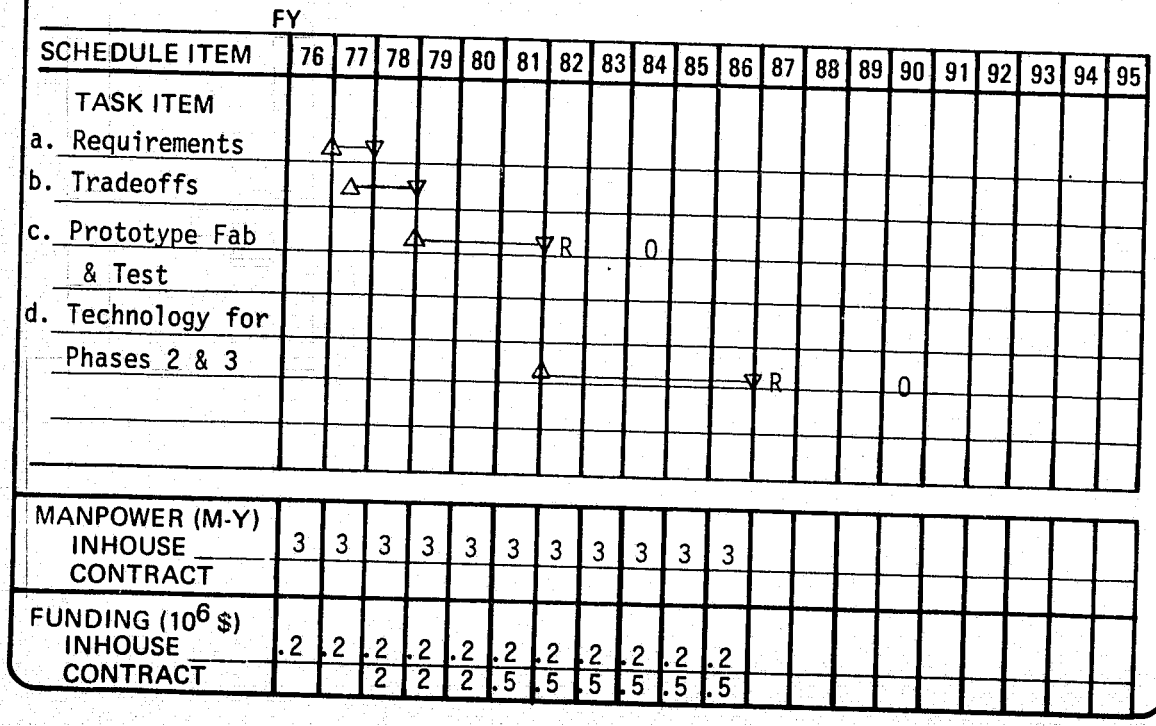
c. Develop technology through prototype fab. 4 test 3 for Phase 1 for SETI

d. Technology dev. for Phases 2 & 3.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

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6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE SPACECRAFT TRANSPONDERS AT 43/86 GHZ

NO. 11 / E-2 / 29B
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Develop technology for spacecraft transponders at 43 and 86 GHZ. Spectrum crowding will force broadcast satellites to higher frequencies.

3. NEED ANALYSIS

a) LEVEL NOW [5], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 198]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [XX] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [ ] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop low-cost spacecraft transponders, including pre-amplifiers, low noise frequency conversion and amplification.

43 and 86 GHZ systems provide the potential for broadcast systems which may resolve some of the spectrum crowding at lower frequencies.

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Transponder, Deep Space, X-Band Uplink, S-X or S-K Downlink

NO. 10/E2/29A
THEME / W.G. / TASK

DATE 4 / 29 / 76

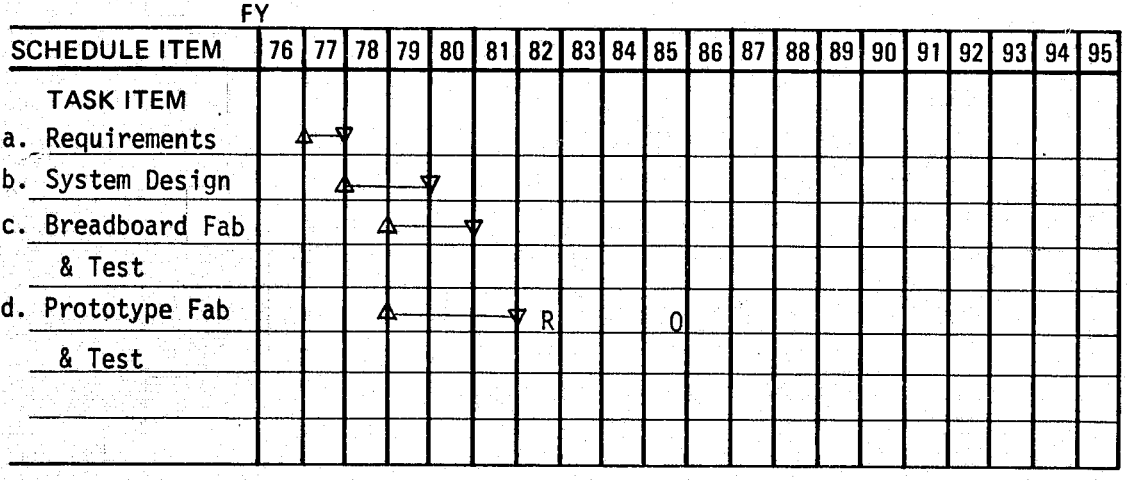
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Develop final set of requirements.
b. System design, including digitizing, as appropriate.
c. Fab. & test breadboards of critical elements.
d. Fab & test prototype units.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Global Positioning System Navigation and Tracking Data Communications

NO. 8,11,12 E2 - 30
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE
Provide G, N&C data from global position system (NAVSTAR)

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1988]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Space borne antenna/receiver compatible with Air Force NAVSTAR system.

Augmentations of the NAVSTAR to accommodate operations above the present NAVSTAR altitude of 11,000 nautical miles.

Second generation system optimized against long term NASA needs at high altitudes.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
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4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Spacecraft Transponders at 43/86 G 1 & 2

NO. 11/E2/29B
THEME / W.G. / TASK

DATE 4 /29 /76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Develop final set of requirements.

b. Design system.

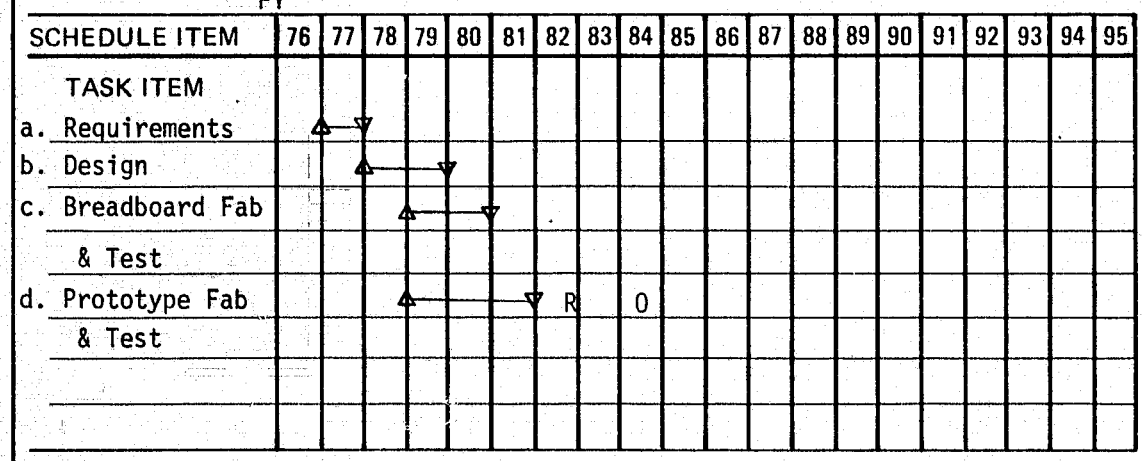
c. Fab and test breadboards to level 3 or 4 the critical elements.

d. Fab and test prototype units of total transponders.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		4	4	4	4	4														
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE		.3	.3	.3	.3	.3														
CONTRACT		.3	1	1	1	1														

SPACE TECHNOLOGY NEED **FORM NO. I**

PAGE 1 OF 2

1. TITLE Low Cost Multi-Service Communications Systems

NO. 11 E2 31
THEME / W.G. / TASK

DATE 4 /28 / 76

2. OBJECTIVE

Develop systems which provide low cost user - service, including point-to-point personal communications over a wide range of information types (multichannel, voice, video-imagery, data such as navigation)

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: [1990]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [X] MEDIUM [ ] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [XX]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Low cost mobile ground terminals; increased radiated power from satellites through combinations of higher power transmitters and larger high-gain antennas; shaped multibeam antenna systems; R.F. spectrum utilization techniques; broad banding and multiplexing techniques to accommodate multiple channels & video data; bandwidth compression; methods of meeting RFI requirements of the CCIR. Low cost methods of overcoming the atmospheric attenuation problems of the higher frequencies including lasers required by wideband information; Encrypting for privacy. Low cost user terminal displays.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
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5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Global Positioning System - Navigation and Tracking Data Communications

NO. 8,11,12 E-2 30
THEME / W.G. / TASK

DATE 4 / 28 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

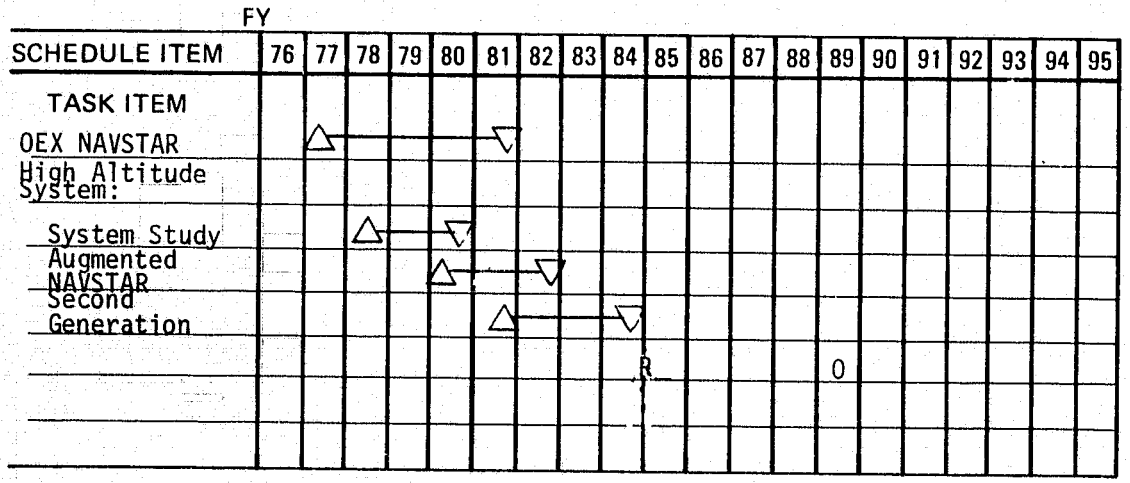
Build on DOD NAVSTAR system by developing compatible antenna/receivers for spacecraft. For operations higher than 11,000 nautical miles develop second generation NAVSTAR to assure communication link. Direct communication with NAVSTAR satellites.

7. ALTERNATIVE APPROACHES/OPTIONS Relay satellites to communicate with the baseline NAVSTAR system

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

OEX (Orbiter Experiment Program) plans experiment using modified NAVSTAR receiver.

9. TECHNOLOGY SCHEDULES



MANPOWER (M-Y)																				
INHOUSE		1	2	3	3	6	6	4	3											
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE		.05	.1	.15	.15	.3	.3	.2	.15											
CONTRACT		.2	.4	.6	.6	.6	.6	.4	.2											

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1

PAGE 1 OF 2

1. TITLE Active, Modular, Multi-Frequency, Phased Array, Antennas.

NO. 9 / E2/ 32
THEME / W.G. / TASK

DATE 4 / 26 / 76

2. OBJECTIVE

Develop modular antenna systems with self-contained distributed transmitters and low noise pre-amplifiers, at S, X and K band.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: [1981]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

None

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop technology through shuttle demonstration of modular antenna systems. Preliminary system analysis to resolve requirements for planetary missions (and potential for Earth orbit missions). System design, fabrication, and test then to be oriented toward meeting defined system objectives.

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Low Cost Multi-Service Communications Systems NO. 11 E2 31 THEME / W.G./ TASK

DATE 4 / 28 67

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

High power communications satellite(s) with large antennas and capability of relaying information from ground stations or other satellites (Earth Resources, etc.). Narrow and broad beam, multiple access capability. Use of higher microwave frequencies and lasers.

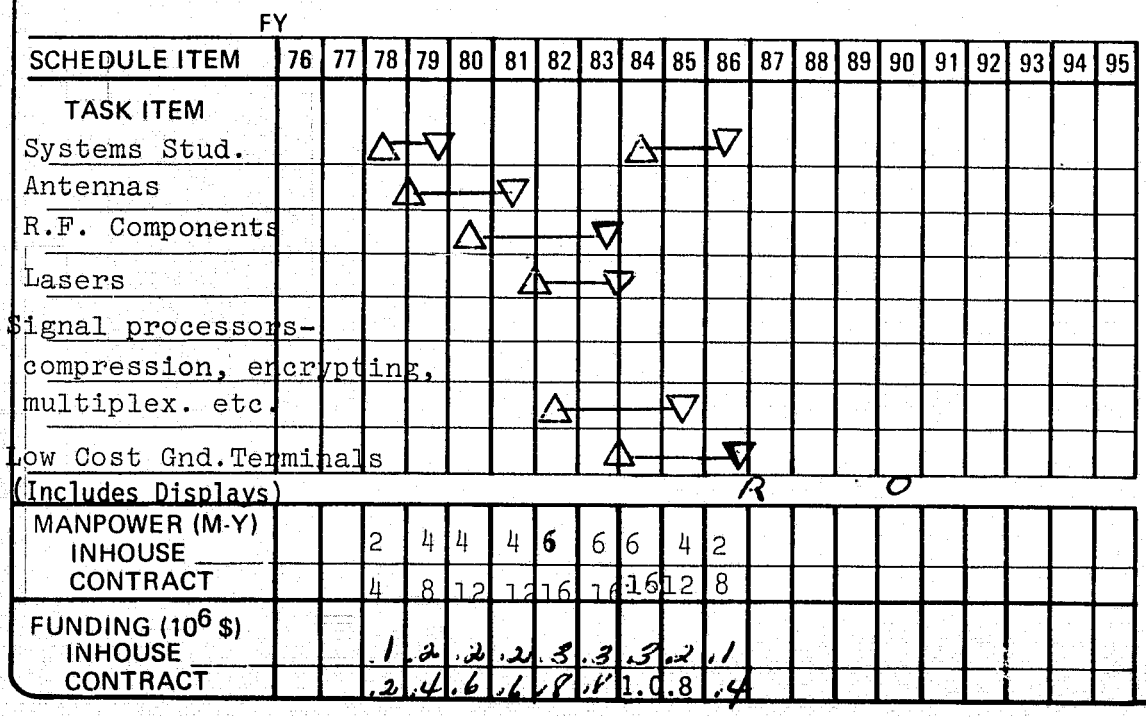
Overall approach is a multipurpose communications satellite. Extensive systems studies to address cost and technology trades

7. ALTERNATIVE APPROACHES/OPTIONS Dedicated ground-to-space and space-to-space communications satellites for each type of application.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

TDRS, CTS, NAVSTAR, MARISAT

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE Relay Technology for Planetary Spacecraft

NO. 10/E-2/ 33
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Perform analysis and system studies necessary to provide cost effective configurations for relay communications to probes, landers, penetrators, or sub-satellites.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [4] FOR OPERATIONAL SYSTEM USE BY [DATE: 1984]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE RTOP 506-20-22

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Propagation modeling study.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop set of system requirements summarizing potential missions.
Design, develop, and test relay system candidates in simulated planetary environments.
Emphasis on cost effective, multi-mission, maximum performance applications.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
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4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Active, Modular, Multi-Frequency, Phased Array Antennas

NO. 9/E2/32
THEME / W.G. / TASK

DATE 4 /29 /76

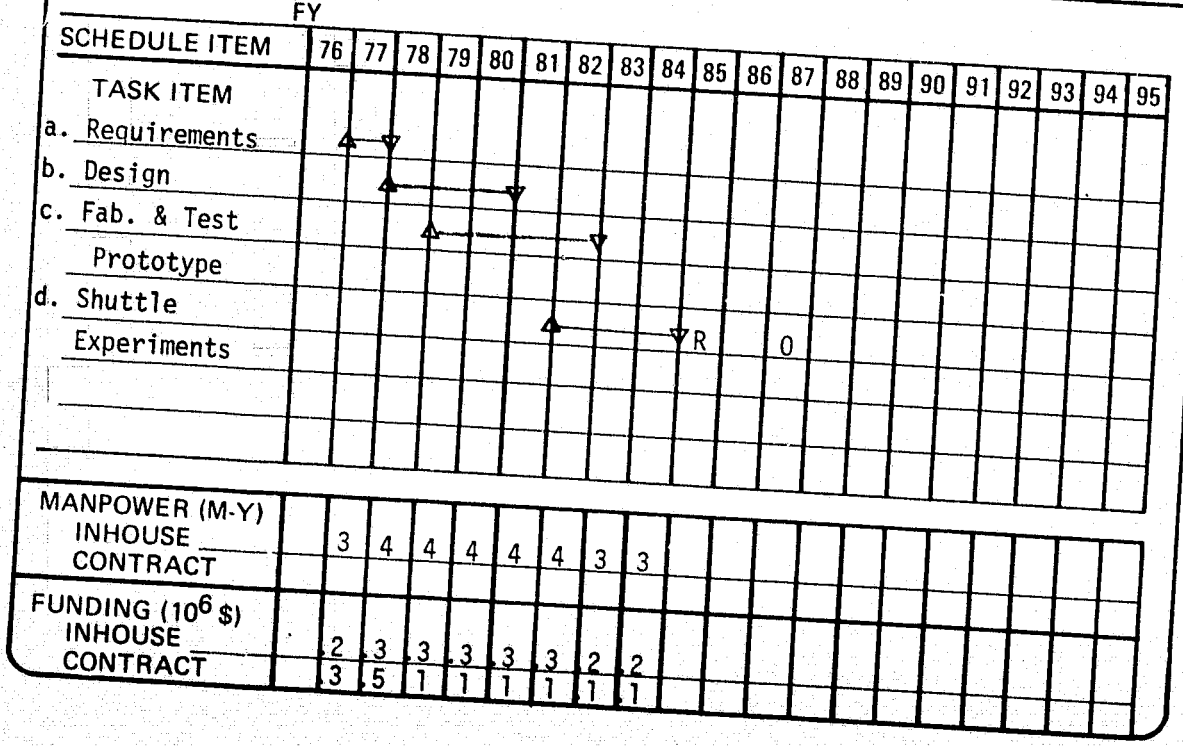
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Develop set of requirements consistent with potential missions.
b. Prototype system design
c. Prototype Fab. and Test
d. Shuttle Experiments.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED

FORM NO. 1

1. TITLE Propogation Modeling

NO. 10/E-2/34
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Develop understanding of effects on radio wave transmissions through or near the sun, interplanetary media, and planetary atmospheres.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [ ] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [4] FOR OPERATIONAL SYSTEM USE BY [DATE: 1984]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [ ] MEDIUM [X] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE RTOP 506-20-22

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop theory describing effects of the sun, interplanetary media, and planetary atmospheres on communications link performance, to the point that link tolerances on atmospheric effects are less than 1 db.

Continue a follow-on activity until flight tests have confirmed theory.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Relay Technology for Planetary Spacecraft

NO. 10/E2/33
THEME / W.G. / TASK

DATE 4 /29 /76

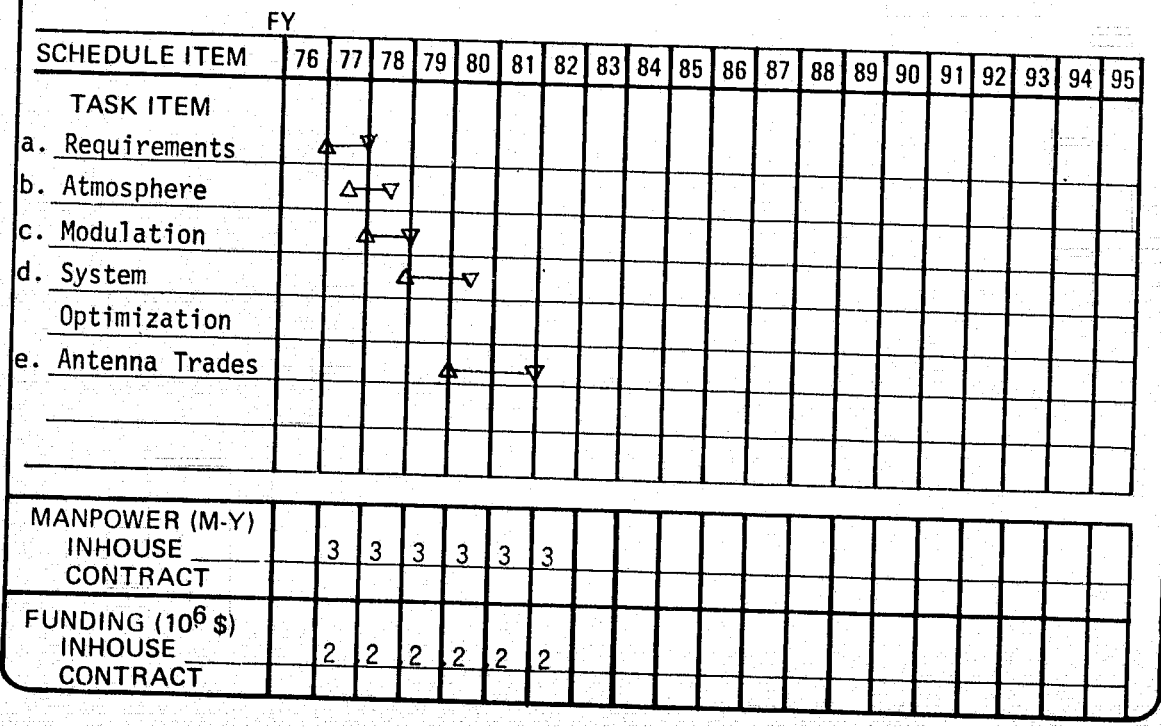
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Establish set of performance requirements.
b. Review data on atmospheric effects.
c. Establish performance of coherent, non-coherent, and hybrid modulation techniques.
d. Relay system configuration trades.
e. Antennas and antenna pointing.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

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2. THEORY FORMULATED TO DESCRIBE PHENOMENA
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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE Near Field Communications Systems Including Visual Communications

NO. 7,8,10,12 E2 - 35
THEME / W.G. / TASK

DATE 4 / 26 / 76

2. OBJECTIVE

Develop communications systems to meet near field requirements of space station and other vehicles employing multiple EVA astronauts, subsatellites or detached teleoperators.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [X] FOR OPERATIONAL SYSTEM USE BY DATE: 1985

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [XX] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [XX] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X] GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ] OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

System approaches to solve near field-far field compatibility problems.

Antenna and frequency selection techniques to avoid shadowing and antenna pattern nulls. Wide band width low carrier frequency RF components.

Multiple access communications.

Television cameras employing reliable, long life solid state TV cameras - CCD, CID, integrated optics/visual sensors, stereo, color response and resolution improvements, high brightness resistance.

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 2 OF 2

TITLE Propogation Modeling

NO. 10/E2/34
THEME / W.G. / TASK

DATE 4 / 28/ 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Analyze effects of previous projects (Helios, Viking, Pioneer) comparing results with theory.

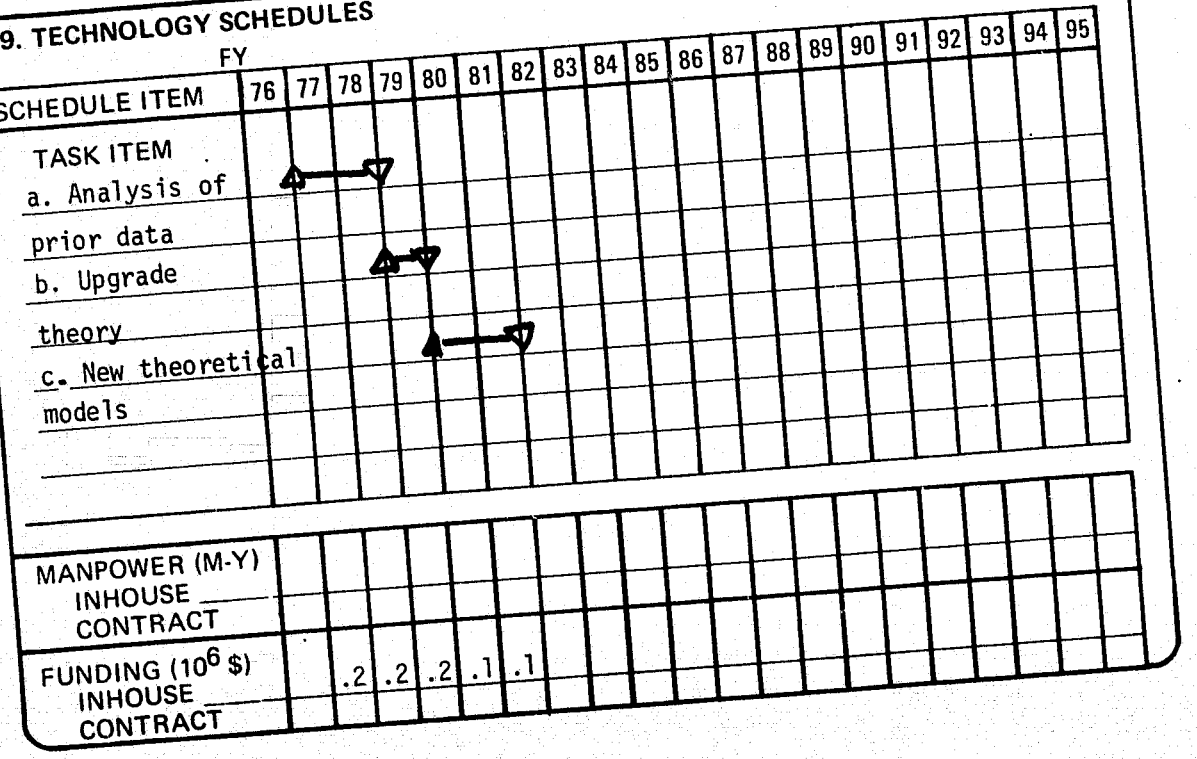
b. Upgrade theoretical models where appropriate.

c. Perform detailed communications effects analysis for areas where theory is missing.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



LEVEL OF STATE OF ART

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SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 1 OF 8

1. TITLE RF Power Amplifiers, UHF

NO. 11 E2 36A
THEME / W.G. / TASK

DATE 4 / 27 / 76

2 OBJECTIVE To develop a high power RF system technology for space broadcast application (solid state).

3. NEED ANALYSIS

a) LEVEL NOW [4], WILL BE LEVEL [4] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY DATE: 1980

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
(Check one or more)
OTHER (Specify) [ ]

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Advancement of solid state UHF component efficiencies required; low power combining possible.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Final amplifier efficiency directly affects the DC power requirements (linear relationship).
Transistor junction temperature ($\approx 125^{o}C$) requires solution of thermal problems. Loss of efficiency due to power combining losses in output circuit components (switches, diplexers, filters, etc.) has to be minimized. Critical parameters are power output, efficiency, size, weight, and long life.

SPACE TECHNOLOGY NEED — **FORM NO. I**

TITLE RF Power Amplifiers, UHF

NO. 11 - E2 - 36A
THEME / W.G. / TASK

DATE 4/ 27/ 76

6A RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Develop a solid state UHF power amplifier and associated power conditioning and output circuit components (switches, filters, power combiners, etc.) required for direct broadcast application such as disaster warning. Power level 50-500W, bandwidth 20 MHz, gain 30dB.

7 ALTERNATIVE APPROACHES/OPTIONS Crossed field amplifier - has to be developed. Power combining of many low power sources is feasible.

8 CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Disaster Warning Satellite Study, March 1971, NASA-LeRC
Disaster Warning System, NASA CR-134622, Report, CSC
Disaster Warning Satellite Study Update, July 1975, NASA-LeRC

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Tradeoffs	△	—▽																		
Thermal		△	—▽																	
AMPL Design		△	—▽																	
Breadboard Test			△	—▽																
Devl/Fab.			△	——	R															
MANPOWER (M-Y) INHOUSE		2	2																	
CONTRACT		4	5	5	2															
FUNDING (10^6 $) INHOUSE																				
CONTRACT		.7	1	.7																

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED — **FORM NO. I**

1. TITLE RF Power Amplifiers, X-Band — NO. 10 - E2 - 36B (THEME / W.G. / TASK)

DATE 4 / 27 / 76

2. OBJECTIVE (X Band)

To develop an X-Band microwaveaamplifier design for dual mode TWT to support the deep space communication requirements.

3. NEED ANALYSIS (X Band)

a) LEVEL NOW [5], WILL BE LEVEL [5] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1985]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Further development and refinement of multi-stage depressed collector and power processor efficiencies.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Design to achieve good overall efficiency with good phase and gain performance with a tapered helix structure and use of multi-stage depressed collector.

SPACE TECHNOLOGY NEED

FORM NO. I

TITLE RF Power Amplifiers, X-Band

NO. 10/11 - E2 - 36B
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Develop a dual mode, 100W/50W tapered Helix amplifier augmented with a multi-stage depressed collector and spent beam refocusing system. The amplifier efficiency will be > 60%.

7. ALTERNATIVE APPROACHES/OPTIONS

Less efficient amplifier can be used with increase in prime power. Data transmission rate can be reduced.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Microwave Amplifier Technology RTOP 506-20-23

Microwave Space Communications Experiment RTOP 645-25-04

9. TECHNOLOGY SCHEDULES

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK ITEM																				
Design		△	▽																	
Thermal		△	▽																	
Prot. Test		△	▽																	
Eng. Test			△	▽		R														
MANPOWER (M-Y) INHOUSE		2	2	2																
CONTRACT		3	3	4																
FUNDING (10^6 $) INHOUSE		.2	.1																	
CONTRACT		.2	.4	.5	.2															

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 5 OF 8

1. TITLE RF Power Amplifiers, 12 GHz NO. 10/11 - E2 - 36C
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE (12 GHz)
To develop a 12 GHz high power amplifier technology for space communications application.

3. NEED ANALYSIS

a) LEVEL NOW [7], WILL BE LEVEL [7] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1981]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR
ENHANCING: HIGH [X] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [ ] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY High power wave guide chain component loss minimization; power processor system design (high power).

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Advancement of efficiency (>50%) of a high power 12 GHz amplifier by utilization of more efficient multi-stage depressed collectors, minimum system weight and volume and high efficiency power processor design. Critical parameters are:

Long life operation in space, minimum loss and distortion of signal, high voltage operation in space and resolution of thermal problems.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

TITLE RF Power Amplifiers, 12 GHz

NO. 10/11 - E2 - 36C
THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

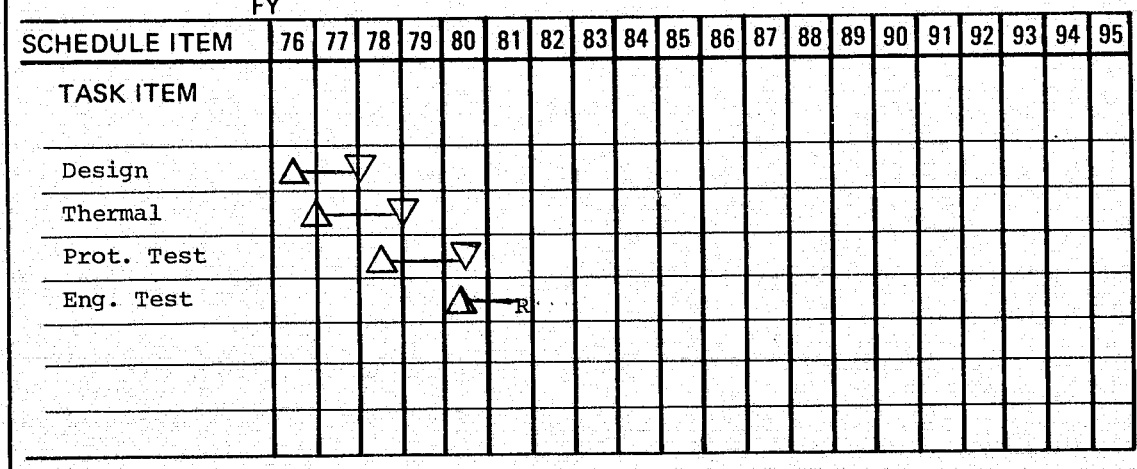
Develop a 12 GHz high efficiency microwave amplifier at power levels of several hundred watts and efficiency of > 50%. Open envelope tube operation may be possible.

7. ALTERNATIVE APPROACHES/OPTIONS Power combining of many less efficient tubes - in phase power combiners to be developed. Increase of solar array power required.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

Present CTS TWT system has efficiency of ≈45% at ≈ 200W.

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		2	2	1	1	1														
CONTRACT		3	4	3	3	1														
FUNDING (10^6 $)																				
INHOUSE		.1			.1	.1														
CONTRACT		.2	.2	.5	.5	.2														

LEVEL OF STATE OF ART

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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

PAGE 7 OF 8

1. TITLE RF Power Amplifiers, 40/80 GHz

NO. 11 - E2 - 36D
THEME / W.G. / TASK

DATE 4 / 27 / 76

2. OBJECTIVE

To establish high power RF system technology for 41-43 GHz and 84-86 GHz.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7] FOR OPERATIONAL SYSTEM USE BY [DATE: 1988]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [X]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

Thermal component stress will result in high power component development problems. Heat rejection problem has to be addressed.

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Component manufacture to extreme tolerances and cathode current density requirements require an advancement in the state of the art. Beam refocusing efforts will be required in addition to advances in multi-stage depressed collector technology. Thermal power loading may approach 1000 W/CM^2 in the RF interaction structure. Significant advances in a number of disciplines will be required to solve these problems.

SPACE TECHNOLOGY NEED FORM NO. I

PAGE 8 OF 8

TITLE RF Power Amplifiers, 40/80 GHz NO. 11 - E2 - 36D

THEME / W.G. / TASK

DATE 4 / 27 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

Microwave amplifiers and passive high power RF components have been developed for terrestrial applications. Approaches to space systems must be identified and developed employing the efficiency enhancement techniques used at lower frequencies. Efficiencies up to 40% are feasible.

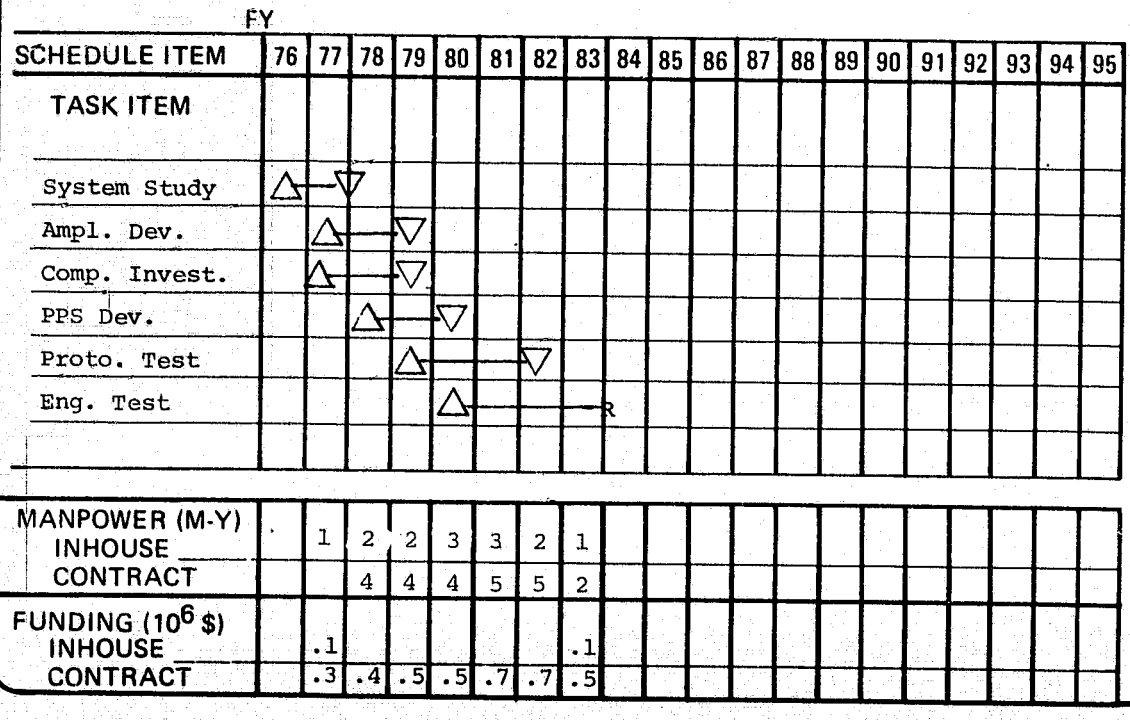
7. ALTERNATIVE APPROACHES/OPTIONS

Low power combining techniques at very low efficiency and high raw power requirement.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

High power transmitter technology	RTOP 650-60-14
Microwave Amplifier Technology	RTOP 506-20-23

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		1	2	2	3	3	2	1												
CONTRACT			4	4	4	5	5	2												
FUNDING (10^6 $)																				
INHOUSE		.1						.1												
CONTRACT		.3	.4	.5	.5	.7	.7	.5												

SPACE TECHNOLOGY NEED

FORM NO. !

1. TITLE Antenna Development for Global Services

NO. 11/E-2/37
THEME / W.G. / TASK

DATE 4 / 28 / 76

2. OBJECTIVE

Design, fabricate, and test breadboard spacecraft antennas required for global services theme.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1990]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [X] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop to level 5 the following antenna systems:

(a) Multiple beam (25), 200 ft diameter, S-band antenna.

(b) X-band planar arrays up to 2 nautical miles long, 16 feet wide.

(c) S-band array up to 10 feet wide, 5.4 nautical miles long.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
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7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED FORM NO. I

TITLE Near Field Communications
Including Visual Communications

NO. 7,8,12 E-2 35
THEME / W.G. / TASK

DATE 4 / 28 / 76

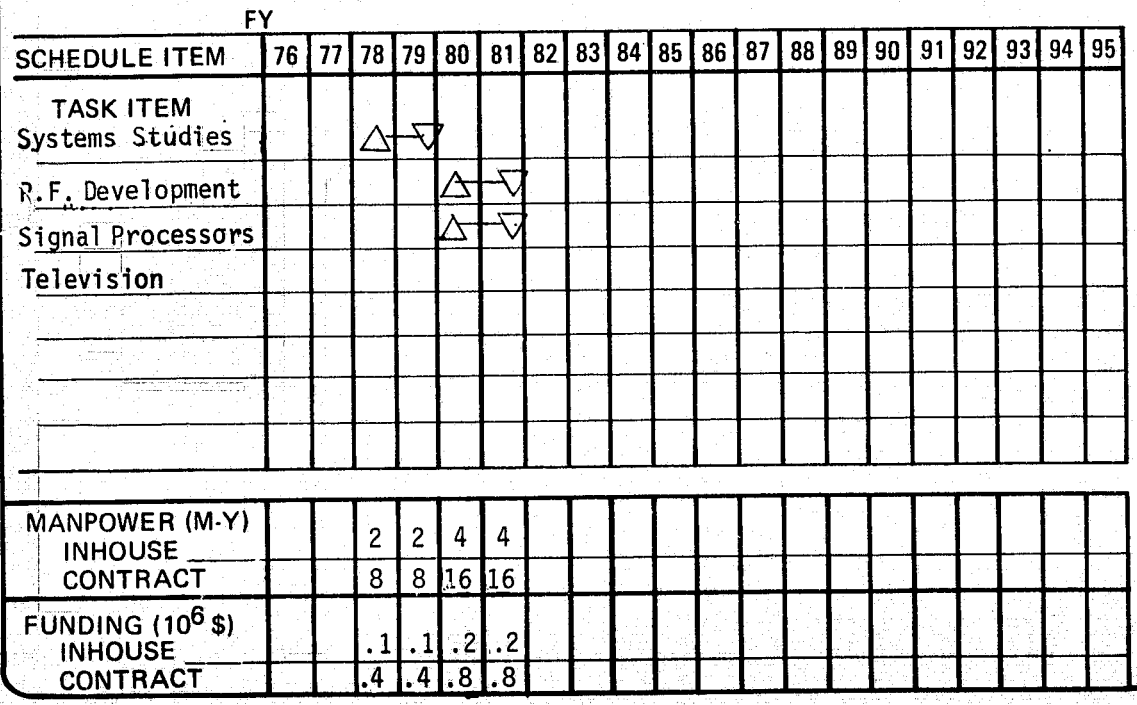
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

System studies to optimize frequency selection and antenna strategy against bandwidth requirements of teleoperators, subsatellites, extra-vehicular astronauts and effects of high power transmitters, low noise receivers associated with Far Field Communication links. Development of low weight, low power, wide band R.F. and signal processing equipment on teleoperators and extravehicular astronauts. Solid state TV cameras.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	78	79	80	81
MANPOWER (M-Y)				
INHOUSE	2	2	4	4
CONTRACT	8	8	16	16
FUNDING (10^6 $)				
INHOUSE	.1	.1	.2	.2
CONTRACT	.4	.4	.8	.8

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 1 OF 2

1. TITLE SETI Transponder

NO. 9 / E2 / 38
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE
Develop transponder for SETI which provides conversion to desired downlink frequency plus required amplification.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY DATE: 1984

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED
Develop technology for very wide bandwidth low noise transponder for SETI. Bandwidth requirements are 600 mhz for Phases 1 and 2, and 1800 mhz for Phase 3.

Development includes stable oscillator (10^{-10}/Hour) for control of translation.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
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6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. 1
PAGE 2 OF 2

TITLE Antenna Development for Global Services

NO. 11/E2/37
THEME / W.G. / TASK

DATE 4 /29 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Develop antenna requirements for proposed missions

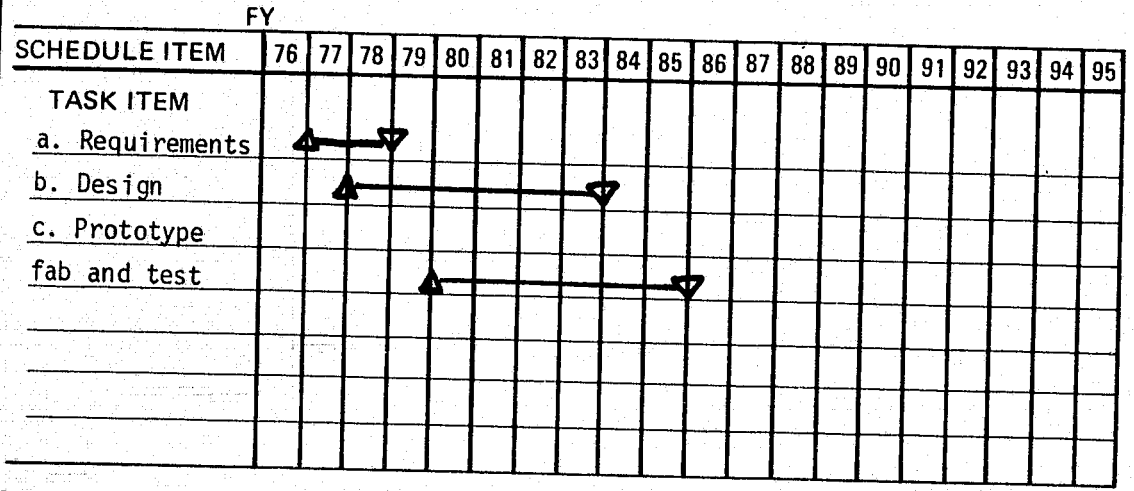
b. Antenna design

c. Antenna prototype fab and test

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y) INHOUSE		3	4	4	5	5	5	5	5	4										
CONTRACT																				
FUNDING (10^6 $) INHOUSE		.2	.3	.3	.3	.3	.3	.3	.3	.2										
CONTRACT					2	2	2	2	2	1										

SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE SETI Relay System Design

NO. 9 / E2 / 39
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE

Develop potential relay design for SETI and upgrade technology in required areas.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1984]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [X]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE _____

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop system configurations, including tradeoff of microwave and laser communications, for very wideband relay systems. Required bandwidth is 600 mhz for Phases 1 and 2, and 1800 mhz for Phase 3.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE SETI Transponder

NO. 9 /E2/ 38
THEME / W.G. / TASK

DATE 4 / 29 / 76

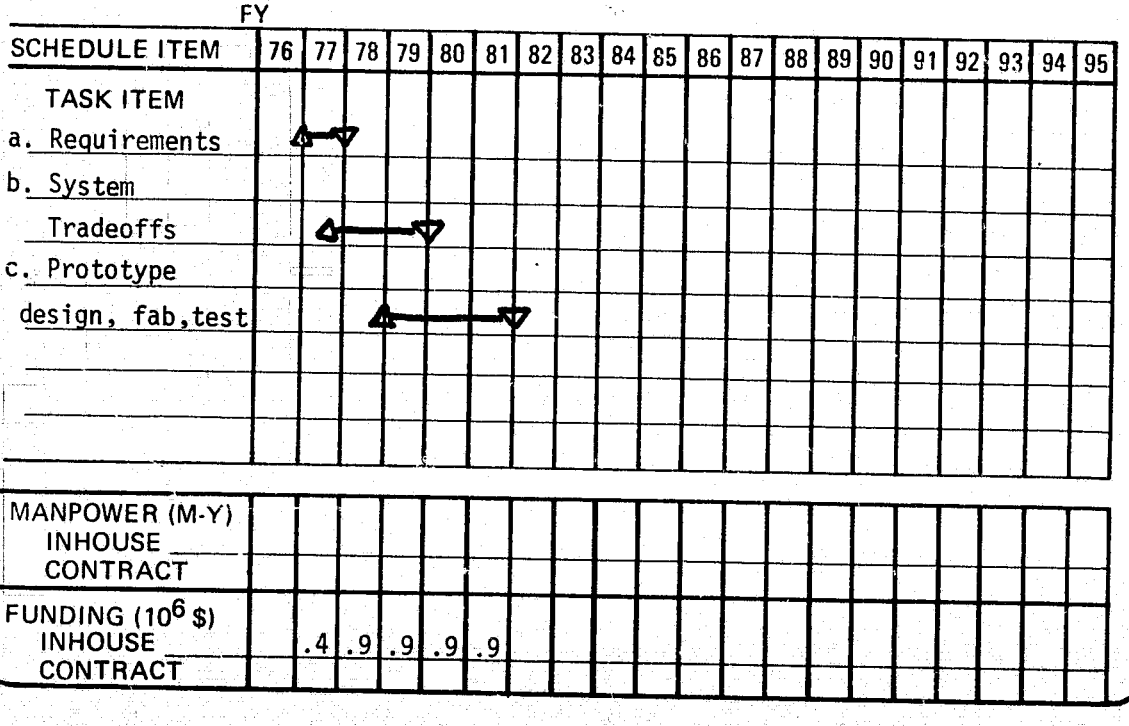
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Develop requirements for transponder.
b. Tradeoff potential system configurations.
c. Prototype design, fab and test.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED

FORM NO. I

1. TITLE Multi-element Broadband Array Technology

NO. 09/E-2/40
THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE Develop technology for obtaining phase-preserving combination of broad band signals from arrays of large spatial extent.

3. NEED ANALYSIS

a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [7]* FOR OPERATIONAL SYSTEM USE BY [DATE: 1990]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [XX] LOW [ ]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [X] OR
ENHANCING: HIGH [ ] MEDIUM [ ] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [X]
GRD TEST [X] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] _____ (Check one or more)

f) R&T BASE CANDIDATE X

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY Cables or waveguide technology

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop technology for large antennas arrayed over large areas, preserving phase and achieving low overall system temperatures.

*Demonstrated as part of a space-ground system.

LEVEL OF STATE OF ART
1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I

TITLE SETI Relay Systems Design

NO. 9 / E2 /39
THEME / W.G. / TASK

DATE 4 / 29 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a. Finalize system requirements.

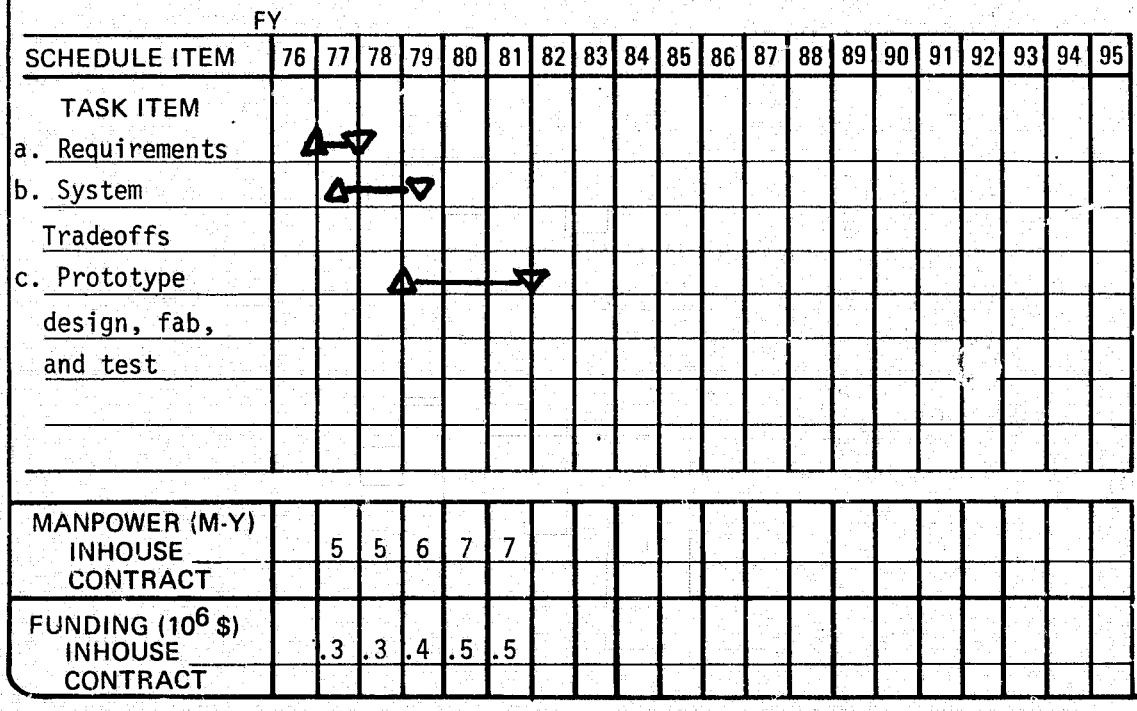
b. Investigate potential operating frequencies and tradeoff system configuration, including lasers.

c. Prototype design and test for critical elements.

7. ALTERNATIVE APPROACHES/OPTIONS

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED **FORM NO. I**

PAGE 1 OF 2

1. TITLE Low Cost High Performance Ground Antennas NO. 9/E-2/41 THEME / W.G. / TASK

DATE 4 / 29 / 76

2. OBJECTIVE

Develop design for a single large antenna to support SETI in the initial phases of search.

3. NEED ANALYSIS

a) LEVEL NOW [3], WILL BE LEVEL [3] UNDER EXISTING PLANS.

b) REQUIRED ADVANCEMENT – SHOULD BE TECHNOLOGY READY AT LEVEL [5] FOR OPERATIONAL SYSTEM USE BY [DATE: 1980]

c) RISK IN ACHIEVING ADVANCEMENT:
HIGH [ ] MEDIUM [ ] LOW [XX]

d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [ ] OR
ENHANCING: HIGH [ ] MEDIUM [XX] LOW [ ]

e) TASKS NEEDED: STUDY [X] ANALYSIS [X] RESEARCH [ ]
GRD TEST [ ] AIR CRAFT TEST [ ] SPACE FLIGHT TEST [ ]
OTHER (Specify) [ ] (Check one or more)

f) R&T BASE CANDIDATE

4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY

5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED

Develop technology for large (100m class) ground antennas emphasizing low cost reproducibility, and improved figure of merit, compared to current systems.

LEVEL OF STATE OF ART

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED
5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
6. MODEL TESTED IN AIRCRAFT ENVIRONMENT
7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

FORM NO. I
PAGE 2 OF 2

TITLE Multi-element Broadband Array Technology

NO. 09/E-2/46
THEME / W.G. / TASK

DATE 4 / 29 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

a) Perform study of system requirements and potential system configurations.

b) System analysis and design.

c) Prototype fabrication.

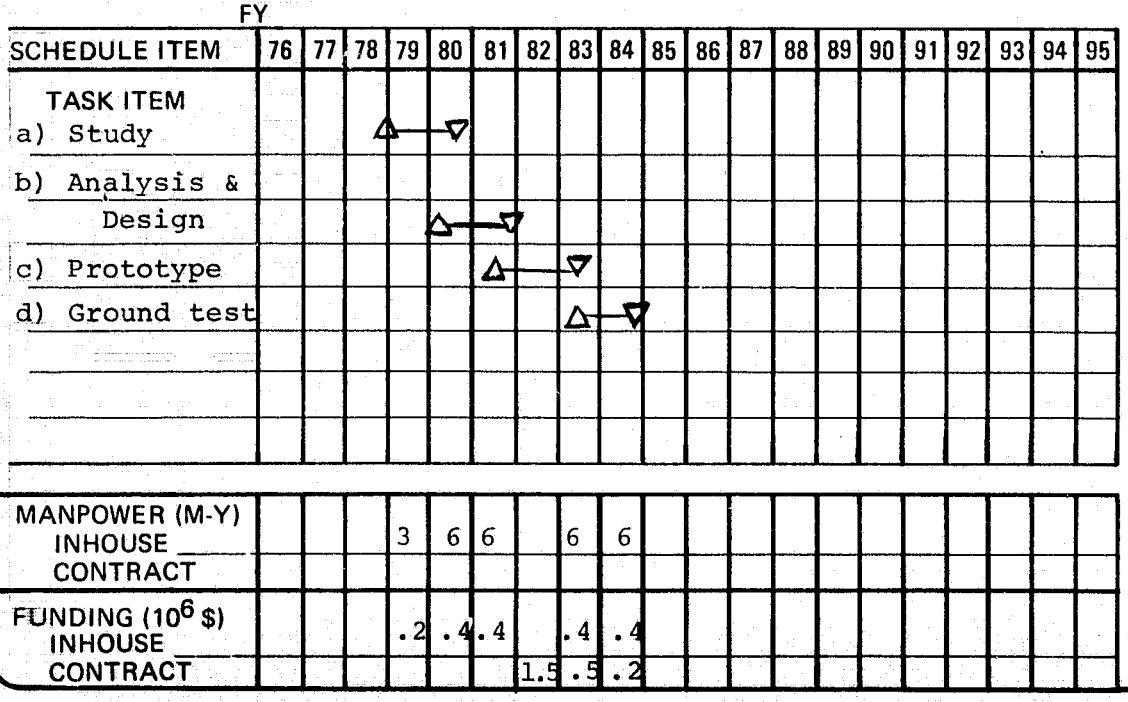
d) Ground test.

7. ALTERNATIVE APPROACHES/OPTIONS Large single antennas.

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

None at present.

9. TECHNOLOGY SCHEDULES



SPACE TECHNOLOGY NEED

TITLE Low Cost High Performance Ground Antennas

NO. 9/E-2/41
THEME / W.G. / TASK

DATE 4 / 29 / 76

6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED

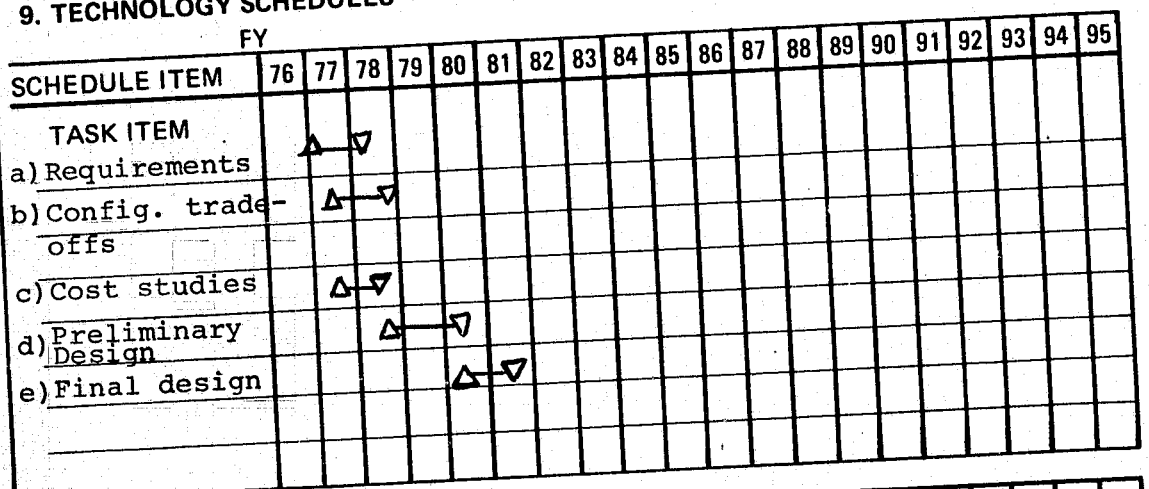
a) Establish requirements: i.e., operating frequencies, environment, life, operating strategy.
b) Compare alternate configurations.
c) Cost studies.
d) Preliminary Design.
e) Final Design.

7. ALTERNATIVE APPROACHES/OPTIONS

None

8. CURRENT/PLANNED RELATED ACTIVITIES (RTOP, OTHER)

9. TECHNOLOGY SCHEDULES



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)		6	8	15	15	5														
INHOUSE																				
CONTRACT																				
FUNDING (10^6 $)		.4	.5	1	1	.3														
INHOUSE																				
CONTRACT				1	2															

III-2-C

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

FORM II
FORM III

(List in numerical order, 1 — Highest Priority)

WORKING GROUP E-2

DATE 4 / 29 / 76

	TECHNOLOGY NEED NO. / THEME NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV.TRANS. SYS.	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	OAST DIV. K	FY 78 K
1	END-TO-END DATA MANAGEMENT	7	1	13	1	1	2	x		1		100 50	750
2	AUTONOMOUS, FAULT TOLERANT DATA HAND.	5	7	14	2	11	6	x		3		250	210
3	MODULAR DATA SYSTEM ARCHITECTURE	6	8		8	7	7	x		4		250	315
4	DATA SET SELECTION		6	7	3	3			x	2			300
5	HI-RATE DATA PROC.				6	2		x	x	6		250 150	800
6	SPECTRUM ANAL. MULTI-CHANNEL			2	9	18				21			
7	STELLAR SYSTEM ANAL.				19				x	25			200
8	LARGE CAP. OB. DATA STORAGE				5	5		x		10		300	600
9	LO-COST DIST. SYSTEM					6				12			
10	MICRO. ELECT. TECH.	4	9	10	11	16		x	x	18		600	660
11	RADIATION HARDENED COMPONENTS				10	19		x		16		400	1400
12	PARALLEL IMAGE PROC.				18	9		x	x	9		500	1100
13	PATTERN RECOG. ANAL.			3	4	8		x	x	5		200 100	1700
14	LG. CAP. OG. DATA ST.			8		4		x	x	11		100	800

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

FORM II
FORM III

(List in numerical order, 1 — Highest Priority)

WORKING GROUP E-2

DATE 4 / 29 / 76

	THEME NO. / TECHNOLOGY NEED NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV.TRANS. SYS.	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	OAST DIV. K	FY 78 K
21	SAFETY	2							x	27		-	350
22	RFI *			8					x	24			1000
23	WAVE POWER TRANSFER									20			2500
24	LASER POWER TRANSFER	1			20					19			
25	SP-SP COMM		3		7	10	3	x		7		500	600
26	ON-BOARD, M-CH/LOOP		4				4		x	29			200
27	SETI RECEIVER			1					x	30			3000
28	ANTENNA SETI			4					x	33			1050
29	TRANSPONDERS			6	17	14		x	x	14		600	800
30	GPS		5				5			23			
31	LO-COST MULTI-SERV. CH.					13				5			800
32	ACTIVE PHASED ARRAY				16	17		x	x	17		150	900
33	RELAY				15			x	x	22		150	200

SPACE TECHNOLOGY NEED PRIORITY ASSESSMENT

(List in numerical order, 1 — Highest Priority)

FORM II
FORM III

WORKING GROUP E-2

DATE 4 / 29 / 76

	TECHNOLOGY NEED NO. / THEME NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV. TRANS. SYS.	NASA R&T		SUMMARY PRIORITY ASSESSMENT			
								Current	R&T Base	WG	TT	OAST DIV. K	FY 78 K
34	PROPOGATION MODEL				12			x	x	26		100	150
35	NEAR-FIELD COMM.	3	2		13		1			28			
36	RF POWER AMPL.				14	15		x	x	18		540	1300
37	ANTENNA GLOBAL					18			x	13			1500
38	SETI TRANSPONDER			6					x	32			800
39	SETI RELAY			11					x	31			400
40	MULTI-ELEMENT BROAD-BAND ARRAY TECHNOLOGY			12									
41	LOW COST HIGH PERF GROUND ANTENNAS			5									

SPACE TECHNOLOGY ADDITIONAL INITIATIVE — FORM IV

TITLE High Rate Data Processor — DATE 4 / 29 / 76

TT NO. _____ OR WORKING GROUP NO. F2

OBJECTIVE

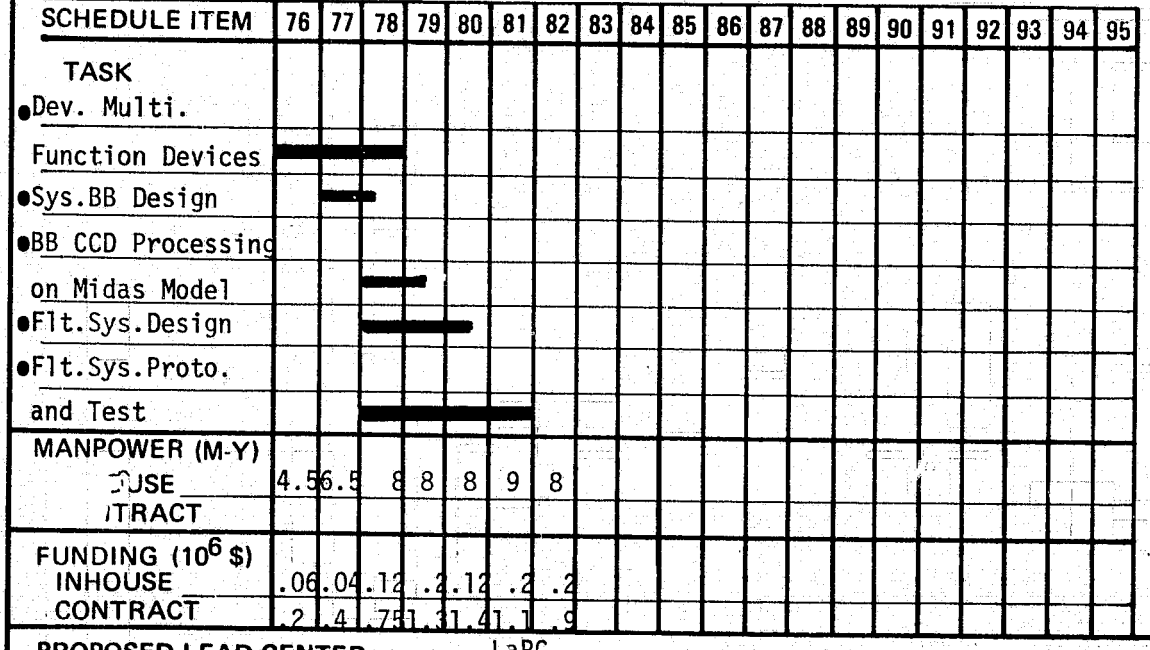
Develop a protoflight programable data processor for remote sensing vehicles leading towards a 1000 fold decrease in data density sent back to earth processing stations.

JUSTIFICATION The cost and time required to collect, transmit, and process remotely sensed data with existing facilities is prohibitive. Recent developments in device technology using CCDs will provide techniques for performing pertinent data processing onboard spacecraft.

TECHNICAL APPROACH/PLAN

Under planned activities, a programable multifunction processor CCD will be developed in FY78. A partially populated breadboard of a processor will be developed and tested to confirm circuit and device performance. An algorithm strategy will be defined from existing bases of resource data using a recently developed ground base multispectral processor. A breadboard and protoflight CCD processor will be developed, fabricated, and evaluated to perform a variety of processing functions. Limited A/C tests will be conducted.

SCHEDULE



PROPOSED LEAD CENTER LaRC

RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIATIVE STATEMENT

SPACE TECHNOLOGY ADDITIONAL INITIATIVE **FORM IV**

TITLE High Density Microelectronics **DATE** 4 / 29 / 76

TT NO. _____ **OR WORKING GROUP NO.** E2

OBJECTIVE

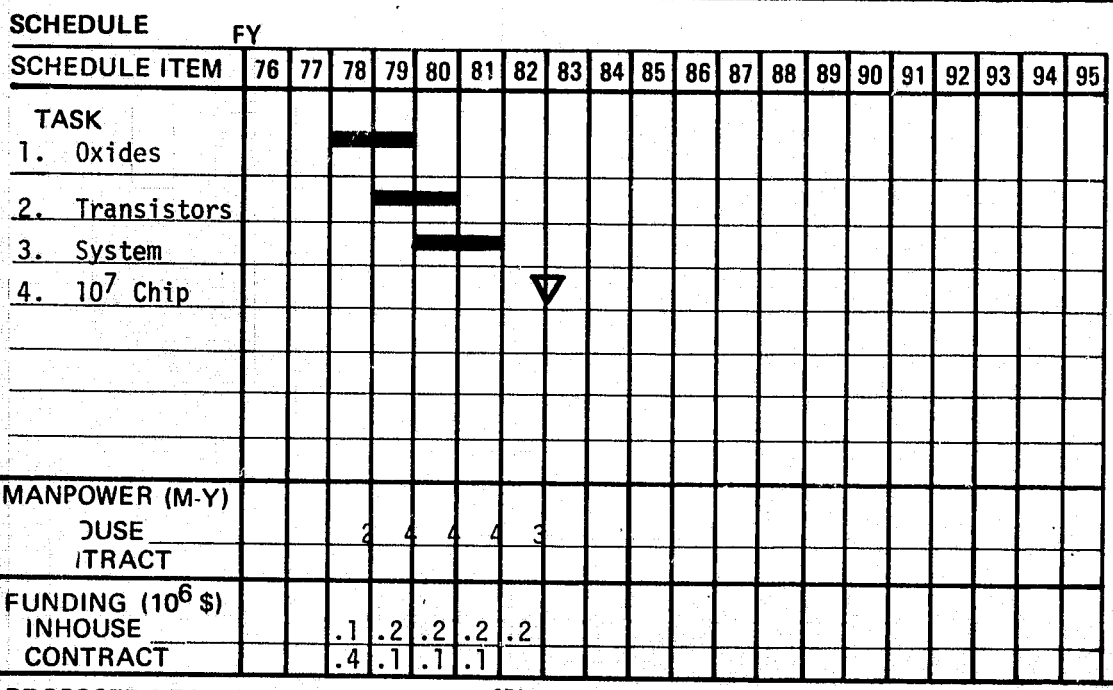
Develop the technical base for practical fabrication of high density MOS components with 10^6 - 10^7 transistors per chip.

JUSTIFICATION The need for high speed, onboard processing has been identified by the workshop. High density chips will enable high rate processing and large storage systems to be implemented reliably and cost effectively.

TECHNICAL APPROACH/PLAN

The approach is to exploit electron beam lithography in order to pattern microelectronic circuits having lateral dimensions in the order of 1 micron. Thin oxide (~100Å) techniques will be developed to accommodate these dimensions. Feasibility will be established by fabricating a chip having 10^7 MOS transistors.

SCHEDULE



PROPOSED LEAD CENTER JPL

RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIATIVE STATEMENT

SPACE TECHNOLOGY ADDITIONAL INITIATIVE **FORM IV**

TITLE Artificial Retina System **DATE** 4 / 29 / 76

TT NO. _____ **OR WORKING GROUP NO.** E2

OBJECTIVE
Develop a photoreceptor array imbedded in a logic matrix on a silicon LSI chip to achieve real-time parallel image processing.

JUSTIFICATION Information from current imaging systems is extracted as raw gray level data and then sent to earth for processing. The artificial retina provides a method for directly extracting scene data thereby increasing speed while reducing operating costs.

TECHNICAL APPROACH/PLAN
The approach is to utilize silicon LSI technology to implement a logic matrix imbedded in the photoreceptor array. The logic will execute algorithms which will preprocess the raw data to levels where features can be extracted (contour, texture, motion, etc.).

SCHEDULE

SCHEDULE ITEM (FY)	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
TASK																				
Design			▽																	
Algorithms			▽																	
Feasibility						▽														
Demonstration							▽													
MANPOWER (M-Y)																				
INHOUSE			5	8	10	10	10													
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE			.5	.6	.8	.8	.8													
CONTRACT			.1	.2	.4	.7	.7													

PROPOSED LEAD CENTER JPL

RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIATIVE STATEMENT

SPACE TECHNOLOGY ADDITIONAL INITIATIVE **FORM IV**

TITLE Unified CCD Data Processor **DATE** 4 / 29 / 76

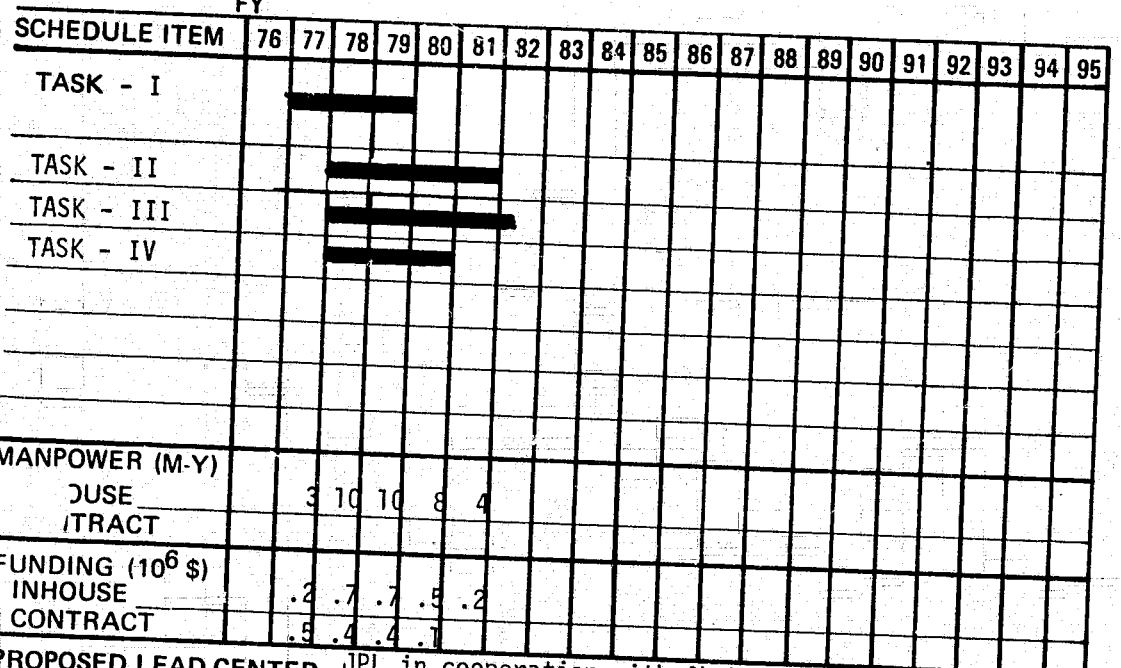
TT NO. _____ **OR WORKING GROUP NO.** E2

OBJECTIVE
Develop and demonstrate a CCD processor to increase data processing capability for a wide range of microwave and multispectral imaging systems including radar imaging.

JUSTIFICATION High resolution multispectral imaging systems produce data rates which are difficult to implement in a cost effective way. CCD technology offers a practical solution.

TECHNICAL APPROACH/PLAN Task I: Develop a test bed processor and demonstrate using Seasat A data from ground stations. Task II: Develop system architecture for modular microprocessor control. Task III: Develop onboard processor. Task IV: Algorithm development.

SCHEDULE



	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
MANPOWER (M-Y)																				
INHOUSE		3	10	10	8	4														
CONTRACT																				
FUNDING (10^6 $)																				
INHOUSE		.2	.7	.7	.5	.2														
CONTRACT		.9	.4	.4	.1															

PROPOSED LEAD CENTER JPL in cooperation with LaRC

RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIATIVE STATEMENT

SPACE TECHNOLOGY ADDITIONAL INITIATIVE **FORM IV**

TITLE Space Conditioning Technology for High Power Microwave ~~Amplifiers~~ **DATE** 4 / 29 / 76

TT NO. _____ **OR WORKING GROUP NO.** E2

OBJECTIVE

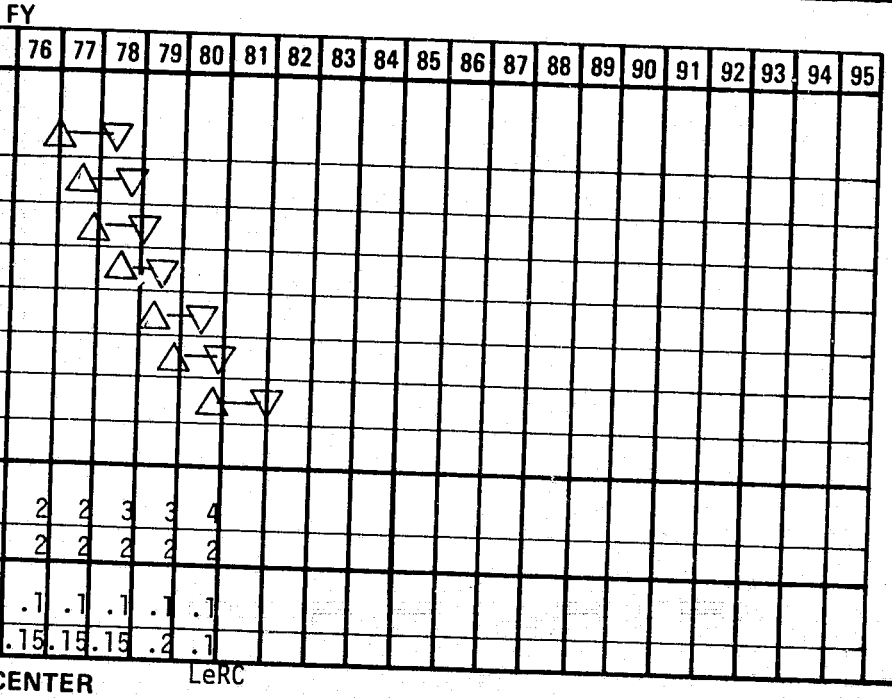
To develop the technology for processing and operating high power open-envelope amplifiers in space

JUSTIFICATION Present envelope vacuum deterioration limits tube life (outgassing, thermal stress, multipactor, X-rays, etc.)

TECHNICAL APPROACH/PLAN

Program will be initiated to investigate techniques and develop technology for space processing and operation of open envelope amplitrons, initial plans ~~include terrestrial vacuum chamber and Shuttle Orbiter tests.~~

SCHEDULE



	76	77	78	79	80
MANPOWER (M-Y)					
OUSE	2	2	3	3	4
ITRACT	2	2	2	2	2
FUNDING (10^6 $)					
INHOUSE	.1	.1	.1	.1	.1
CONTRACT	.15	.15	.15	.2	.1

PROPOSED LEAD CENTER LeRC

RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIATIVE STATEMENT

SPACE TECHNOLOGY ADDITIONAL INITIATIVE **FORM IV**

TITLE Autonomous, Fault Tolerant Data Handling & Control System **DATE** 4 / 29 / 76

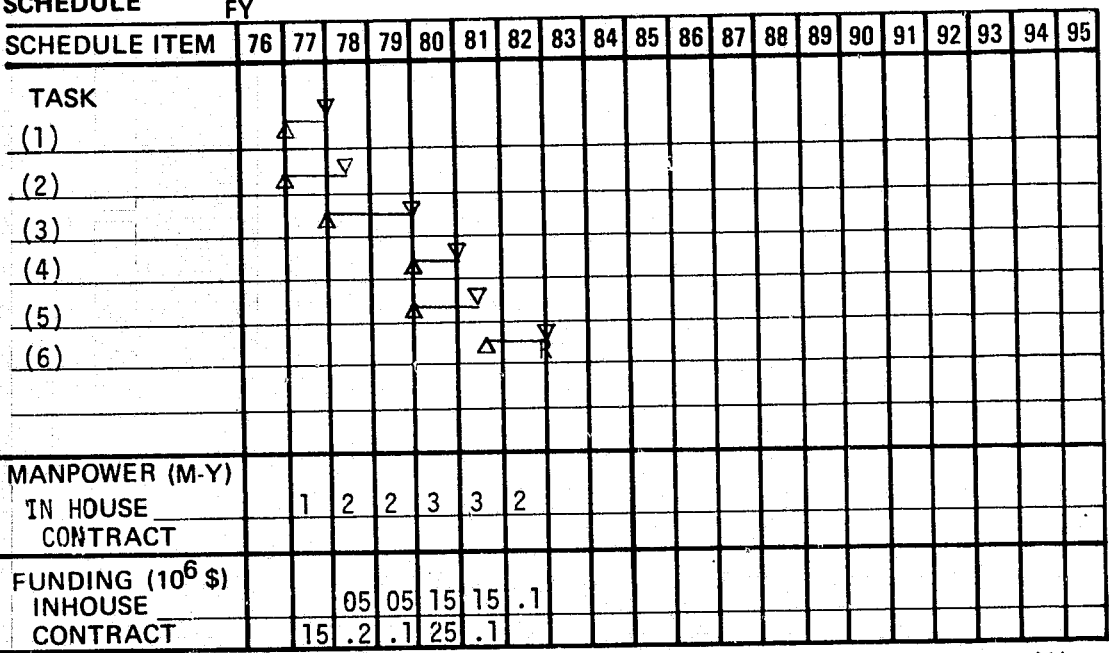
TT NO. _____ **OR WORKING GROUP NO.** E-2

OBJECTIVE
To develop a modular, fault tolerant data handling & control system derived from existing LSI processor technology

JUSTIFICATION There exists a need to develop highly reliable, long life data/control components & system technology for integration with suitable S/C subsystems.

TECHNICAL APPROACH/PLAN
1) Develop the system technology for Fault Tolerant Hardware/Software
2) Survey LSI Processor Technology & select candidate components
3) Fabricate Breadboard system & integrate suitable portions with selected S/C components (power, propulsion, control)
4) Test system fabricated in (3)
5) Develop & Fabricate engineering model system.
6) Test & evaluate engineering model system.

SCHEDULE



PROPOSED LEAD CENTER LeRC for above work. Shared responsibility with MSFC & JPL on overall agency effort

RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIATIVE STATEMENT