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# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# OAST SPACE THEME WORKSHOP

# VOLUME III

(NASA-TM-80009) OAST SPACE THEME WORKSHOP.
VOLUME 3: WORKING GROUP SUMMARY. 2: DATA
HANDLING, COMMUNICATIONS (E-2). A.
STATEMENT. B. TECHNOLOGY NEEDS (FORM 1).
C. PRIORITY ASSESSMENT (FORM 2) (NASA) G3/12

N79-15121

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# 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 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 farterm 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) <u>Performing the Data Processing at the Most Cost Effective</u>

  <u>Point in the System.</u> (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

4.

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.

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SPACE TECHNOLOGY NEED FORM NO. I PAGE 1 OF 2 1. TITLE END-TO-END DATA MANAGEMENT NO. ALL EZ
THEME / W.G. / TASK COMPONENT OR BREADBOARD TESTED IN RELEVANT DATE 4 / 26/ 76 2. OBJECTIVE To develop and utilize techniques, simulation tools, and a reconfigurable MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT flight experiment to enable design, analysis and proof of concept with the ENVIRONMENT IN THE LABORATORY purpose of allowing & demonstrating cost effective, throughut 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 PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED OTHER (Specify) (Check one or more) f) R&T BASE CANDIDATE THEORY FORMULATED TO DESCRIBE PHENOMENA THEORY TESTED BY PHYSICAL EXPERIMENT OR 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, endto-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, LEVEL OF STATE OF ART 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"

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FORM NO. I

SPACE TECHNOLOGY NEED

COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT

BASIC PHENOMENA OBSERVED AND REPORTED THEORY TESTED BY PHY MATHEMATICAL MODEL

PAGE 1 OF 7-12 / E-2 / 2 1. TITLE Autonomous, Fault Tolerant Data Handling, THEME / W.G. / TASK Control, and Communication Systems 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 [], WILL BE LEVEL [] UNDER EXISTING PLANS. b) REQUIRED ADVANCEMENT - SHOULD BE TECHNOLOGY READY AT LEYEL 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 [ RESEARCH X ANALYSIS [ GRD TEST X AIR CRAFT TEST SPACE FLIGHT TEST X (Check one or more) PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED OTHER (Specify) 750K through F.Y. 1980 f) R&T BASE CANDIDATE 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.

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SPACE TECHNOLOGY NEED

AND TRANSFER SYSTEMS

1. TITLE

	DATE 4 / 28 / 76
SPACE ENVIRONMENT	<ol> <li>OBJECTIVE         Provide a system of modular components and functions to meet the needs of future spacecraft such as lower cost, adaptability, fault tolerance,     </li> </ol>
STACE ENVIRONMENT	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
	d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING X OR
	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
	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.

MODULAR ARCHITECTURE FOR DATA PROCESSING

FORM NO. I

PAGE 1 OF \_2

NO

7-12 / E-2 / 3

THEME / W.G. / TASK

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LEVEL

	SPACE TECHNOLOGY NEED	FORM NO. I PAGE 1 OF2
	1. TITLE DATA SET SELECTION	NO. 8, 10, 11/E-2 / 4 THEME / W.G. / TASK
187		DATE 4 /28 /76
OARD TESTED IN RELEVA NBORATORY AFT ENVIRONMENT ENVIRONMENT	2. OBJECTIVE Develop system concepts/demonstrate feas go/no-go data set selection on the basis spectral characteristics, data threshold	of such parameters as spatial,
5. COMPONENT OR BREADBO. ENVIRONMENT IN THE LAB 6. MODEL TESTED IN AIRCRA 7. MODEL TESTED IN SPACE E	3. NEED ANALYSIS  a) LEVEL NOW 3, WILL BE LEVEL UND b) REQUIRED ADVANCEMENT — SHOULD BE TO AT LEVEL 5 FOR OPERATIONAL SYSTE c) RISK IN ACHIEVING ADVANCEMENT: HIGH MEDIUM X LOW COMPLISHMENTS: ENHANCING: HIGH X MEDIUM COMPLISHMENTS: OTHER (Specify) COMPLISHMENTS: OTHER (Specify) COMPLISHMENTS:	ENABLING OR  LOW  KENABLE OR  KENABLE OR
1. BASIL FIENDMENN DESENDED AND REPORTED 2. THEORY FORMULATED TO DESCRIBE PHENOMENA 3. THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL 4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED	4. COMPLEMENTARY TECHNOLOGY ADVANCEME USE OF THIS TECHNOLOGY  Data analysis algorithm development in an multi-spectral classification.  5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRACCOMPLISH NEED  1. Merging of hardware, firmware, and so selected set of algorithms using image 2. Evaluation of effectiveness of approarms.	RED TO  oftware technology to implement a ging sensor data.
OF STATE OF ART	Major thrust of this activity will be the to implement the pattern recognition and	e development of modular firmware go/no-go decision algorithms.

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5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE FARDBATORY

LEVEL 1. BASIC PHENOMENA OBSERVED AND REPORTED OF STATE 2. THEORY FORMULATED TO DESCRIBE PHENOMENA

THEME / W.G. /  DATE 4 /29 / 76  2. OBJECTIVE Develop a general modular processing capability to handle rate data from imaging systems, multispectral scanners, and other remsensing 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 LOW (6)  d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING OR ENHANCING: HIGH MEDIUM LOW (7)  e) TASKS NEEDED: STUDY [8] ANALYSIS RESEARCH [8]  GRD TEST AIR CRAFT TEST SPACE FLIGHT TEST [8]  OTHER (Specify) (6)  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, classificat compression, etc., using:  (1) Multivariant statistics-clustering and ground truth (2) Dev. specific processing algorithms 3. Develop parallel array architecture utilizing LSI microprocessor technology architecture utilizing LSI microprocessor	1. TITL	E HIGH RA	TE DATA P	ROCESSOR			NO.	10,1		E-2
2. OBJECTIVE Develop a general modular processing capability to handle rate data from imaging systems, multispectral scanners, and other rem 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	· ·							THEN	NE / \	W.G. / T
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6. RECOMMENDED A	\PPF	ROA	CH	/PR	ogi	RAN	1 PL	AN	TO	AC	COI	MPL	ISH	NE	ED					n
algorithms																				
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SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	88	90	31	92	931	34	90
TASK ITEM																				
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l)Algorithm review				=	-		ļ					_	-		_	-	<del> </del>	ļ	-	
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3)Fabrication/Test			_		<u> </u>	Ė				_	_	_		<u> </u>	<u> </u>	-	-	-		-
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FUNDING (10 <sup>6</sup> \$)	1	1	T	†																
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5. COMPONENT OR BREADBOARD TESTED IN RELEVANT

1. TITLE Multichannel Spectrum Analyzer (MCSA)	NO. 09 / E-2 / 06
Real-time Pourier Processor (109bin) ("FYP")	THEME / W.G. / TASK
	DATE 4 / 29/ 76
	DATE/
2. OBJECTIVE Develop systems that will permit conti	inuous scanning of
2300 MH <sub>2</sub> band.	
3. NEED ANALYSIS	
a) LEVEL NOW 3, WILL BE LEVEL 4 UNDER EXI	STING PLANS.
b) REQUIRED ADVANCEMENT - SHOULD BE TECHNO	
AT LEVEL 7 FOR OPERATIONAL SYSTEM USE	
c) RISK IN ACHIEVING ADVANCEMENT:	
HIGH MEDIUM X LOW	
	BLING X OR
gallin i w Tyllin i i ber i blake i market i <u>' — kirale</u> i kirale i — <u>— —</u> i kir	ow U
e) TASKS NEEDED: STUDY X ANALYSIS X	RESEARCH X E FLIGHT TEST
0	evel at (Check one or more)
and the control of th	_dedicated`šyštem
f) R&T BASE CANDIDATE	· · · · · · · · · · · · · · · · · · ·
4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS RE	EQUIRED FOR
USE OF THIS TECHNOLOGY Concomitant developm	
Recognition Analyzer and Display will be requi	rea to analyze output
of UCSA	
5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO	0
ACCOMPLISH NEED	
1. Develop 10 <sup>6</sup> bin prototype Pipeline Cordic	FFT analyzer by F.Y. 78
2. Develop 600 MH <sub>3</sub> - 1200 MH <sub>3</sub> digitizer (appr	
possible) by F.Y. 79.	
3. Develop 10 <sup>12</sup> to 10 <sup>13</sup> bit RAM power spectru	m raster memory by
F.Y. 80.	
	······································
4. Develop optimal 10 <sup>9</sup> bit Pipeline Cordic FF	l analyzer prototype
4. Develop optimal 10 <sup>9</sup> bit Pipeline Cordic FF by F.Y. 80.	l analyzer prototype
by F.Y. 80.	
by F.Y. 80.	Analyzer.

	PAGE 2 OF 2
SPACE TECHNOLOGY NEED	NO. 10,11 E-2 5 THEME / W.G. / TASK
TITLE HIGH RATE DATA PROCESSOR	THEME / W.G. / TASK
HILL HIGH INIT	DATE 4 /29 / 76
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCO The approach involves pasically three steps: (1)	OMPLISH NEED  Nevelop device and systems
6. RECOMMENDED APPROACH.	be technologies in test ped
technology. (2) Ground demonstration of candid technology. (3) Selection of technology and in processors. (3)	plementation arccessors and
processors. (3) Selection of technology and in processors. including LSI microprocessor	for array pro-
control.	
7. ALTERNATIVE APPROACHES/OPTIONS The alternative practice and practic	native is a complex, high power
7. ALTERNATIVE APPROACHES/OPTIONS The altern digital approach which is not necessarily practicely for ground systems	tical for onboard application
digital approach which is not necessarily removed systems	use.
digital approach which is not necessary or cost effective or timely for ground systems	OTHER)
	, 0
500-20-11 Teen Devices	
506-20-11 - Data Systems 506-18-21 - Electron Devices 506-20-10 - High Capacity Data Systems Cluster compression Preprocessi	ng for Landsat D.
506-18-21 - Electron Devices  506-20-10 - High Capacity Data Systems  656-xx-xx - Gluster compression Preprocession  656-xx-xx	
9. TECHNOLOGY SCHEDULES	1 2 2 91 92 93 94 95
1 -1-0 70 90 81 82 83 84 8	5 25 87 88 89 90 91 92 93 94 95
SCHEDULE ITEM 78 77 78 78 80 0	
TASK ITEM	
Device Tech.	
System Tech.	
Test Bed	
MicroProc. Arch.	
Flt. Test Proto	
MANPOWELL IN 10 5 18 10 10 10 10 10 10 10 10 10 10 10 10 10	
INHOUSE	
FUNDING (106 \$) .06 .3, .9 .9 .6 .4 .2	
FUNDING (10 <sup>6</sup> \$) .06 .3 .9 .9 .6 .4 .2 INHOUSE .2 .9 1.21.71.5 1.1 .9	

5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY 6. MODEL TESTED IN AIRCRAFT ENVIRONMENT 7. MODEL TESTED IN SPACE ENVIRONMENT

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 DEMONSTRATE

LEVEL 1. OF STATE 2. OF ART 3.

SPACE TECHNOLOGY NEED	PAGE 1 OF 2
1. TITLE Stellar Sensing System Array Processor	NO. 10 E2 7
	THEME / W.G. / TA
2. OBJECTIVE	DATE 4 / 27 / 76
Develop an array processor capable of performing	the function of
photographic film in astronomical applications, w	hen augmented with
proper detector arrays.	
3. NEED ANALYSIS	
a) LEVEL NOW 2, WILL BE LEVEL UNDER EXI	STING DI ANG
D) REQUIRED ADVANCEMENT - SHOULD BE TECHNO	1004
AT LEVEL DI FOR OPERATIONAL SYSTEM USE	SY DATE: 1991
CONTISK IN ACHIEVING ADVANCEMENT:	
HIGH MEDIUM X LOW	
d) CRITICALITY TO THE ACCOMPLISHMENTS: ENAE	BLING OR
ENHANCING: HIGH MEDIUM X	W 🔲 WC
e) TASKS NEEDED: STUDY X ANALYSIS X	RESEARCH X
GRD TEST X AIR CRAFT TEST SPACE	
	(Check one or mor
f) R&T BASE CANDIDATE	
4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REC	DUIRED FOR
Large detector arrays	for all
of interest to astronomy, LSI technology, parallel architecture and software.	processing system
architecture and software.	
5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO	
ACCOMPLISH NEED	
(1) Study of candidate detector array characterist	ics and image enhance-
algorithms.	
(2) Development of processor architecture, interfa	ces and data display
(3) Development of feasibility demonstration model	
<u> </u>	interpretagn and an experience of the control of th

TASK ITEM comp. Sim. Study  06 bin const.&test4  09 bin design  09 bin subunit construct. & test const																						
TITLE MULTICHANNEL SPECTRUM ANALYZER (MCSA)  Real-Time Fourier Processor (109 Bin) ("FTP")  THEME /W.G./TASK  DATE 4 / 28/ 76  6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED  1. Build 106 bin analyzer and test over 2.0 year period  at Arecibo  3. Develop techniques for synthesizing 109 bin analyzer by paralleling  106 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  FY  SCHEDULE ITEM 76 77 78 78 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95  TASK ITEM omp. Sim. Study A. TO OB DIA STEEL STEE							,					<u></u>										
Real-Time Fourier Processor (10 <sup>9</sup> Bin) ("FTP")  Real-Time Fourier Processor (10 <sup>9</sup> Bin) ("FTP")  DATE 4 / 28/ 76  6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED  1. Build 10 <sup>6</sup> bin analyzer and test over 2.0 year period  at Arecibo  3. Develop techniques for synthesizing 10 <sup>9</sup> bin anayzer by paralleling 10 <sup>6</sup> 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  FY  SCHEDULE ITEM 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95  TASK ITEM omp. Sim. Study A TO 06 bin const. Atesta 09 bin subunit ogstruct. & test 09 bin McSA const and test 09 bin McSA const and test 09 bin McSA const 19	SPACE TECHNOLO	OGY	NE	ED	<u>.</u>							-			PA	GE:			_	Ю. І		
Real-Time Fourier Processor (10 <sup>9</sup> Bin) ("FTP")  THEME /W.G./TASK  DATE 4 / 28/ 76  6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED  1. Build 10 <sup>6</sup> bin analyzer and test over 2.0 year period  at Arecibo  3. Develop techniques for synthesizing 10 <sup>9</sup> bin anayzer by paralleling  10 <sup>6</sup> 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  FY SCHEDULE ITEM 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95  TASK ITEM omp. Sim. Study A TP  0 <sup>6</sup> bin const. &test ta	TITLE MULTICH	IANN	EL	SPE	CTF	RUM	ANA	\LYZ	ZER	(MC	SA)	)			NIC	. 0	9		E	2	0(	5
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED  1. Build 10 <sup>6</sup> bin analyzer and test over 2.0 year period  at Arecibo  3. Develop techniques for synthesizing 10 <sup>9</sup> bin anayzer by paralleling  10 <sup>6</sup> 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  FY  SCHEDULE ITEM  76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95  TASK ITEM omp. Sim. Study  0 <sup>6</sup> bin const. & test 09 bin McSA const and test  ther data process. V  AND OP bin MCSA const and test  MANPOWER (M-Y) 1 8 13 18 10 10 10 15 15 15 15  WANPOWER (M-Y) 1 1 8 13 18 10 10 10 15 15 15 15  UNDING (10 <sup>6</sup> s) 1NHOUSE  LUNDING (10 <sup>6</sup> s) 1NHOUSE  102 2 2 3 3 3 1 1 1 1 1 1 2 2 2 2 2	Real-Time Fo	uri	er	Pro	ces	sor	(1	09	Bin	) (	"FT	P")										
6. RECOMMENDED APPROACH/PROGRAM PLAN TO ACCOMPLISH NEED  1. Build 10 <sup>6</sup> bin analyzer and test over 2.0 year period  at Arecibo  3. Develop techniques for synthesizing 10 <sup>9</sup> bin anayzer by paralleling  10 <sup>6</sup> 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  FY  SCHEDULE ITEM  76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95  TASK ITEM  omp. Sim. Study  0 <sup>6</sup> bin const. & test  0 <sup>9</sup> bin design  0 <sup>9</sup> bin subunit ogstruct. & test  10 <sup>9</sup> bin SASA const and test  ther data process. Pr  MANPOWER (M-Y)  INHOUSE  CONTRACT  4 30 50 70 20 20 20 20 25 35 35 35 35  UNDING (10 <sup>6</sup> \$)  INHOUSE  LINE ARC AND				·				: :							DΛ	TE	1	.,	28/	76		
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LEVEL OF STATE OF ART

SPACE TECHNOLOGY NEED	FORM NO. I PAGE 1 OF3
1. TITLE Large Capacity Onboard Storage Systems	NO. 10,11/ E2 / 8 THEME / W.G. / TASK
	DATE4 / 27 / 76
2. OBJECTIVE Development of high density data storage technologicapable of storing 10 <sup>9</sup> -10 <sup>10</sup> bits and containing to	ogies for space applications no moving parts.
3. NEED ANALYSIS  a) LEVEL NOW 4, WILL BE LEVEL 5 UNDER EX  b) REQUIRED ADVANCEMENT — SHOULD BE TECHN  AT LEVEL 7 FOR OPERATIONAL SYSTEM USE  c) RISK IN ACHIEVING ADVANCEMENT:  HIGH B MEDIUM LOW A  d) CRITICALITY TO THE ACCOMPLISHMENTS: EN  ENHANCING: HIGH X MEDIUM   e) TASKS NEEDED: STUDY ANALYSIS X  GRD TEST X AIR CRAFT TEST SPA  OTHER (Specify) X Flt. Design & Dev.  f) R&T BASE CANDIDATE 200K (for A) plus 300K	OLOGY READY BY DATE: '83, '90 A B  ABLING OR LOW RESEARCH CE FLIGHT TEST (Check one or more)
TO THE START ARY TECHNOLOGY ADVANCEMENTS I	REQUIRED FOR A, basic research in
5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED ACCOMPLISH NEED A. Meld NASA concepts for fault tolerance and relation NASA and DOD components. Supports the Strawman the solar system in the requirement for large consystems.	modular architecture with package for exploration of
B. NASA is currently developing a 10 <sup>8</sup> bit bubb improvement in bit storage density, data rates, Consideration of alternate approaches, primaril should be made since it is not clear that 10 <sup>10</sup>	access time, etc. is require y CCD and optical storage

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9. TECHNOLOGY S  F  SCHEDULE ITEM  TASK ITEM  1.Matls. & Proc.  2.Device des. & de  3.System design  4.System fab.	76	DU	LE	S				ole	rar	ıt F	Runc	lowr	L Ac							
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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

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1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR
MATHEMATICAL MODEL
4. PRETINENT FILINGTION OR CHARACTERISTIC DEMONSTRATED

LEVEL OF STATE OF ART

1. Ti	LE LOW COST DISTRIBUTION SYSTEM NO. 11/F2/09 THEME / W.G. / TASK
	DATE 4 /_27/ 76
ם	JECTIVE velop the incremental (only) technology for processing, routing and
	stributing remote sensing and DCP data to user networks on a "fixed or
_	d interactive basis. Assumes pre-existence of an operational
3. N	ntralized system. ED ANALYSIS
	LEVEL NOW 3, WILL BE LEVEL 4 UNDER EXISTING PLANS.
	REQUIRED ADVANCEMENT - SHOULD BE TECHNOLOGY READY
	AT LEVEL 7 FOR OPERATIONAL SYSTEM USE BY DATE: 1985
(	RISK IN ACHIEVING ADVANCEMENT:
	HIGH MEDIUM X LOW STAR SNAPLING WOOD
	CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING X OR ENHANCING: HIGH MEDIUM LOW LOW
	TASKS NEEDED: STUDY X ANALYSIS X RESEARCH X
	GRD TEST X AIR CRAFT TEST X SPACE FLIGHT TEST X
1111	OTHER (Specify) (Check one or more
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	/ Nati BASE GARDIDATE
4. C	MPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR SE OF THIS TECHNOLOGY Pre-existence of an operational gigabit/sec
	entralized" system is required. Assumed this baseline will develop ou
01	existing and planned technology.
5. S	ECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO
	COMPLISH NEED
1 - 1, e 🕞	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)
	Regional processor (pattern recognition, etc.) development
5	Develop automatic routing system
c	Low cost user terminal design
0	그런 그렇는 그 전 생활은 사람이 남들 사람이 되고 있다. 그런 보험 사람들은 함께 하는 뭐라는 일하고 살았다.
	Low cost user console design (for interaction)

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(1) Technology Rev						<b></b>														
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COMPONENT OR BREADBOARD TESTED IN RELEVANT MODEL TESTED IN AIRCRAFT ENVIRONMENT **ENVIRONMENT IN THE LABORATORY** 

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.

FORM NO. I

PAGE 1 OF

MODEL TESTED IN SPACE ENVIRONMENT

PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED

THEORY FORMULATED TO DESCRIBE PHENOMENA

LEVEL OF STATE OF ART

THEORY TESTED BY PHYSICAL EXPERIMENT OR

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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

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

LEVEL OF STATE OF ART

1. TITLE RADIATION HARDENED ELECTRONIC  COMPONENTS  DATE 4 /28 / 76  DATE 4 /28 / 76  DATE 4 /28 / 76  2. OBJECTIVE To provide a radiation hardened component technology which will withstand a total integrated dose of 10 <sup>6</sup> 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 1 LOW 6  d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING 0R ENHANCING: HIGH MEDIUM 1 LOW 6  e) TASKS NEEDED: STUDY 1 ANALYSIS RESEARCH 1 SPACE FLIGHT TEST 0 THER (Specify) 7 (Check one or mo 1) R&T BASE CANDIDATE 186-68-83(1.3M), 506-18-34 (400K)  COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY  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	SPACE TECHNOLOGY NEED	FORM NO. PAGE 1 OF2
2. OBJECTIVE To provide a radiation hardened component technology which will withstand a total integrated dose of 10 <sup>6</sup> 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 LOW 0 d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING OR ENHANCING: HIGH MEDIUM LOW 0 e) TASKS NEEDED: STUDY X ANALYSIS RESEARCH GRAPH TEST SPACE FLIGHT TEST 0 THER (Specify) (Check one or mo f) R&T BASE CANDIDATE 186-68-83(1.3M), 506-18-34 (400K)  COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY  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	1. TITLE RADIATION HARDENED ELECTRONIC	No control of
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ENVIRONMENT IN THE LABORATORY MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED-IN SPACE ENVIRONMENT COMPONENT OR BREADBOARD TESTED IN

c) RISK IN ACHIEVING ADVANCEMENT: HIGH X MEDIUM LOW [ ENHANCING: HIGH X MEDIUM e) TASKS NEEDED: STUDY X ANALYSIS X GRD TEST X AIR CRAFT TEST FUNCTION OR CHARACTERISTIC DEMONSTRATED OTHER (Specify) f) R&T BASE CANDIDATE (New) 500K THEORY TESTED BY PHYSICAL EXPERIMENT OR (electron beam or X-ray) 5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED 1. Design of custom LSI arrays. data (contour, motion, texture, etc.). STATE ART

SPACE TECHNOLOGY NEED FORM NO. I PAGE 1 OF\_ 1. TITLE PARALLEL IMAGE PROCESSING NO. 10,11 E-2 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 d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING OR LOW 🗍 RESEARCH: X SPACE FLIGHT TEST (Check one or more) 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY LSI arrays; high density lithography Develop pre-processing algorithms for feature extraction from raw

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<sup>\*</sup>Includes funding from 186-68-83

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1.	TITLE PATTERN RECOGNITION ANALYZER	NO. 9/E2/ 13
	AND DISPLAY (PRA)	THEME / W.G. / TASK
		DATE 4 / 28/ 76
2. gen	OBJECTIVE (1) Develop visual interactive sy t signals in the massive output file of the I	ystem for identifying intelli- Fourier Analyzer (FTP); (2)
aut	omated pattern recognition scanner for ident	ifying intelligent signals with
hig	h probability and acceptably low false alarm	rate.
7	NEED ANALYSIS	
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	b) REQUIRED ADVANCEMENT - SHOULD BE TEC	
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	OTHER (Specify) Test as part of overa	all SETI system(Check one or more)
	f) R&T BASE CANDIDATE New. Need \$1.1 r	million in FY 77
4.	COMPLEMENTARY TECHNOLOGY ADVANCEMENT USE OF THIS TECHNOLOGY	TS REQUIRED FOR
	Large memory (11/E2/14) and FTP (9/E2/06), .	large space antenna (09/E2/30)
<u> </u>		
5.	SPECIFY TECHNOLOGY ADVANCEMENT REQUIRE ACCOMPLISH NEED	ED TO
1.	Determine display media/human factors matche	ed to solve display problem.
2.	Feasible hardware implementation.	
3.	Test and evaluate candidate systems on SETI	
4.	Synthesize and test optimal zoom display (w	ith 10 <sup>12</sup> memory)
5.	Survey likely intelligent patterns.	
6.	Develop suitable P.R. algorithms.	
7.	Implementation of algorithms with selected	hardware.
4	Continuing development of device technology	for PRA
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COMPONENT OR BREADBOARD TESTED IN RELEVANT MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT **ENVIRONMENT IN THE LABORATORY** 

SPACE TECHNOLOGY NEED

FUNCTION OR CHARACTERISTIC DEMONSTRATED THEORY FORMULATED TO DESCRIBE PHENOMENA THEORY TESTED BY PHYSICAL EXPERIMENT OR BASIC PHENOMENA OBSERVED AND REPORTED

LEVEL OF STATE OF ART

FORM NO. I PAGE 1 OF 2 1. TITLE Large Capacity Ground Data Storage System NO. 9.11 E2 THEME / W.G. / TASK 4 / 28 / 76 DATE\_\_ 2. OBJECTIVE Develop a high capacity (10<sup>15</sup> bits), high transfer rate (10<sup>10</sup> 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 [ STUDY ANALYSIS X e) TASKS NEEDED: 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 Erasable storage materials for optical and USE OF THIS TECHNOLOGY 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. 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.

TI	THE PATTERN RECOGNITION ANALYZER (PRA)  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, ISI & CCD memory development by NASA and industry. Large memories (11/E2/14)  9. TECHNOLOGY SCHEDULES
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	MANPOWER (M-Y) INHOUSE CONTRACT 2 22 40 38 16 22 34 36  FUNDING (10 <sup>6</sup> \$) INHOUSE 1 1 1 2 2 15 1 2 2  1 1 2 2 19 8 1.11.71.8

SPACE TECHNOLOGY NEED	FORM NO. I
1. TITLE Safety in the Multipurpose  Space Power Platforms	NO. <u>7 - E2 - 21</u> THEME / W.G. / TASK
	DATE 4 /26 / 76
To develop the systems technology to establish aspects in the handling of space power  3. NEED ANALYSIS  a) LEVEL NOW 1, WILL BE LEVEL 5 UNDER EXECUTED ADVANCEMENT — SHOULD BE TECHNOM AT LEVEL 5 FOR OPERATIONAL SYSTEM USES OF RISK IN ACHIEVING ADVANCEMENT:  HIGH MEDIUM LOW X  d) CRITICALITY TO THE ACCOMPLISHMENTS: ENALED ANALYSIS X  ENHANCING: HIGH MEDIUM CORREST VILLE ANALYSIS X	XISTING PLANS.
4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS RIUSE OF THIS TECHNOLOGY None  5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED  Development of general safety guidelines as well these, such as automatic mgt. techniques which servomechanism loops within the more traditional bias inputs to traditional control loops. Commaspects must also be considered. The advanceme one of system development, rather than component a study is necessary to ascertain whether or no in (for example) on-board multiprocessors is necessary than the system function.	l as the implementation of establishes additional l power mgt. system, or as unications and coding nt necessary is probably t development. However,
	1. TITLE Safety in the Multipurpose  Space Power Platforms  2. OBJECTIVE To develop the systems technology to establis aspects in the handling of space power  3. NEED ANALYSIS  a) LEVEL NOW 1, WILL BE LEVEL 5 UNDER EDUIRED ADVANCEMENT - SHOULD BE TECHNOW AT LEVEL 5 FOR OPERATIONAL SYSTEM USE COMMENT - SHOULD BE TECHNOW AT LEVEL 5 FOR OPERATIONAL SYSTEM USE COMPLISHMENTS: ENJOY ENHANCING: HIGH MEDIUM COMPLISHMENTS: ENJOY ENHANCING: HIGH MEDIUM COMPLISHMENTS: ENJOY ENHANCING: HIGH MEDIUM COMPLETE STUDY ANALYSIS OF THE SPACE OF THE SPACE OF THE STECHNOLOGY ADVANCEMENTS RECOMPLISH NEED Development of general safety guidelines as well these, such as automatic mgt. techniques which servomechanism loops within the more traditional bias inputs to traditional control loops. Communication of the system development, rather than component a study is necessary to ascertain whether or no in (for example) on-board multiprocessors is necessary.

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5. COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABDRATORY 6. MODEL TESTED IN AIRCRAFT ENVIRONMENT 7. MODEL TESTED IN SPACE ENVIRONMENT

SPACE TECHNOLOGY NEED

RADIO FREQUENCY INTERFERENCE

(RFI) ANALYSIS, SETI THEME / W.G. / TASK DATE 4 R8 / 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 d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING X OR HIGH MEDIUM | LOW [ e) TASKS NEEDED: STUDY X ANALYSIS X RESEARCH [ GRD TEST X AIR CRAFT TEST SPACE FLIGHT TEST MATHEMATICAL MODEL PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED 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.

FORM NO. I

E2- 22a

PAGE 1 OF \_\_\_

NO.

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 1 OF2
	1. TITLE RADIO FREQUENCY INTERFERENCE (RFI)  ANALYSIS, MSPP  NO. 7 /E-2/ 22b  THEME / W.G. / TASK  DATE 4 /28 / 76
COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY MODEL TESTED IN ARCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT	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:
S. 6. I 7. MONSTRATED	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 (Check one or more) f) R&T BASE CANDIDATE
WAENA OBSERVED AND REPORTED MULATED TO DESCRIBE PHENOMENA TED BY PHYSICAL EXPERIMENT OR CAL MODEL UNCTION OR CHARACTERISTIC DEMONSTRATED	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.
LEVEL 1. BASIC PHENOMENA OBSERV OF STATE 2. THEORY FORMULATED TO I OF ART 3. THEORY TESTED BY PHYSIC MATHEMATICAL MODEL 4. PERTINENT FUNCTION OR C	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.
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SPACE TECHNOLOGY NEED FORM NO. I PAGE 1 OF _2
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 \( \frac{1}{2} \), WILL BE LEVEL \( \frac{4}{2} \) UNDER EXISTING PLANS. b) REQUIRED ADVANCEMENT - SHOULD BE TECHNOLOGY READY AT LEVEL \( \frac{7}{2} \) FOR OPERATIONAL SYSTEM USE BY \( \text{DATE: } \) T990  c) RISK IN ACHIEVING ADVANCEMENT: HIGH \( \text{M} \) MEDIUM \( \text{LOW} \)  d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING \( \text{X} \) OR ENHANCING: HIGH \( \text{M} \) MEDIUM \( \text{LOW} \) LOW \( \text{LOW} \) e) TASKS NEEDED: STUDY \( \text{X} \) ANALYSIS \( \text{X} \) RESEARCH \( \text{X} \) GRD TEST \( \text{X} \) AIR CRAFT TEST \( \text{SPACE FLIGHT TEST } \( \text{X} \) OTHER (Specify) \( \text{Check one or more} \)
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.

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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

1. BASIC PHENOMENA DBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR
MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED

LEVEL OF STATE OF ART

1. TITLE Laser Power Transmission	INU// EZ/ Z4
	THEME / W.G. / TAS
	DATE 4 / 28 / 76
2. OBJECTIVE  Develop system design and compower transmission	components for space-te-space laser
b) REQUIRED ADVANCEMENT — :	VEL 3 UNDER EXISTING PLANS. SHOULD BE TECHNOLOGY READY ONAL SYSTEM USE BY DATE: 1991 MENT: LOW \[ \]
d) CRITICALITY TO THE ACCOMP ENHANCING HIGH	LISHMENTS: ENABLING X OR
e) TASKS NEEDED: STUDY X  GRD TEST X AIR-CRAFT  OTHER (Specify)	ANALYSIS X RESEARCH X TEST SPACE FLIGHT TEST X (Check one or more
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 COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY
 MODEL TESTED IN AIRCRAFT ENVIRONMENT
 MODEL TESTED IN SPACE ENVIRONMENT

LEVEL 1. BASIC PHENDMENA OBSCRIVED AND REPORTED
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OF ART 3. THEORY TESTED BY PHYSICAL EXPERIMENT OR
MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED

NV	.TITLE Space-to-Space Wide Band Communications	PAGE 1 OF _2
DATE 4 /26 / 76  COBJECTIVE communication systems for multiple point-to-point communications in space between Advanced Space Transportation Vehicles and those used in Industrialization of Space.  NEED ANALYSIS  a) LEVEL NOW 2 WILL BE LEVEL 2 UNDER EXISTING PLANS. b) REQUIRED ADVANCEMENT - SHOULD BE TECHNOLOGY READY AT LEVEL 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 (Check one or more) f) R&T BASE CANDIDATE  COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY  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.	TILE THE SO SPACE ATAC DATA COMMUNICACIONS	NO. 8&12 E2 25 THEME / W.G. / TASK
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in Industrialization of Space.  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	OBJECTIVE Develop communication systems for multiple poin	nt-to-noint communications
in Industrialization of Space.  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 (Check one or more) f) R&T BASE CANDIDATE  COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR USE OF THIS TECHNOLOGY  SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED Support wide band communications (numerous voice, data, and video channel: 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.	in space between Advanced Space Transportation	Vehicles and those used
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multi-beam antennas for simultaneous transmissions to multiple vehicles.	using frequencies above K band: i.e. millimeter	waves and DSC hands above
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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

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LEVEL 1. BASIC PHENOMENA OBSERVED AND REPORTED
OF STATE 2. THEORY FORMULATED TO DESCRIBE PHENOMENA
OF ART 3. THEORY TESTED BY PHYSICAL EXPERIMENT OR —
MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED

SPACE TECHNOLOGY NEED	FORM NO. PAGE 1 OF 2
1. TITLE On-Board Multi-Loop, Multi-Channel	NO. 8-12 E-2 26
Communications System	THEME / W.G. / TAS
	DATE 4 / 28 / 76
2. OBJECTIVE Develop systems which meet the onboard (inte	rnal) voice, video, data
and command communications requirements of l stations	arge multi-man space
3. NEED ANALYSIS  a) LEVEL NOW 2, WILL BE LEVEL 2 UNDER b) REQUIRED ADVANCEMENT — SHOULD BE TECH AT LEVEL 5 FOR OPERATIONAL SYSTEM U	HNOLOGY READY
c) RISK IN ACHIEVING ADVANCEMENT: HIGH MEDIUM X LOW   d) CRITICALITY TO THE ACCOMPLISHMENTS:	NAPLING
ENHANCING: HIGH MEDIUM	NABLING X OR LOW
e) TASKS NEEDED: STUDY X ANALYSIS X GRD TEST X AIR CRAFT TEST SF	RESEARCH X
OTHER (Specify)	(Check one or mo
4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS USE OF THIS TECHNOLOGY	REQUIRED FOR
5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED ACCOMPLISH NEED Low cost (probably using expandable standard)	
weight and high reliability (application of fand multiplexing), application of tracking and multiple types of signals (voice, video, communication)	iber optics for transmissic telephony techniques to
communication modes. Audio and video termina TV flat panel or projection displays.	1 devices such as color

PACE TECHNOLOGY	' NĒ	ED							·				PA	GE	2 O			10.	} 	
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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

1. BASIC PHENOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR 4. PERTINENT FUNCTION OF

LEVEL OF STATE OF ART

SPACE TE	CHNOLOGY NEED		FORM NO. PAGE 1 OF2
1. TITLE	LOW NOISE RECEIVER		NO9,10/E2/27
			THEME / W.G. / TA
			— DATE <u>4</u> / <u>28</u> / <u>76</u>
2. OBJECT	IVE		
Develo	pp low noise receiver sys	tem for SETI, e	either for Earth or
		system required	for Orbiting Deep Space
<u>Statio</u>	on (ODSRS)		
3. NEED A			
a) LEV	EL NOW [3], WILL BE LEV	EL 3 UNDER E	EXISTING PLANS
b) REQ	<b>DUIRED ADVANCEMENT - S</b>	HOULD BE TECH	NOI OGY READY
ΑI	LEVEL [5] FOR OPERATION	DNAL SYSTEM US	SE BY DATE: 1984
c) RISK	IN ACHIEVING ADVANCE	MENT:	
	GH MEDIUM	LOW X	
d) CRIT	TICALITY TO THE ACCOMPL	ISHMENTS: EN	NABLING X OR
EN TAG	HANCING: HIGH	MEDIUM [	LOW 🗌
e) IASK	KS NEEDED: STUDY X	ANALYSIS X	RESEARCH X
07	RD TEST X AIR CRAFT	TEST SPA	ACE FLIGHT TEST
01	THER (Specify)		(Check one or mo
f) R&T	BASE CANDIDATE		
4. COMPLEN	MENTARY TECHNOLOGY A	DVANCEMENTS (	REQUIRED FOR
USE OF T	THIS TECHNOLOGY		
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ACCOMPL	TECHNOLOGY ADVANCEM LISH NEED	ENT REQUIRED	TÓ
a. Rec	ceiver noise temperature:	less than 3K.	
the state of the s	ceiver bandwidth: 300 mhz	VII. 1 V V V V V V V V V V V V V V V V V V	
c. Tun	nable over 1.4 GHZ to and	enna frequency	limit using either tunabl
	ser or tunable cooled up	converters.	
mas	ser or tunable cooled up		erate at fixed convension
mas Orb	ser or tunable cooled up piting Deep Space Station		erate at fixed conversion
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Communicat	ion	s										- -			Th	HEM	1E /	W.C	3./	ΓAS
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TASK ITEM																				
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5. COMPONENT OK BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY 6. MODEL TESTED IN AIRCRAFT ENVIRONMENT 7. MODEL TESTED IN SPACE ENVIRONMENT

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

LEVEL OF STATE OF ART

		PAGE 1 OF _2	NO
1. TITLE Antenna Anal	lysis/Design for		-
- ODSRS		THEME / W.G. /	TA
		DATE 4 / 29 / 76	
2. OBJECTIVE Ponform	Territoria de la compansión de la compan		
Pertorm	trade studies ne	ecessary for antenna selection, th	e <u>n</u>
provide developm	ent thru prototy	pe model test.	
3. NEED ANALYSIS			_
	WILL BE LEVEL	2 UNDER EXISTING PLANS.	
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71 ELVEL [5] F(	OR OPERATIONAL	SYSTEM USE BY DATE 1984	
CHIEVIN ACHIEVIN	G ADVANCEMENT	:	
HIGH ME	DIUM X LOV	w 🗂	
d) CRITICALITY TO T	HE ACCOMPLISHM	MENTS: ENABLING X OR	
ENHANCING: [	HIGH L MEDI	IUM I IOW I	
e) TASKS NEEDED:	STUDY [X] AND	ALVOIS VI DESEADON O	
COD TEAT [V]	***	——————————————————————————————————————	
GUD 1531 [X]	AIR CHAFT TEST	SPACE FLIGHT TEST	
OTHER (Specify)	AIR CHAFT TEST	SPACE FLIGHT TEST (Check one or	mc
OTHER (Specify)  f) R&T BASE CANDID	DATE	SPACE FLIGHT TEST (Check one or	mc
OTHER (Specify)  f) R&T BASE CANDID  COMPLEMENTARY TEC	OATE	SPACE FLIGHT TEST (Check one or	<u>mc</u>
OTHER (Specify)  f) R&T BASE CANDID	OATE	SPACE FLIGHT TEST	mc
OTHER (Specify)  f) R&T BASE CANDID  COMPLEMENTARY TEC	OATE	SPACE FLIGHT TEST (Check one or	mc
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OTHER (Specify)  f) R&T BASE CANDID  COMPLEMENTARY TEC  USE OF THIS TECHNOL	ATR CRAFT TEST  OATE CHNOLOGY ADVAN OGY	SPACE FLIGHT TEST (Check one or NCEMENTS REQUIRED FOR	mc
OTHER (Specify)  f) R&T BASE CANDID  COMPLEMENTARY TEC	ATR CRAFT TEST  OATE CHNOLOGY ADVAN OGY	SPACE FLIGHT TEST (Check one or NCEMENTS REQUIRED FOR	m
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OTHER (Specify)  f) R&T BASE CANDID  COMPLEMENTARY TEC  USE OF THIS TECHNOL  SPECIFY TECHNOLOGY  ACCOMPLISH NEED  Finalize antenna re	ATR CRAFT TEST  OATE CHNOLOGY ADVAN OGY ADVANCEMENT F	SPACE FLIGHT TEST (Check one or NCEMENTS REQUIRED FOR REQUIRED TO	
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OTHER (Specify)  f) R&T BASE CANDID  COMPLEMENTARY TEC  USE OF THIS TECHNOL  SPECIFY TECHNOLOGY  ACCOMPLISH NEED  Finalize antenna re  level. Current es:  SETI Phase 1  SETI Phase 2	ATR CRAFT TEST  OATE CHNOLOGY ADVAN OGY  ADVANCEMENT F Cequirements then timate of require Antenna Diameter 30 300	SPACE FLIGHT TEST (Check one or (Check one o	
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COMPONENT OR BREADBOARD TESTED IN RELEVANT

FORM NO. I SPACE TECHNOLOGY NEED PAGE 1 OF 2 10 / E2 / 29A 1. TITLE Transponder, Deep Space, X-Band Uplink, NO. S-X or S-K Downlink 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 MEDIUM [ HIGH X **ENHANCING:** LOW | STUDY X e) TASKS NEEDED: ANALYSIS X RESEARCH GRD TEST X AIR CRAFT TEST SPACE FLIGHT TEST PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED (Check one or more) OTHER (Specify) 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.

SPACE TECHNOL	-OG	Y N	EE	D													FO	RM	NO	. 1	
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SPACE TECHNOLOGY NEED FORM NO. I PAGE 1 OF 2 1. TITLE SPACECRAFT TRANSPONDERS AT 43/86 GHZ 11 NO. / E-2 / 29B THEME / W.G. / TASK 4 /28 / 76 COMPONENT OR BREADBOARD TESTED IN RELEVANT DATE 2. OBJECTIVE Develop technology for spacecraft transponders at 43 and 86 GHZ. Spectrum MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT crowding will force broadcast satellites to higher frequencies. **ENVIRONMENT IN THE LABORATORY** 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 6 ~ d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING X OR ENHANCING: HIGH 🗌 MEDIUM LOW  $\square$ e) TASKS NEEDED: STUDY X ANALYSIS [ RESEARCH GRD TEST X AIR CRAFT TEST SPACE FLIGHT TEST X PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED OTHER (Specify) (Check one or more) f) R&T BASE CANDIDATE THEORY FORMULATED TO DESCRIBE PHENOMENA 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR THEORY TESTED BY PHYSICAL EXPERIMENT OR BASIC PHENOMENA OBSERVED AND REPORTED USE OF THIS TECHNOLOGY 5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO MATHEMATICAL MODEL 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. LEVEL OF STATE OF ART

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1. TITLE Global Positioning System Navigation NO.8 and Tracking Data Communications  DATE  2. OBJECTIVE Provide G., N&C data from global position system (NAVS)  3. NEED ANALYSIS  a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING FOR OPERATIONAL SYSTEM USE BY DATE OF THE ACCOMPLISHMENTS: ENABLING [1] ENHANCING: HIGH [1] MEDIUM [X] LOW [1] CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING [2] ENHANCING: HIGH [3] ANALYSIS [X] RESEAR GRD TEST [X] AIR CRAFT TEST [3] SPACE FLIGHT OTHER (Specify) [3]  f) R&T BASE CANDIDATE  4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED USE OF THIS TECHNOLOGY  5. SPECIFY TECHNOLOGY ADVANCEMENT REQUIRED TO ACCOMPLISH NEED Space borne antenna/receiver compatible with Air Force NAME of the Air	AGE 1 OF 2 ,11,12 E2 - 30
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1. TITLE Low Cost Multi-Service Communication 1. E2		<b>FORM NO.</b> PAGE 1 OF2
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SPACE TECHNOLOGY NEED FORM NO. I PAGE 1 OF 2 1. TITLE Active, Modular, Multi-Frequency, 9 / E2/ 32 NO. THEME / W.G. / TASK 4, 26, 76 DATE 2. OBJECTIVE Develop modular antenna systems with self-contained distributed transmitters and low noise pre-amplifiers, at S, X and K band. 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: LOW. d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING OR MEDIUM [X] LOW [ STUDY X ANALYSIS X RESEARCH X AIR CRAFT TEST SPACE FLIGHT TEST X (Check one or more) 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.

PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED THEORY FORMULATED TO DESCRIBE PHENOMENA THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL

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SPACE TECHNOLOGY NEED PAGE 1 OF NO. 10/E-2/ 33 Relay Technology for Planetary 1. TITLE THEME / W.G. / TASK Spacecraft DATE 4 / 28 / 76 2. OBJECTIVE
Perform analysis and system studies necessary to provide cost ENVIRONMENT IN THE LABORATORY MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT 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: MEDIUM LOW HIGH [ d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING OR HIGH MEDIUM X LOW F ENHANCING: STUDY X ANALYSIS X e) TASKS NEEDED: RESEARCH X GRD TEST X SPACE FLIGHT TEST AIR CRAFT TEST (Check one or more) OTHER (Specify) FUNCTION OR CHARACTERISTIC DEMONSTRATED RTOP 506-20-22 f) R&T BASE CANDIDATE 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR THEORY TESTED BY PHYSICAL EXPERIMENT OR 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

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SPACE TECHNOLOGY NEED FORM NO. I PAGE 1 OF 1. TITLE Propogation Modeling 10/E-2/34 THEME / W.G. / TASK COMPONENT OR BREADBOARD TESTED IN RELEVANT DATE  $\frac{4}{28}$  /76 2. OBJECTIVE Develop understanding of effects on radio wave transmissions through MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT or near the sun, interplanetary media, and planetary atmospheres. ENVIRONMENT IN THE LABORATORY 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 T MEDIUM X LOW [ e) TASKS NEEDED: STUDY X ANALYSIS X RESEARCH T GRD TEST X AIR CRAFT TEST SPACE FLIGHT TEST CHARACTERISTIC DEMONSTRATED OTHER (Specify) (Check one or more) f) R&T BASE CANDIDATE RTOP 506-20-22 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR THEORY FORMULATED TO DESCRIBE PHENOMEN THEORY TESTED BY PHYSICAL EXPERIMENT OR 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 tha 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

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1. BASIC PHI NOMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR
MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATE

LEVEL OF STATE OF ART

DATE	SPACE TECHNOLOGY NEED	FORM NO. I PAGE 1 OF2
2. OBJECT DECommunications systems to meet near field requirements of space station and other vehicles employing multiple EVA astronauts, subsatell 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	1. TITLE Near Field Communications Systems Including Visual Communications	THEME / W.G. / TASK
or detached teleoperators.  3. NEED ANALYSIS  a) LEVEL NOW 22, WILL BE LEVEL 22 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	2. OBJECTIVE	
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 X LOW COMPLISHMENTS: ENABLING X OR ENHANCING: HIGH MEDIUM LOW COMPLISHMENTS: ENABLING X OR ENHANCING: HIGH SHOULD HOW COMPLETE STUDY X ANALYSIS X RESEARCH COMPLET (Check one or more of the complete of the comp	which defices employing multip	r field requirements of space ole EVA astronauts, subsatelli
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 componen Multiple access communications.  Television cameras employing reliable, long life solid state TV cameras—CCD, CID, integrated optics/visual sensors, stereo, color response and	a) LEVEL NOW 2, WILL BE LEVEL 2 UNDER b) REQUIRED ADVANCEMENT — SHOULD BE TEC AT LEVEL X FOR OPERATIONAL SYSTEM IS c) RISK IN ACHIEVING ADVANCEMENT: HIGH MEDIUM X LOW COMPLISHMENTS: ENHANCING: HIGH MEDIUM COMPLISHMENTS: HIGH	CHNOLOGY READY USE BY DATE: 1985  ENABLING (X) OR LOW
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Multiple access communications.  Television cameras employing reliable, long life solid state TV cameras - CCD, CID, integrated optics/visual sensors, stereo, color response and	Antenna and frequency selection techniques to	O avoid shadowing and
ors, integrated optics/visual sensors, stereo, color response and	Multiple access communications.	
resolution improvements, high brightness resistance.	Television cameras employing reliable, long 1 CCD, CID, integrated optics/visual sensors s	ife solid state TV cameras -
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SPACE TECHNOLOGY NEED	PAGE 2 OF _2
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	DATE 4 / 28/ 76
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6. RECOMMENDED APPROACH/PROGRAM P  a. Analyze effects of previous pr	rojects (Helios, Viking, Ploneer)
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b. Upgrade theoretical models who	ere appropriate.
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SCHEDULE ITEM 76 77 78 79 80 81  TASK ITEM  a. Analysis of  prior data  b. Upgrade  theory	
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SCHEDULE ITEM 76 77 78 79 80 81  TASK ITEM a. Analysis of prior data b. Upgrade theory c. New theoretical models  MANPOWER (M-Y) INHOUSE	
SCHEDULE ITEM 76 77 78 79 80 81  TASK ITEM  a. Analysis of  prior data b. Upgrade  theory  c. New theoretical  models	

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COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT

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FORM NO. I SPACE TECHNOLOGY NEED PAGE 1 OF \_8 36A 1. TITLE RF Power Amplifiers, UHF THEME / W.G. / TASK 4,27,76 DATE 2 QBJECT:YE 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: LOW X MEDIUM | HIGH  $\square$ ENABLING X OR d) CRITICALITY TO THE ACCOMPLISHMENTS: LOW [ MEDIUM HIGH  $\square$ ENHANCING: RESEARCH X ANALYSIS X e) TASKS NEEDED: STUDY SPACE FLIGHT TEST X AIR CRAFT TEST GRD TEST X (Check one or more) OTHER (Specify) BASIC PHENOMENA OBSERVED AND REPORTED THEORY FORMULATED TO DESCRIBE PHENOMENA THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL PERTINENT COMONSTRATED PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED f) R&T BASE CANDIDATE 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR Advancement of solid state UHF component effi-USE OF THIS TECHNOLOGY ciencies required; how 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 (≈125°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, LEVEL OF STATE OF ART and long life.

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FORM NO. I SPACE TECHNOLOGY NEED PAGE 3 OF \_8 RF Power Amplifiers, X-Band 36B 1. TITLE NO. THEME / W.G. / TASK 4 / 27/ 76 DATE COMPONENT OR BREADBOARD TESTED IN RELEVANT 2. OBJECTIVE (X Band)
To develop an X-Band microwaveaamplifier design for dual mode TWT to MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT support the deep space communication requirements. **ENVIRONMENT IN THE LABORATORY** 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 HIGH X MEDIUM LOW [ **ENHANCING:** e) TASKS NEEDED: STUDY | ANALYSIS X RESEARCH X AIR CRAFT TEST SPACE FLIGHT TEST X GRD TEST X (Check one or more) OTHER (Specify) PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED f) R&T BASE CANDIDATE THEORY FORMULATED TO DESCRIBE PHENOMENA THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR BASIC PHENOMENA OBSERVED AND REPORTED USE OF THIS TECHNOLOGY Further development and refinement of multistage 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. LEVEL OF STATE OF ART

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COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY MODEL TESTED IN AIRCRAFT ENVIRONMENT

FORM NO. I SPACE TECHNOLOGY NEED PAGE<sup>5</sup> OF \_8 1. TITLE RF Power Amplifiers, 12 GHz NO. 10/11 E2 - 36C THEME / W.G. / TASK DATE 2. OBJECTIVE (12 GHz)
To develop a 12 GHz high power amplifier technology for space communications application. MODEL TESTED IN SPACE ENVIRONMENT 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: LOW X MEDIUM HIGH | d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING OR HIGH X MEDIUM LOW **ENHANCING:** STUDY | ANALYSIS X RESEARCH X e) TASKS NEEDED: AIR CRAFT TEST SPACE FLIGHT TEST X GRD TEST X (Check one or more) MATHEMATICAL MODEL
PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED OTHER (Specify) f) R&T BASE CANDIDATE BASIC PHENOMENA OBSERVED AND REPORTED THEORY FORMULATED TO DESCRIBE PHENOMENA 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR THEORY TESTED BY PHYSICAL EXPERIMENT OR 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. parameters are: Long life operation in space, minimum loss and distortion of signal, high LEVEL OF STATE OF ART voltage operation in space and resolution of thermal problems.

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FITLE RF Power A	mpl	ifi	ers	,	12 (	Hz							ľ	١٥.	10	/11		E2	<b>-</b> (	36C
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	FORM NO. I PAGE <sup>7</sup> OF 8
1. TITLE RF Power Amplifiers, 40/80 GHz	NO. 11 - E2 - 36D THEME / W.G. / TASK
	— DATE <u>4 / 27 / 76</u>
2.OBJECTIVE To establish high power RF system technology is	or 41-43 GHz and 84-86 GHz.
ENHANCING: HIGH MEDIUM  e) TASKS NEEDED: STUDY ANALYSIS  GRD TEST AIR CRAFT TEST S  OTHER (Specify)  f) R&T BASE CANDIDATE  4 COMPLEMENTARY TECHNOLOGY ADVANCEMENT	HNOLOGY READY USE BY DATE: 1988  ENABLING X OR LOW
addressed.	

SPACE TECHNOLO	OGY	NE	ED	- '										PA	GE <sup>8</sup>	F 3' OI			O. I	
TITLE RF Power	Amp	lif	ier	s,	40/	80	GHz							NC					2 <b>-</b>	36
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6. RECOMMENDED													PLIS	SH I	VEE	D		•		
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COMPONENT OR BREADBOARD TESTER IN RELEVANT **ENVIRONMENT IN THE LABORATORY** 

BASIC PHENOMENA OBSERVED AND REPORTED

SPACE TECHNOLOGY NEED

1. TITLE Antenna Development for Global Services

THEME / W.G. / TASK DATE\_4 28 76 2. OBJECTIVE Design, fabricate, and test breadboard spacecraft antennas required MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT for global services theme. 3. NEED ANALYSIS a) LEVEL NOW [2], WILL BE LEVEL [2] UNDER EXISTING PLANS. b) REQUIRED ADVAN EMENT - SHOULD BE TECHNOLOGY READY AT LEVEL 5 FOR OPERATIONAL SYSTEM USE BY DATE: 1990 c) RISK IN ACHIEVING ADVANCEMENT: MEDIUM X LOW [ HIGH ENABLING X OR d) CRITICALITY TO THE ACCOMPLISHMENTS: 9 ~ LOW  $\square$ HIGH MEDIUM **ENHANCING:** STUDY X ANALYSIS X RESEARCH e) TASKS NEEDED: GRD TEST X AIR CRAFT TEST SPACE FLIGHT TEST (Check one or more) OTHER (Specify) PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED f) R&T BASE CANDIDATE THEORY FORMULATED TO DESCRIBE PHENOMENA THEORY TESTED BY PHYSICAL EXPERIMENT OR MATHEMATICAL MODEL 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

FORM NO. !

PAGE 1 OF \_\_2 11/E-2/37

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COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT SPACE TECHNOLOGY NEED

PAGE 1 OF \_ 9 / E2 / 38 SETI Transponder 1. TITLE 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 d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING X OR MEDIUM [ HIGH | ENHANCING: ANALYSIS [X] RESEARCH \_\_ e) TASKS NEEDED: STUDY X AIR CRAFT TEST SPACE FLIGHT TEST GRD TEST X (Check one or more) OTHER (Specify) PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED f) R&T BASE CANDIDATE 4. COMPLEMENTARY TECHNOLOGY ADVANCEMENTS REQUIRED FOR THEORY TESTED BY PHYSICAL EXPERIMENT OR 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  $(10^{-10}/\text{Hour})$  for control of translation.

FORM NO. I

LEVEL OF STATE OF ART

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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 SOACE ENVIRONMENT

1. TITLE SETI Relay System Design	NO. <u>9 / E2 / 39</u>
	THEME / W.G. / TAS
	DATE 4 /29 / 76
2. OBJECTIVE	
Develop potential relay design for	SETI and upgrade technology in
required areas.	The second secon
3. NEED ANALYSIS	
a) LEVEL NOW 3, WILL BE LEVEL	UNDER EXISTING PLANS.
b) REQUIRED ADVANCEMENT - SHOU	LD BE TECHNOLOGY READY
AT LEVEL 5 FOR OPERATIONAL	SYSTEM USE BY DATE: 1984
c) RISK IN ACHIEVING ADVANCEMENT HIGH  MEDIUM  LO	
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e) TASKS NEEDED: STUDY X AN	
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f) R&T BASE CANDIDATE	
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5. SPECIFY TECHNOLOGY ADVANCEMENT	REQUIRED TO
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ACCOMPLISH NEED  Develop system configurations, incl	uding tradeoff of microwave and lase
ACCOMPLISH NEED  Develop system configurations, incl communications, for very wideband r	uding tradeoff of microwave and lasemelay systems. Required bandwidth is
ACCOMPLISH NEED  Develop system configurations, incl	uding tradeoff of microwave and lase
ACCOMPLISH NEED  Develop system configurations, incl communications, for very wideband r	uding tradeoff of microwave and lase
ACCOMPLISH NEED  Develop system configurations, incl communications, for very wideband r	uding tradeoff of microwave and lase
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ACCOMPLISH NEED  Develop system configurations, incl communications, for very wideband r	uding tradeoff of microwave and lase
ACCOMPLISH NEED  Develop system configurations, incl communications, for very wideband r	uding tradeoff of microwave and lase

1. BASIC PHENDMENA OBSERVED AND REPORTED
2. THEORY FORMULATED TO DESCRIBE PHENOMENA
3. THEORY TESTED BY PHYSICAL EXPERIMENT OR
MATHEMATICAL MODEL
4. PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRA

LEVEL 1. OF STATE 2. OF ART 3.

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1. TITLE	Multi-element Broadband Array	NO. 09/E-2/40
-	Technology	THEME / W.G. / T.
		DATE 4 / 29/ 76
2 OB 1507	TAVE	
	Develop technology for obtain	
	ination of broad band signals f	rom arrays of large
spat	ial extent.	
3. NEED A	ANALYSIS	
a) LEV	VEL NOW 2, WILL BE LEVEL 2 UNDE	R EXISTING PLANS.
	QUIRED ADVANCEMENT - SHOULD BE TE	
	LEVEL 7 FOR OPERATIONAL SYSTEM	USE BY   DATE: 1990
	K IN ACHIEVING ADVANCEMENT: IGH	
	TICALITY TO THE ACCOMPLISHMENTS:	ENABLING X OR
	NHANCING: HIGH MEDIUM	LOW []
4	SKS NEEDED: STUDY X ANALYSIS	
		SPACE FLIGHT TEST
C	OTHER (Specify)	(Check one or
f) R&	T BASE CANDIDATE X	
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4. COMPL	EMENTARY TECHNOLOGY ADVANCEMEN	TS REQUIRED FOR waveguide technology
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4. COMPL	EMENTARY TECHNOLOGY ADVANCEMEN	
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4. COMPLIUSE OF	EMENTARY TECHNOLOGY ADVANCEMEN	waveguide technology
4. COMPLI USE OF 5. SPECIF ACCOM	EMENTARY TECHNOLOGY ADVANCEMEN THIS TECHNOLOGY Cables or THIS TECHNOLOGY Cables or	waveguide technology ED TO
4. COMPLUSE OF USE OF 5. SPECIF ACCOM Devel	EMENTARY TECHNOLOGY ADVANCEMEN  THIS TECHNOLOGY Cables or  Y TECHNOLOGY ADVANCEMENT REQUIR  IPLISH NEED	waveguide technology  ED TO  as arrayed over large
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4. COMPLUSE OF USE OF  5. SPECIF ACCOM Devel areas	EMENTARY TECHNOLOGY ADVANCEMENT THIS TECHNOLOGY Cables or THIS TECHNOLOGY ADVANCEMENT REQUIR TECHNOLOGY ADVANCEMENT REQUIR TECHNOLOGY for large antennation, preserving phase and achieving	waveguide technology  ED TO  as arrayed over large
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<sup>\*</sup>Demonstrated as part of a space-ground system.

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COMPONENT OR BREADBOARD TESTED IN RELEVANT ENVIRONMENT IN THE LABORATORY SPACE TECHNOLOGY NEED

1. TITLE Low Cost High Performance Ground

THEME / W.G. / TASK Antennas DATE 4 / 29/ 76 2. OBJECTIVE
Develop design for a single large antenna to support SETI MODEL TESTED IN AIRCRAFT ENVIRONMENT MODEL TESTED IN SPACE ENVIRONMENT 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 | KX WOJ 6 ~ d) CRITICALITY TO THE ACCOMPLISHMENTS: ENABLING OR **ENHANCING:** HIGH [] MEDIUM XX LOW [ STUDY X ANALYSIS X e) TASKS NEEDED: RESEARCH GRD TEST AIR CRAFT TEST SPACE FLIGHT TEST PERTINENT FUNCTION OR CHARACTERISTIC DEMONSTRATED OTHER (Specify) (Check one or more) f) R&T BASE CANDIDATE THEORY FORMULATED TO DESCRIBE PHENOMENA THEORY TESTED BY PHYSICAL EXPERIMENT OR 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

FORM NO. I

PAGE 1 OF\_

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b)	System a	na]	Lys	is	an	d o	des	ig	n.													
<u>c)</u>	Prototyp	e f	ab	ri	cat	io	n.							<u>.</u>	1111					- 14.		
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d) Preliminar		sig	n.															-
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9. TECHNOLOGY S F SCHEDULE ITEM TASK ITEM a) Requirements b) Config. trad offs	76 7	DULE 77 78 Δ Δ	S 79	80	81							89			92	93	94	95
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9. TECHNOLOGY S  F SCHEDULE ITEM  TASK ITEM  a) Requirements b) Config. trad offs c) Cost studies d) Preliminary e) Final design  MANPOWER (M-Y	CHED Y 76 7	DULE 77 78 Δ Δ	S 79 7 A 1 8 1	80 7	81	82						89			92	93	94	95

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THEME NO.	7 SPACE POWER	8 SPACE INDUST.	9 SETI	10 SOLAR SYS. EXPL.	11 GLOBAL SERVICE	12 ADV.TRANS. SYS.		A R&T			RY PRIO	7
TECHNOLOGY NEED NO.					JE II VIOL	010.	Current	R&T Base	WG	π	OAST <sub>K</sub> DIV.	FY 78
END-TO-END DATA MANAGEMENT	7	1	13	1	1	2	x		1		100 50	750
AUTONOMOUS, FAULT TOLERANT DATA HAND.	5	7	14	2	11	6	x		3		250	210
MODULAR DATA SYSTEM ARCHITECTURE	6	8		8	7	7	x		4		250	315
DATA SET SELECTION		6	7	3	3			x	2			300
HI-RATE DATA PROC.				6	2		x	х	6		250 150	800
SPECTRUM ANAL. MULTI-CHANNEL			2	9	18				21			
STELLAR SYSTEM ANAL.				19				×	25			200
LARGE CAP. OB. DATA STORAGE				5	5		x		10		300	600
LO-COST DIST. SYSTEM					6				12			
MICRO. ELECT. TECH.	4	9	10	11	16		х	×	18		600	:660
RADIATION HARDENED COMPONENTS				10	19		x		16		400	1400
PARALLEL IMAGE PROC.				18	9		x	×	9		500	1100
PATTERN RECOG. ANAL.			3	4	8		х	х	5		200 100	1700
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SAFETY	2							x	27			<del>: 35</del> 0
ŔŦĨ			8					x	24			1000
WAVE POWER TRANSFER									20			2500
LASER POWER TRANSFER	1			20					19	Let		
SP-SP COMM		3		7	10	3	x		7		500	600
ON-BOARD, M-CH/LOOP		4				4		x	29			200
SETI RECEIVER			1					x	30			3000
ANTENNA SETI			4					×	33			1050
TRANSPONDERS			6	17	14		x	x	14		600	800
GPS		5				5			23		-	
LO-COST MULTI-SERV. CH.					13				5			800
ACTIVE PHASED ARRAY				16	17		x	×	17		150	900
RELAY				15			x	x	22		150	200

				GY NEED PR I order, 1 – High		PSE 22M F W T		WORKIN	IG GR	OUP	E-2	FORM
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THEME NO. TECHNOLOGY NEED NO.	SPACE POWER	SPACE INDUST.	9 SETI	10 SOLAR-SYS. EXPL	11 GLOBAL SERVICE	12 ADV.TRANS. SYS.		A R&T		SUMM	ARY PRIOR	-
					JENVICE	313.	Current	R&T Base	WG	П	OAST DIV. K	FY 78
PROPOGATION MODEL				12			×	x	26		100	150
NEAR-FIELD COMM.	3	2		13		1			28			
RF POWER AMPL.				14	15							
ANTENNA GLOBAL							x	х	18		540	1300
SETI TRANSPONDER			6		18			x	13			1500
SETI RELAY								х	32			800
MULTI-ELEMENT BROAD-			- 11					×	31			400
BAND ARRAY TECHNOLOGY			12									
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OBJECTIVE Develop a protofl leading towards a processing static	n IU	000	tol	d d	lecr	eas	se i	n d	lata	de	ensi	ty	sen	t b	ack	to	ea	ırth	1		- -
JUSTIFICATION remotely sensed of ments in device to pertinent data pr	tech	ı wı <del>ınol</del>	tn <del>logy</del>	exi us	st1 ing	ng 1-CC	tac Ds	ili <del>Wil</del>	tie I p	s i	S D	roh	idir	tiv	e.	Re	cen	it. c	eve	or	ī-
Under planned act developed in FY78 developed and tes strategy will be developed ground processor will be processing functi	def def basede ons	A p l to ine e m	oart co d f ult ope	ial nfi rom isp	ly rm ex ect	pop cir cist ral ric	oula cui ing pr cate	ted ta ba oce	l br nd ses sso and	ead dev of r.	lboa rice re A alu	rd <u>pe</u> sou bre ate	of rfo rce adb	a p rma da oar	roc nce ta	ess usi	or An ng	wil alg a r	ll b ori ece	e thm ntl	y CC
SCHEDULE ITEM	Y 76	77	78	79	80	81	82	83	84	25	86	27	ΩΩ	QQ	on	01	02	102	F <sub>04</sub>	95	<b>]</b>
TASK Dev. Multi.												5,	30	53	30	31	34	33	34	30	
Function Devices																					
●S <u>ys.BB Design</u> ●BB CCD Processing											2.7										
ADD COD LLOCESSING			١. ١	` i		1						-					1	1.	• :	•	1
o <u>n Midas Model</u>																					
o <u>n Midas Model</u> •Flt.Sys.Design					-																
on Midas Model  •Flt.Sys.Design  •Flt.Sys.Proto.  and Test  MANPOWER (M-Y)  □USE	4.5	6.5	8	8	8	9	8														
on Midas Model  Flt.Sys.Design  Flt.Sys.Proto.  and Test  MANPOWER (M-Y)	4.5	6.5	$\dashv$																		

RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIATIVE STATEMENT

SPACE TECHNOLO	OGY	ADD	ITIO	NAI	. IN	ITIA	λΤΙ	/E			-				F	OR	Mi	V		
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OBJECTIVE Develop the tech											ior	ı of	<u>hi</u>	gh	der	si	ty N	10S		-
JUSTIFICATION identified by the processing and language effectively.	e wo	rksh	op.	Hic	ah d	dens	it	/ ch	ips	พา	11	ena	ble	hi	ah	rai	e	t		
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 (~100A) techniques will be developed to accommodate these dimensions. Feasibility will be established by fabricating a chip having 107 MOS transistors.															_					
SCHEDULE FY																				
SCHEDULE ITEM	76	77 7	8 79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	
TASK 1. Oxides																				
2. Transistors																				
3. System			$\perp$																	
4. 10 <sup>7</sup> Chip					<u> </u>	7	7													
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MANPOWER (M-Y)		4	╀-										-							
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FUNDING (10 <sup>6</sup> \$) INHOUSE CONTRACT		.;	.2	.2	.2	.2							- 1 - 1							
PROPOSED LEAD	ENIT	.Eb	11.1		<u>ا</u> انا ار	PL			1100	لـــ			Ш				Ш			_
		-11	-							<u> </u>										
RECOMMENDATIO	NS F	OR F	ULL	ER	DE\	/EL	OPN	/EN	то	FI	VIT						NT			

SPACE TECHNOLOGY ADDITIONAL INITIATIVE FORM IV														/							
TITLE Artific	ial	Re	tin	a S	yst	em									D	ATE	_4	_/_	29	_/_	76
-					_	TT	NO.				OR	WO	RK	ING	GF	OU	P N	ο.	E2		
OBJECTIVE Develop a photor chip to achieve	ece rea	pto 1-t	r a ime	rra pa	y i ral	mbe Tel	dde im	d i age	n a pr	lo oce	gic ssi	ma ng.	tri	x 0	n a	si	lic	on	LSI		
JUSTIFICATION gray level data a provides a method while reducing op	nd <del>fo</del>	the <del>r d</del>	n s <del>ire</del>	ent <del>ct1</del>	to	ea	rth	fo	r p	roc	ess	ing		The	ar	tif	ici	al	ret		
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 F	Υ																				
SCHEDULE ITEM	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	
TASK Design				7	7																٠
Algorithms					_	7												L			
Feasibility	1					$\nabla$															
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SPACE TECHNOLOGY ADDITIONAL INITIATIVE FORM IV														
TITLE Autonomous, Fault Tolerant Data Handling &	DATE 4 / 29 / 76													
Control System TT NO OR WORK	ING GROUP NO. E-2													
OBJECTIVE To develop a modular, fault tolerant data handling & co														
from existing LSI processor technology														
JUSTIFICATION There exists a need to develop highly	reliable, long life													
data/control components & system technology for integra	ation with suitable													
S/C subsystems.														
TECHNICAL APPROACH/PLAN  1) Develop the system technology for Fault Tolerant Ha	rdware/Software													
2) Survey LSI Processor Technology & select candidate components														
3) Fabricate Breadboard system & integrate suitable portions with selected														
370 COMPONENTS (PONS.)														
4) Test system fabricated in (3) 5) Develop & Fabricate engineering model system. 6) Test is avaluate engineering model system.														
SCHEDULE engineering model system.														
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PROPOSED LEAD CENTER LeRC for above work. Shared	l responsibility with													
MSFC & JPL on overall agency effort														
RECOMMENDATIONS FOR FULLER DEVELOPMENT OF INITIA	ATIVE STATEMENT													