Workshop on Technologies for the New Millennium Program

May 14 - 16, 1996

Marriott Rivercenter

San Antonio, TX

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- Autonomy
- Microelectronics
- MAMs
- In-Situ Instruments/MEMs
- Instrument Technologies and Architectures

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List of Attendees

Plenary Session I
5/14/96

Welcome/Introduction

Robert Metzger

Introduction

- Update on overall Program Status
  - Last meeting February 1995 at Pasadena
- Agenda

Program Overview

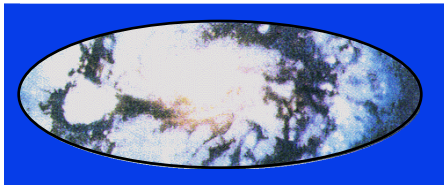
Kane Casani

Exploration For The 21st Century

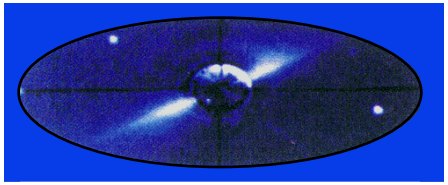
The New Millennium

E. Kane Casani
Program Manager

GOALS OF SPACE AND EARTH SCIENCE

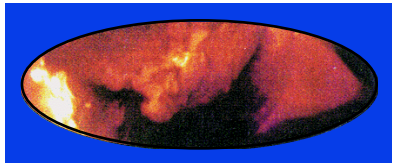


ORIGIN AND EVOLUTION OF THE UNIVERSE

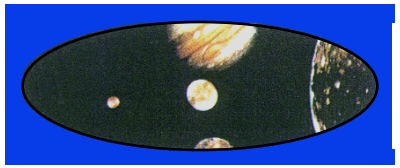


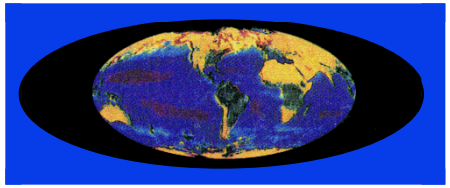
YOUNG STARS AND PLANETARY SYSTEMS

OUR SUN



OUR SOLAR SYSTEM





EARTH AND LIFE ON EARTH

FUTURE OF PLANET EARTH
ORIGIN AND DISTRIBUTION OF LIFE IN THE UNIVERSE

NEW MILLENNIUM GOALS

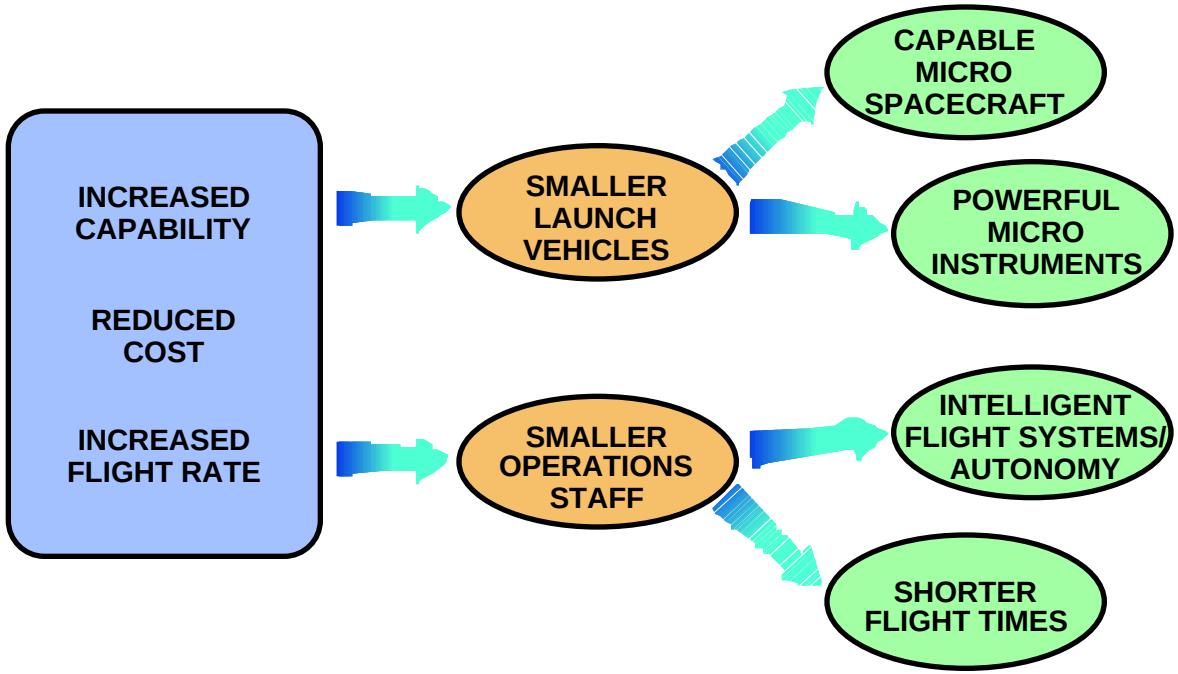
Revolutionize NASA's space and earth science programs to achieve exciting and frequent missions] in the 21st Century through:

1. Developing and validating revolutionary technologies

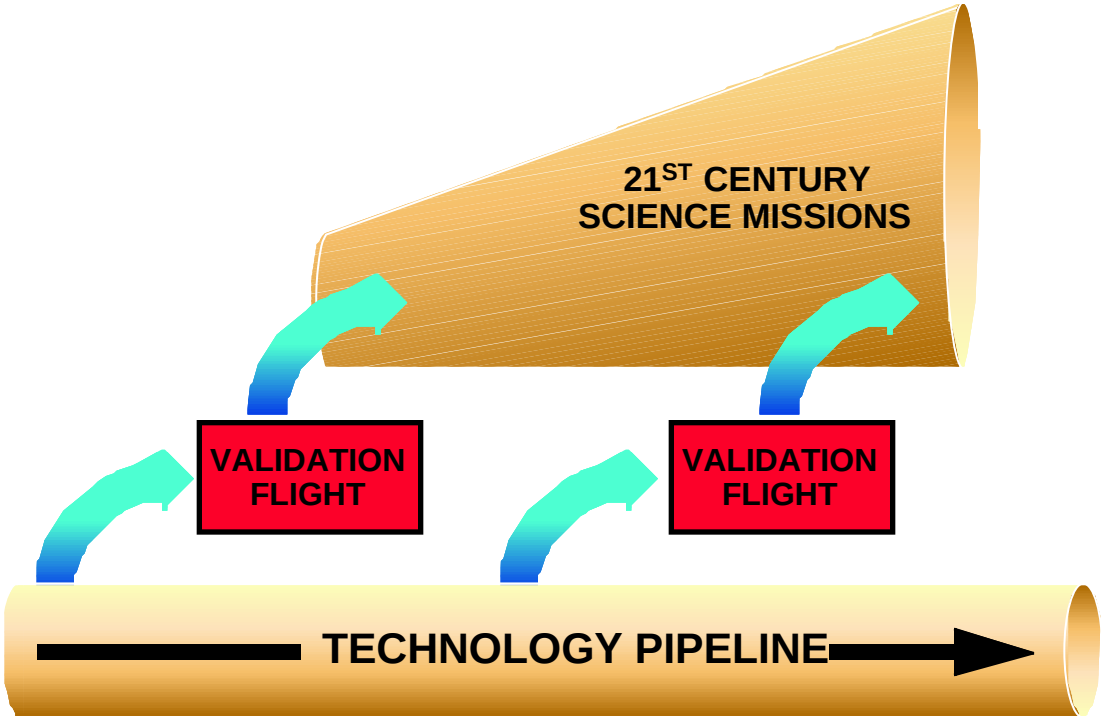
2. Reducing development times and life cycle mission costs

3. Promoting nationwide partnering and coordination

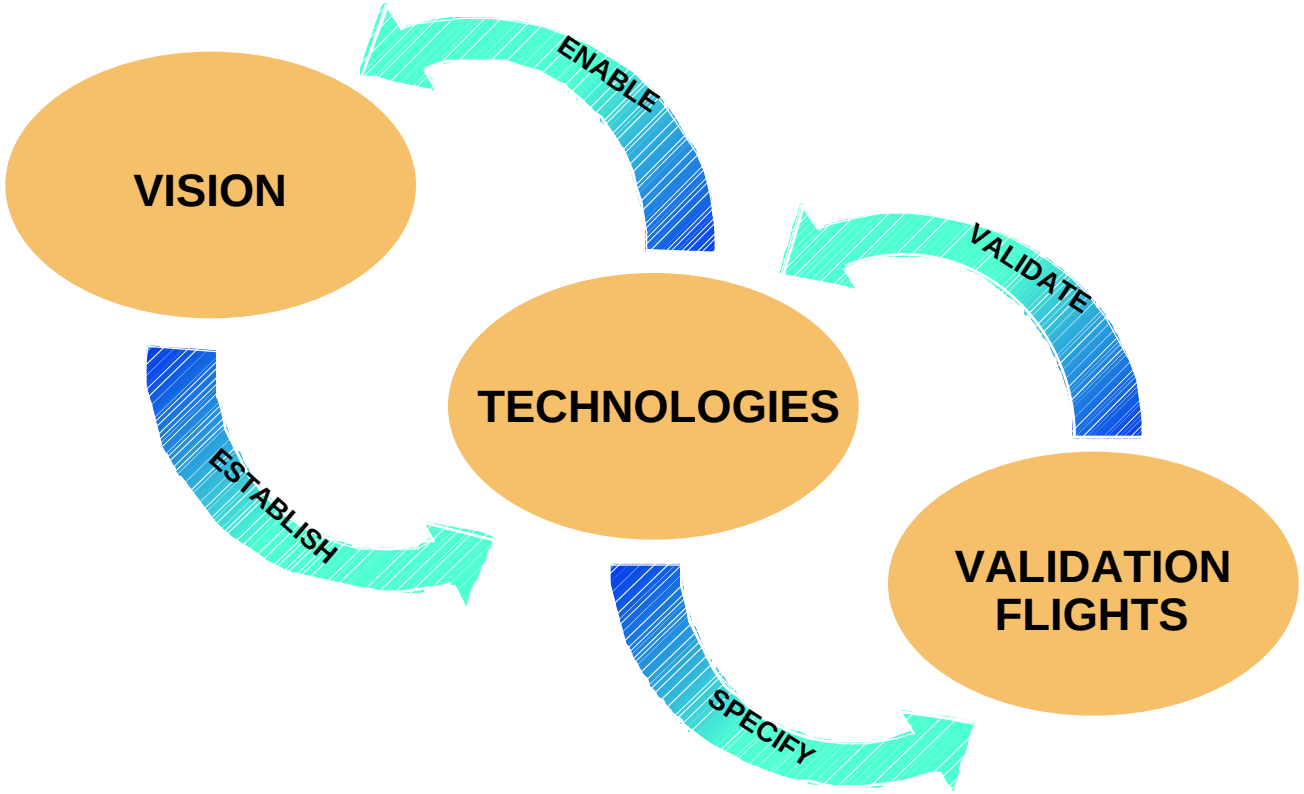
KEY CAPABILITIES ENABLE THE VISION



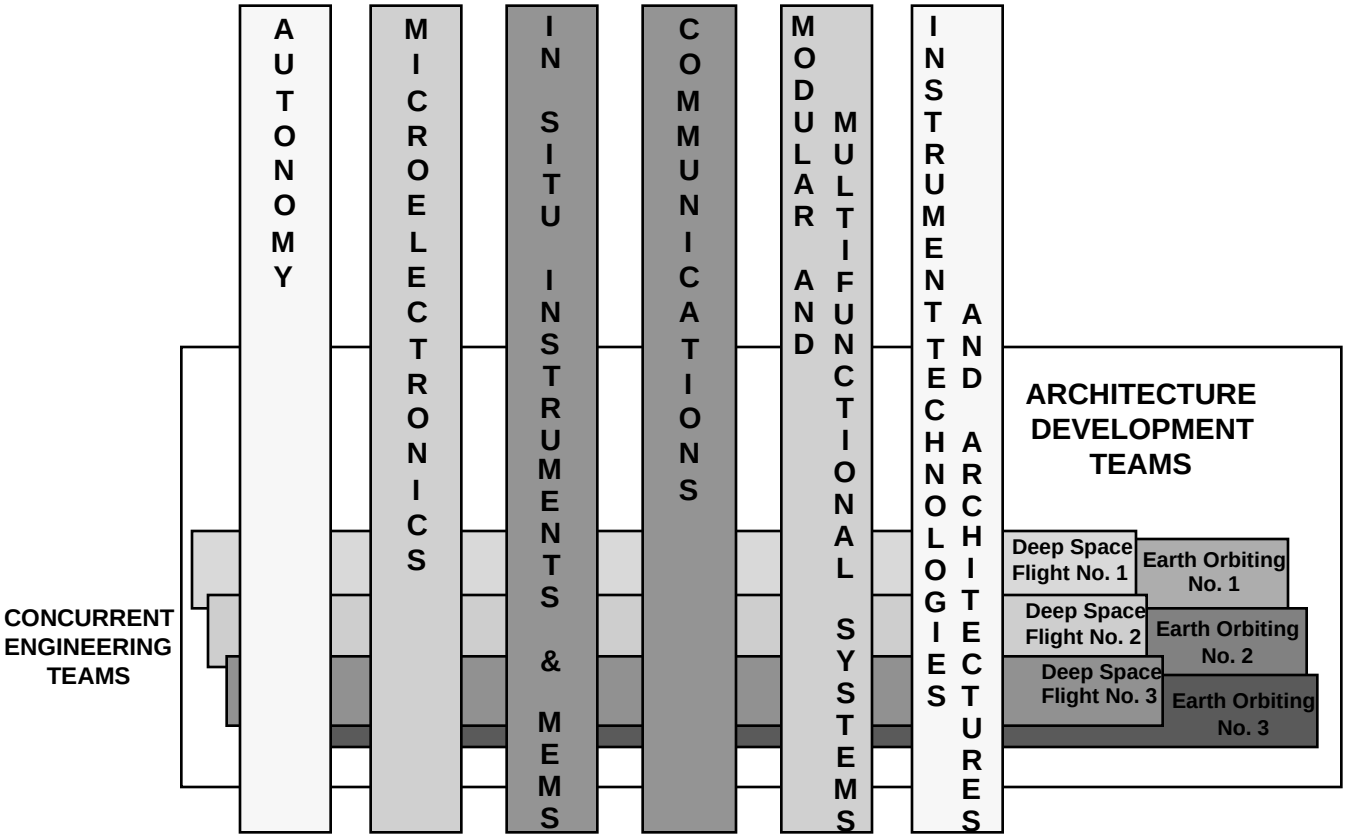
TECHNOLOGY INFUSION INTO 21ST CENTURY SCIENCE MISSIONS



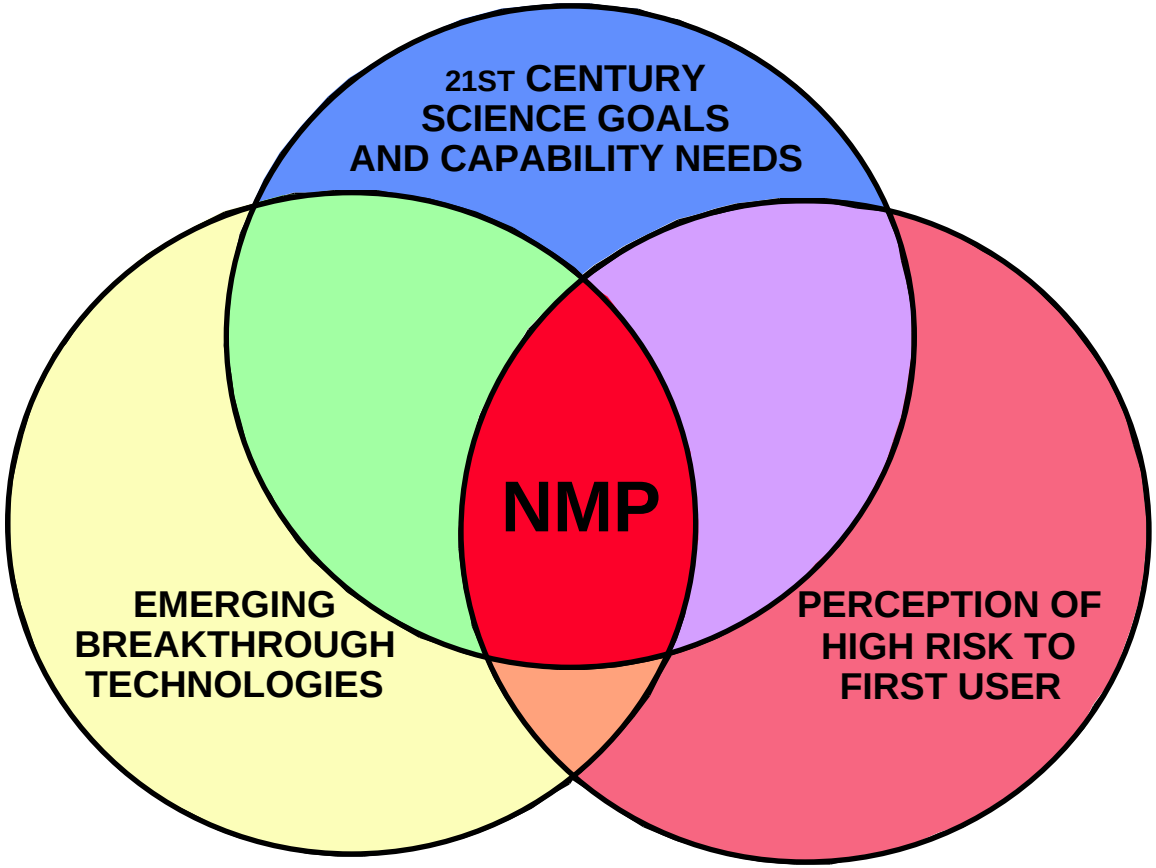
PROGRAM PROCESS



NEW MILLENNIUM INTEGRATED PRODUCT DEVELOPMENT TEAMS



PROGRAM FOCUS



Program Status Update

Robert Metzger

Agenda

- Programmatics
- Program Chronology
  - Deep Space Mission Set Selection
  - EO Mission Planning
  - IPDT
- Points of Contact

Programmatics

- Program line item in federal budget
  - Code S - Office of Space Science
  - Code Y - Office of Mission to Planet Earth
  - Code X - Office of Space Access & Technology

New Millennium Program

N M P

New Millennium Program Office
(760)

E. Kane Casani, Program Manager
Barbara Wilson, Deputy Program Manager
Fuk Li, Deputy Program Manager, Earth Orbiting Missions

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Betty Preece

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Ralph Roncoli , JPL
Bryant Cramer, GSFC

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William Rafferty, JPL
Gene Fujikawa, LeRC

Instrument Technologies & Architectures IPDT

Chris Stevens, JPL
Roger Avant, GSFC

Modular and Multifunctional Systems IPDT

Joel Sercel, JPL
Brantley Hanks, LaRC

DS Flight 1 Small Body

Dave Lehman
Barbara Swanson, Secretary

DS Flight 2 Microprobes

Sarah Gavit
Jan O'Connor, Secretary

DS Flight 3 Interferometer

Tony Spear
TBD, Secretary

EO Flight 1

Dale Schulz, GSFC

EO Flight 2

EO Flight 3

5/996

Budget Guidelines

	FY96	FY97	FY98	FY99	FY00
Code S					
Development	30	30	50	50	50
LV	12	12	8	11	15
Code Y					
Development	10	10	15	15	15
LV		9	9	9	9
Code X					
Development	14	39	36	25*	25*

* EO Funding Only, DS to be determined.

Major Activities 1995/96

Mar.-Sep.	Secure Program Approval
Mar.	Identify Deep Space (DS) Potential Missions
Jun.-Jul.	Select Integrated Product Development Team (IPDT) Members
Aug.-Sep.	Select DS Mission Partner
Sep.	Approval for DS1 & technologies
Nov.	EO1 Definition/Workshop
Nov.	IPDT Workshop
Feb.	DS2 Approved
Mar.	Program Replanned
Apr.	EO1 Approved

Deep Space Missions

- **Aug. 95**
  - DS1 Partner selected
- **Sept. 95**— DS1 Approved
  - Asteroid/Comet Flybys
  - Baseline technologies
    - Solar Electric Propulsion
    - BMDO Scarlet Solar Array
    - Integrated Camera Spectrometer
  - DS2 Concept approved
- **Nov 95**
  - Baseline full technology suite for DS1 & DS2
  - Cost profile accepted
  - Directed to add 2 technologies to DS pending funding

Deep Space Missions

- **Dec. 95**
  - DS1 Design Concurrence Review
- **Feb. 96**
  - DS2 Payload solidified and mission approved
- **Apr. 96**
  - DS2 becomes part of Mars 98 payload
- **May 96**
  - Option exercised for DS1 spacecraft partner

Earth Orbiting Mission

- **Early 95**
  - Code Y full participant
- **Nov. 95**
  - Mission development status at JPL
- **Dec. 95**
  - Preliminary mission selection presented to HQ
- **Feb. 96**
  - Pasadena Workshop
    - Panelists from industry, academia and government
    - Recommended VIS/IR land imager instrument
- **Mar. 96**
  - Mission selected by HQ
    - GSFC approved for implementation phase
    - Life cycle mission costs capped at $90M
    - Existing contract vehicles used for spacecraft/instrument build

IPDT's

- **Jun. 95**
  - RFP issued for 4 teams
  - Streamlined acquisition process
  - 230 proposals received, 23 team members selected
- **Jul. 95**
  - Instruments RFP issued
  - 152 proposals received, 14 team members identified
- **Aug. 95**
  - Government participation solicited
- **Sep. - Nov. 95**
  - Roadmaps development
  - Technology candidates for DS1 & DS2
- **Nov. 95**
  - 1st annual technology workshop
  - Cross pollination of teams
  - Roadmapping activities coordinated/structured
- **Nov. 95 - Mar. 96**
  - Roadmapping complete
  - Technologies selected for flight
  - Development efforts underway

Points of Contact

New Millennium Program Office
http://nmp.jpl.nasa.gov

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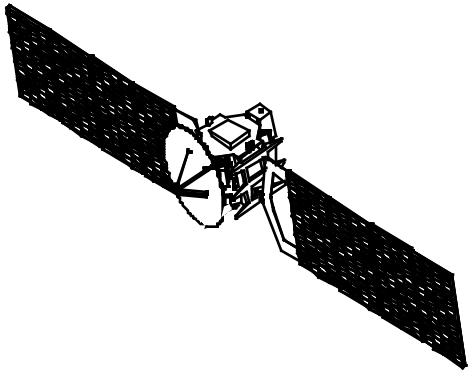
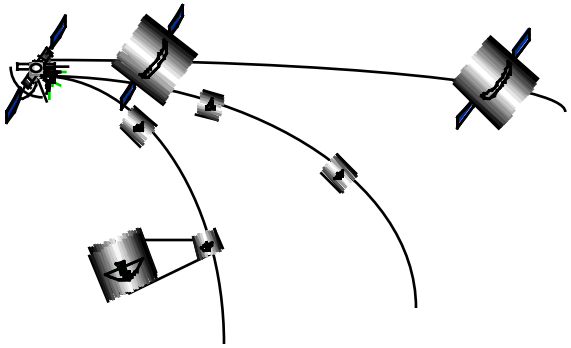
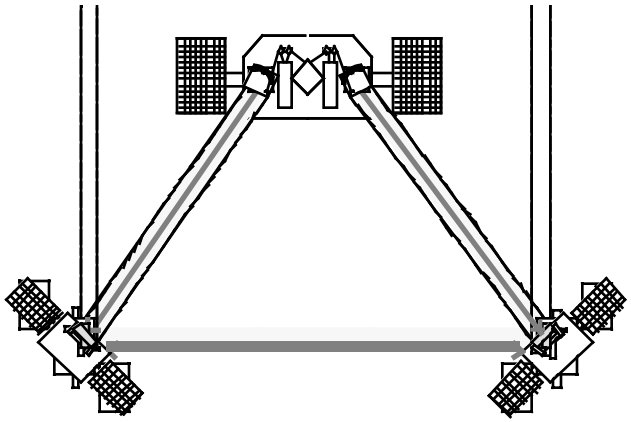
DS-1: Asteroid and Comet Flyby



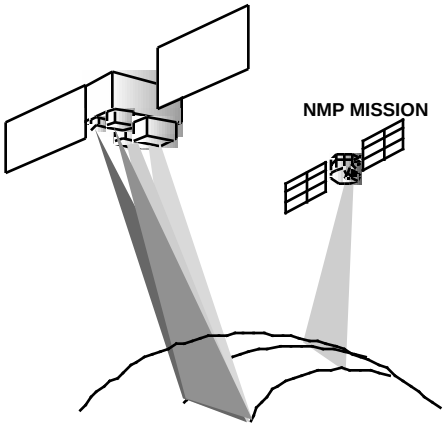
DS-2: Mars Microprobe



DS-3: Free-Flying Interferometer



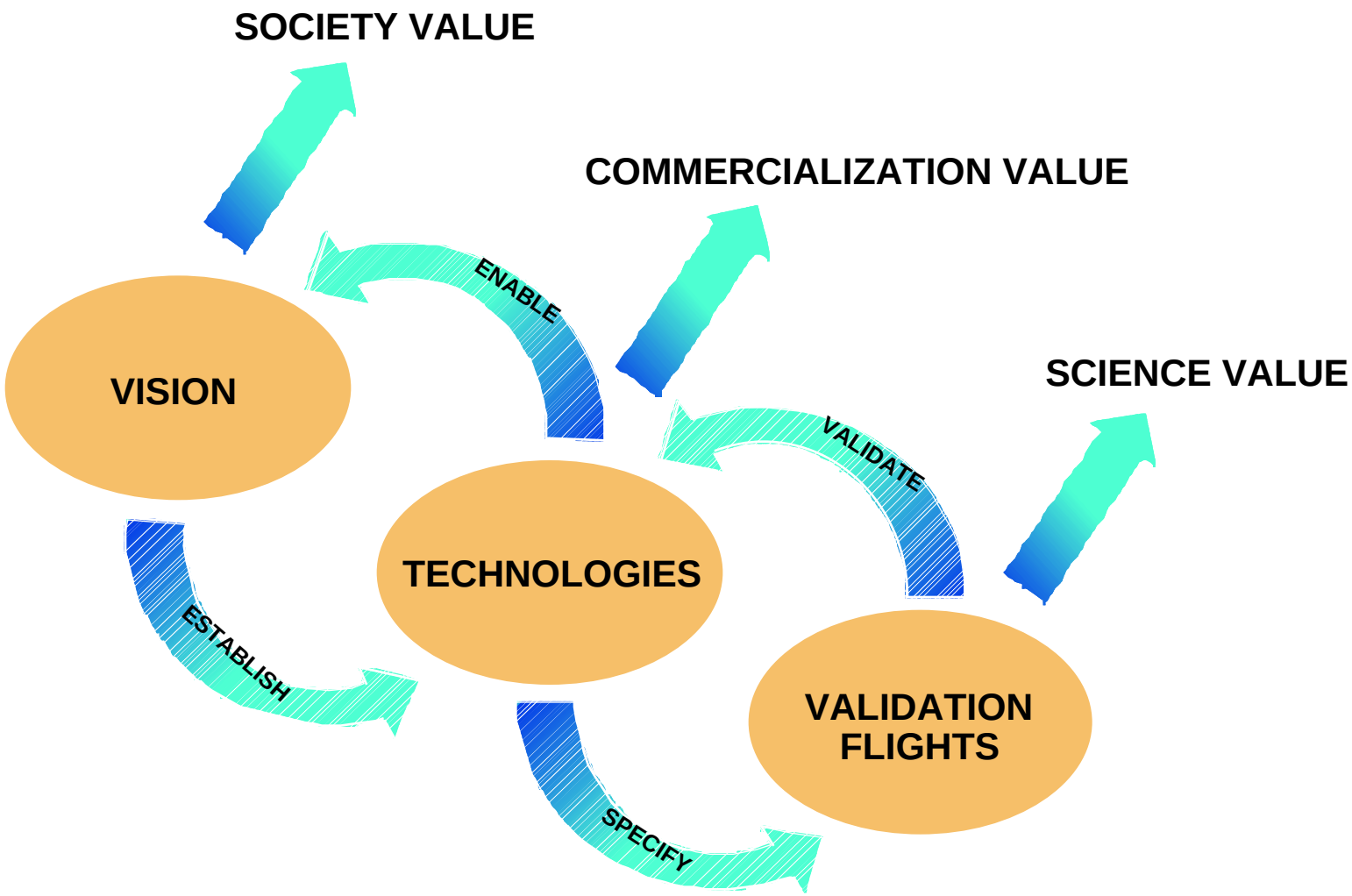
EO-1: Earth Imaging Mission



IPDT Technology Process/Status

Barbara Wilson

PROGRAM PROCESS



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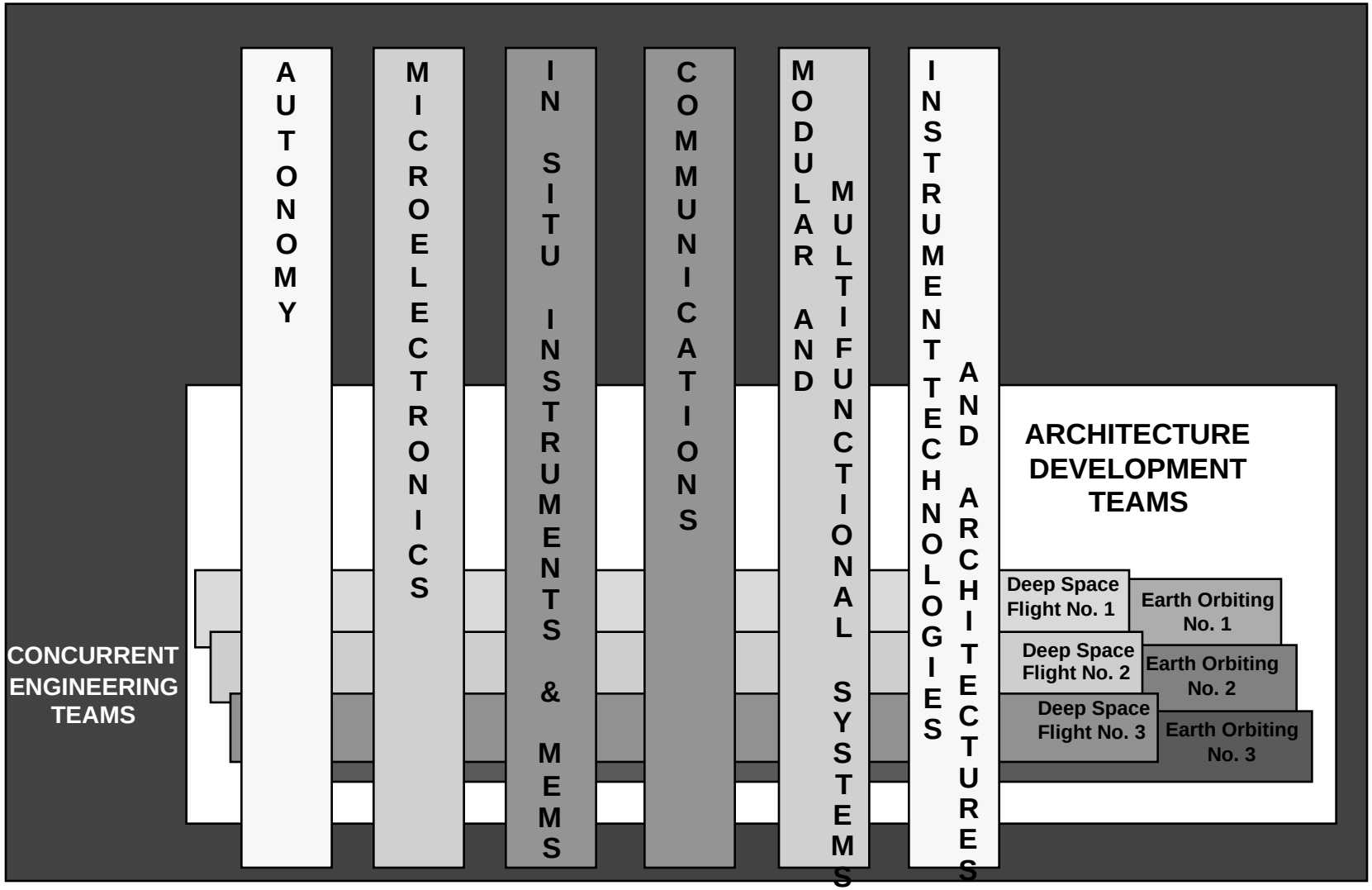
Technology and Fligth Selection Process Summary DS-1 Status

NEW MILLENNIUM INTEGRATED PRODUCT DEVELOPMENT TEAMS



New Millennium Program

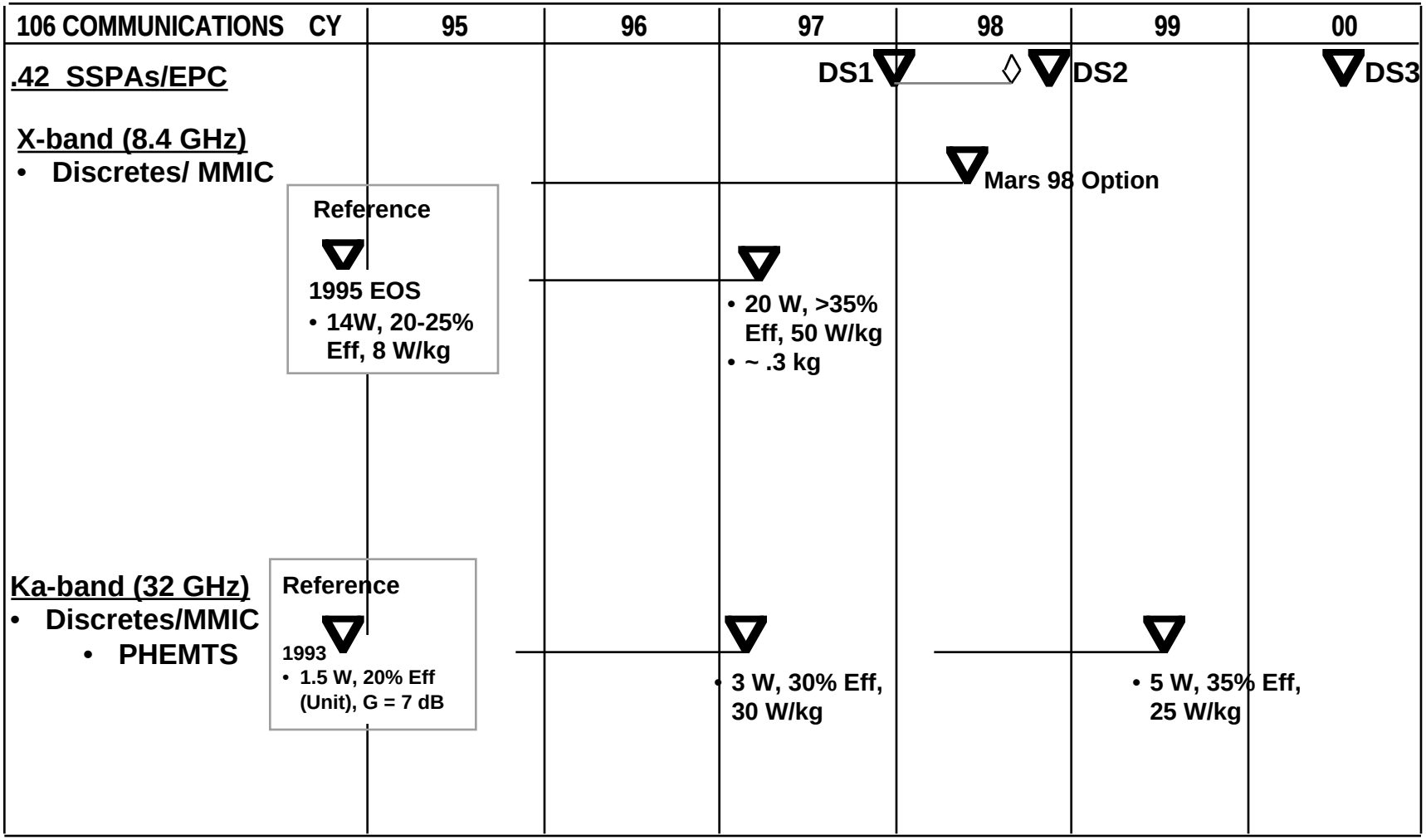
IPDT MEMBERSHIP

	COMMS	AUTO	MICRO	MAMS	ISIM	IT&A
Lockheed Martin	M	M	M	M	M	
Boeing	M		M			
Loral	M		M			
University of Michigan	M					
TRW	M	M	M		M	
Carnegie Mellon University		M				
Hughes Danbury OS		M				
ISX Corporation		SB/CP				
OCA Applied OPT.		M				
Stanford University		M/2			M	
Microcosom, Inc.		SB/CP				
Honeywell			M			
Space Computer Company			SB/M			
University of CA. San Diego			M			
Optivision			SB/M			
University of Southern California			M			
University of Arizona				CP	M	M
L'Garde				SB/M		
Olin				M		
SSG Inc.				SB/CP	M	M
Yardney				SB/CP		
University of Colorado				CP		
Massachusetts Inst. of Tech. (MIT)			M	CP	M	
Hughes SBRC					M	M
Los Alamos National Laboratory					M	
Orbital Science Corporation					M	M
Southwest Research Institute					CP	M
Sandia National Laboratory			M		CP	
University of Wisconsin					CP	M
Rochester Institute of Technology					CP	M
Ball Aerospace					CP	M
Georgia Institute of Technology			M			
Langley Research Center			M	M		M
ITT						M
Lockheed Sanders						M
University of Massachusetts						M
Lewis Research Center	M	M	M	M		
Ames Research Center		M				
Goddard Space Flight Center	M	M	M	M	M	M
Marshall Space Flight Center						M
USAF Phillips Laboratory		M	M	M	M	
ARPA					CP	
National Science Foundation					M	
MIT Lincoln Laboratory						M

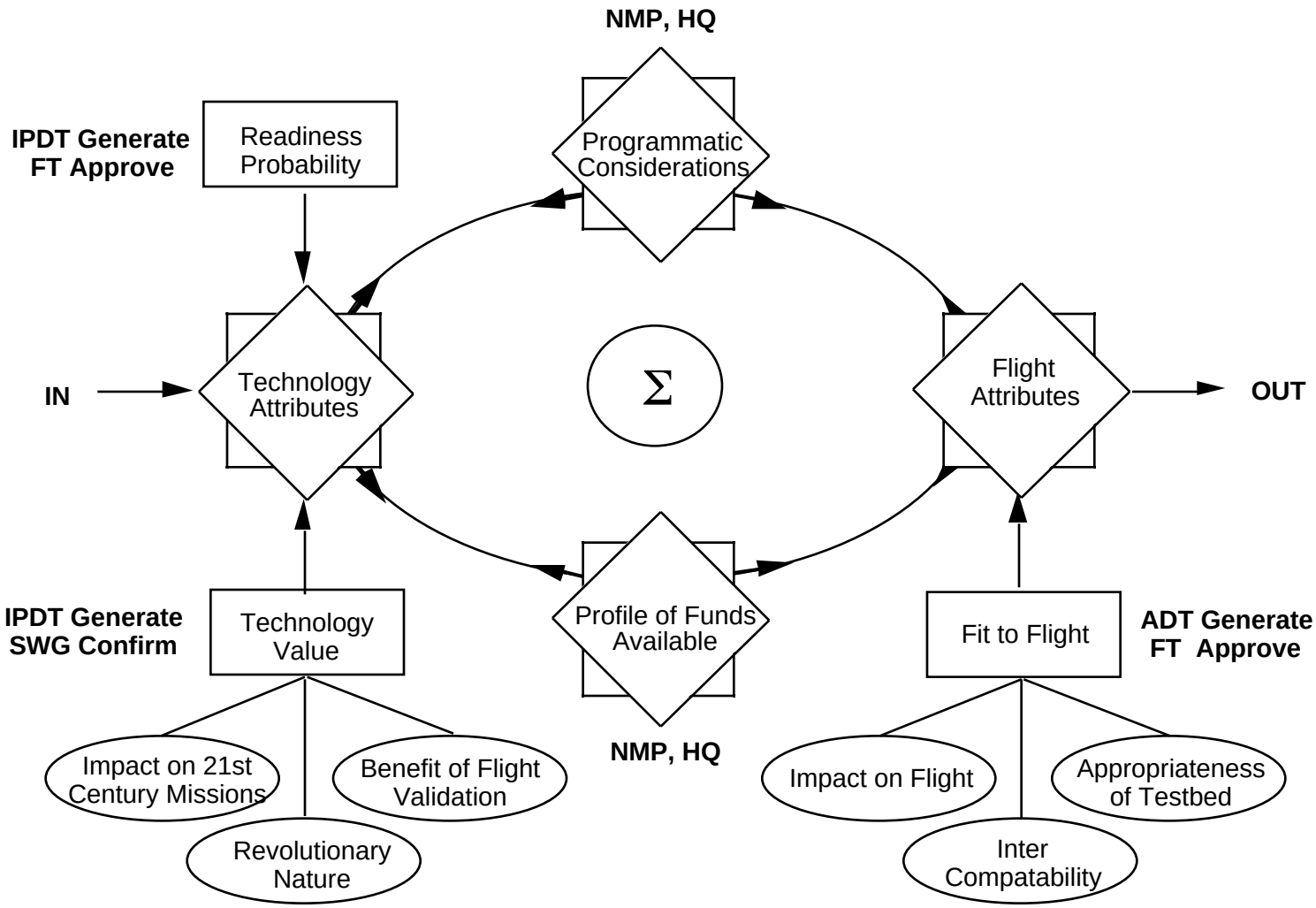
44 ORGANIZATIONS
7 SMALL BUSINESSES
12 UNIVERSITIES

M TEAM MEMBER
CP COOPERATING PARTNER
SB SMALL BUSINESS

MILESTONES/SPECIFICATIONS



SELECTION OF TECHNOLOGIES

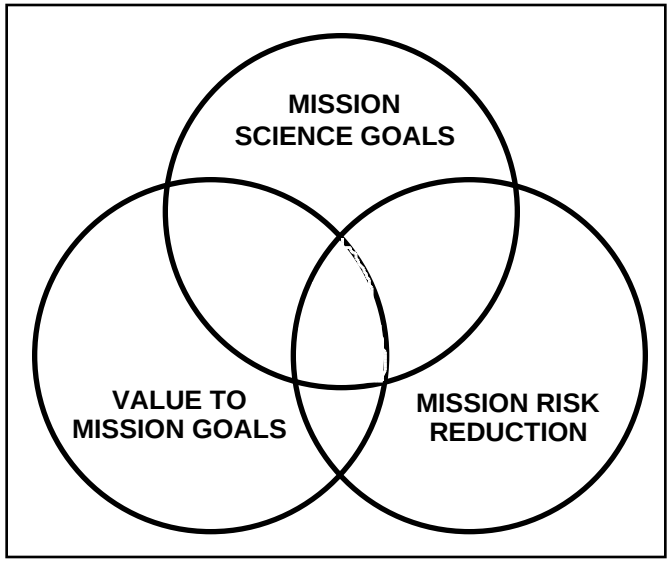


COMPARISON: SCIENCE MISSIONS *VS* TECHNOLOGY VALIDATION FLIGHT

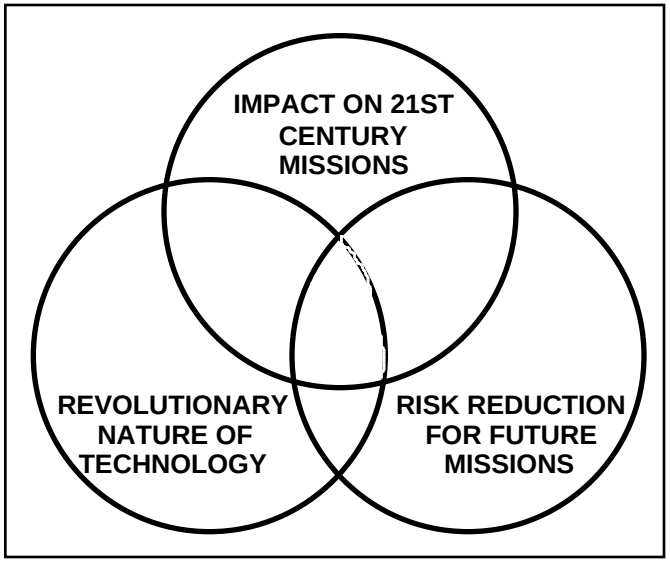
	SCIENCE MISSION	TECHNOLOGY VALIDATION FLIGHT
PRIMARY PURPOSE	ACHIEVE SCIENCE GOALS	VALIDATE KEY TECHNOLOGIES
PRIMARY DATA	SCIENCE MEASUREMENTS	ENGINEERING DATA INCLUDING DEMONSTRATION OF SCIENCE RETURN
OPTIMIZATION CRITERIA	INDIVIDUAL MISSION SCIENCE	PAYOFF FOR 21ST CENTURY MISSIONS
FLIGHT SYSTEM GOAL	COST EFFECTIVE SCIENCE	COST EFFECTIVE VALIDATION
NEW TECHNOLOGY SELECTION	OPTIMIZE INDIVIDUAL MISSION	REDUCE COST OF FUTURE MISSIONS

TECHNOLOGY SELECTION ATTRIBUTES

SCIENCE MISSION



TECHNOLOGY VALIDATION FLIGHT



New Millennium Program

Technology Assessment for DS-1

TECHNOLOGY DATA									PROVIDER
SELECTED TECHNOLOGIES	IPDT	CATEGORY	IMPACT ON 21ST CENT.	REV. NATURE	VALUE OF FLT. VAL.	PROB. OF READINESS	TECH VALUE (V=A*B*C)	EXPECTED VALUE (V*P)	TECHNOLOGY SUPPLIERS
Ion propulsion system	N/A	I	3	3	3	0.95	27	26	JPL, LeRC
Integrated camera spectrometer	IT&A	I	3	3	3	0.9	27	24	SSG, Rockwell, HP, Reticon, AT&T, JPL
SCARLET concentrator array	MAMS	I	2	2	3	0.8	12	10	AEC ABLE, BMDO
Small deep space Transponder	N/A	I	2	2	2	0.9	8	7	Motorola
Remote agent ops architecture	Auto	II	3	3	3	0.85	27	23	CMU, TRW, ARC, JPL, AF/PL
3D stack processor	µE	II	3	3	3	0.85	27	23	Loral, TRW, Boeing, SCC, LMSC, AF/PL, JPL
On-board cruise op. nav.	Auto	II	2	3	3	0.85	18	15	JPL
Composite parabolic antenna	Comm	II	2	2	3	0.9	12	11	Boeing
DC/DC HDI & pwr switches	µE	II	3	2	2	0.9	12	11	LMSC
Low power 0.18 µm electronics	µE	III	3	3	3	0.9	27	24	MIT/LL, GIT, ARPA, JPL
Ka-band SSPA	Comm	III	3	2	3	0.9	18	16	LMSC
Multifunctional structure	MAMS	III	2	3	2	0.95	12	11	LMSC/AFPL
Beacon mode operations	Auto	III	2	3	2	0.9	12	11	U. CO. AF Academy, JPL
Process Millenia	MAMS	N/A	2	3	2	0.9	12	11	U. CO. AF Academy, JPL
Integrated space physics package	ISIM	III	3	2	3	0.5	18	9	SWRI, JPL

insert Technologies for Flight Execution

insert
Three Gates System

insert
Mission Any Gate Consequence

Summary of Out-Of-House Technology Investment
DS-1 DS-2

DEEP SPACE 1: ASTEROID/COMET FLYBY

TECHNOLOGY	IPDT	PARTNER
SCARLET Solar Concentrator Array	MAMS	AEC-Able
Ion Propulsion System	DS-1	Hughes
Small Deep Space Transponder	Comm	Motorola
Integrated Camera Spectrometer	IT&A	SSG Rockwell U. AZ
Particles & Fields Instrument	ISIM	SwRI LANL
3D Avionics System	µE	SCC Loral Lockheed Martin Boeing TRW Irvine Sensors UCSD
Low Power Electronics	µE	GIT USC MIT Lincoln Labs
Autonomous Optical Navigation	Auto	CMU TRW
Multifunctional Structure Panel	MAMS	Lockheed Martin
Ka-band Solid State Amplifier	Comm	Lockheed Martin
Composite Antenna	MAMS	Boeing
Out-of-House Technology Investment		**16 M$**

DEEP SPACE 2: MARS MICROPROBE

TECHNOLOGY	IPDT	PARTNER
Non-Ablative Aeroshell	DS-2	Ultramet SNL ARA NM Tech.
Programmable Microtransceiver	Comm	Atmel OH Univ.
Power Eletcronics - Mixed Signal ASICs	µE	Boeing
Water Detection Instrument	ISIM	Caltech
Ultra-Low Temperature Lithium Battery		Industry TBD
Microcontroller		Industry Consortium
Flexible Interconnect Cabling		Lockheed Martin
Meteorological High-g Preseure Sensor		Stanford Univ. Industry TBD
Soil conductance		Industry TBD
Out-of-House Technology Investment		**13 M$**