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Deep Space Systems Technology Program (DSST - X2000) Future Deliveries

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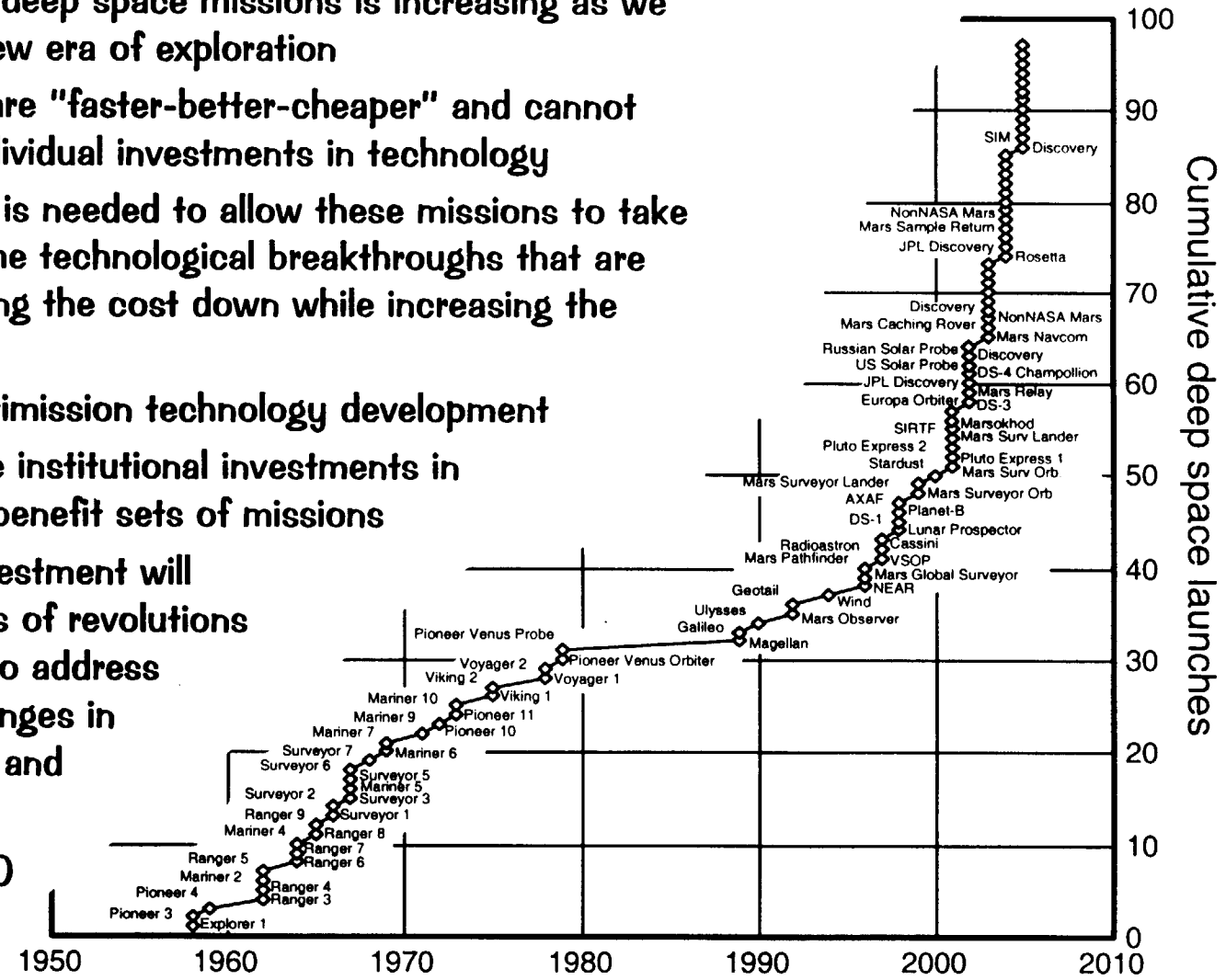
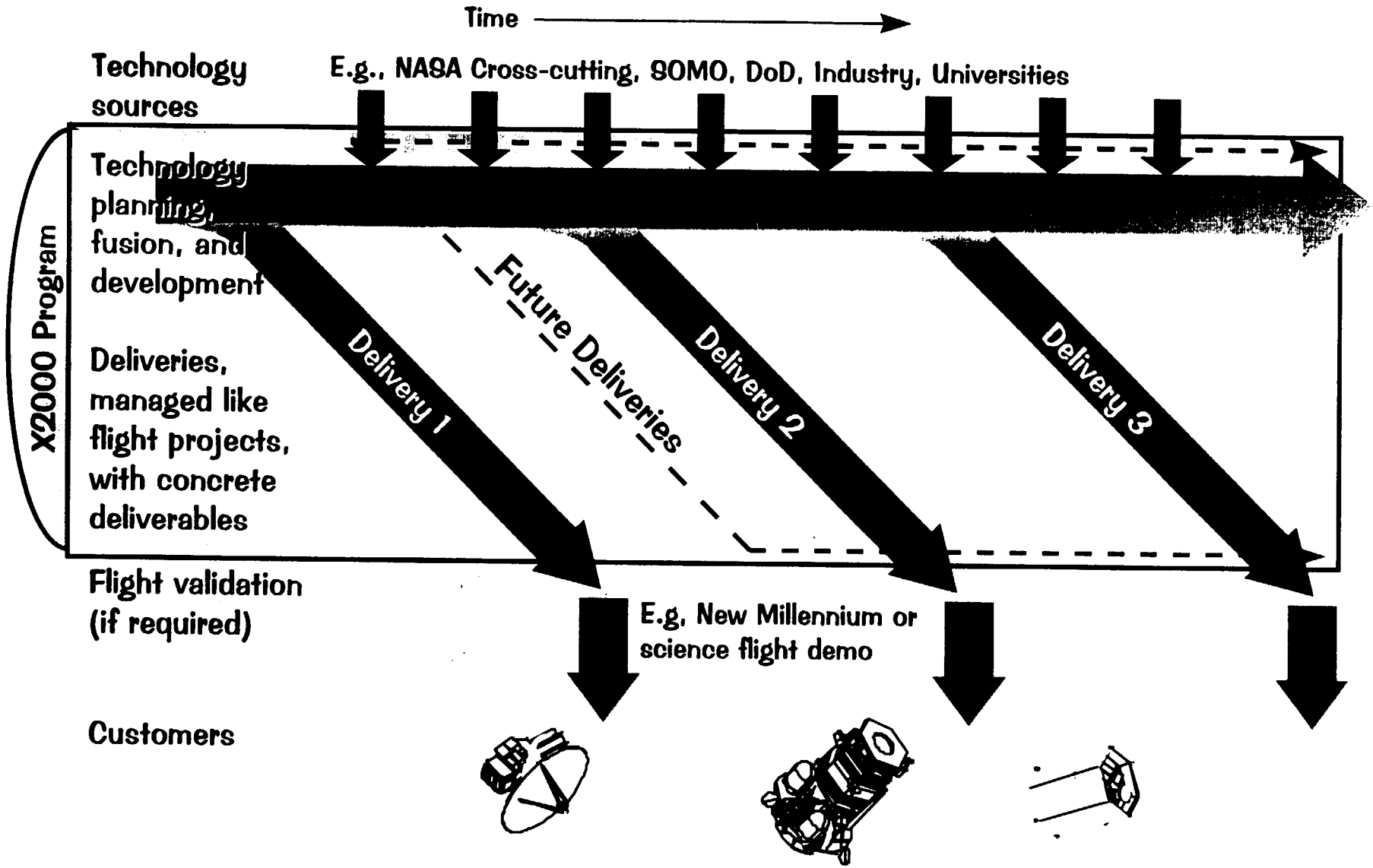
DSST Program Context

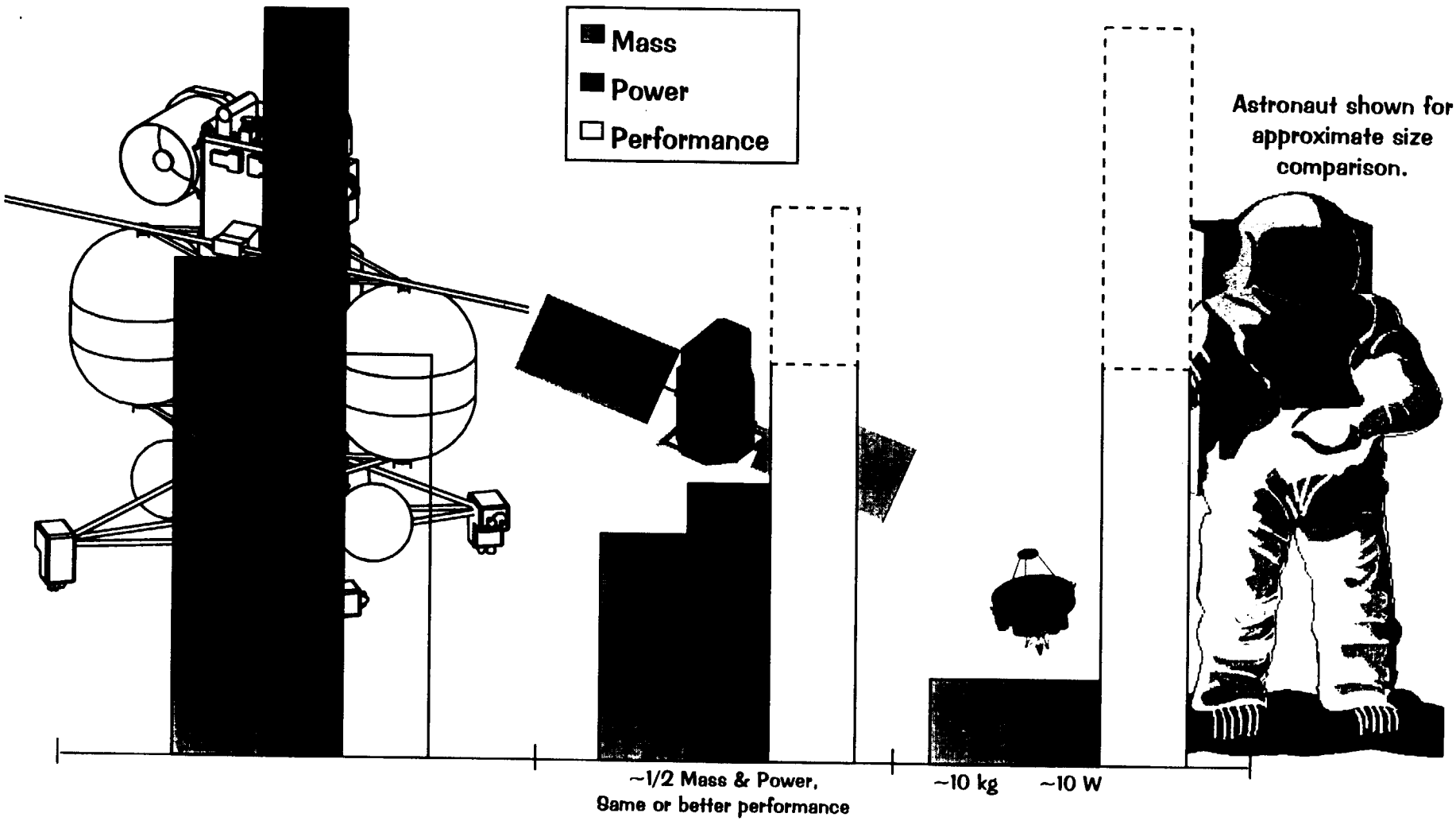
- The number of deep space missions is increasing as we embark on a new era of exploration
- New missions are "faster-better-cheaper" and cannot afford large individual investments in technology
- A new process is needed to allow these missions to take advantage of the technological breakthroughs that are critical to getting the cost down while increasing the science
- The key is multimission technology development
- NASA will make institutional investments in technology to benefit sets of missions
- Continuous investment will provide a series of revolutions in technology to address common challenges in mission design and execution
- This is X2000



X2000 Concept

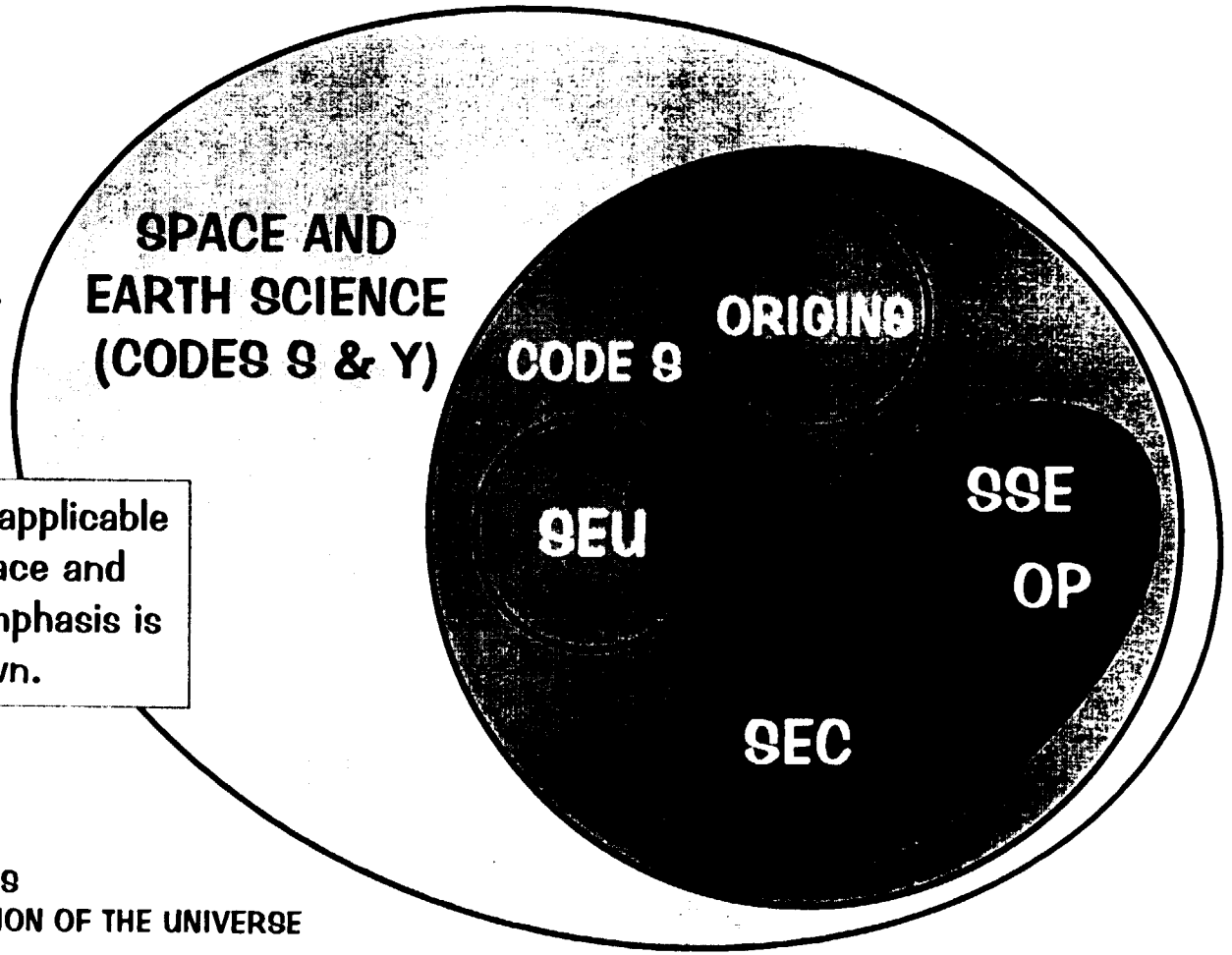


General Trends in Future Deliveries



... while maintaining low recurring cost →

Mission Set Focus by NASA Organization



Products are broadly applicable even outside of Space and Earth Science, but emphasis is placed as shown.

CODE Y - EARTH SCIENCE
CODE S - SPACE SCIENCE
ORIGINS - SEARCH FOR ORIGINS
SEU - STRUCTURE AND EVOLUTION OF THE UNIVERSE
SEC - SUN EARTH CONNECTION
SSE - SOLAR SYSTEM EXPLORATION
OP - OUTER PLANETS (in general)

(DARKER SHADING INDICATES HIGHER EMPHASIS ON MISSION SET NEEDS)

Deep Space Systems Technology Program - Future Deliveries

Focus Technology on Future Science Mission Needs

(some illustrative examples)

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Need advanced capabilities in many diverse systems: Orbiters, landers, probes, rovers, aircraft, networks, sub-surface, submarine, penetrators, aerobots, ...?

Mars/Venus Aerobot

Benefit to Solar System Exploration and more: Discovery, Mars, Earth Science, Space Physics, DoD, ...

Space Physics Networks

Small Body In-Situ Exploration and Sample Return

Saturn Ring Observer

Very Large Aperture Systems

Titan Organic Explorer

Europa Lander

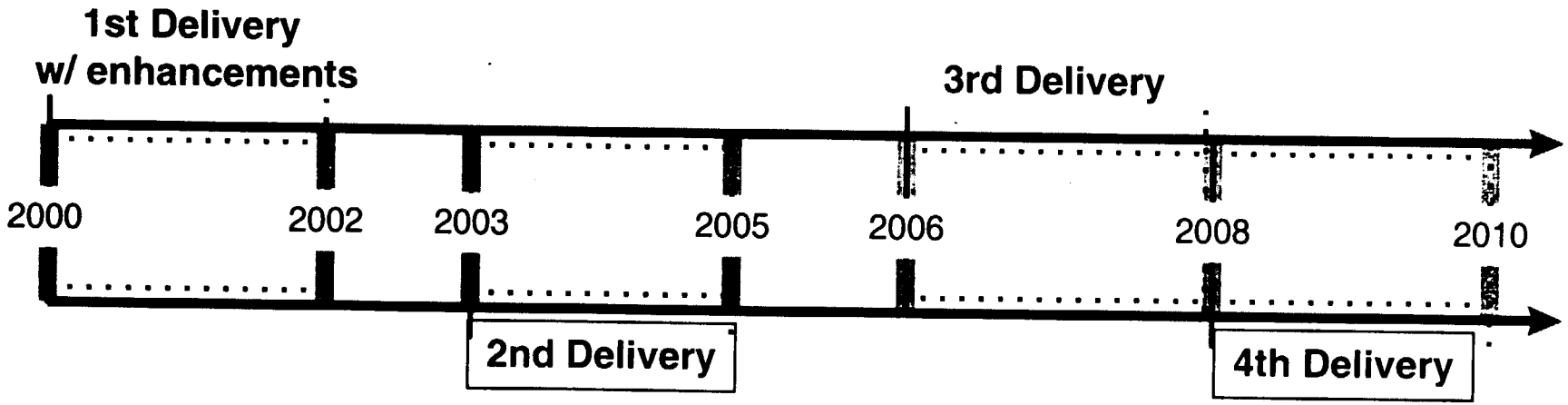
Deep Multi-Probes

X2000 Future Deliveries Vision

- On 4-6 year centers, revolutionize the *flagship mission, full spacecraft* capability.
- In between these deliveries, enable *new systems* for new exploration approaches and provide a path for progress towards the next revolution.
- Provide both:

  a ***sharpening*** of traditional capabilities (orbiters, flybys, probe carriers, landers, etc.),

  a ***broadening*** of the exploration toolset (daughter s/c, aerobots, sub-surface systems, etc.)



Future Deliveries Roadmap

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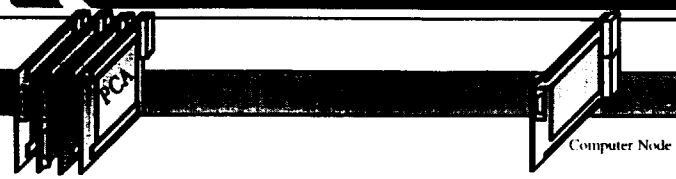
DS8T X2000

Avionics



System On A Chip

Propulsion

Miniature Thruster Valve

Miniature Pressure Regulator Hot Gas Propulsion

MEMS

Telecommunications

S1M

10 cm Aperture

30 cm Aperture

Structure

Bonded Composite Structure

Composite Multi-Functional Structures

Embedded Functions

Thermal

Aluminum & Louvre Radiators

Mini-Loop Heat Pipe with Electrochromic materials

Mechanical Pumped Cooling Loop

Power

OPSP ARPS

Next Generation ARPS High Efficiency, Small Package

MDS

Flight and Ground Software for a Complete Spacecraft.

Enhanced Software with Increased Functionality

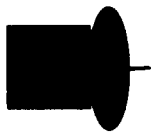
Increased Autonomous Mission Planning and Decision Making

03 04 05 06

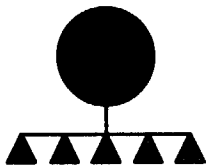
Deep Space Systems Technology - Delivery 2

Digital / Analog Avionics
Power Avionics
Micro IMU/NAV
Micro Star Tracker
Multi-functional Structure
Flexible Thermal Control

Integrated Avionics



Optical Deep Space Communications



Micro-Propulsion

Relay Communications

Key Engineering Model Assemblies Demonstrated Through Integrated System Functional and Environmental Testing

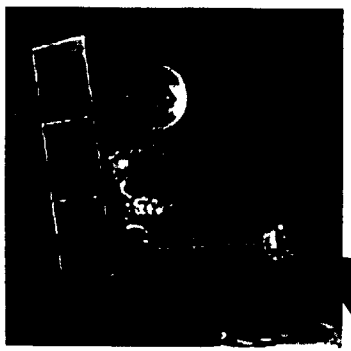
Objectives

- Enable deep space microspacecraft systems in the 10kg to 50kg class.
- Ensure broad applicability through flexible system architecture.
- Take appropriate intermediate steps towards Delivery 3 technology objectives.
- Dramatically reduce the cost of software and ops development through the use of the Mission Data System (flexible flight/ground s/w).
- Deliver tested high technology capability by December 2003.

Deep Space Systems Technology Program - Future Deliveries

Delivery 2 Will Benefit Many Systems

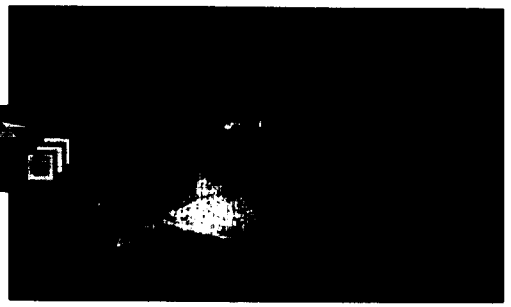
(some examples)



Planetary Micro-Mission Carriers or Science Platforms

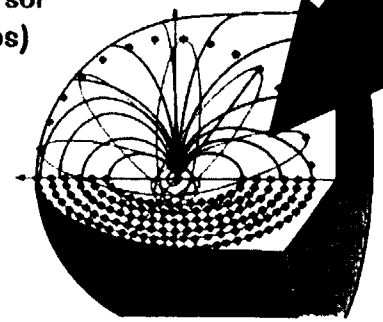
Aerobots, rovers, and other small platforms

Delivery 2 System



Interstellar Precursor (Solar Sail Demos)

Daughter spacecraft or other separable payloads



Networks of tiny spacecraft

Gossamer spacecraft; large lightweight structures with distributed functions in small nodes.

= Integrated Avionics

/ = Deep Space/Relay Communications

= Micro Propulsion

CGS - 10
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Closing Remarks

- DSST Future Deliveries is pursuing a wide variety of technologies for demonstrations in ~2003, ~2006, and beyond.
- Currently formulating plans for and seeding key technology areas in avionics, propulsion, communications, thermal control, structures, power sources, and software architecture.
- Selection of microspacecraft deliverables for 2003 is under way, and current ideas have been shown here.
- Will begin development in selected delivery areas in FY00.
- Seeking collaborative efforts to increase the effectiveness of limited funding.