UTILIZATION OF SPACE STATION FREEDOM FOR TECHNOLOGY RESEARCH

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ABSTRACT

Space Station Freedom presents a unique opportunity for technology developers to conduct research in the space environment. Research can be conducted in the pressurized volume of the Space Station's laboratories or attached to the Space Station truss in the vacuum of space. Technology developers, represented by the Office of Aeronautics and Space Technology (OAST), will have 12% of the available Space Station resources (volume, power, data, crew, etc.) to use for their research.

Most technologies can benefit from research on Space Station Freedom and all these technologies are represented in the OAST proposed traffic model. This traffic model consists of experiments that have been proposed by technology developers but not necessarily selected for flight. Experiments to be flown in space will be selected through an Announcement of Opportunity (A.O.) process. The A.O. is expected to be released in August, 1992. Experiments will generally fall into one of the 3 following categories; (1) Individual technology experiments, (2) Instrumented Space Station, and (3) Guest investigator program. The individual technology experiments are those that do not instrument the Station nor directly relate to the development of technologies for evolution of Space Station or development of advanced space platforms. The Instrumented Space Station category is similar to the Orbiter Experiments Program and allows the technology developer to instrument subsystems on the Station or develop instrumentation packages that measure products or processes of the Station for the advancement of space platform technologies. The guest investigator program allows the user to request data from Space Station or other experiments for independent research.

When developing an experiment, a developer should consider all the resources and infrastructure that Space Station Freedom can provide and take advantage of these to the maximum extent possible. Things like environment, accommodations, carriers and integration should all be taken into account. In developing experiments at Langley Research Center an iterative approach is proving useful. This approach uses Space Station utilization and subsystem experts to advise and critique experiment designs to take advantage of everything Station has to offer. Also, solid object modeling and animation computer tools are used to fully visualize the experiment and its processes. This process is very useful for attached payloads and allows problems to be detected early in the experiment design phase.

UTILIZATION OF SPACE STATION FREEDOM FOR TECHNOLOGY RESEARCH

OVERVIEW
ATTACHED PAYLOADS
DESIGN CONSIDERATIONS

Presented To:
Space Station Freedom Utilization Conference

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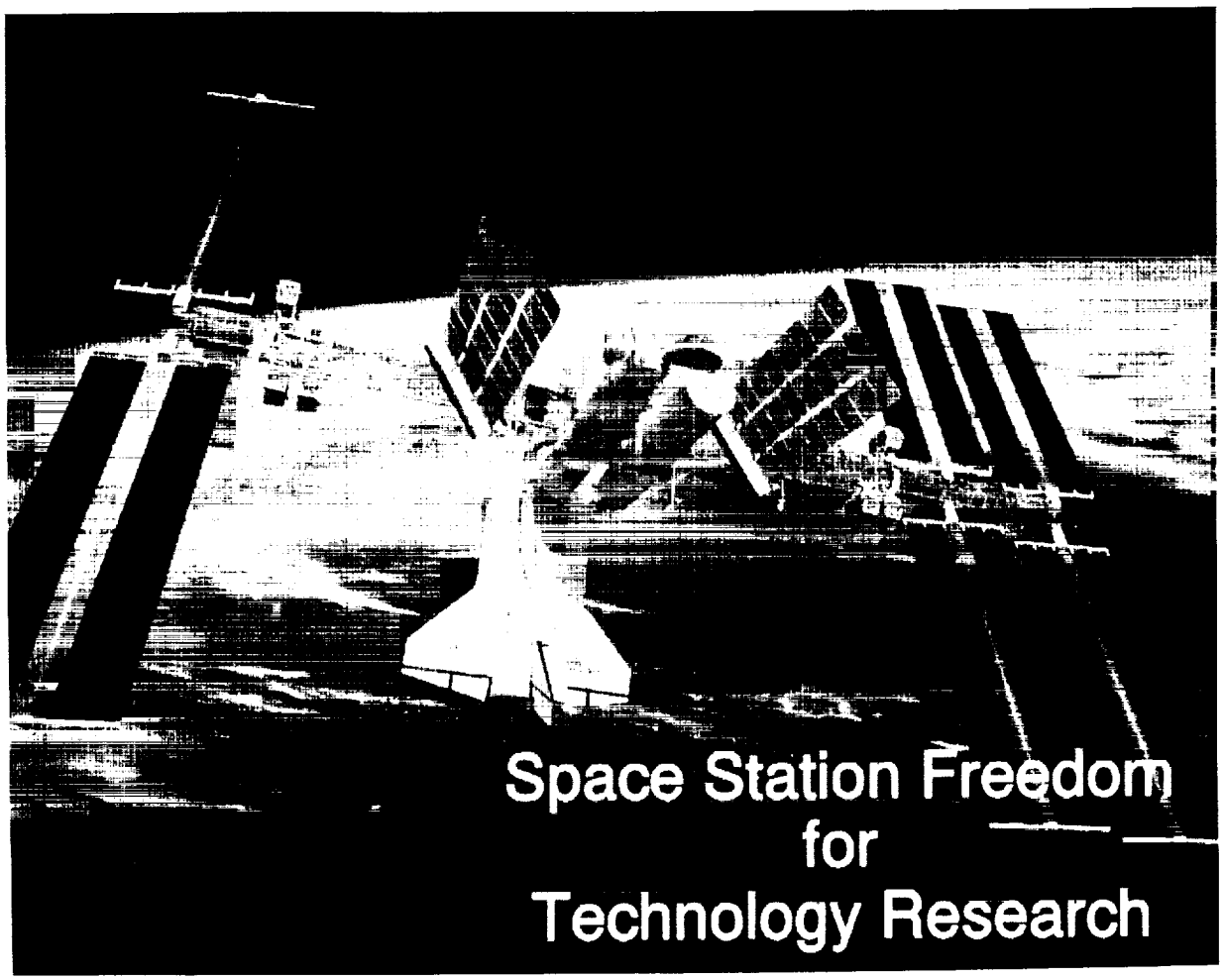
August 5, 1992

LaRC
LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA



ALLOCATION OF SSF RESOURCES

NASA ALLOCATIONS

U.S. LAB	97%	MTC	PMC
EXTERNAL TRUSS	97%		
ESA LAB	47%		
JEM LAB & EXPOSURE FAC.	47%		

OAST SUB-ALLOCATION

12% OF NASA ALLOCATION

UP/DOWN MASS	ONBOARD DATA STORAGE
UP/DOWN VOLUME	PAYLOAD RACKS
DOWN LINK	ATTACHED PAYLOAD SITES
POWER	CREW TIME

IN-SPACE TECHNOLOGY EXPERIMENT NEEDS

ENVIRONMENT

PRESSURIZED VOLUME
UNPRESSURIZED SITES

RESOURCES

POWER
CREW
DATA
SPACE STATION FREEDOM

SSF CAN SUPPLY ALL TECHNOLOGY EXPERIMENT REQUIREMENTS

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FREEDOM

TECHNOLOGIES TO BENEFIT FROM SSF

- MATERIAL EXPOSURE RESEARCH
- STRUCTURAL DYNAMICS
- SPACE OPERATIONS
- SPACE CONSTRUCTION
- LIFE SUPPORT SYSTEMS
- ELECTRONICS
- FLUIDS
- ROBOTICS
- POWER
- THERMAL

TECHNOLOGIES REPRESENTED IN CURRENT OAST TRAFFIC MODEL

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PROPOSED TRAFFIC MODEL FOR SSF
(FOR PLANNING PURPOSES)

	1995	1996	1997
ATTACHED P/Ls*	MODAL IDENTIFICATION EXP		S/C STRAIN & ACOUSTIC SENSORS S/C MATERIALS & COATINGS MICROELECTRONIC DATA SYS EXP
PRESSURIZED P/Ls*		MANNED OBS. TECHN. IN-SITU TRACE CONTAM. ANA. TRANSIENT UPSET PEHNOM. VLSIC INFO. SCIENCE EXP. SYS.	ACOUSTIC CONTROL TECH. INTERNAL SARR ADV. SENSOR DEVELOPMENT
LSE		BATTERY CHARGER CAMERA CAMERA LOCKER PASSIVE DOSIMETER FILM LOCKER	DIGITAL OSCILLOSCOPE GEN. PURPOSE HANDTOOLS EM-SHIELDED LOCKER
	1998	**1999**	**2000**
ATTACHED P/Ls*	EXTERNAL SARR THERMAL INTERFACE TECH FLIGHT DYNAMICS ID POLYMER MATRIX COMP.	CRYO-TANK SERVICING EXP. LDR STRUCTURAL EXP. LIQUID STREAM TECH. TEST BED	ADV. ADAPTIVE CONTROL FTS FORCE REACTION SYS. SPATIAL PERCEP. AUDITORY REFLEX
PRESSURIZED P/Ls*	RISK-BASED FIRE SAFETY FLIGHT CREW HEALTH	MICROBIOLOGICAL MONITOR FOR S/C REGENERATIVE LIFE SUPPORT, T-1	ROBOT FOR LABORATORY QUANTIZED VORTEX STR. He TWO-PHASE FLUID BEHAVIOR
LSE	L.S. ELECTRODE IMPED. MONITOR REFRIGERATOR FREEZER SPECIMEN LABELING DEVICE CLEANING EQUIPMENT FLUID HANDLING TOOLS		

*UP PAYLOADS ONLY

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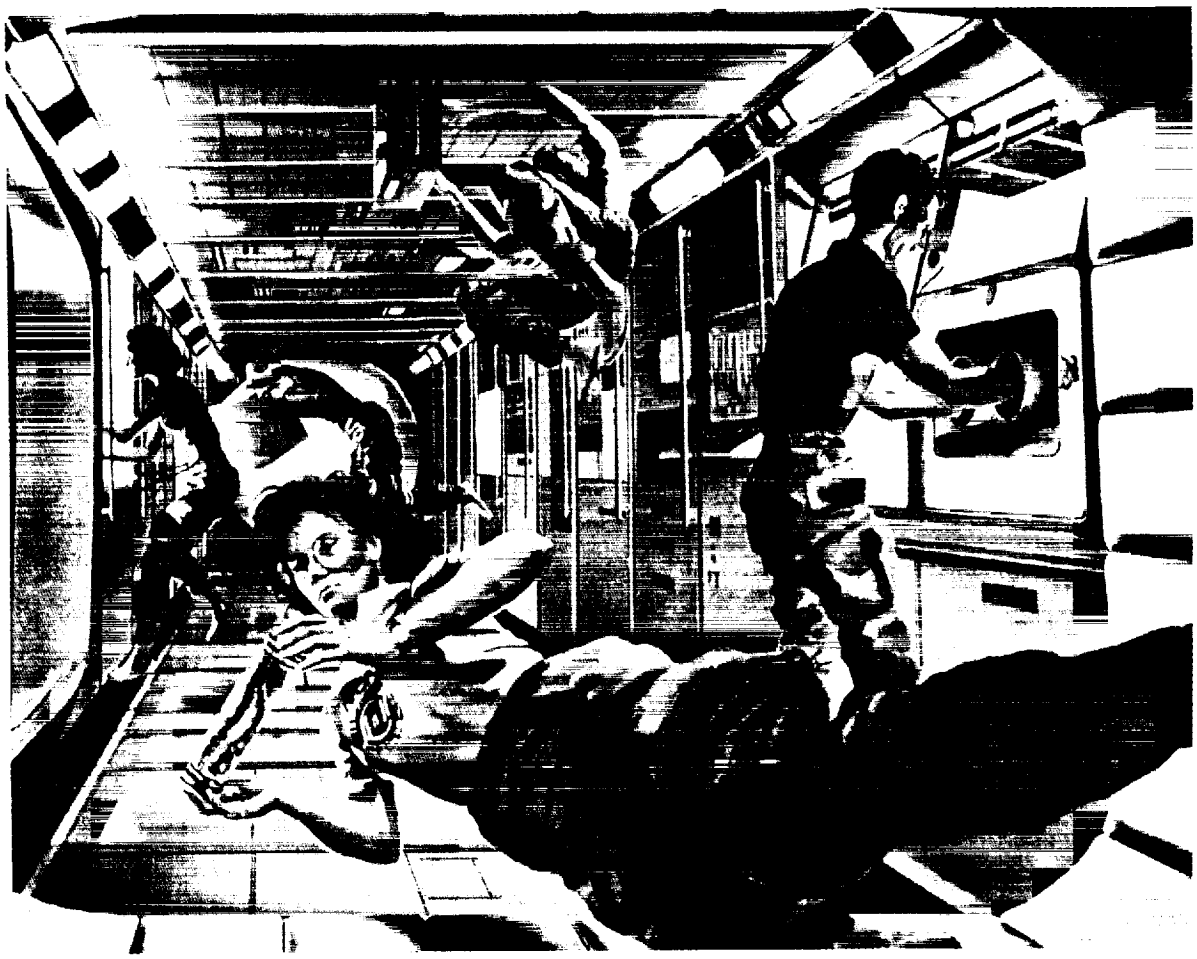
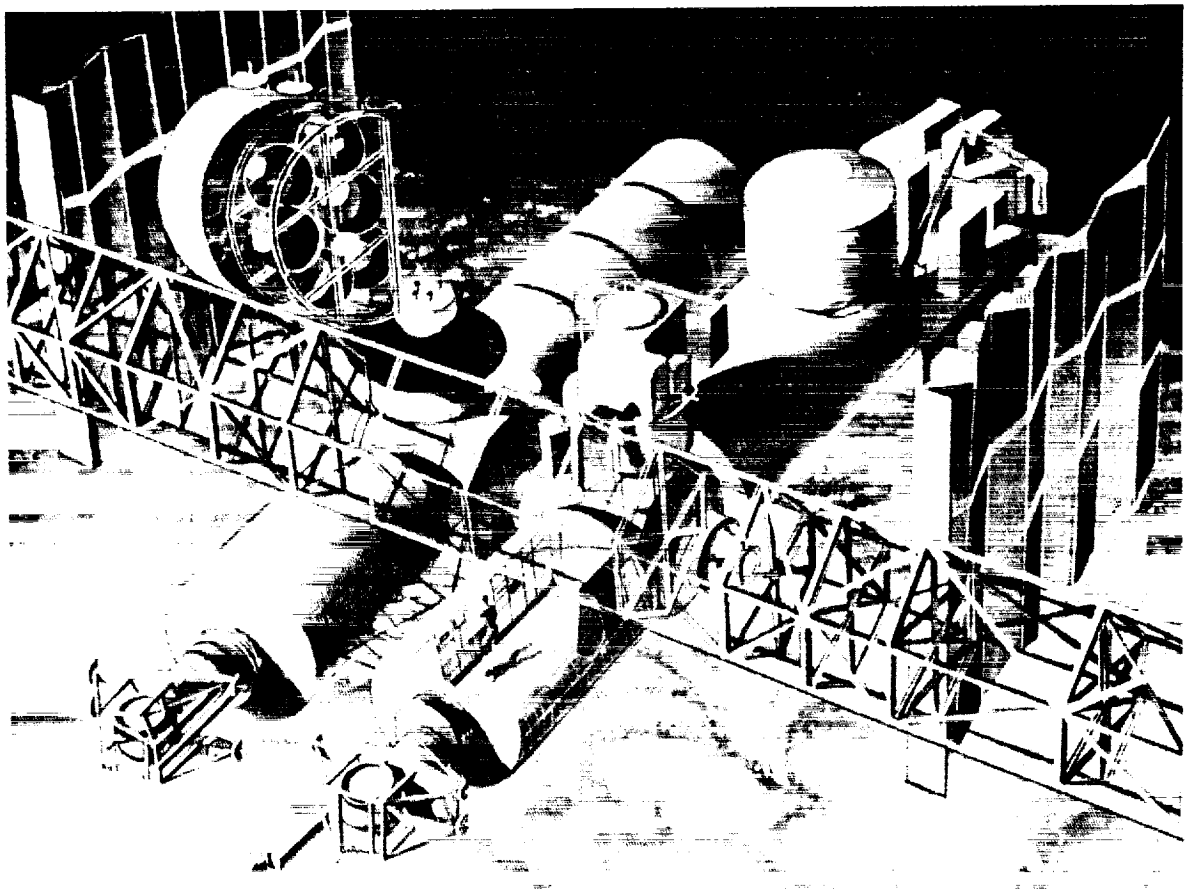
TECHNOLOGY PAYLOAD CATEGORIES

- INDIVIDUAL TECHNOLOGY PAYLOADS
  - SPACECRAFT MATERIALS AND COATINGS
  - ADVANCED SENSOR DEVELOPMENT
  - TRANSIENT UPSET PHENOMENON IN VLSIC
- INSTRUMENTED SPACE STATION
  - OEX TYPE EXPERIMENTS
  - INSTRUMENT STATION SUBSYSTEM
    - STRUCTURES- MIE
    - ENVIRONMENTAL
    - THERMAL
    - DATA
- GUEST INVESTIGATOR PROGRAM
  - USE DATA FROM EXISTING INSTRUMENTS
    - MIE
    - STATION SUBSYSTEM INSTRUMENTS

TECHNOLOGY PAYLOAD DESIGN CONSIDERATIONS

- ENVIRONMENT
  - PRESSURIZED PAYLOADS
  - ATTACHED PAYLOADS
- PAYLOAD ACCOMMODATIONS
  - RESOURCES AVAILABLE
    - POWER, DATA, CREW, ETC.
  - REAL ESTATE
    - RACKS, ATTACHMENT SITES, PALLETS
- CARRIER
  - TRANSPORTATION
  - PLM/ULC
  - RACK/DRAWER/ULC
- INTEGRATION
  - ONTO CARRIERS
  - ONTO STATION





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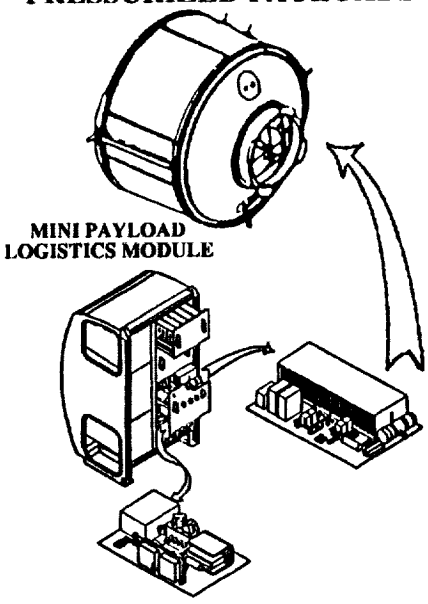
PAYLOAD CARRIER SYSTEMS

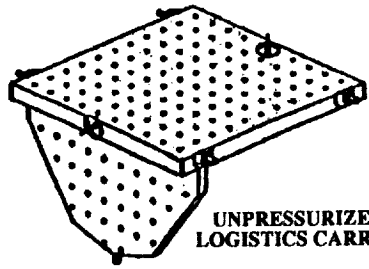
PRESSURIZED PAYLOADS



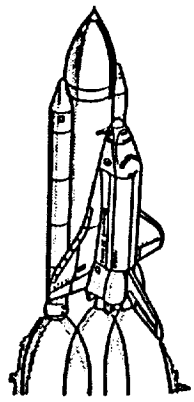
MINI PAYLOAD LOGISTICS MODULE

INTERNATIONAL STANDARD PAYLOAD RACK

ATTACHED PAYLOADS



UNPRESSURIZED LOGISTICS CARRIER



TRANSPORTATION

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ATTACHED PAYLOADS

EXAMPLE

PAYLOAD SITES:	STARBOARD 1 - Available May 1997 STARBOARD 2 - Available May 1997 PORT 1 - Available August1997 PORT 2 - Available August 1997
PAYLOAD VOL. ENVELOPE:	DIFFERENT AT EACH SITE
DATA:	1553 LOCAL BUS (MAX THROUGHPUT 700 kbps MINUS OVERHEAD)
EVA:	INSTALL PROPULSION MODULE ADAPTOR SYSTEM
THERMAL:	NONE
CARRIER:	UNPRESSURIZED LOGISTIC CARRIER OF SOME DESIGN
STATION INTEGRATION:	PMAS PAYLOAD PALLET ROBOTIC INSTALLATION

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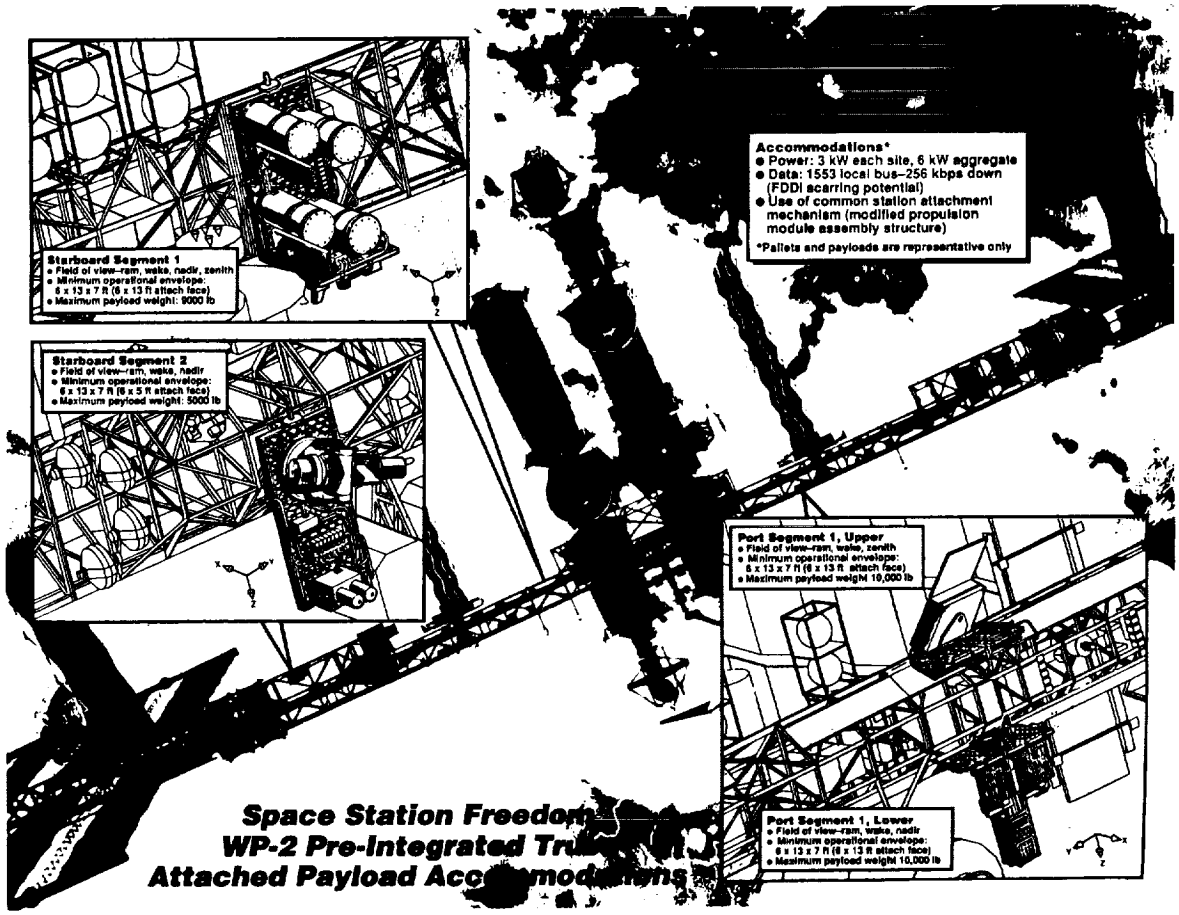

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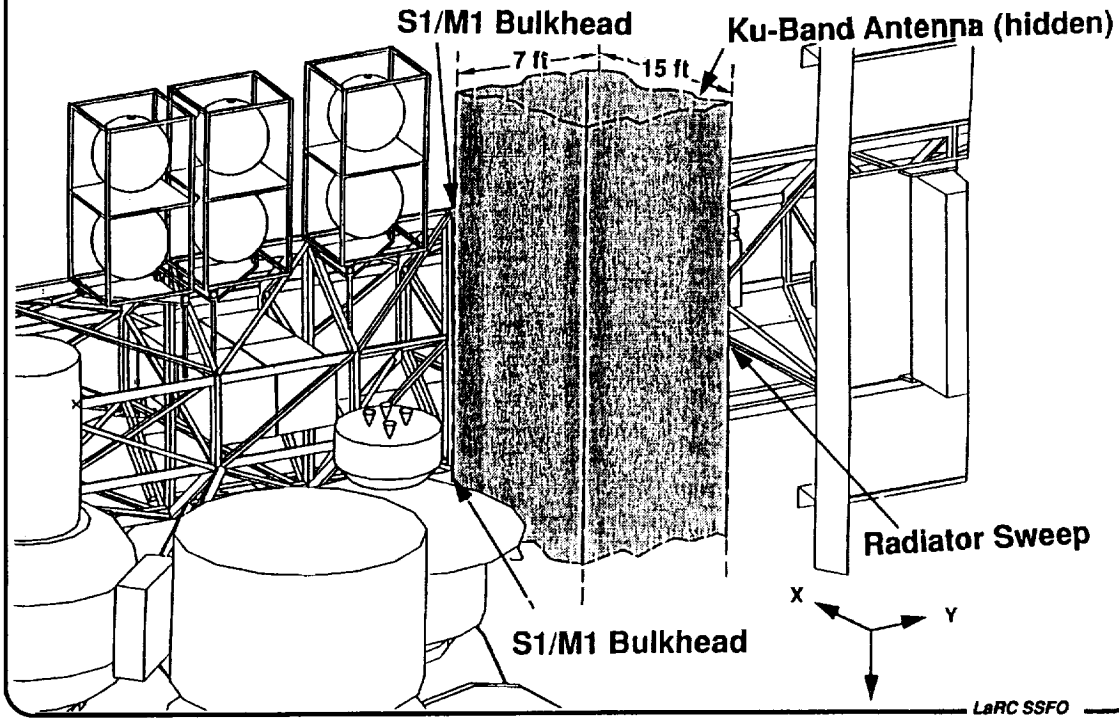
ATTACHED PAYLOAD OPERATIONAL ENVELOPE

SITE - STARBOARD 1



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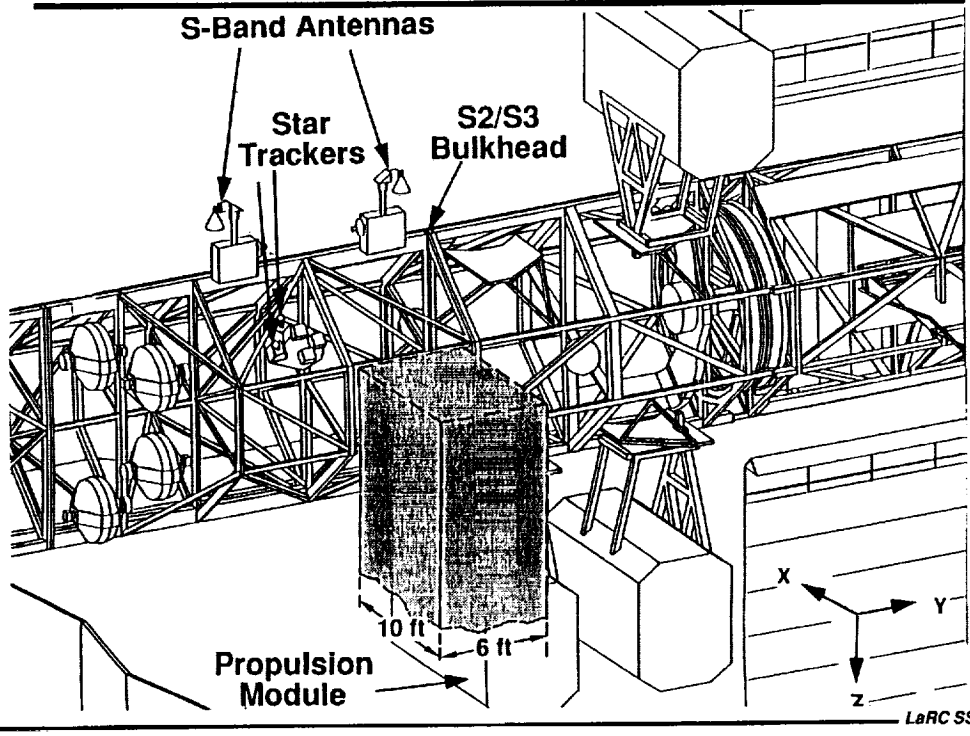
ATTACHED PAYLOAD OPERATIONAL ENVELOPE

SITE - STARBOARD 2



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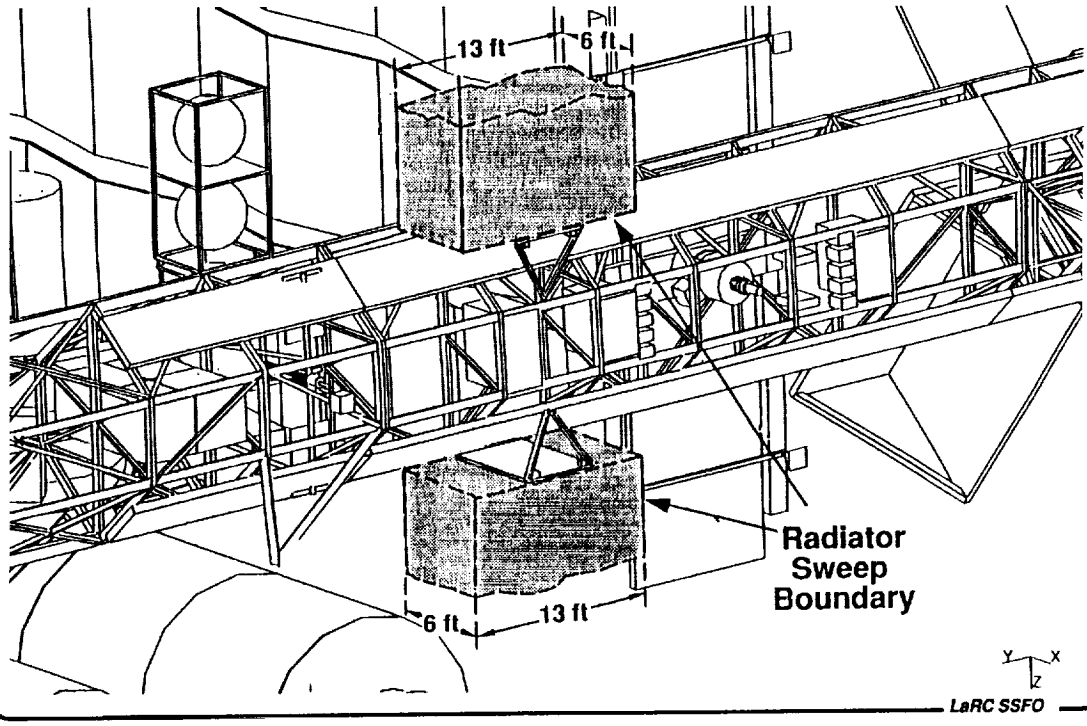
FREEDOM

ATTACHED PAYLOAD OPERATIONAL ENVELOPE

SITE - PORT 1 AND PORT 2



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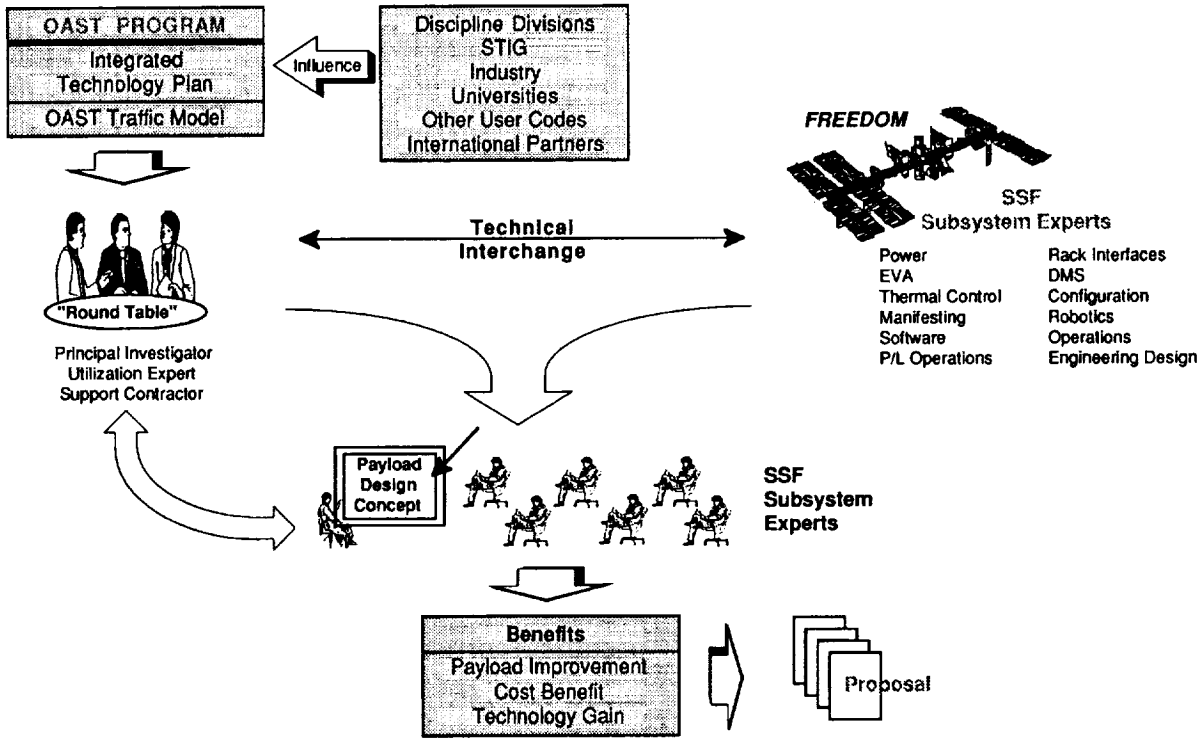
A TECHNOLOGY PAYLOAD DESIGN APPROACH



SOLID OBJECT MODELING

- GIVES VISUAL PERSPECTIVE OF CARRIER AND EXPERIMENT
- ALLOWS OBSERVATION OF PROBLEMS EARLY IN DESIGN
  - S-BAND ANTENNA CLOSE TO EXPERIMENT
  - U.S. LAB MAY VENT ONTO EXPERIMENT
  - VIEWING
  - SHADOWS
  - ETC.

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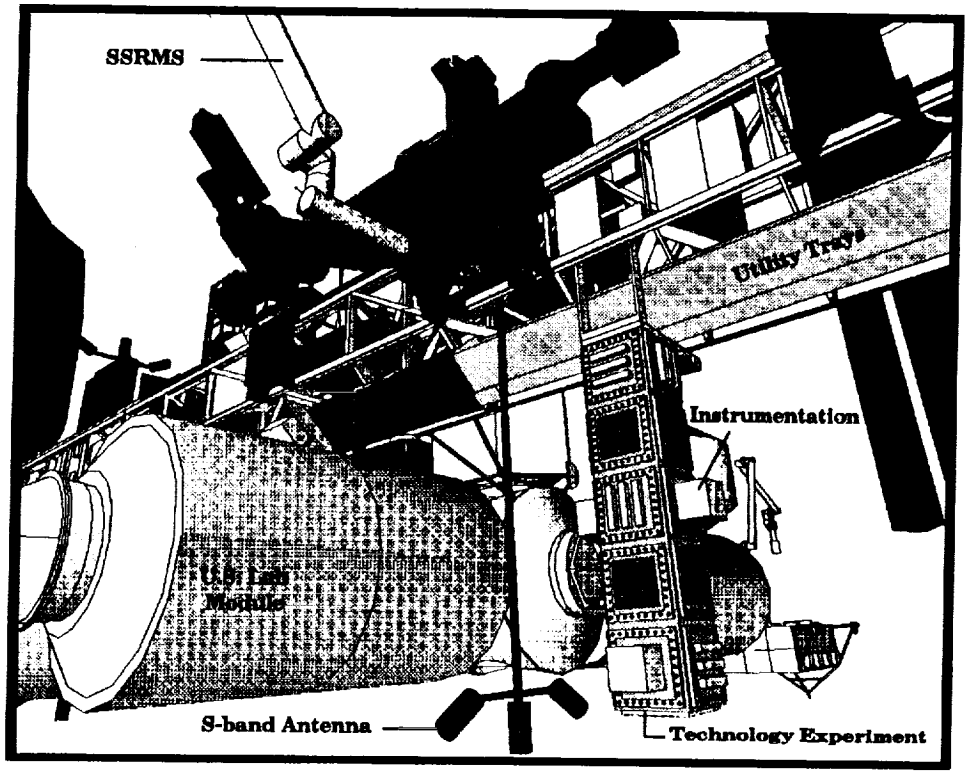
Technology Experiment Example



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ANIMATION

- ANIMATION ALLOWS FULL VISUALIZATION OF SCENE
  - WAVEFRONT USED AS ANIMATION TOOL
  - WAVEFRONT USES 3D OBJECT
  - 2D IMAGES CAN BE RENDERED FROM 3D OBJECTS FOR STILLS OR VIDEO
- ALLOWS OBSERVATION OF PROBLEMS EARLY IN DESIGN PROCESS
  - MOTION RESTRICTIONS BECAUSE OF UNKNOWN OBSTACLES
  - KEEP OUT ENVELOPES
  - MOVEMENT RESTRICTIONS OF ROBOTIC ARMS
  - COMPLICATED MOVEMENTS SHOWN VISUALLY INSTEAD OF EXPLAINED

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OAST ANNOUNCEMENT OF OPPORTUNITY

SPACE EXPERIMENTS PROGRAM

- PURPOSE
  TO SOLICIT PROPOSALS FOR EXPERIMENTS IN THE TECHNOLOGY CATEGORIES
  - SPACE MATERIALS, COATINGS, AND ENVIRONMENTAL EFFECTS
  - CRYOGENIC FLUID HANDLING
  - HUMAN SUPPORT
  - SPACE POWER
  - IN-SPACE CONSTRUCTION, REPAIR, AND MAINTENANCE
  - SCIENCE SENSORS AND SENSOR COOLING
  - VIBRATION ISOLATION
  - SPACE COMMUNICATION
- APPROACH
  - APPROXIMATELY FIFTY PROPOSALS SELECTED BY RIGOROUS REVIEW PROCESS FOR PHASE A
  - DOWN-SELECTION TO PHASE B, LEADING TO NON-ADVOCATE REVIEW
  - NEW EXPERIMENTS READY FOR FLIGHT STARTING 1997
  - ANY SUITABLE CARRIER UTILIZED, INCLUDING SSF, SHUTTLE, ELV
- STATUS
  - EXPECTED RELEASE IN AUGUST