LEO AND GEO MISSIONS

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The Challenger disaster in early 1986 occurred about the same time that a Presidential commission known as the National Commission on Space (NCOS) was finishing its work. The NCOS vision of our Nation's future in space included recommendation that NASA's long-range plans for a world-leadership space program be developed and accelerated. The Challenger disaster, however, almost stopped our space program in its tracks. We could not even make effective use of our ability and experience in the use of expendable launch vehicles (ELV). As a result, plans already established had to be drastically revised and new plans had to be made. For example, Cobe was complete redesigned to fly on an ELV after having been designed and built for the shuttle. Meanwhile NASA created the Space Leadership Planning Group (SLPG) to formulate space mission plans covering a 50-year period based on Agency goals and objectives responsive to NCOS recommendations. This paper presents an interim view of the status of SLPG plans for low-altitude and geosynchronous (LEO, GEO) missions.

For transportation from ground to low Earth orbits and orbits between LEO and GEO, the missions utilize the shuttle and its successors, heavy-lift unmanned cargo vehicles, expendable launch vehicles, manned and unmanned orbital vehicles (OMV, OTV), and a dedicated class of passenger-carrying vehicles. In space, the mission model payloads are accommodated on LEO and (later) GEO space stations, unmanned co-orbiting and polar-orbiting platforms in LEO, GEO platforms, GEO shack, the spaceport, and free-flying satellites. In-orbit servicing is expected to be made available initially in LEO by using the space station, and later in GEO. This capability will permit repairs, equipment changes, and pickup and delivery of supplies or manufactured goods. Activities in both domains can support missions to the Moon, Mars, and interplanetary space.

Mission timelines are based on an annual budget growth of about 2.4 percent and the accompanying translation of research and technology into the transportation and infrastructure base. Specific LEO and GEO missions are shown chronologically up to the year 2035 together with mass-launched and cost estimates. Broad mission and program categories include families of telescopes, electromagnetic and wavelength instruments, the Explorer series, micro- and variable-gravity facilities, radio astronomy, Earth observations, meteorology (weather and climate), magnetic fields, spacelab, bioplatforms, materials processing, and communications. The technology research and development missions in LEO and GEO relate to power, propulsion, robotics servicing and assembly, shielding, environmental effects, docking, waste processing, bioregenerative life support, and medical facilities.

SCIENCE

- EARTH, SOLAR SYSTEM, UNIVERSE

HUMAN PRESENCE

- EXPLORATORY MISSION, BASES, SETTLEMENTS, COLONIES (MOON, MARS)

ENTERPRISE

- DEVELOP SPACE TECHNOLOGY
- TECHNOLOGY APPLICATIONS (U.S., INT'L, COMM'L)
- COMMERCIAL INVOLVEMENT & INVESTMENT
- SPACE TOURISM/UNIVERSITY
- EDUCATIONAL INITIATIVES

Figure 1. - NASA general program goals.

- DATA BASES
  - TO 1985 LANGLEY DATA BASE (TO 2010)
  - TO 1986 CIVIL NEEDS DATA BASE (TO 2035)

- NASA
  - 1985-87 ADVANCED MISSIONS WORKING GROUP (2035, I. BEKEY)
  - 1986-87 SPACE LEADERSHIP PLANNING GROUP (2035, I. BEKEY)
  - 1986-87 CIVIL SPACE LEADERSHIP INITIATIVES (1995 ERA) (S. RIDE)
  - 1986-87 MIXED FLEET STUDY (NASA/HQ)

- OTHER
  - 1986 NATIONAL COMMISSION ON SPACE
    NASA ADVISORY COMMITTEE
    NATIONAL ACADEMY OF SCIENCES
    PROFESSIONAL SOCIETIES (E.G., AIAA)

Figure 2. - NASA and related planning activities.

- DATA BASES
- PROGRAM OPTIONS, WHEN, THRUSTS, EMPHASES
- TRANSPORTATION
- INFRASTRUCTURE
- TECHNOLOGY DEVELOPMENT
- EXTERNAL EFFECTS: NATIONAL, INTERNATIONAL, COMMERCIAL
- EDUCATION, TOURISM

Figure 3. - Scope of planning activities.

- MARS: ROBOTIC, HUMAN
- LUNAR: BASES
- CORE PROGRAM
- COMMON ELEMENTS - ALL THRUSTS:
  - SPACE STATION
  - SHUTTLE, SHUTTLE DERIVED VEHICLES (SDV)
  - EXPENDABLE LAUNCH VEHICLES (ELV)
  - SPACE STAION (GEO & LEO)
  - PLATFORMS (LEO CO-ORBITING & POLAR, GEO)
  - ORBITAL MANEUVERING & TRANSFER VEHICLES (GROUND & SPACE STATION BASED OMV'S & OTV'S)

Figure 4. - Candidates for space thrust.

- UNIVERSE
  - NATURE, ORIGIN, EVOLUTION
- SOLAR SYSTEM
  - NATURE, ORIGIN, EVOLUTION (MOON, MARS)
- EARTH
  - LAND, OCEANS, ATMOSPHERE, BIOSPHERE
- SUN-EARTH
  - ENVIRONMENTAL IMPACT, SOLAR PROCESSES
- ORIGIN OF LIFE
  - SETI
- SPACE ENVIRONMENT EFFECTS (ON HUMANS, PROCESSES)
- TECHNOLOGY
  - DEVELOPMENT, APPLICATIONS, COMMERCIALIZATION
- BASES
  - LEO, GEO, MOON, MARS, INTERPLANETARY SPACE

Figure 5. - LEO and GEO objectives.

- TRANSPORTATION:

  EARTH TO LEO OR GEO
  WITHIN LEO OR GEO DOMAINS
  LEO TO GEO OR OTHER PLANETS & DEEP SPACE

- INFRASTRUCTURE:

  SPACE STATION
  FREE FLYERS
  PLATFORMS

- SERVICING:

  ASSEMBLY, MANUFACTURING, RETRIEVAL

- COMMUNICATIONS:

  COMMAND, CONTROL

- OPERATIONS:

  EARTH & SPACE SCIENCE, METEOROLOGY, EDUCATION

Figure 6. - NASA activities in LEO and GEO.

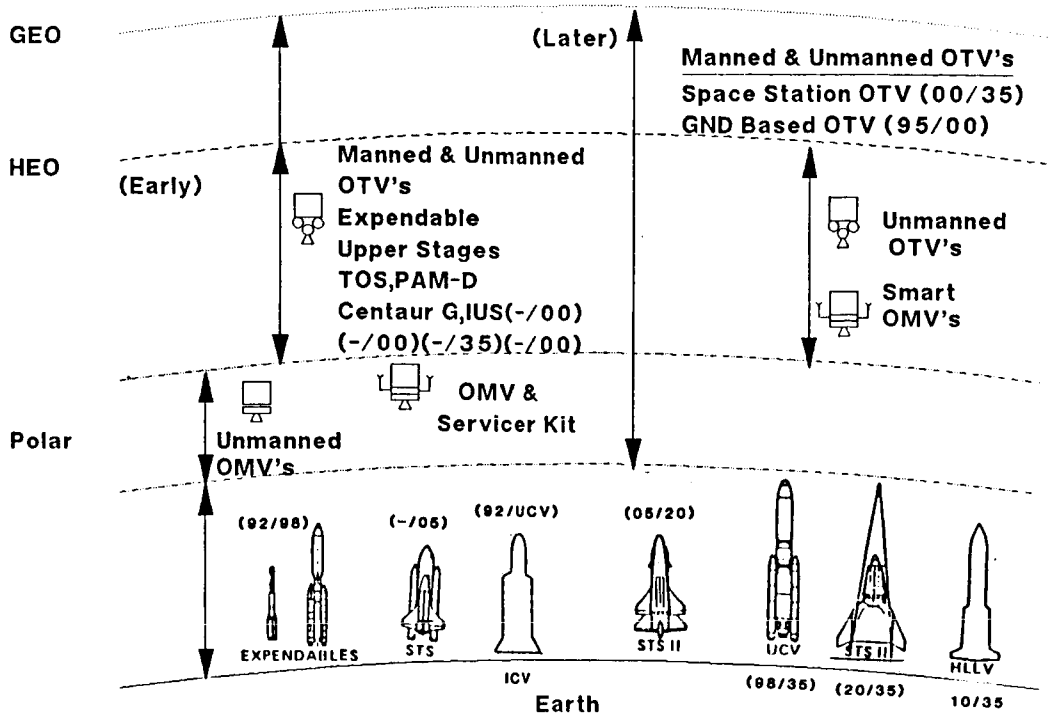

Figure 7. - NASA LEO and GEO transportation.

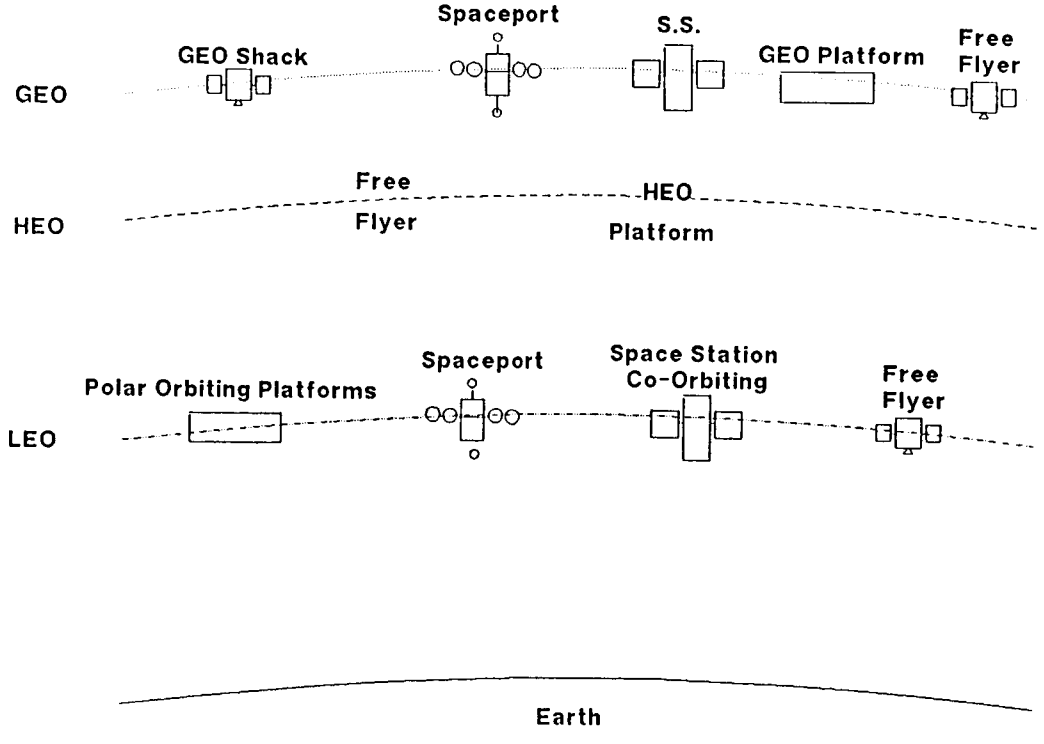

Figure 8. - NASA LEO and GEO infrastructure.

- SATELLITES, OBSERVATORIES, PLATFORMS
  - TELESCOPE: E.G., IR, OPTICAL, IMAGING, SOLAR & OTHER TARGETS
  - EXPLORERS: RAYS, MAGNETICS (MFE) GRAVITY (GRM), ATMOSPHERE, FIELDS & PARTICLES
  - OBSERVATORIES: EARTH OBSERVATIONS, SPACE SCIENCE, ATMOSPHERE
  - COMMUNICATION: ANTENNAS IN GEO
  - TETHERED SYSTEMS
- LEO SS: MATERIAL PROCESSING, SPARTAN, POWER, HEAT TRANSFER
- GEO SS: LIFE SCIENCE, VARIABLE-G, CENTRIFUGE
- GEO SHACK: (NOT PERMANENT PRESENCE)
- SHUTTLE: SPARTAN, HITCHHIKER, SPACELAB, GAS

Figure 9. - NASA LEO and GEO missions.

	1990 - 2010	2010 - 2035
MASS/YR (10^6 LB)		
TOTAL	0.30 - 5.60	3.0 - 7.0
PAYLOAD	0.15 - 1.20	1.0 - 2.2
PAYLOADS INTO ORBIT		
PER YR	15 - 74	40 - 130
TOTAL 0 - 2,500 LB	184	194
2,500 - 10,000 LB	286	248
10,000 - 30,000 LB	187	620
30,000 LB	171	608
	828	1670

Figure 10. - Mission model comparison.