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OPERATIONAL CAPABILITIES AND LEGAL IMPLICATIONS OF A MILITARY SPACE PLANE

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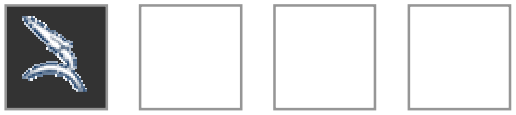
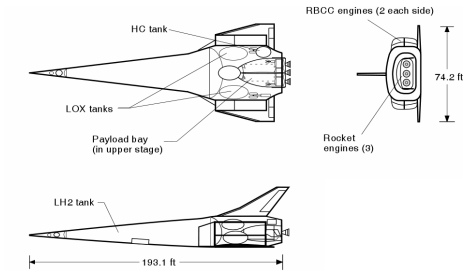


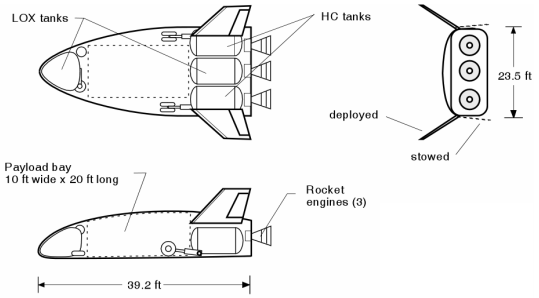
Overview of the Firm

Vision



SpaceWorks Engineering, Inc. (SEI) is here to examine the imagined future with real tools.

SEI can provide consul to those seeking to exploit outer space, from transportation to infrastructure, for public and private, from science to tourism. Our conceptual level toolsets and method can help determine feasibilities of space systems, viabilities in the marketplace, and determine the temporal impacts of technology on public and private actors. We forecast future markets making determinations of future policy and media initiatives.



About

SpaceWorks Engineering, Inc. (SEI) is a small aerospace engineering and consulting company located in metro Atlanta. We specialize in providing timely and unbiased analysis of advanced space concepts ranging from space launch vehicles to deep space missions.

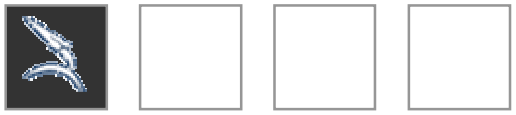
Our practice areas include:
- **Space Systems Analysis**
- **Technology Prioritization**
- **Financial Engineering**
- **Future Market Assessment**
- **Policy and Media Consultation**

From Vision to Concept

Including:
- **Engineering design and analysis**
- **New concept design**
- **Independent concept assessment**
- **Full, life cycle analysis**
- **Programmatic and technical analysis**

Recent Firm Engagements

NASA MSFC Advanced Concepts Group: 3rd Gen RLV concept assessment and engineering tool development
NASA 2nd Gen RLV / Space Launch Initiative (SLI) Program: Advanced Engineering Environment (AEE)
NASA Headquarters: FY2002 RLV technology goals assessment
NASA inter-center Value Stream Analysis Program: Micro and macro level technology implications for 3rd Gen RLVs
NASA MSFC Integrated Technology Assessment Center (ITAC): Space transportation technology prioritization
Revolutionary Aerospace Systems Concept (RASC) Program at NASA MSFC: Database and tool development
NASA Institute for Advanced Concepts (NIAC): Phase I Award for Mars Telecommunication Networks
SAIC and NAL (Japan): ATREX engine test program performance assessment
Lockheed Martin Astronautics: Assessment of optimization codes for space transportation case studies
DARPA: Responsive Access Small Cargo Affordable Launch (RASCAL) program subcontract for performance analysis
NASA MSFC Program Planning Office: Heavy-lift launch vehicle configurations predicated on SLI technologies
White paper (available at www.sei.aero) on past case studies and future investment strategies for RLVs



Overview

Impetus on Space:

- Commission to Assess United States National Security Space Management and Organization
  - The extent of U.S. dependence on space and the vulnerabilities it creates demand that space be recognized as a top national security priority.
  - The U.S. government is not yet arranged or focused to meet the national security space requirement of this century.
  - Throughout history, there has been conflict in every medium (air, land and sea) and space will be no different. The United States must defend against hostile acts in and from space.

Sources of Development:

- United States military in particular has been a supplier of both space infrastructure (satellites) and developer of transportation services
- In projected budgets for fiscal years 2002 to 2007, United States Air Force (USAF) is projected to spend 86 percent of total allocated space funding of $165 billion
- NASA has been investing over the last few years in the Space Launch Initiative (SLI), a five billion dollar program to essentially help make a decision around 2006 on whether to replace or upgrade the current Space Shuttle fleet
  - Essential requirements for NASA's system are different than those envisioned by USAF planners for their SOV.

Introduction

Space and the Military:

- The militarization of space has in essence already occurred.
- Between the years 1959 through 1995, the ratio of civilian to military outer space launches was nominally at 5:4 relationship.

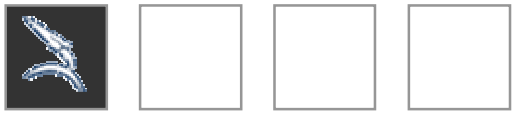
Concept:

- Any legal examination of such a system has to include details about the characteristics of such a system coupled with the most recent military perceptions of its use.
- This examination attempts to provide some clarity as to what is meant by the most recent incarnation of the U.S. Air Force's military space plane (MSP)
- Any such MSP will have dual-use capability to service civil and commercial space launch markets.

MSP Definition:

- A Military Space Plane (MSP) is in essence an atmospheric/space delivery architecture that can consist of multiple stages to deliver payloads into space and onto the surface of earth. The MSP is a delivery mechanism to enable space transportation. A MSP is a version of a reusable launch vehicle (RLV) that has specific abilities required for military users.

Motivation



MSP Concept Overview

Military Space Missions and Operational Functions

Missions	Operational Functions	Example Assets and Programs
Space Control	Space surveillance, protection, prevention, and negation	Space surveillance network
Force Enhancement	Navigation, satellite, communications, environmental, monitoring, surveillance and threat warning, command and control, and information operations	Global Positioning System (GPS)
Space Support	Launch operations, satellite operations, modeling, simulation, and analysis/force evaluations	Air Force satellite control network
Force Applications	Intercontinental ballistic missile sustainment, conventional strike	Minuteman III

MSP Architecture Elements

Space Operations Vehicle (SOV):

- Core component of the architecture is a reusable first stage vehicle
- The SOV will have the capability of carrying multiple payloads with turnaround times (TATs) measured in hours instead of the current months for the U.S. Space Shuttle

Space Maneuver Vehicle (SMV):

- Reusable upper stage
- Could house a third/upper stage

Modular Insertion Stage (MIS):

- Expendable upper stage

Common Aero Vehicle (CAV):

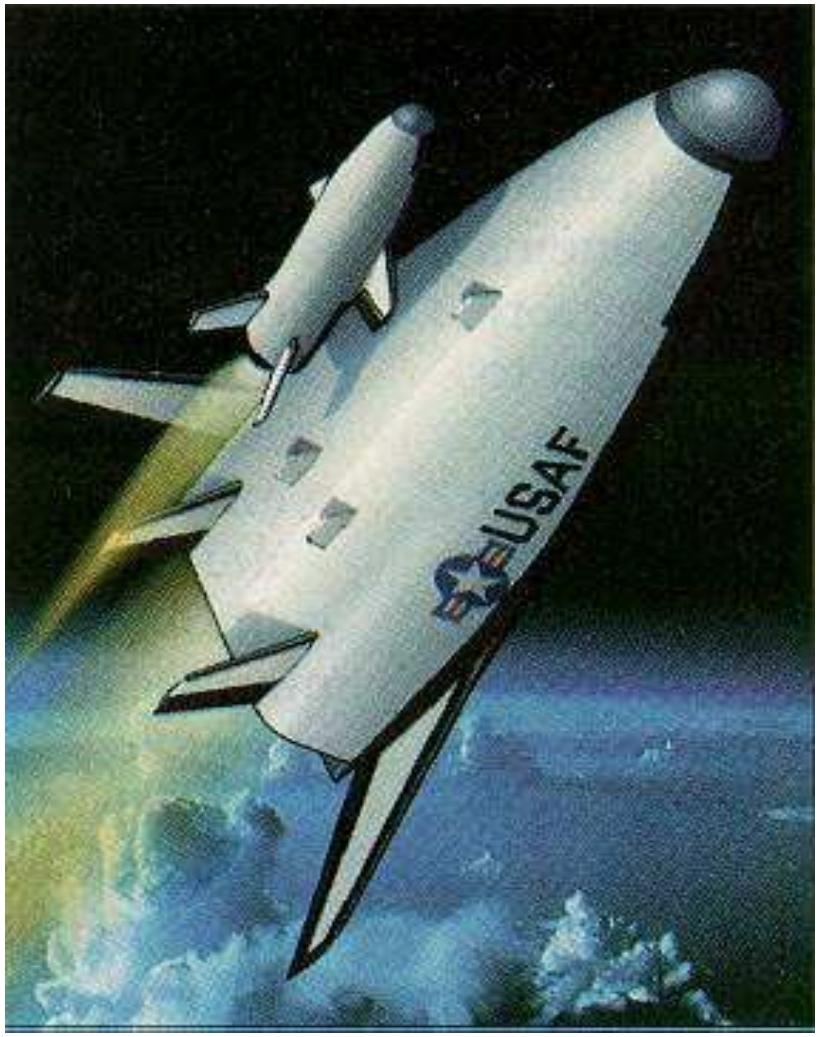
- Maneuvering reentry vehicle

Orbital Transfer Vehicle (OTV):

- Move payload from one orbit to another

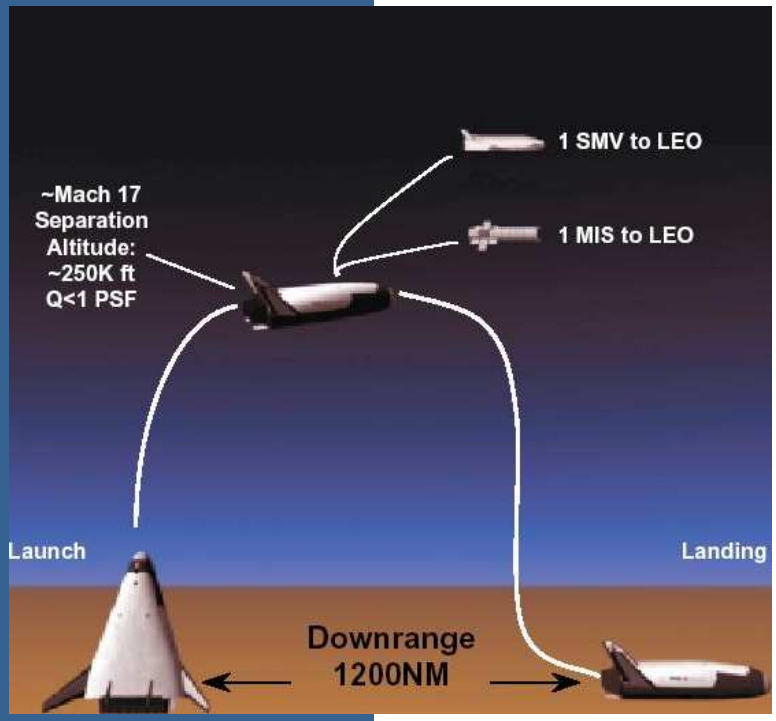
MSP Capabilities

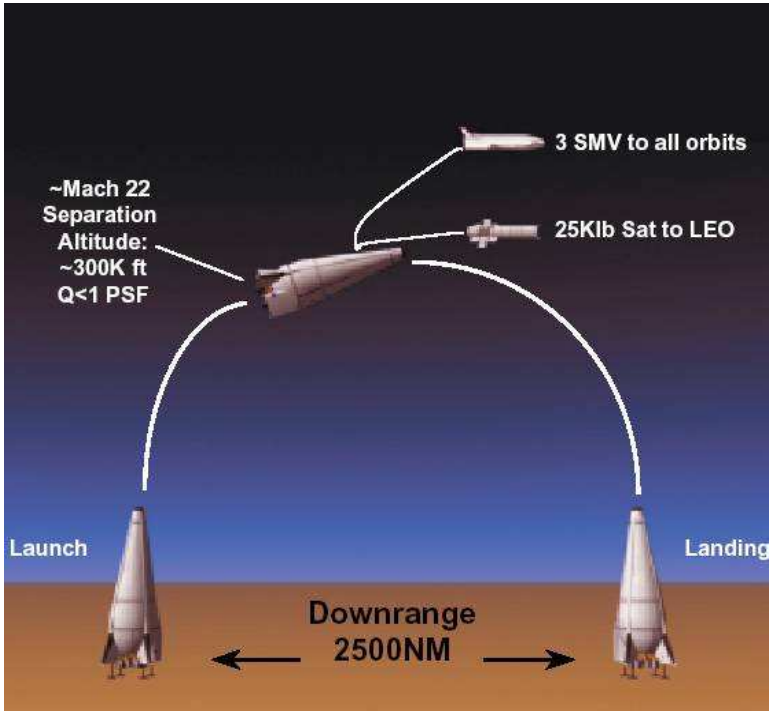
- The SOV shall be capable of supporting space control, force application, force enhancement, and force support missions by providing low cost, high ops tempo launches of SMV, CAV, and MIS payloads to mission orbits or trajectories.
- Orbit-capable and sub-orbital SOVs shall be capable of executing sub-orbital, pop-up profiles that allow safe launch and recovery from U.S. bases.
- The MSP System shall be capable of autonomous, virtually commanded, or crewed operations depending on future requirements evolution.
- The MSP System shall provide aircraft-like levels of operability and maintainability to allow high sortie rates.
- Orbit-capable SOVs shall be capable of supporting once around missions while returning to their launch site.



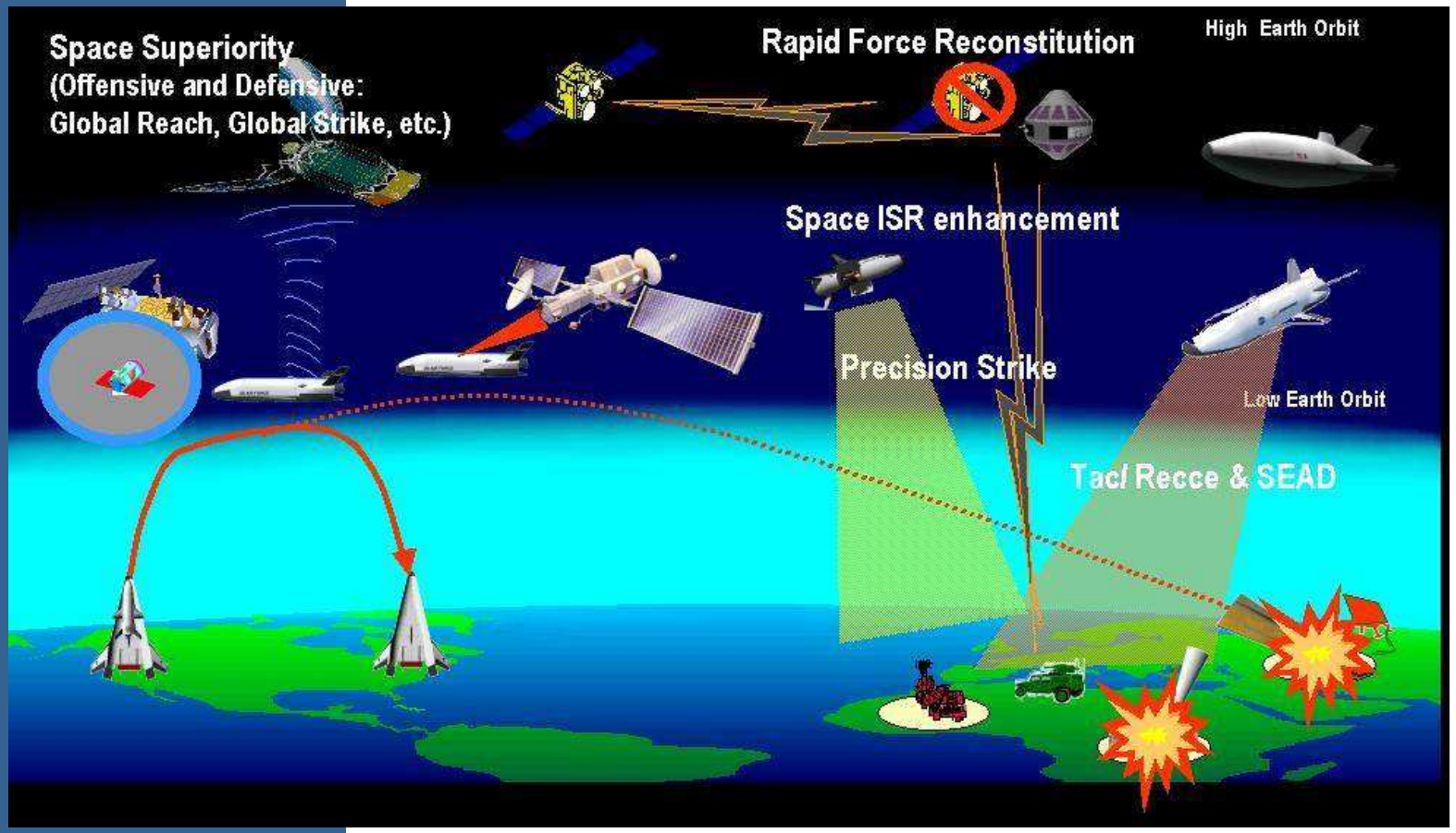
Notional Military Space Plane (MSP)

Space Maneuver Vehicle (SMV)





Pop-Up Flight Profile of Notional Sub-Orbital and Orbital Military Space Plane (MSP)



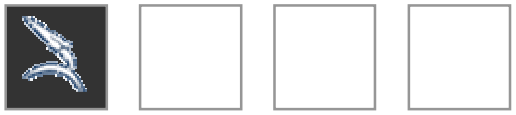
Theater Impact of MSP

Requirement	Range
Sortie Utilization Rates	
Emergency surge	3-4 sorties/24 hrs.
Turn Times	
Emergency surge	2-8 hours
System Availability	
Mission Capable Rate	75-95 percent
Cross Range	
CONUS pop-up cross range @1200nm	250-400 nm
Mission Duration	
On-orbit time	24–72 hours
Alert Hold	
Hold Mission Capable	15 days
Design Life	
Primary Structure	250-500 sorties
Engine life	100-250 sorties
External Payload Weight	
Carriage Capacity	15,000-20,000 lb
Payload Capability	
Pop-up MIS payload east	2,000 –4,000 lb
Pop-up MIS payload polar	1,000 – 4,000 lb
Maintenance and Support	
Maintenance man hours/sorties	50-100 hours

Sample MSP Requirements

Sample Payloads for MSP SOV

Sensors and Telecommunications	Hyper-spectral Imaging Radar SIGNIT Meteorological Systems GPS MILSATCOM
Vehicles (Can also carry payloads)	SMV MIS CAV Micro-satellites OTV
Weapons	Precision Munitions (Ground) Anti-Satellite (ASAT) Electronic Warfare Nuclear National Missile Defense



Legal Implications

Legal Issues

Military Self Defense:

- Justification for military use in self-defense (Article 51 of the United Nations charter)
- U.S. custom allows the military to investigate and develop space technologies (National Aeronautics and Space Act of 1958, as amended)
- Doctrine of preemptive first strike against terrorist targets

Legality of Payloads:

- The payload determines the ultimate nature of this transportation system
- A defensive payload in space could conceivably be reconfigured for offensive purposes

Uncrewed Nature of a MSP:

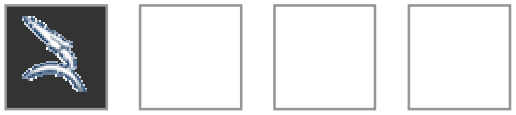
- Classification of cruise missiles in the 1988 INF Treaty
- Future semi-atmospheric propulsion systems such Rocket Based Combined Cycle (RBCC) propulsion systems being an MSP closer to the definition of UAVs and UCAVs
- Arming of predator UAVs with Hellfire missiles in early 2002 during the U.S. engagements in Afghanistan have shown the military's willingness to rethink the limitations of the INF treaty

Overflight:

- MSPs enable Continental U.S. (CONUS) operations that allow for global strike missions

Coordinated Development:

- These RLV programs seek development of vehicles that could immediately be used to service the commercial marketplace
- General Agreement on Trades and Tariffs (GATT) Article XXI, referred to as the "security exception"



Conclusions

Observations

- The MSP should more appropriately be thought of as a delivery mechanism than an actual weapon.
- Subsequently, the legality of a MSP is inherent upon the payload it carries.
- Various MSP configurations exist, both defensive and offensive with easy interchangeability between either.
- The SOV portion of the architecture may not be capable by itself of positioning weapons in space.
- However, additional add-on components like the SMV and CAV could be used for offensive space purposes.
- MSPs enable much faster response times and global access.
- MSPs have the capability to provide asymmetric capabilities to upset the reaction times of adversaries.
- However, the capabilities of the SOV/SMV may not enable revolutionary classes of payloads but can deliver existing or evolutionary payloads in differing manners.
- MSP development may enable faster development of future commercial RLVs.

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