Space and National Security: Overview and Issues

Space Studies Colloquium

University of North Dakota

Dr Pete Hays, 11 Oct 2010

Space Trends

Then--Few		Now--Many
• Useful • Advantageous • Monolithic	Space Capabilities	• Critical • Indispensable • Full-spectrum
• National Leadership	Space Users	• National Leadership • All Command Elements • Individual Joint Warfighter
• Unchallenged • Environmental	Threats and Competition	• Multi-faceted • Contested • Congested
• Deliberate • Stove-pipes	Command, Control, and Organizational Structures	• Dynamic • Integrated • Networked

Space has become an integral part of both military operations and the global economy

6Cs: Current Attributes of Space Environment

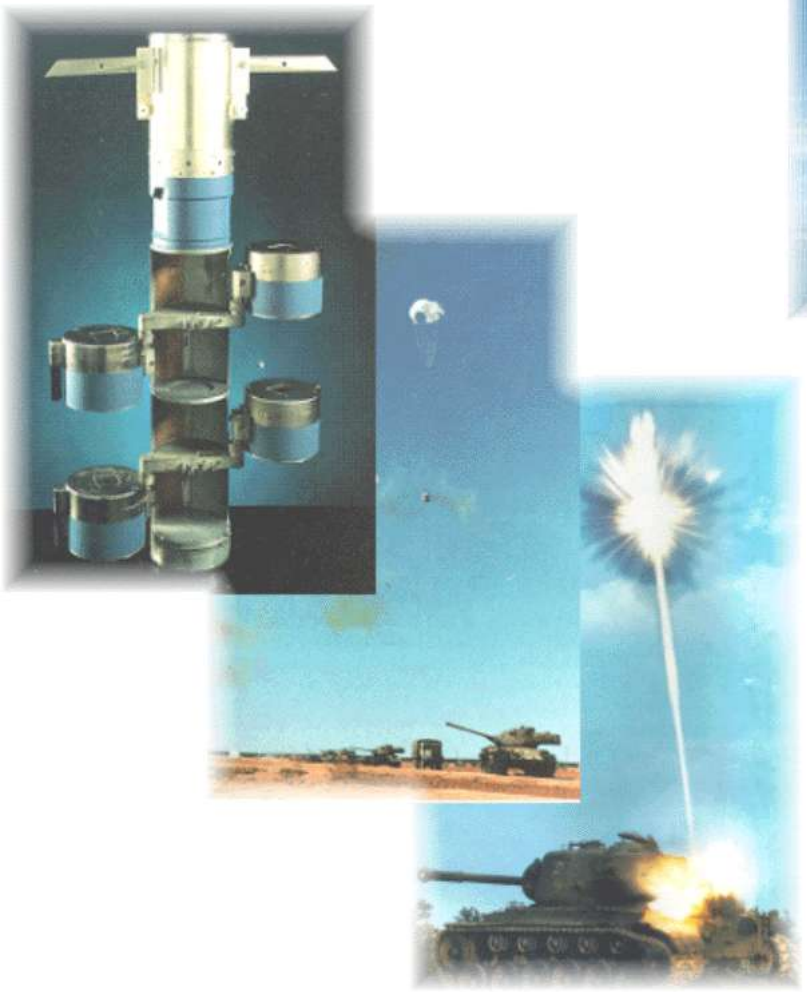
- **Contested**
- **Congested**
- **Competitive**
- Costly
- Commoditized
- Complex

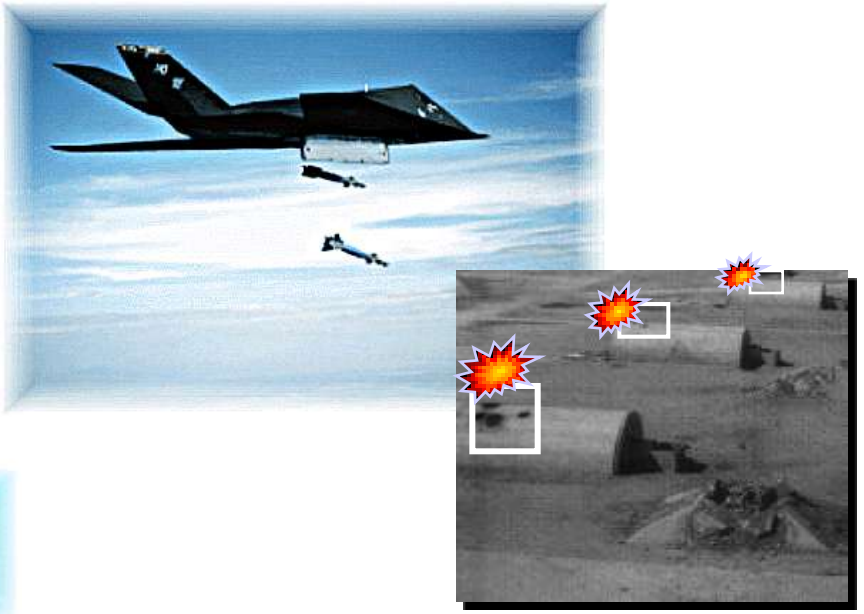
Old Way Of Warfare: Attrition

- Surface centric
- Estimated intelligence
- Force-on-force
- Mass bombing raids
- Many weapons per target
- High casualties/collateral damage
- Inaccurate weapons
- Airpower as a supporting force

World War II: 1941-1945

Transformational Warfare: Precision



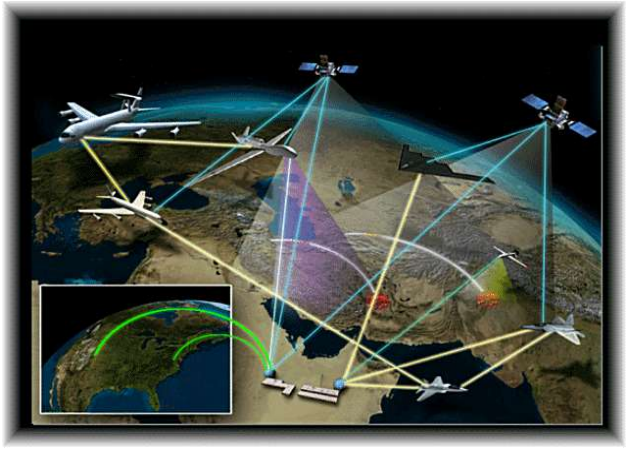


- Air centric
- Near real-time intelligence
- Emergence of nodal attack
- Stealth technology
- Fewer aircraft per target
- Precision guided munitions (7%)
- Airpower as a supported force

Desert Storm: 1991

Current Way Of War: Hybrid

Common Operational Pictures



Coalition Air Ops Centers

- **Air, space, and network centric**
- **Joint and coalition warfare**
- **Increasing UAS employment for ISR and strike; full motion video**
- **Highly integrated C^4ISR**
- **Maximum use of precision guided munitions (70% total, near 100% of time critical targets)**
- **Dynamic retasking; few aircraft per target; minimal collateral damage**
- **Enemy use of conventional, un-conventional, and terrorist tactics, perhaps simultaneously**

Allied Force, Enduring Freedom, Iraqi Freedom: 1999-

A Space Enabled Reconnaissance-Strike Complex: The New American Way of War

KTO, 1991	**Unguided**	245,000	92%
(Desert Storm): 37 Days	**Laser/EO-guided**	20,450	8%
1 Mbps/5K Forces			
Serbia, 1999	**Unguided**	16,000	66%
(Allied Force)	**Laser/EO-guided**	7,000	31%
78 Days; 24.5 Mbps/5K	**GPS-guided**	700	3%
Afghanistan, 2001-02	**Unguided**	9,000	41%
(Enduring Freedom)	**Laser/EO-guided**	6,000	27%
90 Days; 68.2 Mbps/5K	**GPS-guided**	7,000	32%
Iraq, 2003	**Unguided**	9,251	32%
(Iraqi Freedom)	**Guided**	19,948	68%
29 Days; 51.1 Mbps/5K			

GPS and Precision Strike

Fewer Sorties for a Greater Effect

Position, Navigation and Timing - GPS → **Precision Engagement**

1500 B-17 sorties
9000 bombs (250#)
One 60’ x 100’ target
W.W.II

30 F-4 sorties
176 bombs (500#)
One Target
Vietnam

1 F-117 sortie
2 bombs (2000#)
Two Targets/Sortie
Desert Storm

1 B-2 sortie
16 bombs (2000#)
16 Targets/Pass
All Weather

Moving Target Kill – SDB II Integration

NORTHROP GRUMMAN

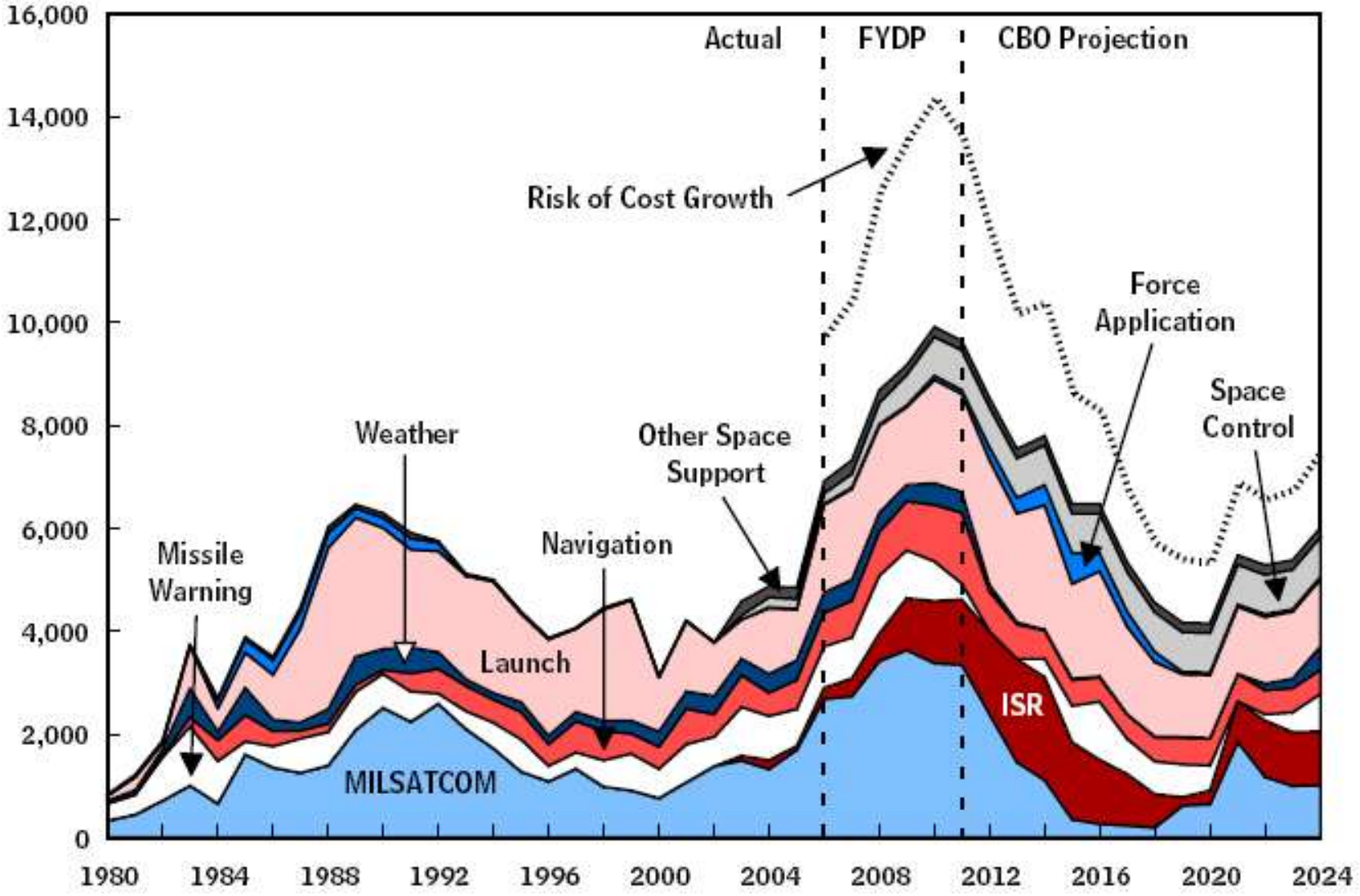
Description

- Upgrades display system and stores management processors to integrate Universal Armament Interface and SDB II MTK weapon

Current Momentum

- FY07 MTK/SDBII initiated display system upgrade
- Design, demonstration and test of primary cockpit displays replacement unit
- FY08 continuation will complete the final design and deliver two prototype displays

Major Military Space Program Investments (Millions of 2006 dollars)



DOD Investment in Major Space Programs

Fiscal year 2009 dollars in millions[a]						
	2008	2009	2010	2011	2012	2013
RDT&E	3,204.4	2,996.2	2,751.2	2,452.9	1,933.9	1,836.1
Procurement	2,859.7	4,185.0	4,369.6	3,115.2	3,276.7	2,829.2
Other[b]	22.5	17.5	18.1	10.5	12.2	0.0
Total	**6,086.6**	**7,198.7**	**7,138.8**	**5,578.6**	**5,222.7**	**4,665.3**

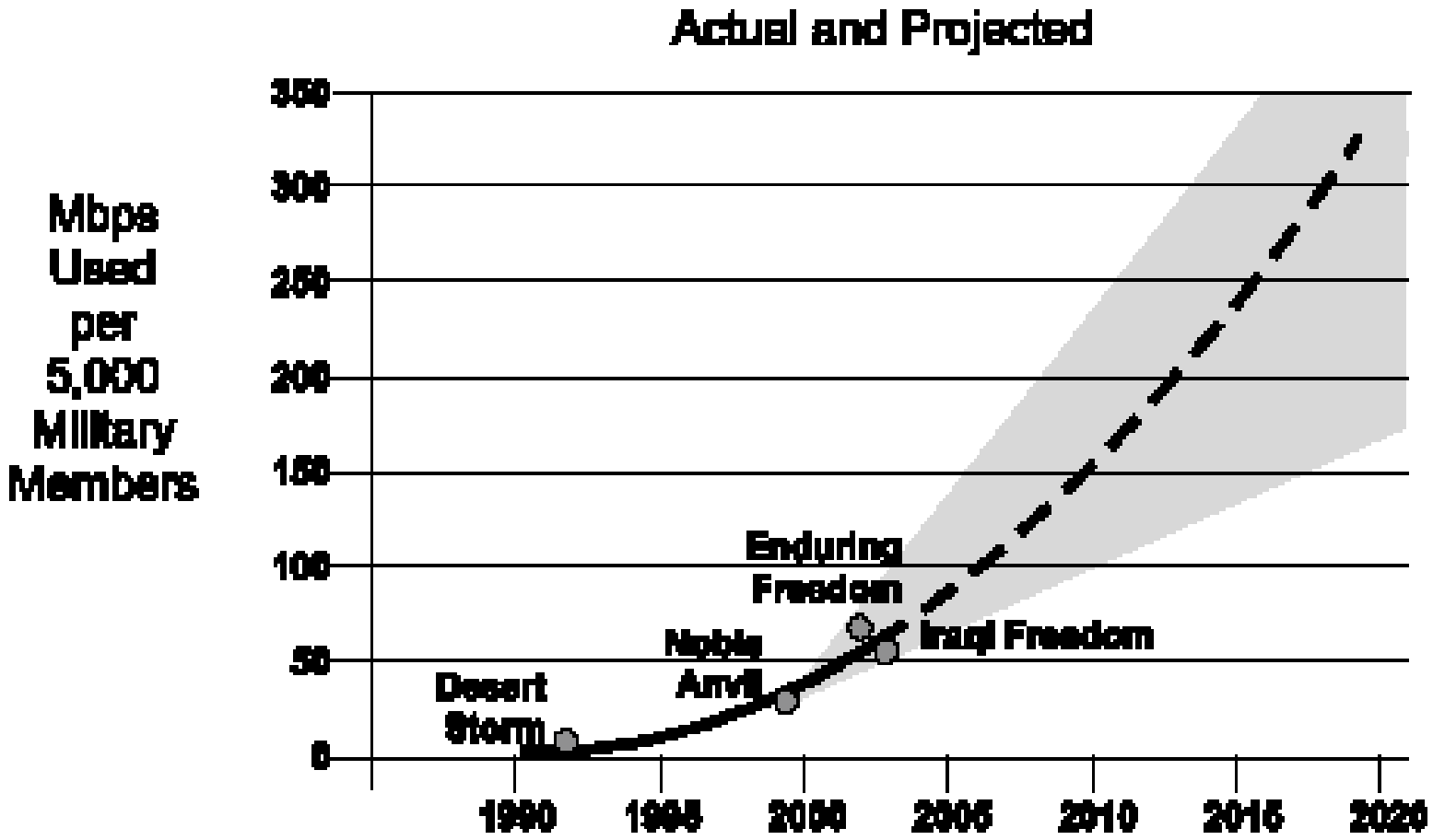
Source: GAO analysis of fiscal year 2009 DOD data.

Note: Numbers may not add due to rounding.

[a]Includes the following programs: Advanced Extremely High Frequency, Evolved Expendable Launch Vehicle, Global Broadcast Service, Navstar Global Positioning System, Global Positioning System IIIA, Mobile User Objective System, National Polar-orbiting Operational Environmental System, Space Based Infrared System High, Space Based Space Surveillance Block 10, Space Tracking and Surveillance System, and Wideband Global SATCOM. Does not include development efforts that have yet to formally initiate acquisitions, including Third Generation Infrared Surveillance, Infrared Augmentation Satellite, and Transformational Satellite Communications System.

[b]Other includes military construction and acquisition operations and maintenance costs.

Growth in SATCOM Demand



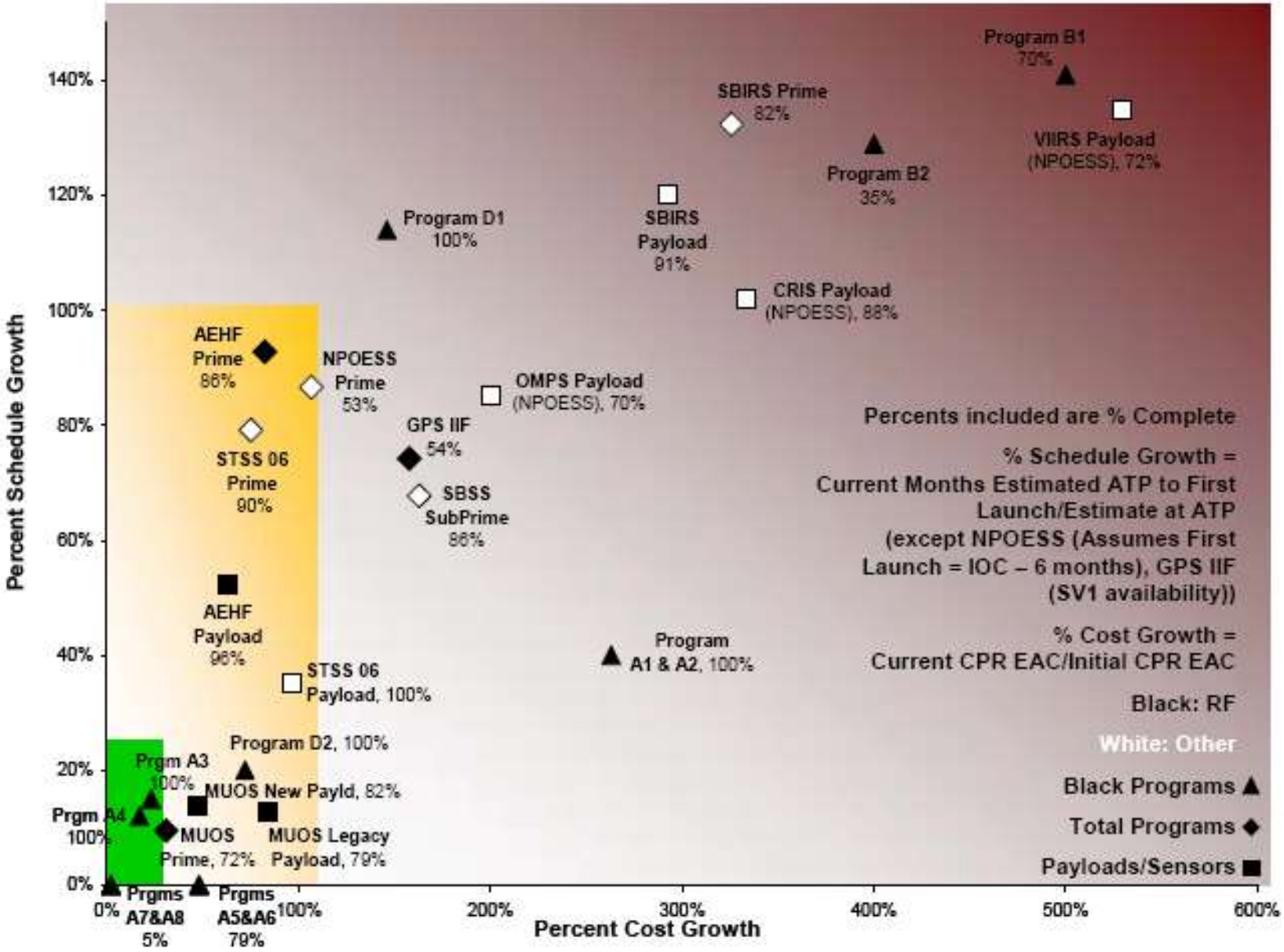
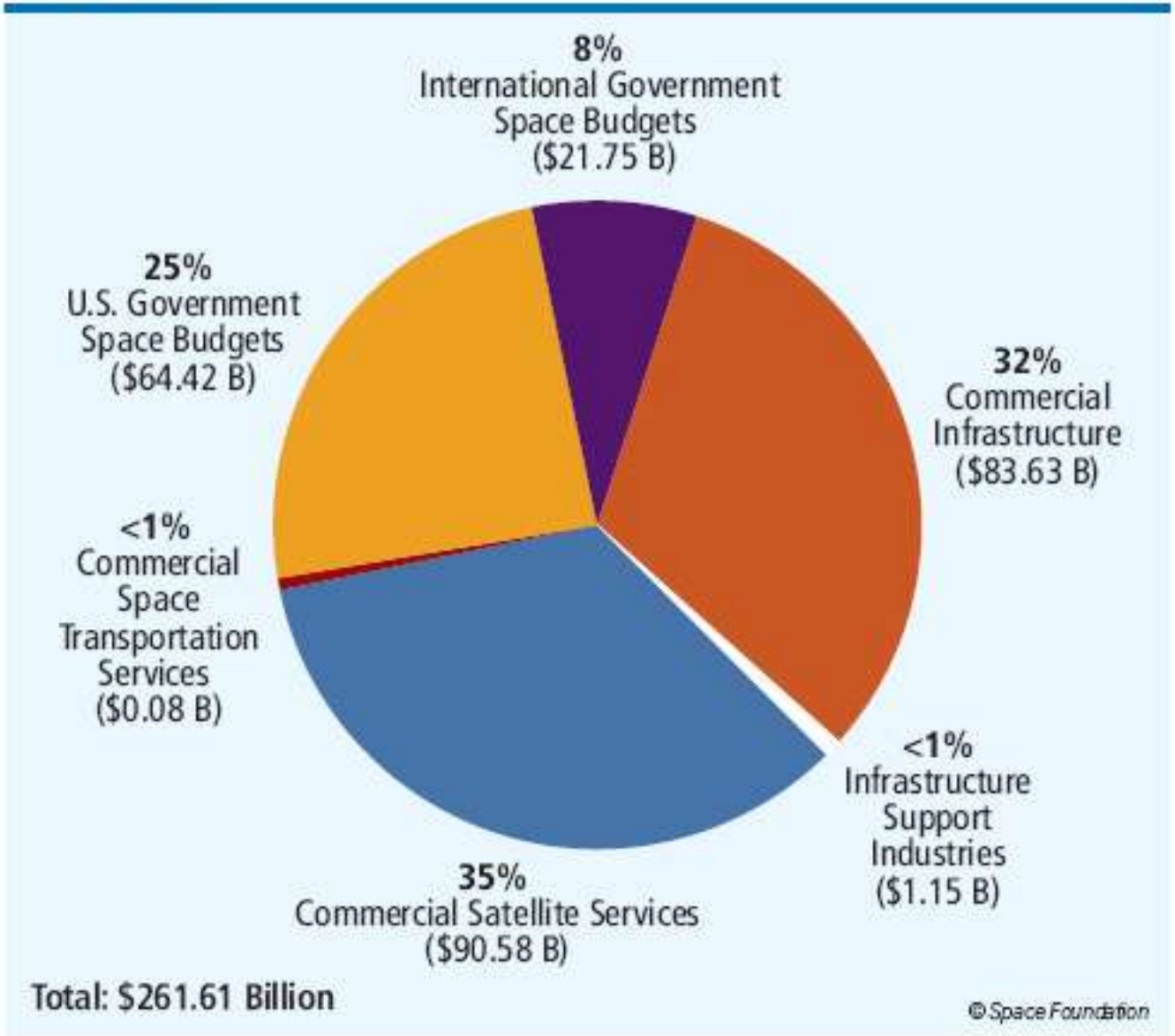
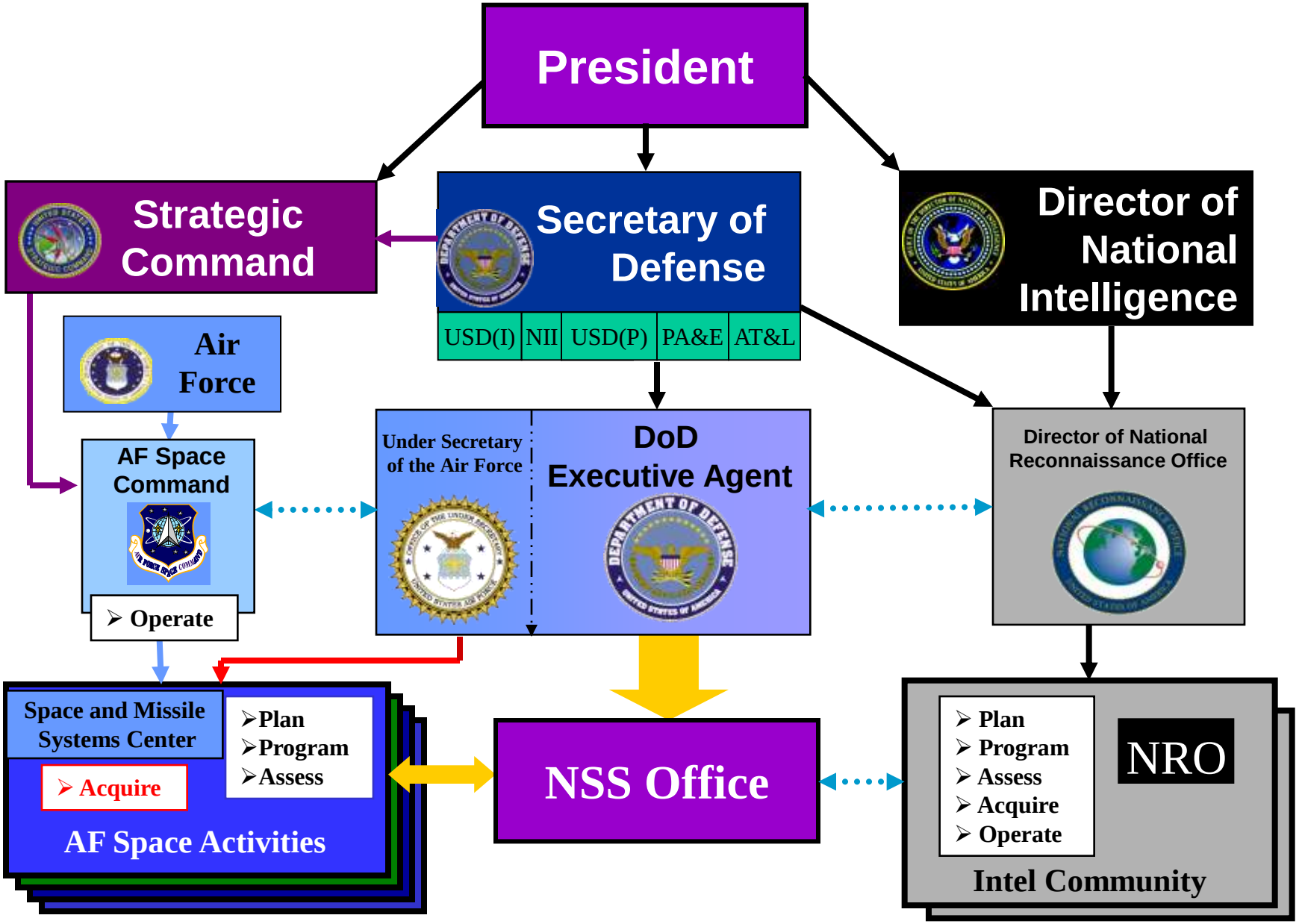

Percent Schedule Growth
140%
120%
100%
80%
60%
40%
20%
0%
0%
100%
200%
300%
400%
500%
600%
Percent Cost Growth
Program B1
70%
SBIRS Prime
82%
VIIRS Payload
(NPOESS), 72%
Program B2
35%
Program D1
100%
SBIRS
Payload
91%
CRIS Payload
(NPOESS), 88%
AEHF
Prime
86%
NPOESS
Prime
53%
OMPS Payload
(NPOESS), 70%
GPS IIF
54%
STSS 06
Prime
90%
SBSS
SubPrime
86%
AEHF
Payload
96%
Program
A1 & A2, 100%
STSS 06
Payload, 100%
Program D2, 100%
Prgm A3
100%
MUOS New Payld, 82%
Prgm A4
100%
MUOS
Prime, 72%
MUOS Legacy
Payload, 79%
Prgms
A7&A8
5%
Prgms
A5&A6
79%
Percents included are % Complete
% Schedule Growth =
Current Months Estimated ATP to First Launch/Estimate at ATP
(except NPOESS (Assumes First Launch = IOC – 6 months), GPS IIF (SV1 availability))
% Cost Growth =
Current CPR EAC/Initial CPR EAC
Black: RF
White: Other
Black Programs
Total Programs
Payloads/Sensors

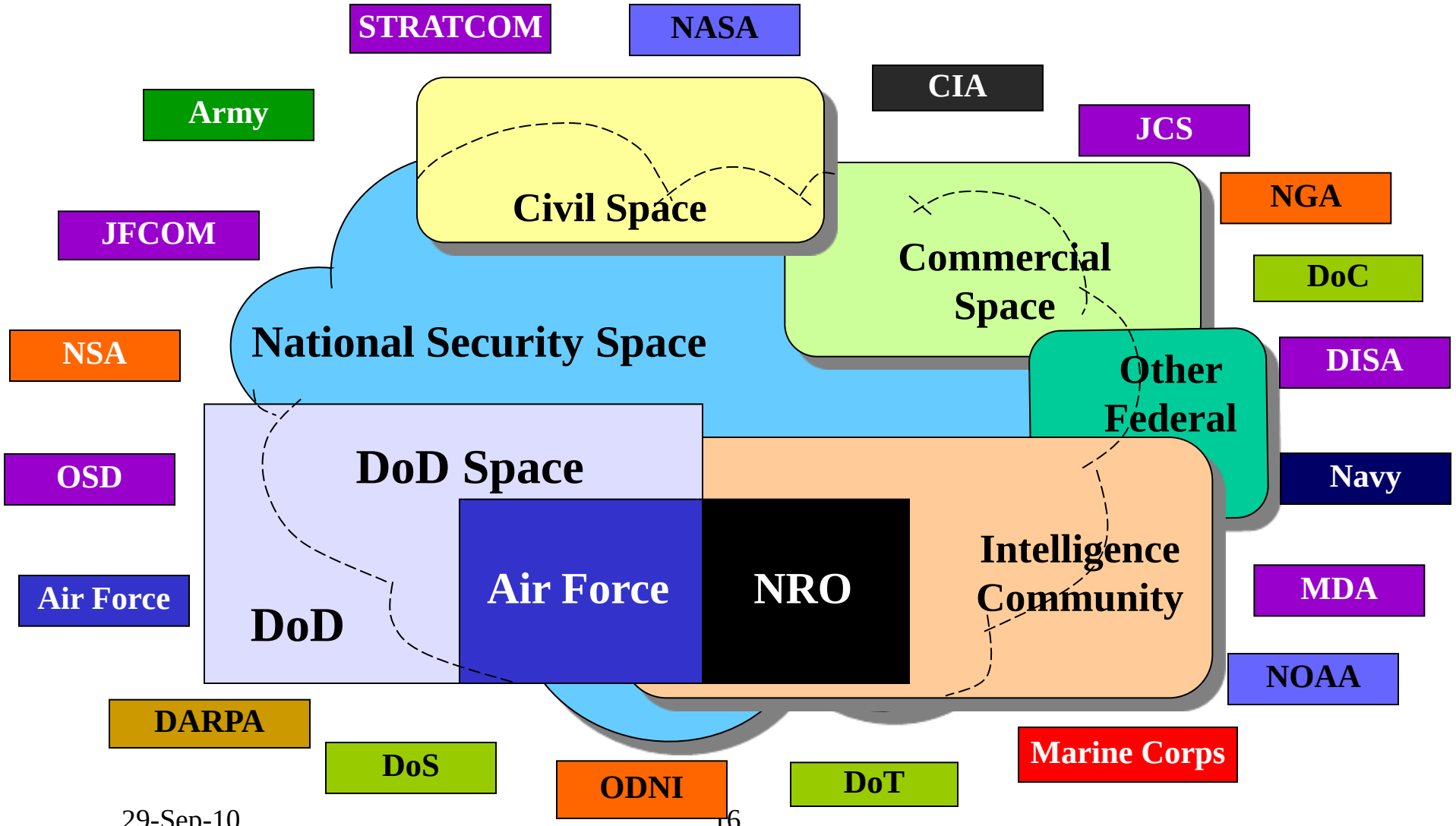
EXHIBIT ES1. Global Space Activity, 2009





* Other DoD Depts & Agencies

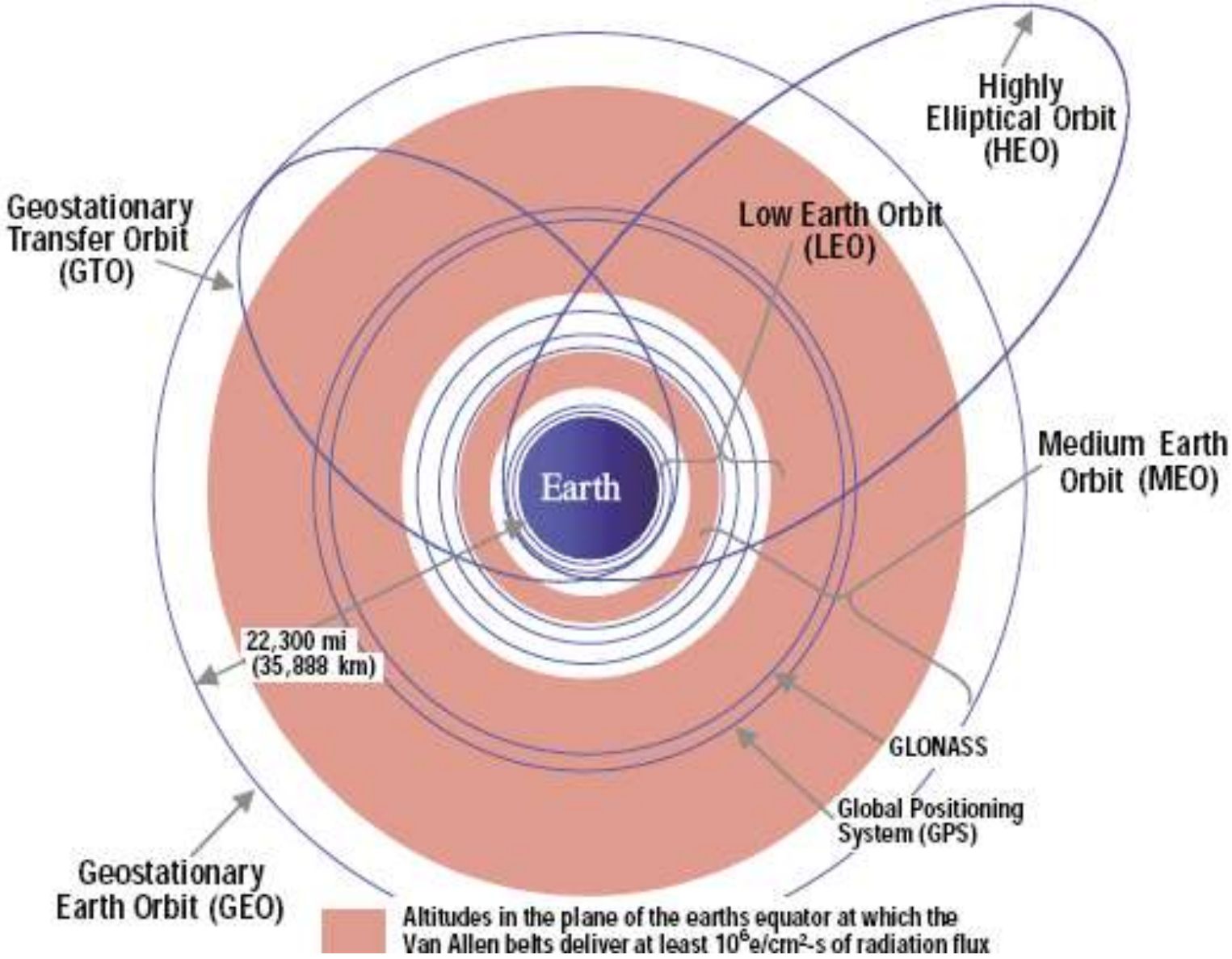
U.S. National Security Space Community

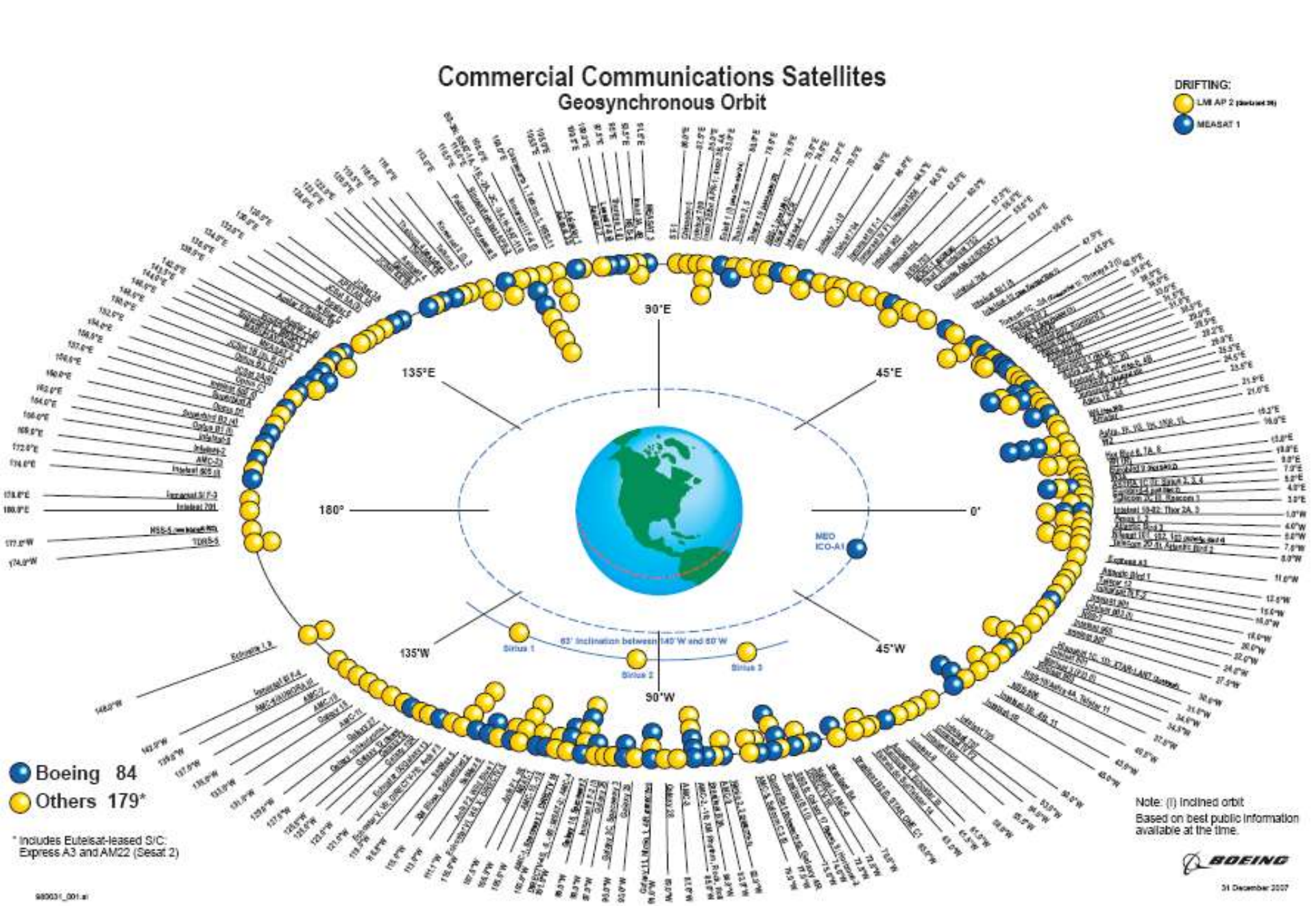


Force Enhancement Missions, Primary Orbits, Major Systems

Environmental Monitoring	Communications	Position, Navigation, and Time	Integrated Tactical Warning and Attack Assessment	Intelligence, Surveillance, and Reconnaissance (ISR)
Polar LEO	Geostationary Orbit (GSO)	Semi-synchronous Orbit	GSO and LEO	Various
Defense Meteorological Support Program (DMSP) --- National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	Defense Satellite Communications System (DSCS) II, DSCS III, Ultra-High Frequency Follow-on (UFO), Milstar, Global Broadcast System (GBS), Iridium, Wideband Global System (WGS), Advanced Extremely High Frequency (AEHF), commercial systems --- Mobile User Objective System (MUOS), Polar Military Satellite Communications System, Transformational Communications System (TSAT)	Global Positioning System (GPS) GPS II GPS IIR GPS IIR-M GPS IIF --- GPS III	Defense Support Program (DSP), GPS --- Space-Based Infra-Red System (SBIRS) , Space Tracking and Surveillance System (STSS)	Imagery (IMINT) Satellites, Signals Intelligence (SIGINT) Satellites, Space-Based Surveillance System (SBSS), commercial systems --- Future Imagery Architecture (FIA), Integrated Overhead SIGINT Architecture (IOSA), Space Radar

Orbit Types

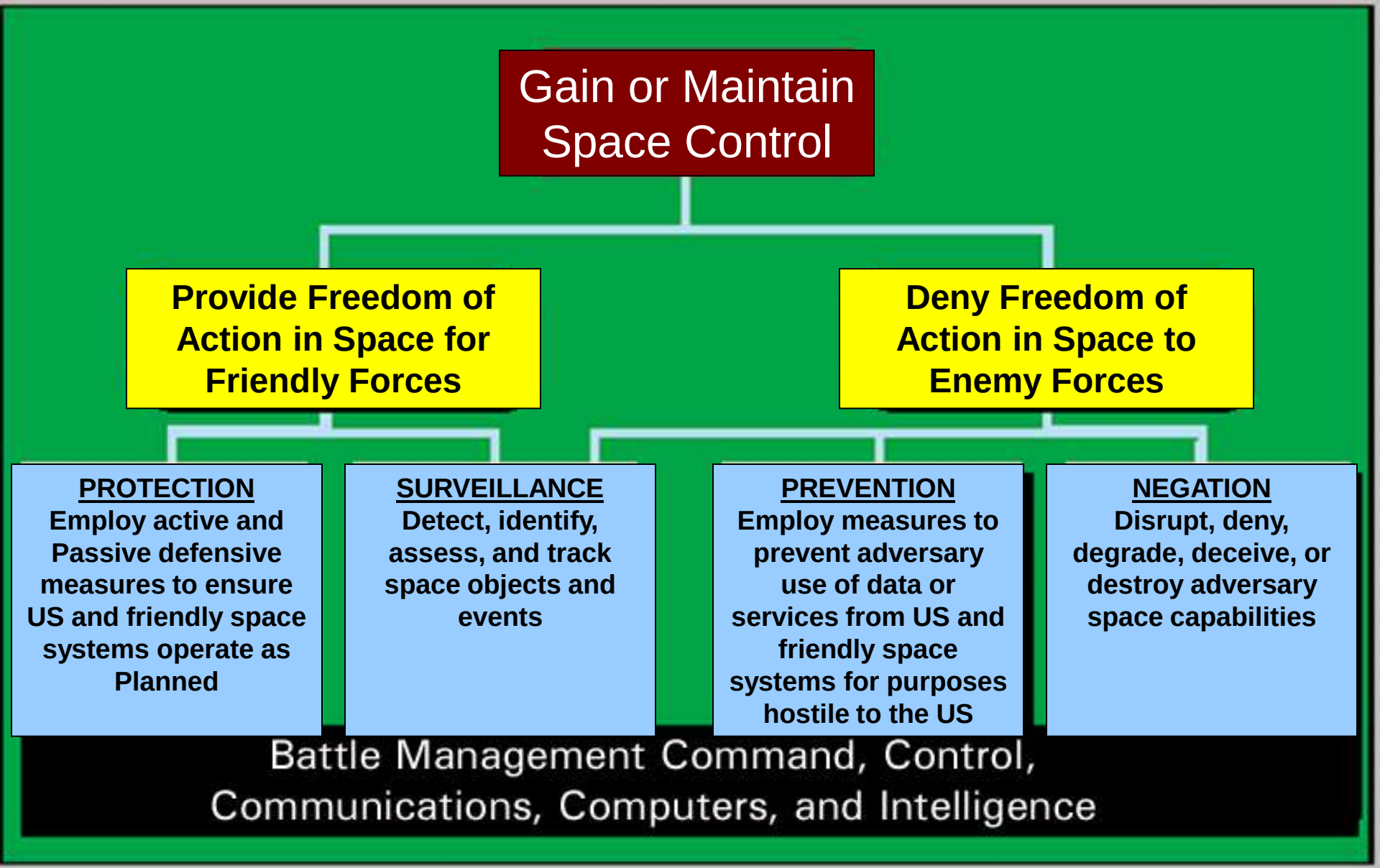

Highly
Elliptical Orbit
(HEO)
Geostationary
Transfer Orbit
(GTO)
Low Earth Orbit
(LEO)
Earth
Medium Earth
Orbit (MEO)
22,300 mi
(35,888 km)
GLONASS
Global Positioning
System (GPS)
Geostationary
Earth Orbit (GEO)
Altitudes in the plane of the earths equator at which the
Van Allen belts deliver at least 10^6e/cm^2-s of radiation flux


Commercial Communications Satellites
Geosynchronous Orbit
DRIFTING:
LMI AP 2
MEASAT 1
90°E
135°E
45°E
180°
0°
135°W
45°W
90°W
MEO
ICO-A1
63° inclination between 140°W and 60°W
Sirius 1
Sirius 2
Sirius 3
Boeing 84
Others 179*
* Includes Eutelsat-leased S/C:
Express A3 and AM22 (Sesat 2)
Note: (I) Inclined orbit
Based on best public information
available at the time.
BOEING
31 December 2007

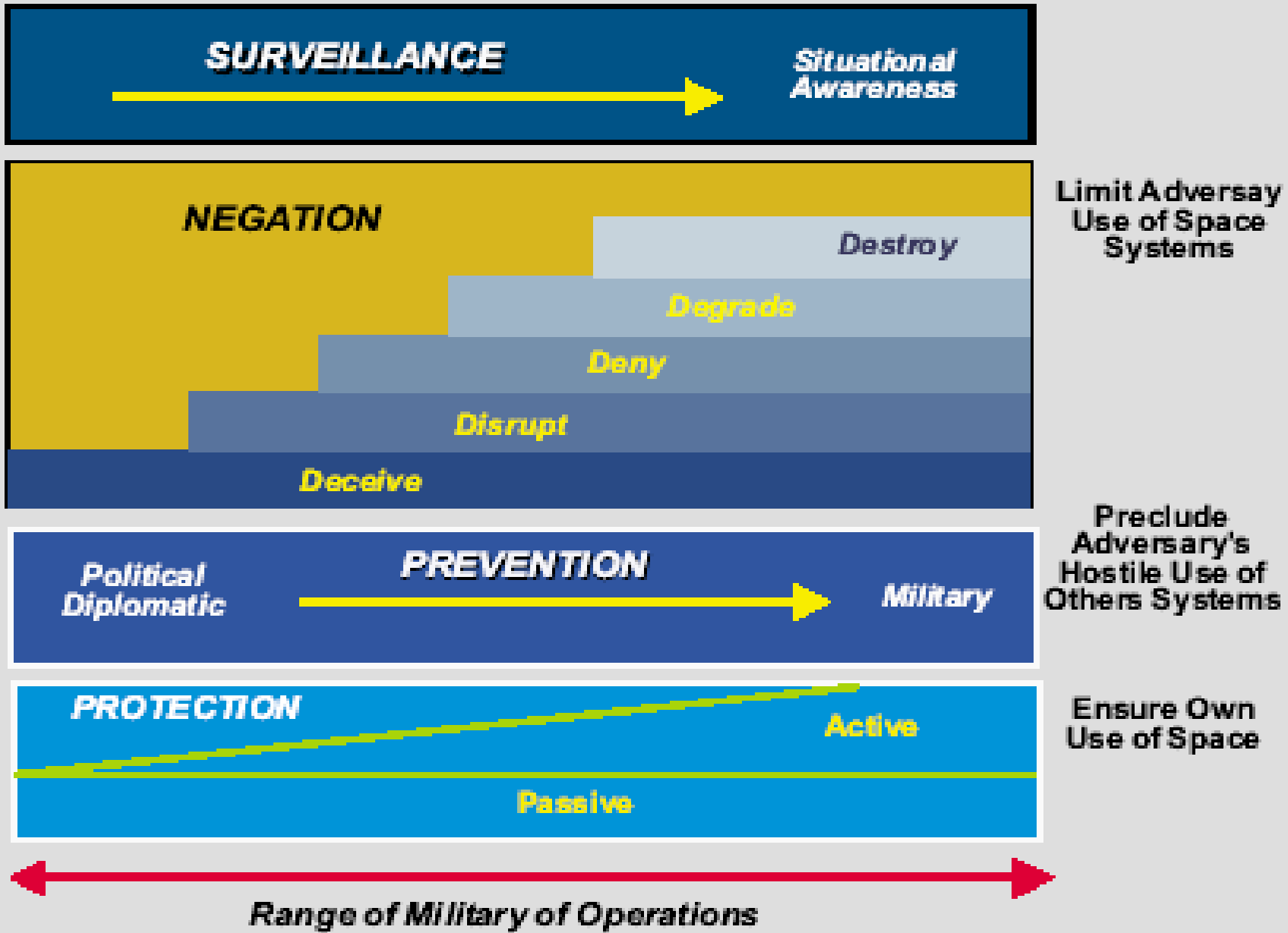
	Primary Value and Functions of Military Space Forces	*Space System Characteristics and Employment Strategies*	*Conflict Missions of Space Forces*	*Appropriate Military Organization for Operations and Advocacy*
Sanctuary	• Enhance Strategic Stability • Facilitate Arms Control	• Limited Numbers • Fragile Systems • Vulnerable Orbits • Optimize for NTMV	• Limited	NRO
Survivability	Above functions plus: • Force Enhancement	• Terrestrial Backups • Distributed Architectures • Autonomous Control • Hardening • Redundancy • On-Orbit Spares • Crosslinks • Maneuver • Less Vulnerable Orbits • Stealth • Attack Warning Sensors • 5 Ds: Deception, Disruption, Denial, Degradation, Destruction • Reconstitution Capability • Defense • Convoy	• Force Enhancement • Degrade Gracefully	Major Command or Unified Command
Control	• Control Space • Significant Force Enhancement		• Control Space • Significant Force Enhancement • Surveillance, Offensive, and Defensive Counterspace	Unified Command or Space Force
High Ground	Above functions plus: • Decisive Impact on Terrestrial Conflict • BMD		Above functions plus: • Decisive Space-to-Space and Space-to-Earth Force Application • BMD	Space Force

Attributes of Military Space Doctrines

SPACE CONTROL MATRIX



SPACE CONTROL MISSIONS



Four Space Sectors

- Civil
- Commercial
- Intelligence
- Defense

Civil Sector Drivers

- STS Retirement
- ISS Operations and Retirement
- Reliance on foreign spaceflight providers
- NASA Exploration Vision
  - Vestiges of Bush initiative v Obama vision
    - NASA budget and congressional direction
    - International cooperation on vision
    - Ares I and V contracts
    - Commercial spaceflight providers
- NASA Science Vision
  - JWST
  - Climate change monitoring

Commercial Sector Drivers

- Telecommunications recovery and new services
  - Fiber Optics v Satcom
- Launch Services
  - Dec 04 Nat'l Space Transportation Policy
  - Supply glut
  - Insurance
  - ITAR and export controls
  - Launch constraints
  - Space tourism
- Remote Sensing
  - PDD-23 and GWB Policies; EO way ahead
  - NGA: ClearView and NextView contracts

CSIS, Feb 2008: Briefing on Working Group on Health of U.S. Space Industrial Base and the Impact of Export Controls

F1: Overall health of top tier "good" but fragile and areas of concern

F2: Inadequate ability of USG and industry to execute programs

F3: US SIB largely dependent on NSS budget

Implication: NSS "owns" SIB; must encourage and enable to compete in global market or employ arsenal model

F4-5: Rapidly emerging foreign space capabilities; US does not control proliferation; US space preeminence under challenge

F6-9: US export controls have not prevented rise of foreign space capabilities; they have sometimes encouraged ("ITAR-free"); US benefits from access to foreign innovation and human capital but increasingly difficult; controls constrict US engagement and partnership with global space community; growing separation; some current controls conflict with National Space Policy

F10-11: US market share steadily declining; increasingly difficult for US companies to complete (particularly 2nd and 3rd tier firms)

F12-13: Export control policy to protect sensitive security space capabilities is important; unanimous agreement control process can be improved without harming national security

Intelligence Sector Drivers

- Horizontal Integration
  - Role of DNI, NRO, NGA, USD(I)
  - Back to the Future of NRO?
- Young DSB Report: Future Imagery Architecture xcelled
  - EO way ahead; gap mitigation
- Space Radar xcelled
  - Replacement capabilities?
    - AESA, DTED, SAR, and SMTI

Four Defense Space Mission Areas

- Space Support
- Force Enhancement
- Space Control
- Force Application

Defense Sector Drivers

- Recapitalization, Protection, Resilience
- Young DSB Report: SBIRS and EELV
- Increasing reliance on commercial SATCOM: 80% in OIF
  - Transformational Communications Architecture: WGS, AEHF, no TSAT, capabilities for AISR, C/NOTM?
- Replacement for SR capabilities, MTI?
- Continuing organization and management issues: Space Commission, Young IAP, Schlesinger Nuc TF, SPR, QDR, HQ USAF

Key Ongoing and Upcoming Issues

- Foster Better Integration of DOD and IC Acquisition and Operations
- Improve Space Situational Awareness
- Develop Space Professional Workforce
- Improve NSS Acquisition, Management, and Organization
- Create Operationally Responsive Space Capabilities
- Reform Export Controls
- Institutionalize Resilience and Protection Measures
- Become Selectively Interdependent with State-of-the-World International and Commercial Capabilities

Space Doves

- **“Unlike the strategy for nuclear weapons, there exists no obvious strategy for employing space weapons that will enhance global stability. If the precedent of avoiding destabilizing situations is to continue—and that is compatible with a long history of US foreign policy—one ought to avoid space-based weapons.”**
  - **Lt Col Bruce M. Deblois, “Space Sanctuary,” *APJ*, 1998**

Militarization Realists

- **“fighting *into* space looks feasible and we should plan for the eventuality. Fighting *in* space shows little promise, while fighting *from* space looks impractical for the foreseeable future, with or without treaties.”**
  - **Maj William L. Spacy II, *Does the United States Need Space-Based Weapons*, 1999**

Inevitable Weaponizers

- **“we know that every medium—air, land and sea—has seen conflict. Reality indicates that space will be no different. Given this virtual certainty, the United States must develop the means both to deter and to defend against hostile acts in and from space.”**

– Space Commission Report, 2001

Space Hawks

- **[concerted development of space weapons by the United States] "will buy generations of security that all the ships, tanks, and airplanes in the world will not provide. . . . Without it, we will become vulnerable beyond our worst fears."**
  - **Sen Bob Smith (R-NH) "Challenge of Space Power," *APJ*, 1999**

Five Potential Paths to Use of Space Weapons

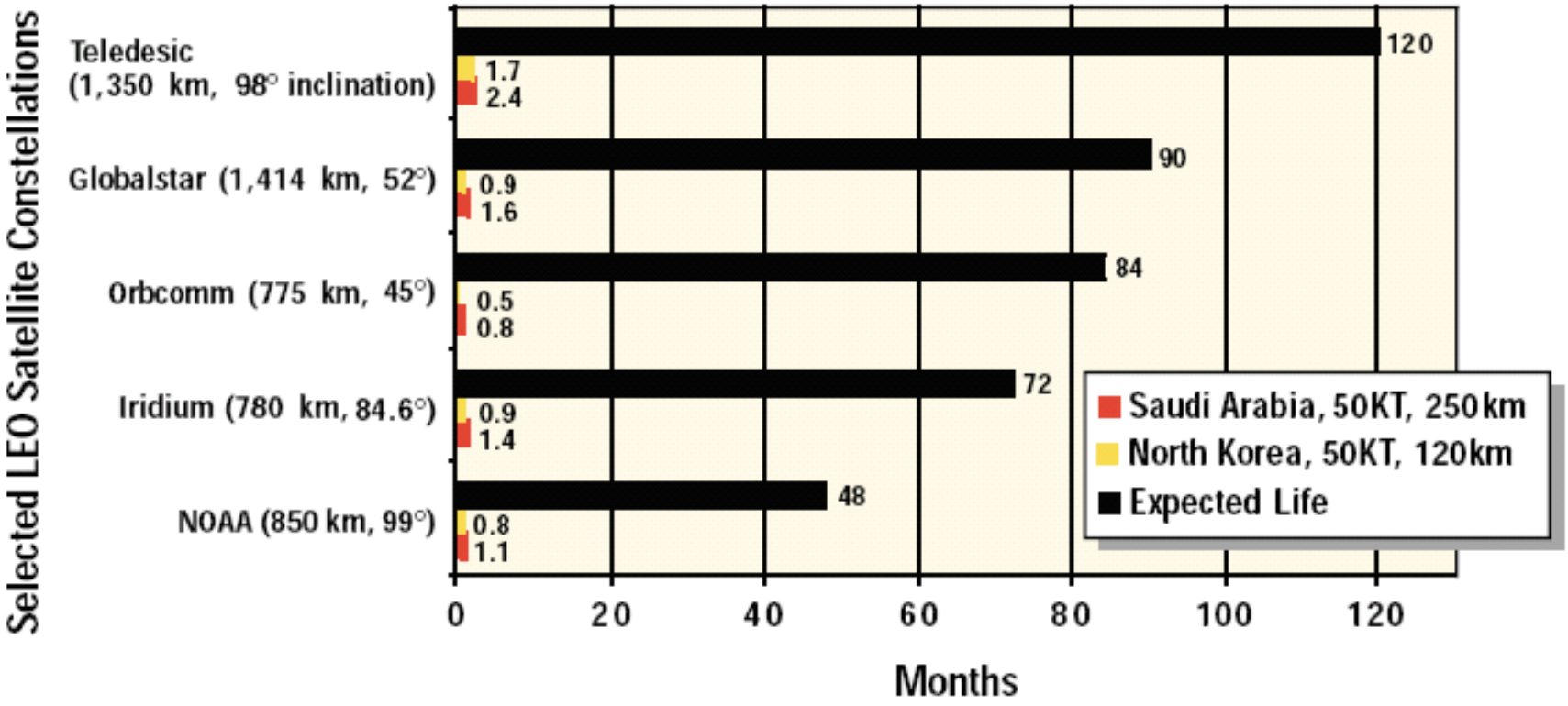
- High-Altitude Nuclear Detonation
- Slippery Slope
- Boost-Phase BMD
- Flag Follows Trade
- Astropolitiks

High-Altitude Nuclear Detonation

- Potential to Disable *all* Nonhardened LEO Satellites
- Prompt Kill for LOS; Effect falls with $1/R^2$
- Gradual Fatal Dose in Weeks to Months
- Potential for $100B+ in Damage
- Starfish Test July 1962; 1.4 MT
- Hardening Possible for 2-3% System Costs

– DTRA HALEOS Study, April 2001

Figure 18: Estimated Effects of Low-Yield, High-Altitude Nuclear Detonations on the Service Lives of Selected LEO Satellites



Note: System hardness assumed twice natural environment

Source: Data from Webb, "Implications of Low–Yield High Altitude Nuclear Detonation," slides 47 and 64.

Slippery Slope

- Range of "weapon-like" options: 5Ds, EW, Laser "Dazzling," Space Mines, Many Residual Capabilities
- "If force application is construed broadly enough to include terrestrial-based applications of military force aimed at affecting orbital systems and their use, one can argue that space warfare has already arrived even though no space-based weapons are currently deployed."
  - Barry D. Watts, *The Military Use of Space*, 2001

Boost-Phase BMD

- Space is Best Basing Mode for Global Boost-Phase Coverage; No Crisis Deployment or Contested Airspace/Littoral
- Limited Engagement Window (70-300 sec); Predelegation or Man-in-the-Loop?
- Even Limited BMD System can have Significant ASAT Capability
- Crisis Stability; Expense; Technologies

Flag Follows Trade

- Neomercantilist Military Protection of New Economic and Strategic Center of Gravity
- "Our investment in space is rapidly growing and soon will be of such magnitude that it will be considered a vital interest—on par with how we value oil today . . ." "it is not the future of military space that is critical to the United States—it is the continued commercial development of space that will provide continued strength for our great country in the decades ahead. Military space, while important, will follow."

  – General Howell M. Estes, III, 1998

Astropolitiks

- Withdraw from current OST-dominated space regime; establish benign free-market sovereignty in space
- Use current and near-term capabilities to seize military control of LEO
- Establish "a national space coordination authority" to "define, separate, and coordinate the efforts of commercial, civilian, and military space projects."
  - "The ultimate goal . . .is not the militarization of space. Rather, the militarization of space is a means to an end, part of a longer-term strategy. The goal is to reverse the current international malaise in regard to space exploration, and to do so in a way that is efficient and that harnesses the positive motivations of individuals and states striving to improve their conditions. It is a neoclassical, market-driven approach intended to maximize efficiency and wealth."
    - Everett C. Dolman, *Astropolitik*, 2001

Key Developments, Events, and Systems

- V-2 brushes edge of space, 3 Oct 42
- RAND's first report, "Preliminary Design of an Experimental World-Circling Spaceship," Apr 46
- Paul Kecskemeti RAND report, 4 Oct 50
- TCP Mar 54-Feb 55; Nov 54 Oval Office meeting: Birth of U-2 and WS-117L; First U-2 Overflight Jul 56
- NSC 5520, May 55; IGY 1 Jul 57-31 Dec 58
- Open Skies Proposal, Jul 55; Stewart Committee Jul-Aug 55; Jupiter-C: 600 miles altitude and 3000 miles downrange, 20 Sep 56
- Sputnik, 4 Oct 57
- Gaither Report, Nov 57; Johnson Hearings, Nov 57-Jan 58; Killian Science Advisor, Nov 57
- Gen T.D. White "Aerospace Concept" Nov 57
- Vanguard Failure 6 Dec 57; Explorer 1 Launch 31 Jan 58

Key Developments, Events, and Systems

- ARPA, Feb 58; NASA Oct 58; Civ-Mil Seam; ABMA to NASA 1 Jul 60
- NSC 5814, Aug 58
- CNO Burke Recommends Unified Command, Sep 59
- Bold Orion ASAT Test, 19 Oct 59
- CORONA Failures, 28 Feb 59-19 Aug 60 (XIV); SAMOS Panel; NRO Created, Aug 60
- Systems Command Established 1 Apr 60
- DoDD 5160.32 , 6 Mar 61, USAF "EA" for Space
- "Blackout Directive" 23 Mar 62
- SAINT
- Dyna-Soar, X-20, Cancelled 10 Dec 63; MOL started
- Program 505 (Aug 63-67); Program 437 (Jun 64-Apr 75)
- LTBT: nuc testing banned except underground, Vela Hotel NUDET System, first NTMV

Key Developments, Events, and Systems

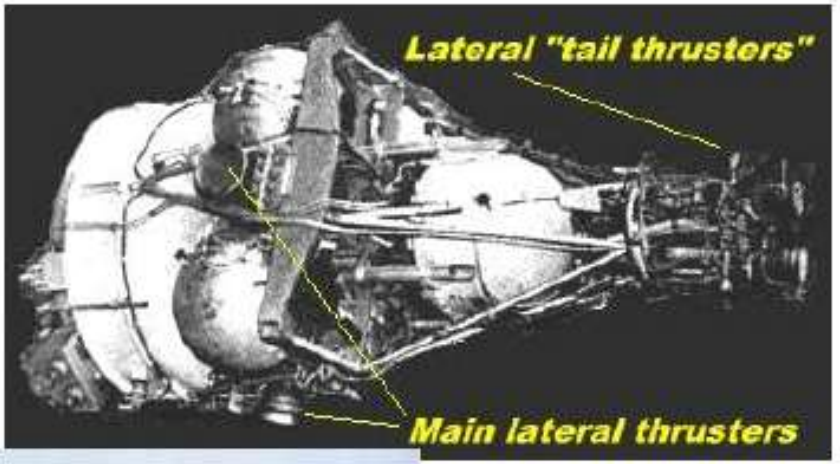
- NASM 156 Committee, Banning the Bomb, OST
- MOL Program 10 Dec 63-10 Jun 69
- SAMSO, 1 Jul 67
- STS Announced, 5 Jan 72
- SALT I, ABMT and NTMV, 26 May 72
- KH-11, 19 Dec 76
- NSDM-333 and 345, 18 Jan 77, MHV ASAT
- PD-37, 11 May 78; PD-42, 10 Oct 78
- AFSPC Established, 1 Sep 82
- SDI Speech, 23 Mar 83
- USSPACECOM Established, 23 Sep 85
- MHV ASAT Test, 13 Sep 85

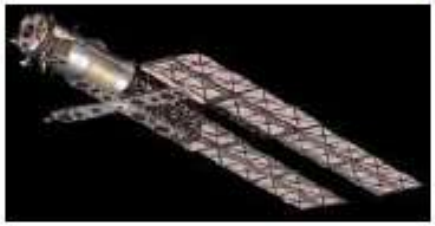
ASAT Arms Control Efforts

- Development and testing of ASAT capabilities not covered by OST or other space agreements
- Two-Track Diplomacy with three rounds of US-USSR ASAT negotiations 1978-79
- USSR testing moratorium 1982-86; Congressional restrictions on MHV ASAT testing
- DST was only “bucket” of AC that did not lead to agreements during 1980s-90s
- Ongoing PAROS and PPTW efforts at CD; UNGA Resolutions

Soviet Space Systems and Co-Orbital ASAT

Rorsat





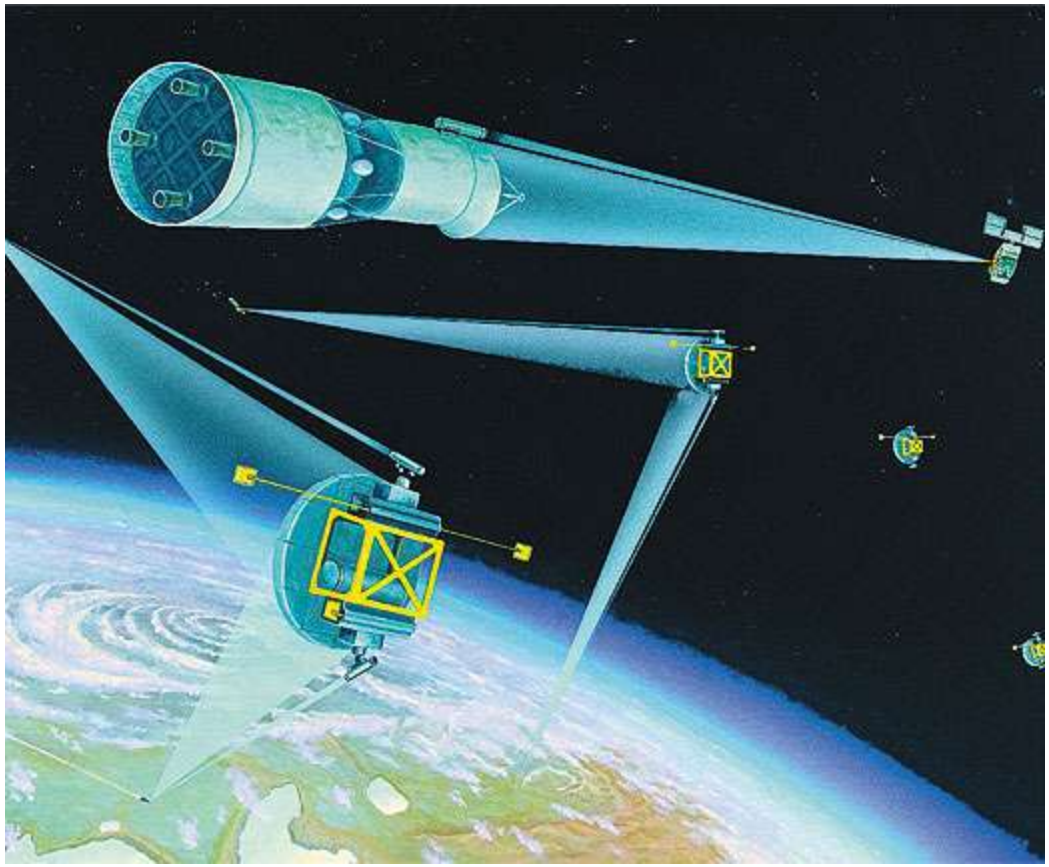
Eorsat

DS-P1-M Target Satellite

Energia carrying Skif DM (Polus) prototype "battle station"

Soviet Space Systems and Co-Orbital ASAT

- Many details about system remain classified or unclear; used two types of satellites: co-orbital active killers (Istrebitel or killer) and passive targets
- First tests, Polyot-1 and Polyot-2, conducted in 1963 and 1964; Subsequently 19 target satellite tests and 22 killer satellite tests. Full operational capability in 1972; last test on 18 Jun 1982
- Killer satellites tested in 1970s ready for launch within 90 minutes (using a Tsiklon booster); could close within less than one kilometer of target satellites within 40-50 minutes
- Aug 1983: Yuri Andropov announced a moratorium on design, construction, and testing; moratorium ended in Sep 1986
- May 1987: Michael Gorbachev visited Baikonur and saw co-orbital killer satellite and prototype of anti-satellite and anti-missile platform called Narvad (Guard). General Zavalishin, who escorted Gorbachev, used this opportunity to advocate resumption of testing. Zavalishin pointed at similar US developments and promised to cover up ASAT launches so no one would suspect tests were taking place. As Zavalishin recalls, "...Gorbachev issued incoherent and wordy explanations, which concluded with a polite, but resolute refusal."
- Ironically, only few days after this conversation, on 15 May 1987, the first heavy-lift Energia rocket blasted off from Baikonur, carrying Skif DM (Polus) spacecraft, which was later described as a prototype "battle station" in space. Due to a software glitch, the 90-ton-class spacecraft never made it into orbit

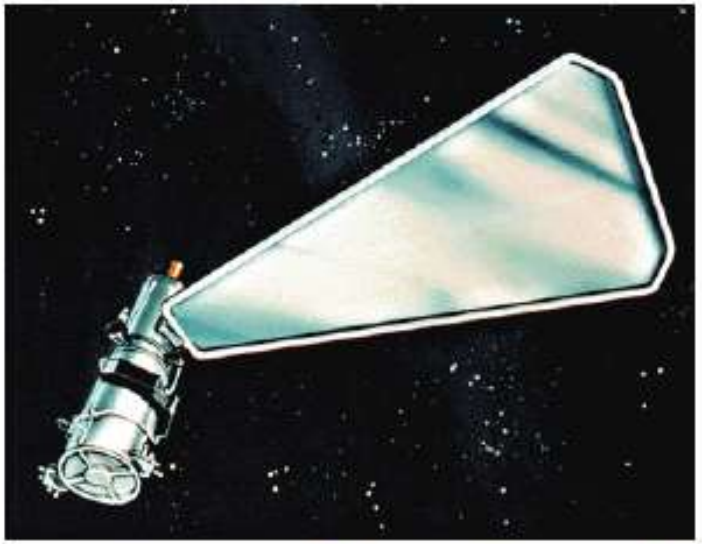


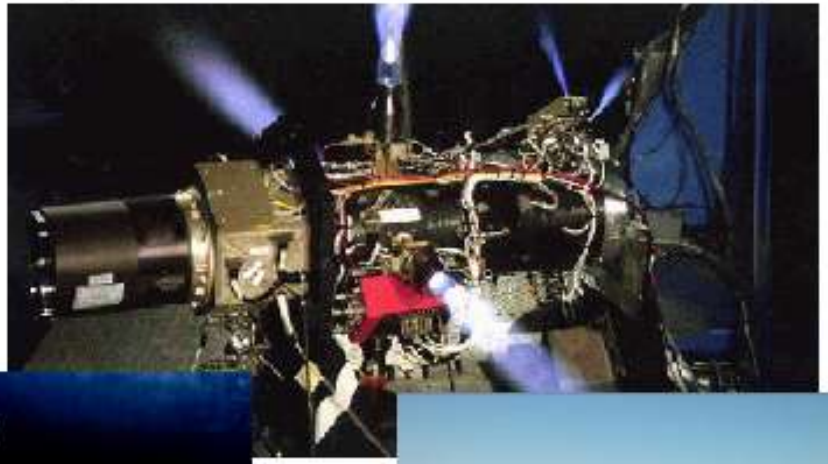
DIA, *Soviet Space Power* Cover, 1987

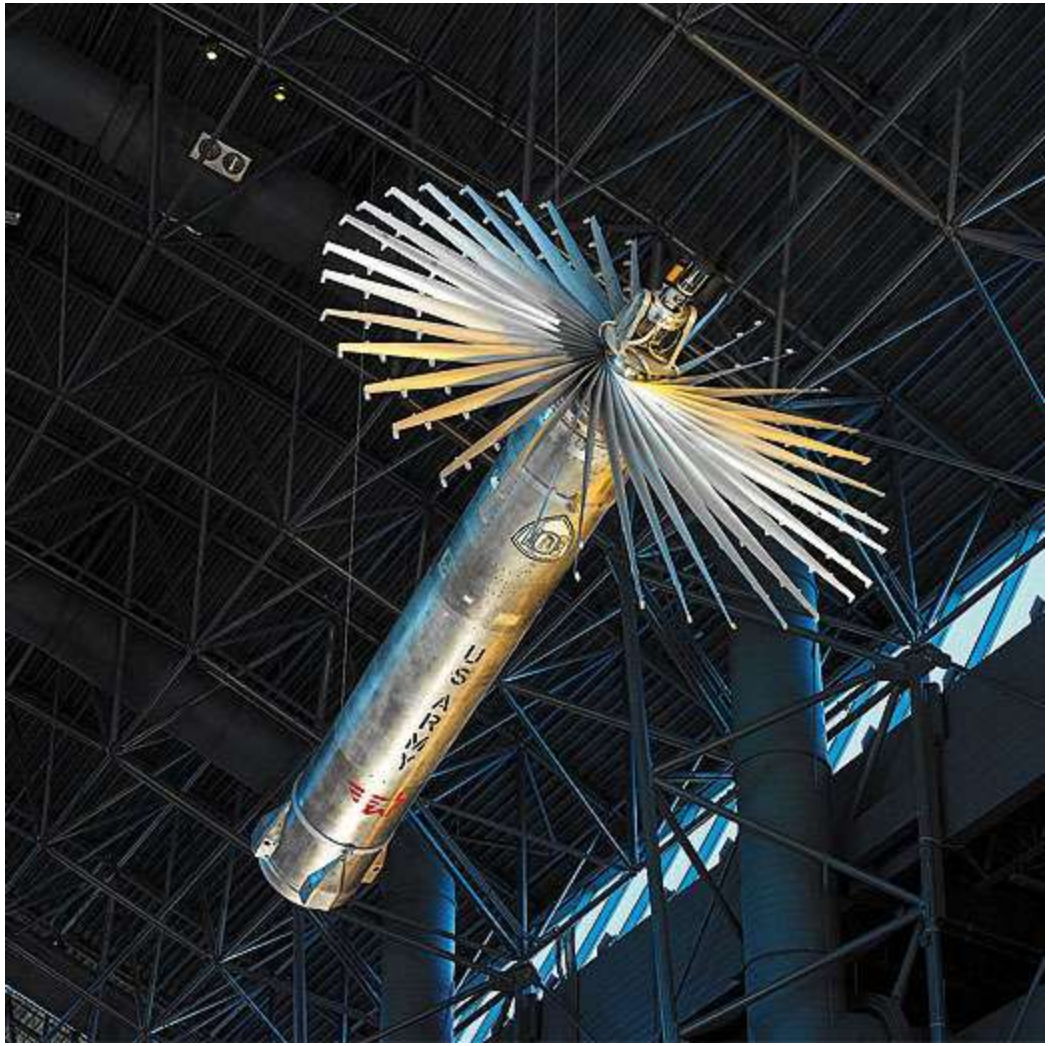
Gorbachev at *Energia* Launch Pad, Tyuratam (Baikonur Cosmodrome, Kazakhstan), May 1987


МИР

US ASAT Systems and Residual Capabilities



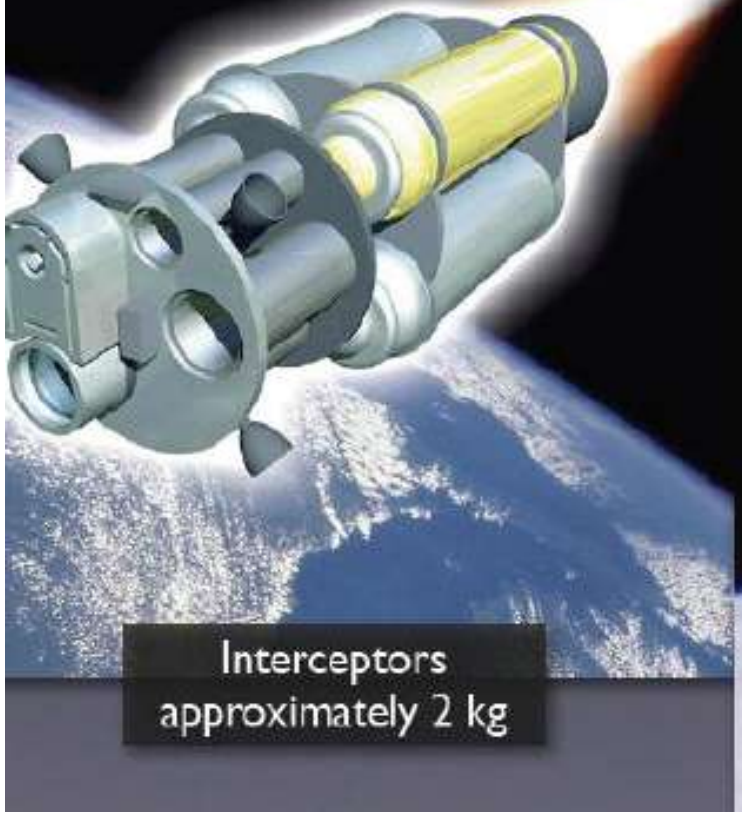




U.S. Army Homing Overlay Experiment, NASM

Brilliant Pebbles Interceptors

Interceptors travel 5 miles/sec (rifle bullet travels 1/2 mile/sec)



Interceptors approximately 2 kg

Brilliant Pebbles Pros and Cons

Pros

- Small, lightweight, distributed constellation
- Rapid, "assembly line" construction, off-the-shelf parts and technology. Iridium proved this concept, and Teledesic was to employ it as well
- In 1991, the Pentagon estimated that BP could be deployed and operated for 20 years for around $11-16B, compared to $50-60B for THAAD and land/sea-based NMD
- Meets the "Nitze" criteria
- No technological "showstoppers"

Cons

- Constellation of 1,000 would be required for limited defense
- Truly global coverage to defend against a massive missile barrage would require 7,000-100,000 Brilliant Pebbles
- Deployment would have violated the 1972 ABM Treaty (at the time)
- Deployment could lead to a race to weaponize space, or to increased asymmetrical capabilities by adversaries


U.S. AIR FORCE

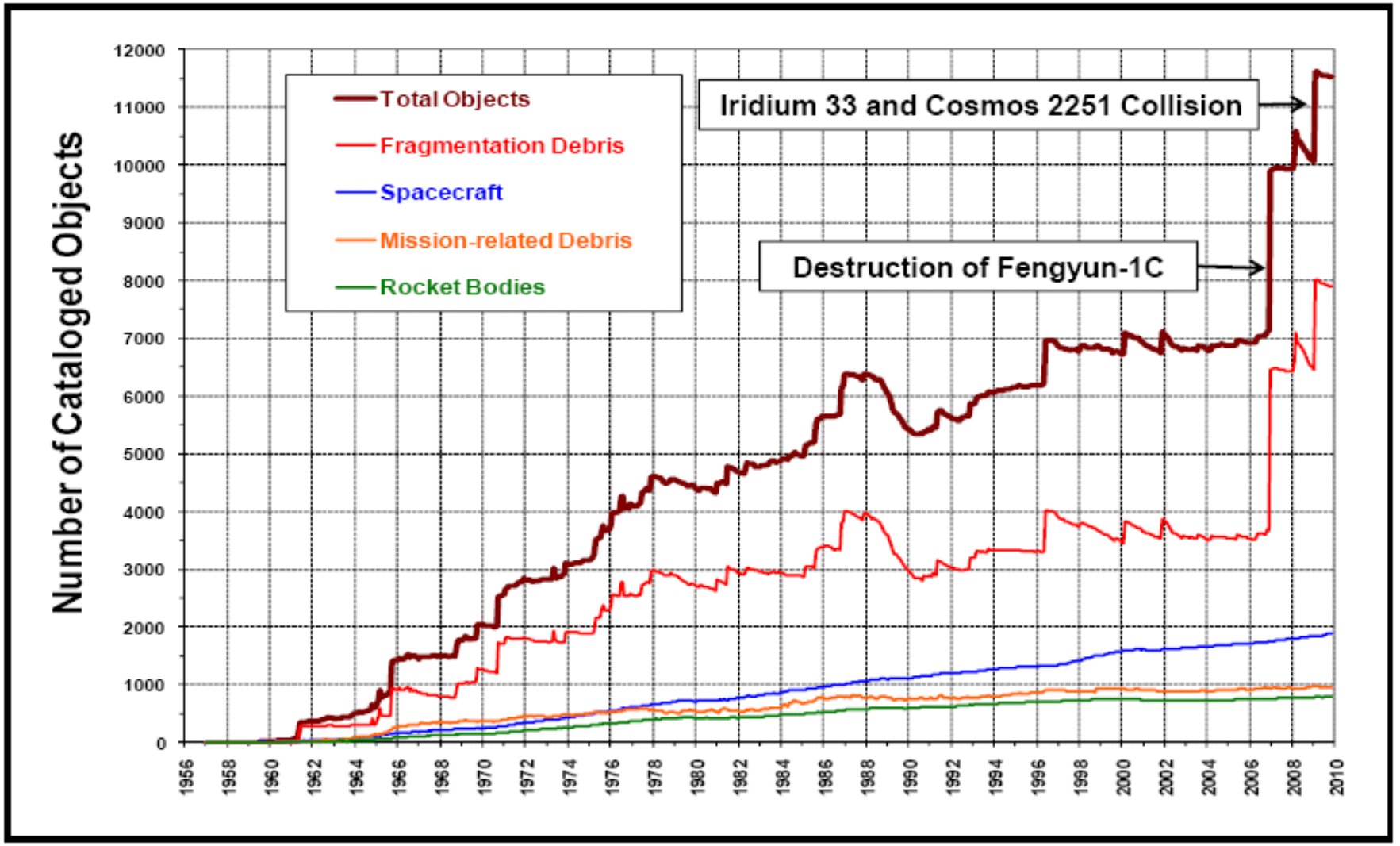


Figure 1. Growth of the cataloged LEO space object population (objects with orbital periods less than 127 minutes).

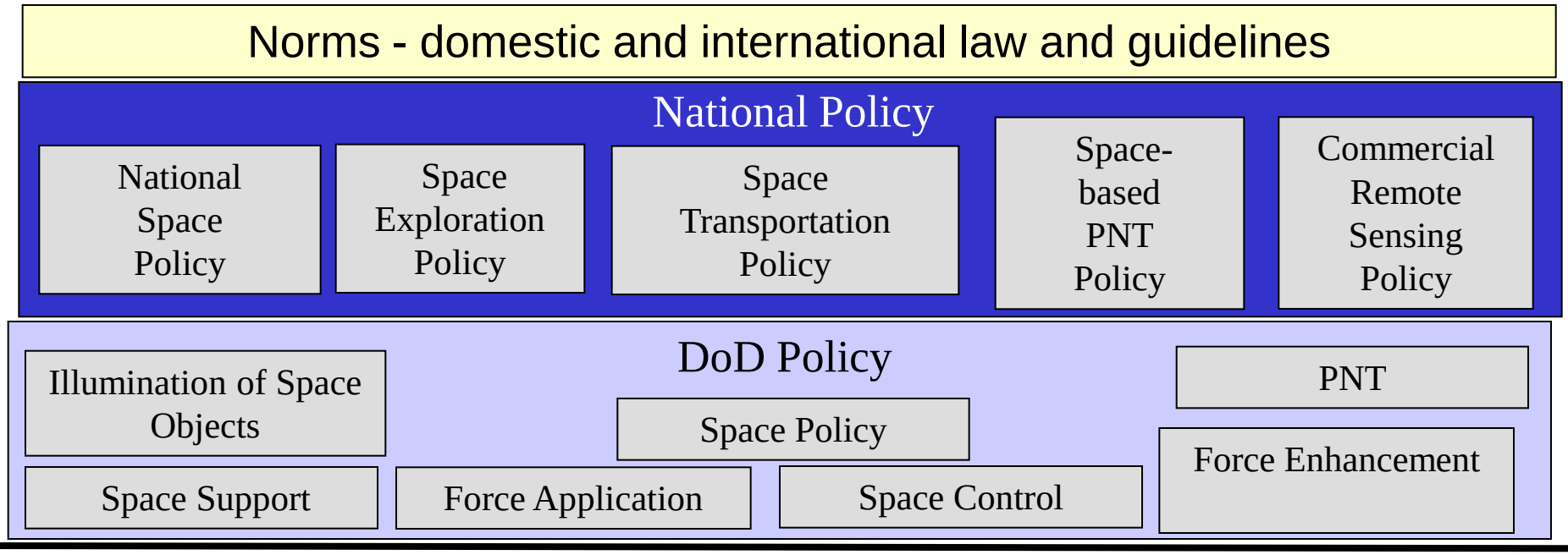
SSA Concepts and Jargon

- ***Conjunctions***: close approaches, or potential collisions, between objects in orbit
- ***Propagators***: complex modeling tools used to predict the future location of orbital objects; satellite operators currently use different propagators and have different standards for evaluating and potentially maneuvering away from conjunctions; maneuvering requires fuel and shortens operational life of satellites
- ***Ephemeris***: Data and sets of variables that completely describe orbital paths; ***two-line element sets (TLEs)*** are most commonly used ephemeris data; much of this data is contained in the form of a ***satellite catalog****;* U.S. public catalog at space-track.org; other entities maintain their own catalogs
- ***Perturbations***: Orbital paths constantly change, or are perturbed, by a number a factors including Earth's inconsistent gravity gradient, solar activity, and the gravitational pull of other orbital objects. Perturbations cause propagation of orbital paths to become increasingly inaccurate over time; beyond approximately four days into the future predictions about the location of orbital objects can be significantly inaccurate.
- ***Commercial and Foreign Entities (CFE) Pilot Program***: Established by Congress in 2004, extended to end of FY10; Dec 08 Unified Command Plan made STRATCOM responsible for SSA and also CFE a/o 1 Oct 09; now **SSA Data Sharing Program**

Current Debris Status and Issues; Nick Johnson Congressional Testimony, 28 Apr 09

- Debris environment spans 100-20,000+mi above Earth; debris mass <1oz-many tons
- 4,600+ space missions since 1957; debris objects include defunct spacecraft, derelict launch vehicle orbital stages, intentional refuse, and products of more than 200 satellite explosions and collisions.
- Today, U.S. Space Surveillance Network, managed by STRATCOM, tracks more than 21,000 objects in Earth orbit (~95% is debris). However, SSN can only track larger pieces of debris, typically 10cm (4in) in diameter; debris as small as half an inch exceeds 300,000. Debris possesses tremendous energies, collision between debris only 0.5in and operational spacecraft has potential for catastrophic consequences.
- In 1995, NASA was first USG organization to establish formal space debris mitigation guidelines. In 2001, the U.S. Government Orbital Debris Mitigation Standard Practices, (based on NASA guidelines) adopted. Fundamental elements of NASA guidelines adopted in 2002 by IADC. In 2007, UNCOPUOS and UNGA adopted similar guidelines.
- NASA requires conjunction assessments for all its maneuverable spacecraft. Collision Avoidance maneuvers in last 12 months: EOS in LEO X2, TDRSS in GEO, ISS in LEO X2
- 1961-96: average increase in catalogued debris was 270/year; 1996-06 rate dropped to only 70/year; BUT Jan 07 Chinese ASAT Test and Feb 09 Iridium-Cosmos collision increased cataloged debris 40%; Chinese ASAT accounts for 25% of catalogued objects
- Debris already present is sufficient to lead to more collisions and generate more debris; in the future, such collisions are likely to be principal source of new debris. Most effective means of limiting collisions is removing large “dead” satellites and rocket bodies. However, remediation of near-Earth space environment presents substantial technical and economic challenges.

Space Policy Framework



Strategy Framework for National Security Space

National Security Strategy

National Defense Strategy

National Intelligence Strategy

National Military Strategy (NMS)

NMS for Space Operations

SPR

NIS for Space Operations

National Security Space Strategy

National Security Space Plan

3 Questions

- Why a New National Space Policy?
- What Does it Change?
- Why Do You Care?

PPD-4

Why a New National Space Policy?

1. New Administration
2. Evolving Strategic Context
3. Changing Space Domain

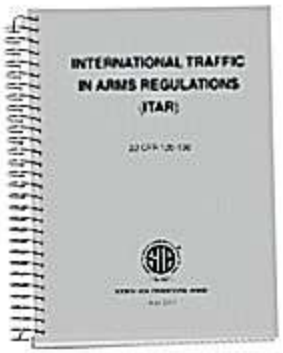
Congested & Contested? Yes

"United States national security is critically dependent on space capabilities, and this dependence will grow." *National Space Policy, 2006*

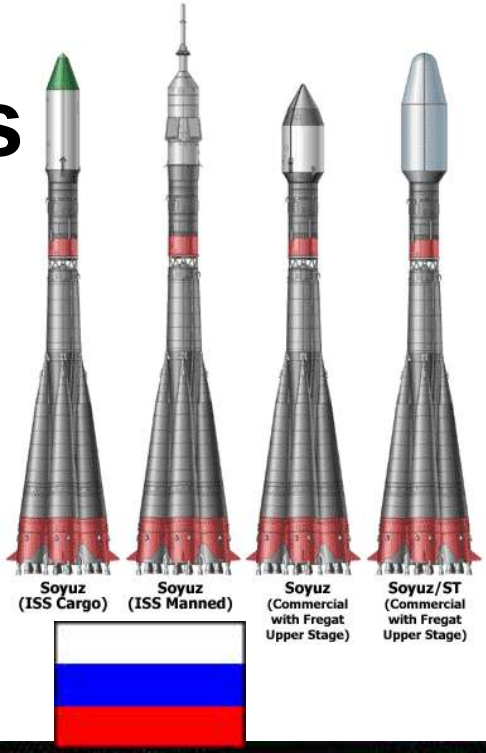
- Space capabilities are vital to U.S. national and global interest, but face a wide range of maturing threats and challenges
  - Congested - increased access to and use of space– orbital crowding; spectrum competition; debris; collision risk
  - Contested - Adversaries continue to seek means to deny space advantages

- 2002 - Falun Gong reportedly began jamming and hijacking TV on Chinese COMSATs
- 2003 - Iran jams Telestar-12 & Iraqis jam GPS
- 2005 - Libya reportedly jams Telestar-12
- 2007 - China tests direct-ascent anti-satellite
- 2008 - Interference on Terra SAT & LANDSAT
- 2009 - Iran launches experimental satellite
- 2009 - Iridium 33 – COSMOS 2251 collision
- 2009 - North Korea space launch attempt fails
- 2010 – Chinese Interceptor test
- 2010 – Iranian SATCOM Jamming

Counter Space Threat Continuum



Competitive? Yes



What Does it Change?

PPD-4

Key Changes

- **Commercial and civil emphasis**
- **Goal of greater/expanded international cooperation**
- **Desire for norms of responsible behavior in space**
- **Opened door to arms control discussions**
- **Focus on assurance mission-essential functions (vice space protection)**
- **[classified language made some changes too]**

…some things didn't change:

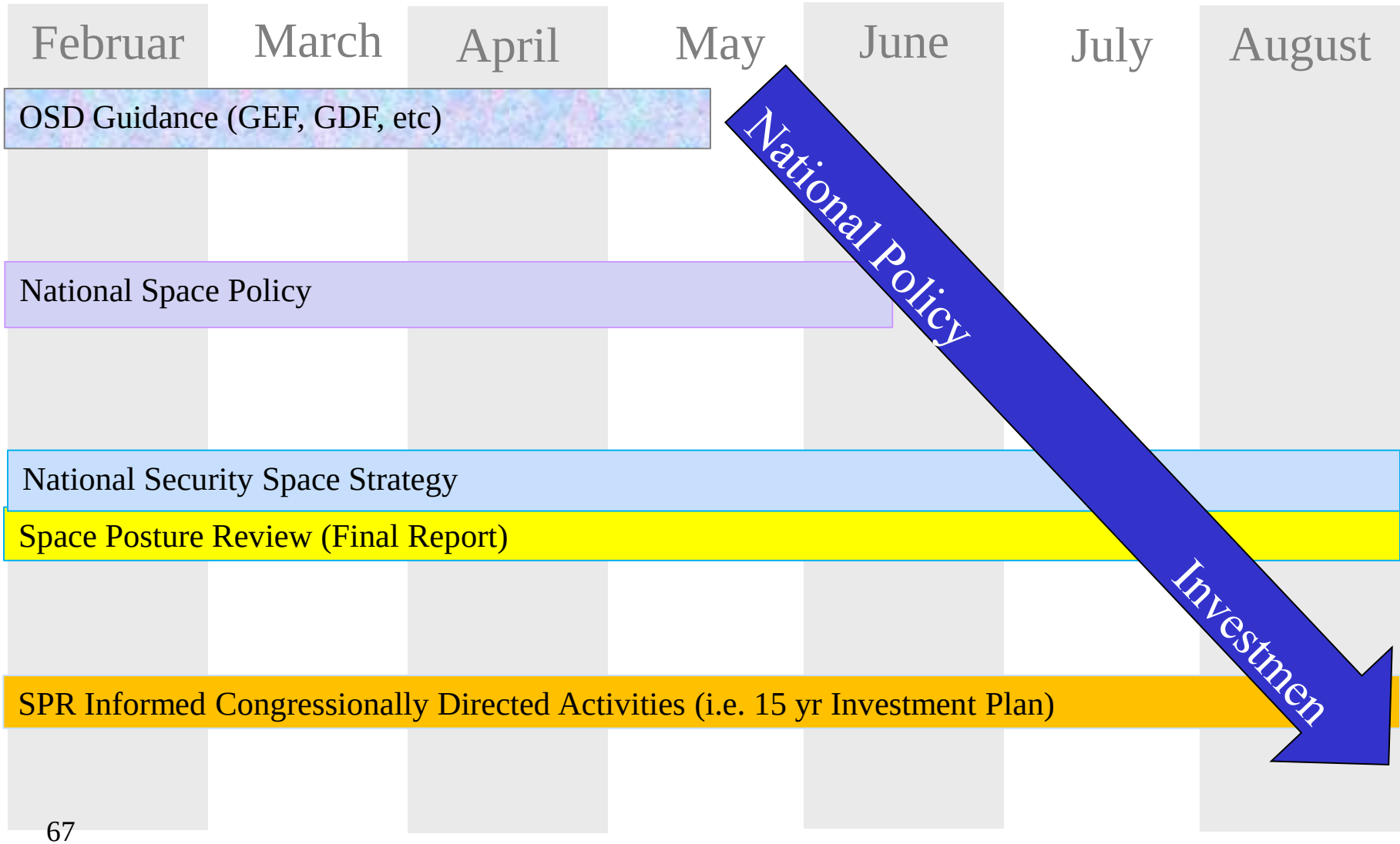
- **Acquisition**
- **Space Pros (STEM)**
- **ITAR**
- **Etc…**

Implementation Guidance
More Directive with Hard Suspenses.
DoD Got 15 Major Taskers!

Why Do You Care?

PPD-4

Intend to put our money where our strategy is…



This Policy Will Drive Greater Changes (Ex: NSSS)

- NSSS (planned for release late Aug / early Sept)
  - Closes out SPR and links strategic direction to programmatics
  - Objectives:
    - Strengthen safety, security, stability in space
    - Maintain and enhance strategic advantages
    - Energize the industrial base
  - Approaches (the Five P's):
    - Promote responsible use of space
    - Provide improved U.S. capabilities
    - Partner with other responsible nations, international organizations, and commercial firms
    - Prevent and deter (deter = key concept) attacks on space infrastructure
    - Prepare for attacks and operations in a degraded environment

5 Ps

- ***Promote*** responsible use of space
  - Norms of behavior or "rules of the road"
  - Code of conduct
    - Debris
    - Interference
    - KE ASAT test ban?
    - Proximity ops?
  - Arms control????
    - What is a weapon?
    - How do you verify?
    - What is equitable?

Best chance for early success.
More questions than answers right now…

5Ps

- ***Provide*** improved U.S. capabilities
  - Our strategy requires a paradigm shift
  - The new policy does not have these words="Freedom of Action"
    - But…in order the **lead** a coalition of space-faring nations…and have something enticing to bring players to the table (read "hooked" on our space stuff), we must still be IN THE LEAD in some areas
  - So the paradigm shift is from: space dominance and cooperate with nobody….
  - To: maintain enough strategic advantage to support national needs while sharing state of the world capabilities to create mutual dependencies and cost sharing

5Ps

- ***Partner*** with other responsible nations, international organizations, and commercial firms
  - Push toward greater interoperability, integration, and reliance on international and commercial partners
    - Shared constellations (WGS model)
    - Interoperable terminals (i.e. Galileo/GPS user equip)
    - Jointly developed constellations (JSF-like model)
    - Innovative commercial opportunities (hosted payloads)

5Ps

- ***Prevent*** and deter attacks on space infrastructure
  - Achieve deterrence effects in space
    - More distributed, robust architectures to deny benefits of attack
    - Impose costs / deny
  - Also seek to deter aggression against commercial and international assets the United States relies on
    - SATCOM (SES, Intelsat, Eutelsat, Inmarsat, etc)
    - International capabilities that we rely on (Skynet in the future?)

5Ps

- ***Prepare*** for attacks and operations in a degraded environment
  - Greater resilience of U.S. capabilities
    - Distribute capabilities across more platforms (hosted payloads)
    - Responsive alternatives for augmentation / reconstitution (ORS)
  - Distribute capabilities across partners' platforms
    - Strategic partnerships with commercial firms ("CRAF for space"?)
  - Maintain mission-effective alternatives for operations in a degraded space environment
    - Re-learn to fight and win without less/hampered space capes
    - Cross-domain solutions (i.e. air comm layer)
    - Strategic messaging of U.S. ability to succeed in degraded space environment (benefit denial)

Backup Slides