Threats to Space Systems and Protecting Space Systems from Attack

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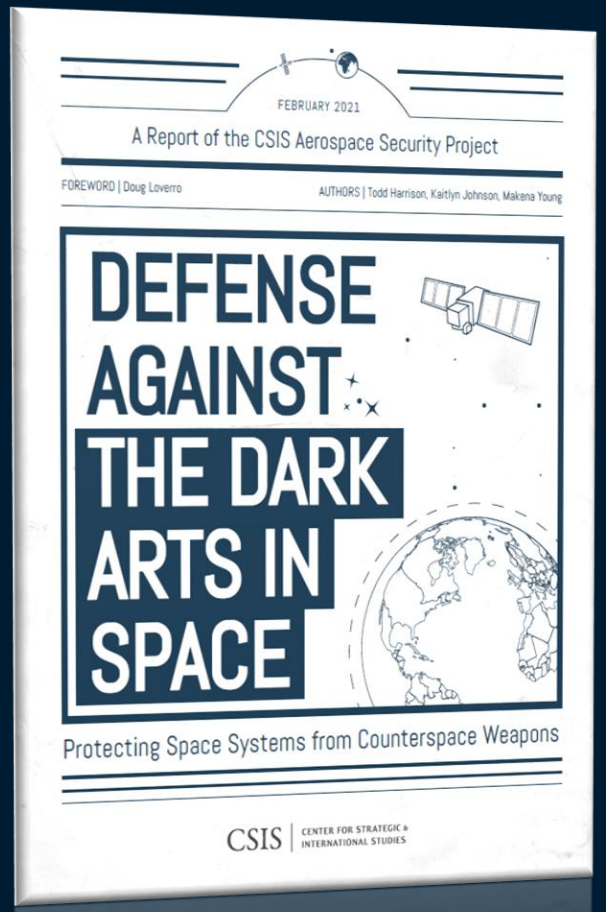
Our Mission: Educate and Inform the Public Debate



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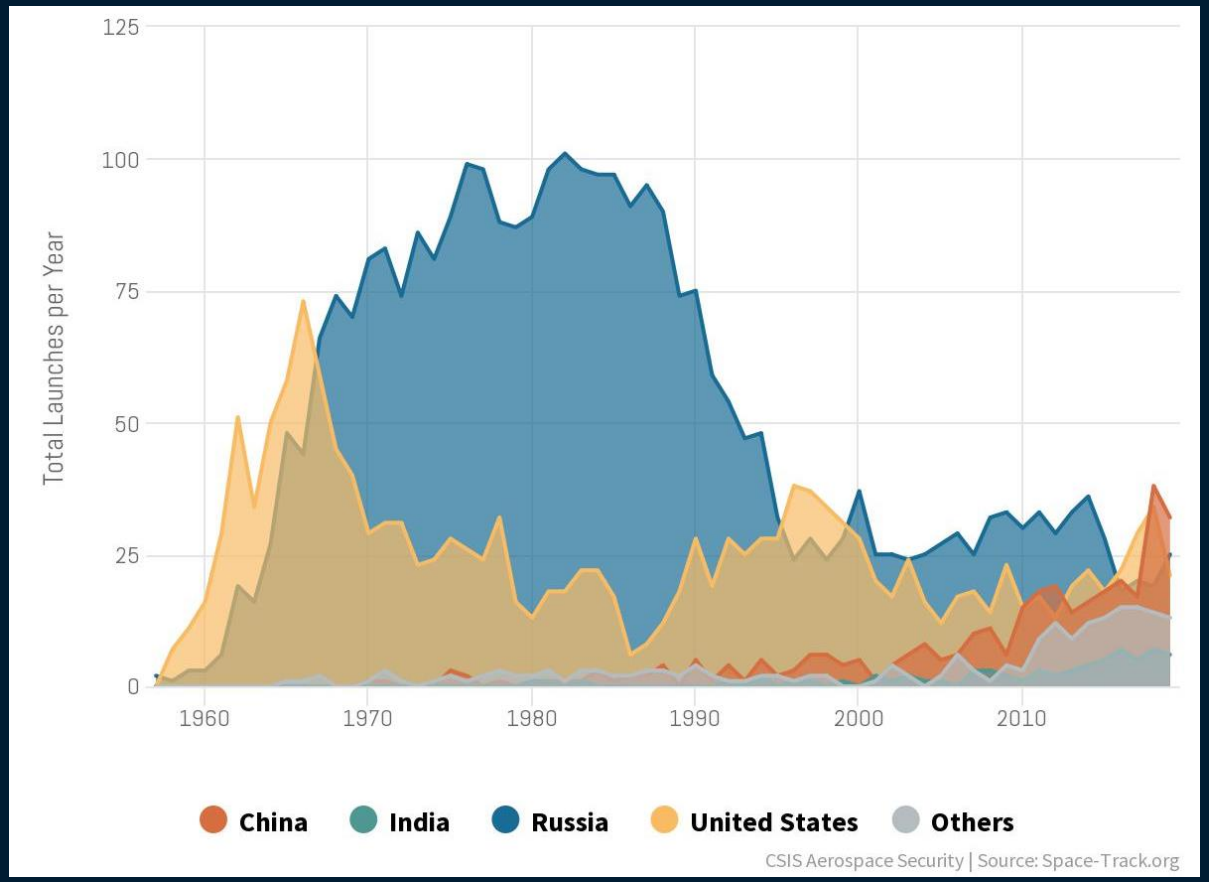
What has changed in space?

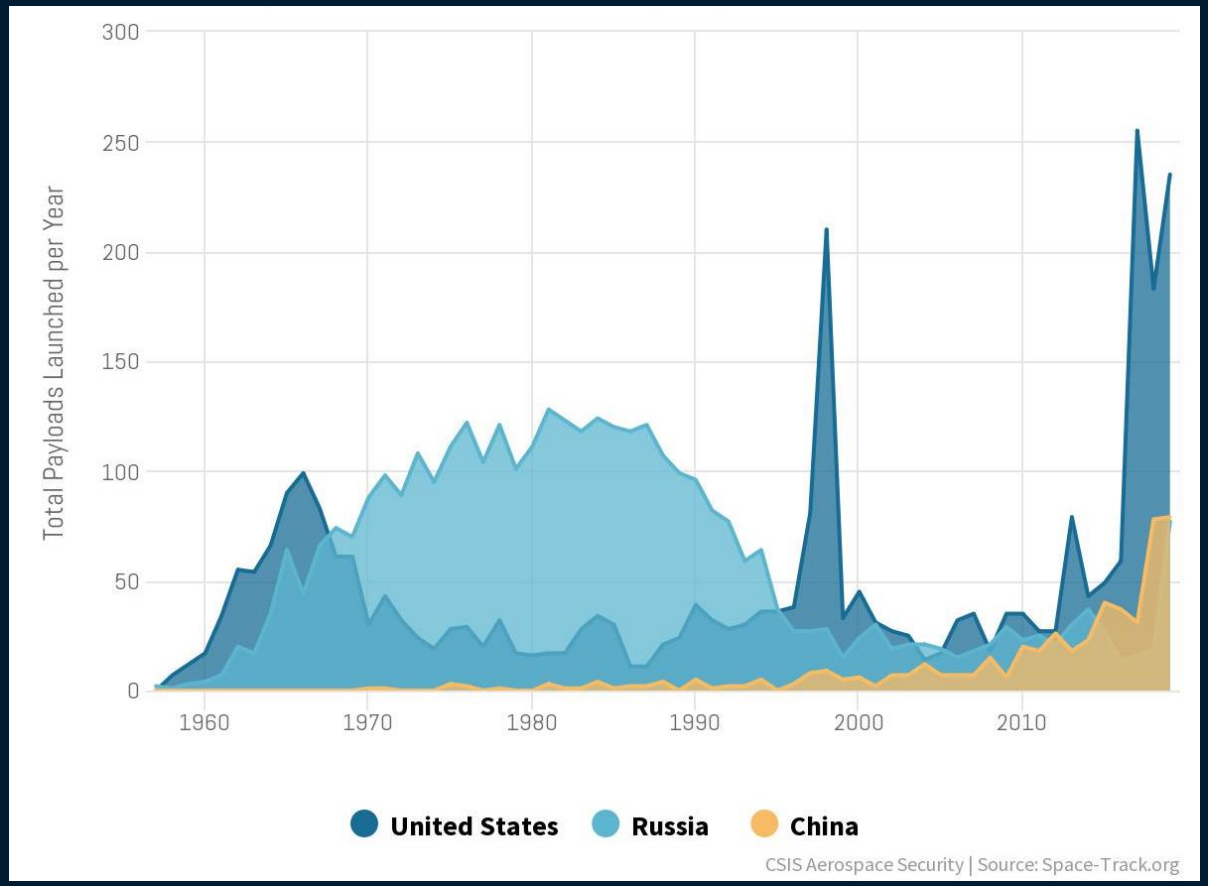
- **Diverse:** More international, more commercial
- **Disruptive:** New entrants, new commercial missions
- **Disordered:** Lack of widely accepted norms, gaps in current laws and treaties
- **Dangerous:** "Juicy" targets in space, proliferation of counterspace capabilities

More Diverse: No Longer Dominated by U.S. & Russia

Launches by Country



Payloads by Country



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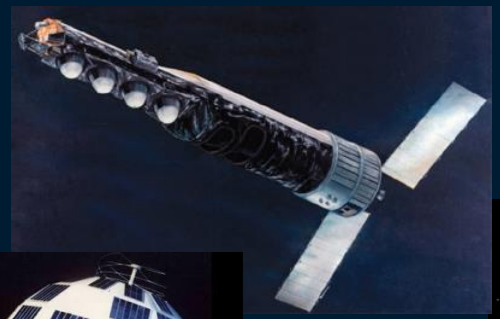
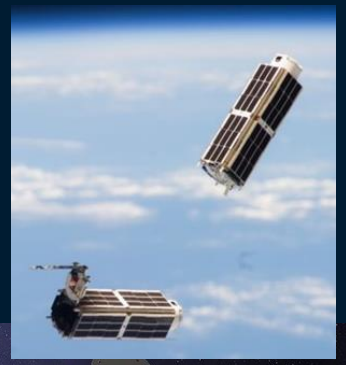
More Disruptive: New & Expanding Commercial Missions

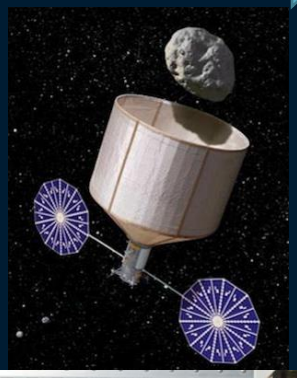
Government-Dominated → Private Sector-Dominated

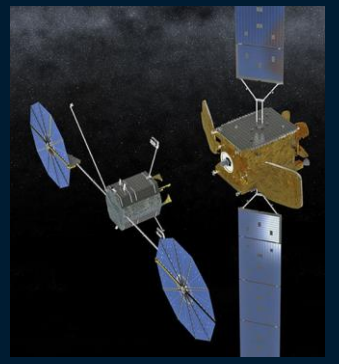








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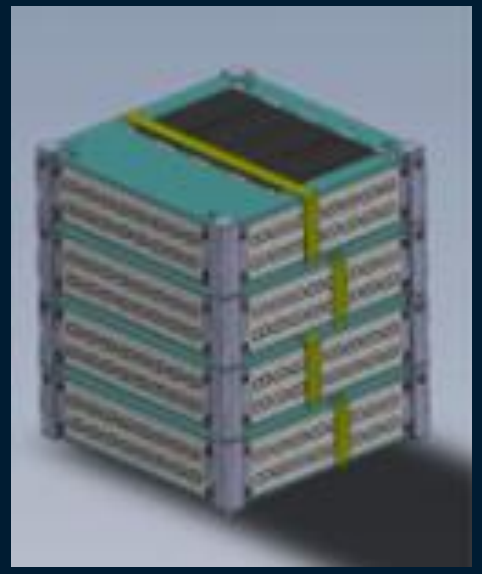
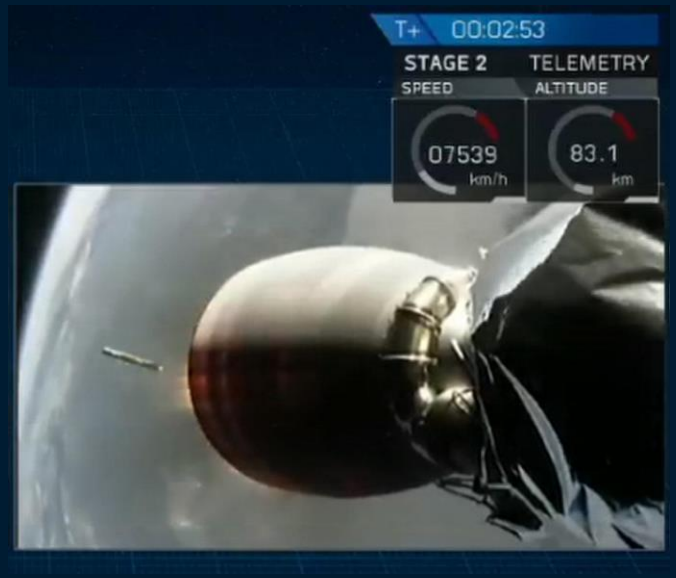
More Disordered: Laws & Regulations Not Keeping Pace



SpaceBee 1-4

Indian PSLV



Falcon 9 Second Stage Video Feed

Falcon Heavy / Spaceman

More Dangerous: Greater Dependence on Space

Dependent on space systems across the full spectrum of combat

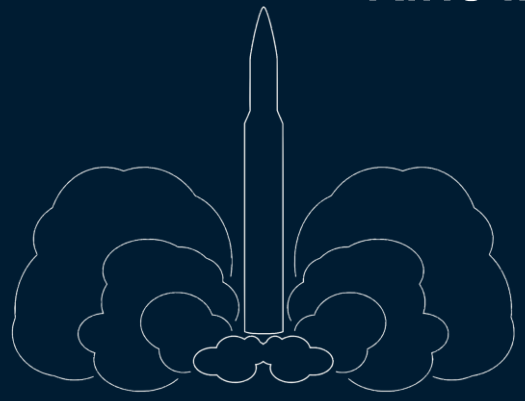
Counter-Terrorism Operations

High-End Combat

Nuclear Command & Control

More Dangerous: Proliferation of Threats

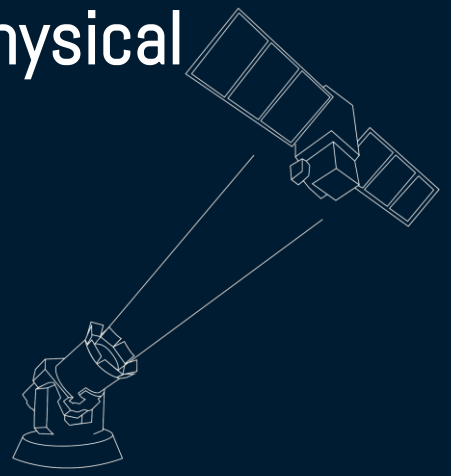
Kinetic Physical



- Direct ascent ASAT
- Co-orbital ASAT
- Ground station attacks

Non-Kinetic Physical

- Lasers
- High-powered microwave
- Electromagnetic pulse (EMP)

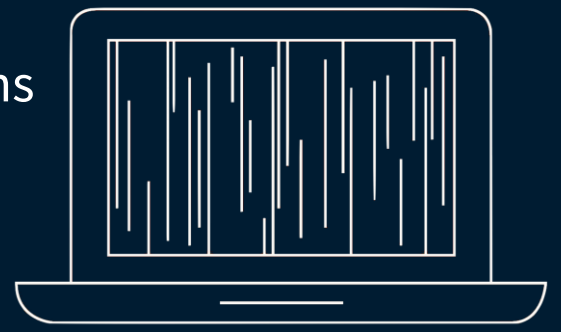


Electronic

- Uplink jamming
- Downlink jamming
- Spoofing

Cyber

- Monitoring traffic patterns
- Intercept / exploit data
- Corrupt data
- Command and control intrusion



Space Defense: Understanding Objectives

Objectives of Attacker Could Include:

- Inflict economic harm
- Signal resolve / deter conflict on Earth
- Disrupt sensor-to-shooter kill chain
- Penetration aid for terrestrial strikes
- Permanently altering balance of power in space

Objectives of Defender Could Include:

- Deter conflict from extending into space
- Buy time for operations in other domains
- Defeat and quickly restore capabilities
- Permanently shift balance of power in space

Passive Space Defenses

Architectural

Disaggregated Constellations

Distributed Constellations

Proliferated Constellations

Diversified Architectures

Redundant, Mobile, or Hardened Ground Stations

Technical

Exquisite Space Domain Awareness

Space-based Radio Frequency Mapping

Antenna Nulling and Adaptive Filtering

Electromagnetic Shielding

Filtering and Shuttering

Jam-resistant Waveforms

Encryption and Air-Gapped Systems

Operational

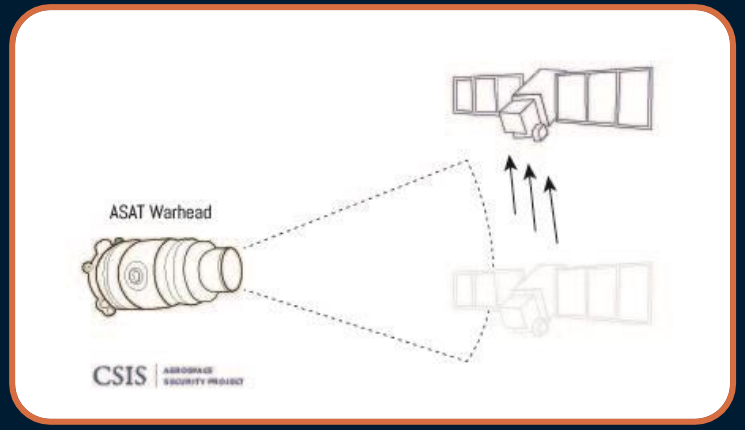
Stealth

Rapid Deployment

Reconstitution

Deception and Decoys

Maneuver



Active Space Defenses

Space-Based

Jamming and Spoofing

Laser Dazzling or Blinding

Shoot-Back

Physical Seizure

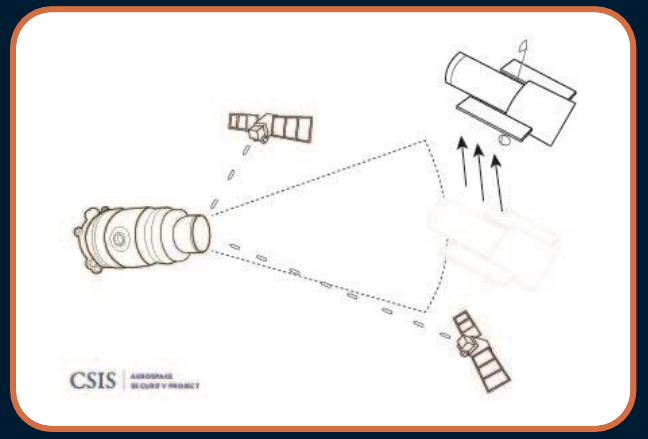
Terrestrial-Based

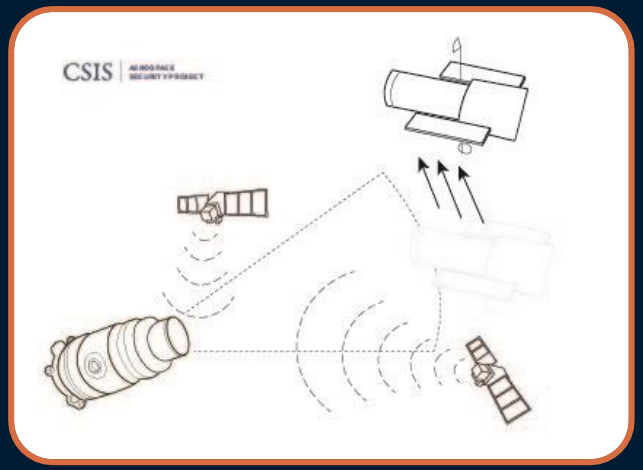
Cyberattacks

Jamming and Spoofing

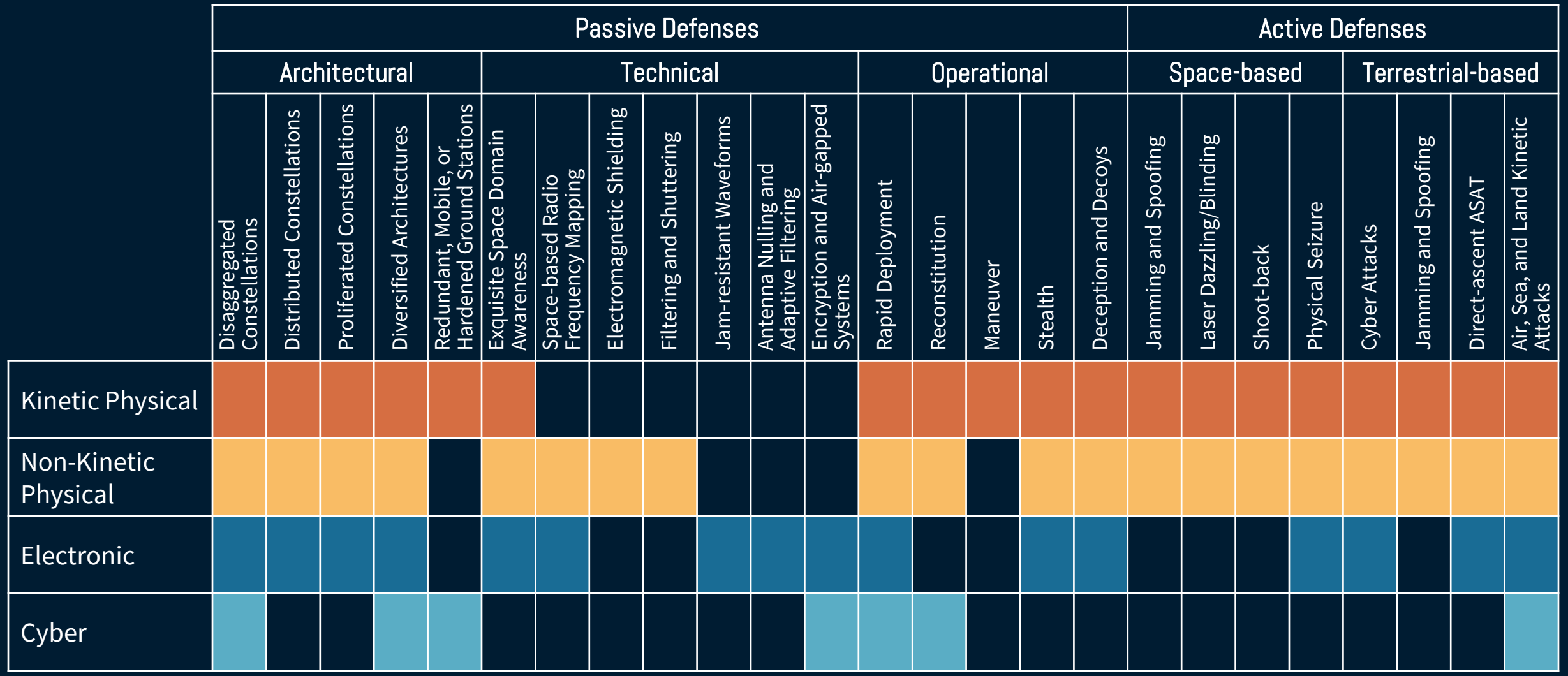
Direct-Ascent ASAT

Air-, Sea-, and Land-Based Kinetic Attacks





Matching Defenses to Threats



Example Dual-Use Capabilities

What constitutes a space weapon?

- Not well defined in existing international agreements
  - Partial Test Ban Treaty of 1963
  - Outer Space Treaty of 1967
- Disagreements in more recent proposed agreements
  - Russian / Chinese PPWT
  - EU Code of Conduct
- Hard to reach an agreement to limit or ban something if you can't agree on what it is
- Recent U.S. announcement of direct ascent ASAT test moratorium is an incremental step designed to jumpstart the process

Framework for Types of Space Weapons

	Earth-to-Space	Space-to-Space	Space-to-Earth
Kinetic	**Example:** Direct-ascent ASAT **Have they been demonstrated?** Direct-ascent ASAT weapons have been tested by the United States, Russia, China, and India. The United States and Soviet Union tested nuclear weapons in space in the 1960s.	**Examples** Co-orbital ASAT, Space-based Missile Defense Interceptors **Have they been demonstrated?** The Soviet Union tested co-orbital kinetic ASAT weapons repeatedly during the Cold War.	**Examples** Space-based Global Strike (e.g., “Rods from God”) **Have they been demonstrated?** While the U.S. military has contemplated space-based weapons for prompt global strike, there are no open-source examples of such a system being tested.
Non-Kinetic	**Examples** Uplink Jammer, Laser Dazzler/Blinder, Cyberattack **Have they been demonstrated?** Multiple nations have demonstrated these capabilities, including Russia, China, Iran, and others.	**Examples** Co-orbital Crosslink Jammer, Co-orbital High-powered Microwave **Have they been demonstrated?** No open-source examples could be found of such a system being demonstrated, although such tests could look like remote proximity operations to outside observers.	**Examples** Space-based Downlink Jammer, Space-based High-powered Laser **Have they been demonstrated?** While the U.S. military has contemplated space-based lasers for boost-phase missile defense, there are no open-source examples of such a system being tested.

Deterrence in Space

Focus is on improving deterrence posture in space at all levels of conflict, from gray zone to major combat operations

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Deterrence holds when the perceived costs of doing something exceed the perceived benefits.


Questions?
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