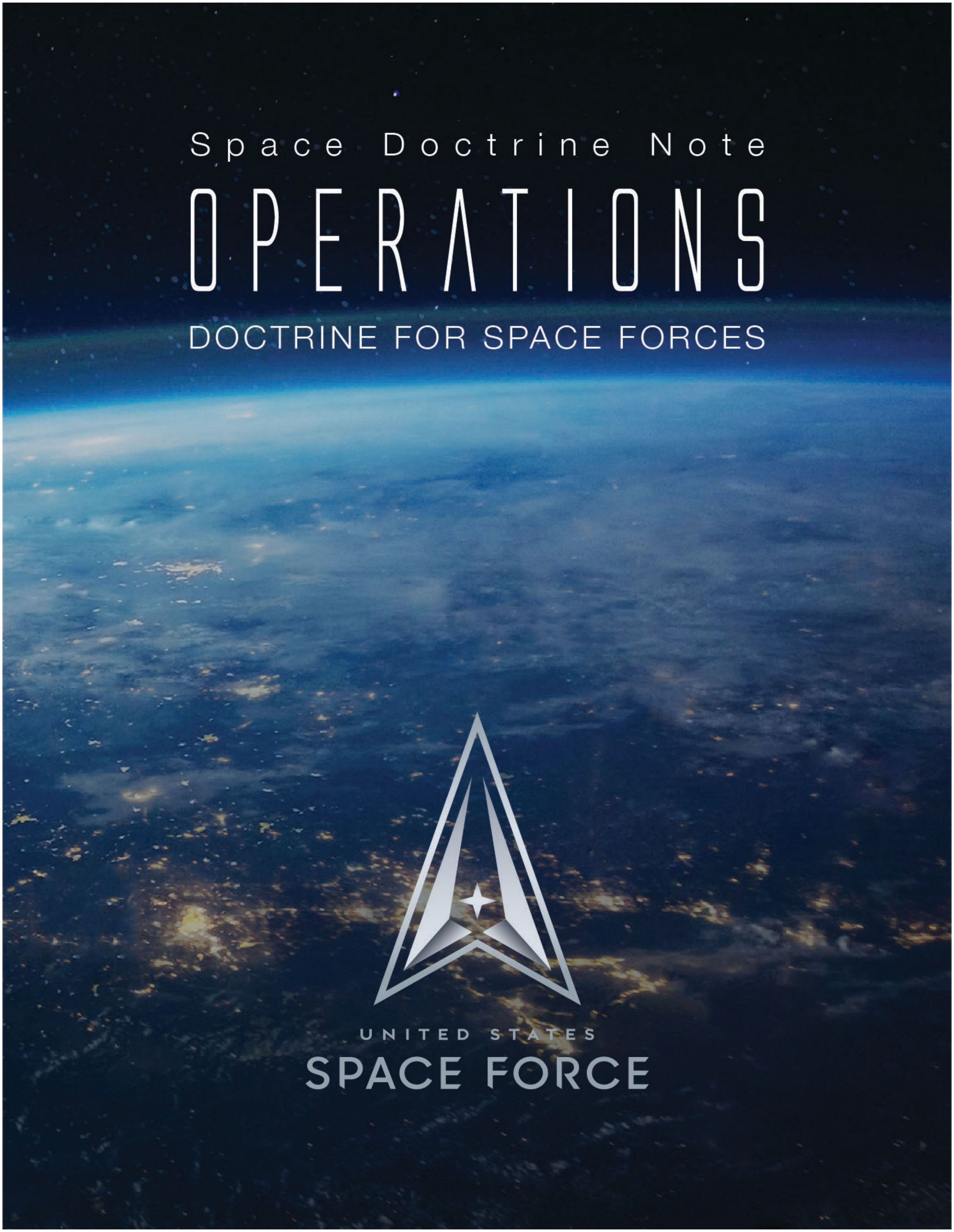

Space Doctrine Note

# OPERATIONS

## DOCTRINE FOR SPACE FORCES

UNITED STATES
SPACE FORCE

Space Doctrine Note (SDN) *Operations*

Headquarters United States Space Force

JANUARY 2022

## PREFACE

### Purpose

Space doctrine notes (SDNs) examine problems and potential solutions to support space doctrine development and revision. SDNs can bridge potential doctrine gaps. This SDN addresses the advantages space operations provide to military forces. It supplements the Space Capstone Publication (SCP) and provides context for operational space activity across the competition continuum. This document reflects current doctrine, procedures, and policy guidance.

### Application

The guidance in this SDN is not authoritative or directive. Instead, this SDN provides a point of departure for discussion and debate as our Service continues to refine its first authoritative operational doctrine document. If conflicts arise between this SDN and a joint publication (JP), the JP will take precedence for the activities of joint forces, unless the Chairman of the Joint Chiefs of Staff provides more current and specific guidance.

JACK D. FULMER II, Colonel, USSF
Commander, Delta 10

## Table of Contents

**Table of Figures**

# Chapter 1: Introduction

Operations are a military action or the carrying out of a strategic, operational, tactical, service, training, or administrative military mission. Space operations are military actions, conducted across the competition continuum. They include both traditional and irregular warfare, to deliver effects to the joint force, to create a period of a relative degree of advantage of one force over another, and to support an environment of security that enables freedom of action for the Department of Defense (DOD) and its allies and partners.

Military strategy, derived from national policy and strategy as well as Combatant Commander intent, and informed by doctrine, provides a framework for conducting operations. The purpose of doctrine is to enhance the operational effectiveness of US forces. Operational art and design are used to organize and employ military capabilities by integrating ends, ways, and available means to determine how, when, where, and for what purpose space forces will be employed. These factors combine to influence a potential adversary's disposition before combat, to deter support for hostile activities, and to ensure that the US, allied and partner tactical, operational, and strategic objectives. In the execution of these responsibilities, the JFC should integrate space forces into the planning and execution processes.

Military space forces operate in the space domain, the dynamic and complex environment above the altitude where atmospheric effects on airborne objects become negligible. This challenging mission requires a comprehensive concept of operations to meet evolving threats and challenges across the competition continuum. USSF forces do not operate in the space domain alone. Space operations are integral to all-domain operations and, at the same time, dependent on operations in the land and cyberspace domains. Terrestrial facilities - including launch, command and control (C2), continuity of operations (COOP) locations, and terrestrial based radars - are essential to space operations. Space operations are data intensive, relying on terrestrial communications links in addition to terrestrial-to-space /space-to-terrestrial, and space-based communications links via the cyberspace domain. Leveraging assets in multiple domains enables space operations and allows space to support missions across all domains and across the competition continuum. SDN *Operations* provides guidance for space operations describing:

- Operations in space shaped by all domain characteristics and threats across those same domains.
- Operations across the core competencies highlighted in figure 1, delivering effects to the joint force and achievement of spacepower responsibilities.

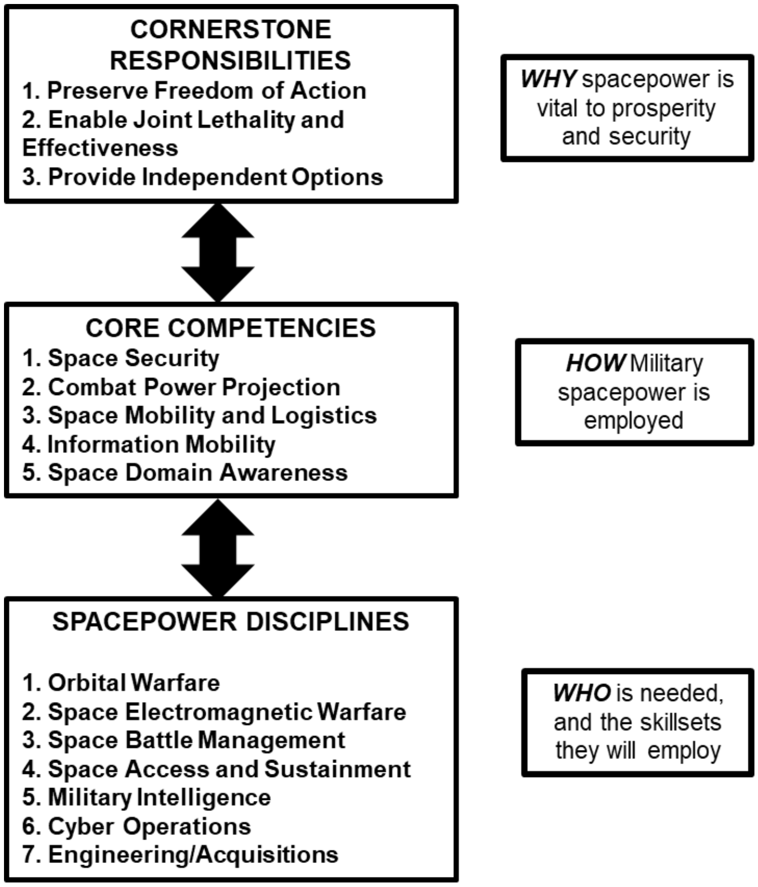


**Figure 1. Spacepower relationships**

Doctrine reflects fundamental principles and best practices, based on extant capabilities and incorporating changes derived from lessons learned during operations, training, wargames, exercises, and, when appropriate, validated concepts. Future operational doctrine publications for USSF will delve into additional detail for operations within the core competencies and the spacepower disciplines (figure 1). Those subordinate publications will allow USSF to discuss each area of space operations in significant detail, including how space supports JFC options throughout the competition continuum.

## Chapter 2: Space Operations

Execution of operations in the space domain requires actions in the orbital, terrestrial, and link segments. Understanding the employment of space requires knowledge of orbital segment characteristics, terrestrial and link segment support to space operations, and threats across all three segments.

**Segment Characteristics**

a. **Orbital Segment.** The orbital segment consists of a spacecraft in the space domain. Spacecraft follow an orbital path in space, influenced by the pull of gravity and atmospheric drag in lower orbits. There are three nested orbital regimes of primary concern in the space domain: geocentric regime, the cislunar regime, and the solar regime. Currently, most space operations occur within the geocentric regime in the geosynchronous Earth orbit (GEO) (geostationary orbit is a type of GEO), highly elliptical orbit (HEO), medium Earth orbit (MEO), low Earth orbit (LEO) (polar orbits are a specialized type of LEO) or a transfer orbit moving between orbits. A key orbital trajectory (KOT) is any orbit relative to a celestial body from which a spacecraft can support users, collect information, defend other assets, or engage the adversary (a transfer orbit is not typically a KOT)**.** For current space operations, the relevant celestial body is Earth.

1) **GEO.** GEO spacecraft orbit at the same rate the Earth rotates upon its axis. Spacecraft in GEO trace a figure eight (i.e., orbital ground trace) over the ground; the higher the inclination, the larger the ground trace. A geostationary orbit is a special type of GEO placed directly over the equator at zero inclination, so the spacecraft appears at a fixed point in the sky to observers on the ground. GEO allows constant line of sight (LOS) observations within a very large footprint covering 42 percent of the Earth's surface. A GEO footprint extends to 77–81 degrees of latitude; higher latitudes fall outside the footprint. GEO is ideal for worldwide communications, surveillance, reconnaissance, observing large-scale weather patterns, and missile warning.

2) **HEO.** HEO takes the shape of a long ellipse. At their most distant points from Earth (apogee), spacecraft in HEO may be over 25,000 miles away. On the other side of the elliptical orbit, the spacecraft's closest point of approach (perigee) could be only a few hundred miles above the Earth's surface. HEO provides very long dwell times near apogee. Satellites in HEO are normally highly inclined, so the long dwell times occur over high latitudes, providing coverage over Alaska, northern Russia, Scandinavia, Canada, and the Arctic Ocean. HEO dwell times in the northern or southern hemisphere (depending on inclination) are nearly 10 hours of a 12-hour long orbit. Two spacecraft set in phased orbits can provide

continuous high-latitude coverage, filling the polar coverage gaps of GEO spacecraft. HEO is ideally suited for communications, scientific, surveillance, missile warning, and environmental monitoring missions over higher latitudes.

3) **MEO.** MEO has no formal altitude but is considered to include those orbits between LEO and GEO. A semi-synchronous orbit is a special case that repeats an identical ground trace after two revolutions, each taking just under 12 hours. Special types of MEO include semi-synchronous orbits that are nearly circular and HEO when they are highly eccentric.

4) **LEO.** LEO is relatively close to the Earth, so spacecraft use less powerful transmitters for communications and achieve higher-resolution imagery with similar-sized apertures compared to objects in higher orbits. LEO spacecraft have the disadvantage of only being in the view of a terrestrial user or station for the short period when overhead. Continuous coverage requires a constellation of spacecraft spaced evenly around several orbital planes. The average time to orbit the Earth is approximately 90–100 minutes. LEO is ideal for ISR, environmental monitoring, and small communications satellites. Science instrument payloads and manned space-flight missions also frequently use these orbits.

b. **Terrestrial Segment.** The terrestrial segment encompasses all the terrestrial based facilities and equipment required to launch and operate a spacecraft, exploit space data as well as terrestrial based radars for surveillance.

c. **Link Segment.** The link segment comprises the signals in the electromagnetic spectrum (EMS) and the nodes that connect the orbital segment to the terrestrial segment as well as the individual terrestrial segments to each other.

**Threats to Space Operations**

The space domain is a naturally hazardous environment, and is increasingly contested, degraded, and operationally limited. Space operations face threats across all domains including those that are intentional, unintentional and naturally occurring.

a. **Intentional Threats.** Intentional attack or sabotage of space-based assets, terrestrial-based systems, operations centers, terrestrial-based radars, launch facilities, C2 nodes, communications relays, or supporting infrastructure can take many forms including directed energy, cyber threats, nuclear detonation (NUDET), electromagnetic pulse (EMP), and physical attack.

1) **Directed Energy (DE) Threats.** DE threats include laser, radio frequency (RF), and particle-beam weapons. Laser systems can temporarily disrupt or deny capabilities or permanently degrade or destroy subsystems. Electromagnetic energy from terrestrial or space-based sources can support attacks on electronic

components as well as the link segment, including uplink, downlink, and crosslink signals.

2) **Cyberspace Threats.** Malicious cyberspace activities including cyberspace attacks may disrupt or deny space-based or terrestrial based computing functions used to conduct or support spacecraft operations and to collect, process, and disseminate mission data.

3) **NUDET**. Because the effects of a NUDET expand rapidly, it is not necessary to target a specific orbital, terrestrial or link asset. NUDETs create charged particles and present an additional hazard to spacecraft not directly impacted by the initial detonation. The radiation generated by the detonation could damage spacecraft components and shorten their effective operational lives from years to days.

4) **EMP**. An EMP will induce damaging voltages and currents into unprotected electronic circuits and components of affected spacecraft, terrestrial nodes, and their associated links. Air or ground bursts could render terrestrial and link segment inoperable for weeks or months.

5) **Physical Attack.** Physical attack takes different forms depending on the segment under attack. Antisatellite (ASAT) weapons are capable of destroying or degrading spacecraft and spacecraft components and/or denying or disrupting their capabilities. More advanced ASAT weapons could employ proximity operations and robotic arms to seize or damage target spacecraft or use standoff capabilities. Physical attack on terrestrial nodes or links can include any destructive or disruptive type of nonnuclear attack, cutting communications lines or any attack on personnel.

b. **Unintentional Threats and Natural Hazards.** Additional threats and hazards exist from natural or unintentional sources.

1) **Environment and Debris**. Natural and environmental threats, in an increasingly congested space domain include weather, space debris, and naturally occurring electromagnetic interference (EMI). The increased congestion raises the possibility of collision, which could damage spacecraft and result in additional debris. The resulting debris could accumulate and congest the most valuable orbits for the foreseeable future. Environmental threats, including solar radiation events, micro-meteors, ionospheric disturbances, thunderstorms, and cloud cover cause increasing concern to space-based and terrestrial communications links, as well as sensitive spacecraft components, introducing the potential for damage or interference.

2) **EMI**. The demand placed on the EMS continues to grow as the number of spacecraft, users, and services increases. As the congestion in the space domain

increases, so does the potential for signal interference. Further complicating the issue, international spectrum management practices create uncertainty in gaining access to the required spectrum and impose strict limitations on power, bandwidth, and coverage.

## Chapter 3: Spacepower Responsibilities and Competencies

Guardians, as forces presented to the Combatant Commanders, execute space operations across a set of core competencies to deliver the desired effects to the joint force. Space operations preserve freedom of action, enable joint lethality and effectiveness, and provide independent options. Figure 2 highlights these cornerstone responsibilities and the core competencies of spacepower as they relate to the joint functions and delivering unified effects for the joint force and simultaneously deterring or influencing adversary actions.

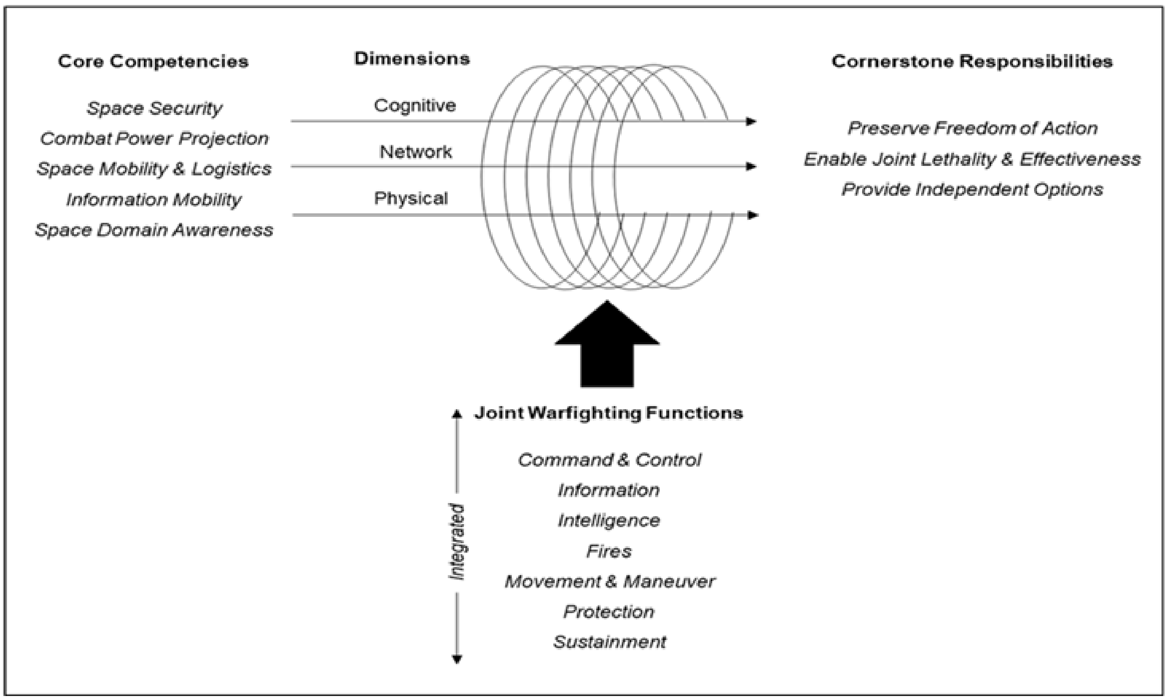


**Figure 2. Delivering cornerstone responsibilities**

### Relative Advantage

Being cognizant of the level of relative advantage in the space domain is of primary concern to Guardians as it informs how to achieve freedom of action, and the continuous provision of space-enabled capabilities to the joint force across all domains and all levels of the competition continuum. The relative level of advantage necessary to achieve and preserve freedom of action, captured in figure 3, hinges on the idea of reducing prohibitive interference from adversary forces, while simultaneously putting the adversary in a disadvantaged position. Prohibitive interference could prevent the USSF forces from delivering the desired effects whether that interference is to the orbital, terrestrial, or link segment. Guardians, as presented forces, conduct orchestrated operations across the joint functions at the strategic, operational, and tactical levels and across all domains. This integrated and holistic approach enables the US to gain a relative advantage over its adversaries. Framed by existing laws and policies, the US leverages the capabilities of allies and partners, and where appropriate commercial and academia, to achieve a relative level of advantage in space.

**Space Parity - Space Superiority - Space Supremacy**
***- Relative Degrees of Advantage Among Adversaries -***

**Space Parity**. Parity reflects any condition where no force derives a relative advantage over another at a given time. However, friendly space operations and military objectives may still be achieved.

**Space Superiority**. A relative degree of control in space of one force over another that would permit the conduct of its operations without prohibitive interference from the adversary while simultaneously denying their opponent freedom of action in the domain at a given time.

**Space Supremacy**. Supremacy implies that one side could conduct operations with relative impunity while denying space domain freedom of action to an adversary.

**Figure 3. Parity, superiority, and supremacy**

**Space Security**

Space Security establishes and promotes stable conditions for the safe and secure access to space activities. Cooperation and coordination are the defining attributes of space security, making partnerships among the DOD, the intelligence community (IC), allies, partners, commercial entities and academia essential. In addition, resilience measures support operations across a wider range of scenarios, conditions, and threats, despite hostile action or adverse conditions. The combined effects of Space Security actions establish and maintain an environment, with stable conditions, from which the cornerstone responsibilities of preserve freedom of action, enable joint lethality and effectiveness, and provide independent options are realized.

a. **Partnerships.** As the space domain becomes increasingly congested and contested, developing and maturing key partnerships increases resilience and is a critical enabler of Space Security. To make the most of these relationships, investment in the development of partner capacity, both materiel and human capital, as well as establishing reciprocal information sharing are required. To the maximum extent possible, the reciprocal sharing of operational data and information among partners should occur on tactically relevant timelines, and as long as it is consistent with security regulations. At the same time, protection of information from classified sources and methods, proprietary information or information from allies and partners is of paramount importance. Shared education across the space disciplines creates a common intellectual foundation for the DOD, IC, allies, and partners. Joint and combined training courses, events, and exercises that develop space operators across the community and build additional experience reinforce this educational foundation. Integrating operations, operations centers, and planning events with members from across the space community creates a foundation for information sharing and collaboration in areas such as anomaly resolution and resource sharing such as hosted payloads. Chapter 4 discusses partnerships and the integration of shared capabilities further. Areas where partnerships, shared information and shared experience increase security and reduce vulnerabilities include:

1) **Anomaly Resolution**. During nominal operations, anomalies may occur across all segments of the space architecture (orbital, terrestrial, and link) that negatively affect operations. Space operators must consider the potential of intentional interference as the source of an anomaly due to the increasingly congested and contested nature of the space domain. Whilst most organizations have similar processes to assess and resolve these anomalies, to mature our Space Security environment, it is essential for partners to cooperate and coordinate within the anomaly resolution process. Partners should share definitive space environment effects, whether intentional, unintentional, or natural, once known, taking operations security into consideration to avoid revealing vulnerabilities. Collaboration and sharing information across DOD, IC, allies, partners and where appropriate commercial and academic partners increases understanding of anomalies, regardless of the domain or whether the source is intentional, unintentional or a natural hazard.

2) **Hosted Payloads.** Hosting a payload on a commercial spacecraft or one owned and operated by an ally or partner is a means of not only reducing cost but also distributing US presence across the space environment. The shared cost and teaming, increase the need to share information and mature the relationship between partners. In addition, hosting a payload on the spacecraft of a commercial provider or another country complicates adversary planning. Hosted payload arrangements require consultation with the servicing legal office.

3) **Movement and Maneuver Coordination.** The movement and maneuver joint function is a central tenet to securing positional advantage. Coordination of movements and maneuvers among DOD, IC, allied, and partner assets, regardless of organization or flag, is essential, and should be part of standard operational procedures. This includes activities across all three segments, such as physical movement of spacecraft, EMS management, or activating terrestrial continuity of operations (COOP) plans.

b. **Resilience and Protection Measures.** Other means of increasing Space Security include actions to increase the resilience or protect aspects of space assets in all segments.

1) **Resilience Measures.**

i. **Disaggregation.** The separation of capabilities into different platforms, payloads, terrestrial locations, or orbit.

ii. **Distribution.** Use of several nodes, working together, to perform the same mission or functions as a single node, eliminating single points of failure. In addition, distribution allows for gradual degradation and presents an adversary the problem of a far larger number of targets.

iii. **Diversification.** Systems contributing to multiple missions; using different platforms; different orbits; or leveraging capabilities through partnerships.

iv. **Proliferation.** Deploying larger numbers of the same platforms, payloads, or systems of the same types to perform the same mission.

v. **Deception.** Actions or system implementation designed to confuse or mislead an adversary with respect to the location, capability, operational status, mission type, and/or robustness of an asset.

2) **Protection Measures.**

i. **Electromagnetic Spectrum Operations.** Understanding, manipulating, and managing the link segment supporting space operations. Appropriate electromagnetic battle management, electromagnetic spectrum management, and electromagnetic protection enable space operations. Electromagnetic spectrum operations in support of space may leverage alternate paths, changing frequencies, moving spot beams or altering beam shape.

ii. **Movement and Maneuver.** Maneuvering spacecraft to deny the adversary the opportunity to track and target them or to avoid debris. Relocating terrestrial nodes complicate adversarial targeting of facilities and their associated cyberspace infrastructure.

iii. **Hardening.** Hardening of space system links and nodes, and terrestrial facilities allows them to operate through attacks and environmental hazards.

iv. **Cybersecurity.** Actions taken to prevent unauthorized access to, exploitation of, or damage to information technology infrastructure, and the information contained therein, to ensure its availability, integrity, authentication, confidentiality, and nonrepudiation.

**Combat Power Projection (CPP)**

CPP integrates defensive and offensive operations to maintain a desired level of freedom of action relative to an adversary. Guardians execute CPP in concert with the other USSF core competencies and all domain effects across the competition continuum to support operations in all domains. In peacetime, recognized and credible CPP capacity underpins the Nation's ability to influence events, shape, deter, and compel or deter adversary perceptions and behavior, promote global stability, and provide, in conjunction with allies and partners, a means of collective security. Across the competition continuum, CPP encompasses the use of informational power in conjunction with physical power to create lethal and nonlethal effects, shaping an adversary's capabilities, perceptions, decision-making, and will.

1) **Defensive Operations.** Successful space defensive operations preserve space combat power in support of operations in all domains and neutralize or reduce the effectiveness of adversary actions. When exercising self-defense, operations may include the use of a reasonable and proportionate response to a hostile act, or demonstrated hostile intent from any domain. Defensive operations include disrupting an adversary's ability to target or attack spacecraft or other systems supporting space operations. Defensive operations also safeguard space assets from unintentional threats and natural hazards such as space debris, RF interference, and naturally occurring phenomena such as solar radiation. Defensive operations, demonstrating the ability to limit the anticipated advantages of actions against US and allied space forces, safeguard against hazards and limit opportunities for an adversary to hide or mask actions.

2) **Offensive Operations.** The US may undertake offensive operations within the bounds of US domestic laws and policy, and international law to negate an adversary's use of military or hostile space capabilities, reducing the effectiveness of adversary forces in all domains. Offensive operations target an adversary's space capabilities using a variety of reversible and nonreversible means. These may include actions to deceive, disrupt, deny, degrade, or destroy the adversary's military space capabilities. As adversaries become more reliant on space capabilities, offensive operations have greater opportunity to reduce an adversary's ability to interfere with or commit hostile acts against the US and its allies and partners in all domains, hindering their ability to effectively organize, coordinate, and orchestrate a military campaign. Offensive operations may occur in all domains and may result in a variety of negation measures all intended to neutralize adversary assets and their ability to interfere with DOD, ally, or partner operations. Military space forces leverage Information Warfare capabilities, particularly public affairs, to communication a credible threat of unacceptable counteraction or that the cost of action outweighs the perceived benefits to adversaries. Based on this, they may choose not to attack space assets. In addition, displaying the capabilities and communicating the resolve to respond to an attack using all appropriate instruments of national power could

cause an adversary to believe the cost of the attack is not worth the benefit.

3) **All-Domain Capabilities.** The effectiveness of offensive and defensive operations depends on the availability and capability of specific resources and systems. In all cases, planners should consider a layered, joint plan to preserve their assets across all domains to conduct operations. The following are examples of capabilities across all domains that could be used, if and when available, to conduct or support space operations:

   i. **Aircraft.** Through a variety of kinetic and non-kinetic means, aircraft may negate an adversary's ability to jam DOD and allied spacecraft, or deliver other space effects.

   ii. **Surface Forces.** Surface forces can achieve significant effects through surface fires and the ability to occupy and secure key areas. Contributors may include conventional land forces, maritime forces, or special operations forces.

   iii. **Electromagnetic Warfare (EW).** EW can suppress adversary C2, integrated air defense systems, Satellite Communication (SATCOM), and other military use of the electromagnetic spectrum.

   iv. **Cyberspace Operations.** Offensive and defensive cyberspace operations can affect an adversary's space system architecture and their ability to affect US, allied, and partner space assets.

   v. **Missiles.** Missiles can target adversary terrestrial or orbital targets, such as launch facilities, terrestrial stations, infrastructure, or spacecraft.

   vi. **DE Weapons.** Land-, maritime-, air-, or space-based DE weapons could be capable of a wide range of effects against spacecraft from disruption to destruction.

   vii. **Navigation Warfare (NAVWAR***)*. Preventing adversary use of positioning, navigation, and timing (PNT) information whilst protecting the unimpeded use of the information by friendly forces and preserving peaceful use of this information outside the area of operations.

**Space Mobility and Logistics**

Space mobility and logistics (SML) enables movement and support of military equipment and personnel in the space domain, from the space domain back to Earth, and to the space domain. SML is integral to delivering freedom of action and independent options to the joint force. SML leverages DOD, allied, partner, commercial, academia, and civil capabilities, consistent with U.S. law and policy, thereby increasing resilience to space operations, introducing options for Guardians and joint forces delivering effects, and complicating adversary plans. SML for any space system architecture provides a positional advantage through mobility and the support of forces through logistics. SML capabilities executed by Guardians and joint forces fall into two areas: space access and on-orbit sustainment.

a. **Space Access.** Space access includes the launch services to move a spacecraft from Earth to orbit, as well as the facilities supporting those operations. Leveraging ridesharing as well as alternate launch services and locations increases resiliency of space operations.

   1) **Space Launch Services.** Space launch services constitute a portion of the mobility function providing the ability to move spacecraft, payloads, and materiel into space as well as to reconstitute space-based capabilities. The reconstitution of spacecraft constellations may require responsive, safe, and reliable access to space launch as well as the ready availability of replacement spacecraft, properly trained personnel to launch the systems, and appropriate facilities and equipment.

   2) **Launch Vehicle Ridesharing.** Rideshare is the approach of sharing available launch vehicle performance and volume margins with two or more spacecraft that would otherwise go underutilized. In addition to cost-effective use of available launch vehicles, ridesharing drives cooperation between acquirers, payload operators, and launch companies. Improvements and advances in rideshare capabilities, processes, standardization, and technology continues to open more opportunities for the space community to leverage this option.

   3) **Launch Facilities**. Launch facilities contribute to assured, responsive, safe and reliable access to space during government-sponsored space launch operations as well as DOD test and evaluation flight-testing. Launch complex facilities meet the need to fuel, protect, and connect launch vehicles prior to launch. Launch and landing pads allow for the delivery of assets to and from the space domain.

   4) **Launch Control Facilities**: Launch control facilities allow for coordinated communication during launch operations including communications with the launch vehicle and all launch support infrastructure prior to and through the early stages of flight. Telemetry, tracking, and commanding (TT&C) antennas enable near real-time monitoring during launch and early orbit operations to ensure safety and mission requirements. Booster and payload facilities house and protect launch vehicles and spacecraft during construction and integration prior to launch.

b. **On-Orbit Sustainment.** On-orbit sustainment spans the lifecycle of a spacecraft, including maintenance, operations related to reconstitution, operational degradation or loss, and end-of-life actions. Maneuvers, and rendezvous and proximity operations (RPO), support these actions. Maneuvering includes movement of a spacecraft into and within orbits (re-phasing) whether for initial deployment, station keeping, disposal, or reconstitution of a constellation on-orbit. RPOs consist of intentional maneuvers to bring space objects close together to conduct close proximity operations, and/or docking.

1) **Maintenance.** Servicing a spacecraft physically, such as replacing components or refueling, or remotely, such as updating software, allows a spacecraft to remain operational for extended periods. Additionally, servicing can incorporate modifications and/or improvements to adapt a spacecraft's capability for future threats.

2) **Reconstitution.** Restoration of functionality following the degradation or loss of a capability. In the event of a system degradation or loss, spacecraft operations may satisfy or mitigate a capability gap through repositioning, reconfiguring, re-designating, or acquiring the use of other on-orbit assets, including reconstitution with civil, commercial, or allied capabilities. Responsive launch operations support reconstitution delivering new spacecraft to orbit.

3) **Residual Operations.** When a spacecraft can no longer conduct its primary missions, the opportunity to employ it to support other operations, experiments, testing or training expands options for space operations.

4) **Disposal.** Spacecraft are properly disposed of at their end-of-life to minimize space debris and collision risk. Potential options include controlled or uncontrolled atmospheric reentry, transfer to a disposal orbit, or direct retrieval. Planners should consider disposal options during lifecycle development and on-orbit employment to ensure the viability of disposal at the spacecraft's end-of-life.

**Information Mobility (IM)**

For space operations, IM provides timely, rapid, and reliable collection and transportation of data in support of tactical, operational, and strategic decision making across the competition continuum. As depicted in figure 4, IM includes purposeful data collection from systems and sensors (both space-based and terrestrial based) as well as the associated communications architectures that data transits, including networks, links, nodes, and related hardware.

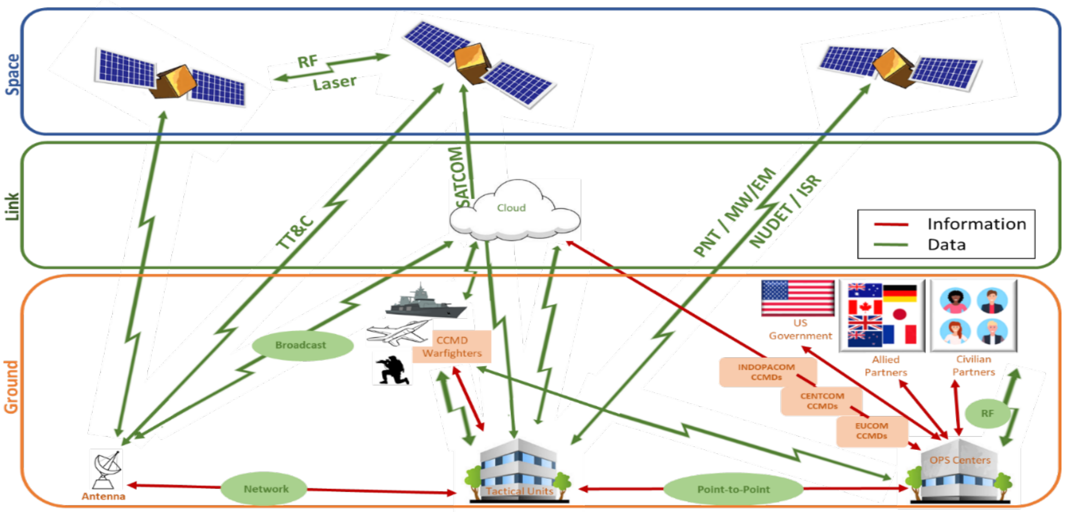


**Figure 4. Information mobility**

a. **Communications.** Data from all domains ride along communications architectures that include networks, links, nodes, and related hardware, which are essential to space operations. Military space forces deliver critical communications architecture to the joint force providing global coverage and/or focused capacity in a refined geographic area. SATCOM, including military, allied, partner, commercial and civil capabilities, delivers near real-time, over-the-horizon voice and data connectivity. SATCOM facilitates C2 to all-domain operations including survivable communications for presidential support, nuclear C2, and TT&C for spacecraft operations. SATCOM also provides critical connectivity and mitigates some impacts of terrain masking from local radio systems for tactical forces and disadvantaged users whose rapid movement and geographically dispersed deployments remove them from direct access to terrestrial communications infrastructures. SATCOM mitigates interference to critical communications and data transfer by executing tactics such as beam shaping and antenna nulling, providing advantages to all-domain operations.

b. **Positioning, Navigation, and Timing.** Space-based PNT provides multiuse services integral to US national security, economic stability, transportation safety, and homeland security. Space-based PNT provides the joint force with precise three-dimensional positioning capability, navigation options, and a precise time reference. PNT enables orbital rendezvous between space systems (e.g., space docking for the International Space Station) through position autonomy and precise timing to spacecraft.

c. **NUDET Detection.** NUDET detection delivers a persistent, global, and integrated surveillance of critical regions of the globe and provides information on location, height of burst, and yield of NUDETs to the President of the United States, Secretary of

Defense, Combatant Commanders (CCDRs), Defense Threat Reduction Agency, and the Federal Emergency Management Agency. NUDET detection provides allies and senior leaders the requisite timely warning and characterization to support threat/nonthreat determination, follow-on decision making, monitoring of international treaties and agreements, and identification of proliferators to counter weapons of mass destruction.

d. **Missile Warning (MW).** MW includes strategic and theater warning sensors and their distinct communications architectures. Space-based and terrestrial MW sensors provide launch detection, tracking, tactical warning, and attack assessment information to operational command centers. Additionally, these multi-mission assets support space domain awareness (SDA), missile defense, battlespace awareness, and intelligence.

1) **Strategic MW.** Space-based and terrestrial sensors, leverage terrestrial and SATCOM networks to ensure redundancy, provide assured survivable/endurable notification to national leaders of a missile attack, unambiguous attack characterization, and battle damage assessment (BDA) throughout the response timeline. Strategic MW provides allies and partners with attack assessment data via shared early warning.

2) **Theater MW:** Space-based and terrestrial sensors provide timely warning of missile attack to geographic CCMDs and forward-deployed personnel. Collectively, space-based sensors provide continuous coverage of all CCMD areas of responsibility (AORs). Theater systems take advantage of direct downlinks, broadcast SATCOM, and tactical communications systems to ensure redundancy. The theater-event system architecture enables rapid dissemination of missile-event warning messages to decision makers, thereby enabling passive defense, active defense, and offensive operations.

e. **Intelligence, Surveillance and Reconnaissance.** ISR capabilities leverage space-based and terrestrial sensors as well as processing, exploitation, and dissemination systems to enable enhanced understanding of adversary capabilities and intentions in support of current and future operations. Integrated space ISR operations, including analysis, assessments, and target development will deliver actionable intelligence to compress the find, fix, track, target, engage, and assess (F2T2EA) process, also known as closing the operational kill chain, across the competition continuum. The processing, exploitation, and dissemination of space-based ISR capabilities varies between supported and supporting relationships.

f. **Environmental Monitoring.** Environmental monitoring supports operations in all domains. Accomplishing the DOD environmental monitoring function depends on allied, partner, and civil assets for collecting environmental information. The resulting data is available to the DOD weather centers to analyze, characterize, and predict the natural terrestrial and space environment and its impact to joint all-domain operations.

**Space Domain Awareness (SDA)**

SDA encompasses the effective identification, characterization, and understanding of any factor associated with the space domain that could affect space operations and thereby affect the security, safety, economy, or environment of our Nation. SDA is fundamental to the conduct of all space operations and is dependent on integrating ISR and environmental monitoring information across the orbital, terrestrial and link segments. As presented in figure 5, SDA is concerned with situational awareness in all segments of a space system architecture. USSF and CCMD units that provide SDA data should work with other US government departments and agencies within the scope of applicable strategy and policy, to effect unity of effort, cooperation, data sharing, and efficient use of multi-mission sensors.

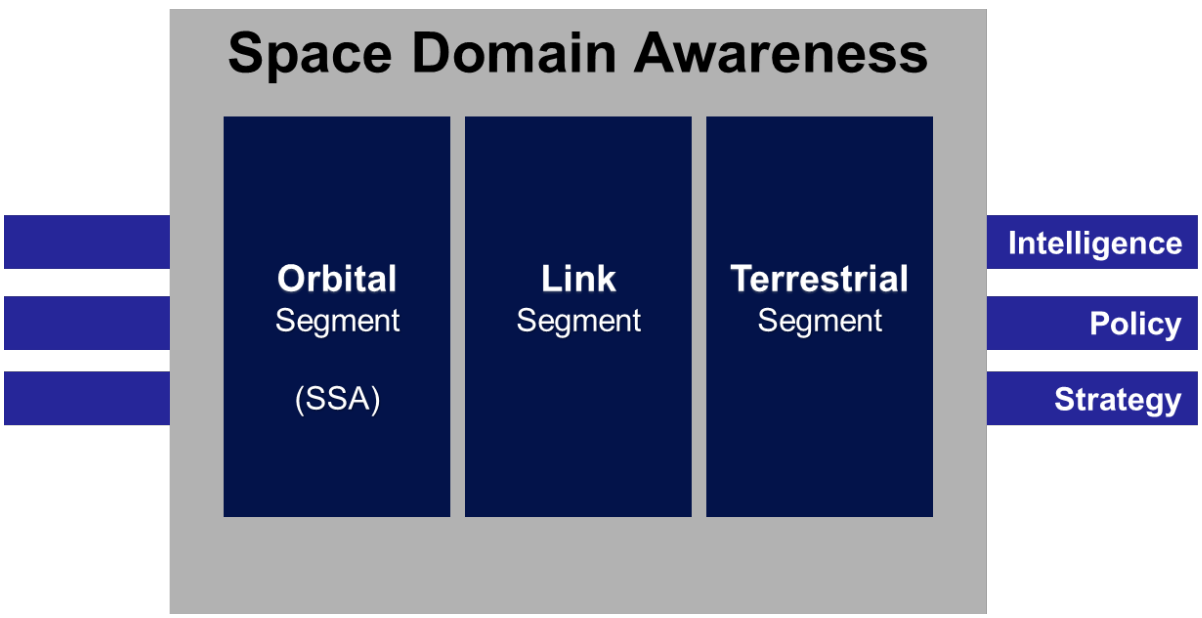


**Figure 5. Space domain awareness**

a. **Space Situational Awareness (SSA).** SSA, a subset of SDA, addresses the orbital segment. Joint Publication (JP) 3-14 defines SSA as "the requisite foundational, current, and predictive knowledge and characterization of space objects and the operational environment upon which space operations depend." SSA includes the tracking of all launched and orbital objects by the dedicated and contributing sensors allowing Guardians and joint forces to maintain the status of space objects. This capability is foundational and allows warfighters to predict the future location of space objects and the overall operational environment. Space operations, military and civilian, depend on this knowledge base. SSA includes: detect/track/identify, characterization, threat warning and assessment, and data integration and exploitation.

1) **Detect / Track / Identify (D/T/ID)**. D/T/ID is the ability to search, discover, and track spacecraft and events; distinguish objects from others; and recognize objects as belonging to certain types and missions. SSA sensors take into consideration the object(s) being D/T/ID as well as the KOT and orbital regime. D/T/ID also considers a space object's current movement, position, future position, position with respect to other spacecraft, and debris near the object to support collision avoidance.

2) **Characterization.** Characterization is the ability to describe a specific spacecraft tracked and identified by terrestrial or orbital sensors. Characterization includes the spacecraft's potential employment, tactics, intent, and activity, across all segments. This information provides the JFC and other decision makers with the knowledge and confidence to assess adversary space capabilities and support allies, partners, commercial and civil space operations. Data sharing partnerships among DOD, other US government agencies, allies, partners, commercial, and civil space entities support the characterization of friendly spacecraft. Delta 7 and the National Air and Space Intelligence Center (NASIC), provide foreign space and space threat information as well as additional information that facilitates the service's ability to determine other countries' intent; tactics, techniques, and procedures; strategy; capabilities; and vulnerabilities.

3) **Threat Warning and Assessment (TW&A).** TW&A is the ability to warn decision makers of potential or actual attacks, space environmental effects, and space system anomalies. The joint force requires the assessment of events related to space operations and advanced warning of potential events or threats and the impacts to spacecraft and/or the ability to deliver effects. TW&A data may also contribute to indications and warnings of events or threats that might affect non-space capabilities and/or non-DOD capabilities and services.

4) **Data Integration and Exploitation (DI&E).** DI&E is the final step in delivering decision-quality fused, correlated and integrated multi-source data to enable decision-making and SDA. Decision-quality SSA data enables earlier predictions at higher confidence levels and more responsive courses of action for space and non-space forces.

b. **Terrestrial and Link Awareness.** As part of the all domain nature of space operations, situational awareness for the terrestrial and link segment are equally important. This information will come from a variety of sources including other services and agencies. Presentation of SDA requires the fusion of this information with SSA to support understanding, exploitation, and decision-making.

## Chapter 4: Partnerships

For maximum effect, employment of spacepower requires integration and synchronization with allies and partners, as was introduced in the Space Security section of Chapter 3. Partnerships include government and non-federal entities such as commercial entities and academia. Synchronization, coordination, and integration of these partnerships across the competition continuum as illustrated below in the graduated partnership employment framework in figure 6 is key to achieving unified action.

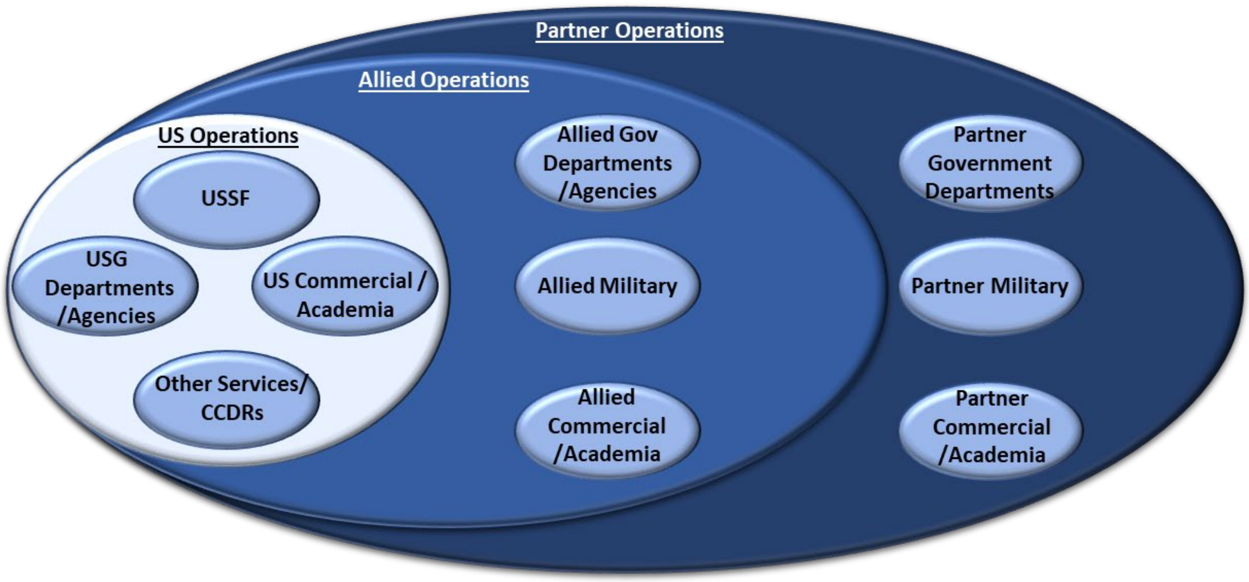


**Figure 6. Partnership employment framework**

### Key Partnerships

a. **National Reconnaissance Office (NRO).** The NRO is the US Government agency in charge of designing, building, launching, and maintaining America's intelligence satellites.

b. **Intelligence Community (IC).** The IC collects and analyzes information and produces intelligence products and data to contribute to USSF and CCMD planning and operations. Executive Orders govern USSF ISR operations and interagency cooperation. ISR forces comply with the Director of National Intelligence directives and are executed in accordance with JP 2-0 "*Joint and National Intelligence Support to Military Operations*." The National Geospatial-Intelligence Agency (NGA) and National Security Agency (NSA) are key IC partners in space operations.

c. **National Aeronautics and Space Administration (NASA).** NASA is an independent federal government agency responsible for the civilian space program, aeronautics, and space research and development. A memorandum of understanding (MOU) between NASA and the USSF defines mutual support between organizations.

d. **Department of Commerce (DOC).** The DOC is home to several organizations supporting space operations.

   1) **National Oceanic and Atmospheric Administration (NOAA).** NOAA provides natural environmental data and exploitation information to the space community in partnership with DOD environmental monitoring agencies.

   2) **Office of Space Commerce (OSC).** Space Policy Directive 3 directs the establishment of OSC as the government lead for space traffic management subject to any necessary statutory and regulatory updates.

   3) **National Telecommunications and Information Administration (NTIA).** NTIA provides federal systems electromagnetic spectrum management.

e. **Federal Communications Commission (FCC).** The FCC regulates civil communications systems including civil SATCOM.

f. **Federal Aviation Administration (FAA).** The FAA is the regulatory authority for licensed launch/reentry (commercial and those government launches where the government does not substantively direct the operation) and approves spacecraft for launch that are not under the authority of another government agency. The FAA has responsibility for public safety during commercial space launch and reentry activities. The FAA has a statutory authority to protect national security and foreign policy interests and plays a crucial role in the protection of public safety and government space assets during launch and reentry activities through its Office of Commercial Space Transportation. The Department of the Air Force and FAA finalized a MOA for streamlined launch and reentry licensing procedure on 15 June 2021.

**Specialized Partnerships**

The US maintains a number of special relationships to support the space cornerstone responsibilities:

a. **The Five Eyes (FVEY) Intelligence Alliance**. This is an agreement among several nations that allows for automatic sharing of signals intelligence.

b. **Combined Space Operations Initiative.** The US, Australia, United Kingdom, Canada, New Zealand, France, and Germany are strengthening norms and standards of behavior, and leveraging combined capabilities through the Combined Space Operations Initiative MOU. This MOU allows for cooperation across the spectrum of spacepower, including development of space systems, improving education, synchronizing policy, increasing exercise participation, and standardizing tactics, techniques and procedures.

c. **North Atlantic Treaty Organization (NATO) Alliance**. Established by treaty in 1949, the NATO alliance now includes 30 countries.

d. **Japan and the US Alliance**. A post-World War II Security Treaty initially signed in 1951 forms the basis for this alliance.

e. **South Korea and US Alliance.** A mutual defense treaty signed between the US and the Republic of Korea in 1953 forms the basis for this alliance.

f. **Responsive Space Capabilities (RSC) MOU**. The 2014 RSC MOU initiates, conducts, and manages research, development, test, and evaluation cooperation related to responsive space capabilities. Members include the US, Great Britain, Canada, Australia, New Zealand, Germany, Italy, Netherlands, Norway, Spain, and Sweden.

**Commercial and Academic Capability Integration**

The DOD, its allies, and partners increasingly rely on commercial and academic capabilities to perform various tasks, some of which are not organic capabilities in the military structure. Many commercial and academic sources supporting space operations are high-demand, therefore planners need to consider procurement lead-time as they conduct their requirements development. Leveraging commercial or academic capabilities for any of the core competencies is always constrained by the level of acceptable risk, legal, and policy considerations. Combat Power Project (CPP) operations are purely military functions, excluding them from commercial or academic participation.

## Appendix A: Acronym Listing

| | |
|---|---|
| **C2** | command and control |
| **CCDR** | combatant commander |
| **CCMD** | combatant command |
| **CJCSI** | Chairman of the Joint Chiefs of Staff Instruction |
| **COMSPACEFOR** | Commander of Space Force Forces |
| **D/T/ID** | detect / track / identify |
| **DE** | directed energy |
| **DI&E** | data integration and exploitation |
| **DOC** | Department of Commerce |
| **DOD** | Department of Defense |
| **DoDD** | Department of Defense Directive |
| **EMI** | electromagnetic interference |
| **EMS** | electromagnetic spectrum |
| **ESA** | European Space Agency |
| **EW** | electromagnetic warfare |
| **F2T2EA** | find, fix, track, target, engage, and assess |
| **FAA** | Federal Aviation Administration |
| **FCC** | Federal Communications Commission |
| **FVEY** | Five Eyes |
| **GFM** | global force management |
| **GPS** | Global Positioning System |
| **HEO** | highly elliptical orbit |
| **IC** | Intelligence Community |
| **IM** | information mobility |
| **ISR** | intelligence, surveillance, and reconnaissance |
| **ITU** | International Telecommunication Union |
| **JDN** | Joint Doctrine Note |
| **JFC** | Joint Force Commander |
| **JP** | Joint Publication |
| **JTF** | Joint Task Force |
| **KOT** | key orbital trajectory |
| **LEO** | low Earth orbit |
| **LOS** | line of sight |
| **MOU** | memorandum of understanding |
| **MTO** | mission-type orders |
| **MW** | missile warning |
| **NASA** | National Aeronautics and Space Administration |
| **NASIC** | National Air and Space Intelligence Center |
| **NATO** | North Atlantic Treaty Organization |
| **NAVWAR** | navigation warfare |
| **NGA** | National Geospatial-Intelligence Agency |
| **NOAA** | National Oceanic and Atmospheric Administration |

| | |
|---|---|
| **NRO** | National Reconnaissance Office |
| **NSA** | National Security Agency |
| **NTIA** | National Telecommunications and Information Administration |
| **NUDET** | nuclear detonation |
| **ODMSP** | orbital debris mitigation standard practices |
| **OIF** | Operation Iraqi Freedom |
| **OOD** | Operation Olympic Defender |
| **OPLAN** | operation plan |
| **Ops** | operations |
| **OSC** | Office of Space Commerce |
| **OT&E** | organize, train and equip |
| **PED** | processing, exploitation and dissemination |
| **PNT** | positioning, navigation, and timing |
| **RF** | radio frequency |
| **RSC** | Responsive Space Capabilities |
| **RPO** | rendezvous and proximity operations |
| **SATCOM** | satellite communication |
| **SCP** | Space Capstone Publication |
| **SDA** | space domain awareness |
| **SDN** | Space Doctrine Note |
| **SDP** | Space Doctrine Publication |
| **SFFOR** | Space Force Forces |
| **SM** | standard missile |
| **SMF** | space mission force |
| **SML** | space mobility and logistics |
| **SSA** | space situational awareness |
| **SSC** | Space Systems Command |
| **SWS** | space warning squadron |
| **TT&C** | telemetry, tracking, and commanding |
| **USAF** | United States Air Force |
| **USSF** | United States Space Force |

## Appendix B: Applicable Laws and Policy

1. **1945 Charter of the United Nations (UN)** – Generally prohibits the threat or use of force in aggression unless authorized by the UN Security Council but acknowledges right of individual (national) and collective self-defense.
2. **NATO Article 5, 4 April 1949** – Article 5 defines the *casus foederis*. It commits each member state to consider an armed attack against one or more member state, in Europe or North America, to be an armed attack against them all.
3. **1967 Outer Space Treaty** – Is the foundational international space treaty that contains broad principles related to the use and exploration of outer space. Some of the key principles include that: outer space shall be free for the exploration and use by all States, is not subject to national appropriation, and the moon and other celestial bodies shall be used exclusively for peaceful purposes. Further, the treaty prohibits placement of nuclear weapons or other weapons of mass destruction in orbit or stationed in outer space in any other manner.
4. **1968 Rescue and Return Agreement** – Provides that states shall take all possible steps to rescue and assist astronauts in distress, and that the states shall, upon request, provide assistance to launching states in recovering space objects that return to Earth and are discovered in territory under their jurisdiction.
5. **1972 Liability Convention** – Establishes international rules and procedures concerning the liability of launching states for damage caused by their launched space objects.
6. **1976 Registration Convention** – Creates a mandatory system of registering objects launched into outer space.
7. **1977 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques** – Prohibits military or other hostile use of techniques to deliberately manipulate natural processes – the dynamics, composition or structure of the Earth, including among other things its atmosphere and outer space.
8. **Executive Order 12333, U.S. Intelligence Activities, 4 December 1981** – Addresses goals, direction duties, and responsibilities with respect to the national intelligence effort.
9. **2001 Orbital Debris Mitigation Standard Practices (ODMSP) and the November 2019 Update to the ODMSP** - Limits the generation of new, long-lived debris and mitigates existing debris by establishing guidelines controlling debris released during normal operations, minimizing debris generated by accidental explosions, selecting safe flight profile and operational configuration to minimize accidental collisions, and executing of post mission disposal of space structures

10. **CJCSI 3121.01B, Standing Rules of Engagement, 2005** – Provides implementation guidance on the application of force for mission accomplishment and the exercise of self-defense. Establishes fundamental policies and procedures governing the action to be taken by US commanders during all military operations and contingencies and routine Military Department functions.
11. **Executive Order 13470 30 July 2008**– Amends Executive Order 12333 to strengthen the role of the Director of National Intelligence.
12. **DoDD 3100.10, Space Policy (18 October 2012, Incorporating Change 1, 4 November 2016)** – Addresses the need to deter aggression, promote stability and responsible use of space, integrate space capabilities, and improve space mission assurance.
13. **2013 National Space Transportation Policy** – Establishes policy to ensure the US has access to diverse regions of space, from suborbital to Earth's orbit and deep space, in support of civil and national security missions.
14. **JP 2-01, Joint and National Intelligence Support to Military Operations, 5 July 2017** – Explains the role of intelligence in military operations; describes joint and national intelligence organizations, responsibilities, and procedures; discusses intelligence operations, the intelligence process and intelligence support to joint operations planning.
15. **Space Policy Directive-2, Streamlining Regulations on Commercial Use of Space, 24 May 2018** – Presidential memorandum directing new policy regarding commercial space regulations, streamlining of launch and remote sensing regulations, consolidating the responsibilities for the DOC with respect to its regulation of commercial space activities, and directing reviews of radiofrequency and export control policy.
16. **Space Policy Directive-3, National Space Traffic Management Policy, 19 June 2019** – Establishes the policy and goal of shifting space traffic management shifting responsibility from DOD to DOC for providing publically releasable SSA data to satellite operators.
17. **2019 International Telecommunication Union Constitution** – Forbids harmful interference while generally acknowledging military freedom of action.
18. **2020 National Space Policy** – Emphasizes the importance of assuring US access to space, promoting a robust commercial space industry, returning Americans to the Moon and preparing for Mars, leading exploration, and defending US and allied interests in space.
19. **Space Policy Directive-4 Establish the United States Space Force, 19 February 2019** – Calls on the Secretary of Defense to submit a legislative proposal to create a sixth branch of the United States' Armed Forces to organize, train and equip military space forces to ensure unfettered access to, and freedom to operate in space and to provide vital capabilities to joint and coalition forces in peacetime and across the spectrum of conflict.

20. **2020 Irregular Warfare Annex to the National Defense Strategy** – Explains that irregular warfare is to be institutionalized as a core competency with sufficient, enduring capabilities to advance national security objectives across the spectrum of competition and conflict, in alignment with the National Defense Strategy.
21. **2020 DoDD 2311.01, DOD Law of War Program** – DOD program implemented to prevent law of war violations by military and civilian employees, which includes specialized training, legal advisors, guidance, reporting requirements and accountability actions.
22. **2020 ITU Radio Regulations** – Governs international allocation of EMS bands and GEO orbital slots.
23. **Memorandum of Understanding between the National Aeronautics and Space Administration and the United States Space Force, 21 September 2020** – Continues the longstanding partnership or mutually beneficial collaboration activities in furtherance of space exploration, scientific discovery, and security.
24. **Law of War (treaty and customary)** – That part of international law that regulates the conduct and conditions of armed hostilities.

## Appendix C: Glossary

**Adversary –** A party acknowledged as potentially hostile to a friendly party and against which the use of force may be envisaged. (JP 3-0)

**Combat Power Projection** – integrates defensive and offensive operations to maintain a desired level of freedom of action relative to an adversary. Combat Power Projection in concert with other competencies enhances freedom of action by deterring aggression or compelling an adversary to change behavior. (Space Capstone Publication)

**Competition Continuum** – A world of enduring competition conducted through a mixture of cooperation, competition below armed conflict, and armed conflict. (JDN 1-19)

**Deceive.** Measures designed to mislead an adversary by manipulation, distortion, or falsification of evidence or information into a system, to induce the adversary to react in a manner prejudicial to their interests. (JP 3-14, Change 1)

**Degrade.** Measures designed to permanently impair (either partially or totally) the adversary's use of a system, usually with some physical damage to the affected system. (JP 3-14, Change 1)

**Deny.** Measures designed to temporarily eliminate an adversary's use, access, or operation of a system for a period, usually without physical damage to the affected system. (JP 3-14, Change 1)

**Destroy.** Measures designed to permanently eliminate the adversary's use of a system, usually with physical damage to the affected system. (JP 3-14, Change 1)

**Disrupt.** Measures designed to temporarily impair an adversary's use or access of a system for a period, usually without physical damage to the affected system. (JP 3-14, Change 1)

**Electromagnetic Battle Management.** The dynamic monitoring, assessing, planning, and directing of operations in the electromagnetic spectrum in support of the commander's concept of the operation. (JP 3-85)

**Electromagnetic Pulse.** A strong burst of electromagnetic radiation caused by a nuclear explosion, energy weapon, or by natural phenomenon, that may couple with electrical or electronic systems to produce damaging current and voltage surges. (JP 3-85)

**Electromagnetic Spectrum Operations.** Coordinated military actions to exploit, attack, protect, and manage the electromagnetic environment. (JP 3-85)

**Enable Joint Lethality and Effectiveness** – Space capabilities strengthen operations in the other domains of warfare and reinforce every Joint function – the US does not project or employ power without space. At the same time, military space forces must rely on military operations in the other domains to protect and defend space freedom of action. Military space forces operate as part of the closely integrated Joint Force across the entire conflict continuum in support of the full range of military operations. (Space Capstone Publication)

**Information Mobility** – The timely, rapid, and reliable collection and transportation of data across the range of military operations in support of tactical, operational, and strategic decision making. (Space Capstone Publication)

**Intelligence Community** – All departments or agencies of a government concerned with intelligence activity, in either an oversight, managerial, support, or participatory role. (JP 2-0)

**Key Orbital Trajectory (KOT)** – An orbit from which a spacecraft can support users, collect information, defend other assets, or engage the adversary. (Space Capstone Publication)

**Mission Command** – Is the conduct of military operations through de-centralized execution based upon mission-type orders. (JP 3-31)

**Neutralize -** To render enemy personnel or materiel incapable of interfering with a particular operation. (JP 3-0)

**Preserve Freedom of Action** – Unfettered access to and freedom to operate in space is a vital national interest; it is the ability to accomplish all four components of national power – diplomatic, information, military, and economic – of a nation's implicit or explicit space strategy. Military space forces fundamentally exist to protect, defend, and preserve this freedom of action. (Space Capstone Publication)

**Provide Independent Options** – A central tenet of military spacepower is the ability to independently achieve strategic effects. In this capacity, military spacepower is more than an adjunct to landpower, seapower, airpower, and cyberpower. Across the conflict continuum, military spacepower provides national leadership with independent military options that advance the nation's prosperity and security. Military space forces achieve national objectives by projecting power in, from, to space. (Space Capstone Publication)

**Spacepower Employment** – This is the action of applying the spacepower disciplines to a required area of operations, in order to achieve a level of space superiority. (Space Capstone Publication)

**Space Mobility and Logistics** – Enables movement and support of military equipment and personnel into the space domain, from the space domain back to Earth, and through the space domain. (Space Capstone Publication)

**Space Security** – Establishes and promotes stable conditions for the safe and secure access to space activities for civil, commercial, intelligence community, and multinational partners. (Space Capstone Publication)

**Space Superiority** – A relative degree of control in space of one force over another that would permit the conduct of its operations without prohibitive interference from the adversary while simultaneously denying their opponent freedom of action in the domain at a given time. (Space Capstone Publication)

**Space Domain** – The area above the altitude where atmospheric effects on airborne objects become negligible. (Space Capstone Publication)

**Space Domain Awareness** – Encompasses the effective identification, characterization, and understanding of any factor associated with the space domain that could affect space operations and thereby impact the security, safety, economy, or environment of the nation. (Space Capstone Publication)

**Space Situational Awareness** – The requisite foundational, current, and predictive knowledge and characterization of space objects and the operational environment upon which space operations depend. (JP 3-14)