

FM 3-14

ARMY SPACE OPERATIONS



OCTOBER 2019

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This publication supersedes FM 3-14, dated 19 August 2014.

HEADQUARTERS, DEPARTMENT OF THE ARMY

FOREWORD

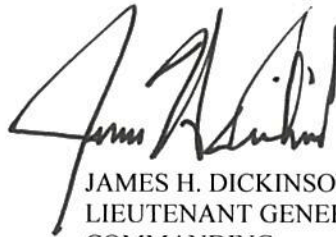
Doctrine is a cornerstone in our Army's successful support of national objectives; it provides a common perspective on which to plan, train, and conduct military operations, and establishes common terminology throughout the force. This field manual is a fundamental element of the Army's professional body of knowledge on space operations. It discusses how the Army's space capabilities are applied to both Army space-enabled operations and Army space support to joint operations.

Unified land operations and joint space capabilities are indivisible. Army space capabilities are integrated into large-scale combat operations at the strategic, operational, and tactical levels of warfare, and we must increasingly leverage space capabilities in preparation for current and future conflicts. Competitors and potential adversaries are aware of the U.S. military's use of space-enabled equipment and will try to disrupt those assets. The space domain is critically important to joint forces, and it takes an integrated team effort to continuously secure our operations in space, and deter or counter potential adversaries from threatening U.S. military space dominance.

The Army depends on space capabilities to enable and enhance land warfare; virtually every Army and joint operation benefits from these capabilities. The use of space domain assets increases the effectiveness of our combat forces. Space assets are critical to the Army's ability to communicate; navigate; target, find, fix, and finish the enemy; anticipate weather and its impact on operations; and build situational awareness with vital intelligence.

Integrating space domain capabilities into mission planning and training will prepare and enable our forces to successfully fight and win future conflicts in a denied, degraded, and disrupted space operational environment (D3SOE) while protecting our homeland, our warfighters, and our way of life.

There are many changes on the Army's horizon, especially with regard to the expanding array of space applications and effects available to the warfighter. Army space operations will remain agile and committed to ensuring that Army and joint forces get the expected and necessary level of support they need to prevail in battle, and the full range of military operations. Army space operations will continue to enhance the effectiveness of all warfighting functions, and the Army will forge ahead in developing, implementing, and synchronizing space capabilities into current unified land operations and future multi-domain operations.



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COMMANDING

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Army Space Operations

Contents

	Page
	PREFACE.....iv
	INTRODUCTIONv
Chapter 1	ARMY SPACE OPERATIONS OVERVIEW 1-1
	Section I – Army Space Overview..... 1-2
	Dependency on Space 1-2
	Army Space Capabilities 1-4
	Contested Space Domain..... 1-11
	Unified Land Operations Use of Space Capabilities 1-11
	Section II – Space Fundamentals 1-11
	Space Segments 1-11
	Orbital Characteristics 1-12
	Army Space Core Competencies 1-14
Chapter 2	SPACE OPERATIONAL ENVIRONMENT 2-1
	Space Domain Is A Warfighting Domain 2-1
	The Space Operational Environment 2-2
	Electromagnetic Operational Environment..... 2-7
	Hazards, Threats, and Vulnerabilities 2-14
	Risk Management..... 2-15
	Space Policy 2-16
Chapter 3	ARMY SPACE CAPABILITIES..... 3-1
	Section I – Space Capabilities..... 3-1
	Space Situational Awareness..... 3-2
	Positioning, Navigation, and Timing 3-2
	Space Control..... 3-3
	Satellite Communications 3-6
	Satellite Operations 3-12
	Missile Warning 3-15
	Environmental Monitoring..... 3-17
	Space-Based Surveillance and Reconnaissance 3-18

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	Section II – Space-Enabled Capabilities	3-19
	Friendly Force Tracking	3-19
	Commercial Imagery	3-21
	Tactical Exploitation of National Capability	3-21
	Section III – Army Space Proponent and Contributors	3-22
	Army Space Proponent Role	3-22
	Cyberspace Proponent Role	3-23
	Signal Proponent Role	3-23
Chapter 4	ARMY SPACE OPERATIONS	4-1
	Section I – Army Space Operations	4-1
	Army Space Support Elements	4-2
	Army Space Support Teams	4-3
	Army Headquarters, Corps and Division	4-3
	Unified Land Operations Use of Space Capabilities	4-9
	Army-Wide Space Training Considerations	4-14
	Section II – Joint Space Operations	4-15
	United States Space Command	4-15
	Space Coordinating Authority	4-16
Chapter 5	PLANNING, PREPARING, EXECUTING, AND ASSESSING	5-1
	Army Design Methodology	5-1
	Planning for Space Operations	5-1
	Preparing for Space Operations	5-11
	Executing Space Operations	5-12
	Assessing Space Operations	5-12
Chapter 6	SPACE PRODUCTS	6-1
	Purpose of The Space Input	6-1
	Space Input to the Intelligence Preparation of the Battlefield Process	6-2
	Space Running Estimate	6-7
	Satellite Operational Status	6-8
Appendix A	ANNEX C, APPENDIX 18 TEMPLATE	A-1
	GLOSSARY	Glossary-1
	REFERENCES	References-1
	INDEX	Index-1

Figures

Figure 1-1. Army space operations concept overview	1-3
Figure 1-2: Illustration of basic satellite orbits	1-12
Figure 2-1. Space operations persistence across the joint phasing model	2-13
Figure 2-2. Space threat categories	2-15
Figure 3-1. Key satellite communications features	3-6
Figure 3-2. Regional satellite communications support center support assignments	3-10
Figure 3-3. Regional satellite communications support center organizations	3-12
Figure 3-4. Wideband satellite communications operations centers mission overview	3-14

Figure 3-5. Friendly force tracking data flow overview 3-20
Figure 6-1. Situation template with space area of interest 6-3
Figure A-1. Sample Annex C, Appendix 18–Space Operations format A-2

Tables

Introductory table 1. New, modified, and rescinded Army terms.....vi
Table 1-1. Characteristics of satellite orbits 1-13
Table 2-1. Bandwidth comparison 2-8
Table 3-1. Satellite communications attributes..... 3-7
Table 5-1. Receipt of mission 5-3
Table 5-2. Mission analysis 5-5
Table 5-3. Course of action development 5-7
Table 5-4. Course of action analysis 5-8
Table 5-5. Course of action comparison 5-8
Table 5-6. Course of action approval 5-9
Table 5-7. Orders production, dissemination, and transition..... 5-9
Table 6-1. Space weather impact summary 6-4

Preface

Field manual (FM) 3-14, *Army Space Operations*, provides an overview of space operations in the Army and is consistent and compatible with joint doctrine. FM 3-14 links Army space operations doctrine to joint space operations doctrine as expressed in joint publication (JP) 3-14, *Space Operations* and other joint doctrinal publications. This FM establishes guidance for employing space and space-based systems and capabilities to support U.S. Army land warfighting dominance. It provides a general overview of overhead support to Army operations, reviews national guidance and direction, and outlines selected unique space-related Army capabilities. The doctrine in this FM represents the Army's best use of its space capabilities. This manual also contains tactics and procedures outlining how to plan, integrate, and execute Army space operations.

The principal audience for FM 3-14 encompasses all members of the Army profession, including Army commanders and staffs, to assist in the planning and incorporation of space capabilities into operations. It will aid Army and joint force commanders in planning and executing cohesive joint operations throughout the entire operational environment. Commanders and staffs of Army headquarters serving as joint task force or multinational headquarters should also refer to applicable joint or multinational doctrine concerning the range of military operations and joint or multinational forces. Trainers and educators throughout the Army may also use this manual.

Commanders, staffs, and subordinates ensure their decisions and actions comply with applicable U.S., international, and in some cases, host-nation laws and regulations. Commanders at all levels ensure their Soldiers operate in accordance with the law of war and the rules of engagement (see FM 6-27).

FM 3-14 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which FM 3-14 is the proponent publication (the authority) are marked with an asterisk (*) in the glossary. Definitions for which FM 3-14 is the proponent publication are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition.

FM 3-14 applies to the Active Army, Army National Guard/Army National Guard of the United States, and United States Army Reserve unless otherwise stated.

The proponent of FM 3-14 is the United States Army Space and Missile Defense Command (USASMDC). The preparing agency is the US Army Space and Missile Defense Center of Excellence. Send comments and recommendations on a DA Form 2028 (*Recommended Changes to Publications and Blank Forms*) to Director, Army Space and Missile Defense School, Headquarters USASMDC ATTN: SMDC-CE-TI (FM 3-14), 1330 Inverness Drive, Suite 440, Colorado Springs, Colorado 80910; by e-mail to usarmy.peterson.smdc.list.smdc-doctrine@mail.mil; or submit an electronic DA Form 2028.

Introduction

Over the last three decades, assumptions of individual domain supremacy and the break in great power security competition drove the U.S. joint force doctrine, equipment, and readiness posture. These assumptions have evolved when faced with recent changes to peer and near-peer nation capabilities and approaches to warfare.

In order to win in a complex operational environment (OE), Army forces should provide the joint force with multiple options, integrate the efforts of multiple partners, operate across multiple domains, and present threat actors with multiple dilemmas. Army space operations provide Army and joint forces with global combat advantage using highly technical capabilities to create multiple dilemmas for threat actors on the battlefield.

The space domain is a warfighting domain with different characteristics from air, land, maritime, and cyberspace domains. The National Military Strategy of the United States of America identified the space domain as a global commons—those portions of the Earth, outside national jurisdiction, all actors have rightful access to. This FM is rooted in Army operations and consistent with joint doctrine.

Nearly every Army operation relies on the advantages provided by space capabilities and effects to enhance the effectiveness of combat forces. Space capabilities permit enhanced situational understanding; provides global communications; enables precise and accurate fires; supports the conduct of joint expeditionary entry, movement, and maneuver operations; and provides a conduit for cyber electromagnetic operations supporting Unified Land Operations. These capabilities directly support large scale combat operations by enhancing command and control, providing secure communications over extended distances and across areas without modern infrastructure.

Potential adversaries have identified U.S. reliance on space-based capabilities as a critical vulnerability and will attempt to exploit it in order to deter and degrade our ability to act. Army space operations seek ways to maintain assured access to space capabilities, and when necessary, to achieve its objectives in spite of the adversary's counterspace efforts.

Army space operations are conducted around the globe, but engaged regionally. Army space operations often are an integral part of a joint team used to plan, fight, and adapt operations across the range of military operations. Army space operations continue to evolve to meet the requirements of a complex and rapidly changing OE.

Army space doctrine refines and expands upon joint space doctrine by defining those space tactics and procedures relevant to unified land operations and applicable to large scale combat operations. Army space operations applies to the tactical, operational, and strategic levels of war, but the results are often challenging to quantify which level or levels benefit as modern conflict may not be easily divided into discrete levels. In an internet-connected world which often exploits social media, theater-level tactical actions may have far-reaching operational and strategic-level impacts. The space capabilities form the framework for how space operations supports the Army warfighting functions.

The principles that successfully guide unified land operations are applicable to the space domain. The Army uses space-based capabilities to support its dominance in unified land operations. Space operations are critical to the range of military operations as many space capabilities are embedded in Army operations.

Summary of Changes

FM 3-14 was completely rewritten to document Army-centric space operations. The current manual aligns Army doctrine with JP 3-14. FM 3-14 updates terminology, highlights the critical support Army space operations play in joint operations, and links space operations with the warfighting functions. A summary of changes is below.

- Adds an Army space operations overview diagram to chapter 1.
- Greatly expands on operational environment and clearly identifies how space capabilities contribute to the operational environment.
- Removes unit specific battalion and below material which is inappropriate to an FM.
- Discusses capabilities such as positioning, navigation, and timing; satellite operations; satellite communications; and space control as integrated effects and not isolated, stove-piped functions.
- Updates the operations process in chapter 5.
- Renames Annex N–Space Operations as Appendix 18–Space Operations to Annex C of the base order.

The following terminology is deleted per Department of Defense Dictionary.

Introductory table 1. New, modified, and rescinded Army terms

Term	Remarks
prevention	Term rescinded.
space force application	Term rescinded.
space force enhancement	Term rescinded.
space mission areas	Term rescinded.
space support	Formal definition rescinded, used informally as a commonly understood term
space surveillance	Formal definition rescinded, used informally as a commonly understood term
space system	Formal definition rescinded, used informally as a commonly understood term
theater event system	No longer a defined term.
space domain	New term.
space joint operating area	New term.
defensive space control	Modified definition.
negation	Modified definition.
offensive space control	Modified definition.
space coordinating authority	Modified definition.
space forces	Modified definition.
space situational awareness	Modified definition.
space superiority	Modified definition.

Chapter Organization

FM 3-14 contains six chapters and one Appendix:

Chapter 1 is an overview of Army space operations. It includes a top-level operational view (known as an OV-1) of Army operations utilizing space capabilities and serves to illustrate the dependencies upon space operations and space-based connectivity. It categorizes and describes the functions of Army space operations and Army space-enabled operations. It identifies and describes operations in a contested environment and describes the space domain environment.

Chapter 2 is the space OE and how it is shaped by national and Army space policy. It includes how Army space operations uses operational and mission variables to contribute to antiaccess and area denial operations resulting in mission assurance. Army space operations reside in a contested space environment and the persistence of Army space operations drives missions and space operations tempo.

Chapter 3 identifies Army space capabilities, describes Army space operations regarding those capabilities, and identifies the various Army proponents and their roles in space operations.

Chapter 4 discusses Army space operations, roles, and responsibilities at headquarters levels, operations for Army space elements, coordination between Army and joint forces related to space operations, and how Army space operations supports each of the six warfighting functions, and special operations forces.

Chapter 5 discusses planning, preparing, executing, and assessing space capabilities within the operations process.

Chapter 6 identifies space input to the intelligence preparation of the battlefield, and developing the space running estimate.

Appendix A identifies Appendix 18–Space Operations to Annex C of the base order, its relationship to other annexes, its content, and the considerations for preparing Appendix 18.

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Chapter 1

Army Space Operations Overview

Unified land operations and Army space operations are indivisible. A typical Army Brigade Combat Team has over 2,500 positioning, navigation, and timing (PNT)-enabled devices and over 250 satellite communications (SATCOM)-enabled devices used to conduct precision fires, movement, maneuver, communications, protection, command and control, and other mission requirements.

This chapter provides a general overview of the depth and breadth of available space capabilities to conduct unified land operations. It recognizes the different career specialties the Army uses to support space operations and space-enabled operations. It identifies how the Army must plan to operate in a contested space domain which may be exploited by threat actors to create a denied, degraded, and disrupted space operational environment (D3SOE). It provides space fundamentals lists the approved Army space core competencies.

1-1. The space capabilities the Army uses are dependent on both the space domain (the physical location where space-based satellites transmit and receive signals) and Army space operations to conduct the planning, coordination, integration, and synchronization of space capabilities across all functions within unified land operations. While the Army is capable of completing its assigned mission in a D3SOE, it is more agile and efficient when using space capabilities to their fullest ability.

1-2. Space operations are inherently joint and Army space forces routinely coordinate with Army, joint, and unified action partners on the best way to employ space capabilities. U.S. Army space operations are firmly established in national, Department of Defense (DOD), and Service level policies that guide space operations. Army Space force personnel consist of trusted Army professionals who work diligently to assure continuous access to space capabilities.

1-3. Assured access to space capabilities is a framework of capabilities, actions, and processes to assure Soldiers can to shoot, move, and communicate where and when desired, to achieve the commander's intent. The Army invests in space capabilities and its use of the space domain is broad. Space capabilities enable and enhance tactical operations across the range of military operations. Many aspects of space operations have become normalized in Army operations and are routinely integrated into mission plans. However, assured access to space capabilities is a necessity for agile and efficient mission operations.

1-4. The *space domain* is defined as the area above the altitude where atmospheric effects on airborne objects become negligible (JP 3-14). The space domain is a physical location where military, civil, and commercial space activities are conducted and the upper limit extends infinitely outward. Military activities within the space domain are conducted to achieve U.S. national security objectives.

1-5. *Space forces* are the space and terrestrial systems, equipment, facilities, organizations, and personnel, or combination thereof, necessary to conduct space operations (JP 3-14). A *space asset* is the equipment that is an individual part of a space system, which is or can be placed in space or directly supports space activity terrestrially (JP 3-14). The space forces and space assets support all warfighting functions and enable the Army to communicate, navigate, target hostiles, protect our forces, and operate in a contested OE more efficiently.

1-6. The *space environment* is the environment corresponding to the space domain, where electromagnetic radiation, charged particles, and electric and magnetic fields are the dominant physical influences, and that encompasses the earth's ionosphere and magnetosphere, interplanetary space, and the solar atmosphere (JP 3-59). Space operations are those operations impacting or directly utilizing space-based assets to enhance the potential of the U.S. and unified action partners. The *space joint operating area* is the operational area, bounded by the space domain, assigned to Commander, United States Strategic Command, in which space operations are conducted (JP 3-14).

1-7. Space capabilities provide a global perspective as space-based sensors provide support to unified land operations. Space capabilities contribute solutions to counter theater antiaccess (A2) and area denial (AD) strategies. *Antiaccess* is action, activity, or capability, usually long-range, designed to prevent an advancing enemy force from entering an operational area (JP 3-0). *Area denial* is action, activity, or capability, usually short-range, designed to limit an enemy force's freedom of action within an operational area (JP 3-0).

SECTION I – ARMY SPACE OVERVIEW

DEPENDENCY ON SPACE

1-8. For over a half century, space capabilities have enhanced the effectiveness of joint forces during times of peace and times of war, reinforcing the significance of space capabilities when integrated across the range of military operations. Mission planning requires consideration of space operations across all domains, activities, and an organization processes to ensure capabilities are available, integrated, and effects used.

1-9. JP 3-14 lays the foundation of joint space doctrine by establishing principles for the integrated employment of space capabilities. It recognizes each Service has a unique role in providing space capabilities, and the capabilities provided by one service are integrated into the planning and operations of all services. As designated by the DOD, each Service component provides different space-related capabilities designed to complement the space capabilities of the other Services, not duplicate them. The Air Force provides launch services, the Air Force and Navy acquire military satellites, the Army and Air Force manage long-haul use of military SATCOM, and all three operate satellites. The Army, Navy, and Air Force provide ground hardware, and all Services benefit from space capabilities.

1-10. *Space superiority* is the degree of control in space of one force over any others that permits the conduct of its operations at a given time and place without prohibitive interference from terrestrial or space-based threats (JP 3-14). In unified land operations, space superiority enables freedom of maneuver and accurate fires, when and where needed. Space superiority is a function of the space domain and may be maintained for long periods of time, or obtained for short windows of time for specific operations. Space superiority contributes decisive wins in high-intensity conflicts against any adversary, anytime, and anywhere.

1-11. The Army leverages space capabilities to support unified land operations from large scale combat operations to individual Soldiers at the tactical level of warfare. Space capabilities enhance the Army's ability to communicate, navigate, accurately target the enemy, protect and sustain our forces, and enable intelligence preparation of the battlefield (IPB). While the Army is dependent on Army space operations, it is sometimes difficult to observe the effects or direct impact of space operations because the desired effect may be difficult to observe.

1-12. Allied Joint Publication (AJP)-3.3, states, "To ensure effective integration, all personnel engaged in the planning, conduct, and supervision of joint operations must have a common and clear understanding of how space capabilities (military, civil, commercial, national, and multinational) contribute to joint operations, and how military space operations can be integrated in military operations to achieve alliance security objectives. They should also be aware adversaries will increasingly seek to exploit their own access to space products with military utility; many of these can easily be purchased from commercial sources."

1-13. Commanders at all echelons must understand the fundamental principles and advantages space operations bring to all Army operations, the disadvantages associated with not understanding space capabilities, and the impact to mission operations when friendly forces are denied the use of space capabilities. Space operations bring essential capabilities with unique tools to influence, enable, and enhance all mission areas in unified land operations. Unit commanders must have a clear understanding of the space capabilities available that contribute to mission operations and how best to utilize those assets.

1-14. Army space operations conceptual overview is illustrated in figure 1-1. The illustration highlights how unified land operations and Army space operations are indivisible across the range of military options in an OE. Without these capabilities, unified land operations as they are conducted today would be significantly different.

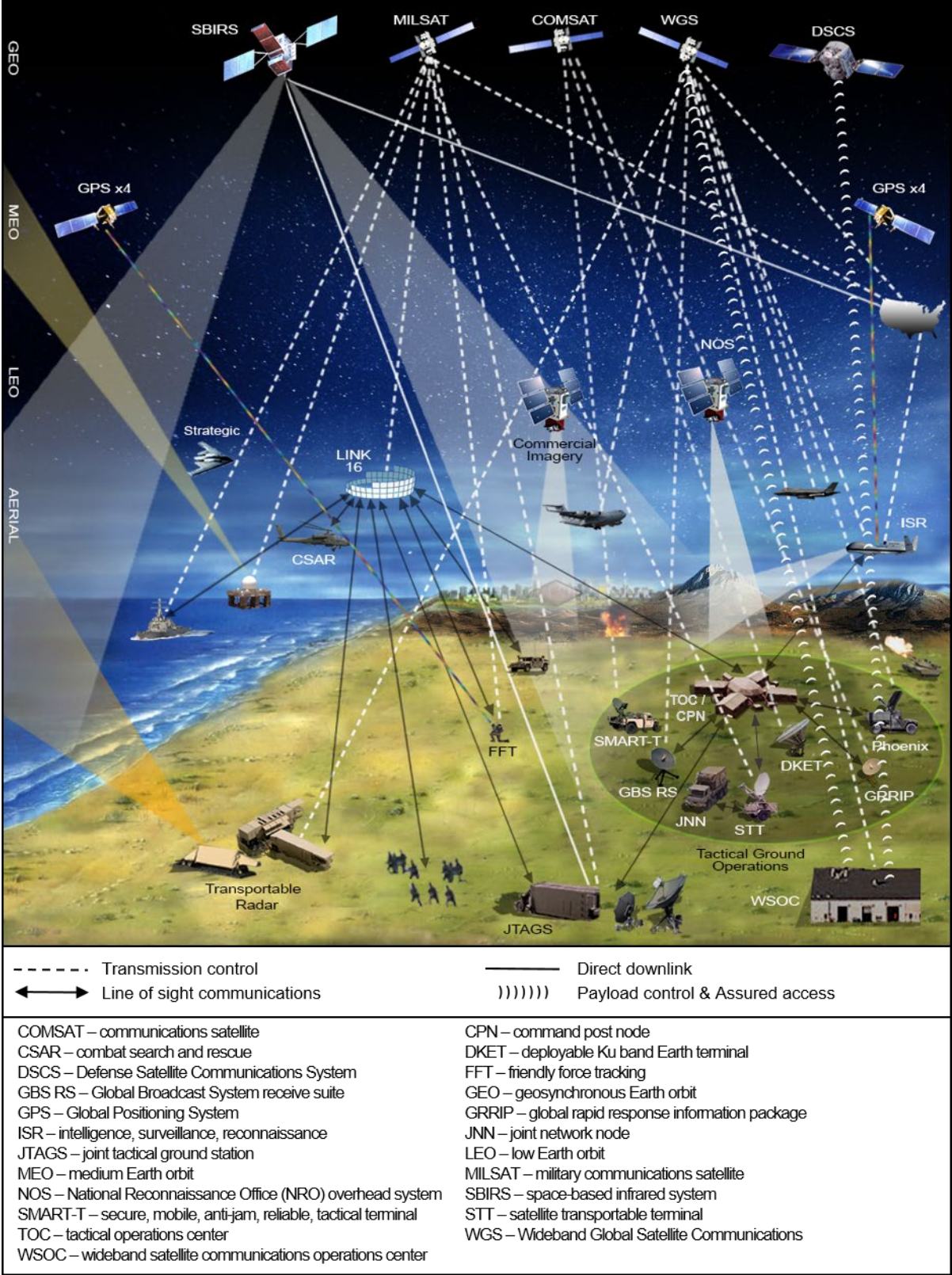


Figure 1-1. Army space operations concept overview

ARMY SPACE CAPABILITIES

1-15. All Services contribute to and use the body of knowledge residing within the ten codified space capabilities. Some capabilities are provided by other Services and Agencies, but they are required to support Army operations and contribute to the success of Army missions. Army space operations may receive space-related intelligence and environmental monitoring products through Army intelligence channels, directly from other Services, centers, or agencies.

1-16. The distinct space capabilities, effects, and products used by the Army, joint, allied forces, and partner nations are planned, developed, prepared, and made available to the force by Soldiers conducting Army space operations and space-enabled operations. The Soldiers conducting space operations and space-enabled operations may be assigned to space operations, signal, cyber, electronic warfare, intelligence operations, and other military operations specialties. Not all Army Soldiers who configure and use equipment reliant on space capabilities are designated as space operators. However, these Soldiers are instrumental to the Army's critical use of space capabilities in unified land operations.

1-17. Army space-related activities include:

- Army space operations, duties, and responsibilities are centered on these eight codified joint space capabilities: space situational awareness (SSA), PNT, space control, SATCOM, satellite operations, missile warning, environmental monitoring, and space-based intelligence, surveillance, and reconnaissance. There are two other codified joint space capabilities—nuclear detonation detection and spacelift—but the Army has no involvement with those.
- Army space-enabled operations are not specifically codified in joint doctrine as space capabilities, but are combined, derived, or second order tasks and actions enabled by space capabilities. These include, but are not limited to, joint friendly force tracking (FFT), network transport of Department of Defense information network, commercial imagery, National Reconnaissance Office overhead systems, Army tactical exploitation of national capabilities (TENCAP) program, National-to-Theater program interfaces, geospatial intelligence, integrated broadcast service, and common interactive broadcast.

ARMY SPACE OPERATIONS

1-18. Legal considerations are substantive to space operations and many are laid out in space policies. Employing space capabilities brings up complex legal considerations involving international law, the law of armed conflict, and relevant codes of conduct. Considerations of proportionality, military necessity, discrimination, and humanity apply equally to the space domain as to operations elsewhere (AJP-3.3). Consistent with the inherent right of self-defense, the Army must deter others from interference and attack, defend our space assets, and contribute to the defense of multinational space assets. If deterrence fails, the Army must defeat efforts to negate U.S. space capabilities consistent with the standing rules of engagement.

1-19. *Space situational awareness* is the requisite foundational, current, and predictive knowledge and characterization of space objects and the OE upon which space operations depend (JP 3-14). SSA involves characterizing, as completely as necessary, the space capabilities operating within the terrestrial environment and the space domain. SSA combines the output of a wide variety of products and sources, including intelligence and cyberspace sources, to provide insight into adversary use of space capabilities and their potential to threaten friendly space capabilities. SSA contributes to a commander's ability to understand adversary intent. SSA is a key component for space control because it is the foundation for accomplishing all space control tasks.

1-20. PNT. The space-based *Global Positioning System* (GPS) is a satellite-based radio navigation system operated by the Department of Defense to provide all military, civil, and commercial users with precise PNT. The GPS is a DOD owned and operated global navigation satellite system (GNSS)—the general term applied to any space-based system providing PNT information across the globe. GPS provides essential, precise, and reliable timing information which enables forces to more effectively execute unified land operations. Assured PNT information is a mission essential element in nearly every modern weapon system.

- GPS enables precision attack from stand-off distances, reducing collateral damage and allowing friendly forces to avoid threat areas. It enables FFT to avoid specific areas and aid in rescue operations; it increases tactical operating ranges by providing specific location coordinates, fosters precision movement and maneuver, enables unmanned aerial systems which provide situational understanding, and many other functions. Precision timing provides the Army the ability to synchronize tactical digital networks, wide area networking, and communications capabilities such as frequency hopping. It enables targeting and fires with increased lethality and reduces collateral damage to civilians and infrastructure.
- The loss of GPS may yield a decrease in the efficiency to conduct mission operations. All Soldiers must understand the extent their forces and equipment rely on PNT information and how degraded or denied GPS information may impact Army operations. The impact to systems go beyond handheld GNSS devices. The loss of GPS may impact network time protocol—which helps keep communications networks and computers synchronized—command and control devices, maneuver forces, aviation platforms, precision munitions, and other systems.

1-21. *Space Control* is the operations to ensure freedom of action in space for the U.S. and its allies and deny an adversary freedom of action in space (JP 3-14). The Army conducts space control by using globally deployable units to conduct surveillance and assessment of space systems in support of military and civil operations. Units conducting space control plan and conduct system diagnostic monitoring, vulnerability assessments, data integrity studies, and quality control in support of U.S. military SATCOM or other capabilities. Space control supports freedom of action in the space domain for friendly forces, and when necessary, defeats adversary efforts to interfere with or attack U.S. or allied space systems and negates adversary space capabilities. It consists of defensive space control (DSC), offensive space control (OSC), and navigation warfare (NAVWAR).

- *Defensive space control* is active and passive measures taken to protect friendly space capabilities from attack, interference, or unintentional hazards (JP 3-14). These actions protect friendly SATCOM and other space capabilities from attack, interference, unauthorized intrusions, or unintentional hazards.
- *Offensive space control* is offensive operations conducted for space negation (JP 3-14). *Negation*, in space operations are measures to deceive, disrupt, degrade, deny, or destroy space systems (JP 3-14).
- *NAVWAR* is the deliberate defensive and offensive action to assure and prevent PNT information through coordinated employment of space, cyberspace, and electronic warfare operations (JP 3-14). The effects of a NAVWAR environment on systems are complex and ranges from limited in scope and area to enveloping an entire area of responsibility (AOR). NAVWAR effects include varying conditions from mildly degraded to totally disrupted GNSS signals, and may include spoofing— an emulated signal with false and misleading information. Space operations focus on space-based PNT signals, situational understanding, and space control operations. Cyberspace operations protect friendly networks that leverage GNSS, while targeting similar adversary capabilities. Electronic warfare operations—consisting of electronic support, electronic attack, and electronic protection—conducted in support of NAVWAR denies adversary access to GNSS information, and protects friendly capabilities within the electromagnetic spectrum (EMS).

1-22. SATCOM provides the necessary connectivity for worldwide communications and mobile forces operating over large, dispersed areas. It provides the Army critical connectivity for tactical maneuver forces and Soldiers whose rapid movement and geographically dispersed deployments move them away from direct access to land lines and line of sight communication.

- Each regional satellite communications support center (RSSC) is a multi-service, multi-agency organization providing theater communication planners with a single point of contact for satellite access planning of military narrowband, wideband, protected band, and commercial SATCOM support. The RSSC is the theater center of expertise for all military and commercial SATCOM serving operating forces. The Army manages four RSSCs.
- The Army is the Consolidated SATCOM System Expert for Wideband and Narrowband SATCOM systems, and satellite communications system expert for Defense Satellite Communications System (DSCS), Wideband Global Satellite Communications (WGS), Mobile

User Objective System, and the Global Broadcast Service. Duties of the Consolidated SATCOM System Expert include providing continuous support to deconflict, assess, analyze, and integrate SATCOM information, status, configurations, synchronization, sustainment issues, deployment issues, and anomalies for all Services and joint operations.

1-23. Satellite Operations. Satellite Operations maneuver, configure, operate, and sustain on-orbit assets and are characterized as spacecraft and payload operations. The Army has primary responsibility for planning, operational management, and payload control of DOD's wideband satellite systems. The major elements of Army satellite operations are transmission control, satellite payload control, assured access to SATCOM (included using wartime reserve modes, contingency plans for outages, the ability to re-route services across all platforms, to reconstitute or augment existing capabilities, or to neutralize the source of the disruption), and support to electromagnetic interference resolution on military narrowband and wideband SATCOM constellations.

- The Army operates five wideband satellite communications operations centers (WSOC). A unique satellite control battalion with specially trained Signal Soldiers conducts satellite payload configuration management, implements satellite transmission plans, conducts link monitoring, and controls DOD wideband military SATCOM systems. Each WSOC provides transmission control and satellite payload control for DOD wideband military SATCOM systems enabling wideband SATCOM for all users on these constellations. WSOCs provide support to electromagnetic interference resolution on DSCS and WGS constellations. Strategic wideband SATCOM is used to carry high volumes of communications around the world and is the primary fixed and transportable means for reachback communications from in-theater headquarters to those in continental U.S. Operating these centers enables communications for the Commander in Chief, Secretary of Defense, Chairman of the Joint Chiefs of Staff, all Services, State Department, intelligence activities, combatant commanders, and international partners.

1-24. Theater Missile Warning.

- Missile warning is based on detecting an event. Ground-based radars detect the movement of ballistic missiles and high energy infrared (heat) events—such as the hot exhaust of an intercontinental ballistic missile. Theater missile warning reports these detections throughout the depths of the battlespace.
- Provides joint forces with theater early warning to dissuade, deter, and defeat ballistic missile attacks. Joint Tactical Ground Stations (JTAGS) provide in-theater warning of ballistic missile launches. JTAGS units receive downlink data directly from space-based infrared sensors on ballistic missile launches, other events of interest, and battlespace characterization—such as a large oil refiner explosion.
- JTAGS ground stations are forward deployed and strategically located to provide warning and threat characterization in support of the U.S. homeland defense and theater ballistic missile defense. JTAGS units process and provide warning, alerting, and cueing information to joint forces commanders, tier 1 command centers, forward joint forces, and other interested units.

1-25. Environmental Monitoring. Space forces provide data on meteorological, oceanographic, and space environmental factors which might affect military operations. Space capabilities provide data for forecasts, alerts, and warnings of the space environment which may negatively impact space assets, space operations, and terrestrial users. Imagery capabilities can provide joint force planners with current information on sub-surface, surface, and air conditions, such as trafficability and land use, beach conditions, vegetation, cloud cover, and moonlight percentage. Imagery may be used by the Army Corps of Engineers to monitor civil infrastructure during natural disasters and for humanitarian assistance and disaster relief. Knowledge of these factors allows ground forces to avoid adverse environmental conditions while taking advantage of other conditions to enhance operations. This space-based capability supports IPB by providing the information needed to identify and analyze potential courses of action.

1-26. Space-based intelligence, surveillance, and reconnaissance is a joint space capability. A *space capability* is the ability of a space asset to accomplish a mission or the ability of a terrestrial-based asset to accomplish a mission in or through space (JP 3-14). Within the Army, the deputy chief of staff, intelligence (G-2) is the responsible agent for providing intelligence to Army forces. Refer to Army doctrine publication (ADP) 2-0 for information on Intelligence operations.

ARMY SPACE ELEMENTS AND TEAMS

1-27. An Army space support element (SSE) serves as an integral part of the headquarters staff directly involved in the staff planning and targeting process, and coordinates directly with other space staffs on procedures for space support requests and reachback support. They are assigned to every Army, corps, and division headquarters staff. SSEs are part of the military decisionmaking process (MDMP) to ensure space capabilities and effects are optimized to meet the commander's intent. They identify the utility of employing specific space capabilities, coordinate for those capabilities which do not fall under the purview of other staff elements, integrate them into plans, and ensure they are synchronize in operations. They develop Appendix 18–Space Operations to Annex C of a commander's base plan or order to describe how Army space operations are integrated into the concept of operations.

1-28. Army space brigade and battalions provide trained and ready Soldiers to conduct SATCOM, satellite operations, missile warning, and space control directly supporting the warfighter, and provides other capabilities for Army and joint space operations. An Army space support team (ARSST) provides space planning expertise, capabilities, products, and SSA of space assets. The team deploys and integrates with a host unit to provide direct support to Army brigades and higher echelons (as necessary), Army Special Operations forces, Marine Expeditionary Forces, and may be deployed to support an SSE. An ARSST team may be tailored in a variety of ways to fulfill a request for forces.

1-29. An Army space control planning teams provide the Army with space control planning capabilities. The focus of the space control planning teams is to support commands exercising operational control of space control systems and capabilities. Space control planning teams operate at the combatant commander or joint force commander level where they integrate into the headquarters element. They provide space control planning integration and expertise on Army space control capabilities to coordinate effects, timing, and tempo with centralized operational space control capabilities. Planning for space control operations should be conducted by space operations Soldiers who are subject matter expertise in space control.

1-30. An Army space coordination element has Army space operations coordination responsibilities. Residing within an Army battlefield coordination detachment at a theater air operations center, they coordinate land component commanders space operations requirements between air component commander and the space coordinating authority (SCA). They assist SSEs to ensure Army space equities are recognized and incorporated into joint space operations, assist in the joint space planning process, and assist in the development of space priorities in support of the land component commander.

ARMY SPACE-ENABLED OPERATIONS

1-31. Network Transport. SATCOM is a key means of information transport for unified land operations. SATCOM systems provide long-haul capability, multi-path options for tactical communications, communications on-the-move, beyond line of sight communications, and flexibility to commanders and warfighters. SATCOM systems are located at every echelon in the Army and support all operations. Support to intra-theater communications and connectivity to Department of Defense information network provides critical services routed through military narrowband and wideband SATCOM constellation. These services include the Defense Switched Network, Defense Red Switched Network, Defense Messaging System, video teleconferencing, Telemedicine, Non-classified Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), and the global mission networks.

1-32. Expeditionary Signal Units. An expeditionary signal unit provides communications support for an area of operations to establish a tactical network. An appropriately sized expeditionary signal unit—brigade, battalion, company, or platoon—contains the necessary personnel, transmission systems, network management systems, and mission command information systems necessary to create a correctly sized, complete communications node.

1-33. Army tactical ground operations depend on signal Soldiers to establish satellite terminal connectivity to use SATCOM for network transport. The tactical operations center is the center of activity behind tactical battlefield operation where many of the SATCOM feeds terminate, the data is digested, and used to make decisions. From headquarters at the battalion, up to corps, and often higher, the tactical operations center is where staff sections come together to make battlefield decisions and issue orders.

1-34. Satellite terminals provide commanders and Soldiers with assured, reliable, high-speed, high-capacity satellite terminal connectivity using military and commercial satellite constellations operating across the ultrahigh frequency, super-high frequency, and extremely high frequency bands. The use of SATCOM increases the operational reach and situational awareness of the entire force. The most common SATCOM enabled equipment and terminals supporting tactical ground operations includes:

- The tactical communications node provides the principal network backbone element and support command post operations for the mobile tactical network. The tactical communications node has communication and networking equipment and allows Soldiers the ability to access a network at a variety of security levels. While at-the-halt, the tactical communications node is equipped with a variable height antenna to improve line of sight connectivity and specific satellite equipment for high throughput.
- The command post node establishes a small to medium communications node that extends limited NIPRNET, SIPRNET, secret and non-classified voice and video telecommunications services. The command post node uses and a satellite transportable terminal to connect with a joint network node via line of sight connectivity.
- Joint network node is a vehicle-mounted, satellite-based communication system. The system provides beyond line of sight access to NIPRNET and SIPRNET capabilities with secure and non-secure voice and video telecommunications.
- The satellite transportable terminal is a trailer-mounted SATCOM terminal that provides network transport for the joint network node. It is designed to support tactical missions which require high throughput communications.
- The Phoenix is a vehicle-mounted tactical satellite communications terminal. It provides a signal battalion assured access to SATCOM and operational flexibility in a tactical environment by providing a rapidly deployable capability. It has high capacity, inter-theater range for networked battle command and control information.
- Global Rapid Response Information Package (known as GRRIP) provides secure, beyond-line of sight voice and video telecommunications without the need for local network infrastructure. It provides early entry capability and situational awareness in air-to-land missions and supports initial entry teams that require high bandwidth network capability in austere environments.
- Transportable Tactical Command Communications (known as T2C2) are high-bandwidth satellite terminals designed to enable initial entry forces to connect to the Army networks. It provides voice and video telecommunications in an austere environment with limited infrastructure.
- The Secure, Mobile, Anti-Jam, Reliable, Tactical–Terminal (known as SMART-T) is a protected band SATCOM system which enables commanders at brigade and higher to operate in a D3SOE.
- Global Broadcast Service receive suite (known as GBS-RS) provides high-speed one-way broadcast of informative products such as video, imagery, maps, and weather data to deployed tactical operations centers and garrisoned forces without overloading host unit command and communication networks.

1-35. *Friendly force tracking* is the process of fixing, observing, and reporting the location and movement of friendly forces (JP 3-09). FFT systems provide a commander the ability to track Army and joint units of all sizes. It integrates SATCOM and PNT to provide continuous joint FFT to combatant commanders, agencies, allies, and unified action partners. FFT improves situational awareness by providing the location and movement of forces equipped with devices that transmit position location information to the theater common operational picture (COP). Integrating the FFT information into the theater COP is of great importance if a friendly force unit needs to be reinforced or removed from a difficult situation. FFT systems provide the exact location information necessary to track units, and thus contribute to effective command and control, situational understanding, personnel recovery, and fratricide avoidance.

Note: The COP is the primary tool for supporting the commander’s situational understanding. All staff sections provide input from their area of expertise to the COP.

1-36. Commercial imagery. Unclassified commercial satellite imagery is used by joint and Army forces, other government agencies, and multinational partners in the combatant commander’s area of responsibility

to enhance knowledge of the environment within the operational area. Unclassified commercial satellite imagery is especially useful during coalition operations since it is more easily approved for release to share with foreign militaries for enhanced mission operations.

1-37. National Reconnaissance Office overhead systems (known as NOS)—formerly referred to as national technical means—are spaced-based sensors designed to collect data in order to support intelligence analysis. National Reconnaissance Office overhead systems provides timely and accurate geospatial intelligence and signals intelligence to national, strategic, operational, and tactical level requirements. Current and future planning, nodal placement, and capability development is led by the National Reconnaissance Office, intelligence community functional managers, and coordinated through the G-2 as the Army’s intelligence community element lead.

1-38. Army TENCAP program. The Army TENCAP is a congressional mandate program responsible for understanding, influencing, and integrating current and emerging space-based national systems data into the tactical decision making process. It delivers unique capability as the Army’s lead activity to influence, leverage, and integrate the national intelligence enterprise to benefit the Army through various ground, air, and space capabilities.

1-39. Geospatial Intelligence and Geospatial Engineering. Geospatial intelligence is a discipline that exploits and analyzes imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced locations on the Earth. Geospatial intelligence consists of imagery, imagery intelligence, and geospatial information. Geospatial engineers provide the capabilities and activities that contribute to a clear understanding of the physical environment by providing geospatial information and services to commanders and staffs. Both disciplines utilize remote sensing capabilities from space-based capabilities to perform their duties.

1-40. At echelons above corps, geospatial intelligence reside at Military Intelligence Brigade–Theater and at reach back centers such as National Ground Intelligence Center. The Army’s National-to-Theater program leverages remote sensing data and imagery from ground, airborne, and spaced-based assets to provide timely, tailored ground-related geospatial intelligence data. These products, and services support the DOD, Army Service component commanders, their supported unified commands, subcomponent command, and the intelligence community. Geospatial engineering capabilities reside in the engineer brigade, or geospatial planning cell, with reach-back to the Army Geospatial Center. For more information on geospatial intelligence see ATP 2-22.7.

1-41. At corps and below, local geospatial intelligence cells reside at the corps, divisions, brigade, special operations forces, special mission units, security force assistance brigades, and military intelligence brigades. The geospatial intelligence cells are co-located military intelligence and engineer personnel to synchronize efforts and improve support to the commander and staff.

1-42. Signals intelligence is intelligence derived from communications, electronic, and foreign instrumentation signals (JP 2-0). Signals intelligence leverages spaced-based capabilities to provide unique intelligence information. It complements intelligence derived from other sources and is often used for cueing other sensors to potential targets of interest.

1-43. Integrated broadcast service and common interactive broadcast. The integrated broadcast service and common interactive broadcast capabilities occur within Army Military Intelligence channels with mission partners.

- Integrated broadcast service and common interactive broadcast are integrated dissemination systems which allow producers the means to disseminate strategic, operational, and tactical-level information to the warfighter via multiple transmission paths in accordance with consumer-generated dissemination priorities. These broadcast services are the DOD worldwide standard networks for transmitting time-sensitive tactical to strategic intelligence and targeting data to all echelons of Joint Service operational users. Users capture the valuable and unique characteristics of the broadcasts, update their situational awareness, and integrate their capabilities. The operational architecture promotes the integration and interoperability of joint, allied, and unified action forces and systems.
- Common interactive broadcast is a robust multi-sensor, multi-source intelligence exploitation capability. It is a set of approved ultrahigh frequency SATCOM military standards which support

the requirements of a single broadcast using a single common message format for integrated broadcast service. The common interactive broadcast is a theater-based ultrahigh frequency SATCOM broadcast used to connect the producer community with deployed Soldiers. The primary focus of the common interactive broadcast is to facilitate the reporting and dissemination of threat warning and situation awareness data to combat forces in near real time.

1-44. Expeditionary Army space operations. Used to disrupt and deny enemy A2 and AD capabilities. The primary design is to protect the joint force by targeting critical enemy assets such as integrated air defense systems, cruise and ballistic missiles, aerial attack capabilities, and surveillance capabilities. Fires are employed to open windows of advantage across the battlefield. Joint forces are supported throughout all phases of the joint operation.

1-45. The forward-deployed units operates in theater as part of the counter-A2 and AD force in support of a geographic combatant command and assigned to an Army Service component command. Units integrate space operations with intelligence, information operation cyberspace, electronic warfare operations, and signal assets to support force protection, target development, and information operations as required. Units deliver offensive and defensive cyber effects, leverage joint and Army space capabilities, and employ electronic warfare to support mission objectives. Units provide 24-hour command and control, and continuous mission analysis to ensure synchronized operations. The four detachment subordinate teams are intelligence, cyberspace electromagnetic activities, space operations, and signal.

1-46. Space teams consist of two entities, a space control planning team on the headquarters staff and a space crew to provide effects.

- The space control planning team provides an organic space support planning capability, and consist of space control personnel. The space control planning team characterizes adversary, neutral, and friendly space capabilities operating within the terrestrial environment and the space domains. They integrate space control and SSA into operations and serve as an advisor to the staff members on space control capabilities and limitations. They are the conduit between the staff, higher headquarters, and external space support agencies for all space-related activities.
- The space crew delivers space-related effects. They characterize space capabilities operating within the battlespace, support freedom of action within the space domain for friendly forces, and defeat enemy efforts that interfere with or attack joint or allied space systems. The space crew denies windows of opportunity for the enemy to exploit operations through the space domain. They conduct assessment of space systems to support military operations, plan and conduct vulnerability assessments, conduct data integrity studies, and quality control to support U.S. military SATCOM.

HIGH ALTITUDE OPERATIONS

1-47. High altitude air operations are not considered space assets. However, they are so closely aligned with space capabilities they belong to the same Force Modernization Proponent. High altitude platforms are designed to augment capabilities provided by space-based satellites and provide additional capabilities not readily available from space-based sensors in a rapidly changing environment. High altitude operations are conducted utilizing the joint aerial layer network between 60,000 and 100,000 feet above mean sea level.

1-48. High altitude platforms provide rapidly deployed capabilities to tactical forces. Platforms include super-pressure balloons, zero-pressure balloons, long endurance fixed-wing aircraft, and dirigibles. Payloads may be configured to accommodate one or multiple missions and may be configured as requirements change. Payloads may include pseudolites—ground or high altitude-based satellite imitators—synthetic aperture radar, wide-area motion sensors, bi-static radar, peer-to-peer data links, and re-transmission or extension payloads such as very high frequency, ultrahigh frequency, Ka-band, and other radio band signals.

1-49. A few advantages of high altitude operations over space-based platforms are persistence over an area, extended operating distances for line of sight communications, and being physically closer to the AOR which may provide better imagery. One of the disadvantages of high altitude operations compared to space-based platforms is the necessity to have air superiority.

CONTESTED SPACE DOMAIN

1-50. Operations in the space domain are increasingly contested, degraded, and operationally limited. The Army and joint forces must plan to operate in a contested space domain. The threat to Army and joint operations from a contested, degraded, and operationally limited space domain may create critical vulnerabilities for threat actors to exploit against unified land operations. These perceived vulnerabilities make contesting the space domain attractive to threat actors. Threat actors may take A2 and AD actions in an attempt to create multiple effects against U.S. and allied forces. Army forces must be prepared to conduct operations against A2 and AD actions.

1-51. ***Denied, degraded, and disrupted space operational environment is a composite of those conditions and influences in which space-enabled capabilities have been impaired by hostile threats or non-hostile means.*** Army space operations must remain flexible to commanders' needs and stay agile in response to threat actor exploitation efforts to place Army and joint forces into a D3SOE, which is the results of a threat actor implementation of A2 and AD strategies. D3SOE is the most recognizable impact to space operations from threat actors. The difference between D3SOE and OSC is that D3SOE is an enemy AD strategy to negate U.S. capabilities and OSC is used to negate enemy capabilities.

1-52. Maneuver in the space domain is similar to maneuver conducted in the physical domains, but more complex. For instance, maneuver in a physical domain requires three-dimensional positioning and time. Maneuver in the space domain can be physical or virtual. It requires the ability of Soldiers to adapt or adjust operating parameters such as frequency, power, or modulation to gain a relative advantage over the enemy. Maneuver in the space domain puts the Army and joint force in a position of relative advantage over the enemy and may help counter the effects of a D3SOE.

UNIFIED LAND OPERATIONS USE OF SPACE CAPABILITIES

1-53. Operations conducted in the space domain are a significant force multiplier because of their cross domain connectivity and the asymmetric advantage provided. Space operations are integral to successfully conducting large scale combat operations as part of unified land operations.

The Army's warfighting functions, weapons, and battle systems are vitally dependent on space. We must fully leverage allied, national, and joint space capabilities to enable our warfighting functions and provide space support to all ground component forces.

2013 Army Strategic Planning Guidance

1-54. It is within the warfighting functions framework many space operations dependencies are identified.

SECTION II – SPACE FUNDAMENTALS

SPACE SEGMENTS

1-55. The space domain is the ultimate high ground and gives users the advantage of a global, persistent perspective of the strategic, operational, and tactical situation. Satellites are well suited for communications, PNT, weather, reconnaissance and surveillance, imagery, mapping, and intelligence operations because of the access and perspectives they provide. They provide freedom of action, global reach, responsiveness, and insights to A2 and AD, and are not constrained by geographic borders or denied regions. However, space operations are bound by constraints such as physics, international law, and policies. Each has a unique set of challenges and vulnerabilities. The space domain is divided into three segments.

1-56. The three discrete, but related space domain segments are:

- The ground segment—consists of ground-based facilities and equipment supporting command and control of space assets, ground-based processing equipment, Earth terminals, user equipment, SSA sensors, and the interconnectivity between the facilities in which this equipment is housed.
- The space segment—the operating area corresponding with the physical space domain.
- The link segment—consists of signals connecting ground and space segments through the EMS. This normally includes telemetry, tracking, and signals necessary for controlling the spacecraft

and may also include satellite payload signals such as the SATCOM signal enabling communication between points on the ground, or the PNT signal enabling navigation.

1-57. Military activities are conducted in the space domain to achieve national security objectives. Space operations are generally supported in some way by satellites in orbit around the Earth. The space domain is interrelated with the other domains and properly integrating these complex functions with the other military activities is critical for successful operations.

ORBITAL CHARACTERISTICS

1-58. The unique operating parameters of sensors on space-based assets are a function of orbital characteristics, not the sensors. A space-based asset may have frequent revisit rates or long dwell times, but never both. Different orbits are conducive to different missions and support different operations. Inclination is the degrees an orbital plane is angled relative to the equatorial plane—an orbit with zero inclination orbits over the equator. Higher inclinations provide more northern/southern ground coverage. Satellite orbits are grouped into general categories defined by their altitude above the Earth and the shape of the orbit. The four primary orbit types are briefly discussed and illustrated in figure 1-2.

- Low Earth orbit (LEO)—up to 1,600 kilometers (km) (1,000 miles) above the surface of the Earth. Satellites in this orbit are close to the Earth and move quickly relative to the ground.
- Medium Earth orbit (known as MEO)—any orbital asset above LEO and below geosynchronous Earth orbit (GEO). This orbit is most frequently associated with GPS, which operates at approximately 19,300 km (12,000 miles) above Earth's surface. Satellites in this orbit can provide SATCOM with less signal delay, higher capacities, and may support resilient operations.
- GEO—an orbit approximately 37,000 km (22,300 miles) above the Earth where a satellite circles the Earth once every 24 hours, keeping pace with the Earth's rotation. A geosynchronous orbit with inclination other than zero will trace a figure 8 over to the surface of the Earth, centered on the equator. A geosynchronous orbit with inclination equal to zero is called a geostationary orbit. This orbit hovers over one point on the surface of the Earth, directly over the equator.
- Highly elliptical orbit. These orbits are oval-shaped with the Earth offset to one end. A satellite's altitude typically ranges from 1,000 km (600 miles) above the Earth at perigee (point closest to Earth), to about 40,000 km (25,000 miles) at apogee (point farthest from Earth) where it has a long dwell time over a large area. The highly elliptical orbit is inclined from the equatorial plane so a satellite may dwell for long periods over latitudes where GEO do not have coverage.

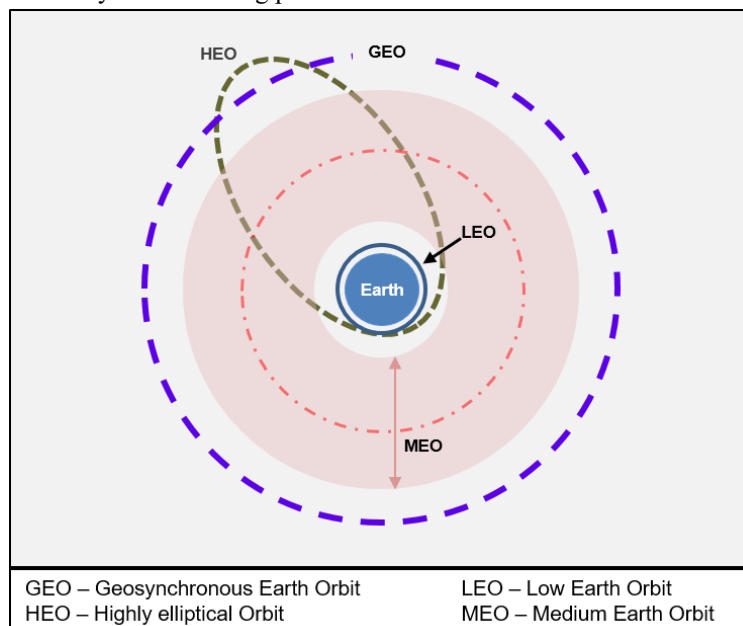


Figure 1-2: Illustration of basic satellite orbits

1-59. As an example, if the Earth were represented by a basketball, most LEO would be within one inch of the ball. A medium Earth orbit would be centered approximately 14.5 inches above the ball, and GEO would be 27 inches above the ball.

1-60. While unfettered access to satellites in Earth orbit provides a tremendous advantage for information dissemination and collection, there are limitations. Spacecraft follow strict motion and orbital mechanic laws of physics. Revisit rates, coverage area, and dwell time over areas targeted for observation are functions of spacecraft orbits. For example, a highly elliptical orbit yields a long dwell time over large areas but is designed for only partial hemisphere access, while a LEO provides global access but a short access time. Generally, only minor changes to orbits are made after initial orbit insertion due to finite fuels onboard.

1-61. Space-based sensors are vital to all phases of operations, and particularly in non-contiguous areas. Theater downlink and direct downlink are fundamental to timely, assured, and responsive support to the ground maneuver force. Space-based collection assets operate within established orbital paths. Changing the orbit requires time and the use of a limited propellant supply. Space-based assets are susceptible to threat denial and deception practices. Table 1-1 lists the characteristics of each orbit type.

Table 1-1. Characteristics of satellite orbits

<i>Type</i>	<i>Description</i>	<i>Advantages</i>	<i>Disadvantages</i>	<i>Uses</i>
<i>Low Earth Orbit</i>	<ul style="list-style-type: none"> • Circular shaped • Earth’s surface up to ~1,600 km (1,000 miles) above Earth 	<ul style="list-style-type: none"> • Near Earth – high resolution and signal strength 	<ul style="list-style-type: none"> • Small coverage area over Earth surface • Limited time over Earth’s surface (moves quickly) 	<ul style="list-style-type: none"> • Surveillance • Reconnaissance • Weather collection • Human space flight
<i>Medium Earth Orbit</i>	<ul style="list-style-type: none"> • Circular shaped • Between ~1,600-35,400 km (1,000-22,000 miles) above Earth • GPS ~19,300 km (12,000 miles) above Earth 	<ul style="list-style-type: none"> • Stable orbit • Less signal latency 	<ul style="list-style-type: none"> • Highest radiation level environment • Higher capacity 	<ul style="list-style-type: none"> • Positioning, navigation, and timing • Communication
<i>Geo-synchronous Earth Orbit</i>	<ul style="list-style-type: none"> • Circular shaped • ~37,000 km (23,000 miles) above Earth 	<ul style="list-style-type: none"> • Continuous coverage over specific area • Coverage nearly hemispheric 	<ul style="list-style-type: none"> • Far from Earth – resolution and signal limitations • Easier to jam • Signal latency 	<ul style="list-style-type: none"> • Communication • Surveillance • Reconnaissance • Weather collection • Missile warning
<i>Highly Elliptical Orbit</i>	<ul style="list-style-type: none"> • Oval shaped • Perigee: ~ 1000 km (600 miles) • Apogee:~40,000 km (25,000 miles) 	<ul style="list-style-type: none"> • Long dwell time over a large area • Coverage of high North or South latitudes 	<ul style="list-style-type: none"> • Continuous coverage requires multiple satellites 	<ul style="list-style-type: none"> • Communication over high latitudes • Scientific • Surveillance • Reconnaissance
GPS - Global Positioning System		km – kilometers		

1-62. A related limitation is predictability. The position of satellites in LEO may be accurately predicted. Predictions of satellite locations based on current orbit characteristics can be made weeks in advance. This predictability makes space-based information collection susceptible to camouflage, denial, and deception. Soldiers can use this information to their benefit when dealing with enemy capabilities—not considering such limitations could lead to unanticipated results. In addition to these limitations, many spacecraft are high-demand, low-density assets and may not be able to satisfy all demands. It is the responsibility of the space operations officer to ensure this information is known by the staff during mission planning.

ARMY SPACE CORE COMPETENCIES

1-63. A *core competency* is an essential and enduring capability that a branch or an organization provides to Army operations (ADP 1-01). An organization may have multiple core competencies, the purpose of which, is to provide a clear statement of what an organization does in broad, easily understood terms.

1-64. The Army core competencies for space-forces are the attributes that bring strengths, advantages, and contributions to the Army. Army space core competencies serve as a frame of reference by articulating the responsibilities of all Army space forces and their overarching roles. The core competencies provide the foundation for Army space tasks related to those functions. Army space forces must understand and excel at the Army space core competencies. They are used to organize and develop training, assist in managing the Army space force, and are an integral part of space doctrine. The three Army space core competencies are:

- Integrate space capabilities;
- Deliver space effects; and
- Employ space enablers.

1-65. **Integrate space capabilities.** To operate in complex environments, the Army depends greatly on assuring its forces have access to vital space capabilities. To assure this access, Army space forces will:

- Plan, develop, acquire, and integrate Army, joint, coalition, and commercial space required capabilities (excluding intelligence capabilities) across the warfighting functions to enable the full range of military operations.
- Synchronize space control operations, NAVWAR operations, and integrated joint special technical operations with lethal and non-lethal operations such as electronic warfare and cyberspace operations to achieve desired operational effects.
- Ensure the space architecture is integrated in a manner that provides resiliency in a D3SOE.
- Prepare and train all echelons of Army forces to work through a D3SOE.
- Plan and integrate Army space capabilities to support homeland operations.
- Integrate space capabilities with cyberspace networks to deliver and defend critical mission data.
- Examples include SSE operation planning, ARSST integration, NAVWAR planning, and fusion of space operations, cyberspace, and electronic warfare.

1-66. **Deliver space effects.** To generate and deliver effects that achieve overmatch across the warfighting functions, Army space forces will:

- Conduct space control operations to deny adversaries assured access to space capabilities.
- Conduct coordinated NAVWAR operations to deny PNT advantages to adversaries.
- Coordinate with integrated joint special technical operations to ensure all non-lethal effects supporting joint operations are synchronized.
- Conduct DSC to protect assured access to space capabilities.
- Create effects across multiple domains by leveraging all space capabilities.
- Examples include: pace control and NAVWAR operations.

1-67. **Employ space enablers.** To support Army and joint forces with space capabilities, Army space forces employ space-enabler capabilities to:

- Exercise operational and technical control of space assets and high altitude payloads.
- Launch and provide platform control of Army space assets and high altitude systems which employ tactically focused payloads.
- Exploit space architectures to provide space-enabled operations for mission-essential systems.
- Examples include: JTAGS, WSOCs, and joint FFT.

Chapter 2

Space Operational Environment

The Army uses space-based capabilities to support its dominance in decisive actions. Space capabilities are critical elements of Army operations. Moreover, the need for the U.S. Army to accomplish space operations is firmly established in policy and practice. Many space capabilities are well integrated into Army operations. Army space operations supports critical components of offensive, defensive, and stability or defense support of civil authorities operations. Army space operations enable all Army warfighting functions.

This chapter describes how Army space operations directly support and contribute to joint operations and the unified land operations. It also describes how Army space operations help enable the tenets of unified land operations.

SPACE DOMAIN IS A WARFIGHTING DOMAIN

2-1. The space domain supports and enables all other domains—it is interdependent with the air, land, and maritime domains, and interconnected with the cyberspace domain. Space operations are fundamental to all domains. Army space operations are heavily influenced by understanding the constraints, limitations, and operational needs of the land component users. Army space operations includes all aspects of planning, preparation, integration, and execution.

2-2. The execution of Army space operations contributes to, supports, and enables Army operations. Modern warfare has forced the transition of space operations from merely an enabler to a warfighting domain prepared to assure space operations through all phases of conflict. Space operations enable force responsiveness and create potential opportunities for the Army, joint, and multinational partners. Space operations defends our space capabilities against aggressive counterspace operations of others.

2-3. Army thinking about space operations has evolved. The Army no longer regards the space domain as a permissive environment where it only considers natural factors during mission planning. When operating in the space domain, the space planner has to consider hazards (conditions), threats (hostile actions), and vulnerabilities (system characteristics) which may impact the mission. Army space operations are focused on ensuring hazards, threats, and vulnerabilities are mitigated as much as possible.

2-4. The space domain optimizes the use of functions such as PNT, beyond line of sight communications, information collection and dissemination, early warning, and environmental monitoring. Activities in the space domain enable freedom of action for operations in all other domains. Operations in the other domains may create effects in and through the space domain. Operating in the space domain grants significant operational advantage such as beyond line of sight communications, increased situational understanding, and increased navigational and targeting accuracy. Operations in all domains are positively impacted by access to the space domain.

2-5. As with other operational areas, when deliberate fires (such as electromagnetic or directed energy) are directed into or out of the space domain, the fires should be coordinated between the affected combatant commands if time permits. By honoring the boundaries of the space domain, combatant commanders help to preserve SSA, spacecraft life span, and space system performance. This facilitates freedom of action in the space domain and improves support to terrestrial operations. It is important to note missile defense operations transiting through the space domain are not pre-coordinated due to the short-notice self-defense actions required to defeat enemy missile attacks. Refer to FM 3-27 for more information on ballistic missile warning and defense.

2-6. The Army executes space operations and contributes to establishing and maintaining space superiority consistent with the needs of unified land operations. The Army continually incorporates existing and

emerging space domain capabilities and effects to further improve the effectiveness of its operations. The Army's ability to protect space forces through space control and countering enemy capabilities being used for purposes hostile to U.S. national interests yields military power and contributes to space superiority.

2-7. The Army is more lethal when enabled by space capabilities and it endeavors to preserve its combat power. The Army leverages the advantages of space capabilities and counterspace effects to accomplish a wide variety of missions.

2-8. *Information operations* are the integrated employment, during military operations, of information-related capabilities in concert with other lines of operation to influence, disrupt, corrupt, or usurp the decision-making of adversaries and potential adversaries while protecting our own (JP 3-13). Space operations support information operations by using the space capabilities. Space-enable information operations uses capabilities such as SATCOM, PNT, space-based surveillance and reconnaissance, missile warning, and environmental monitoring.

2-9. Space capabilities are a significant force multiplier when integrated with joint operations. Space operations enhance many areas including situational understanding, fires, movement, cyberspace electromagnetic activities, electronic warfare, information operations, protection, and many other capabilities. Space operations aid high-tempo, noncontiguous, dispersed, and decentralized operations across the range of military operations.

THE SPACE OPERATIONAL ENVIRONMENT

2-10. An OE is a composite of the conditions, circumstances, and influences that affect the employment of capabilities and bear on the decisions of the commander (JP 3-0). An OE includes and encompasses physical areas and factors of the air, land, maritime, space, and cyberspace domains. An OE for any specific operation not only includes isolated conditions of interacting variables that exist within a specific area of operations, but also interconnected influences from a global or regional perspective, such as the political and economic influences that impact conditions and operations. Defining the OE results in the identification of significant threat characteristics which may affect friendly and enemy operations.

2-11. An OE is neither domain specific nor a Service component; however, there are domain-centric considerations that contribute to an overall OE understanding. While Army space operations are most effective when integrated into operations, it is necessary to isolate elements of a space OE to determine what the variables are and how they may be integrated into the larger battlefield OE.

2-12. A critical challenge for commanders, staffs, and unified action partners is creating shared understanding of their OE, an operation's purpose, problems, and approaches to solving problems (ADP 6-0). A Space operations officers' insights and understanding of how space operations enables joint and Army operations across the range of military operations are critical to developing a comprehensive space OE that contributes to a shared understanding of the overall OE. Space operations officers provide a foundation for developing shared situational understanding of the overall OE across all domains, improving awareness and understanding of friendly forces' dependency on space capabilities, improving understanding of capabilities and limitations for friendly forces and the adversaries, and highlighting other conditions of the OE. The resulting understanding of the OE should be linked to the commander's common understanding through the warfighting functions.

2-13. Analysis of the broad aspects of the space OE in terms of the operational variables provides relevant information senior commanders and their staff's use to understand, visualize, and describe the OE. *Operational variables* are a comprehensive set of information categories used to describe an operational environment. The operational variables are political, military, economic, social, information, infrastructure, physical environment, and time (known as PMESII-PT).

2-14. Upon receipt of a warning order or mission, Army commanders filter relevant information from the operational variables and narrow their focus using the six mission variables. *Mission variables* are the categories of specific information needed to conduct operations. The mission variables are mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (known as METT-TC). These variables are used by space planners during analysis to facilitate understanding.

2-15. When viewing an OE, it is important to take a holistic approach and identify friendly, neutral, and hostile actors. An OE includes the interacting variables within a specific area of operations as well as connected regional or global influences, such as politics and economics. Each commander's OE is a sub-set of a higher commander's OE. This is particularly important to space operations due to its global reach and tactical impact.

2-16. Understanding an OE is an on-going, iterative process that continues throughout an operation. The iterative steps are critical for a constantly evolving discipline like space operations. An OE consists of many interrelated variables and sub-variables, as well as the relationships and interactions among those variables and sub-variables. The space OE during planning will be different from the space OE at the start of operations, and will likely be significantly different from the space OE at the end of operations.

CHANGING NATURE OF AN OPERATING ENVIRONMENT

2-17. An OE is not static but continually evolves. This evolution results from opposing forces and actors—organizations and individuals—interacting and their ability to learn and adapt. As actors take action within an OE, the OE changes. It is critically important commanders and staff should not view actors as static; they constantly change over time. Actors may become less or more hostile over time. Commanders, staffs, and Soldiers must continuously reassess an OE for changing conditions. The complex and dynamic nature of an OE may make attribution and determining the relationship between cause and effect difficult.

2-18. Fundamental to mission success is the ability for space operations officers to anticipate and analyze potential space-related problems and develop solutions. Based on their understanding and analysis of a problem, space operations officers select and apply the right solutions to perform required tasks. Further adding to the challenge, the space OE remains dynamic throughout all phases of conflict.

2-19. Army space operators understand unified land operations to provide a space-focus to planning and analysis applicable to unified land operations. It is up to Army space operations officers on the staff to make sure the space OE is understood by the staff and space capabilities are planned and integrated into unified land operations in support of joint combined arms operations.

2-20. Commanders must seek opportunities for exploiting success. As the environment changes, continuous analysis of the operational variables help reveal opportunities, such as greater cooperation among the local population of a town or the ability to advance forces along a previously unsecured route. To exploit opportunities successfully, commanders and staffs should thoroughly understand and appreciate the application of the operational variables.

OPERATIONAL VARIABLES

2-21. The OE is described in terms of eight operational variables. The framework for analysis conducted for any OE should always consist of all eight variables. The operational variables are fundamental to developing a comprehensive understanding of an OE. Operational variables are those aspects of the OE which differ from one operational area to another and affect operations. Operational variables describe both the military aspects of an OE and the population's influence on it—they help improve situational understanding.

2-22. Analysis of each variable, applied through the lens of space operations, contributes to a comprehensive understanding of the OE and how the OE may affect mission operations. By applying the operational variables to a specific OE, the space planner, in coordination with other planners, gains a holistic and detailed understanding of the OE. Analysis continues systemically to identify existing and potential relationships among aspects of each of the operational variables. A brief description, along with space-related considerations for each operational variable follows.

Political

2-23. Describes the distribution of responsibility and power at all levels of governance – may be formally constituted authorities, informal, or covert political powers. Covers everything from recognized state leader to the tribal leader in a local village. Conducting analysis using the space capabilities framework may reveal significant insights and understanding of the leaders, population, and OE.

- SSA
 - Attribution of actions and liability of incidents.
 - Reentering objects and notifications - understanding size of the reentering object (is it likely to survive) and where it will likely impact.
- PNT—interruption of GPS or other GNSS signals may have an impact on political stability due to its wide use, including:
 - Timing signals are used by allied and threat nations’ militaries and commercial sectors such as banking, stock markets, power grids, and computer networks.
 - Positioning information supports targeting accuracy, troop movement and maneuver, and other operations supported by tagging, tracking, and location.
 - Navigation information keeps logistics and supply chain management aware of resources, fosters agile decision-making to rerouting supplies when interrupted by inclement weather or attacks. Secondary and tertiary routes are more quickly developed to help facilitate deliveries with minimal delays. Used by shipping to improve location accuracy for shipping lanes.
- Space control—helps political considerations by providing attribution of related actions and activities.
- SATCOM—interruptions of SATCOM may have an impact on political stability.
 - Political restraints placed on Army or joint operations regarding use of specific frequencies which might impact space capabilities and overall mission.
 - Information operations.
 - Internet availability for computer networks for military (NIPRNET and SIPRNET), business, and commercial or social use.
- Missile warning and defense—provides protection and warning indications for political considerations.
 - Attribution of actions from foreign missile launches and state involvement which drives public opinion and political authorities.
 - Confirmation of events and battle damage assessments.
- Environmental monitoring information is used by space operations to provide potential impacts to SATCOM and PNT-dependent operations as well as SSA and missile warning indications which could have wide-ranging political implications.
- Space-based surveillance and reconnaissance provides information which may have significant impact on political decisions.

Military

2-24. Explores the military and or paramilitary capabilities of all actors, including friendly, neutral, and enemy in a given OE. Space planners should consider how unified action partners use space capabilities and how proficient or knowledgeable other forces are at integrating space capabilities into the mission. Space operations should consider the ability of enemy military to affect mission operations by placing Army, joint, and unified action partners in a D3SOE. They should consider the dependency of enemy military on SATCOM, PNT, space control, and missile warning capabilities.

- SSA—operations within the space domain are continuously being contested. The Army and joint forces require on-going awareness and assessment of the changing space environment, the changing threats, and the impacts to the forces. Attribution of actions drives military operations and assures responses are focused against the actual threats.
- PNT—interruption of GPS or other GNSS signals may have an impact on mission operations:
 - Timing signals are used to synchronize mission operations, radios, computer networks, and many other information technology equipment.
 - Positioning information supports targeting accuracy, troop movement and maneuver, and other operations supported by tagging, tracking, and location.
 - Navigation information keeps troop movement and maneuver precise and accurate.

- Space control—used to protect joint and allied space capabilities while denying space capabilities to the adversary, as situations require. The DOD employ a variety of measures to help assure the use of the space domain for all responsible parties. Consistent with the inherent right of self-defense, deters others from interference and attack, and defends our space systems. NAVWAR allows the Army to take deliberate defensive and offensive actions to assure Army and joint forces have access to PNT.
- SATCOM—interruption of SATCOM will have a direct and immediate impact on all military operations. Interruption of a signal can cause significant degradation to all mission operations.
- Satellite operations—access to military satellites is dependent upon transmission control and payload control so military operations get a reliable satellite signal, and know the data is verified legitimate.
- Missile warning and defense—provides warning indications, protection for troops, and confirmation of events for battle damage assessment. Enables attribution of actions of state involvement and specific missile launches which provides additional characteristics of threat actors' capabilities.
- Environmental monitoring information can provide significant, wide-ranging impacts due to actual or possible interruptions to SATCOM, PNT, SSA, missile warning indications, force protection, and overall on mission operations.
- Space-based surveillance and reconnaissance supports information which may have significant impact on military, commercial, and civil space sectors.

Economic

2-25. Encompasses individual and group behaviors related to producing, distributing, and consuming resources. Does the village have a high unemployment rate that makes it easy for the enemy to coerce villagers to perform tasks for pay or other benefits? Space operations should consider financial means available to purchase space capabilities from a third party that may provide asymmetric advantages. Space capabilities may be helpful by increasing interaction with locals or harmful as may be the case with AD capabilities.

- SSA—understanding adversary intent and the stability of the host nation's economic community contributes to the joint force commander's situational understanding of natural resources and likelihood host nation citizens support friendly actions. Strong economies foster strong citizenship and help deter insurgent actors.
- PNT—the global economy has numerous dependencies on reliable GPS signals. Interruption of GPS or other GNSS signals may have an impact on economic stability. Timing signals are used by many nations' commercial sectors—for banking, stock markets, power grids, news media and telecommunications capabilities including cellular networks, computer networks and cloud computing, agricultural sectors for large-scale farming, construction sectors for precise survey, and transportation sectors for navigation and accurate delivery forecasts.
- SATCOM—interruptions of SATCOM may have an impact on political stability, economic stability,
 - Interruptions to SATCOM may have economic impacts on commercial sector from lack of economic news and transfer of monetary funds.
 - Internet availability for computer networks for military (NIPRNET and SIPRNET), business, and commercial or social use.
- Missile warning and defense—provides warning indications and protection opportunities. A missile impact could cause large scale destruction of critical infrastructure which could cripple portions or an entire economic structure.

Social

2-26. Describes the cultural, religious, and ethnic makeup within an OE and the beliefs, values, customs, and behaviors of society members. Consider who the influential people are in the village—for example, are they religious leaders, tribal leaders, warlords, criminal bosses, prominent families, or even teenagers with

smart phones. Space operations should consider access to social media and world-wide influences which may garner support or drive civil unrest.

- SSA
 - Attribution of actions and liability of incidents, such as with the Iridium 33 and Kosmos-2251 collision.
 - Reentering objects and notifications - understanding size of the reentering object (is it likely to survive) and where it will likely impact.
- PNT—interruption of GPS or other GNSS signals may have an impact on social stability due to its wide use, including:
 - Disruption to timing signals used for banking, power grids, and computer networks may have unforeseen or negative consequences on social network used by unified action partners.
 - Navigation capabilities keeps traffic moving smoothly. Disruption to these capabilities may have negative consequences—including traffic jams, deadly accidents, and high incidents of missed work—when attributed to the specific actions of a military may be used to support or erode social attitudes.
- SATCOM—interruptions of SATCOM may have an impact on political stability.
 - Political restraints placed on Army or joint operations regarding use of specific frequencies which might impact space capabilities and overall mission.
 - Political restraints placed on civilian population regarding specific frequencies for military use—including television, radio, internet, and wireless device access—which might impact public opinion of the local population and support for military action.
 - Information operations.
 - Internet availability for computer networks for military (NIPRNET and SIPRNET), business, and commercial or social use.
- Missile warning and defense—provides protection and warning indications for political considerations.
 - Attribution of actions from foreign missile launches and state involvement which drives public opinion and political authorities.
 - Confirmation of events and battle damage assessments.

Information

2-27. Describes the nature, scope, characteristics, and effects of individuals, organizations, and systems that collect, process, disseminate, or act on information. How much access to news media or the internet do the local leaders, influential persona, and general population have? Space operations should consider how access to internet and world-wide influences may be increased or decreased using SATCOM.

- SSA
 - Attribution of actions and liability of incidents such as with the Iridium 33 and Kosmos-2251 collision.
 - Reentering objects and notifications—understanding size of the reentering object (is it likely to survive) and where it will likely impact.
- SATCOM—interruptions of SATCOM may have an impact on political stability.
 - Political restraints placed on Army or joint operations regarding use of specific frequencies which might impact space capabilities and overall mission.
 - Information operations.
 - Internet availability for computer networks for military (NIPRNET and SIPRNET), business, and commercial or social use.

Infrastructure

2-28. Composed of the basic facilities, services, and installations needed for the functioning of a community or society. This may include the functionality of electrical generators and similar utility systems.

- SSA— intelligence outputs such as maps and knowledge of specific critical infrastructure builds a picture of critical assets to protect and likely targets.
- PNT—interruption of GPS or other GNSS signals may have an impact on the infrastructure stability due to timing signals which are used by commercial sectors such as banking, stock markets, power grids, computer networks, and many other commercial endeavors.
- Space operations should consider how commercial unclassified maps may help determine remaining infrastructure or how GPS may be able to help guide displaced people through the rubble of destroyed neighborhoods.

Physical Environment

2-29. Includes the geography, man-made structures, climate, weather, and hazards in the area of operations. What types of terrain or weather conditions in the area of operations favor enemy operations?

- Space operations should consider the possibility of GPS interference and SATCOM obscurra due to tall buildings and mountains, as well as the impact to missile warning indications and reporting.

Time

2-30. Describes the timing and duration of activities, events, or conditions within an OE, as well as how the timing and duration are perceived by various actors in the OE. At what times are people likely to congest roads or conduct activities that provide a cover for hostile operations?

- Space operations help commanders and staffs understand their dependencies on GPS. It enables precision targeting with reduced collateral damage. GPS enables FFT, increased tactical operating ranges, rapid maneuver, unmanned aerial system, surveillance and reconnaissance support for situational understanding, and many other functions. Precision timing enhances synchronized tactical digital networks, communications, and wide area networking capabilities.

MISSION VARIABLES

2-31. Commanders and staffs require a mission analysis focused on their specific situation. The tactical echelons translate the operational variables identified by the operational headquarters into the mission variables. Mission variables are the categories of relevant military information used for planning operations as part of the MDMP. Mission analysis uses the six Army mission variables of mission, enemy, terrain and weather, troops and support available, time available, and civil consideration.

2-32. Commanders and staffs use the mission variables to filter the broader scope of operational variables into information that directly affects a specific mission—the information staffs need to conduct an operation and commanders need to exercise command and control. Mission variables refine the understanding of a situation and describe the characteristics of a specific area of operation within the OE. Space planners use the mission variables to identify critical space-related information applicable to mission planning. These provide the baseline for selecting the right capabilities to be used. Knowing the mission, threat, and OE allows commanders to identify and plan for the optimal capability package.

2-33. An effective mission analysis considers the potential impact space capabilities have within an OE. The Army space planners participates in planning actions to help form the problem statement, mission statement, planning guidance, initial commander's critical information requirements, and essential elements of friendly information. Failure to identify or misidentify the effect mission variables might have on operations can hinder decision making and result in the development of an ineffective battle plan.

ELECTROMAGNETIC OPERATIONAL ENVIRONMENT

2-34. Military operations are complicated by operations dependent on the EMS. The EMS is congested and military operations are contested which creates both opportunities and vulnerabilities requiring diligence to ensure operations are not compromised. The *electromagnetic operational environment* (EMOE) is the background electromagnetic environment and the friendly, neutral, and adversarial electromagnetic order of battle within the electromagnetic area of influence associated with a given operational area (JP 6-01). The need for military forces to have assured access to, and use of the EMS drives the conditions of the EMOE.

2-35. All mission operations, military support functions, civil sectors, and private organizations are dependent upon the EMS. Some of the functions and operations dependent on the EMS include but are not limited to:

- Space operations, intelligence, cyberspace, electronic warfare, signal, and information operations;
- Command and control;
- Maneuvering forces;
- Targeting and attack;
- Communications and data transmission;
- Civil infrastructure control.

2-36. The increase in portability and affordability of sophisticated electronic equipment guarantees the EMOE will continue to expand, change, and influence how wars are fought. Commanders must shape the EMOE to ensure friendly forces can operate while denying the same privilege to the adversary, when necessary. Commanders should understand the EMOE is a subset of the overall OE—it permeates all environments, and it drives mission operations more intrinsically than tanks, mortars, and bullets.

2-37. Maneuver in the EMS is similar to the physical domains, but more complex. For instance, maneuver in the air domain requires three-dimensional positioning and time, while EMS maneuver requires the ability of military forces to adapt or adjust EMS operating parameters (e.g., frequency, power, modulation) to gain an advantage over the enemy (JP 6-01).

2-38. EMOE is a unique maneuver environment upon which all five warfighting domains depend. Commanders must focus achieving control of, and freedom of maneuver within the EMS. The military’s dependency on the EMS is a reality of the modern battlefield. The *electromagnetic environment* (EME) is the resulting product of the power and time distribution, in various frequency ranges, of the radiated or conducted electromagnetic emission levels encountered by a military force, system, or platform when performing its assigned mission in its intended operational environment (JP 3-13.1).

FREQUENCIES

2-39. The EMS is the range of frequencies of electromagnetic radiation from zero to infinity. It is divided into 26 bands, each designated by an alphabetically designate bands (JP 3-13.1). The EMS crosses all domains, and it provides a vital link between the cyberspace and space domains.

2-40. Frequency band designation are often confusing as the military, the International Telecommunication Union, the Institute of Electrical and Electronics Engineers, and traditional bands use the same designation to represent different frequency ranges. These differences cause confusion as bands often overlap the boundaries between two frequency segments. Refer to table 2-1 for a comparison of bandwidth frequencies.

Table 2-1. Bandwidth comparison

Designation Used in FM 3-14	ITU Band	ITU Frequency Range (gigahertz)	Traditional Band	Traditional Frequency Range (gigahertz)	IEEE Band	IEEE Frequency Range (gigahertz)
Narrowband	UHF	0.3 – 3	UHF	.3 – 3	UHF	0.3-1
			L	0.39-1.55	L	1-2
			S	1.55-4.20	S	2-4
Wideband	SHF	3 – 30	SHF	3 – 30		
			C	4.20-5.75	C	4-8
			X	5.75-10.90	X	8-12
			Ku	10.90-22.0	Ku	12-18
			K	10.90-36.0	K	18-26.5
Protected band	EHF	30 - 300	EHF	30 – 300		
			Ka	22.0-36.0	Ka	26.5-40
EHF – extremely high frequency SHF – super-high frequency UHF – ultrahigh frequency			IEEE – Institute of Electrical and Electronics Engineers ITU – International Telecommunication Union NOTE: Band letter designations are not abbreviations.			

2-41. The frequency band influences the throughput capacity and amount of protection provided to the communications system, such as interference, anti-jam capability, probability of interception, and probability of detection capabilities. Military SATCOM uses a range of frequencies to meet user requirements at all levels of conflict. Ultrahigh frequency and super-high frequency bands lend themselves to supporting SATCOM in benign and degraded environments, whereas, extremely high frequency lends itself to providing greater protection in highly contested or nuclear environments.

CONTESTED SPACE OPERATIONAL ENVIRONMENT

2-42. It is understood all warfare is contested. As warfare has evolved, the OE has expanded into all domains. Battles are waged in an OE where physical forces, capabilities, and effects are dependent on the EMS and characterized by a contested EME.

2-43. A contested EME applies to a wide variety of operations, including, but not limited to space operations, cyberspace, electronic warfare, missile warning, terrestrial and space weather, lethal and non-lethal fires, intelligence, and information operations. A contested EME may affect operations in one or multiple domains. Operating within a contested EME has the potential to severely impact operations across all missions.

2-44. A *permissive environment* is an OE in which host country military and law enforcement agencies have control, as well as the intent and capability to assist operations that a unit intends to conduct (JP 3-0). Permissive environments identify circumstances where adversaries show negligible domain influence and minimal effects to friendly operations. The U.S. has been operating almost exclusively in a permissive space domain for most of the last half century. Today, conducting space operations entirely in a permissive environment is rare.

2-45. A *hostile environment* is an OE in which host government forces, whether opposed to or receptive to operations that a unit intends to conduct, do not have control of the territory and population in the intended operational area (JP 3-0). Hostile environments describe circumstances where threat actors deliberately exhibit unfavorable influence upon one or more domains producing effects which impact friendly operations.

2-46. A contested space domain creates a hostile environment where threat actors exert persistent, successful influence on the space domain or EMS producing pronounced effects on space operations. Like other domains, operations within the space domain are constantly being contested. A contested EME may affect operations across all domains, and impact active and passive measures.

2-47. Threat actors have developed capabilities which can contest the space domain and attack the ground, link, and space segments of SATCOM, PNT, missile warning, space-based surveillance and reconnaissance, environmental monitoring and other electromagnetic environment efforts. These attacks can have significant impact on all mission operations, and can significantly disrupt timelines and resources required to accomplish the mission. When operating in a contested space environment, commanders must consider defensive efforts and planning for when to request the use of offensive space operations. It is likely the enemy will use counterspace capabilities regularly and often as they are inexpensive to obtain, easy to produce, and often difficult to locate. Thus, an enemy can contest the space environment to degrade a window of opportunity during an attempt to penetrate enemy defense.

2-48. The space planner must understand the system strengths, weaknesses, and limitations of joint and partner nations when considering the usage and integration of their space capabilities. They must have a knowledge of the threats to those systems and understanding what steps can be taken to prevent or limit an adversary's access to those vulnerabilities. This understanding assists in the assessment of the operational risk and potential mitigation measures for the joint force if space capabilities are degraded or lost.

ANTIACCESS AND AREA DENIAL STRATEGY

2-49. A contested environment is often characterized by an impaired ability to conduct operations due to the employment of A2 and AD strategies. Generally, A2 affects movement to a theater while AD affects movement within a theater.

2-50. Space operations may contribute solutions to counter theater A2 and AD threats to allow freedom of maneuver through enemy defenses to gain, maintain, and dominate control across all domains. Examples of how space operations help counter A2 and AD strategies include:

- Space-based assets usually provide initial notification of short range ballistic and cruise missiles fired from distant naval and air platforms which give Soldiers sufficient time to don protective gear and take cover.
- Space-based assets help identify long-range enemy air defenses used to challenge airspace for both tactical operations and strategic airlift, thereby contesting air superiority.

2-51. The Army has taken an increased role in suppressing enemy air defenses as it becomes increasingly tougher for air operations to gain air superiority against peer competitors when trying to gain entry to a hostile environment. Army space operations are a piece of the multifunction approach to countering A2 and AD. The U.S. military dominance in all domains will be contested by peer and regional powers and the Army may not enjoy the permissive advantages of forward basing it enjoyed in the past.

2-52. A2 is the effects of systems employed by a threat actor which challenge the employment of joint forces during expeditionary and sustained operations to gain access close to enemy terrain. The adversaries intent is to make liberation of these areas too costly in terms of military and political resources, and erode influence, regional and global will, and influence public opinion. AD describes a threat actor's strategy to deny friendly forces superiority in one or more domain, which is essential to effectively conducting rapid and decisive tactical maneuver on land.

2-53. An A2 and AD strategy implemented in one domain or location may have little or no effect on other domains or other locations. Threat efforts may cause one component to operate in a hostile environment, while another component is able to operate in a permissive environment. Conversely, an A2 and AD strategy implemented in one domain may have detrimental effect on operations across all domains and in other locations. Commanders should be aware of hostile EME actions which may only have limited effects.

2-54. The Army will face opponents who have developed strategies by learning from past conflicts. The most prominent anticipated strategy expected from an enemy is A2 and AD. These strategies focus on denying unified action partners the use of traditional staging and force development models by restricting access to key geographical areas and force-generating assets. In many instances, the use of ballistic missiles, cruise missiles, and unmanned aerial systems are a key component of an enemies' strategy.

2-55. Contested access to and use of the global commons—those portions of the Earth outside national jurisdiction all state actors have rightful access to—will significantly complicate military plans and operations. A threat actor may employ conventional or hybrid capabilities as part of an AD strategy, including the use of conventional integrated air-defense systems, long range rockets, and cruise missiles.

2-56. Adversaries may attempt to create one or multiple effects against joint and unified action partners. Army forces must be prepared to conduct operations against A2 and AD actions. D3SOE is the result of a threat actor implementing A2 and AD strategies against U.S. and unified action partners and it is the most recognizable impact to space operations from threat actors.

DENIED, DEGRADED, AND DISRUPTED SPACE OPERATIONAL ENVIRONMENT

2-57. Army and joint operations use space-based capabilities delivered to all domains via the EMS. The threat to Army and joint operations from a contested EME may create vulnerabilities which makes contesting space capabilities attractive to threat actors. Army space operations must remain responsive and flexible to commanders' needs and stay agile in response to the efforts of threat actors to place joint forces in a D3SOE.

2-58. D3SOE is the Army space operations portion of the larger contested EME. A D3SOE may affect operations in any one or more domains, and may impact active and passive measures. Mission critical systems operate in the radio, microwave, infrared, ultraviolet, and x-ray portions of the spectrum, all of which are subject to interference.

2-59. Army forces must be prepared to conduct operations in and through a D3SOE. Denied, degraded, and disrupted are used in a different context than they are for OSC, but the definitions are consistent with the usage in JP 3-14 and described below.

- Deny—temporary total elimination of the use of space capabilities, effects, or associated linkages.
 - Degrade—permanent impairment (either partial or total) of the use of space capabilities, effects, or associated linkages usually with physical damage.
 - Disrupt—a temporary impairment that weakens or diminishes the use of space capabilities, effects, or associated linkages upon which the Army, joint forces, and allies depend.
- 2-60. The space operating environment is harsh. Interference may come from hazards or threat actors.
- Threat actors may attempt to create one or multiple effects against joint and unified action partners. They include individuals, groups of individuals, paramilitary or military forces, nation-states, or national alliances and their actions. Possible impacts to mission from D3SOE should be taken into account during all phases of planning cycles.
 - Hazards are not threats. They are usually predictable and preventable, and may be reduced through effective risk management efforts. Natural phenomena may create hazardous conditions which cause damage, destroy life and vital resources, or prevent mission accomplishment. Naturally occurring environmental factors are hazards which may negatively impact the proper function of a satellite, an associated ground-system, or the EMS and must be considered during the planning process.
- 2-61. D3SOE applies to both physical and electromagnetic conditions, circumstances, and influences which affect the employment of space capabilities. Operating in D3SOE requires identifying threat actors' actions to deny, degrade, or disrupt space capabilities, effects, or associated linkages necessary to protect against those actions. Some threats which may contribute to D3SOE include physical damage to satellites or ground equipment; signal jamming; signal spoofing; electronic interference with space-related assets, ground control nodes, control link, or on-orbit assets; and disabling or deceiving user equipment. The most likely risk to tactical operations is jamming and spoofing directed against SATCOM and PNT links.
- 2-62. A D3SOE should not be allowed to prevail as the dominant environment within a combat scenario. Ground force commanders should make every effort to detect, prioritize, and eliminate enemy threats that propagate a D3SOE. Commanders and staffs must understand how current and potential threats and hazards affect their forces. Threats and hazards must be analyzed during the initial planning phase. They must be continually identified, monitored, assessed, and revised to identify vulnerabilities throughout mission operations as they adapt and change over time. Understand both threats and hazards helps the commander visualize potential impacts on operations.
- 2-63. Adversaries are constantly seeking ways to create D3SOE effects and use them to their advantage. The Army depends on Soldiers to understand unit equipment, capabilities, limitations, vulnerabilities, tactics, techniques, and procedures to fight through a D3SOE. Army space capabilities and effects contribute to successful unified land operations.

ARMY AVIATION CHALLENGE OF NEGOTIATING A CONTESTED OPERATIONAL ENVIRONMENT

- 2-64. Army Aviation operations, intelligence, and command and control functions interact continuously with products and capabilities available through, or enhanced by, space assets. These assets empower manned and unmanned aviation capabilities to be lethal and informed, or potentially ineffective if those space assets are compromised from D3SOE. Ground force commanders must be able to operate with or without such space assets and understand the criticality of re-establishing disrupted or denied capabilities as soon as possible. Temporary capabilities may be provided by Army Aviation manned or unmanned platforms.
- 2-65. Army aviation may provide limited capabilities typically associated with space-based assets such as communications, navigation, or reconnaissance to the ground force commander in the D3SOE. Army Aviation is affected by the environment and line of sight range restrictions. Unmanned aircraft systems dependent on PNT will need to maximize sensor stand-off distance to support in a D3SOE. Army Aviation has limited ability to augment certain capabilities, including
- Communications retransmission;
 - Additional means of reconnaissance and information collection (including Synthetic Aperture Radar and Ground Moving Target Indicator);

- Enhancement of precision fires; and
- Reliable targeting resource for non-GPS reliant precision munitions such as inertial navigations systems.

SPACE OPERATIONS PERSISTENCE ACROSS THE JOINT PHASING MODEL

2-66. There is usually a difference between the phase the ground operations are in and the phase space operations are in—or any EMS-dependent elements are in—particularly when ground forces are in the shaping phase. For example, space operations may be in the deter, seize the initiative, or even entering the dominate phase of an operation while ground operations are firmly rooted in the shape phase. In EMS-dependent operations the threat is rarely destroyed. The threat rarely acquiesces when U.S. forces win a campaign and troop redeployment occurs. The threat to space operations are continuous.

2-67. A major characterization defining space operations are persistence—persistence of threats and persistence of operations. For mission areas reliant on the EMS, the operations are never-ending, the capabilities are never cased, and space forces never stand-down in completion of their mission to redeploy because operations are constantly being contested.

2-68. Persistence of threats and hazards applies to both ground-based and space-based assets. Whether in battle or in reset, Soldiers are always impacted by persistent counterspace threats. The space threat directly impacts Soldiers and may be applied against space-based assets, or against the ground assets by disrupting a satellite communications or navigation signal. Even during peacetime operations, a threat actor could easily disrupt worldwide SATCOM, PNT, missile warning, and other critical space-based capabilities which may have significant military, commercial, and civil impacts.

2-69. Traditionally, Army forces conduct training in preparation for deployment, deploy forces to an area of responsibility, win in a complex environment, redeploy forces, and reset. Sometimes a campaign is complete in a few months, sometimes it requires constant rotation of forces over a decade or more, but the campaign ends and troops redeploy. Troops stop deploying for that campaign and the force has the opportunity to reset; they conduct an end-to-end review of the mission, evaluate doctrine, update tactics, techniques, and procedures, and conduct training for the next mission.

2-70. EMS-dependent operations are never complete. They must constantly meet combatant commander needs worldwide—even when there is no campaign to fight. Persistence of space operations is akin to performing maintenance on a car while driving down the road—space operations are constant, and are being contested by threat actors every day. There is never a reset—only a persistence barrage of attack must be defended.

2-71. The six activity phases—shape, deter, seize initiative, dominate, stabilize, and enable civil authorities—provide a framework for understanding a joint operation. A phase is a planning and execution tool used to divide an operation in duration or activity (JP 5-0). Phasing helps commanders and staffs visualize, plan, and execute an entire operation and define requirements in terms of forces, resources, time, area, and purpose. Phasing helps in planning and controlling operations during execution. Within a phase, a large portion of the force executes similar or mutually supporting activities.

2-72. Phases are rarely discrete. They often overlap and some phases may occur multiple times, while others may not occur. Commanders may compress, expand, or omit a phase entirely. Phases may or may not be conducted sequentially and many activities from a phase may begin in a previous phase and continue well into subsequent phases.

2-73. While the phasing model is a planning and execution tool, it is important to recognize it is more applicable to traditional operations than it is for those areas reliant upon the EMS. There are several reasons for this, including: lack of definition of what electromagnetic actions constitute an act of aggression, and the reluctance of commanders to initiate an operation plan (OPLAN) when a threat actor only executes electromagnetic actions against U.S. forces. It is fairly straight forward to identify an act of aggression if a company of tanks start moving and firing on friendly forces. However, it is more challenging to identify intentional jamming of a limited frequency range of the EMS or orchestrating a distributed denial of service attack as an act of aggression.

2-74. Army space forces are engaged in high tempo operations while traditional ground forces are firmly rooted in the shape phase. Army space operations focus on preventing and deterring conflict by constantly conducting shaping, deterrence, and stabilization activities. Synchronized space operations with unified action partners contribute to partnership building, which aids in stability, deterrence, and civil authority.

2-75. When enemy troops are on-the-move and bullets, mortars, and missiles start to fly, the need to initiate an OPLAN becomes clear. Shaping is ongoing and the effort to deter, seize the initiative, and dominate the battlefield begins. Generally speaking, in the absence of direct combat there is no need to implement an OPLAN—troops shape the environment—but are not in battle.

2-76. EMS-dependent operations are different because of their persistent nature—space operations activities and the level of effort in the shaping phase may not be significantly different from those in the dominate phase. These operations are definitely out of phase when ground forces are not in battle and will likely be out of phase with ground operation phases when an OPLAN is implemented. Actions like intentionally jamming specific frequencies of the EMS or helping orchestrate a distributed denial of service attack against friendly networks are not viewed as triggers to initiate an OPLAN. What would likely be viewed as a seize initiative phase for traditional battle is often viewed simply as daily harassment in the EMS. Once an OPLAN is implemented, response to these actions are viewed as dominate phase activities. This clearly illustrates why traditional battle and battle between EMS-dependent operations must be viewed differently by commanders and staffs within the framework of war.

2-77. The battle framework was originally developed to conduct battle in the close and deep areas so we could engage the enemy across the depth of their formation. The deep fight was conducted with uncommitted forces used to disrupt the uncommitted echelons of the enemy. While the objective was to disrupt those forces by the time they got to the close fight, disrupting the uncommitted echelons of the deep fight had no immediate impact on the close fight.

2-78. With space operations, the reach is worldwide and nearly instantaneous; there is no such thing as a deep area with uncommitted echelons. From a space domain perspective, space operations are always engaged in all phases simultaneously across the entire battlefield, without regard to whether the battle occurs in the close area, deep area, or EME (see figure 2-1). In space operations, the different phases of battle are compressed; occur rapidly, and phases are often indistinguishable from each other. Army space operations support all phases of an operation. As operations progress over time, the capacity and intensity of space operations increase to counter enemy efforts.

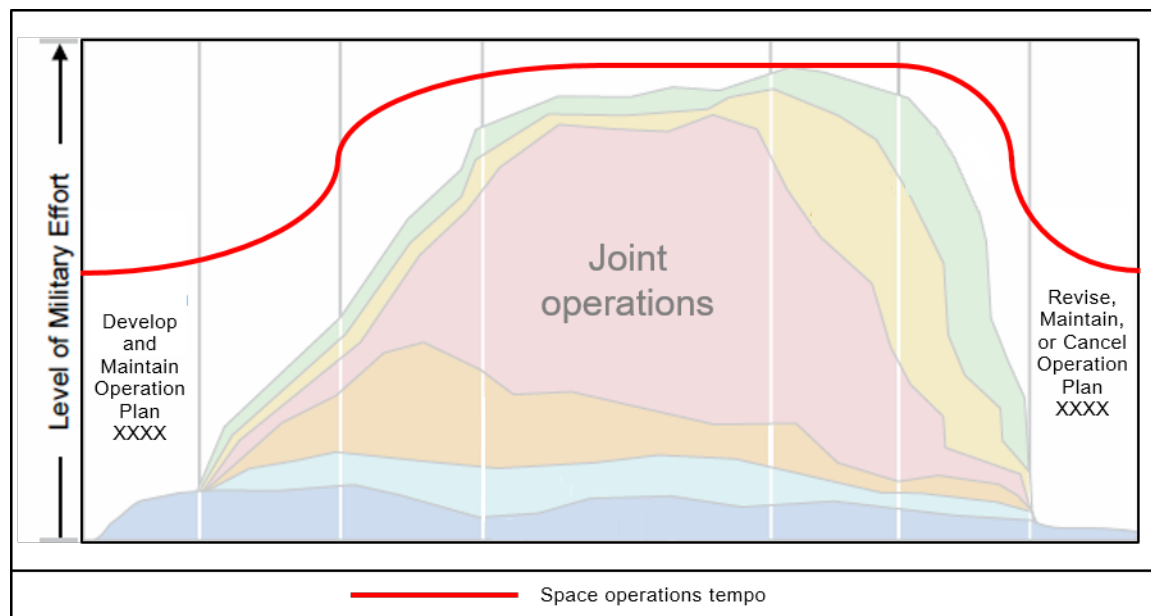


Figure 2-1. Space operations persistence across the joint phasing model

2-79. The effects generated against opposing forces using the EMS may be felt nearly instantaneously. Effects delivered with precision and simultaneity, compress the amount of time the enemy has to respond—

it causes confusion to the enemy and gives joint and unified action partners the advantage. The results are a convergence of effects, synchronized across all domains, where effects in the deep area may immediately influence the close fight, where the dominate phase influences the shape phase and the battlefield shrinks immensely for both time and battlespace. Creating and exploiting short windows of advantage is essential for success on the modern battlefield.

HAZARDS, THREATS, AND VULNERABILITIES

2-80. A *hazard* is a condition with the potential to cause injury, illness, or death of personnel; damage to or loss of equipment or property; or mission degradation (JP 3-33). Hazards are different from threats—they are usually predictable and preventable, and may be reduced through effective risk management efforts. Hazardous conditions are able to destroy life, damage vital resources, and prevent mission accomplishment. Understanding hazards and their effects on space operations allows the commander to better understand the terrain, weather, and other factors that support the mission. Understanding hazards also helps the commander visualize potential impacts on operations, if they occur. Successful interpretation of the environment aids in correctly opposing threat courses of action within a given geographical region.

2-81. Naturally occurring hazards in the space environment are the result of electromagnetic interference, which is the result of complex interactions between the Sun's electromagnetic energy and the Earth's magnetic field. Electromagnetic interference can create hazards on a variety of a spacecraft's subsystems. Geomagnetic storms and energetic particle events cause ionospheric scintillation, coronal mass ejections and solar flares which cause radio bursts, x-rays, and electronic ultraviolet radiation; all are sources of naturally occurring electromagnetic interference. These can result in a variety of impacts.

- Interference to SATCOM signals which results in distorted and intermittent signals.
- Distorted or interrupted high frequency ground and aircraft radio communications, which includes radio propagation errors, short wave fade, and blackout.
- Radar interference which leads to false returns, inaccurate ranging, and observation of reflected objects outside system characteristics.
- Induced accuracy errors on GNSS.
- Drag, excess charging, and damage on a spacecraft which shortens the spacecraft life.
- Trajectory errors on satellite launches.
- False readings from spacecraft sensor payloads.

2-82. A *threat* is any combination of actors, entities, or forces that have the capability and intent to harm U.S. forces, U.S. national interests, or the homeland (ADP 3-0). A threat is a fundamental part of an overall OE for any operation. Threats actors may include individuals, groups of individuals (organized or not organized), paramilitary or military forces, nation-states, or national alliances.

2-83. When assessing a threat, it is helpful to sort the possible threat types into the four distinct categories, summarized in figure 2-2:

- Lethal physical weapons attempt to strike directly or create a detonation near a satellite or ground station. These include—
 - Direct ascent anti-satellite weapons—a sub-orbital missile launched directly at a satellite.
 - Co-orbital anti-satellite weapons—a weapon launched into orbit and maneuvered to the target at a time chosen by the owner.
 - Attack on a satellite ground station using a variety of weapons such as guided missile, rocket, artillery, or improvised explosive device.
- Non-lethal physical weapons such as electromagnetic emitters may have physical effects on space systems without making physical contact.
 - Lasers—may be used to temporarily dazzle or permanently blind mission-critical sensors on a satellite.
 - High powered microwave weapons—may be used to disrupt a satellites' electronics or cause permanent damage to electrical circuits and processors.
 - Electromagnetic pulse weapons—may be used to create high radiation levels in the space domain used to damage unshielded satellites in the affected and nearby orbits.

- Directed energy attacks target the means by which space systems transmit and receive data by electromagnetic jamming or spoofing radio frequency signals.
 - *Electromagnetic jamming* is the deliberate radiation, reradiation, or reflection of electromagnetic energy for the purpose of preventing or reducing an enemy’s effective use of the EMS, and with the intent of degrading or neutralizing the enemy’s combat capability (JP 3-13.1). an emulated signal with false and misleading information
 - Spoofing is a technique of broadcasting an emulated signal with false or misleading information in an attempt to deceive a receiver or system into processing the fake data. Spoofing is designed to provide incorrect results to mislead users, discredit the receiver, or corrupt the data.
- Cyberspace attack targets the data and the systems dependent upon the data rather than the radio frequency band in which the information is transmitted. Cyberattacks may target the ground stations, end-user equipment, or the satellites.

<p>Lethal – Physical Weapons (bullets, mortars, munitions)</p> <p>Examples include:</p> <ul style="list-style-type: none"> • Direct ascent anti-satellite • Co-orbital anti-satellite • Attack on ground facilities 	<p>Directed Energy Weapons (targets the means a systems uses to transmit/receive data)</p> <p>Examples include:</p> <ul style="list-style-type: none"> • Electromagnetic jamming • Spoofing
<p>Non-Lethal – Physical Weapons (electromagnetic emitters)</p> <p>Examples include:</p> <ul style="list-style-type: none"> • Lasers • High-powered microwave • Electromagnetic pulse 	<p>Cyberspace Weapons (targets data and systems)</p> <p>Example includes:</p> <ul style="list-style-type: none"> • Ground stations • End user equipment • Databases • Satellites

Figure 2-2. Space threat categories

2-84. Commanders and staffs should understand how current and potential threat actors organize, equip, train, employ, and control their forces. They must continually identify, monitor, and assess threats as they adapt and change over time. The techniques for evaluating the threat (as described in ATP 2-01.3) provide a standardized model to articulate various threat capabilities, analyze a threat actor's intent to determine possible enemy courses of action, and identify threat vulnerabilities to support mission analysis and operations. When a commander understands the threat, they can visualize, describe, direct, and assess operations to seize, exploit, and retain the initiative.

2-85. A *vulnerability* is the characteristics of a system that cause it to suffer a definite degradation (incapability to perform the designated mission) as a result of having been subjected to a certain level of effects in an unnatural (man-made) hostile environment (JP 3-60). Space control measures help mitigate risks and defend against threat actors taking advantage of the vulnerabilities. A few of the possible system vulnerabilities to space operations include:

- Making required ground station or stations unusable by means such as using a bomb to destroy all or part of the facility, or cutting the power supply.
- Jamming a ground station, link, or user’s equipment.
- Cyberspace attack.

RISK MANAGEMENT

2-86. Risk management is all about mission assurance and success—it is the logic behind identifying, assessing, and controlling risks arising from operational factors and making decisions that balance risk cost with mission benefits. The Army uses risk management to help maintain combat power while ensuring mission accomplishment in current and future operations. Risk management applies to operational and nonoperational activities. Army leaders must take prudent risks and make decisions based on informed

judgment, risk management principles, and intuition. Failure to include space capabilities, limitations, and vulnerabilities during mission assessment may lead to an inaccurate risk assessment for the overall mission. Risk management is a function of the probability of an event occurring and the severity of the event expressed in terms of the degree to which the incident affects combat power or mission capability.

2-87. Risk management does not eliminate a risk, but will reduce or offset risks when applied properly. Using risk management processes increases operational effectiveness and the probability of mission accomplishment. It is a systematic way of identifying threats and vulnerabilities, assessing them, and managing the associated risks. Commanders, staffs, Army leaders, Soldiers, and Army Civilians are all responsible to conduct risk management.

2-88. Risk management is a continuous process. Risks should be monitored throughout an operation to assess the likelihood of occurrence for each risk and develop new risks as the OE changes. Risk management practices are applied across all Army space operations, day-to-day activities, events, and training functions. Space operations Soldiers use this continuous process to identify vulnerabilities and assess threats; develop and recommend controls to minimize the impacts to operations; and continuously evaluate risks as conditions change.

2-89. Some space-related items to consider during a mission execution risk assessment should include, but not be limited to, SATCOM availability and security; PNT accuracy for fires, movement, and maneuver; NAVWAR implications; and identification of terrestrial and space weather with the impacts on unified land operations. In addition to identifying hazards, threats, and vulnerabilities, general categories for risk management associated with space operations include policy, planning, operational, and technical.

2-90. Policy risk. This pertains to adherence to the many levels of National, DOD, and Service policy, appropriate authorities, legal guidance, and international law. Policies address space boundaries, authorities, and responsibilities. Commanders and staffs should conduct risk assessments and consider potential cascading and collateral effects due to the military's distributed use of national, military, and commercial SATCOM systems, PNT use, and NAVWAR effects.

2-91. Increased risk occurs where policy fails to address operational necessity. If policy fails to keep pace with peer capabilities, our Soldiers may not be able to conduct the appropriate responses in a timely manner. For example, using the space domain for only peaceful purposes may prompt concerns for our ability to thoroughly protect ourselves, our space capabilities, and deliver necessary capabilities and effects.

2-92. Planning risk. This risk pertains to the consequences of not fully integrating space capabilities and effects into all aspects of mission plans. Examples include failure to integrate space capabilities and effects across all mission areas, over-stating the expectation of a space capability, and over-classification which may prohibit key players from actively participating in space planning.

2-93. Operational risk. This pertains to the consequences threat actors pose to space operations which may impact mission effectiveness. Operational consequences may result in joint forces and unified action partners operating in a D3SOE. An attack on space forces may be targeted toward a ground facility or an on-orbit asset and may damage equipment which could cause impacts from degraded capabilities to mission failure.

2-94. Technical risks are exploitable weaknesses in systems. Many weapon system within the Army is enabled or enhanced in some way by space capabilities, creating potential vulnerabilities. These potential vulnerabilities may directly impact the Army's ability to project military power to support missions. Space operations Soldiers examine the technical risk when planning mission operations to ensure risks are properly assessed and minimized in operations. Refer to ATP 5-19, *Risk Management* for more information.

SPACE POLICY

2-95. All levels of the U.S. space policy—national, DOD, and Service—have direct and influential impacts on defining the space OE. Army space operations derives its authorities from these policies. It draws a clear linkage from strategic national policies to the Army's operational space forces. As part of the 'Preserve Peace Through Strength' pillar, the *National Security Strategy* identifies access to the space environment as a vital interest and clearly identifies the U.S. must maintain our leadership and freedom of action in the space domain.

“The United States considers unfettered access to and freedom to operate in space to be a vital interest. Any harmful interference with or an attack upon critical components of our space architecture that directly affects this vital U.S. interest will be met with a deliberate response at a time, place, manner, and domain of our choosing.”

National Security Strategy

2-96. The *National Space Policy* clearly articulates the policy of the U.S. is to conduct space operations deemed necessary for national security. Space operations are used for peaceful purposes while developing civil and commercial use of the space environment. National, DOD, and Army space policies embrace the prudent use of the space environment for security purposes. These policies make it clear space operations are a critical element of defense capabilities and should be carefully and purposefully developed by each Service, as appropriate, to help provide a balanced overall capability for the range of military operations. The national-level policies and joint directives have a direct bearing on Army space operations in support of unified land operations.

NATIONAL SPACE POLICY

2-97. The *National Space Policy* commits the U.S. space program to a leadership role in the world. The U.S. will use the space domain to preserve peace and protect national security, civil, and commercial interests. The *National Space Policy* has specific guidelines for DOD and are directly applicable to DOD and Army space operations. The Army should:

- Be responsible, with support from the Director of National Intelligence, for the development, acquisition, operation, maintenance, and modernization of SSA capabilities;
- Develop capabilities, plans, and options to deter, defend against, and, if necessary, defeat efforts to interfere with or attack U.S. or allied space systems;
- Maintain the ability to execute space capabilities; and

2-98. The policy identifies a set of guidelines that apply to all federal departments, agencies, and activities conducted in the three distinct but independent sectors of commercial, civil, and national security space capabilities. Some prominent national security space activities Army operations supports are identified in the ‘National Security Space Guidelines’ section of the document.

- Develop, acquire, and operate space systems and supporting information systems and networks to support national security, and enable defense and intelligence operations during times of peace, crisis, and conflict.
- Ensure cost-effective survivability of space capabilities, including supporting information systems and networks, commensurate with their planned use, the consequences of lost or degraded capability, the threat, and the availability of other means to perform the mission.
- Develop and implement plans, procedures, techniques, and capabilities necessary to ensure critical national security missions. Options for mission assurance may include rapid restoration of space assets and leveraging allied, foreign, and or commercial space and non-space capabilities to help perform the mission.
- Maintain and integrate space surveillance, reconnaissance, and other information to develop accurate and timely SSA. SSA information should be used to support national and homeland security, civil space agencies, human space flight activities, and commercial and foreign space operations.
- Develop and apply advanced technologies and capabilities that respond to changes to the threat environment.

DEPARTMENT OF DEFENSE SPACE POLICY

2-99. DOD directive (DODD) 3100.10, *Space Policy* implements the *National Space Policy*, establishes DOD space policy, and assigns DOD responsibilities for space capabilities. It addresses the need to deter aggression, promote stability and responsible use of the space domain, integrate space capabilities, and improve mission assurance. The *National Military Strategy* recognizes space domain as one of the global commons and notes our ability to project power from this global commons may be at risk. The space domain

is critical for Army operations, yet it is becoming increasingly more vulnerable to malicious actions. Space capabilities and applications will be integrated into the strategy, doctrine, concepts of operations, education, exercises, operations, and contingency plans of joint forces. DOD space capabilities will be sufficiently robust, ready, secure, survivable, resilient, and interoperable.

2-100. The Services should act in accordance with DODD 3100.10.

- Integrate space capabilities and applications into all facets of their strategy, doctrine, education, training, exercises, wargames, experiments, and operations.
- Organize, train, equip, and provide forces for space operations, including operating in a D3SOE. D3SOE is a composite of the conditions, circumstances, and influences which affect the employment of space capabilities and effects. D3SOE applies to physical assets and the EMS, and an impact to either may seriously test the limits of adaptability for all mission operations.

2-101. DOD space capabilities, effects, and activities contribute to national security by:

- Providing support for the inherent right of self-defense and defense commitments to allies and partners;
- Deterring, warning, and, if necessary, defending against enemy attack;
- Ensuring hostile forces cannot prevent U.S. use of space capabilities;
- Countering, if necessary, space systems and services used for hostile purposes;
- Enhancing operations of U.S. and allied forces;
- Ensuring U.S. ability to conduct military and intelligence space capabilities;
- Satisfying military and intelligence requirements during peace and crisis as well as through all levels of conflict; and
- Supporting the activities of national policy makers, the intelligence community, the President of the U.S., Secretary of Defense, combatant commander, military Services, other federal officials, other government agencies, and continuity of government operations.

ARMY SPACE POLICY

2-102. The Secretary of the Army and the Chief of Staff of the Army approved AR 900-1, *Department of the Army Space Policy* in April 2017.

Space capabilities are critical enablers to projecting land power and winning in close combat. The Army's warfighting functions (mission command, intelligence, movement and maneuver, fires, protection, and sustainment) are all enhanced by incorporating space capabilities.

Army Space Policy

2-103. The Army's space policy clearly recognizes the Army's dependency on space capabilities and continuing commitment to space operations. Army strategic space goals are explicitly echoed in AR 900-1. The Army's has four broad space-related objectives.

- Maximize the effectiveness of current space capabilities in support of operational and tactical land warfighting needs.
- Influence the design, development, acquisition, and concepts of operation of future space systems that enable and enhance future land forces.
- Advance the development and effective use of responsive, timely, and assured joint interoperable space capabilities.
- Seamlessly integrate relevant space capabilities into the operating force.

2-104. The Army space policy confirms access to, and use of space capabilities are essential to operational success. Army space capabilities provide effects on the battlefield, enhance operational support to operating forces, and contribute to successful execution of Army missions.

2-105. The *National Space Policy*, *DOD Space Policy*, and Army space policy reflect the critical aspect space capabilities serves for current and future military operations. Space capabilities are an integral part of Army operations and necessary to achieve and maintain Army and joint land warfighting dominance.

Chapter 3

Army Space Capabilities

The Army maintains deployable elements, capabilities, and provides effects to Army and joint forces. These capabilities and effects are available continuously for planned operations, contingencies, and other surge requirements and operations. They are intended to support planned, crisis, contingencies, and other surge requirements. Section I discusses the Army space capabilities, and how they are used to support mission operations. Section II provides an understanding of the space enabled capabilities used within the Army. Section III addresses the unique responsibilities of those Army Proponents who have specified roles in space operations.

3-1. The Army relies on space capabilities and systems to provide global positioning, SATCOM, weather and related environmental conditions, and intelligence collection platforms. These systems are critical enablers used by the Army to plan, communicate, navigate, maneuver, engage the enemy, provide missile warning, maintain situational understanding, protect, and sustain forces. Space capabilities are ubiquitous, and regularly used by every element of the Army and the joint force. Planning and coordination with national, Service, joint, and theater resources takes place through liaison with space operations officers.

3-2. Space capabilities increase force effectiveness across the range of military operations through improved SSA, increased efficiency with which units employ fires, maneuver, and other capabilities. The space domain affords commanders near-persistent access to A2 and AD, which is an important characteristic not always afforded to air, land, or maritime operations.

3-3. Space capabilities may be provided to Soldiers by the Army, other Services, civil agencies, and commercial entities. Units plan, coordinate, and integrate space capabilities into their operations through organic coordinating staffs. SSEs or other attached Army space forces provide space operations expertise to organizational staff and units as directed by the unit commander.

3-4. Many command and control systems rely heavily upon space operations, and that reliance carries with it an inherent vulnerability when conducting operations. Units train to maximize the capabilities space assets provide in a permissive environment; they also train to operate in the hostile environment of a D3SOE. All Soldiers receive training to recognize when they are operating in a D3SOE and the tactics, techniques and procedures to apply to work through the conditions and successfully complete their mission.

SECTION I – SPACE CAPABILITIES

3-5. Space capabilities enable the Army and joint force to operate across the range of military operations. Each Service has specific responsibilities assigned regarding space operations. Two or more Services may have responsibilities within the same capability, but the Services focus on different aspects of the capability, complementing each other without duplicating the efforts. The Army has significant responsibilities focused on capabilities uniquely conducted by or directly applicable to Army space operations. SSA is a key component for space operations because it builds the foundation for accomplishing all other space operations.

Army Space Capabilities

- SSA
- PNT
- Space control (DSC, OSC, NAVWAR)
- SATCOM
- Satellite operations
- Missile warning
- Environmental monitoring
- Space-based surveillance and reconnaissance

SPACE SITUATIONAL AWARENESS

3-6. SSA is fundamental to conducting space operations. It integrates space-based surveillance, collection, and processing; environmental monitoring; status of U.S. and cooperative nations satellite systems; status of U.S. and multinational space readiness; and analysis of the space domain. SSA must incorporate understanding of the space capabilities and intent of those who pose a threat to Army space operations and capabilities. SSA includes physical, virtual, information, and human dimensions; and the factors, activities, and events of all entities conducting, or preparing to conduct space operations. Simply stated, SSA includes detection, characterization, and assessment of the capabilities and intent of our adversaries.

3-7. SSA requires in-depth knowledge of the space domain, understanding of the OE, intelligence on all foreign space systems, correlation of effects to a cause, and proper distribution and sharing of SSA information. SSA supports these four key objectives.

- Ensure space operations and spaceflight safety. SSA provides the infrastructure to ensure space operators understand the conditions which could adversely impact successful space operations and spaceflight safety, such as collision avoidance of on-orbit assets.
- Implement international treaties and agreements. SSA is a means by which compliance can be verified and by which violations can be detected.
- Protect space capabilities. The ability to monitor all space activity enables protection of space capabilities, helps deter others from initiating attacks against terrestrial and space capabilities, and assures allies of continuing support during peace, crisis, and conflict.
- Protect military operations and national interests. SSA supports and enhances military operations.

3-8. SSA operations are continuous to ensure the current and future locations of terrestrial and space systems are known with reliable accuracy. SSA is fundamental to unified land operations because it characterizes space capabilities and integrates information collection analysis which contribute to the Army's ability to understand and react to enemy intent.

3-9. Characterization of friendly assets is necessary to support friendly system anomaly resolution, establish baselines for evaluating enemy space object identification and surveillance capabilities, and supports indications and warning development.

3-10. SSA provides the commander the ability to identify the space capabilities available and impacts to operations in the area of operations. It provides insight into enemy space capabilities and threats to U.S. space capabilities. Understanding enemy intent is critical to every operation. SSA operations are continually ongoing to ensure the current and future locations of all satellites are known. Friendly forces may be warned when enemy space-based information collection assets will be in position to view and record friendly force activities. SSA supports assured communications which are critical for friendly PNT, FFT, and SATCOM capabilities to assess unwanted intrusions, attacks, interference, or unintentional hazards. SSA safeguards targeting and fires assets from unintentional hazards such as radio frequency interference and other naturally occurring phenomenon.

POSITIONING, NAVIGATION, AND TIMING

3-11. The GPS is a constellation of Earth orbiting satellites and associated ground control stations providing timing data to military and civilian users all over the world. Public law and national policy mandates GPS is designated for both military and civilian use.

3-12. The GPS system is operated by the Air Force. Each GPS satellite broadcasts a continuous timing signal so properly equipped users with direct line of sight access to the satellites can receive and use the signals simultaneously. When signals from at least four satellites are being received, a GPS receiver can calculate three-dimensional position. With the proper equipment users obtain the timing signal and can calculate current position and velocity. GPS is a passive system; therefore, a Soldier can receive and use the signal without emitting a signal that might compromise their location.

3-13. GPS provides a continuous, precise, all-weather timing signal accurate to a few nanoseconds (ten-billionths of a second). This signal is used to support navigation services, including:

- Three-dimension position information (latitude, longitude, and altitude) accurate up to 5 meters;
- Velocity within a fraction of a mile per hour;
- Support to an unlimited number of users and areas.

3-14. Only DOD-approved GPS receivers must be used for Army or joint operations. All DOD combatant users must use GPS precise positioning service systems. Users must be aware commercial GPS receivers do not offer the same performance or protection that military receivers provide. In order to provide the best anti-jam protection, military receivers must be loaded with the latest communications security key.

3-15. GPS signals enable precision targeting and fires from stand-off distances with increased lethality and reduced collateral damage, precise troop movement and maneuver, and communication. It fosters extended operational reach, control of the operational tempo, and enhanced command and control. GPS data is a mission essential element in many weapon systems and combat operations. It enables FFT, unmanned aerial systems, space-based surveillance and reconnaissance support for situational understanding, and many other functions. Precision timing enhances the Army's the ability to synchronize tactical digital networks, communications, and wide area networking capabilities.

3-16. GPS systems is particularly useful in featureless or obscured terrain. It allow precise maneuver without sighting specific geographic features. Soldiers can rendezvous to join or support other troops using waypoints.

3-17. The use of GPS is prolific for determining personnel location and for weapon system applications. GPS signals can be received and the calculations made in a highly dynamic environment, so the GPS receiver and processing equipment can be used in precision-guided munitions as a means to increase their accuracy. GPS is integrated in equipment such as field artillery cannon and rocket systems and munitions that significantly increase delivery accuracy. A few examples of munitions which use GPS for guidance include the Army Tactical Missile System, the Multiple Launch Rocket System, and Excalibur 155 millimeter artillery ammunition. The GPS components in missiles and projectiles enable in-flight corrections that significantly improve accuracy over ballistic projectiles or munitions using only inertial guidance.

3-18. Precision munitions require greater accuracy. Therefore, GPS receiver equipment is sometimes coupled with a terrain matching system, terminal homing device, or automatic target recognition capability to increase accuracy. This facilitates target destruction with smaller or fewer munitions while reducing collateral damage. It also enables strikes in direct support of combat action executed closer to friendly positions. Employment of GPS-aided munitions can assist in reducing fratricide and collateral damage. GPS-aided delivery allows for smaller warheads, thus increasing the range of the weapon.

3-19. Offensive and defensive operations are enhanced with precision navigation aids. The GPS signal can be used in stability operations to maintain a distance buffer between opposing forces in a truce or stand-down situation. Marking the coordinates for a demarcation line makes it easier for forces on both sides to remain on their own side of the demarcation line. Surveying demarcation lines and marking them with GPS-surveyed locations help forces with GPS receivers to avoid inadvertently crossing these lines.

3-20. The GPS signal is susceptible to electromagnetic interference because the EMS is congested, and GPS operates on specified frequencies which cannot be changed.

SPACE CONTROL

3-21. Space control enables freedom of action in the space domain for the U.S. and its allies, defeats efforts to interfere with U.S. and multinational space systems, and denies a threat actor freedom of action in the space domain. Space control can be used to deny communications and propaganda tools (such as satellite television and satellite radio) to enemy leadership. The three components of space control are DSC, OSC, and NAVWAR.

DEFENSIVE SPACE CONTROL

3-22. DSC is the actions taken to protect friendly SATCOM and other space capabilities from attack, interference, unauthorized intrusions, and hazards. DSC is focused on responding to man-made threats which may affect the terrestrial and space systems. DSC actions safeguard assets from hazards such as space debris,

radio frequency interference, and other naturally occurring phenomenon such as radiation and space weather. A robust DSC capability influences enemies' perceptions of space capabilities and makes them less confident in successfully interfering with those capabilities. Friendly forces may be warned when enemy space-based reconnaissance and surveillance assets will be in a position to view and record activity. An example of DSC enabled by SSA is forces using camouflage, concealment, and deception techniques to protect themselves when notified of potential space-based observations.

3-23. DSC operations protect our capabilities from deliberate interference and threat actor' attacks. DSC preserves access to, and use of, space capabilities by reacting to events affecting U.S. and multinational space capabilities. DSC is built on the capabilities to detect and characterize interference, locate the source of interference, and defeat the interference, all of which support deterring deliberate interference. DSC is consistent with the inherent right of self-defense, deters others from deliberate interference and attack, defends our space systems, contributes to the defense of multinational space systems, and if deterrence fails, supports efforts to attack them.

3-24. DSC provides encryption and protection of vital communications and information collection links necessary to support the force in permissive operations and D3SOE. Protection of assets from adversarial exploitation ensures the commander's ability to communicate and navigate in a D3SOE. Passive DSC protection measures such as encryption and electronic hardening of GPS receivers increases the likelihood Soldiers will receive GPS information in a D3SOE. Active DSC protection actions such as geo-locating jamming sources assist Soldiers to find, fix, and destroy jammers.

OFFENSIVE SPACE CONTROL

3-25. OSC is offensive actions taken to negate attacks against U.S. and friendly space assets. The importance of space capabilities in military operations makes it crucial to be capable to negate enemy efforts interfering with or attacking U.S. and multinational space capabilities. OSC actions employ both reversible and nonreversible effects. Measures include actions against ground, data link, and space segments or user to deceive, disrupt, deny, degrade, or destroy enemy's space systems, or to thwart hostile interference on U.S. and multinational space systems.

- 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.
- 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.
- 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.
- 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.
- Destroy—measures designed to permanently eliminate the adversary's use of a system, usually with physical damage to the affected system.

NAVIGATION WARFARE

3-26. The intent of NAVWAR is to ensure unimpeded access to GNSS for joint forces and multinational partners while denying the same to the enemy. It encompasses various offensive, defensive, and support activities (such as surveillance, reconnaissance, and EMS management) to ensure unimpeded availability and integrity of PNT information. NAVWAR may be implemented in a localized area or across all domains and mission areas. NAVWAR should be a consideration in all joint planning efforts. As it has strategic implications, it is incumbent upon the Army and joint forces to minimize unintended disruption to civil PNT services for non-combatants outside the military area or operations.

3-27. The effects of NAVWAR on many systems are complex and may be limited in scope to a few miles or cover an entire AOR. It includes varying conditions from mild degradation to total GNSS denial, and may include GNSS signal spoofing. The loss of GNSS signal may yield a significant decrease in the ability to conduct mission operations. The impact due to GNSS interference—intentional or otherwise—goes far

beyond handheld receiver devices. Loss of signal may impact command and control, precision munitions, maneuver forces, aviation platforms, network timing protocol, civil and commercial activities.

3-28. The approach to successful NAVWAR operations are through characterization, assured PNT, and NAVWAR attack. Army forces execute NAVWAR operations by integrating Army capabilities and effects into joint operations to create a leveraged force multiplier. Army NAVWAR includes operations that characterize the GNSS environment to gain situational understanding of friendly and threat actors' intent, capabilities, and actions.

- Characterization is the ability to understand, visualize, and describe the local PNT environment. It includes accurate and timely assessments of the OE, including terrestrial, aerial, and space environments, and the potential impact to these areas and mission in order to plan and conduct unified land operations. Characterization of the environment provides an assessment of PNT availability throughout the duration of a mission. Characterization requires a persistent and integrated network of surveillance and reconnaissance systems and information processing to fuse the data into a cohesive picture. It includes the capability to determine the effects of the environment on sensors, weapons, and munitions to deliver fires. It includes obscurants, enemy capabilities, and intent.
- Assured PNT is reliable, secure, and resilient GNSS data delivered with data integrity to friendly forces to conduct decisive maneuver and employ precision fires. Assured PNT includes GNSS augmentation such as using multi-sensor PNT devices to take advantage of other GNSS and non-GPS signals. Passive measures include the use of anti-jam antennas to null jammers and improved military GPS receivers used to assure access to PNT. Defensive protection measures include shielding the receiver—if possible—to block the interference and using proven tactics, techniques, and procedures. Conducting realistic training in a D3SOE provides Soldiers the ability to experience these conditions during Home Station and Combat Training Center training exercises. Training provides Soldiers at all echelons the opportunity to exercises PNT mitigation techniques in a D3SOE.
- NAVWAR attack is the ability to deny threat actors the use of GNSS through a variety of methods including offensive cyber operations, space operations, and electronic attack. NAVWAR attack exploits threat actor's dependencies and vulnerabilities. NAVWAR effectiveness requires the application of space operations, cyberspace operations, and electronic attack capabilities to be synchronized with lethal and nonlethal effects to deliver the desired effects. NAVWAR can be used to support entry operation, contribute to defeating A2 and AD strategies, enable deep shaping and strike, and allow local area dominance while preserving access for friendly forces and civil use. NAVWAR requires multi-domain approach and must be synchronized with kinetic attacks. Space operations focus on PNT signals, situational understanding, and space control operations. Cyberspace operations protect friendly networks that leverage GNSS, while targeting similar adversary capabilities. Electronic warfare combines electronic support, electronic attack, and electronic protection to understand the impacts of NAVWAR operations, deny adversary access to GNSS information, and protect friendly capabilities using specific frequencies.

3-29. GNSS disruptions should be anticipated so NAVWAR capabilities should be integrated into the operations process. Planners must understand how the enemy may attempt to negate the use of GNSS using NAVWAR techniques and be able to characterize the NAVWAR landscape to identify threats to friendly GNSS capabilities. GNSS characterization requires a comprehensive awareness and synchronized approach from space operations, cyberspace, and electronic warfare to be effectively integrated into battle plans.

3-30. Commanders and staffs should understand the extent to which their forces and equipment rely on GNSS data and how degraded or denied GNSS data impacts operations. They should have situational understanding of the GNSS landscape. They should understand the impact NAVWAR will have on their operations, and must recognize the risk to Soldiers and mission in a NAVWAR environment. Soldiers should be able to recognize the indications of NAVWAR on their equipment, be prepared to employ basic techniques to mitigate the effects, and notify higher echelons when indications are present. If basic techniques are not successful, Soldiers should be prepared to implement actions into a primary, alternate, contingency, emergency (PACE) plans. A PACE plan should include steps, processes, and considerations associated with operating in a D3SOE.

SATELLITE COMMUNICATIONS

3-31. SATCOM is a general term used to describe all satellite-based communications—it includes commercial, military, allied, and civil SATCOM providers. Commercial SATCOM are leased SATCOM assets provided by commercial entities encompassing DOD bandwidth, DOD-owned or leased commercial-band terminals and gateways landing DOD mission, and commercial SATCOM used by the DOD but provided by commercial entities using commercial terminals. Military SATCOM are the SATCOM assets owned and operated by the DOD in the frequency bands reserved for use by the U.S. government. It includes those systems owned and operated by the DOD. Military SATCOM also includes Enterprise Gateways (to include DOD Gateways) and Service gateways.

3-32. The Army employs a combination of military and commercial systems to support its SATCOM requirements. Army forces require a mixture of narrowband, wideband, commercial and protected SATCOM for rapid transport of voice, video, and data between the lowest tactical level and headquarters at all echelons. The capability to move operational information provides increased situational awareness, enables commanders the opportunity to conduct decentralized operations, and extends joint capabilities to the tactical level.

3-33. SATCOM offers many unique features to the operating forces as illustrated in figure 3-1. Using a global network of military and commercial communication satellites, operating forces at all levels of command can overcome limited infrastructure, execute reachback operations, enable two-way flow of data to critical nodes, provide support to special users, and increase overall command and control effectiveness. Further, SATCOM provides critical connectivity for maneuvering forces whose rapid movement and deployments in non-contiguous areas take them beyond available line of sight communication networks.

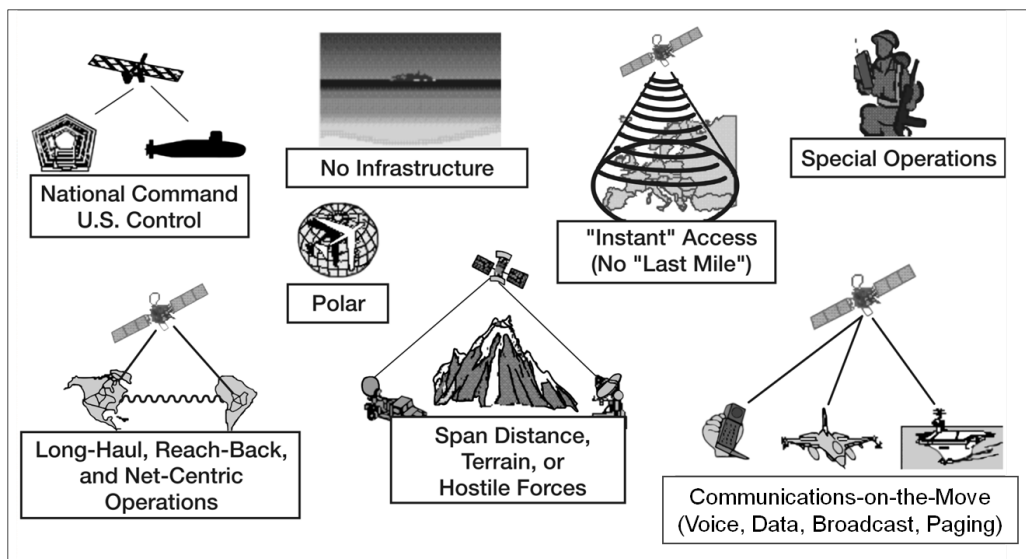


Figure 3-1. Key satellite communications features

3-34. SATCOM collectively provides an essential element of national and DOD communications worldwide. It allows information transfer from the highest levels of government to tactical level for all matters. SATCOM supports a variety of media, including voice, video, and data services. The satellites' functionality is generally transparent to the user; SATCOM does not create information, but serves as a transport medium.

3-35. SATCOM provides updated targeting information and intelligence updates in near real time. Sensor-to-shooter links enable improved situational awareness, allowing Soldiers to assess fire control techniques and effectiveness. SATCOM capabilities transmit data such as position, operational status, equipment, aircraft conditions, transit data, maintenance diagnostics, and prognostics. Table 3-1 summarizes the general SATCOM attributes.

Table 3-1. Satellite communications attributes

<i>Frequency Band</i>	<i>Advantages</i>	<i>Limitations</i>
Narrowband	<ul style="list-style-type: none"> • Small terminals, low power • Economical • Highly mobile • Penetrates foliage 	<ul style="list-style-type: none"> • Vulnerable to nuclear events • Susceptible to jamming, interference, scintillation • Low capacity, crowded spectrum • Access is limited
Wideband	<ul style="list-style-type: none"> • More bandwidth and channels • Global connectivity • Flexibility in routing • Greater protection features • Less vulnerability to nuclear blackout or scintillation 	<ul style="list-style-type: none"> • Limited frequency allocation • Susceptible to jamming • Ground terminals are larger and expensive
Protected band	<ul style="list-style-type: none"> • Extensive bandwidth • Uncrowded spectrum • Jam resistant • Small equipment • Least vulnerability to nuclear blackout or scintillation 	<ul style="list-style-type: none"> • Technologically complex • Susceptible to rain and atmospheric attenuation • Expensive to outfit • Ground terminals are large, complex, and expensive

3-36. Systems operating in the ultrahigh frequency range are referred to as narrowband SATCOM systems. Systems operating in the super-high frequency bands where the bandwidth is primarily used for larger capacity are referred to as wideband SATCOM systems. Satellite systems operating in the extremely high frequency bands are referred to as protected band SATCOM systems. These systems are specifically designed to use the bandwidth to counter electromagnetic interference events and work through nuclear scintillated environments. The frequency band influences the throughput capacity and degree of protection naturally provided to the communications system.

3-37. All SATCOM operate on specific electromagnetic frequencies a spacecraft is designed to use. Link segment signals enable communication between two or more points on the ground and the PNT signal used for navigation.

SATELLITE COMMUNICATIONS SYSTEMS AND TRANSPORT

3-38. SATCOM provide significant advantages across the range of military operations, from Army-level strategic operations down to a tactical-level, expeditionary force. These SATCOM capabilities and transport services support the Army.

- Global reach from the national command authority to the deployed forces.
- Connection to Defense Information Systems Agency services in austere environments.
- Near real time information from sensor to shooter.
- Missile warning indications provided ground and space-based sensors to support an area of operations.
- Direct downlink of space-based reconnaissance and surveillance sensors into Army TENCAP systems in support of both situational understanding and targeting.
- Advanced geospatial intelligence to enable operations and defeat enemy camouflage, concealment and deception.
- Commercial space imagery which supplements national sources to support planning, theater security cooperation, combat assessment, situational understanding, and cartography.
- Immediate access to tactical networks.
- Access for isolated special operations forces without terrain or distance limitations.

- Long-haul backbone data transport and reachback to home station.
- Transmission capabilities that span beyond line of sight distances, terrain obstructions, or hostile forces.

Department of Defense Narrowband Satellite Communications Systems

3-39. The narrowband SATCOM systems support secure voice and data transmission at relatively low data rates for mobile and fixed users. These systems are primarily designated to support highly mobile, tactical users. Compact terminal equipment and omnidirectional antennas allow deployed forces to conduct tactical command and control and quickly exchange both voice and data communications.

3-40. Some Narrowband SATCOM systems have cellular-like capabilities which increases DOD narrowband capacity and access. These system provide worldwide, point-to-point communication to multi-Service organizations with fixed and mobile terminal users and allows Soldiers to connect directly to Defense Information Systems Network services such as to Defense Switched Network, NIPRNET, and SIPRNET.

Department of Defense Wideband Satellite Communications Systems

3-41. The wideband SATCOM systems support multichannel, secure voice, and high data-rate communications for command and control, crisis management, and intelligence data transfer services. The heaviest use of wideband communications is multiplexed, wideband, switched networks. Many wideband users employ large, fixed ground terminals to support DOD enterprise-wide voice, data, and video wideband networks. Small mobile and relocatable terminals support operations for high-capacity, multichannel communications aboard ships, aircraft, and ground forces.

Department of Defense Protected Satellite Communications Systems

3-42. The protected SATCOM systems support survivable voice and data communications not normally found on other systems. Its unique characteristics give it attributes such as anti-jam and scintillation-resistance along with low probability of interception or detection. Use of the protected SATCOM system has often been associated with strategic forces and command and control systems. Protected band capabilities are in demand by tactical and special forces who require anti-jam and low probability of radio transmission interception or detection. Systems typically operate in the extremely high frequency range.

Commercial Satellite Communications Systems

3-43. Commercial SATCOM might offer greater capacity which can be used to meet and augment the Army's rapidly growing information needs. Some wideband services and personal communications services such as fixed satellite service and mobile satellite service are examples of current commercial SATCOM support to strategic and tactical mobile users.

- Fixed satellite service provides invaluable support to current military operations.
- Mobile satellite service uses Iridium and Inmarsat services to complement military SATCOM narrowband services to provide highly mobile communications.

3-44. Commercial SATCOM systems are advantageous to support much of the Army's predictable, wideband fixed SATCOM needs. Leasing commercial services affords the Army faster access to advanced commercial technologies than traditional government programs. In an environment where both the DOD and adversaries have similar access to advanced technologies and commercial services, sustaining military advantage likely rest on the DODs ability to integrate those technologies and commercial services into its force structure faster and more effectively than an adversary.

3-45. Army units seeking to employ commercial SATCOM must follow all specified procedures, satellite access requests, appropriate reports, and satellite database numbers for each commercial satellite network. Army units obtain commercial SATCOM services through the Army Network Enterprise Technology Command and the U.S. Air Force, and must report their arrangements and expenditures for commercial satellite services to the headquarters, Department of the Army chief information officer or assistant chief of staff, signal (G-6) office. Satellite provisions obtained through the U.S. Air Force include terms and conditions for resolution and mitigation of electromagnetic interference and other anomalies.

3-46. To ensure DOD receives ready assured access to commercial services when and where needed, leases for those services must be procured in the early stages of a contested EME or before the spectrum becomes too congested. Access and availability to commercial services are based on the terms of the lease or contract. Experience shows that commercial satellite services may sometimes become unreliable during periods of political tension or open hostilities. Commercial SATCOM is an important component of DOD communications and requirements are thoroughly reviewed before employing these communications.

SATELLITE COMMUNICATIONS SUPPORT SYSTEMS

3-47. The Joint Staff administers the military SATCOM requirements process, which formally documents users' needs for SATCOM as a precondition for satellite access. The DOD SATCOM operational manager has responsibility for validating combatant command and agency requirements for SATCOM resources. The access process is supported by satellite operations.

3-48. Military SATCOM requires a lot of interaction and planning to ensure users' needs are validated, required resources are available, and proper support is offered when problems are experienced. Elements of the SATCOM support system include SATCOM System Experts, Consolidated SATCOM System Experts, RSSCs, and the Global Network Operations and Security Center.

SATELLITE COMMUNICATIONS SYSTEM EXPERTS

3-49. SATCOM System Experts and Consolidated SATCOM System Experts have detailed knowledge of assigned system(s) and spectrum. They provide technical, operational, and engineering support as required. Specific military SATCOM System Expert duties include:

- Provide continuous, 24 hour per day operational support;
- Provide RSSC manning;
- Ensure integrated spectrum operations;
- Advocate user requirements;
- Develop policy and procedures;
- Operationally advise program managers; and
- Assist transition planning.

3-50. A Consolidated SATCOM System Expert is assigned for each SATCOM spectrum (band) and a SATCOM System Experts is assigned for each system used in the delivery of military SATCOM. The mission of the Consolidated SATCOM System Expert and SATCOM System Expert is to provide the military with SATCOM management, planning, control, and protection resources. Consolidated SATCOM System Experts coordinate and integrate cross-system inputs with support from SATCOM System Experts. Consolidated SATCOM System Experts provide continuous support to deconflict, assess, analyze, and integrate SATCOM information, status, configurations, synchronization, sustainment issues, deployment issues, and anomalies.

3-51. The military narrowband Consolidated SATCOM System Expert and the specific SATCOM System Expert responsibilities include the manning the RSSCs for narrowband planning, managing the increased resources for payload operations management and transmission control, and certifying all terminals used across the narrowband satellite payload.

3-52. The military wideband Consolidated SATCOM System Expert and the specific SATCOM System Expert responsibilities include the operational payload management and development and sustainment for specific SATCOM control architecture.

REGIONAL SATELLITE COMMUNICATIONS SUPPORT CENTER

3-53. The Army operates four RSSCs responsible to plan and manage regional SATCOM support to the operating forces. They provide theater communication planners with a single point of contact for narrowband, wideband, protected band, and commercial SATCOM support. RSSCs provide joint forces with global SATCOM system status, maintain situational awareness for current and planned SATCOM operations, and

support satellite anomaly and electromagnetic interference resolution and management. They are the theater center of expertise for all military and commercial SATCOM serving the operating forces.

3-54. RSSCs are a multi-Service organization staffed by representatives from Department of the Army, Department of the Air Force, and Department of the Navy. RSSCs direct and coordinate SATCOM resource configuration changes with transmission control facilities such as WSOCs, Milstar satellite operations center, and the naval computer and telecommunications area master station. The RSSCs work with customers, government agencies, and other Services for commercial SATCOM service.

Capabilities

3-55. RSSCs are the day-to-day operational interface with the user. All users are assigned to an RSSC as their focal point for SATCOM planning, management, and access support. General locations of the four fixed RSSCs and current combatant command support assignments are depicted in figure 3-2. In general, the RSSCs support combatant commanders and their forces in routine, deliberate, and crisis action planning of SATCOM resources. RSSC personnel participate in planning conferences and appropriate workgroups to identify and plan theater SATCOM support requirements for mission operations. RSSCs process user satellite access requests and publish satellite access authorizations for approved missions.

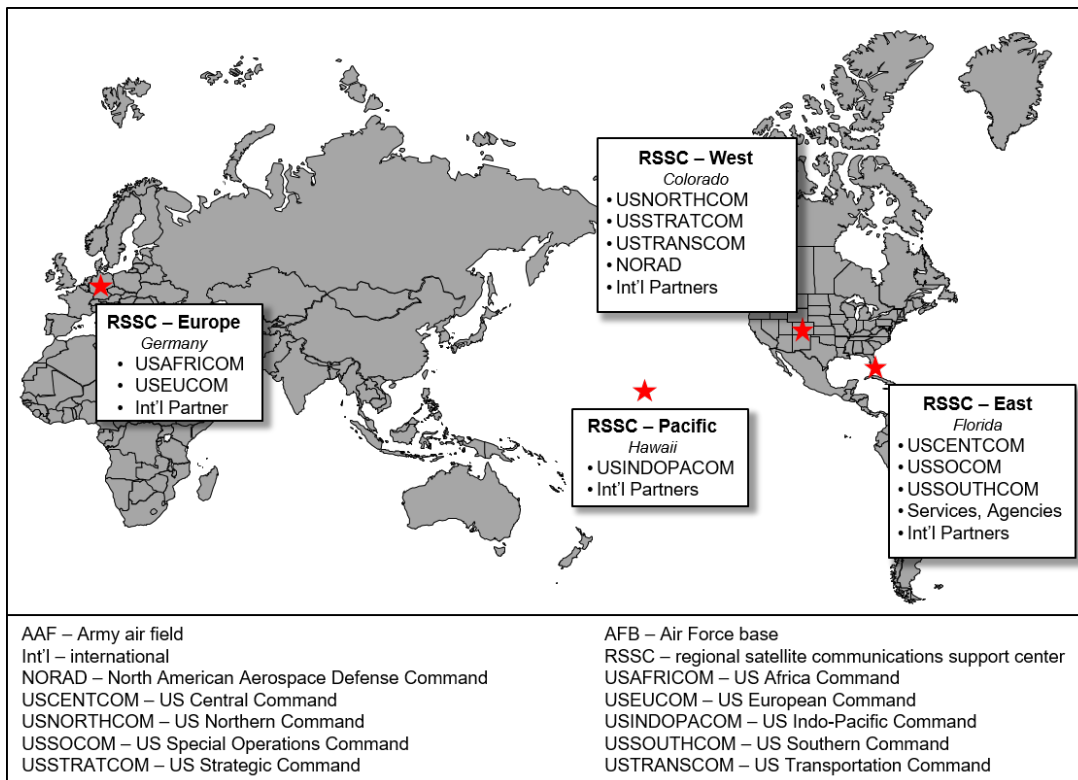


Figure 3-2. Regional satellite communications support center support assignments

3-56. RSSCs perform the following day-to-day management functions for SATCOM resources in direct support of combatant commander assigned theater forces and other users:

- Accept and analyze validated satellite access requests and develop solutions;
- Plan resource assignments, coordinate resource sharing and borrowing, and publish satellite access authorizations;
- Assist combatant commander and planners to implement networks and adjudicate usage conflicts;
- Monitor SATCOM systems status (readiness) and outage information; and
- Coordinate user response to satellite anomalies.

- 3-57. RSSCs support combatant commanders with deliberate and crisis action planning:
- Provide SATCOM support assessments in defining requirements and developing OPLANs, contingency plans, and communication annexes, theater policy, and procedures;
 - Perform battle drills, analyze scenarios, and provide assessments; and
 - Track resource utilization and recommend changes for optimizing resources.
- 3-58. RSSCs support to theater spectrum management activities:
- Assist in SATCOM restoral actions in response to electromagnetic interference or anomalous conditions; and
 - Assist in the joint frequency management office with spectrum allocations and frequency assignments.
- 3-59. RSSCs coordinate planning for SATCOM interfaces to the Department of Defense information networks:
- Facilitate interfaces to the gateways; and
 - Coordinate planning with Defense Information Systems Agency field offices contingency and exercises branch for Department of Defense information networks access.
- 3-60. RSSCs support and United States Space Command (USSPACECOM) in maintaining global situational understanding:
- Monitor on-going SATCOM support and assess impact of system changes and anomalies on current, planned, and future operations;
 - Provide data updates on SATCOM resources allocated to specific users;
 - Coordinate allocation and resource sharing with other RSSCs; and
 - Develop contingency plans for catastrophic failure.

Staffing

- 3-61. The RSSCs provide direct support to the combatant command and theater forces as the focal point for all SATCOM planning matters. RSSCs interact with each other, consolidated SATCOM systems experts, spectrum specific global watch officers, USSPACECOM, and Service unique satellite command and control centers to coordinate and facilitate the implementation of their plans.
- 3-62. The Army Service component command provides management responsibilities for day-to-day operations and key personnel for each RSSC. Each RSSC consists of individual SATCOM spectrum planning cells staffed with planners by respective Service component. Each designated Consolidated SATCOM System Expert has administrative control responsibilities for their respective assigned personnel. The RSSCs conduct continuous, 24-hour operations.
- 3-63. The planners are proficient in dealing with management and control issues for their particular systems. Current RSSC staffing responsibilities are listed below and illustrated in figure 3-3 (on page 3-12).
- Army:
 - Wideband and super-high frequency SATCOM.
 - Narrowband and ultrahigh frequency SATCOM.
 - Navy: Narrowband and legacy ultrahigh frequency SATCOM.
 - Air Force:
 - Protected band.
 - Commercial SATCOM fixed and mobile satellite services.
 - Defense Information Systems Agency: Consolidated SATCOM System Expert for military gateways supporting both military and commercial SATCOM.

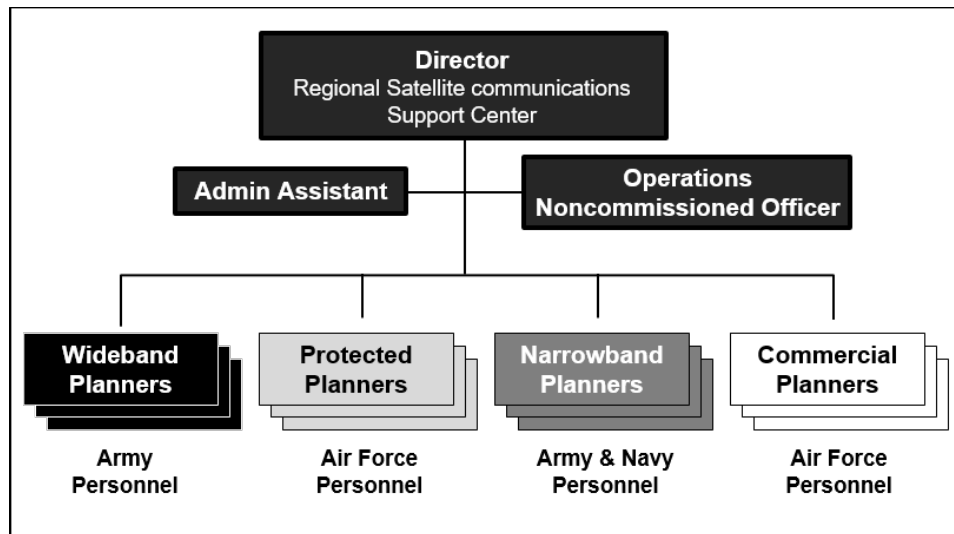


Figure 3-3. Regional satellite communications support center organizations

Standard Tasking Process

3-64. Request for support and products are made via the combatant commander or directly to the RSSC. RSSCs continually analyze resource assignments to make optimization recommendations to combatant commanders and users. Personnel at each RSSC liaise with combatant commanders, Consolidated SATCOM System Experts, users, and control centers to maintain situational awareness and respond to changing demands and requirements.

3-65. A unit requiring satellite access submits a satellite access request via its theater chain of command—making sure the theater Service component is included—to the combatant commander communications directorate, Service, or Agency for review and validation. A validated satellite access request is sent to the appropriate RSSC for analysis and planning. If sufficient system resources are available, the RSSC develops a satellite access authorization, coordinates pertinent terrestrial interfaces, provides data for satellite configuration and control, and reports its status. If system resources are unavailable, the request is denied and sent to the combatant commander’s communications directorate to determine if resources can be borrowed or preempted from other users.

3-66. Approved satellite access authorizations are sent to the originating unit authorizing operational access. Additionally, RSSCs direct and coordinate resource configuration directives with satellite operations centers to implement and monitor communication plans. Individual satellite operations centers have primary responsibility for monitoring and troubleshooting active networks.

GLOBAL NETWORK OPERATIONS AND SECURITY CENTER

3-67. Global Network Operations and Security Center. The Army global network operations and security center provides situational awareness and reporting for the Army LandWarNet. It includes the SATCOM transport layer which provides end-to-end communication services for applications within a layered architecture of network components. In this capacity, the Army global network operations and security center monitors the performance and operation of SATCOM ground terminals in support of the Army’s regional communications requirements. By assessing bandwidth, utilization, environmental factors, throughput, performance, and outages (planned and unplanned), they provide on-demand operational situational understanding of Army SATCOM communications in order to determine system availability and integrity.

SATELLITE OPERATIONS

3-68. Satellite operations maneuver, configure, operate, and sustain on-orbit assets and are characterized as either spacecraft or payload operations. Payload operations includes monitoring and commanding of the satellite payload to collect data or provide capability in the OE. They are designed to deploy, operate, and

sustain systems in the space environment. Payload operations are critical to the communications, command and control, movement, maneuver, protection, and sustainment of space assets.

3-69. Soldiers at Army satellite operation centers have responsibility to monitor, sustain, and conduct payload operations of DODs wideband and narrowband satellite systems. Army wideband satellite operations maintains a backup control capability through its WSOCs for the SSA and network common user equipment for some constellations.

3-70. Globally dispersed operations centers such as the WSOCs and strategic Earth terminal sites, provide vital links between the satellite and controllers to execute spacecraft and payload operations. Satellite operations contribute to unified land operations through payload operations that ensure secure SATCOM is available for use when needed. Large scale combat operations are possible because of the enhanced communications enabled by transmission control and active payload management.

3-71. Satellite operations are characterized as spacecraft and payload operations. Payload operations include monitoring and commanding of the satellite payload to collect data or provide capability in the OE. As a critical and essential link between the satellite operator and the operational force, satellite operations include protection mechanisms to ensure access to space assets. Satellite operations provide significant contributions to SSA.

SATELLITE CONTROL BATTALION

3-72. A Satellite Control Battalion operates the payloads on satellites in military wideband constellations. The battalion operates the five WSOCs to manage SATCOM networks, conduct transmissions, controls satellite payloads, and supports electromagnetic interference resolution on military wideband constellations. Signal Soldiers with specialized satellite control training perform these missions. These operations centers enable SATCOM in support of strategic level communications and planning.

3-73. The WSOCs support Army operations through—

- The use, control, and monitoring of military wideband satellites.
- Established satellite links.
- Monitoring and maintaining the satellite link quality.
- Satellite link power management.
- SATCOM Earth terminal monitoring.
- Terminal positive control and subnetwork control.
- Transmission control and communications payload control of military wideband satellites.
- Payload command and telemetry.
- Support to electromagnetic interference resolution.

WIDEBAND SATELLITE COMMUNICATIONS OPERATIONS CENTER

3-74. WSOCs provide satellite payload and transmission control for DOD communications satellites providing wideband SATCOM for military forces. Strategic wideband SATCOM is used to carry high volumes of communications through large terminals located around the world. The primary means for reachback communications from in-theater headquarters to those in continental U.S. is via military wideband SATCOM.

3-75. The WSOCs are the focal point for:

- Conducting payload command and telemetry functions;
- Transmissions monitoring functions; and
- Strategic and tactical terminal control functions for military wideband satellites.

3-76. WSOC responsibilities include:

- Controlling terminal access;
- Maintaining operational databases;
- Responding to transmission anomalies and alarms;

- Monitoring the health and status of the spacecraft;
- Monitoring for unauthorized users and electromagnetic interference;
- Evaluating the quality of communication links;
- Implementation of restoral plans on a 24-hour basis; and
- Reporting SSA information.

Command

3-77. Through the satellite control battalion, the Army exercises operational control responsibilities for the WSOCs. The Wideband Consolidated SATCOM System Expert provides technical direction and the RSSCs develop configuration plans for the communications payloads executed by the WSOCs.

3-78. The WSOCs are geographically dispersed and provide continuous, 24-hour coverage of all assigned satellites through local and remote monitoring and control equipment. Each company of the satellite control battalion is strategically positioned and has access to remote monitoring and control equipment at select gateway sites to provide command and control for military wideband satellites. Figure 3-4 provides an illustration of the battalion’s mission, which includes transmission control, payload control, and assured access to resources.

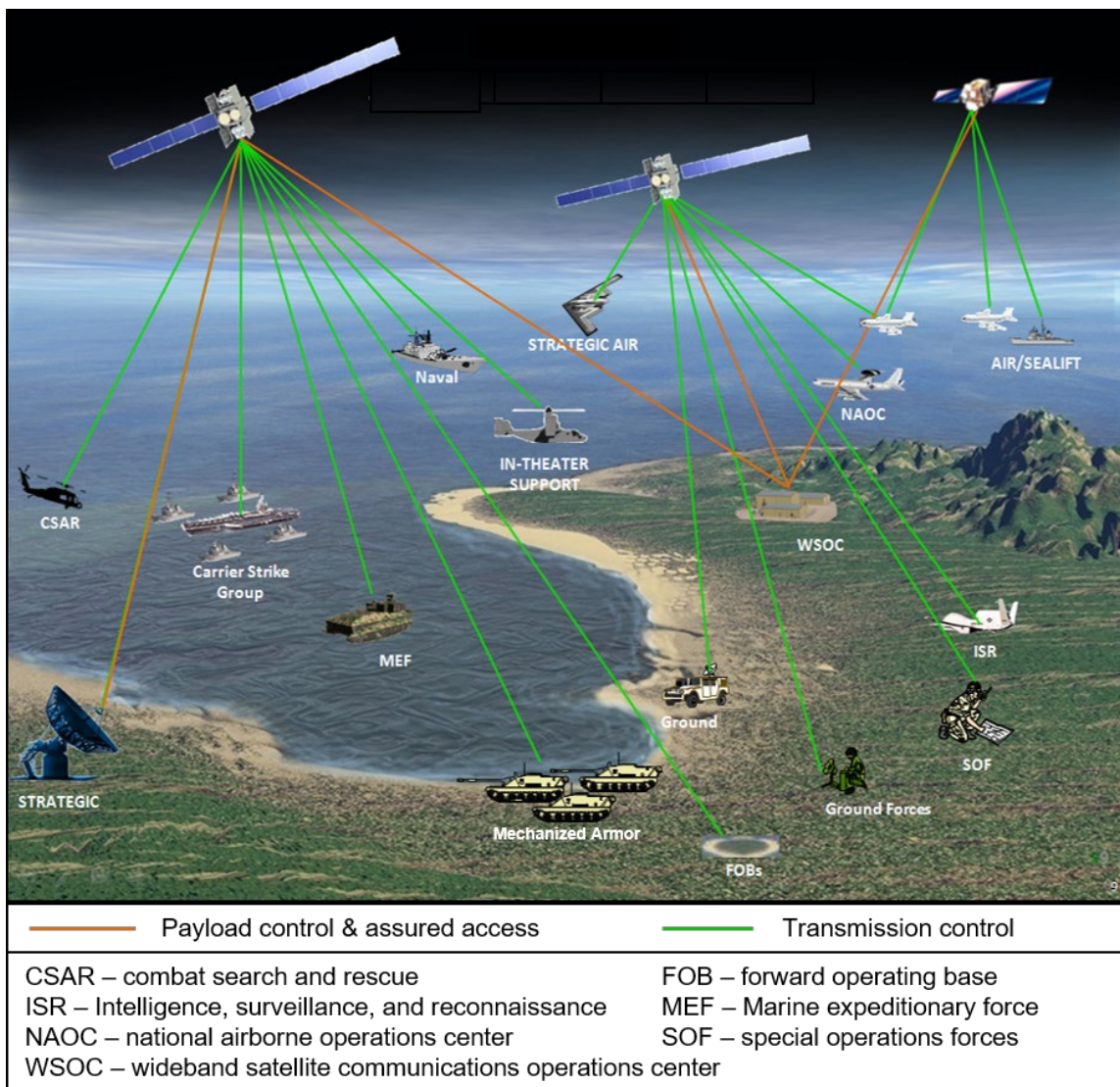


Figure 3-4. Wideband satellite communications operations centers mission overview

Capabilities

3-79. All WSOCs constantly conduct spectrum monitoring of assigned satellites to detect interference, observe random anomalies, and identify problematic trends, such as declining power output from solar arrays or unexpected buildup of heat in electronic components on the spacecraft. All WSOCs perform spectrum monitoring and provide support to electromagnetic interference resolution.

3-80. Transmission control. The WSOCs ensure users do not exceed their allocated share of power and bandwidth resources. WSOC personnel manage satellite resources and monitor user's compliance with established directives and resource allocations. The WSOCs implement the rules of access, bandwidth, and frequency allocations. They provide continuous worldwide communications in support of strategic level communications and planning.

3-81. Tasking Process. The WSOCs are tasked by the appropriate RSSC to execute satellite payload configuration changes, thereby implementing payload and transmission control. Upon detailed allocation planning for SATCOM resources, the RSSCs task the appropriate WSOC in accordance with configuration management requirements levied by the wideband Consolidated SATCOM System Expert. The wideband Consolidated SATCOM System Expert take into consideration combatant commander, communications requirements from around the world, and direction from Joint Staff.

MISSILE WARNING

3-82. Theater missile warning provides joint forces with early warning to dissuade, deter, and defeat ballistic missile attacks via theater ballistic missile warning from deployed JTAGS. Space-based missile detection capabilities assist the commander by providing early warning of enemy ballistic missile launches to theater forces via theater event system reporting. The theater event system elements receive data from space-based sensors; they process ballistic missile warning information and disseminate to forward joint forces and units. The air and missile defense section or element receiving the data coordinates warning distribution to subordinate units and allies. The theater event system supports the missile defense elements of active defense, passive defense, and attack operations and directly support all warfighting functions.

3-83. Missile warning is comprised of launch detection and missile tracking components. Missile warning sensors are hosted on platforms on orbit, in the air, and on the ground. Both launch detection and missile tracking require space and ground systems to process raw sensor data into reports.

- Launch detection sensors provide real time and post-launch analysis to determine orbital characteristics and potential conjunctions with other objects on orbit. Launch detection data is used to evaluate events which could directly or indirectly threaten the U.S. or multinational space assets. Launch detection data is analyzed to determine potential impacts on assets so timely warnings and recommendations for suitable countermeasures may be considered.
- Missile warning is the ability to detect missile launch events, track launch-related objects, discriminate specific objects as a threat, and have a high degree of certainty the trajectory or impact location is a threat to U.S. homeland, territories, and other designated areas.

3-84. Missile warning reports are transmitted to combatant commanders, and air and missile defense assets; they contain detection and predicted impact location to facilitate a response to the attack. Missile warning provides decision makers with pertinent information and operations centers the data for creating awareness via a COP.

3-85. Missile warning tracking uses all available space and ground system data to provide senior leaders and allies the requisite timely warning and characterization of ballistic missile events. Missile Tracking includes launch detection, mid-course tracking, terminal phase re-entry, impact prediction, nuclear detonations detection (to support threat and non-threat determination), and follow-on decision making.

3-86. Air and missile defense command and control nodes use missile warning to cue active and passive defenses against incoming enemy ballistic missiles.

- Passive defenses include warning affected troops and populations to take protective measures.
- Active defense includes use of Army missiles to destroy enemy ballistic missiles before they

impact their targets as well as cueing other land, air, sea-based missile defense sensors, and weapon systems.

3-87. The Space-Based Infrared System, and the legacy Defense Support Program satellites make up the Space-Based Infrared System constellation which provides space-based missile warning. The Space-Based Infrared System constellation host sensors which detect infrared energy (heat) from sources such as a missiles booster exhaust. Data is transmitted to the Space-Based Infrared System Mission Control Station and the theater event system elements of missile warning.

3-88. The theater event system provides assured missile warning to the geographic combatant commands. Army space operations are responsible to provide in-theater missile warning. The theater missile warning detachments, which operate the JTAGS, are strategically positioned worldwide to receive data directly from Space-Based Infrared System satellites in their fields of view. The theater missile warning detachments process the data to identify missile launch points, trajectory, and locations where warheads are likely to impact. The detachments disseminate ballistic missile warning information to theater command centers. Theater missile warning detachments are located to optimize data receipt and theater dissemination.

3-89. Space-based missile warning detection capabilities assist commanders by providing early warning of enemy ballistic missile launches via the theater event system reporting. The theater event system supports the missile defense operational elements of active defense, passive defense, attack operations, command and control, and intelligence architectures. The theater event system broadcasts data to forward units where the air and missile defense section or element coordinates warning distribution to subordinate units and allies. The theater event system warning element directly supports command and control, fires, intelligence, and maneuver operations.

- Identification of missile type supporting passive defense. This may help determine the appropriate chemical, biological, radiological, and nuclear protection measures, if the missile is capable of carrying such warhead and if maneuver units need to go to a higher mission-oriented protective posture level.
- Predicted impact point and time supporting passive defense. The theater event system warns units near the impact point to take protective action. A significant implication is maneuver units confirmed to be not in danger can continue normal operations.
- Estimated launch point supporting attack operations. This provides target intelligence in support of deep attack operations and active defense. The commander may employ combat maneuver forces and fires to attack mobile launch systems, their support areas, and installations. The commander may also employ fires to attack incoming missiles.

3-90. Information provided by space-based sensors support strategic and theater missile warning activities. Space-based sensors support technical intelligence provided to combatant commands, force planners, and policy makers. It contributes to scientific and technical intelligence on foreign threat systems, selected space programs or systems, and supports materiel acquisition. This information supports commanders in executing their intelligence warfighting function in a near real time manner, and influences their decision making process through the provision of a more complete COP.

3-91. To help influence theater activity, space-based missile detection capabilities assist the unit commander by providing early warning of enemy launches. The scope and capabilities of the missile warning systems aids in deterring the enemy from conducting threat missile launch activities. This helps unit commanders assess current and future risk, and gives commanders the ability to shape and influence current engagements. Missile detection helps develop joint, interagency, intergovernmental, and multinational partner capacity.

3-92. Shared Early Warning. The U.S. participates in the shared early warning construct to exchanges launch detection and missile warning information with specific unified action partners and some treaty participating nations. Shared early warning permits joint forces to provide missile warning to allied nations, civilian populations of foreign partners, and neutral parties. The objective of shared early warning is the continuous exchange of missile early warning notifications. Information derived from missile warning sensors allows recipients to take protective measures to help protect noncombatants. This helps stabilize political and military situations. Information on missile launches is provided in near real-time and is the same

quality and timeliness as would be provided to joint and allied forces. Shared early warning information also has the added benefits of building trust between nations and establishing partnerships.

ENVIRONMENTAL MONITORING

3-93. Adverse space weather can impact satellites, communications links, and ground stations which have a cascading effect on Army ground operations. Knowledge of these factors allows forces to mitigate adverse environmental conditions while taking advantage of favorable conditions to enhance operations. Such monitoring also supports IPB by providing the commander with information needed to identify and analyze a potential enemies courses of action (COA).

3-94. Weather influences military planners and is accounted for during the planning, preparation, execution, and assessment of operations. Weather data is part of the information required by commanders and staffs when planning, preparing, executing, and assessing combat operations. The results from analyzing weather data, identifying potential weather effects, and assessing the impact of weather on systems, tactics, and operations provide vital information for commanders to optimally employ their forces.

3-95. Knowledge and understanding of operational effects presented by the space environment are increasingly more relevant within the IPB process. Historically, analysis of the space environment focused on solar and lunar predictions and their effects on tides and illumination. As our understanding of space weather has increased, military considerations for space weather conditions and the implications on operations have increased as well. Space weather events may adversely affect PNT, surveillance and reconnaissance missions, as well as terrestrial and space communications capabilities. Net-centric operations rely extensively on continuously available SATCOM; understanding the influences of space weather events on all communication requirements allow commanders to work mitigation efforts for predicted periods of reduced availability.

3-96. Space capabilities provide data that forms the basis for forecasts, alerts, and warnings for the space environment that may negatively impact space assets and space operations. These space-based environmental monitoring capabilities provide the ability to forecast and warn operating forces of degraded SATCOM and GPS signals due to ionospheric disturbances from space weather.

3-97. Operational planners must focus mission analysis over widespread, geographically diverse areas. For military applications, weather forecast information should be tailored to support operations that range from small surgical strikes to theater-wide operations. Terrestrial weather, space weather, or both may significantly impact both friendly and threat operations.

3-98. Space weather has become an important facet in SATCOM, which is a common means of communication. Although it is impossible to prevent phenomena produced by the sun from affecting communications and navigation systems, forecasting adverse effects on terrestrial and space assets gives commanders increased SSA during planning, preparation, and execution of missions or operations. For example, the Joint Battle Command-Platform provides brigade combat teams with enhanced communications capabilities by utilizing SATCOM, PNT, reporting, and friendly identification. Any space weather impacts on SATCOM may have an adverse effect on brigade combat team operations and mission success. Different types of solar events may have different impacts on equipment, and the impact may be forecast to occur in 2-3 minutes, 1-2 hours, or the next day.

3-99. Space-based meteorological systems provide timely and accurate terrestrial weather, details on environmental conditions, and space environment data. These systems provide the commander a clear understanding of the environmental impacts on operations throughout the depth of the operational area. The Army uses space-based environmental monitoring benefits for planning support to operations. Space-based meteorological payloads:

- Detect terrestrial weather throughout the area of responsibility;
- Provide timely receipt and access of weather observations from remote locations;
- Detect space weather to forecast potential effects and understand actual effects on communications and space assets;
- Detect soil moisture content which can support assessments of trafficability such as unrestricted, restricted, and severely restricted terrain based on recent precipitation and analysis of soil type;

- Vegetation and materials analysis has important benefits to counterinsurgency and law enforcement operations, as well as effects on crop yield and production;
- Detect obscurants and differentiate between types, such as dust, smoke, fog, and oil mist;
- Detect ionospheric disturbances, such as scintillation, which can impact ultrahigh frequency space-based sensor reliability;
- Detect changes in activity in a given area which can be especially beneficial supporting counterdrug, law enforcement, detecting and monitoring environmental damage, and disaster relief; and
- Increase overall understanding of the area of responsibility by using multispectral imagery.

3-100. Terrestrial weather can impact space-based surveillance and reconnaissance. Clouds, heavy rain, and sand storms all have an impact on imagery. Time of day and lighting conditions may affect electro-optical imagery quality. Severe weather around a mission ground station can impact data reception. JP 3-14 further identifies impacts of weather on space capabilities.

- Weather. The terrestrial and space environment can adversely impact a wide range of space systems and missions. Meteorological information is crucial to understanding and reacting to the effects of the environment on both terrestrial and space operations. The environment affects almost all aspects of operations. A few examples are: mission timing, route selection, target and weapon selection, mode of weapon delivery, communications, reconnaissance, and surveillance.
- Space environment. Space capabilities provide data that forms the basis for forecasts, alerts, and warning for space environment that may negatively impact space assets, space operations and their terrestrial users.
- Oceanography. Knowledge of the location and characteristics of oceanographic features, such as sea heights, sea surface ice, currents, fronts, and eddies, is essential to all maritime forces. It is especially critical for undersea warfare operations and may be used by commanders to avoid submarine or maritime mine threats. This knowledge can also be used to concentrate forces in an area where an adversary is most likely to be operating to optimize search and rescue operations at sea, and to help determine optimum locations for amphibious landings.

3-101. The Army receives weather support from the Air Force. Data received from systems such as the Geostationary Operational Environmental Satellites and Defense Meteorological Satellite Program, can provide information on environmental factors that may affect military operations.

3-102. The Army receives geospatial information and services support through National Geospatial-Intelligence Agency and organic Army assets. Imagery capabilities such as multispectral and hyperspectral imagery can provide planners with current information on sub-surface, surface, and air conditions such as trafficability, beach conditions, vegetation, and land use.

SPACE-BASED SURVEILLANCE AND RECONNAISSANCE

3-103. Space-based information collection systems are a crucial enabler supporting all Army operations. Space capabilities are well suited for information collection missions. Satellite systems is well suited for imaging and information collection missions as they allow access to otherwise denied areas. The Army Intelligence Center of Excellence is responsible for space-based reconnaissance and surveillance force integration and life-cycle management of Army-related user equipment. Army access to overhead information collection is provided through established intelligence channels.

3-104. Space-based information collection complements air and ground based information collection. Surveillance from the space domain enables the forces to overcome terrestrial line of sight restrictions and affords coverage of large area of interest. In some cases, such as forced entry, the only early surveillance available will likely be from space assets. Space sensors can provide multispectral, hyperspectral, and synthetic aperture radar imagery, geospatial and signals intelligence, and other various capabilities of value to the supported Army commander. The Army leverages space-based collection through the submission of requests for collection through the joint collection management process.

3-105. When a requirement is designated for collection, a tasking is sent to the appropriate resource through a ground station. Once collected, data is disseminated to the original requester. As with any information collection resource, the capabilities and limitations must be understood.

3-106. Space-based surveillance and reconnaissance activities enable the commander to plan for troop placement and maintain an understanding of enemy activities that may negatively or otherwise impact operations. The information gathered through space capabilities contributes to the development of intelligence and other actions influencing the commander's current and future operational decisions. In-theater, direct downlink capabilities provide timely access to information collection products and responsive support to the ground maneuver force requests for information. Imagery products may be used to assess a unit's movement and maneuver capabilities. Space assets are used for battle damage assessment, strategic warning, monitoring for force buildups, and precision location of enemy forces.

SECTION II – SPACE-ENABLED CAPABILITIES

FRIENDLY FORCE TRACKING

3-107. The mission is to responsively deliver FFT capabilities to provide authorized users with secure, accurate, timely, and actionable information is provided to a COP to improve situational awareness. FFT data services are provided to all combatant commanders, agencies, allies, and multinational partners. The joint, interagency, intergovernmental, and multinational nature of the mission is unique and requires integration across the broad community of interest to execute responsibilities, address user needs, accomplish essential tasks to enable data sharing, and integrate operations.

3-108. FFT systems provide the commander the ability to track small unit patrols and teams intermingled with the local populace. Integrating the FFT information into the theater COP is of great importance if a friendly force unit needs to be reinforced or removed from a difficult situation. FFT systems provide the exact location information necessary to track units, and thus contribute to effective command and control, situational understanding, personnel recovery, and fratricide avoidance.

CAPABILITIES

3-109. FFT capabilities meet data sharing and dissemination needs to enable FFT systems to interoperate with other systems and feed common command and control systems and COP.

3-110. FFT capabilities help avoid fratricide incidents while maintaining a high operations tempo. The majority of FFT devices rely on space assets to maintain critical links associated with tactical navigation operations. The primary information technology application for situational understanding and command and control at tactical command posts is Joint Battle Command-Platform, which uses FFT to share GPS-enabled situational awareness information among command posts at tactical echelons. FFT tagging, tracking and locating devices and personnel recovery devices use GPS and supports tracking of vehicles and personnel; enabling accurate area of operations situational awareness and enhancing awareness of deployed and on-the-move forces.

3-111. As FFT continues to evolve and more systems and devices are deployed globally, the critical need for data interoperability across security and command and control systems continues to increase. FFT roles include:

- Dissemination of information services such as tagging, tracking, and locating and personnel recovery support;
- System expertise for advice in planning, information assurance, device procurement and management, data owner guidance, and COP integration;
- Deliberate planning assistance in support of operational plans and concept plans for FFT activities;
- Data integration consistent with network enabled command and control modernization;
- Emergency message alerting and notification;

- Operations and limited exercise support to include troubleshooting, subject matter expert support, testing, and limited training; and
- Analyzing and developing solutions to satisfy requests for FFT support.

SUPPORT AND DISSEMINATION

3-112. The Army satisfies the FFT mission responsibilities by operating the force tracking mission management center. The force tracking mission management center has global reach and leverages the Department of Defense information networks to provide tailored FFT data translation, cross-domain data transfer, and data dissemination services for authorized users. The force tracking mission management center is a critical link in the FFT architecture between operating forces, national agencies, and the many dissemination architectures. They are the central point for FFT implementation, troubleshooting, and coordination.

3-113. The Army determines the priority of user support requests and endeavors to support all valid operational needs. FFT data is transmitted between devices and systems using line of sight or beyond line of sight SATCOM. The FFT device transmits data to a processing node. The information is routed from the data processing node directly to a COP or through the force tracking mission management center for further processing and dissemination. A graphic illustration of the FFT data flow is in figure 3-5.

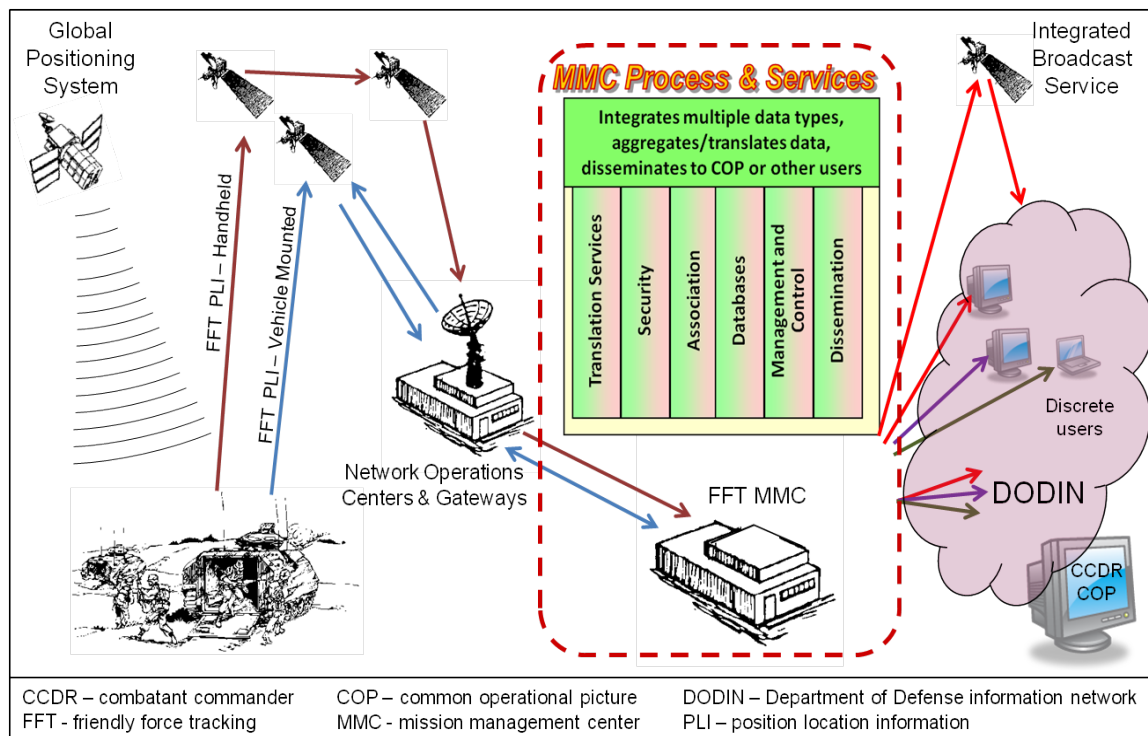


Figure 3-5. Friendly force tracking data flow overview

3-114. Line of sight communications. The receiving platform collects and passes position location information to a central gathering point. The line of sight system is limited to relatively local use and may experience outages as individual platforms lose line of sight access to one another.

3-115. A variety of military and commercial SATCOM have transceivers that receives and transmits the signal to a ground site where a command and control system manager gathers individual platform location information. This information is sent to the user's pre-designated location and incorporated into the COP. In most cases the data is provided to Global Command Control System via SIPRNET or through a designated Integrated Broadcast Service satellite for broadcast over all or part of the area of operations.

COMMERCIAL IMAGERY

3-116. Unclassified commercial satellite imagery is used by U.S. forces, other government agencies, and multinational partners in the combatant commander's area of responsibility to enhance knowledge of the environment within the operational area. All Army organizations and units requiring collection from national or commercial remote sensing capabilities go through local or regional G-2 (or unit equivalent) Collection Management sections. A tasking request for remote sensing data is processed, validated, prioritized, and submitted for collection. When located at an organization that does not have a local or regional G-2 Collection Management section, Army personnel shall contact the Army Departmental Requirements Office at: armydro@nga.mil.

3-117. The NRO serves as the DOD lead for all acquisition or exchange of commercial imagery. Army personnel are required to acquire commercial imagery through existing DOD or intelligence community imagery libraries to the greatest extent possible. When required imagery is unavailable from an approved imagery library, Army personnel are permitted to request a new tasking from space-based sensors following established procedures through the Army Geospatial Center Imagery Office. When new tasks are not satisfied through established processes, Army units may acquire commercial imagery direct from vendors who have a pre-established contract with the U.S. government. The Army Geospatial Center Imagery Office (available at dll-agc-aio@usace.army.mil) collaborates directly with U.S. agencies, services, commercial satellite, and aerial digital imagery vendors to provide requested imagery.

3-118. The SSEs, ARSSTs, and Army space control planning teams rely on unclassified commercial space-based imagery for planning and real-time operations. Commercial imagery is used in support of defense support of civil authorities' missions.

TACTICAL EXPLOITATION OF NATIONAL CAPABILITY

3-119. The Army TENCAP program delivers unique capability as the Army's lead activity to influence, leverage, and integrate the national intelligence enterprise to benefit the Army through the space capabilities. The Army TENCAP program is vital to understanding, influencing, and integrating current and emerging national overhead systems data into the tactical decision making process.

3-120. Army TENCAP evolved from the Army recognition that national overhead systems developed for the National Command Authorities had potential to support Army forces with space capabilities at the tactical level. Throughout the early and mid-1970s the Army explored the tactical applicability of national systems to corps level operations and began developing and fielding tools needed to leverage those systems. The office created to do this, under the auspices of the Deputy Chief of Staff for Operations (now the Army assistant chief of staff, operations), became the Army TENCAP Program.

3-121. The Army's TENCAP Program is managed by Program Executive Office for Intelligence, Electronic Warfare, and Sensors and is directed by a general officer steering group chaired by the Assistant Secretary of the Army for Acquisition, Logistics, and Technology, Military Deputy, Army G-2. Selected Department of the Army headquarters principal staff, the Army Capabilities Integration Center, and the U.S. Army Intelligence Center of Excellence round-out a general officer steering group membership.

3-122. The TENCAP mission is fivefold:

- Conduct cross-agency systems engineering to leverage national capabilities for Army purposes;
- Understand and influence national technologies and architectures;
- Be the Army's technical interface to the National Reconnaissance Office and the National Geospatial-Intelligence Agency;
- Provide core engineering expertise across the national and theater intelligence, surveillance, and reconnaissance layers to integrate national capabilities within Army terrestrial, space, and foundation layers; and
- Leverage the intelligence community's investment in overhead technologies, and transition applicable technologies to the Army to satisfy validated Army requirements.

SECTION III – ARMY SPACE PROPONENT AND CONTRIBUTORS

3-123. AR 5-22 establishes policies, duties, responsibilities, and relationships applicable to the Army Force Modernization Proponent System. The force modernization proponent is the Headquarters, Department of the Army principal official or the commander, commandant, director, or chief of a center, school, institution, or agency with primary duties and responsibilities relative to doctrine, organization, training, materiel, leadership and education, personnel, and facilities, and policy (known as DOTMLPF-P) requirements for a particular function.

ARMY SPACE PROPONENT ROLE

3-124. The USASMDC Space and Missile Defense Center of Excellence is the force modernization proponent designated by the Secretary of the Army as—

- The Army Service component command for space operations.
- The Army Proponent for space operations.

3-125. The Proponent is responsible to—

- Provide existing and emerging Army space capabilities to joint and allied forces to deliver decisive combat power in the area of operations. They
- Plan and execute continuous military space operations and sustain assigned units supporting the combatant command.
- Support all space operational mission areas.
- Employ and integrate Army space forces into global, national, and military operations.

3-126. The Commanding General—

- Exercises administrative, tactical, and or operational control authority and responsibilities over Army space forces for those authorities a combatant command does not exercise.
- Is the personnel developer for space operations officers per AR 600-3, and
- Is the lead agent for implementation of Army space cadre efforts and are executed by the Army Space Personnel Development Office.

3-127. The space Proponent contributions include—

- Provide SSA to Army and joint forces;
- Provide assured PNT;
- Conducts space control operations (to include designated NAVWAR responsibilities);
- Provides missile warning direct to theater command centers via JTAGS;
- Provide space support via ARSSTs;
- Conduct satellite operations at five WSOCs;
- Conduct network integration at four RSSCs as part of the DOD SATCOM.
- Provide day-to-day management for operations at all four RSSCs which provides a single point of contact for narrowband, wideband, protected band, and commercial SATCOM support.
- Consolidated SATCOM Systems Expert for:
 - Military narrowband SATCOM.
 - Military wideband SATCOM.
- SATCOM Systems Expert for:
 - DSCS.
 - Global Broadcast Service.
 - Mobile User Objective System.
 - WGS.
- FFT mission equipping, staffing, and operating the FFT mission management center.

CYBERSPACE PROPONENT ROLE

3-128. The Army Cyber Center of Excellence is the force modernization proponent and performs proponent responsibility for signal, communications networks, information services, cyberspace operations, electronic warfare, and the branch proponent for Signal and Cyber. The Cyber Center of Excellence defines integration tasks for Army operations, with oversight and policy guidance from the G-6. They develop and conduct resident, distributed, and continuing education training in signal and cyberspace specialties.

CYBERSPACE CONTRIBUTIONS

3-129. Cyberspace is a global domain within the information environment consisting of interdependent networks of information technology infrastructures, and resident data, including the Internet, telecommunications networks, computer systems, and embedded processors and controllers. Friendly, enemy, adversary, and host-nation networks, communications systems, computers, cellular phone systems, social media, and technical infrastructures are all part of cyberspace.

3-130. Cyberspace continues to become increasingly congested and contested. Army forces must be able to effectively operate in cyberspace, while controlling the ability of others to operate in that domain. Rapid developments in cyberspace will challenge friendly advantages in cyberspace. While Army forces cannot defend against every kind of intrusion, commanders and staffs should take steps to identify, prioritize, and defend their most important networks and data. Commanders and cyberspace operations experts should also adapt quickly and effectively to enemy and adversary presence inside cyberspace systems.

ELECTRONIC WARFARE CONTRIBUTIONS

3-131. One third of NAVWAR is electronic warfare operations. Electronic warfare combines electronic support, electronic attack, and electronic protection to understand the impacts NAVWAR has on mission operations, deny adversary access to GNSS information, and protect friendly capabilities within the EMS.

SIGNAL PROPONENT ROLE

3-132. The Army Cyber Center of Excellence is the force modernization proponent for Signal. The Cyber Center of Excellence exercises proponent responsibilities for Department of Defense information network operations, network transport and information services, spectrum management, and visual information. The Commanding General, Army Cyber Center of Excellence performs force modernization functions for the Signal Corps and the Commandant, Army Signal School is the Signal branch proponent.

3-133. Army tactical ground operations depend on Signal Soldiers to establish and use SATCOM for inter- and intra-theater, beyond line of sight communications. The tactical operations center is the center of activity where many SATCOM feeds terminate and much of the data is digested and used to make decisions. The satellite terminals provide commanders and Soldiers with assured, reliable high-speed, high-capacity satellite terminal connectivity using both commercial and military satellite constellations operating on and across the military ultrahigh, super-high, and extremely high frequency bands. The use of SATCOM increases the operational reach and situational awareness of the entire force.

3-134. SATCOM is a key means of information transport for unified land operations. Each of the five WSOC's have uniquely trained Signal Soldiers who perform satellite operations of select DOD SATCOM resources. SATCOM systems provide long-haul capability, redundant paths for tactical communications, communications on-the-move, beyond line of sight communications, and flexibility to commanders and warfighters. Support to intra-theater communications and connectivity to Department of Defense information network provides critical services that route through military SATCOM constellations.

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Chapter 4

Army Space Operations

Section I discusses Army space operations, roles, and responsibilities at Army, corps and division headquarters levels. It provides an understanding of the specific roles and functions of Army space elements, which includes SSEs, ARSSTs, and other elements providing support to operations. The SSE is the commander's primary advisor on Army space operations at the Army, corps, and division level. The SSE plans, integrates, and coordinates space support to operations across all warfighting functions. The final part of this section identifies how Army space operations supports each of the six warfighting functions, and special operations forces Section II addresses the unique space operations coordination requirements of joint space operations.

SECTION I – ARMY SPACE OPERATIONS

4-1. Army space operations are founded on the depth and breadth of knowledge of the Army space cadre. Army space cadre members are professionals serving in a multitude of positions across the Army bringing space capabilities to Army operations. The Soldiers and Army Civilians may be assigned to space operations, signal, cyber, electronic warfare, intelligence operations, and other areas supporting all aspects of the operations process. The Army space cadre develops, plans, acquires, and operates space systems and capabilities to fulfill mission requirements. The space cadre is instrumental to the Army's critical use of space capabilities in large scale combat operations. The Army space operations are structured around Active Army, Army National Guard, and United States Army Reserve.

4-2. Space cadre members establishes the conditions that strengthen the mutual trust, esprit de corps, and cohesive teamwork by setting the example and motivating the team to enable professional organizational climates. The space operations officer develops and trusts their team to take disciplined initiative, consistent with leader's intent and bounded by the Army Ethic. The space operations officer delegates the authority for subordinates to take prudent risk, overcome adversity, and accomplish the mission, in the right way.

4-3. The Army functional area 40 is space operations. Space operations officers form the core of Army space operations and are accessed from nearly every military occupational specialty and career field within the Army. This diversity gives the space operations community a broad level of understanding of Army operations. Every space operations officer brings detailed knowledge of space operations, including detailed understanding of space capabilities, D3SOE, using space operations to create a position of relative advantage, and maneuver applied to space operations.

The Army space planners ensures space capabilities and effects are fully integrated into all mission operations and advises the supported commander of the current space assessment.

4-4. A space operations officer is responsible for providing space-related planning, operational support, and expertise on space capabilities. A space operations officer is an honorable servant, Army expert, and steward of the profession who ethically, effectively, and efficiently integrates space capabilities into operations, provides general support to staff operations, and supports both deliberate and crisis action planning.

4-5. The space operations officer's primary analytical tool is the distributed common ground system-Army workstation with Army approved space-unique and common space-related applications, which are approved to connect to the host units distributed common ground system-Army server via SIPRNET. The analytical

tools on the workstations provide the SSEs and ARSSTs with the necessary equipment to accomplish their required tasks.

4-6. Space operations officer responsibilities are below. Refer to FM 6-0 for a list of common staff duties, responsibilities, characteristics, and relationships.

- Advise commanders and staff on the capabilities, limitations, considerations, and effects of space operations specific to the commander's intent, concept of operations, unit mission, and space threat.
- In conjunction with legal counsel, advise commanders on space-related legal authority, and rules of engagement.
- Provide space knowledge, develop the space operations requirements, and prepare the space running estimate as part of the MDMP.
- Ensure active collaboration across the staff, unified action partners, and external entities such as staff counterparts at higher and lower echelons, adjacent units, and the intelligence community to enable shared understanding of the space OE and employ space operations.
- Develop and provide space-related courses of action to support the scheme of maneuver.
- Ensure space operations are integrated into all staff processes.
- Account for space effects, capabilities, constraints, limitations, and second and third order effects.
- Ensure possible effects of a D3SOE are integrated into mission planning.
- Ensure staff awareness of space domain-related electromagnetic interference.
- Maintain the space portion of the COP.
- Ensure space-related capabilities support development of critical asset list and defended asset list.
- Execute assigned tasks, maintain awareness of the challenges facing the unit, and offer space capabilities as solutions.
- Support and perform Army-related integrated joint special technical operations duties and responsibilities, as required.

ARMY SPACE SUPPORT ELEMENTS

4-7. All theater Armies, field armies, corps, and division headquarters have organic SSE for planning, integration, and coordination of space capabilities. The Army SSE is responsible to plan for space capabilities, effects, and support to headquarters and staffs, and support Army space operations personnel deployed in their area of operations. The SSE is the space operations subject matter expert on the staff and provides SSA for the unit. The SSE is assigned to the assistant chief of staff, operations (G-3) staff to provide organic space operation planning and assessment for the commander, staff, assigned, and attached subordinate units.

4-8. The SSE supports all combatant commander operational missions by planning and coordinating joint space assets supporting the theater commander. They provide recommendations for space operations support, additional space operations personnel, and additional equipment required to support Army operations. The SSE coordinates space augmentation requirements in support of OPLAN or the commander's requirement. They also provide assistance with targeting of space-based assets and those reliant on the ground segment.

4-9. The primary role of the SSE is to synchronize space capabilities and effects throughout the operations process to maximizing the positive impact of space capabilities for the commander's needs. They are responsible for maintaining SSA and updating the space portion of the COP. SSE members coordinate space operations objectives and tasks with their counterparts at higher and lower echelons. The SSE serves as the primary command and control element within the staff for space operations.

4-10. The SSE develops the space operations mission statement and concept of space operations, emphasizing aspects of the base plan which require space support and may benefit from the use of space capabilities. They identify space capabilities required to support mission operations or impacts to them, and the risks of enemy counterspace operations. Some space assets and related capabilities require a long lead time for planning and preparation. Adequate support to the mission must account for phasing: the SSE must incorporate effects into shaping operations as well as deter, and seize the initiative as part of decisive

operation. Some space operations are executed before other aspects of the overall operation. Defined, but flexible processes are used to structure space operation planning.

4-11. The SSE focuses on integration of the wide range of space capabilities across all warfighting functions. The SSE educates members of the staff to ensure they are fully aware of space capabilities, limitations, and vulnerabilities. They routinely work with members of the coordinating and special staffs.

4-12. When the number of subordinate echelons exceeds the capacity of the SSE to provide effective support, the SSE should request augmentation from an ARSST. At echelons below division, where no space operations officers are assigned, brigade and battalion staffs receive support from their higher command's SSE in the form of space running estimates and other planning products. Requests for space support, space-related information, or personnel augmentation follow unit standard operating procedures.

4-13. The SSE senior space operations officer may be designated as the command's special technical operations chief if one is not organically assigned. When directed to fill the special technical operations position, the chief will manage the billets for the command, have oversight of special technical operation planning, requests, exercises, operations, and inspections. The chief ensures all special technical operations informational security requirements are met. The details of these operations are largely classified and specific training is required prior to assumption of duties.

ARMY SPACE SUPPORT TEAMS

4-14. An ARSST provides space planning expertise, capabilities, products, and SSA of space assets. When serving as a part of an ARSST, the space operations officer leads a specialized operations team which provides space operations-related support to staff and products in support of the SSE. In the absence of an SSE, the ARSST assumes all roles and responsibilities of the SSE in addition to retaining the duties of an ARSST. ARSST may augment the staff space operations officer at echelon. The ARSSTs are a low-density, high-demand deployable team.

4-15. An ARSST's primary function is to deploy and integrate with a unit's staff to provide direct support. The team provides the commander and staff with situational understanding of the space domain. An ARSST acts in direct support to Army divisions, corps, joint task force, Marine Expeditionary Forces, theater sustainment command, and Army service component command headquarters, and may be deployed to support an SSE. The ARSST's expertise of space capabilities and the ability to produce products significantly contribute to current and future operations. An ARSST team may be tailored in a variety of ways to fulfill a request for forces.

ARMY HEADQUARTERS, CORPS AND DIVISION

CORPS AND DIVISION

4-16. The corps is the focal point for the planning and execution of space operations. The corps is the principal integrator of space capabilities in support of unified land operations. Each corps contains an organic SSE, usually assigned to the movement and maneuver cell. The SSE plans, coordinates, integrates, and synchronizes space capabilities into operations for corps, division, and subordinate units. For space planning, all land component coordination runs up to the corps headquarters. The SSE coordinates directly with other space staffs and SCA for support to meet corps requirements.

4-17. The primary tactical warfighting headquarters is the division. The primary task of the division headquarters is to direct the operations of its subordinate brigade combat teams and supporting brigades. Each division contains an organic SSE, usually assigned to the movement and maneuver cell in the current operations section. The SSE plans, coordinates, and integrates space capabilities into operations for division and subordinate units.

4-18. Division SSEs contain the resources necessary to be an Army forces headquarters during the conduct of a crisis response or limited contingency operations without additional Army augmentation.

RESPONSIBILITIES AND COORDINATION

4-19. The coordination responsibilities at the corps includes all staff sections and workgroups formed ad-hoc. The SSE avoids providing unilateral answers about space capabilities pertaining to other command staffs who have complementary expertise, such as answering a SATCOM-specific question when the answer is clearly an Army G-6 responsibility. In all cases, the SSE coordinates space operations with the appropriate command and staff.

4-20. The SSE maintains awareness of the total space picture and has in-depth understanding of space operational elements, such as the joint force commander with SCA and supporting staff. The SSE maintains contact with other space teams, such as the higher, adjacent, and subordinate unit SSEs, ARSSTs, Army space coordinating elements, theater missile warning detachments, and other teams such as national intelligence support teams and sister Service space capabilities. The SSE pursues direct liaison authority communications as needed, but not already directed. Gaining necessary SSA requires the SSE to network actively within the space community which is dynamic and different from theater to theater. SSEs and ARSSTs routinely coordinate with the Combined Space Operations Center (known as the CSPOC) and the National Space Defense Center.

4-21. To properly execute assigned tasks, the SSE must understand the mission, maintains situational understanding of the mission, and challenges the unit faces. The SSE must be prepared to offer space-related solutions as situations change.

4-22. The SSE conducts planning to integrate space capabilities, support the MDMP, and develops Appendix 18–Space Operations to Annex C of the base order. Commanders and staffs use Appendix 18–Space Operations to Annex C to describe how space operations support the concept of operations described in the base plan or order. The SSE is fully involved in the process, flow of information, and decisions in the headquarters. The SSE works closely with the entire staff to ensure space capabilities and effects are optimized to all warfighting functions. However, the majority of the SSE’s time is focused on the intelligence cell, fires cell, movement and maneuver cell, the cyberspace electromagnetic activity workgroup, electronic warfare cell, and the G-6 section at the Theater Army level (or equivalent staff sections at corps and division) because these staffs rely most heavily on space capabilities. The enemy space assessment portion is included in Annex B –Intelligence. This is the responsibility of the G-2 and is developed with input from the space planner.

4-23. Commanders leverage space capabilities and effects as part of combined arms operations to achieve objectives in all domains, through lethal and nonlethal means. Commanders must be aware of impacts from space operations at all times. Commanders’ staff should:

- Include space operations within the operations process and MDMP.
- Understand and consider the legal implications, operational authorities, opportunities, and risks presented for space operations. Legal counsel participates during all stages of space operation planning and execution, assessing compliance with applicable legal requirements and providing guidance as required.
- Understand the implications of space operations on the mission and scheme of maneuver.
- Understand how the selected COA may affect the prioritization of space assets.
- Identify critical missions or tasks by phase to enable identification of key space capabilities and vulnerabilities.
- Approve high-priority target lists, target nominations, collection priorities, and risk mitigation measures for operation in the space domain.
- Create massed effects by synchronizing space operations with lethal and nonlethal actions to support the concept of operations.

BOARDS, BUREAUS, CENTERS, CELLS, AND WORKGROUPS

4-24. A unit’s battle rhythm should consider space operations and activities, especially when the focus area of the meeting involves reliance on space capabilities. Within division and higher headquarters, the space operations officer supports a variety of standing and ah-hoc workgroups, including the following:

- Lethal and nonlethal targeting workgroup;
- Intelligence cell;
- Movement and maneuver cell;
- Fires cell;
- Air and missile defense section;
- Signal operations;
- Network operations;
- Cyberspace electromagnetic activities workgroup;
- Information operations workgroup;
- Special technical operations workgroup;
- Electronic warfare cell; and
- Staff weather officer

4-25. For all boards, workgroups, planning teams, staff planning, and staff estimates efforts, there should be a synchronized working relationship to ensure all offensive and defensive space operations are addressed, assessed, and included in all operations.

CONSIDERATIONS

4-26. Commanders ethically, effectively, and efficiently employ space capabilities to shape the environment and support offensive and defensive operations. Commanders plan, integrate, and synchronize space capabilities as a unified effort to project power.

4-27. Army space operations officers provide and integrate SSA throughout the supported staff, and incorporates available space capabilities from planning through mission execution. Space operations officers use their expertise to integrate space capabilities, support staff efforts, and utilize software applications to provide relevant plans. Space planners integrate SSA across the staff to enhance the commander's understanding and to shape operations. SSA allows for predictive information in the space OE.

4-28. Not all unified action partners have the same degree of dependencies on space operations; therefore, not all unified action partners share the same level of proficiency conducting space operations. Partner nation's dependencies on the space operations varies widely and some militaries may have limited experience conducting space operations. At the least integrated scale, some forces may only own and use handheld GNSS devices. It is imperative for Army space operations officer to understand they will likely interact with some Soldiers from allied and partner nations who require a basic level of training to effectively communicate plans which have integrated space capabilities.

4-29. Expectation management of space capabilities is vital. Over-selling space capabilities may lead to mission failure. For example, space asset limitations are mostly physics driven. Products from space assets in a LEO are based upon revisit times and asset allocation considerations. Some allied militaries may not be well versed in space fundamentals. It is important to emphasize to commanders and their staff they may not have priority for a desired capability, because the space assets are often national systems or commercially owned and priorities are set by other bodies. Space operations officers may be more informative if they advise commanders and their staff obtaining satellite resources is similar to the procedures used for prioritizing artillery fires and intelligence collection requests.

4-30. Space planners must focus mission analysis over a widespread, geographically diverse area. Space operation planning must provide tailored information which supports operations ranging from small surgical strikes to theater-wide operations.

4-31. Space planners must be aware of how space capabilities support the commander's intent to help facilitate a successful end state. While conducting operational planning, staff sections focus on how their section may influence the battle. Assessed into space operations only after being branch qualified, space planners have a unique perspective how space capabilities affect each function area and overall mission. They support the staff sections by advising each section on the best use of space capabilities and effects. They should attend all applicable planning workgroups to provide expertise on how space operations may support other functions. Space planners must be proactive and adaptive to find solutions to mitigate gaps. They

provide expertise in all space capabilities and should be involved in all aspects of current and future operations.

4-32. The decentralized nature of space operations, combined with multi-use resources drives a wide span of coordination for space planners. Successful space operations rely on collaboration and the rapid exchange of information with all staff sections.

4-33. Decision-making during operations includes executing space operations as planned, adjusting space operations to an unexpected enemy actions. The space planner challenge is to assess how changes in space operations activities affect the overall mission and to determine necessary follow-on actions.

4-34. Monitoring space operations focuses principally on maintaining the effectiveness of space capabilities. Space planners use the critical assets list to monitor the status of critical friendly space capabilities and the status of critical terrestrial, aerial, and space systems. As mission operations unfold, space capabilities and tasks are modified to provide effective support.

4-35. Space effects may require proximity to a target to implement. If commanders determine there is a need for space effects, the space planner determines where the capability reside. The space planner uses the space support request to request space effects if the resource does not exist in the unit or its supporting forces.

4-36. Some space capabilities, effects, and related activities require a long lead-time for planning and preparation. Proper space planning for the mission must account for long lead times so the space planner can ensure the desired capability or effects are available to be incorporate into mission operations.

4-37. The space planner develops the space operations mission statement and concept of space operations. The space mission statement and space concept of operation emphasizes aspects of the base plan that require space capabilities and effects. The space planner identifies space capabilities required to support operations and risks to the mission without them.

4-38. The space operations officer provides the Appendix 18–Space Operations to Annex C of the base order for all operational plans within the supported unit’s area of operations. Appendix 18 is the space appendix to the OPLAN or operation order (OPORD) that directs and notifies units on the conduct of space operations for specific missions. Commanders and staffs may use Appendix 18 to identify how space operations support the base plan or order. The enemy space assessment portion is included in Annex B–Intelligence. This is the responsibility of the G-2 and is developed with input from the space planner.

4-39. Space planners must consider the impact of space operations on each warfighting function. This includes an assessment of current and predicted statuses and availability of all space capabilities and effects. Assessments include counterspace tactics employed and targeting options planned on both sides of the battle. Failure to include space capabilities, limitations, and the expectation of D3SOE during mission assessment may lead to an inaccurate risk assessment for the mission.

4-40. The relationship between the space domain and the cyber domain is unique. Many cyberspace operations depend on space—a critical portion of cyberspace can only be provided via space operations—as cyberspace operations are enabled by the space domain and the space operations. Cyberspace provides the means by which space control and transmission of space sensor data are conducted. Some space capabilities such as NAVWAR are dependent upon operations from both domains. This interrelationship is critical and the linkages must be addressed during all phases of planning and operations to ensure synergy between space operations and cyberspace operations.

FUTURE OPERATIONS CONSIDERATIONS

4-41. The future operations cell monitors current operations and determines implications for operations within the mid-range planning horizon. In addition, it focuses on adjustments to the current operation, including the maneuvering of forces in depth to facilitate continuation of the current operation. All staff sections assist with planning future operations. Future operations serve as a bridge between the plans and current operations integration cells. In coordination with the current operations integration cell, the future operations cell assesses whether it must modify planned operation to achieve the current phase’s objectives. Future operations participates in the targeting workgroup. The future operations cell updates and adds details

to the branch plans foreseen in the current operation and prepares orders necessary to implement a sequel to the operation.

4-42. A *running estimate* is the continuous assessment of the current situation used to determine if the current operation is proceeding according to the commander's intent and if planned future operations are supportable (ADP 5-0). Failure to maintain accurate running estimates may lead to errors or omissions by future operations which may result in flawed plans and bad decisions during execution. Running estimates always include recommendations for current and anticipated decisions affecting friendly and enemy forces. It is the responsibility of the space operations officer to maintain a space running estimate.

4-43. The space running estimate provides the means to conduct space effects tracking and assessment throughout the battle. The space running estimate provides plans and tactics for the protection of space capabilities and enemy countermeasures. This includes new facts and assumptions, as the situation changes and the operation proceeds. New facts and assumptions generate conclusions, and recommendations for the commander in terms of how space capabilities influence and impact the mission.

4-44. Space operations officers develop and maintain the space running estimate. For echelons below division, units may rely on the higher command's space operations officers to provide the space running estimate. The space running estimate describes how space influences and impacts mission at echelons of brigade and below. The space running estimate is not a standalone staff estimate, but rather a series of estimates, which support, and is integrated into the staff estimates of other staff elements.

4-45. The information maintained within the space running estimate supports the unit's ability to perform command and control, information collection, target development, targeting, movement and maneuver, and battle damage assessment. Examples of information tracked within the space running estimate includes but is not be limited to:

- Type, quantity, status, intentions, tactics, and known or suspected locations of threat GPS and SATCOM jammers (active and inactive). This information supports the G-2's ability to develop and maintain, the enemy electronic order of battle which sets the conditions for the development, refinement, and assessment of the information collection plan and the development of lethal and non-lethal targeting options for the commander.
- Ongoing or anticipated areas impacted by GPS jammers and the corresponding effects on GPS-enabled equipment such as:
 - FFT devices, radios, and unmanned aircraft systems;
 - GPS-aided precision guided munitions;
 - GPS-aided target acquisition systems;
- Ongoing or anticipated areas impacted by SATCOM jammers and the corresponding effects on SATCOM and SATCOM-enabled equipment such as:
 - Warfighter information network-tactical;
 - Joint Battle Command-Platform;
 - Command post of the future;
 - Force XXI battle command, brigade and below; and
 - U.S. Marine Corps joint capabilities release.
- Ongoing or predicted impacts of terrestrial and space weather effects on GPS; SATCOM; space-based surveillance and reconnaissance; and missile warning systems, platforms, and architectures.
- Satellite reconnaissance advanced notice reports provide predicted overflights of enemy satellites by type/sensor and associated surveillance and reconnaissance tasking over friendly area of operations to the staff.
- Predicted periods when GPS is degraded and the impacts on GPS guidance accuracies and employment times/locations of GPS aided munitions. This information is assessed using positional dilution of precision values in charts and graphs, and directly supports fires by assessing the proper employment of precision guided munitions at specific times and locations.
- Assessments of the adversary's reliance on organic, commercial, or third-party space capabilities such as SATCOM; space surveillance and reconnaissance; GNSS; and environmental monitoring.

- Availability and status of known enemy's GPS and SATCOM jamming capability and the impacts from these capabilities.
- Battle damage assessment from lethal and non-lethal attacks against threat use of space domain. This supports follow-on requirements for target reengagement options for the commander, and ongoing staff assessment efforts.
- Friendly, neutral, and enemy space order of battle (in coordination with staff G-2).
- Critical asset list and defended asset list.

4-46. Examples of how portions of the space running estimate may support other warfighting functions and their respective staff estimates include, but are not limited to:

- The G-2's intelligence estimate for space intelligence, threat electronic order of battle (type, quantity, vulnerabilities, disposition/ location, tactics, intent of jammers), information collection issues, current and predicted enemy actions against U.S. space capabilities (such as threat jamming operations), ongoing impacts (manmade or naturally occurring) on GPS and SATCOM-enabled information collection and or national surveillance and reconnaissance platforms.
- The G-2's weather estimate/staff weather officer for terrestrial and or space weather and its impacts on operations, especially those relying on space capabilities such as SATCOM, GPS, missile warning, or space surveillance and reconnaissance.
- The G-3's operations estimate. The G-3 is the staff proponent for several information related capabilities to include, but not limited to cyberspace, electronic warfare, and space operations. The G-3 maintains cyberspace effects. They addresses threat activities designed to deny, degrade, or disrupt space-enabled command and control systems.
- The G-3's protection estimate, air and missile defense cell for missile warning, space-based infrared sensor information, and how degradation of space capabilities influence or impact protection efforts.
- The G-3's fires estimate. Use of GPS-aided munitions, employment of unmanned aerial systems for reconnaissance, surveillance, and or attack missions, employment of GPS-enabled field artillery firing platforms, and impacts on GPS-enabled target acquisition systems. This estimate supports input to the attack guidance matrix and or the target synchronization matrix.
- The G-6's signal estimate also includes SATCOM, GPS, and the way in which degradation of these capabilities influences or impacts command and control efforts. In addition, the signal estimate includes D3SOE effects and equities as they pertain to spectrum management operations, NAVWAR considerations, space domain equities represented within the joint restricted frequency list, and the status and trends noted from joint spectrum interference resolution reporting.

CURRENT OPERATIONS CONSIDERATIONS

4-47. The current operations integration cell is the focal point for controlling the execution of operations. This involves assessing the current situation while regulating forces in accordance with commander's intent, the mission, and concept of operations. The chief of operations or assistant G-3 leads this cell. Elements or watch officers from each staff section and liaison officers from subordinate and adjacent units form this cell. All staff sections have representation within the current operations integration cell either permanently, or as required. The current operations integration cell displays the COP and conducts shift changes, assessments, and other briefings as required. It provides information on the status of operations to all staff members and to higher, subordinate, and adjacent units. The current operations integration cell conducts short-range planning and conducts the operations synchronization meeting.

4-48. The current operations integration cell typically tracks ongoing and upcoming operations out to 24 hours. They rely on their tactical standard operating procedures to guide operations and the accomplishment of tasks. Some standard operating procedure items include PACE plans and battle drills. Both PACE plans and battle drills should include steps, processes, and considerations associated with operating in a D3SOE.

4-49. PACE plans are a key requirement for SATCOM planning. A PACE plan establishes the primary, secondary, tertiary, and emergency methods of communications for each warfighting function, typically from higher to lower echelons. Establishing a PACE plan requires care to ensure a secondary or tertiary method of communications does not rely on the primary equipment. PACE plan should be as simple as possible, yet

it should maintain flexibility to provide communications support as reliably as possible during dynamic operations.

4-50. Some unit PACE plans, especially with regard to operating in D3SOE conditions, may include but are not limited to:

- Communications. The Army relies heavily on SATCOM as the primary means to move large volumes of data securely and over great distances. When select SATCOM systems are denied, degraded, or disrupted, alternate systems such as other line of sight systems, land-lines, and manual methods (such as runners) should be employed.
- FFT. Units should consider and train on how to maintain situational understanding of units using beyond line of sight SATCOM, line of sight communications, and analog methods of unit location and status tracking.
- Battle damage assessment. A unit's ability to conduct battle damage assessment often relies on unmanned aircraft system or National Reconnaissance Office overhead systems to collect post-strike information. Units should consider other means such as manned aircraft, ground forces using local drones, and multiple communication means to report data back to higher headquarters. An emergency method for battle damage assessment might be pre-positioned troops—equipped with radios—able to observe a deliberate strike and report back to higher headquarters.
- Precision engagement. In a D3SOE, the fires should be prepared to support and employ multiple types of munitions providing the greatest accuracies available. Commanders and staffs should have PACE plans to achieve the best precision under less-than-optimal tactical conditions.
- Target acquisition. Primary target acquisition often involves the use of unmanned aerial systems, National Reconnaissance Office overhead systems, radars, laser designation systems, and forward observers using SATCOM reporting means. Commanders and staffs should develop PACE plans with the expectation friendly forces will operate in a D3SOE.
- Information collection. Many joint information collection assets rely on GPS, SATCOM, and National Reconnaissance Office overhead systems capabilities. As GPS, SATCOM, and National Reconnaissance Office overhead systems become denied, degraded, and disrupted, commanders and staffs should develop PACE plans on how best to develop and execute their information collection plans to support the commander's priority intelligence requirements in support of decision points, high-value target lists, and high-payoff target lists.
- Manned and unmanned aerial systems rely, in part, on both GPS and SATCOM for data sharing, platform tracking, target acquisition, and command and control. Commanders and staffs should have PACE plans developed and ready to implement to continue flights, operations, target acquisition, reconnaissance and surveillance, and command and control for when GPS and or SATCOM systems become denied, degraded, or disrupted.
- Total asset visibility. Many Army sustainment units primarily rely upon both GPS and SATCOM systems to conduct command and control, and share logistical information between units. As GPS or SATCOM systems become denied, degraded, or disrupted, commanders and staffs should develop PACE plans on how best to continually share logistical information by means other than SATCOM thus using other means such as alternate SATCOM systems, line of sight radios, or runners.
- Missile warning and space-based infrared sensors. Force protection requirements against peer forces who are likely to employ a wide variety and large quantity of ballistic missiles require Army forces to develop PACE plans. These PACE plans should cover the detection of missile launches and static infrared activity, warning to downrange forces, characterization, and geo-location for each detected event when GPS, SATCOM, space surveillance and reconnaissance sensors, and select warning systems and architectures are denied, degraded, or disrupted.

UNIFIED LAND OPERATIONS USE OF SPACE CAPABILITIES

4-51. Commanders apply combat power through one or a combination of warfighting functions using leadership and information to fulfill the mission. According to ADP 3-0, the definition of a warfighting function is, "a group of tasks and systems united by a common purpose that commanders use to accomplish missions and training objectives." Army warfighting functions provide a framework for commanders to

visualize how grouped tasks and systems will be used to accomplish the mission. All Army warfighting functions are enabled and enhanced by space capabilities. It is within the framework of the warfighting functions many space operations dependencies are identified.

4-52. Within the Army, intelligence, surveillance, and reconnaissance and environmental monitoring are areas conducted by intelligence and are executed with the authority and oversight of the headquarters, Department of the Army G-2. Space operations enable intelligence operations, but are also dependent upon intelligence to provide space reconnaissance, surveillance, and intelligence products.

COMMAND AND CONTROL

4-53. Command and control depends on space capabilities and effects to command forces, control operations, drive the operations process, and establish the command and control system. Army space operations support the command and control warfighting function and enables a commander to command the force. A large percentage of the information required to drive the operations process for employment of ground forces are obtained from space assets. The COP supports control of forces by empowering subordinate leaders to be granted greater freedom of action and independence to facilitate initiative and agility to accomplish the commander's overall intent. The SSEs ensure space capabilities are integrated into plans at all echelons during the operations process and space systems vulnerabilities are assessed for risks to mission execution. Refer to ADP 6-0 for discussions on the command and control warfighting function.

4-54. Army space operations are integrated throughout the command and control warfighting function to complement and reinforce the other five warfighting functions. Various space capabilities and effects are used to facilitate the decision making process for command and control.

- SSA is critical to controlling operations and driving the operations process. SSA characterizes the space OE, identifies adversary likely use of space capabilities, adversary threats to friendly space capabilities, and provides insight to understand adversary intent. Space assets enable the MDMP through analysis (supported by space surveillance and reconnaissance) and COA development.
- PNT provides extremely accurate timing critical to tactical and theater networks. FFT information feeds the COP with current unit position data, to help ensure planners have the most up to date location information, and helps avoid fratricide by ensuring adjacent friendly force formations have accurate positional data on each other.
- Space control provides assurance to commanders they will be able to communicate with their staff over extended distances, control operations, and drive the operations process. Thorough space control integration during the planning process helps make certain that friendly forces have assured access to space capabilities, and that offensive space control planning is considered in order to deny adversaries access to space.
- SATCOM enables inter-theater and intra-theater communications while satellite operations help commanders to establish command and control systems and drive the operations process. SATCOM provides secure, integrated communications to all echelons to ensure mission orders and commander's intent are clearly and securely conveyed to all Soldiers. SATCOM on-the-move allows a commander to maintain connectivity during rapidly evolving operations, while the space enabled COP provides a clear picture of the operational situation. Space enabled command and control systems provide a clear COP of the battle to a commander who can move to the best position to assess, direct, and lead. SATCOM is the backbone of the global information grid, which enables command and control and supports mission operations. Warning orders, OPORD, and graphics are often provided through space enabled automated systems and displayed on multiple COP displays.
- Missile Warning and space-based infrared sensors contribute to effective command and control, and support to the planning process. Missile warning enables commanders to know when they are under direct missile attack and to maintain command of their forces.
- Environmental monitoring provides commanders with information that may affect military operations, enabling forces to take advantage of adverse environmental conditions or avoid situations negatively impacting their ability to maneuver.
- Space-based surveillance and reconnaissance enables command and control by providing satellite collections of enemy forces throughout the depth of the battlespace. Space-based surveillance and

reconnaissance is critical in an area of operations where manned aircraft, unmanned aerial systems, and terrestrial intelligence collection are limited by enemy A2 and AD efforts.

MOVEMENT AND MANEUVER

4-55. Space capabilities are a critical facilitator of movement and maneuver operations. All echelons—from theater to company level and below are dependent on space capabilities when executing movement and maneuver. A loss of space capabilities during large scale combat operations means the Army would revert to more conventional operate style. Communications, battle tracking, precise navigation, timely intelligence and many other modern warfare expectations are disrupted.

4-56. Army space operations support the movement and maneuver warfighting function and provides the units with the capabilities to enable rapid movement thereby providing an advantage to friendly forces. Various space capabilities are used to facilitate the decision making process for movement and maneuver. Refer to ADP 3-0 for discussions on movement and maneuver warfighting function.

- SSA provides insight to understanding adversary intent and movement, which allows U.S. and joint forces more time to place joint forces in a position of advantage.
- PNT provides enhanced navigational accuracy in featureless or obscured environments, supports high speed maneuver for positional advantage, and provides accurate location and timing critical to tactical missions. It helps set accurate air corridors and allows aircraft greater ability to follow established corridors. FFT adds a level of fidelity useful to a commander gaining situational understanding when making decisions impacting movement and maneuver of friendly unit positions and fosters timely adjustments to operational plans. FFT capabilities helps mitigate fratricide due to unprecedented knowledge of all joint and allied forces via the COP.
- Space Control. DSC and NAVWAR fosters assured, uninterrupted PNT and take measures to protect friendly force access to space capabilities. DSC can help locate enemy electronic warfare and counterspace capabilities. OSC can assist in operations to deny the enemy use of space capabilities, and protect friendly access to the same.
- SATCOM enables communications on-the-move in areas of limited line of sight communications and allows commanders to communicate beyond line of sight to subordinate elements regardless of the distance from the commander's location. SATCOM allows for commanders and their staff to have current information on subordinate units locations, status, disposition, and provide operational planning guidance to adjust to rapidly evolving tactical situations. Systems such as the Soldier Network Extension and Point of Presence provide tactical commanders with SATCOM capability while stationary or on-the-move.
- Missile warning provides known launch locations with kinematic access and predicted impact points when specific launches are detected. Missile Warning provides timely threat warning of inbound missile and other high energy enemy capabilities and assists in planning for how maneuver formations, command posts, sustainment facilities, and other friendly forces will be positioned on the battlefield. Well-positioned forces helps increase timely warning so troops have sufficient time to take reactive measures to a threat missile event.
- Environmental monitoring provides the commander with information that may affect military operations, enabling forces to take advantage of adverse environmental conditions, or avoid situations negatively impacting their ability to maneuver.
- Space-based imagery and geospatial information provide visualization of terrain for actual and planned missions, and helps identify obstacles and the most likely movement corridors.

INTELLIGENCE

4-57. Intelligence depends on space capabilities and effects to provide intelligence support to force generation, provide support to situational understanding, conduct information collection, and provide intelligence support to targeting and information operations.

4-58. Space-based sensors providing critical input for the production of intelligence. Space-based sensors gather information concerning relevant OE, as well as provide positional relationship of threat forces during

operations. Refer to ADP 3-0 for discussions on the intelligence warfighting function and ADP 2-0 for information about intelligence.

- Geospatial intelligence provides imagery to support planning, combat assessment, situational awareness, and cartography. The various geospatial intelligence remote sensing phenomenology such as synthetic aperture radar, infrared, electro-optical, and multispectral provides planners with current information on surface, subsurface and air conditions such as trafficability, port accessibility, beach conditions, vegetation, change detection, land use, and foundational military intelligence such as detailed knowledge of enemy forces, facilities, disposition, capabilities, and support to target material development.
- PNT is necessary for intelligence sensors to work optimally. PNT provides the precision for ortho-rectified imagery, report enemy locations accurately, and provide a variety of necessary terrestrial and space weather data. Both manned and unmanned aerial intelligence sensors utilize PNT to navigate autonomously and to focus the sensors.
- SATCOM provides the link for direct communications and dissemination of intelligence products.
- Missile warning and space-based infrared sensors may provide indicators of enemy unit locations and intentions.
- Space surveillance and reconnaissance provides detailed knowledge of enemy forces, locations, capabilities, activity, and battle damage assessment, throughout the depths of the battlespace.

FIRES

4-59. Fires depends on all space capabilities to deliver and integrate all forms of Army, joint, and multinational fires, and conduct targeting. Refer to ADP 3-0 for discussions on the fires warfighting function and ADP 3-19 for information about fires.

4-60. Army space operations are integrated throughout the fires warfighting function and include space capabilities which provide robust and reliable geolocation and communications capabilities. PNT supports precision targeting and precision munitions. SATCOM enables real time communications between commanders and forces to enable immediate redirection of fires over extended distances to shape the operations. Weather satellites provide a variety of data points necessary for targeting impacts.

- PNT provides precise positioning data to firing units and feeds the COP so firing units are aware of friendly unit locations. PNT enables accuracy reports for precision guided munitions, Army battle command system, near real-time situational awareness for lethal and nonlethal fires, proper application of fires for proportionality, and reduced collateral damage and FFT fratricide. PNT supports the targeting of enemy forces in contact, integration into fires planning, and the use of precision guided munitions against high value targets.
- SATCOM provides timely BLOS communications between different echelons of firing elements. Command and Control, Intelligence, and Sustainment functions support to fires all rely on SATCOM. SATCOM and PNT supports fires targeting through interfaces on systems like the Advanced Field Artillery Tactical Data System.
- Space assets foster access to deep attack with GPS aided systems such as Army Tactical Missile System by confirming and geolocating target in denied areas
- Missile warning indications can provide a possible footprint of adversary indirect fire activity which may include integrated air defense and multiple rocket launcher systems.
- Environmental monitoring provides data on surface and sub-surface conditions, which provides important mission planning data in support of fires operations.
- Space-based surveillance and reconnaissance contributes to developing the deep picture of enemy unit locations and dispositions—supporting fires deep targeting efforts. In large scale combat operations, Space-based surveillance and reconnaissance may be in position to collect against enemy tactical level targets.

SUSTAINMENT

4-61. Sustainment depends on space capabilities and effects for logistics (maintenance, transportation, supply, field services, distribution, general engineering), personnel services (human resources, financial

management, legal, religious), and health service support mission sets of casualty care, medical evacuation, and logistics. Army space operations support the sustainment warfighting function include facilitating real-time data transfer and visibility for an expeditionary Army. Refer to ADP 3-0 for discussions on the sustainment warfighting function and ADP 4-0 for information about sustainment.

4-62. Various space capabilities are used to facilitate the implementation and decision making process for sustainment.

- SSA helps clarify threat actor intent to foster protection of critical sustainment efforts.
- PNT provides precise location of in-transit vessels enabling hyper-accurate delivery forecasts of resupply efforts shipped to theater. Enables precision engineer operations and infrastructure construction such as airfields, ports, landing zone identification, operating bases, petroleum pipelines, bridges, and minefields. The combat survivor/evader locator radio has an embedded PNT receiver device to facilitate location finding and search and rescue operations. PNT data is critical in providing the Sustainment COP with a clear picture of all friendly force locations and status. The efficient movement of Sustainment forces over large distances of the air, land, and sea lines of communications is most often dependent upon PNT to ensure elements arrive on schedule, with minimum time in transit.
- SATCOM provides important beyond line of sight communications for real time connectivity to the Sustainment COP, allowing for a clear and complete picture of the location and disposition of Sustainment forces across large geographic areas. SATCOM provides reachback for condition-based maintenance, minimizing down time and reducing both maintenance and labor costs. SATCOM linking theaters is fundamental to timely, assured, and responsive support to the sustainment force. SATCOM enables reachback to technical centers and libraries, and provides beyond line of sight network extension. It allows tactical level G4 staffs to coordinate logistic requirements from deployed locations to anywhere in the world and for Sustainment planning staffs to receive timely battlefield updates, and update their operational plans as appropriate.
- SATCOM and PNT are critical to beyond line of sight control and information transfer from unmanned aerial systems reliant on near-continuous data exchange from controllers. They enable engineering tools such as Tele-engineering Communications Equipment for reachback, Automated Route Reconnaissance Kit for route reconnaissance information, and Geospatial Assessment Tool for Engineering Reachback for field data collection and geographic mapping. Topographic engineers and geospatial planning cells require access to the space-enabled global information grid to update and disseminate geospatial information and products. Medical records can be tracked and shared through the continuum of a deployment—from point of injury to the sustaining base. Casualty location can be accurately identified and tracked for trends.
- GPS, SATCOM, and imagery enable the collection and sharing of information on geography, supplies, services, facilities, and transportation activities.
- Space control helps to counter adversaries from jamming communications and PNT signals.
- Missile warning supports early warning and force protection for Sustainment units operating through the depth of the battlespace. Well-positioned forces helps increase timely warning so sustainment troops have sufficient time to take reactive measures to a threat missile event.
- Weather and terrain data helps determine scatter patterns for chemical, biological, and radiological agents, and modeling of hazard predictions to support medical services or health services.
- Space surveillance and reconnaissance can provide information on movement corridors, convoy monitoring, supply routes, and assists force protection by providing warning of enemy activity. They help identify weapon stockpiles, target identification, delivery systems, and dual use facilities. It identifies natural obstacles and provides detailed terrain information such as digital terrain elevation data. Combined with GPS, the information can be used for assessment of local utilities, land use, reservoirs, roads and bridges.

PROTECTION

4-63. The protection warfighting function is a continuous process executed by all commanders, regardless of mission, location, or threat. It consists of a broad set of unit specific, coordinated actions conducted to

protect the force. Protection depends on space capabilities and effects for survivability operations; air and missile defense support; physical security; anti-terrorism; personnel recovery operations; explosive ordnance disposal; risk management; chemical, biological, radiological, and nuclear defense; cyberspace security and defense; and electromagnetic protection. Army space operations support the protection warfighting function supporting freedom of action in all domains preserving the commander's freedom of action and protecting the forces. With situational understanding, commanders have information necessary to respond to given situations such as personnel recovery operations. Refer to ADP 3-0 for discussions on the protection warfighting function and ADP 3-37 for information about protection.

- 4-64. Space capabilities are used for the implementation and decision making process for protection.
- SSA can inform friendly forces of adversary satellites when they are in position to view and record ground activity.
 - PNT is important to protection to accurately identifying threats such as minefields, obstacles, and other potential hazards to friendly forces. PNT enables FFT, assists in personnel recovery operations, helps troops by reducing fratricide, and enables protection through situational awareness.
 - SATCOM provides the ability to transport data to all levels of command, expands the area of operations beyond line of sight, and improves situational understanding for all as SATCOM feeds the COP to ensure situational awareness is available for all components. It provides timely dissemination of friendly force unit locations and dispositions, which greatly assists in fratricide avoidance, and dissemination of information related to all types of threats. The SATCOM
 - DSC and NAVWAR fosters assured, uninterrupted PNT.
 - Space-based missile warning provides launch locations, predicted missile impact points, and warning to forces within the footprint of the predicted impact area to take protective actions.
 - Environmental monitoring provides information on surface and sub-surface conditions and environmental data. Weather and terrain data helps determine scatter patterns for chemical, biological, and radiological agents, and modeling of hazard predictions to support force protection. It can help provide potential decontamination sites, water sources, drainage, routes, cover and concealment, and imagery of environmental disasters.
 - Intelligence gathered from space-based surveillance and reconnaissance assists force protection by providing known launch locations, likely launch vehicles and associated kinematic ranges, and likely warheads. Surveillance and reconnaissance enables access to denied areas to help detect enemy camouflage and obscurants. It can be used to help determine likelihood of adversary attacks using airborne agents and help determine friendly and enemy use of obscurants.

SPECIAL OPERATIONS FORCES

4-65. The joint special operations task force has a space operation cell with Army space operations officers assigned who are trained to plan, coordinate, and integrate space capabilities in their respective missions operations.

ARMY-WIDE SPACE TRAINING CONSIDERATIONS

4-66. An enemy who is able to contest the space domain and force D3SOE conditions will be able to provide some level of disruption to every mission. Enemy forces may be equipped to employ theater-wide D3SOE effects which are part of an A2 and AD strategy. Even small factions and individual threat actors could cause enough D3SOE to have significant impacts on mission accomplishment.

4-67. Experiencing D3SOE effects may hamper mission operations and information operations. Unit training and staff exercises must regularly include a D3SOE. Repetitive training in D3SOE conditions is essential for all units to become competent while operating with reduced space capabilities.

4-68. Training prepares Soldiers to conduct operations according to doctrine, standard operating procedures, and the unit's mission. Training develops the teamwork, trust, and mutual understanding commanders need to exercise command and control to achieve unity of effort. Training must be presented in

realistic environments, including a D3SOE so Soldiers can practice the techniques necessary to adapt and overcome enemies in large scale combat operations.

4-69. The Army space training strategy covers both operational and institutional aspects of training. The operational piece focuses on providing real-world conditions during unit training to counter D3SOE during multi-echelon home station training and combat training centers. Training efforts are focused on ensuring operational units can initiate and maintain access to space capabilities and tactics to apply when operating in contested conditions. Using training devices to replicate D3SOE conditions is critical to providing realistic operational training, especially for PNT and SATCOM. Direct injection devices allow a large maneuver, fires, or other audience to experience D3SOE effects on their space-enabled systems during training and exercises. These training devices realistically replicate the effects of D3SOE, and they are critical for implementing this training.

SECTION II – JOINT SPACE OPERATIONS

4-70. JP 3-14 lays the foundation of joint space doctrine by establishing principles for the integrated employment of space capabilities. It also recognizes the Service components have both complementary but distinct space responsibilities. Each Service component contributes to an integrated whole synchronized by the joint force headquarters. Space forces employ principles of joint operations and enable the application of the principles by other joint forces. Army space operations support the joint force commander's campaign plan. Army space operations support joint force missions and receive support from joint forces and other Service, government, civil, and commercial space assets. Based on unit mission, space operations are integrated throughout the land component forces and other components of the joint force to maximize the space contribution to the joint fight.

4-71. Common responsibilities of each of the Service components are:

- Advocate for space requirements within their respective Services;
- Provide a single service point of contact for access to Service resources and capabilities;
- Make recommendations to combatant commanders on appropriate employment of Service forces;
- Provide space forces to combatant commanders as directed;
- Support planning of space operations and assigned tasking; and
- Support all combatant commanders with expertise in space capabilities and advocacy of desired capabilities as requested.

4-72. Service components have distinctly unique roles to play in providing space capabilities. The distinctly Army space-specific, roles are identified in JP 3-14, but are summarized below:

- Conduct space operations and provides planning, integration, control and coordination of Army forces and capabilities in support of combatant command missions;
- Provides FFT;
- Provide ballistic missile warning from deployed JTAGS;
- Provide space expertise with ARSSTs;
- Conduct SATCOM planning by RSSC;
- Conduct communication transmissions and satellite payload control of the wideband satellite constellations, and support to SSA; and
- The Consolidated SATCOM System Expert for military wideband, military narrowband SATCOM, and the specific SATCOM System Expert for the DSCS, WGS, Global Broadcast Service, and Mobile User Objective System.

UNITED STATES SPACE COMMAND

4-73. The Unified Command Plan establishes USSPACECOM as a geographical combatant command with overall responsibility for military space operations within their assigned AOR. The USSPACECOM AOR and the space domain are closely related, but not identical. The lower limit of the space domain remains undefined while the USSPACECOM AOR starts at 100 km per the Unified Command Plan.

4-74. USSPACECOM is responsible for executing day-to-day, integrated space operations to deliver theater and global effects in support of national and combatant commander objectives. They coordinate space operational-level planning, integration, and coordination to ensure unity of effort in support of military and national security operations and support to civil authorities. Commander, USSPACECOM executes tasking's for space operations through the Combined Space Operations Center. Army space teams and elements coordinate on a daily basis with Combined Space Operations Center.

4-75. Army space forces are normally provided to Commander, USSPACECOM when not organic to a unit. The joint force commander may submit a request for forces requesting Army space operations expertise. Upon validation of the request for forces, the Chairman of the Joint Chiefs of Staff deployment execution order will be sent to unified combatant command, who will task the Army Service component command to provide the forces. If tasked, the Army Service component command will provide Army space operations expertise, capabilities, effects, and coordination support.

4-76. The commander has operational authority for all DOD SATCOM on-orbit assets, control systems, and SATCOM terminal infrastructure. Commander, USSPACECOM, as the supported commander for SATCOM, performs functions and activities of the SATCOM operational manager, including oversight, management, and control of SATCOM resources.

4-77. Due to the nature of space assets, changes to satellite tasking to support one theater can affect other theaters. Therefore, day-to-day command and control and satellite control is accomplished from a strategic perspective rather than a theater perspective. The commander is responsible for conducting joint space operations, and coordinating and conducting space planning through the joint planning process in support of the national military strategy. They assigns appropriate command relationships for space operations to the component commanders; components maintain this strategic perspective in their space planning and operations. Together with the SCA, Army space operations officers ensure space operations are coordinated, deconflicted, integrated, and synchronized at the theater level.

SPACE COORDINATING AUTHORITY

4-78. In space operations, *space coordinating authority* is the responsibility to plan, integrate, and coordinate space operations (JP 3-14)—it is the single most important authority an Army space operations officer must understand. The SCA is responsible for coordinating joint space operations and integrating theater and global space capabilities and effects in an operational area. SCA within a joint force helps coordinate joint space operations and integrates space capabilities and effects that support the combatant commanders. The SCA coordinates space-related support with established objectives and acts on behalf of the combatant commander, with primary responsibility for joint space operation planning. SCA is not a position, but rather an authority imparted upon a commander or individual to coordinate space efforts within the area of responsibility. The SCA within a joint force helps coordinate joint space operations and integrates space capabilities and effects that support the combatant commander.

4-79. The joint force commander may retain SCA, but normally delegates SCA to the component command with the preponderance of space forces. It is important to limit the possibility of interference or redundancy between various space operations, and to deconflict responsibilities. The joint force commander considers the mission, OE, duration of the operation, preponderance of space forces, capabilities made available, and resident command and control capabilities (including reachback) in selecting the appropriate option.

4-80. If SCA is delegated, the director of space forces is normally tasked to execute the daily actions associated with SCA. The SSE assigned to the joint force land component commander advocates for land component space forces and space capabilities. It may be necessary for the SSE to assign a space operations officer to augment the organization with SCA.

4-81. If SCA is delegated to the corps commander, the SSE within the corps supports the joint force land component commander with planning and operations in the role as the SCA and performs the day-to-day staff functions required to execute SCA. When the requirements of serving as the SCA exceed the capabilities of the corps, the corps SSE requests augmentation from an ARSST.

4-82. The SCA gathers operational requirements which may be satisfied by space capabilities and facilitates the use of established processes by joint force staffs to plan and conduct space operations. The SCA's roles and responsibilities include:

- Coordinating space capabilities in the operational area to support joint functions;
- Planning, coordinating, integrating, and synchronizing space operations in the operational area and ensures inputs from the joint force commander's organizations are incorporated;
- Leading coordination for space nominated target development, vetting, and validation to the joint force commander's target nomination list;
- Submitting requests for space forces (such as deployed space forces), requests for space capabilities (such as support to personnel recovery operations), and requests for implementation of specific command relationship; and
- Providing consolidated space requirements through the joint force commander to USSPACECOM.

4-83. The director of space forces is an Air Force construct. Each combatant command normally has a designated director of space forces with a staff. When the Commander, Air Force forces is designated as the SCA, the director of space forces deputy commander is typically an Army space operations officer. When an Army space operations officer is serving in this capacity, the individual is normally responsible for:

- Overseeing day-to-day functions of the staff and accomplish SCA duties;
- Integrating space capabilities, space control operations, and planning into joint operations;
- Providing advice on space capabilities and employment;
- Providing the key staff counsel and training in space operations;
- Assisting with planning and executing theater space operations and applying space capabilities throughout the joint targeting cycle;
- Assisting in coordinating tailored space capabilities throughout the area of responsibility;
- Representing specific land component space operations-related needs and issues;
- Acting as an intermediary between director of space forces staff and all Army space elements;
- Providing reachback support for forward deployed space forces from all Services in area of responsibility; and
- Interacting with multinational space operations personnel within the Combined Space Operations Center.

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Chapter 5

Planning, Preparing, Executing, and Assessing

The operations process describes the activities performed by any military unit to accomplish a mission. This chapter discusses how space operations are incorporated into the operations process. It provides the processes and outputs of the seven MDMP steps with corresponding Army space specific examples. Space planners and space operations play a substantive role in targeting activities, which are one of the several integrating processes to synchronize specific functions throughout the operations process. Finally, the space planner's role in preparing, executing and assessing space operations is provided.

Note: There are no *space planner* positions identified on Army, corps, or division staffs. The SSE or assigned space operations officers have responsibility for integrating space operations into mission planning. Reference to a space planner refers to the organic SSE or space operations officer conducting staff planning responsibilities.

ARMY DESIGN METHODOLOGY

- 5-1. The two primary methods planners use for collaboration on space operations are the Army design methodology and the MDMP. The Army's design methodology and the MDMP do not address the full scope of space operation planning. Both may determine times and locations space operations are integrated to support the concept of operations.
- 5-2. The Army design methodology is a method for applying critical and creative thinking to understand, visualize, and describe unfamiliar problems and approaches to solving them. The Army design methodology is used to assist commanders and staffs with planning. Given the unique and complex nature of space operations, commanders and staffs benefit from implementing the Army design methodology to guide more detailed planning during the MDMP. This entails framing an OE, framing a problem, and developing an operational approach to solve the problem. See ADP 5-0 for additional information on the operations process.
- 5-3. Framing an OE involves critical and creative thinking by a group to build a model that represent both the current state of the OE and the desired end state the OE should resemble at the conclusion of an operation. A planning team designated by the commander will define, analyze, and synthesize characteristics of the operational and mission variables to develop desired future end states. During the framing process, the staff considers opportunities and support provided by space operations.
- 5-4. Framing a problem involves understanding and isolating the root causes of conflict discussed. Actors may represent obstacles for commanders as they seek to achieve desired end states. Creating and employing space capabilities shapes conditions in the OE supporting the commander's objectives.
- 5-5. Collaboration is much more than coordination. Collaboration occurs between multiple people or organizations working together towards a common goal by sharing knowledge and actively building consensus. Throughout the operations process, the space planner must actively and continuously collaborate with commanders, subordinate commanders, staffs, and unified action partners to ensure space capabilities and effects are being efficiently integrated into all aspects of operations.

PLANNING FOR SPACE OPERATIONS

- 5-6. *Planning* is the art and science of understanding a situation, envisioning a desired future, and laying out effective ways of bringing that future about (ADP 5-0). Planning is one of the four major activities of command and control that occurs during the operations process (plan, prepare, execute, and assess).

Commanders apply the art of command and the science of control to ensure space operations support the concept of operations.

5-7. The space planner is the subject matter expert on capabilities and creating effects from the space domain. The space planner ensures all COA meets the requirements for suitability, feasibility, and acceptability regarding the integration of space capabilities and effects. The space planner should understand the level of knowledge partner nations' Soldiers have regarding the use space products and services.

5-8. Involving space planners early in development of the commander's vision and planning allows for collaboration and integration with missions, functions, and tasks. A consideration of space operations is the lead-time required for capabilities and effects. Space planners should be involved early in the OPOD preparation and effects approval process to enhance the integration of space capabilities and effects.

5-9. The space planners develop Appendix 18–Space Operations to Annex C of the base order. They use Appendix 18 to describe in detail how space operations will support the concept of operations outlined in the base order.

5-10. Space planners utilize a variety of working groups when conducting planning for operations, including the cyberspace electromagnetic activity. The cyberspace electromagnetic activity working group is accountable for integrating space operations, cyberspace, and electronic warfare operations and related actions into the concept of operations. The cyberspace electromagnetic activity working group is a critical component of space operation planning and integrates within the staff's battle rhythm. Conducting space planning separately from cyberspace and electronic warfare operations may diminish efficient employment of all three. If uncoordinated, these activities may result in conflicts, mutual interference internally, inability to communicate, loss of intelligence, the degradation of systems capabilities, and other EMS-related anomalies. The cyberspace electromagnetic activity working group will primarily deconflict detection and delivery assets through the planning and targeting processes.

5-11. Space planners participate in all aspects of COA development, analysis, and comparisons. The principle focus a space planner has in the COA process is:

- Determine how space operations can best support commanders intent;
- Determine how space operations can be integrated into mission operations; and
- Provide input on which COA is most supportable and effective.

SPACE PLANNING IN THE MILITARY DECISIONMAKING PROCESS

5-12. MDMP is an iterative planning methodology to understand the situation and mission, develop a COA, and produce an OPLAN or OPOD (ADP 5-0). Space planners and staff are responsible for integrating space operations throughout the MDMP. Members of the SSE are responsible for planning by recommending specific tasks, actions, and methods to integrate space operations into the plan.

5-13. The MDMP consists of seven steps:

- Step 1: Receipt of mission.
- Step 2: Mission analysis.
- Step 3: COA development.
- Step 4: COA analysis (war game).
- Step 5: COA comparison.
- Step 6: COA approval.
- Step 7: Orders production, dissemination, and transition.

Receipt of Mission

5-14. Commanders initiate the MDMP upon receipt or in anticipation of a mission. Space planners and staff members responsible for planning and integrating space operations initiate coordination with higher headquarters staff counterparts to obtain information on current and future space operations, running estimates, and other space planning products.

5-15. The space planners proceed with analysis and assessment of the relevant aspects of the space OE within the area of operations, emphasizing the space environment and friendly, neutral, and enemy space capabilities. Based on the commander’s guidance, planning includes formulating one or more supportable space operations COAs to accomplish the mission. Space-specific planning considerations for the receipt of mission steps are in table 5-1 (below and page 5-4).

Table 5-1. Receipt of mission

Processes and Outputs	Space Considerations and Inputs
<p>1. Supported/supporting space staffs and liaisons alerted, organized, and synchronized.</p> <p>Coordinate with applicable higher and adjacent staff elements.</p> <p>Contact, organize and synchronize with supported/supporting space staffs and liaisons.</p> <p>Determine outside space related agencies to contact and incorporate into the planning process.</p>	<p>Synchronize space operations with the staff and workgroups:</p> <ul style="list-style-type: none"> • Cyber electromagnetic activities workgroup. • Special technical operations workgroup. • Operational protection workgroup. • Future operations workgroup. • Plans workgroup. • Fires and effects coordination workgroup. • Information operations workgroup. • Intelligence synchronization board. • Collection management workgroup. • Missile warning and air defense artillery workgroup. • Missile defense workgroup. • Knowledge management workgroup. • Personnel recovery workgroup. <p>Coordinate space operational requirements with:</p> <ul style="list-style-type: none"> • United States Space Command and the Combined Space Operations Center. • Global Positioning System operations center. • Commander delegated space control authority staff. • Higher, adjacent, and lower echelon space support elements. • Army components and adjacent Service components with space operations expertise. • Army space support teams. <p>Integrate unique capabilities of space control; positioning, navigation, and timing; satellite communications; missile warning; and environmental monitoring capabilities into staff planning.</p>
<p>2. Tools gathered and prepared for mission analysis.</p> <p>Tools include, but not limited to the higher headquarters order or plan and operational graphics; maps and terrain products of the area of operations; standard operating procedures; appropriate field manuals; current running estimates; any design products; and other materials and products required.</p>	<p>Review base operation order and all annexes.</p> <p>Review the space operations Appendix from past operations.</p> <p>Develop space support requests.</p> <p>Review space, electronic warfare, cyberspace, and integrated joint special technical operations standard operating procedures.</p> <p>Determine if the command has the tools and processes to employ provided terrain visualization using space-based imagery and data, such as positioning, navigation, and timing signal blockage visualization or aircraft fly-through.</p>

Table 5-1. Receipt of mission (continued)

Processes and Outputs	Space Considerations and Inputs
<p>3. Updated space running estimate and space-related limitations to the mission.</p> <p>Determine pertinent facts, assumptions, friendly force status, enemy activities and capabilities, and civil considerations.</p>	<p>Provide the space running estimate with other staff sections for incorporation into the mission analysis effort.</p> <p>Impacts of space operations on subordinate elements who do not have embedded space operation planners.</p>
<p>4. Conduct Initial assessment.</p> <p>Understand the staff planning time-line that outlines how long the staff should spend on each military decisionmaking process step.</p> <p>Recognize which outside agencies and organizations to contact and incorporate into the space planning process.</p> <p>Evaluate the staff's space understanding and experience regarding the operation.</p>	<p>Examine how space operations support the type of operation (offensive, defensive, stability, support).</p> <p>Determine general location of the operation and how it is enabled and or constrained by space operations.</p> <p>Determine initial timeline of operation and its impacts to space operations.</p> <p>Provide space operations input to formulate commander's initial guidance and initial warning order.</p>

Mission Analysis

5-16. Commanders and staffs perform mission analysis to better understand the situation and problem, identify what the command must accomplish, when and where it must be done, and why. Space planners and staff members responsible for planning and integrating space capabilities gather, analyze, and synthesize information on current conditions of the OE with an emphasis on the space domain.

5-17. In addition to the four major activities of the operations process, commanders and staffs use several integrating processes to synchronize specific functions throughout the operations process. The integrating processes—IPB, targeting, and risk management—provide an avenue to obtain the space-related threats and hazards to be reviewed and refined. Threat and hazard assessments are continuously reviewed and updated as the OE changes.

5-18. The space planners conduct threat and hazard analysis of space-based resources at Army, corps, and division echelons. This analysis comprises a thorough, in-depth compilation and examination of information and intelligence that address potential threats and hazards in the area of operations.

5-19. The space planner begins mission analysis with the systematic process of analyzing the mission variables in an area of interest to determine the effect on operations. Space planners coordinate with the intelligence staff to identify enemy and adversary capabilities and their use of the space domain to assist in the development of models, situation templates, event templates, high-value targets, named areas of interest, and other intelligence products. Space specific mission analysis planning considerations are in table 5-2 (pages 5-5 and 5-6).

Table 5-2. Mission analysis

Processes and Outputs	Space Considerations and Inputs
1. Conduct space operations analysis of the base operation order and Annexes.	<p>Understanding higher headquarters space operations and capabilities.</p> <p>Understand space operations of adjacent, supporting, and supported units and their relationship to the higher headquarters' plan.</p> <p>Understand joint, interagency, multinational, and non-government organizations space operations in the operational areas.</p>
2. Develop the initial space assessment.	<p>Identify key aspects of the space operational environment and make assumptions about how friendly and threat forces will interact in the space operational environment.</p> <p>Identify critical gaps in commander's knowledge of the space operational environment.</p> <p>Describe how the space operational environment effects potential friendly courses of action.</p>
3. Determine specified, implied, and essential space tasks	<p>Determines essential space tasks for inclusion in the recommended mission statement. Identify any 'be-prepared-to' or 'on-order' space operations missions.</p> <p>Implied task are for all friendly force elements to operate in an autonomous manner during all phases of operations.</p>
4. Review available space assets.	<p>Determine if the organization has the assets needed to accomplish all space operations tasks. If planners identify shortages, request additional resources needed for mission success to the higher headquarters.</p> <p>Identify any deviations from the normal space operations task organization.</p>
5. Determine constraints to space operations.	<p>Identify and understand constraints the commander has placed on space operations. Considerations include use of frequencies and bandwidth, space control capabilities, and sharing space capabilities with partners and allies.</p>
6. Identify critical facts and develop assumptions concerning space operations.	<p>Determine facts concerning space operational and mission variables that can serve as the basis for developing situational understanding for continued planning.</p> <p>Determine assumptions necessary to complete an estimate of the space operations situation and make a course of action decision.</p>
7. Begin risk management of space operations.	<p>Identify threats and hazards to space operations to determine risk.</p> <p>Develop and document risk mitigation actions.</p>
8. Develop initial space operations requirements.	<p>Identify and nominate space-related commander's critical information requirements and friendly force information requirements to the commander and staff.</p>
9. Assist the G-2 with developing the initial space reconnaissance and surveillance synchronization tools.	<p>Identify space requirements and any gaps.</p> <p>Evaluate available space assets to collect information and determine gaps in the use of those space assets.</p> <p>Submit requests for information for adjacent and higher collection support.</p>
10. Assist the G-2 to develop an initial space reconnaissance and surveillance plan.	<p>Develop space reconnaissance and surveillance scheme of support, tasking matrix, and overlays.</p>

Table 5-2. Mission analysis (continued)

Processes and Outputs	Space Considerations and Inputs
11. Update plan	Determine commander's requirements for space briefing. Determine times of collaborative planning sessions and the means by which they will take place.
12. Develop initial themes and messages of space operations.	Identify and engage those actors who may have a part within space operations. Develop a space operations theme that conveys a unifying or dominant idea or image.
13. Develop proposed problem statement concerning space operations.	Compare the current space operational environment to the desired end state. List primary issues or obstacles within the space operational environment that may impede the command from achieving the desired end state.
14. Develop proposed space operations mission statement.	Determine the unit's essential space operations tasks and who has responsibility to execute those tasks. Determine when space operation will start (by time or event), duration of the operation, and where the space effect is needed (area of operations, objective, grid coordinates).
15. Present the space portion of the mission analysis briefing.	Provide the staff with space operations inputs to help the commander understand, visualize, and describe the operations.
16. Develop and integrate initial commander's intent in terms of space operations.	Describes what constitutes success for the operation in terms of space and the conditions defining the end state.
17. Develop and issue initial space operation planning guidance.	Describe when, where, and how the commander intends to employ space to accomplish the mission.
18. Develop space course of action evaluation criteria.	Develop criteria to address factors affecting success and failure of space operations.
19. Assist the staff in issuing a warning order.	Ensure subordinate and supporting space assets receive the warning order.

Course of Action Development

5-20. COA development generates options for subsequent analysis and comparison satisfying the commander's intent and planning guidance. Space planners responsible for planning and integrating space operations apply knowledge gained from the mission analysis step to help with overall COA development. During COA development, space planners identify space capabilities likely to support an initial scheme of operations. The scheme of operations for space describes how the commander intends to use space operations to support the concept of operations with an emphasis on the scheme of maneuver.

5-21. The space planners begin COA development by estimating the relative combat power of friendly and enemy space capabilities, including commercially contracted assets, if applicable. Space planners should integrate their assessment of force ratio into the overall estimate. As the staff develops COA options, the space planners explore friendly space-related activities required to support the operation.

5-22. Upon completion of COA development, space planners update mission analysis outputs, such as the space operations-related input for the commander's critical information requirements and essential elements of friendly information. In addition, the staff updates their portions of the OPORD, including Appendix 18—Space Operations to Annex C of the base order. Space specific COA development considerations are in table 5-3.

Table 5-3. Course of action development

Processes and Outputs	Space Considerations and Inputs
1. Assist the staff with assessing relative combat power.	Analyze force ratios to determine and compare each force's strengths and weaknesses as a function of space operations.
2. Assist the staff to generate options.	Determine the doctrinal requirements for each type of space operation being considered, including doctrinal tasks for subordinate units.
3. Assist the staff to array forces.	Determine the relative space superiority required to accomplish each task using historical planning ratios as a starting point. Determine relative space superiority with regard to civilian requirements and conditions that require attention. Determine forces and capabilities for stability tasks.
4. Assist the staff to develop a broad concept.	Describe how space forces will help accomplish the mission within the commander's intent. Summarize the contributions that space forces will make in order to accomplish the mission.
5. Assist the staff in assigning headquarters.	Assist the staff planners to create a task organization by assigning headquarters to groupings of forces. Consider the types of space assets assigned to a headquarters and the ability of that headquarters to control those units.
6. Assist the staff in preparing course of action statements and sketches.	Assist the staff in portraying how the unit will accomplish its missions using the space domain. Assist the staff with developing a sketch of the space aspects supporting the concept, including the positioning of forces. Together, the statement and sketch cover who (generic task organization), what (tasks), when, where, and why for each subordinate unit.
7. Assist the staff with conducting course of action briefing.	Ensure the staff is provided space operations input for each course of action, to include: <ul style="list-style-type: none"> • Enemy courses of action in the space domain • Space operations considerations that might affect enemy courses of action. • Critical space operations events for each course of action. • Why space assets are arrayed as shown on the course of action sketch. • Why the staff used the selected control measures. • The impact of space operations on civilians. • Updated space operations facts and assumptions. • Refined space operations course of action evaluation criteria.
8. Select or modify course of action for continued analysis.	Commander selects or modifies those courses of action for continued analysis and issues planning guidance.

Course of Action Analysis

5-23. COA analysis enables commanders and staffs to identify difficulties, coordination problems, and probable consequences of planned actions for each COA under consideration. Staff members responsible for planning and integrating space operations use the draft products from COA development to participate in COA analysis. During COA analysis, they refine their scheme of space operations, ensuring that it nests with the scheme of maneuver. Space specific COA analysis considerations are in table 5-4 (page 5-8).

5-24. Upon completion of COA analysis, operational planning continues with drafting and submitting the space support request and then updating these requests when the COA is later refined. Development and submission of the space support request is the primary method by which Army forces request, coordinate, and integrate effects to support space operations.

Table 5-4. Course of action analysis

Processes and Outputs	Space Considerations and Inputs
1. Assist the staff to gather tools.	Gather the tools, materials, and data for the wargame. Assist the staff with maps, computer simulations, and other tools that accurately reflect the space operations environment. These materials may include: <ul style="list-style-type: none"> • Space running estimate. • Space operations event templates. • Completed space operations courses of action, including graphics.
2. List all friendly space forces.	Consider all space elements which may be committed to the operation, paying special attention to support relationships and constraints. This list remains constant for all courses of action.
3. List assumptions concerning space operations.	Review previous space operations assumptions for continued validity and necessity. During the course of mission analysis and course of action development, space planners may have obtained updated or additional information that confirms or denies initial assumptions.
4. List known space operations critical events and decision points.	List points when the commander or staff anticipates making key decisions concerning a specific space operations course of action.
5. Assist the staff in conducting the wargame.	Assess the results of the war game in terms of space operations. Assist the staff in foreseeing actions, reactions, and counteractions of all participants operating in the space domain.

Course of Action Comparison

5-25. COA comparison is an objective process to evaluate each COA independently and against set evaluation criteria approved by the commander and staff. Space planners and staff members responsible for space operations may not have direct involvement in this process, but will provide recommendations for consideration. Upon completion of the COA comparison, output products, and the base OPORD, become the final draft.

5-26. Space planners analyze and evaluate the advantages and disadvantages of each COA from the space operations perspective, considering all space capabilities. Depending on the degree of space capabilities affecting the mission, space planners may use their own matrix to compare COAs, or may integrate space operations input along the elements of combat power or other decision matrix system the staff uses. Space specific COA comparison considerations are in table 5-5.

Table 5-5. Course of action comparison

Processes and Outputs	Space Considerations and Inputs
1. Conduct advantages and disadvantages analysis.	Analyze the courses of action and determine the advantages and disadvantages to space operations in terms of: <ul style="list-style-type: none"> • Minimizing risk to the force and mission accomplishment. • Placing the force in the best posture for future operations. • Providing maximum latitude for initiative by subordinate space elements. • Providing the most flexibility to meet unexpected threats and opportunities.
2. Compare course of action.	Analyze and evaluate the advantages and disadvantages of each course of action from a space operations perspective. Present findings for consideration by the other staff members.

Course of Action Approval

5-27. During COA approval the commander selects the COA that best accomplishes the mission legally, ethically, effectively, efficiently, and in the right way. Considerations of proportionality, military necessity,

humanity, and discrimination must be applied equally. The commander will issue final planning guidance including refined commander’s intent, commander’s critical information requirements, and any additional guidance on priorities for the warfighting functions.

5-28. If the commander modifies a proposed COA or gives the staff an entirely different one, the space operation planner must incorporate those modifications and ensure all staff members understand the changes prior to war-gaming. Space specific COA approval considerations are in table 5-6.

Table 5-6. Course of action approval

Processes and Outputs	Space Considerations and Inputs
Incorporate course of action and any modifications	Develop new commander’s critical information requirements for space operations to support execution. Determine space provided priorities. React to additional guidance provided by the commander

Orders Production, Dissemination, and Transition

5-29. The final step of the MDMP is orders production, dissemination, and transition. The staff will finalize all planning products, including the space operations running estimate. As time permits, the staff may conduct a more detailed war game of the selected COA. The commander will approve the COA after all outputs are internally reconciled.

5-30. Space planners should conduct confirmation briefings with subordinate space elements immediately after orders production. Space specific dissemination considerations are in table 5-7.

Table 5-7. Orders production, dissemination, and transition

Processes and Outputs	Space Considerations and Inputs
Produce and disseminate approved order to subordinate space elements. Appendix 18–Space Operations to Annex C	Disseminate the order to subordinate space support elements, Army space support teams, and other supporting space organizations and elements. Conduct confirmation briefing with subordinate and supporting space elements.

TARGETING ACTIVITIES

5-31. Space planners and space operations play a substantive role in targeting activities. Targeting begins in planning, and it is an iterative process that continues through preparation and execution. The functions of decide, detect, deliver, and assess define the targeting process and occur simultaneously and sequentially during the operations process. Targeting activities for space operations involving the employment of space capabilities and effects closely follow standard targeting processes.

5-32. Targets identified through the operations process appear on the integrated target list. Organic space capabilities, with the proper authority, may be tasked to create the desired effect on the target. Time, synchronization, legal, and operational authorities’ issues may affect the decision to use organic assets. The ability to affect targets may require proximity of capabilities and operational reach access.

5-33. If the unit’s organic abilities or authorities do not fulfill the targeting requirements to support the commander’s intent, they request support from the next higher echelon. As requests pass from echelon to echelon, each unit processes the target packet or request to use organic capabilities and authorities to support the subordinate unit’s requirement. The requirement elevates until it reaches an echelon which can support the requirement with the appropriate capabilities and authorities, or the echelon denies the targeting request. Fulfilling space support requests on targets may not be possible due to prioritization, timing, capabilities, authorization, or conflict with other requirements.

5-34. Identifying targets early in the planning process is key to approval, integration, and synchronization. Integrating the targets into the normal targeting process identifies if the capabilities can achieve the desired

effects. Due to their impact, some space capabilities and effects require synchronization and coordination across the entire staff. Some effects may prohibit friendly use of the space domain—knowingly or inadvertently—and the situational awareness of the space operation will enable the staff in taking the appropriate remediation actions and decisions.

5-35. Targets not available for space effects through Army means may continue to joint echelons for processing. The targets may require additional joint force space assets or authorities to support the Army commander's mission. This could result in the corps and below targets being included on the joint integrated prioritized target list.

5-36. Targets described as systems with components and subcomponents that enable the determination of aimpoints for designated friendly force capabilities. An *aimpoint* is a point associated with a target and assigned for a specific weapon impact (JP 3-60). Developing targets suitable for space effects requires a concerted staff effort. Ultimately, commanders, with the assistance of their staffs decide to employ space capabilities alone or with other capabilities.

Decide

5-37. Decide is the first step in the targeting process. It begins with the MDMP. It does not end when the plan is completed; the decide function continues throughout the operation. Using the outputs from the planning process, commanders and staffs determine where and when space effects will support the concept of operations.

5-38. Due to the nature of space operations, commanders should allow as much planning time as possible when requesting effects through the space domain. Army commanders are encouraged to consider space effects during the targeting process.

5-39. An important part of this step in the targeting process is identifying potential adverse impacts and mitigating them. This requires coordination and synchronization on the part of the staff executing space operations. Any action in space domain, cyberspace, and the EME, either offensive or defensive, must be coordinated and balanced with potential degradation inflicted on friendly systems.

5-40. During the decide step, the staff develops information regarding the space domain and targets by asking:

- What targets can be affected?
- What targets should be affected?
- When and where are the targets likely to be identified, accessed, or otherwise engaged to create desired effects?
- How long will the targets remain accessible?
- What are the related information collection requirements essential to the targeting effort; and how and when must the information be collected, processed, and disseminated?
- When, where, how, why, and in what priority should the targets be affected?
- What are the measure of performance and measure of effectiveness?
- What or who will obtain assessment or other information required for determining the success or failure of each engagement of target nodes?
- Who must receive and process that information, how rapidly, and in what format?

Detect

5-41. Detect is the next critical function in targeting. The information collection plan is a critical component of the detect function. The staff must consider space operations requirements throughout the intelligence process. The G-2 serves a key role in developing and managing the information collection plan specific to space operations.

5-42. The detailed analysis of enemy and friendly space systems provides information on enemy and adversary actions. During the detect step units gather the information needed to gain access, pair a capability, and develop the necessary intelligence to vet and validate nominated targets. After analysis, it may be possible to determine enemy intentions, when combined with other information. Planners attain situational

understanding of space systems through data, such as orbit, geospatial location, signal strength, system type, and frequency of target to focus effects on the intended target.

5-43. The detect function includes tasks in and through specific portions of space domain and cyberspace or the EME to locate, track, and validate targets or follow on action by friendly forces. Planners implement target development, vetting, and validation in parallel with the information collection plan.

Deliver

5-44. Space planners in coordination with the cyberspace electromagnetic activity section, through the targeting process ensure the full synchronization, integration, deconfliction, and employment of space operations, cyberspace, and electronic warfare effects according to the commander's scheme of maneuver. Close coordination between collection assets and delivery assets is critical during the engagement to avoid unintended effects and enable the assessment phase.

5-45. The detect function initiates the guidance and the target is attacked as planned. Close coordination is required between those engaged in detecting targets and those engaged in delivering effects upon targets. Integration and synchronization is vitally important during the deliver step.

Assess

5-46. Assessment occurs throughout the operations process. Targeting of space systems is continually refined and adjusted between the commander and staff during the operation. Assessment provides information on the effectiveness of decide and detect functions and whether the targets need reengaging.

PREPARING FOR SPACE OPERATIONS

5-47. Preparation consists of those activities performed by units and Soldiers to improve their ability to execute an operation (ADP 5-0). Preparation creates conditions that improve friendly forces' opportunities for success. It requires commander, staff, unit, and Soldier actions to ensure the force is trained, equipped, and ready to execute operations. Preparation activities help commanders, staffs, and Soldiers understand a situation and their roles in upcoming operations.

5-48. Mission success depends as much on preparation as on planning. Higher headquarters may develop the best of plans; however, plans serve little purpose if subordinates do not receive them in time. Subordinates need enough time to understand plans well enough to execute them. Subordinates develop their own plans and preparations for an operation. After they fully comprehend the plan, subordinate leaders rehearse key portions of it and ensure Soldiers and equipment are positioned and ready to execute the operation. Space operations officers routinely work with other members of the coordinating and special staffs such as the intelligence cell, signal operations, network operations, movement and maneuver cell, air and missile defense section, fires cell, and staff weather office element.

5-49. Peacetime preparation by units involves building contingency planning databases about the anticipated area of operations. These databases can be used for space operations input to the space running estimate and to plan initial space operations.

5-50. An important element of preparation is developing and implementing the ability to coordinate among relevant units and agencies. The SSE initiates the coordinating activities with other staff sections. Much of this coordination occurs during meetings and workgroups, but SSE members are monitoring other activities which might relate to space operations.

5-51. External coordination—subordinate units, higher headquarters, and other agencies—concerns space assets, resources, or forces which are not under unit control during planning. External coordination also includes coordinating with adjacent units and agencies. In space operations, adjacent refers to any organization affecting a unit's operations. Liaising is an important coordination means. Effective liaising is through command liaison officers, and a member of the SSE may be part of a liaison team. Establishing liaison early in planning supports effective coordination. Practical liaising can be achieved through personal contacts between space organizations.

5-52. Protection consists of a broad set of unit specific, coordinated actions conducted to protect the force. The SSE develops and initiates protection actions during planning, but executes them mainly during preparation and execution. Threat assessment begins during planning and continues throughout preparation. Protection measures may explicitly include space operations elements.

5-53. Resupplying, maintaining, and issuing special supplies or equipment to space operations unit's takes place during preparation. Repositioning logistic assets for units assigned space operations tasks also occurs during preparation. The SSE coordinates with the assistant chief of staff, logistics sustainment section to ensure units assigned space operations tasks receive the necessary support.

EXECUTING SPACE OPERATIONS

5-54. Successful space operations execution relies on mutual trust and cohesive teamwork with rapid information exchange among them. As operations unfold, space operations objectives and tasks are modified to provide effective support.

5-55. Monitoring space operations execution focuses principally on maintaining the effectiveness of space operations. The SSE uses the critical asset list and defended asset list to monitor the status of friendly space operations activities and the status of terrestrial, aerial, and space systems.

5-56. During execution, the SSE assesses space operations execution and how to adjust space operations as the operation unfolds. The need for responsive staff coordination among the SSEs, headquarters, and units participating in space operations intensifies during execution as mission operations progress and vary from the OPORD. The decentralized nature of space operations execution, combined with the multiple command levels involved, entail a wide span of coordination for the SSE.

5-57. Decision making during execution includes executing space operations as planned, adjusting space operations to a changing friendly situation, and adjusting space operations to react to unexpected enemy actions. Space operations may not be executed exactly as planned for a variety of reasons. The SSE's challenge under adverse circumstances is to rapidly assess how changes in space operations execution affect the overall operation and to determine necessary follow-on actions.

ASSESSING SPACE OPERATIONS

5-58. Commanders and staffs continually assess operations by using measure of performance and measure of effectiveness. A *measure of performance* is an indicator used to measure a friendly action that is tied to measuring task accomplishment (JP 5-0). A *measure of effectiveness* is an indicator used to measure a current system state, with change indicated by comparing multiple observations over time (JP 5-0). A measure of effectiveness is an identifiable and measureable event or action, which tells the commander whether the action taken had the desired effect.

5-59. Effects produced on and through space systems, are often not easy to assess. Rarely is damage physically visible or readily apparent. Assessment occurs throughout the operations process. Although assessment is a final step in the operations process, it also informs and guides other activities of the operations process. Assessment involves deliberately comparing forecasted outcomes with actual events to determine the overall effectiveness of force employment. Measure of performance and measure of effectiveness are key activities during assessment.

5-60. SSEs continually assess operations. A measure of performance helps answer questions such as: “Was the action taken?” or “Were the tasks completed to standard?” A measure of performance confirms or denies a task has been properly performed.

- Examples of measure of performance include the following:
 - Success or failure of FFT infrastructure to enable the COP;
 - Have mitigation measures enable uninterrupted operations;
 - Have precision munitions remained within acceptable limits.
 - Have the missile warning alerts provided sufficient accuracy and time to take protective measures; and
 - Have friendly forces been able to maintain communications or GPS lock.
- Examples of measure of effectiveness may include the following:
 - Has solar activity impacted GPS and precision navigation;
 - Ability of electromagnetic interference resolution processes to resolve SATCOM or GPS electromagnetic interference in a timely manner;
 - Timeliness of receipt of commercial satellite imagery products; and
 - Has the enemy’s decision cycle been disrupted due to loss or degraded communications.

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Chapter 6

Space Products

The three separate products a space operations officer prepares are the space-unique inputs to the IPB, the space running estimate, and Appendix 18–Space Operations to Annex C of the base order. The space running estimate is prepared as a tab to the Appendix 18 to the OPLAN, while the SSE provides space input to the intelligence cell’s IPB activity. Both the space running estimate and space input to IPB process are systematic, continuous methods of analyzing and documenting factors affecting space capabilities that affect the OE. These space products present the supported commander and staff with information about the space situation that pertains to accomplishing the unit mission. These products are designed to support other estimates and the MDMP. The purpose of the space running estimate is to systematically consider the space dimension of the area of operation. This chapter outlines the necessary content of space analysis as a tool to identify how space capabilities influence the operations.

PURPOSE OF THE SPACE INPUT

6-1. The purpose of space input to the IPB process is to provide the intelligence cell and other staff elements, with a highly detailed analysis of the space domain and its capabilities and effects within the OE. IPB is an analytical methodology to reduce uncertainties about the enemy and the OE, and fuses the air and space domain, terrain, and weather into a consolidated, coordinated assessment. IPB is the key to preparing for the next engagement and, during peacetime, builds the foundational data that will be updated and enhanced continuously and simultaneously during operations.

6-2. An enemy’s access to space domain or space control capabilities can generate effects with impact across all levels of war. Space-related inputs to the IPB are conducted at the tactical level to support combat operations. It needs to be a focused effort directly impacting the mission or operations that leverage the results of the USSPACECOM space IPB program. This multi-agency intelligence production effort is designed to augment a combatant command’s joint IPB tailored to assessing enemy usage of the space domain with predictive courses of action. The USSPACECOM IPB process is a continuous all-source intelligence production effort tailored to support combatant commander contingency plans and OPLAN in existence.

6-3. The SSE should coordinate through the intelligence cell for access to existing USSPACECOM IPB products during mission analysis. If the SSE’s area of responsibility doesn’t have an available space input to the IPB product, or if further tailoring is necessary, the SSE should submit an intelligence requirement through the collections manager to USSPACECOM. The SSE and intelligence cell should review the joint space IPB to understand the enemy’s use of the space domain, space order of battle, and space control courses of action to integrate into the unit IPB process. Based on the intelligence cell’s limited capacity to focus on the space domain, the SSE should lead the space threat analysis effort, which will eventually be incorporated into the overall intelligence estimate.

6-4. Based on mission variables, staffs down to brigade level need to determine how best to integrate space capabilities and vulnerabilities into their mission analysis process. This effort supports all facets of MDMP and is the key space situation analysis tool used during the operation. The use of space systems may significantly affect operations involving communications, navigation, threat warning, weather monitoring, reconnaissance, and surveillance. Throughout all phases of an operation (from pre-deployment to mission completion), the space domain impact on military operations is a key factor for which the commander must plan. The SSE, in coordination with the rest of the staff, conducts the space running estimate process and space input to IPB, and makes the products available to the staff and the commander.

SPACE INPUT TO THE INTELLIGENCE PREPARATION OF THE BATTLEFIELD PROCESS

6-5. The SSE provides all space unique IPB products for integration to the intelligence cell. These space products are incorporated into the IPB products generated by the intelligence cell for use in the planning, preparing, and executing of all operations. The SSE coordinates closely with the intelligence cell to reduce the potential for redundant analysis.

6-6. The four steps of IPB (per ATP 2-01.3) adequately describe the process required for the SSE to provide the space operations input to IPB. However, as part of the overall mission analysis effort, step 4 also supports the space running estimate with linkage to the army warfighting functions. This is done because the SSE must evaluate the overall capability of the threat to attack or degrade space operations, and this needs to be reflected in graphic format as part of the space input to the IPB. The four IPB steps are:

- Define the OE;
- Describe environmental effects on operations;
- Evaluate the threat; and
- Determine threat courses of action.

STEP 1—DEFINE THE OPERATIONAL ENVIRONMENT

Identification of Space Area of Interest

6-7. Step 1 begins with identification of the supported unit area of operations. Once the area of operations is identified, the area of interest is coordinated with the intelligence cell. Based on a clear understanding of the operational commander's area of operations, the intelligence cell specified area of interest, and the supported unit mission, the SSE determines a separate and distinct space area of interest. The space portion of the area of interest supports and complements the total intelligence cell and movement and maneuver cell effort and is designed to depict the relevance of space to the maneuver commander's engagement.

6-8. The space portion of the area of interest includes the region above and adjacent to the ground portion of the area of operations as illustrated in figure 6-1. The SSE may further subdivide the space area of interest in named area of interests that roughly correspond to low, medium, geosynchronous, and highly elliptical orbits. It starts at ground level, continues through LEO, and terminates with the GEO and above. Satellites moving through the identified space area of interest, space weather, and key terrestrial space-related locations (and associated terrestrial weather) are all considered in the space input to IPB. Space-related activity occurring anywhere outside of the designated space area of interest (such as space weather, space launches, and ground station activity) needs to be considered in this effort only if it directly impacts the operational mission. Identification of the space area of interest should help answer questions, such as:

- What is the status and capabilities of U.S. satellites to support the mission?
- Is the satellite orbit conducive to support operations within the area of operations?

Initial Examination

6-9. Once the space area of interest is identified, the SSE begins an initial examination, in conjunction with the other staff elements, of available information and knowledge gaps that need to be addressed. During the initial examination, the following issues may help determine the information and knowledge gaps and areas where space assets may be requested:

- The operational status of friendly space systems, availability, and importance to mission accomplishment.
- Initial assessment of commercial space, and how it may impact both enemy and friendly operations;
- Impact of terrestrial and space weather on mission operations; and
- Initial assessment of enemy space capabilities;

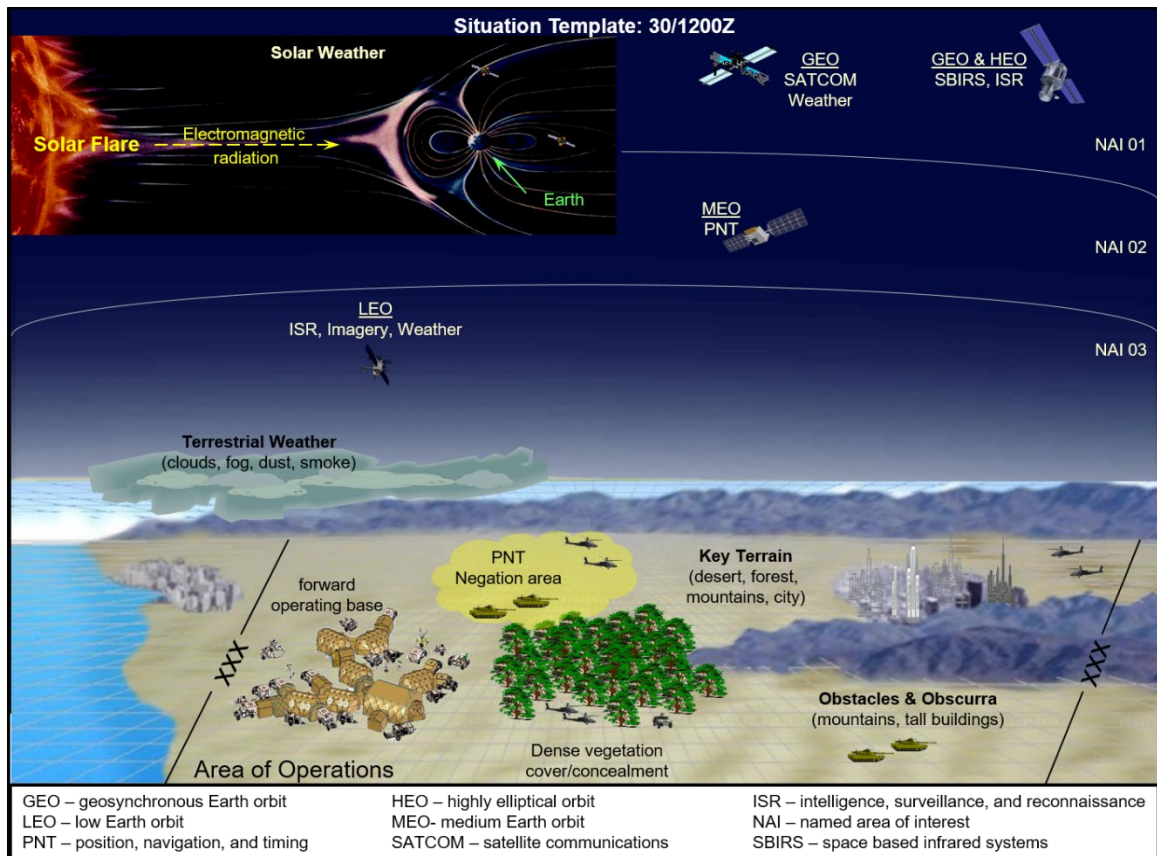


Figure 6-1. Situation template with space area of interest

STEP 2—DESCRIBE ENVIRONMENTAL EFFECTS ON OPERATIONS

6-10. Step 2 includes terrestrial and space weather and terrain analysis relevant to space capabilities. Care is taken during this step to limit the focus to the weather and terrain impacts on space operations; otherwise there is duplication with the intelligence cell effort. In fact, this step is conducted in close coordination with the intelligence cell staff weather officer and terrain team to ensure a complementary effort.

Impact of Space Weather

6-11. The first task of step 2 is to examine the impact of space weather on mission operations. The space environment consists of the full range of electromagnetic radiation and charged particles (electrons and protons, which constitute solar wind) that continually flow from the sun at varying intensities. Several types of solar activity cause energetic particle streams to intensify the normal (or background) levels of solar wind. These changes in solar wind speed and density disturb the Earth's magnetic field as they sweep by, creating geomagnetic and ionospheric storms. The fundamental drivers of space weather activity include solar flares (a rapid, intense variation in solar brightness, including a release of radiation across the EMS) and coronal mass ejections (huge bubbles of plasma ejected from the sun which may reach Earth in as little as 15 hours). These space weather disturbances may potentially degrade both commercial and military capabilities for periods ranging from several minutes to a few hours. More extreme impacts such as loss of system performance are less likely. The potential for space weather to disrupt friendly, civil, commercial, and enemy space systems needs to be integrated early during step 2. Impacts may include space-to-space, space-to-ground, and ground-to-ground communications, radar, and optical sensors across all portions of the EMS. Table 6-1 (page 6-4) is a summary of a space running estimate product reflecting the space weather effects in an area of operation, and may not be all inclusive.

Table 6-1. Space weather impact summary

<i>Space Weather Hazards</i>	<i>Impacted systems</i>	<i>Effects</i>	<i>Available support</i>
Solar flare (X-rays)	<ul style="list-style-type: none"> • High frequency communications 	<ul style="list-style-type: none"> • Shortwave fade 	<ul style="list-style-type: none"> • Shortwave fade advisory
Solar radio bursts	<ul style="list-style-type: none"> • Radars • Ultrahigh frequency satellite communications 	<ul style="list-style-type: none"> • Frequency interface • Target mask 	<ul style="list-style-type: none"> • Solar radio burst advisory
Ionospheric scintillation	<ul style="list-style-type: none"> • Ultrahigh frequency satellite communications • Global Positioning System 	<ul style="list-style-type: none"> • Signal fade • Loss of signal lock 	<ul style="list-style-type: none"> • Scintillation forecast • Post event assessment

- 6-12. The specific phenomena that need to be included in the space weather analysis effort include:
- Electromagnetic radiation that may interfere with communications and radar systems during daylight hours;
 - Energetic charged particles that degrade the performance of high-latitude, ground-based communications and radar systems and that disrupt or damage satellites; and
 - Solar wind events causing ionospheric scintillation in the polar and equatorial areas impair or disrupt SATCOM and GPS signals.

Impact of Terrestrial Weather

6-13. The second task of step 2 is determining the impact terrestrial weather will have on space operations. The staff weather officer has access to the 557th Weather Wing and to the theater specific weather support element databases of terrestrial weather information for the area of operations. The SSE tailors the staff weather officer product to the space analysis effort. For example, the impact on space capabilities will be considerably different during monsoon season in parts of the United States Indo-Pacific Command area of responsibility when compared to the stable, high pressure weather conditions which are common over much of the United States Central Command area of responsibility. The SSE develops a thorough understanding of the mission and effectively analyzes the linkage between terrestrial weather and space capabilities. The Staff Weather Officer tailors space weather information into a product that provides space weather effects on Army operations for the Army Component's area of responsibility for each COCOM.

- 6-14. Some factors related to weather analysis include, but are not limited to:
- Terrestrial weather, such as heavy precipitation, can interfere with SATCOM reception; particularly when operating in frequencies above 10 gigahertz, which includes higher portions of the super-high frequency band, as well as X-, Ku-, K-, Ka-, and extremely high frequency bands;
 - Cloud cover impacting collection of electro-optical imagery and data;
 - Interference with electro-optical, multispectral imagery, and infrared collection;
 - The high moisture content in cloud cover may hinder the infrared detection capability of missile warning sensors; and
 - Degradation of space-based infrared sensors due to cloud cover. If there is a missile threat, the SSE determines if cloud cover may inhibit detecting and reporting on threat missile launches.

Relation Between Terrain and Space Capabilities and Effects

6-15. The third task of the area of operation effects analysis effort focuses on the relation between terrain and space capabilities and effects. It must be understood that while terrestrial impacts are typically addressed in other sections of the IPB, the SSE must consider terrain impacts on the information chain. For example, in restrictive terrain, line of sight issues may restrict access to space systems and result in degraded operations. Analysis for space capabilities may be evaluated automatically or through observation and fields of fire, avenues of approach, key terrain, obstacles, cover, and concealment. Some examples of how terrain impacts space capabilities and effects are identified below.

- Mountainous terrain may impede the basic line of sight between a satellite and a ground terminal or receiver (primarily SATCOM and GPS). Communication satellites in a geosynchronous orbit with high inclinations may move the satellite in and out of the line of site of a receiver due to their ground trace. Mountains and buildings may also affect GPS accuracy. GPS signals, communications, and radar from a satellite may experience multi-pathing, which occurs when the signal is reflected off a mountains or buildings on the way to a receiver. The timing of the GPS signal is impaired which affects the accuracy of the receiver. Though this should only be a minor problem for navigation, it has the potential for a greater impact on GPS guided munitions.
- Information collections systems may also be impacted by terrain as off-center imagery collection may be blocked by mountains and tall buildings. If this happens, the satellite cannot take an image to complete its mission until another revisit provides a better angle.
- Vegetation may also be a consideration when conducting the space related terrain analysis. Dense jungles may require a higher reliance on ultrahigh frequency communications, GPS signal reception may be impeded, and panchromatic imagery will only provide a black and white image of the top of the forests with no penetration. However, multispectral imagery may be able to detect changes in vegetation (destroying, modifying, and camouflage) that indicate enemy activity.

STEP 3—EVALUATE THE THREAT

6-16. Step 3 transitions from an orientation on the environment as a whole to a detailed focus on enemy capabilities. The SSE coordinates with the intelligence cell staff for this information. The desired end effect is knowledge of adversarial space forces, the doctrinal principles that indicate how these space forces are employed, recommended space high-value targets, and an initial assessment of adversarial space courses of action.

6-17. In step 3 of the IPB process, the SSE will coordinate with the intelligence cell for an examination of key enemy space capabilities including use of civil and commercial space assets. The SSE needs to ensure the intelligence cell understands the resulting intelligence products are important and will provide support to the intelligence cell as requested. Important factors to include in step are below.

- Assist the intelligence cell in developing information requirements for intelligence support to space operations.
- A detailed review of the adversarial space threat characteristics and the potential commercial space threat characteristics available to support enemy operations. Knowledge of the space threat characteristics is the necessary first step to understanding the threat. As part of this initial analysis, the SSE needs to consider enemy counterspace capabilities.
- An identification of space capabilities that will probably be employed by the enemy in the specific operation the SSE is analyzing. These enemy space capabilities include organic space systems, third-party space capabilities, enemy access to space capabilities via consortia, and direct enemy use of commercial space assets.
- An analysis of the following factors, regarding enemy force enhancement operations:
 - Reconnaissance and surveillance. What are the near-space and space reconnaissance and surveillance systems (organic, commercial, third-party) available to support military operations? Does the enemy use space reconnaissance and surveillance for strategic or tactical operations? What are enemy tasking, collection, processing, exploitation, and dissemination capabilities for space reconnaissance and surveillance? Does the enemy have the ability to receive and disseminate information in a timely manner to support the targeting process?
 - Missile warning. Most potential adversaries have no space-based missile warning capability. However, the SSE should consider what threat ballistic and cruise missile assets are available, and the capability of friendly space-based warning systems to collect and accurately identify potential threat missile systems. The SSE does not need to analyze threat missile targeting strategies (intelligence cell role) nor attempt to duplicate the air defense role in warning and dissemination.
 - Environmental monitoring. What space weather and remote sensing assets are available to support the enemy? Determine the doctrinal employment of these systems.

- PNT. To what degree does the enemy rely on PNT? What are the key adversarial capabilities that rely on PNT? How is it incorporated into critical operations? What are other PNT alternate capabilities?
- SATCOM. What key military and commercial SATCOM systems does the enemy employ? What is the reliance of the enemy on SATCOM to perform effective mission control?
- A review of the enemy's space control capabilities, which includes:
 - Jammers, ground-based electronic warfare, direct ascent weapons, or directed energy capabilities that may be directed against friendly space assets;
 - Friendly force space capabilities that may be targeted as part of the enemy space control strategy to include satellites, data links, and ground control segments; and
 - Analysis of potential enemy space-related vulnerabilities. Examples are enemy reliance on a single ground station, a single satellite for weather support, poor resolution, or slow tasking, collection, processing, exploitation, and dissemination process for space surveillance and reconnaissance.
- A recommendation of space-related high-value targets. These high-value targets could be vulnerabilities uncovered by analysis or those used to support a specific friendly force mission objective. The SSE should assist the movement and maneuver cell in developing the targeting strategy for nominating high-value targets as part of the targeting process to provide space targeting focus to the Intelligence Cell staff. The high-value targets should be considered for potential negation operations.
- An analysis of general space-related COAs based on enemy doctrine, situation template, accessibility to space assets, and the enemy's operational objectives. Examples include:
 - What type of space capabilities will be most relied upon, such as information collection, SATCOM, and or PNT; and
 - How the enemy will attempt to attack friendly space assets and or protect their forces from U.S. space operations.

STEP 4—DETERMINE THREAT COURSES OF ACTION

6-18. Step 4 of the IPB incorporates efforts from steps 1 through 3. The key tool and most important product of step 4 is the space situation template—refer back to figure 6-1 on page 6-3. The space situation template is a depiction of the space situation: the who, what, where, when, and why of the space operations in support of the plan. It is an assessment and should be presented as such.

6-19. The situation template depicts how the staff believes space impacts the supported command operations. The SSE coordinates with the intelligence cell or staff for this information. Because it includes a detailed threat analysis, the space situation template is coordinated with the staff prior to being briefed or disseminated to the commander and staff. This template is an excellent tool to depict graphically the enemy's most probable COA as it relates to the space aspects of the fight, to include the enemy's perception of how civil, commercial, and friendly satellites are employed. The space situation template can be an important contribution to both the intelligence and the space running estimates. The space situation template is tailored to reflect the impact that enemy, civil, and commercial space systems have on the operational mission. The space situation template is the culminating piece of the space running estimate developed to support the mission analysis phase of MDMP. The following component pieces can be included in development of the space situation template. Each of these component pieces is briefed as the space capabilities analysis to help the staff clearly understand the impact of space environment on the tactical operation. When building the space situation template, consider the following:

- It is a snapshot in time (for example, 301200Z), and must be continually updated;
- It focuses on the space portion of the area of interest to show the direct relation of the space area of interest to the terrestrial maneuver area of operations;
- It depicts the general disposition of friendly and enemy maneuver forces to show the relevance of space capabilities to operations; and
- It reflects key enemy space capabilities; space related targets the enemy may attack, and other actions the enemy may take related to space environment.

6-20. The space situation template depicts friendly satellite systems that may be targeted by the enemy through uses such as SATCOM jamming or the use of camouflage, concealment and deception to deceive friendly space assets. The intelligence cell is a key contributor to this process to ensure enemy intent and space capabilities are accurately assessed in relation to the overall enemy operational objectives. The assessment includes when and where the enemy may conduct counterspace operations to degrade friendly satellites effectiveness, and whether the enemy understands the reliance the Army places on key space capabilities like SATCOM to support extended range operations. The template reflects appropriate symbology to depict this activity, such as a line from the enemy's electronic warfare system to the targeted SATCOM. The SSE will assist the intelligence cell with technical knowledge of enemy space systems and capabilities as required.

6-21. The situation template enables staff to project the most probable enemy space COA for organic, third-party, civil, and commercial space assets, such as:

- Attempts to deceive information collections during satellite over-flight through the use of deceptive activity such as troop movement, muster, decoys, and mock ups;
- Threatened use of weapons of mass destruction;
- The probable targets for enemy collection, the means by which data is collected (geospatial intelligence and signals intelligence), and the expected time delay for tasking, collecting, processing, exploiting, and disseminating data to enemy units. An example might be to anticipate the enemy will use electro-optical against a headquarters because it is a high-value target. The enemy's dissemination timelines support targeting fixed or semi-fixed facilities only;
- Attempt to jam SATCOM, or GPS to protect from precision guided munitions;
- Use commercial SATCOM for regime survival, propaganda, or command and control; and
- Critical enemy space and associated terrestrial nodes to recommend for friendly targeting of high payoff targets. If the enemy has a single point of failure for receipt of satellite imagery, this could be a high payoff target. A key part of the space running estimate effort during step 4 is the identification of enemy space-related high payoff targets.

6-22. The desired end state is, on completion of step 4, the supported commander and staffs have a thorough understanding of how space capabilities influence the pending mission, and the ability to be proactive. The completed space input to IPB will:

- Set the stage for development of Appendix 18–Space Operations to Annex C of the base order;
- Contribute to the development of the intelligence cells' Annex B–Intelligence, collection priorities, and intelligence estimates;
- Provide valid high-value target recommendations;
- Contribute to information superiority over the enemy; and
- Influence COA development and mission execution.

6-23. The space input to the IPB remains valid throughout the operation and should be updated and included in staff updates, as the situation dictates. Although it is an extensive undertaking, the intelligence cell, in coordination with the SSE, will produce tailored and effective mission variable focused space input to the IPB in a reasonable time.

SPACE RUNNING ESTIMATE

6-24. The space running estimate is a complementary product of the space input to the IPB and is provided by the SSE. It is used to recommend the best use of available space capabilities and must be accomplished in close coordination with the commander and staff elements as part of the overall planning process. The space running estimate must be regularly updated to stay current with ongoing operations.

6-25. The space running estimate should not address space reconnaissance and surveillance capabilities. The SSE should coordinate all intelligence requirements through the G-2. The format and content of the space running estimate includes the following:

- Describe the area of operation environment or space area of interest. This can be derived from the information compiled during steps one and two of space IPB;
- Assess enemy space capabilities may be derived from steps three and four of space aspects of IPB and is conducted in close coordination with the intelligence cell;
- Evaluate friendly space force capabilities;
 - Define essential, specified, and implied space tasks;
 - Define space capabilities strengths and vulnerabilities;
 - Identify operational status and relative importance of each space capability to operations function;
 - Identify space control capabilities status, relevance, and possible employment options;
 - Compare current mission requirements versus existing space capabilities' ability to support the operation; and
 - Identify additional space forces which may be necessary for the operation.
- The SSE, in coordination with the staff elements, conducts COA analysis;
 - Describe how space capabilities can support each of the identified friendly force COAs in terms such as suitability, feasibility, and completeness;
 - Identify how space capabilities will affect each COA;
 - Identify the space control strategy for each COA; and
 - The SSE recommends which COA is most supportable from a space capabilities perspective. The most supportable COA is the one where the space architecture is most capable and best suited to support. It is not necessarily the COA with the most dependencies on space capabilities.
- Identify space assumptions;
- Key members of the staff the SSE must coordinate with are:
 - G-2 for space-related intelligence, threat; and information collection issues;
 - G-3 for support to operations, commander's intent, and FFT;
 - G-6 for SATCOM and GPS;
 - Air defense cell for missile warning; and
 - Staff weather officer for terrestrial and space weather.

SATELLITE OPERATIONAL STATUS

6-26. The satellite operational status describes the status of satellites that support (or affect) the commander's area of operations. This includes analysis of key commercial satellites affecting operations to the maximum extent possible. Commercial satellite operators are obligated to provide responsive satellite capabilities to the Army or DOD users who pay for the services, and provide relevant status information through the appropriate channels. Satellites may be partially operational or nonoperational for a variety of reasons that include, but is not limited to:

- Satellite sensor malfunction;
- Satellite maintenance, maneuvering, or repositioning;
- Space environment; and
- Ground station control updating communications software or installing upgrades to satellite systems.

Appendix A

Annex C, Appendix 18 Template

The space operations officer is responsible to prepare Annex C, Appendix 18–Space Operations to of the base order. This appendix provides a format for Appendix 18 in Army plans and orders. The format for the annex can be modified to meet the requirements of the base order and operations. This chapter also includes an example information collection plan.

A-1. Appendix 18–Space Operations provides fundamental considerations, detailed information, and instructions on space forces and capabilities to Annex C of the base OPLAN or order the supported commander can use throughout the operation. Appendix 18 is used to coordinate early with the staff, to include the G-2, G-6, air defense artillery officer, and the special technical operations cell to synchronize efforts and avoid duplication of information.

A-2. Appendix 18 is the primary location for space operations, but space operations information may be found in other annexes and appendices. Complete Appendix 18 as required for amplifying details. For example, SATCOM requirements would normally be covered in Annex K by the J6 and Intelligence, Surveillance, and Reconnaissance requirements would normally be covered in Annex B by the J2. While the G-2 is responsible for producing a space threat portion in the intelligence estimate to Annex B, the SSE may contribute to this product such as providing impacts of space weather on operations. The SSE is responsible for preparing Appendix 18 to the OPLAN or OPORD. Commanders and staffs use Appendix 18 to describe how space operations support the concept of operations described in the base plan or order.

A-3. Appendix 18 uses the standard five-paragraph OPORD format and contains the information indicated in figure A-1 on pages A-2 thru A-5. All references in the content, such as Appendix 2–Operation Overlay to Annex C–Operations refer to the base plan or order. Italicized text is recommendations or amplifying information.

Note: CJCSM 3130.03A is the source document for Appendix 18 material—it takes precedence over this template if any discrepancies exist. Refer to source for additional guidance.

[CLASSIFICATION]

Place the classification at the top and bottom of every page of the attachments. Place the classification marking at the front of each paragraph and subparagraph in parentheses. Refer to AR 380-5 for classification and release marking instructions.

Copy ## of ## copies
Issuing headquarters
Place of issue
Date-time group of signature
Message reference number

Include heading if attachment is distributed separately from the base order or higher-level attachment.

APPENDIX 18–SPACE OPERATIONS TO ANNEX C OPERATION PLAN (OPLAN)/OPERATION ORDER (OPORD) [number] [(code name)]—[issuing headquarters] [(classification of title)]

(U) References: *List documents essential to understanding the attachment.*

- a. *List maps and charts first. Map entries include series number, country, sheet names, or numbers, edition, and scale.*
- b. *List other references in subparagraphs labeled as shown.*
- c. *Doctrinal references for space operations include FM 3-14, JP 3-14, and U.S. National Space Policy.*

(U) Time zone used throughout the Order: *Write the time zone established in the base plan or order.*

1. (U) Situation. *Include information affecting space operations that paragraph 1 of the OPLAN or OPORD does not cover or that needs expansion.*

a. **(U) General.** *Describe the overall general approach Army space operations will use to support mission requirement, the likelihood of operating in a denied, degraded, and disrupted space operational environment, the impact on equipment and to the mission, risk mitigation actions, and how to counter enemy actions to place friendly forces in this environment.*

(1) **(U) Area of Interest.** *Describe the area of interest as it relates to space operations. Refer to Annex B–Intelligence as required.*

(2) **(U) Area of Operations.** *Refer to Appendix 2–Operation Overlay to Annex C–Operations.*

(3) **(U) Terrain.** *Describe the aspects of terrain that impact space operations such as terrain masking. Refer to Annex B–Intelligence as required.*

(4) **(U) Weather.** *Describe the aspects of terrestrial and space weather that impact space operations. Refer to Annex B–Intelligence as required.*

b. **(U) Enemy Forces.** *List known locations and activities of enemy space capable assets and units. List enemy space capabilities that can impact friendly operations. State expected enemy courses of action and employment of enemy and commercial space assets. Refer to Annex B–Intelligence as required.*

c. **(U) Friendly Forces.** *Outline the higher headquarters' plan for space operations and space support teams including but not limited to space support elements, Army space support teams, and an organic space weapons officer. List designation, location, and outline of plans of higher, adjacent, and other space operations-related assets that support or impact the issuing headquarters or require coordination and additional support. For example, the space coordinating authority and specified processes established for the area of responsibility.*

[page number]
[CLASSIFICATION]

Figure A-1. Sample Annex C, Appendix 18–Space Operations format

[CLASSIFICATION]

**APPENDIX 18—SPACE OPERATIONS TO ANNEX C OPLAN/OPORD [number] [(code name)]—
[issuing headquarters] [(classification of title)]**

(1) (U) Interagency, Intergovernmental, and Nongovernmental Organizations. *Identify and describe other organizations in the area of operations that may impact the conduct of space operations or implementation of space-specific equipment, tactics, and capabilities. Consider all multinational, civil, and nongovernmental organizations such as civilian relief agencies and other customers and providers of space-based capabilities. Refer to Annex V—Interagency Coordination as required.*

(2) (U) Civil Considerations. *Describe the aspects of the civil situation that impact space operations. Refer to Annex B—Intelligence and Annex K—Civil Affairs Operations as required.*

(3) (U) Attachments and Detachments. *List units attached or detached only as necessary to clarify task organization. Refer to Annex A—Task Organization as required.*

d. (U) Assumptions. *List space operations-specific assumptions that support the annex development.*

2. (U) Mission. *State the mission of space operations in support of the base plan or order.*

3. (U) Execution.

a. (U) Concept of Space Operations. *Describe how space capabilities support the commander's intent and concept of operations. Establish the priorities of space support to units for each phase of the operation. For example, electromagnetic interference resolution and defended asset list. Also address unique space reliances or vulnerabilities related to unit systems and capabilities. Refer to Annex C—Operations as required.*

(1) (U) Description. *Describe how space capabilities and services support the operations. Emphasize the aspects of the Base plan that will require/affect space capabilities and services. Consider deployment timelines when on-orbit assets must be moved or deployed into the AOR.*

(2) (U) Employment. *If operations are phased, discuss the employment of space assets during each phase. Include discussion of priorities of access, usage, and capabilities in each phase.*

b. (U) Tasks. *Identify space tasks assigned to specific subordinate units, supporting command, or agency that provides support to the plan. Refer to any tasks in base order. Provide a concise statement of the task with sufficient detail to ensure that all elements essential to the operational concept are described properly. If the operation is phased, discuss the tasks of both supported and supporting commands/agencies during each phase. Identify space capabilities required to support the OPLAN, including the following specific areas as applicable:*

(1) (U) Space Situational Awareness. *Address all capabilities and effects related to space situational awareness [understanding] requirements.*

(2) (U) Positioning, Navigation, and Timing. *Provide navigational capabilities that would aid the transit of ships, aircraft, personnel, or ground vehicles and determine the course and distance traveled or position location. Provide Global Positioning System (GPS) accuracy to support GPS-aided munitions.*

(3) (U) Space Control. *Provide information on space capabilities performed by space forces, air assets, or surface assets that ensure friendly forces and deny enemy forces the unrestricted use of space and space capabilities. Identify targetable enemy assets and limitations of targeting. Address all capabilities, effects, and limitations, related to offensive or defensive space control and navigation warfare requirements. Coordinate all plans and activities with cyberspace and electronic warfare to ensure complimentary, not redundant operations, including:*

(a) (U) Defensive Space Control. *Capabilities and effects related to defensive space control.*

[page number]
[CLASSIFICATION]

Figure A-1. Sample Annex C, Appendix 18—Space Operations format (continued)

[CLASSIFICATION]

**APPENDIX 18–SPACE OPERATIONS TO ANNEX C OPLAN/OPORD [number] [(code name)]—
[issuing headquarters] [(classification of title)]**

- (b) (U) Offensive Space Control. *Capabilities and effects related to offensive space control.*
- (c) (U) Navigation Warfare. *Capabilities and effects related to navigation warfare.*

(4) (U) Satellite Communication and Satellite Operations. *Describe the space operations communications plan. Ensure defensive space priorities for satellite communication links are established and coordinated based on operational priorities. Refer to Annex H–Signal as required.*

(5) (U) Theater Missile Warning. *Provide information on the notification of enemy ballistic missile or space-weapon attacks evaluated from available sensor and sources and the possible effect on the operational area. Provide notification of friendly ballistic missile launches and the impacts on the operational areas that would require early warning of affected friendly forces and an estimated point of impact for each launch. Establish provisions, in coordination with the air defense artillery officer, to disseminate information quickly throughout the operational areas. Refer to Annex B–Intelligence, Annex D–Fires, and Annex E–Protection as required.*

(6) (U) Remote Sensing/Environmental Monitoring. *Identify and list meteorological, oceanographic, geodetic, and other environmental support information provided by space capabilities which affect space, air, surface, or subsurface activities and assets. Refer to Annex G–Engineer as required.*

(7) (U) Information Collection. *Provide information pertaining to friendly and enemy forces in or external to the operational areas that would aid in operations and force positioning. Refer to Annex L–Information Collection as required.*

(8) (U) Special Technical Operations. *Provide information on the organization and synchronization of the integrated Army and integrated joint special technical operations and alternate compensatory control measures plans in support of the commander’s objectives. Refer to Annex S–Special Technical Operations as required.*

(9) (U) Nuclear Detonation. *Provide information on the notification of detected nuclear detonations that might affect the operation and require evaluation as to yield and location. Refer to Annex B–Intelligence as required.*

(10) (U) Command and Control. *Provide information and an assessment on friendly space reliance upon satellite communications, missile warning, and network architectures. Determine how organic unit systems and equipment rely upon these communications paths (architectures)*

(11) (U) Cyberspace Electromagnetic Activities. *Integrate cyberspace electromagnetic activities to optimally synchronize their effects. Refer to Annex C–Operations as required.*

c. (U) Coordinating Instructions. *List only instructions applicable to two or more subordinate units not covered in the base plan or order. Document coordination and reachback support requests in accordance with space coordinating authority guidance such as “Space Coordinating Plans” and other directives for the area of responsibility; include unique equipment sustainment and technical points of contact.*

4. (U) Sustainment. *Identify priorities of sustainment for space operations key tasks and specify additional instructions as required. Refer to Annex F–Sustainment as required.*

a. (U) Logistics. *Identify unique sustainment requirements, procedures, and guidance to support space operations teams and operations. Specify procedures for specialized technical logistics support from external organizations as necessary. Use subparagraphs to identify priorities and specific instructions for space operations logistic support. Refer to Annex F–Sustainment and Annex P–Host-Nation Support as required.*

[page number]
[CLASSIFICATION]

Figure A-1. Sample Annex C, Appendix 18–Space Operations format (continued)

[CLASSIFICATION]

**APPENDIX 18—SPACE OPERATIONS TO ANNEX C OPLAN/OPORD [number] [(code name)]—
[issuing headquarters] [(classification of title)]**

b. (U) Personnel. Use subparagraphs to identify priorities and specific instructions for human resources support, financial management, legal support, and religious support. Refer to Annex F—Sustainment as required.

c. (U) Health System Support. Identify availability, priorities, and instructions for medical care. Refer to Annex F—Sustainment as required.

5. (U) Command and Signal.a. (U) Command.

(1) (U) Location of the Commander and Key Leaders. State the location of the commander and key space leaders such as the space coordinating authority, Combined Space Operations Center, electronic warfare officers, and other key reachback leaders.

(2) (U) Succession of Command. State the succession of command if not covered in the unit's standard operating procedures.

(3) (U) Liaison Requirements. State the space liaison requirements not covered in the unit's standard operating procedures, such as air component coordination element or multinational space officers.

b. (U) Control.

(1) (U) Command Posts. Describe the employment of space command, control, and functional chains including their location and contact information.

(2) (U) Reports. List space related reports not covered in standard operating procedures. Refer to any space coordinating authority concept of operations or guidance and Annex R—Reports as required.

c. (U) Signal. Address any space-specific communications requirements such as secure chat communications applications. These often require a lengthy approval process to tunnel through existing networks and should be specified well in advance. Refer to Annex H—Signal as required.

ACKNOWLEDGE: Include only if attachment is distributed separately from the base order.

[Commander's last name]

[Commander's rank]

The commander or authorized representative signs the original copy. If the representative signs the original, add the phrase "For the Commander." The signed copy is the historical copy and remains in the headquarters' files.

OFFICIAL:

[Authenticator's name]

[Authenticator's position]

Use only if the commander does not sign the original attachment. If the commander signs the original, no further authentication is required. If the commander does not sign, the signature of the preparing staff officer requires authentication, and only the last name and rank of the commander appear in the signature block.

TABS: List lower-level attachments (tabs, and exhibits).

DISTRIBUTION: ONLY if distributed separately from the base order, Annex C, or higher-level attachment.

[page number]

[CLASSIFICATION]

Figure A-1. Sample Annex C, Appendix 18—Space Operations format (continued)

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Glossary

The glossary lists acronyms and abbreviations and terms with Army or joint definitions, and other selected terms. Where Army and joint definitions are different, (Army) follows the term. Terms for which FM 3-14 is the proponent (authority) manual are marked with an asterisk (*). The proponent manual for other terms is listed in parentheses after the definition.

SECTION I – ACRONYMS AND ABBREVIATIONS

A2	antiaccess
AD	area denial
AOR	area of responsibility
ARSST	Army space support team
COA	course of action
COP	common operational picture
D3SOE	denied, degraded, and disrupted space operational environment
DOD	Department of Defense
DSC	defensive space control
DSCS	Defense Satellite Communications System
EME	electromagnetic environment
EMOE	electromagnetic operational environment
EMS	electromagnetic spectrum
FFT	friendly force tracking
G-2	assistant chief of staff, intelligence
G-3	assistant chief of staff, operations
G-6	assistant chief of staff, signal
GEO	geosynchronous Earth orbit
GNSS	global navigation satellite system
GPS	Global Positioning System
IPB	intelligence preparation of the battlefield
JTAGS	joint tactical ground station (Army)
KM	kilometers
LEO	low Earth orbit
MDMP	military decisionmaking process
NAVWAR	navigation warfare
NIPRNET	Non-classified Internet Protocol Router Network
OE	operational environment
OPLAN	operation plan
OPORD	operation order

OSC	offensive space control
PACE	primary, alternate, contingency, emergency
PNT	positioning, navigation, and timing
RSSC	regional satellite communications support center
SATCOM	satellite communications
SCA	space coordinating authority
SIPRNET	SECRET Internet Protocol Router Network
SSA	space situational awareness
SSE	space support element
TENCAP	tactical exploitation of national capabilities program
USASMDC	United States Army Space and Missile Defense Command
USSPACECOM	United States Space Command
WGS	Wideband Global Satellite Communications
WSOC	wideband satellite communications operations center

SECTION II – TERMS

aimpoint

(DOD) A point associated with a target and assigned for a specific weapon impact. (JP 3-60).

antiaccess

(DOD) Action, activity, or capability, usually long-range, designed to prevent an advancing enemy force from entering an operational area. Also called A2. (JP 3-0)

area denial

(DOD) Action, activity, or capability, usually short-range, designed to limit an enemy force's freedom of action within an operational area. Also called AD. (JP 3-0)

core competency

(Army) An essential and enduring capability that a branch or an organization provides to Army operations. (ADP 1-01)

defensive space control

(DOD) Active and passive measures taken to protect friendly space capabilities from attack, interference, or unintentional hazards. Also called DSC. (JP 3-14)

***denied, degraded, and disrupted space operational environment**

(Army) A composite of those conditions and influences in which space-enabled capabilities have been impaired by hostile threats or non-hostile means. Also called D3SOE.

electromagnetic environment

(DOD). The resulting product of the power and time distribution, in various frequency ranges, of the radiated or conducted electromagnetic emission levels encountered by a military force, system, or platform when performing its assigned mission in its intended operational environment. (JP 3-13.1)

electromagnetic jamming

(DOD) The deliberate radiation, reradiation, or reflection of electromagnetic energy for the purpose of preventing or reducing an enemy's effective use of the electromagnetic spectrum, and with the intent of degrading or neutralizing the enemy's combat capability. (JP 3-13.1)

Electromagnetic operational environment

(DOD). The background electromagnetic environment and the friendly, neutral, and adversarial electromagnetic order of battle within the electromagnetic area of influence associated with a given operational area. (JP 6-01)

electromagnetic spectrum

(DOD). The range of frequencies of electromagnetic radiation from zero to infinity. It is divided into 26 alphabetically designated bands. (JP 3-13.1)

friendly force tracking

(DOD) The process of fixing, observing, and reporting the location and movement of friendly forces. Also called FFT. (JP 3-09)

Global Positioning System

(DOD) A satellite-based radio navigation system operated by the Department of Defense to provide all military, civil, and commercial users with precise positioning, navigation, and timing. Also called GPS. (JP 3-14)

hazard

(DOD) A condition with the potential to cause injury, illness, or death of personnel; damage to or loss of equipment or property; or mission degradation. (JP 3-33)

hostile environment

(DOD) Operational environment in which host government forces, whether opposed to or receptive to operations that a unit intends to conduct, do not have control of the territory and population in the intended operational area. (JP 3-0)

information operations

(DOD) The integrated employment, during military operations, of information-related capabilities in concert with other lines of operation to influence, disrupt, corrupt, or usurp the decision-making of adversaries and potential adversaries while protecting our own. Also called IO. (JP 3-13)

measure of effectiveness

(DOD) An indicator used to measure a current system state, with change indicated by comparing multiple observations over time. Also called MOE. See also combat assessment; mission. (JP 5-0)

measure of performance

(DOD) An indicator used to measure a friendly action that is tied to measuring task accomplishment. Also called MOP. (JP 5-0)

mission variables

(Army) The categories of specific information needed to conduct operations. (ADP 1-01)

navigation warfare

(DOD) Deliberate defensive and offensive action to assure and prevent positioning, navigation, and timing information through coordinated employment of space, cyberspace, and electronic warfare operations. Also called NAVWAR. (JP 3-14)

negation

(DOD) In space operations, measures to deceive, disrupt, degrade, deny, or destroy space systems. (JP 3-14)

offensive space control

(DOD) Offensive operations conducted for space negation. Also called OSC. (JP 3-14)

operational variables

(Army) A comprehensive set of information categories used to define an operational environment. (ADP 1-01)

permissive environment

(DOD) Operational environment in which host country military and law enforcement agencies have control, as well as the intent and capability to assist operations that a unit intends to conduct. (JP 3-0)

planning

(Army) The art and science of understanding a situation, envisioning a desired future, and laying out effective ways of bringing that future about. (ADP 5-0)

running estimate

(Army) The continuous assessment of the current situation used to determine if the current operation is proceeding according to the commander's intent and if planned future operations are supportable. (ADP 5-0)

space asset

(DOD) Equipment that is an individual part of a space system, which is or can be placed in space or directly supports space activity terrestrially. (JP 3-14)

space capability

(DOD) 1. The ability of a space asset to accomplish a mission. 2. The ability of a terrestrial-based asset to accomplish a mission in or through space. (JP 3-14)

space control

(DOD) Operations to ensure freedom of action in space for the United States and its allies and deny an adversary freedom of action in space. (JP 3-14)

space coordinating authority

(DOD) The responsibility to plan, integrate, and coordinate space operations. Also called SCA. (JP 3-14)

space domain

(DOD) The area above the altitude where atmospheric effects on airborne objects become negligible. (JP 3-14)

space environment

(DOD) The environment corresponding to the space domain, where electromagnetic radiation, charged particles, and electric and magnetic fields are the dominant physical influences, and that encompasses the Earth's ionosphere and magnetosphere, interplanetary space, and the solar atmosphere. (JP 3-59)

space forces

(DOD) The space and terrestrial systems, equipment, facilities, organizations, and personnel, or combination thereof, necessary to conduct space operations. (JP 3-14)

space joint operating area

(DOD) The operational area, bounded by the space domain, assigned to Commander, United States Strategic Command, in which space operations are conducted. Also called SJOA. (JP 3-14)

Note. It is expected SJOA will eventually be modified to reference USSPACECOM.

space situational awareness

(DOD) The requisite foundational, current, and predictive knowledge and characterization of space objects and the operational environment upon which space operations depend. Also called SSA. (JP 3-14)

space superiority

(DOD) The degree of control in space of one force over any others that permits the conduct of its operations at a given time and place without prohibitive interference from terrestrial or space-based threats. (JP 3-14)

space weather

(DOD) The conditions and phenomena in space and specifically in the near-Earth environment that may affect space assets or space operations. (JP 3-59)

threat

(Army) Any combination of actors, entities, or forces that have the capability and intent to harm United States forces, United States national interests, or the homeland. (ADP 3-0)

vulnerability

(DOD) 2. The characteristics of a system that can cause it to be degraded (incapability to perform the designated function or mission) as a result of being subjected to a certain level of effects in an unnatural (man-made) hostile environment. (JP 3-60)

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Index

Entries are by paragraph number, unless otherwise indicated.

A

Administrative control, 3-63, 3-127
Advanced extremely high frequency, 3-35, 3-64
Air and missile defense, 1-38, 3-84, 3-89, 3-91, 4-10, 4-46, 4-63, 5-47
Antiaccess, pg. vii, 1-5, 1-38, 1-39, 1-44, 1-45, 1-48, 2-48 thru 2-55, 3-2, 3-26, 4-66
Appendix 18 to Annex C, pg. vi, pg. vii, 1-25, 4-23, 4-39, 5-9, 5-21, pg. 5-9, pg. 6-1, 6-22, A-1 thru A-3, pgs. A-2 thru A-5
Area denial, 1-5, 1-38, 1-39, 1-44, 1-45, 1-48, 2-26, 2-48 thru 2-55, 3-2, 3-26, 4-66
Army design methodology, 5-1, 5-4
Army space core competencies, 1-58
Army space coordination element, 1-29, 4-21
Army Space proponent contribution, 3-129
Army space support team, 1-26, 1-59, 3-120, 3-129, 4-5, 4-11, 4-13, 4-14, 4-21, 4-72, 4-80, pg. 5-9

B

Bandwidth comparison, pg. 2-8

C

Combined space operations center, 4-21, 4-73, pg. 5-3
Common interactive broadcast, 1-16, 1-38, 3-35
Common operational picture, 1-31, 3-86, 3-92, 3-109 thru 3-117, 4-6, 4-8, 4-47, 4-53, 5-54, 3-59
Consolidated SATCOM System Expert, 1-20, 3-49 thru 3-53, 3-63, 3-65, 3-79, 3-83, 4-72

D

Defense Satellite Communications System, 1-20, 1-21, 3-35, 3-42, 3-64, 3-70, 3-74 thru 3-77, 3-80, 3-81, 3-129

Denied, degraded, and disrupted space operational environment, 1-45, 1-59, 2-25, 2-55 thru 2-64, 2-89, 2-98, 3-4, 3-23, 3-26, 3-30, 4-3, 4-6, 4-40, 4-46, 4-48, 4-50, 4-66 thru 4-69

E

Electromagnetic environment, 1-32, 2-37, 2-38, 2-42, 2-45, 2-56, 2-57, 2-75, 3-47, 5-38, 5-72.
Electromagnetic spectrum, 1-20, 1-36, 1-50, 2-35, 2-37, 2-39, 2-42, 2-56, 2-57, 2-59, 2-65, 2-66, 2-68, 2-71, 2-74, 2-76, 2-79, 2-97, 3-19, 3-25, 3-131, 3-135, 5-10, 6-11

F

Frequencies, 2-39 thru 2-41, 2-74
Friendly force tracking, 1-15, 1-18, 1-31, 1-61, 2-31, 3-10, 3-14, 3-108 thru 3-115, 1-29, 3-129, 4-45, 4-50, 4-56, 4-64, 4-72, 5-59, 6-25

G

Geosynchronous Earth orbit, 1-52, 1-53, pg. 1-13, 4-30, 6-8
Global Broadcast Service, 1-20, 1-30, 3-64, 3-129, 4-72
Global navigation satellite system, 1-18, 1-19, 1-45, 3-25 thru 3-30, 3-132, 3-135, 4-29, 4-45
Global Positioning System, 1-18, 1-52, pg. 1-13, 2-24 thru 2-31, 2-64, 2-77, 3-11 thru 3-19, 3-21, 3-23, 3-26, 3-98, 3-101, 3-111, 4-45, 4-46, 4-50, 4-60, 4-62, pg. 5-3, 5-59, 6-12, 6-15, 6-21, 6-25, pg. A-3

H

Hazard, 2-3, 2-59, 2-61, 2-67 2-77
High altitude operations, 1-41 thru 1-43, 1-61

I

Integrated broadcast service, 1-16, 1-38, 3-117
Intelligence, Information operations, cyber, electronic warfare, and space, 1-41 thru 1-43
Intelligence preparation of the battlefield, pg. vii, 1-9, 1-23, 3-29, 3-96, 3-97, 5-17, 5-35, 6-1 thru 6-6, 6-8, 6-15, 6-17, 6-18, 6-22 thru 6-25

J

Joint friendly force tracking, 1-31, 1-61
Joint Tactical Ground Stations, 1-22, 1-61, 3-84, 3-90, 3-129, 4-72

L

Legal considerations, 1-16, 2-86, 4-6, 4-24, 4-61, 5-26, 5-31, pg. A-5
Low Earth orbit, 1-52 thru 1-54, 1-56, pg. 1-13, 4-30, 6-8

M

Medium Earth orbit, 1-52, 1-53, pg. 1-13
Military decisionmaking process, 1-23, 2-32, 4-5, 4-22, 5-1, 5-4, 5-12 thru 5-14, 5-28, pg. 5-4, pgs. 5-6 thru 5-9, 5-36, 6-4, 6-19
Missile warning, 1-15, 1-26, pg. 1-13, 2-5, 2-7, 2-8, 2-24 thru 2-27, 2-30, 2-38, 2-46, 2-67, 3-1, 3-38, 3-84 thru 3-94, 3-129, 4-21, 4-45, 4-46, 4-50, 4-54, 4-56, 4-64, 4-72, pg. 5-3, 5-59, 6-14, 6-17, 6-25, pg. A-3, pg. A-4
Mission variables, pg. vii, 2-13, 2-32 thru 2-34, 5-2, 5-18, pg. 5-5, 6-4
Mobile User Objective System, 1-21, 3-35, 3-39 thru 3-41, 4-44, 3-64, 3-129, 4-72

N

Navigation warfare, 1-19, 1-59, 1-60, 2-25, 2-85, 2-86, pg. 3-1, 3-20, 3-25

thru 3-30, 3-129, 3-131, 3-132, 3-135, 4-46, 4-56, 4-64, pg. A-4

O

On-orbit assets, 1-21, 2-60, 2-89, 3-7, 3-69, 4-29, 4-75, pg. A-3
 Operation order, 4-39, 5-24, A-2, pg. A-2
 Operation plan/planning, 1-59, 2-71, 2-73, 2-74, 3-58, 3-126, 4-7, 4-9, 4-12, 4-24, 4-31, 4-77, 5-4, 5-10, 5-12, 5-27, pg. 5-4, pg. 5-6, 5-27, 6-2, A-1, A-3, pg. A-3
 Operational control, 1-27, 3-79, 3-126, 3-127
 Operational variables, pg. vii, 2-13, 2-19 thru 2-22, 2-32, 2-33
 Orbital characteristics, 1-52, pg. 1-13, 3-88
 Orbits, 1-51 thru 1-56, pg. 1-13, 2-79, 2-93, 3-11, 3-88, 4-30, 5-41, 6-8, 6-15
 Overhead persistent infrared, 1-22, 1-36, 1-38, 3-84, 3-89, 3-92, 4-46, 4-50

P

Positioning, navigation, and timing, 1-1, 1-15, 1-18, 1-19, 1-31, 1-49, pg. 1-13, 1-60, 2-4, 2-7, 2-8, 2-24 thru 2-27, 2-29, 2-46, 2-60, 2-64, 2-67, 2-85, 2-86, 3-10, 3-25, 3-26, 3-28, 3-36, 3-96, 3-100, 3-111, 3-129, 4-4, 4-54, 4-56, 4-58, 4-60, 4-62, 4-64, 4-69, pg. 5-3, 6-17, pg. A-3

R

Regional satellite communications support center, 1-20, 3-49, 3-50, 3-52, 3-54 thru 3-79, 3-83, 3-129, 4-72
 Risk management, 2-59, 2-77, 2-82 thru 2-85, 4-63, 5-17, pg. 5-5

S

Satellite communications System Expert, 3-49 thru 3-53, 4-72, 4-75
 Satellite communications, 1-1, 1-7, 1-15, 1-19 thru 1-21, 1-25, 1-29 thru 1-31, 1-37, 1-39, 1-49, 1-52, 2-8, 2-24 thru 2-28, 2-30, 2-41, 2-46, 2-60, 2-67, 2-85, 2-86, pg. 3-1 3-10, 3-21, 3-31 thru 3-65, 3-68, 3-72, 3-74 thru 3-76, 3-79, 3-83, 3-96, 3-98, 3-100, 3-102 3-115, 3-129, 3-137, 3-138, 4-20, 4-45, 4-46, 4-49, 4-50, 4-54, 4-56, 4-58, 4-60, 4-62, 4-64, 4-69, 4-72, 4-75, 5-59, 6-12, 6-14, 6-

15, 6-17, 6-20, 6-21, 6-25, A-2, pg. A-4

Commercial satellite communications, 1-20, 1-30, 2-24, 2-26, 2-27, 2-28, 3-31, 3-32, 3-37, 3-44 thru 3-47, 3-54, 3-55, 3-64, 3-129, 6-17, 6-21, pg. A-2

Narrowband satellite communications, 1-20, 1-21, 1-29, pg. 2-8, 3-35, 3-37, 3-39 thru 3-41, 3-44, 3-52, 3-54, 3-56, 3-70, 3-129
 Protected band satellite communications, 1-20, 1-30, pg. 2-8, 3-35, 3-37, 3-43, 3-54, 3-64, 3-129

Wideband satellite communications, 1-20, 1-21, 1-29, pg. 2-8, 3-35, 3-37, 3-42, 3-44, 3-45, 3-53, 3-54, 3-64, 3-70, 3-76, 3-129, 4-72

Satellite reconnaissance advanced notice, 4-45

Satellite operations, 1-15, 1-21, 1-26, 2-25, pg. 3-1, 3-48, 3-55, 3-67, 3-69 thru 3-73, 3-129, 3-138, 4-54

Space capabilities, 1-15
 Space control, vi, 1-15, 1-17, 1-19, 1-26, 1-27, 1-10, 1-45, 1-59, 1-60, 2-6, 2-7, 2-24, 2-25, 2-58, 2-81, pg. 3-1, 3-20 thru 3-24, 3-26, 3-28, 3-120, 3-129, 3-132, 4-54, 4-56, 4-62, 4-64, 4-82, pg. 5-3, pg. 5-5, 6-2, 6-3, 6-17, 6-25, pg. A-4

Space control planning team, 1-27, 1-40, 3-120

Space coordinating authority, pg. vi, 1-28, 4-16, 4-21, 4-77 thru 4-82, pg. A-2, pg. A-4, pg. A-5

Space operational environment, 1-45, pg. 2-2, pg. 5-5, pg. 5-6
 Contested, pg. 2-9

Space operations across the joint model, 2-65 thru 2-76

Space planner, 2-3, 2-22, 2-47, 4-23, 4-28, 4-31 thru 4-40, 5-7 thru 5-12, 5-14 thru 5-25, 5-29, 5-30, 5-43

Space planning, 1-26, 1-28, 2-83, 2-88, 4-13, 4-17, 4-37, 4-76, pg. 5-2, 5-14, pg. 5-4

Space Policy, 2-91

Army, vii, 2-91, 2-92, 2-99 thru 2-101, 2-102

Department of Defense, 2-91, 2-92, 2-97, 2-102

National, vii, 2-91, 2-92, 2-93, 2-95, 2-102, pg. A-2

Space segments, 1-49, 2-46, 3-24

Space situational awareness, pg. vi, 1-15, 1-17, 1-26, 1-40, 1-49, 2-5, 2-24 thru 2-29, 2-94, 2-95, 3-2, 3-5 thru 3-9, 3-21, 3-70, 3-73, 3-78, 3-100, 3-129, 4-7, 4-8, 4-13, 4-21, 4-27, 4-

28, 4-54, 4-56, 4-62, 4-64, 4-72, pg. A-3, pg. A-4

Space situation template, pg. 6-3

Space superiority, pg. vi, 1-8, 2-6

Space support element, 1-25, 1-26, 1-59, pg. 4-1, 4-7 thru 4-14, 4-17 thru 4-23, 4-79, 4-80, 5-12, pg. 5-3, pg. 5-9, 5-49 thru 5-56, 6-3 thru 6-9, 6-13 thru 6-20, 6-23 thru 6-25, A-2, pg. A-2

Special Operations Forces, 1-26, 4-65

T

Tactical control, 3-126

Tactical exploitation of national capability program, 1-15, 1-33, 1-34, 3-38, 3-121 thru 3-124

Targeting 1-18, 1-19, 1-25, 1-37, 2-24, 2-25, 2-31, 2-35, 2-64, 3-10, 3-14, 3-28, 3-34, 3-38, 3-132, 4-6, 4-10, 4-25, 4-26, 4-40, 4-41, 4-45, 4-57, 4-59, 4-60, 4-82, 5-10, 5-17, 5-30 thru 5-40, 5-43, 5-45, 6-17, 6-21, pg. A-4

Target activities, 5-30

Theater event system, 3-84, 3-89 thru 3-91

Theater missile warning, 1-22, 3-84, 3-90, 3-92, 4-21, pg. A-3

Threat, 1-8, 1-44, 1-45, 2-3, 2-44 thru 2-47, 2-49 thru 2-56, 2-59 thru 2-61, 2-65 thru 2-67, 2-77 thru 2-81, 2-83 thru 2-85, 5-17, 6-6, 6-17 thru 6-19, 6-21

Training considerations, 4-66 thru 4-69

U

Unified command plan, 4-73

Unified Land Operations, pg. v, 1-1, 1-5, 1-8, 1-12, 1-14, 1-18, 1-29, 1-46, pg. 2-1, 2-6, 2-18, 2-37, 2-62, 2-85, 2-92, 2-103, 2-104, 3-8, 3-26, 3-138, 4-17, 4-51

United States Space Command, 3-58, 3-61, 3-62, 3-83, 4-73, 4-75, 4-81, pg. 5-3, 6-2, 6-3

V

Vulnerability, 1-19, 1-40, 2-81, 3-4, pg. 3-7

W

Warfighting functions, 1-3, 1-11, 1-14, 1-47, 1-59, 4-5

Fires, 4-59, 4-60

Intelligence, 4-57, 4-58

Command and control, 4-53, 4-54

<p>Movement and maneuver, 4-55, 4-56</p> <p>Protection, 4-63, 4-64</p> <p>Sustainment, 4-61, 4-62</p> <p>Weather, 1-30, pg. 1-13, 2-13, 2-24, 2-30, 2-32, 2-77, 2-85, 2-93, 3-1, 3-95, 3-99, 3-101 thru 3-103, 4-45, 4-46, 4-58, 4-60, 4-62, 4-64, 6-1, 6-4,</p>	<p>6-8 thru 6-10, 6-13, 6-14, 6-25, pg. A-2</p> <p>Staff weather officer, 4-10, 4-46, 5-47, 6-10, 6-13, 6-25</p> <p>Space, 2-38, 2-77, 2-85, 2-93, 3-21, 3-96 thru 3-102, 4-58, 6-8 thru 6-14, 6-17, 6-25, 6-45, A-2, pg. A-2</p> <p>Wideband Global Satellite Communications, 1-20, 1-21, 3-35,</p>	<p>3-42, 3-64, 3-70, 3-74 thru 3-78, 3-80, 3-81, 3-129, 4-72</p> <p>Wideband Satellite Communications operations center, 1-21, 1-61, 3-55, 3-67, 3-70, 3-71, 3-74 thru 3-83, 3-129, 3-138</p>
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30 October 2019

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