CURTIS E. LEMAY CENTER
FOR DOCTRINE DEVELOPMENT AND EDUCATION

ANNEX 3-14 SPACE OPERATIONS

CATALOG OF DOCTRINE TOPICS

Introduction to Space Operations
Space Superiority
Airmen's Perspective on Space Ops
Threats to Space Operations
Space Systems
AF Space Ops throughout the ROMO
Policy Considerations
Legal Considerations

C2 of Space Forces
C2 of Global Space Forces
C2 of Theater Space Forces
Integrating Global w/Theater Space Ops
Support from Non-Military Organizations

Presentation of Forces for Space Ops
Theater Space Operations
Space Coordinating Authority
Director of Space Forces

Global & Multiple Theater Space Ops
614 AOC Organization
Space Tasking Cycle

Space Mission Areas
Space Situational Awareness

Global Space Mission Ops
Global Integrated ISR Ops
Launch Detection
Missile Tracking
Environmental Monitoring
Satellite Communications
Position, Navigation & Timing

Space Support
Assured Access to Space
Satellite Support Ops

Space Control
Defensive Space Control
Offensive Space Control

Planning (Space)

Execution (Space)

Assessment (Space)

Appendix A: Orbital Fundamentals

Appendix B: MILSATCOM Frequency Band

INTRODUCTION TO SPACE OPERATIONS

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Historically, militaries have viewed the "high ground" as essential to maintaining the advantage in warfare. With rare exception, whichever forces owned the high ground gained superior ability to maneuver and maintain visibility of the operational environment to effectively “own the fight.” In that tradition, space assets orbiting high above our planet’s surface offer a superior position and an expansive view of the Earth, as satellites can observe, collect, and disseminate information and enable command and control (C2) of US and allied forces globally.

The Air Force views space operations as integral to joint force planning and operations. Space operations involve space superiority and mission assurance. The essence of space superiority is controlling the ultimate high ground of space. However, space superiority is focused on mission assurance rather than dominating or “owning” space. The ultimate goal of achieving space superiority should be to maintain our own space capabilities when contested and ensure unhindered mission continuity through any conflict.

SPACE SUPERIORITY

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Achieving space superiority is of primary concern to the Airman as it enables the continuous provision and advantages of space-enabled capabilities to joint warfighting operations. The Air Force describes space superiority as "the ability to maintain freedom of action in, from, and to space, sufficient to sustain mission assurance." Space superiority may be localized in time and space, or it may be broad and enduring.

The above Air Force description of space superiority clarifies the definition presented in Joint Publication (JP) 3-14, Space Operations: "the degree of dominance in space of one force over another that permits the conduct of operations by the former and its related land, maritime, air, space, and special operations forces at a given time and place without prohibitive interference by the opposing force." This clarification acknowledges the physics of space orbital mechanics and treaties on international use of space prevent the Air Force from exerting "dominance" over all or portions of space. For example, it may not be practical or in our best interest to assume we can fully deny space capabilities to our adversary. Capabilities such as satellite communications may be provided by commercial entities or through multi-national partnerships. Denying these capabilities to others may equally impact friendly forces.

AN AIRMEN'S PERSPECTIVE ON SPACE OPERATIONS

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Commanders in all disciplines should have a basic awareness of the fundamental advantages and disadvantages offered by space operations in order to effectively employ space capabilities. Space is a domain—like air, land, maritime, and cyberspace—possessing unique characteristics that influence how we operate in it. Maneuver and position are not constrained by national or regional boundaries, but by the laws of physics (Appendix: Orbital Mechanics), existing treaties, and political will. Unlike surface forces that are bound by geographic operating areas, Airmen view space operations globally.

Global and theater space capabilities may be best employed when aligned under a single commander through appropriate and approved command relationships, focused expeditionary organization and equipment, distributed operations, and specialized talent. Airmen should focus on employing space forces to achieve strategic and operational effects. Two tenets of airpower have particular relevance to space operations—persistence and synergistic effects. Operating in the proverbial "ultimate high ground," space systems offer the potential for persistent overhead access. Airpower's ability to observe adversaries allows a commander to counter enemy movements with unprecedented speed and agility. Global space mission operations enable precise, coordinated application of force to achieve synergistic effects against the enemy.

Airmen should understand space capabilities are vital to joint campaign and operational planning. Integration of space capabilities occurs within Air Force, joint, and combined operations in uncontested, contested, and denied environments, and throughout the range of military operations. Since space assets like global positioning system (GPS) and Milstar complement existing capabilities (e.g., navigation aids, long-haul communication), space capabilities are inherently cross-domain integrated. The synergistic effect of combining space capabilities with land, maritime, air and cyberspace capabilities creates an operational advantage for the joint force commander (JFC). Air Force space operations often rely on partnerships with external organizations including other military services, allies, national and civil agencies, and commercial and foreign enterprises. Integration of partner space capabilities requires diligent establishment of command relationships.

THREATS TO SPACE OPERATIONS

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Airmen should be aware of a variety of threats from all domains against space operations. As access to space and space technologies become cheaper and more widely available, many countries are acquiring systems and technologies that can deceive, disrupt, deny, degrade, or destroy elements of space systems. The United States controls almost half of the active satellites in orbit and relies on space for communication, navigation, and intelligence, surveillance, and reconnaissance (ISR) using dedicated military satellites and the communication infrastructure of civil satellites.[1] The effects of potential adversarial counterspace capabilities can be reversible (temporary), such as from satellite communications jamming and cyber attacks, or non-reversible (permanent), such as from direct ascent anti-satellite (ASAT) weapons and high-energy lasers. As more nations rely on the effects derived from space, unconstrained testing of counterspace capabilities challenges the security and stability of the space environment. Neutral and environmental threats include weather, space debris, competing for limited resources such as orbital positions and electromagnetic spectrum, and unintentional signal interference. While not intended to do harm, this category of neutral and environmental threats causes increasing concern due to potential impact on space operations.

Weather. Just as weather affects air operations, space and terrestrial weather can impact satellites, their communications links, and ground segments. For example, solar storms can have a direct impact on the functioning and survivability of our satellites. Thunderstorms can degrade a ground control station's capability as well as interfere with uplinks and downlinks.[2]

Congestion. As more and more countries position assets in space, the domain is becoming more crowded. Thousands of satellites and tens of thousands of pieces of debris orbit the Earth, congesting the physical environment in which our space assets operate.[3] This increases the probability for collision among US space systems and other satellites or space debris.

Electromagnetic Interference. The demand placed on the electromagnetic spectrum continues to grow as the number of users and applications of worldwide satellite

[1] Global Threat Estimate 2010 Annual Report, *Threats to the United States Air Force.*
[2] Annex 3-59, *Weather Operations.*
[3] See generally, Committee for the Assessment of NASA's Orbital Debris Programs, National Research Council, Limiting Future Collision Risk to Spacecraft: An Assessment of NASA's Meteoroid and Orbital Debris Programs, National Academies of Science, 2011.

services increases. International spectrum management practices create uncertainty in gaining access to the required spectrum, increase the probability of interference, and impose limitations on power and coverage.

SPACE SYSTEMS

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Airmen should be aware of the interconnected nature of systems they use and how it integrates into the space system. Space systems consist of spacecraft, mission packages, ground stations, data links, launch systems, and supporting infrastructure. A data link includes the uplink and downlink signal. Data links are classified as control links for operating space systems and mission links for users to leverage space capabilities. Supporting infrastructure refers to infrastructure directly related to space operations such as space surveillance and command and control (C2).[1]

[1] JP 3-14, *Space Operations*.

ROLE OF AIR FORCE SPACE OPERATIONS THROUGHOUT THE RANGE OF MILITARY OPERATIONS

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Due to the global nature of space capabilities, space operations are conducted non-stop and integrated in virtually every military effort. Space capabilities apply across the range of military operations (ROMO) due to the continued presence and accessibility of space assets. Space forces provide an asymmetric advantage to military forces and operations whether responding to engagement, security cooperation, and deterrence operations, contingencies and crisis response operations, or major operations and campaigns. These characteristics ensure successful accomplishment of the Air Force space mission across the ROMO.

Use of space capabilities in military engagement, security cooperation, and deterrence activities helps shape the operational environment and keep the day-to-day tensions between nations or groups below the threshold of armed conflict while maintaining US global influence. In contingency and crisis response operations, space forces in collaboration with national intelligence community agencies, service components, commercial, and interagency partners provide early and persistent battlespace awareness to decision makers. For major operations and campaigns, space operations are integrated in the joint operation planning process (JOPP) at the joint force commander (JFC) level and air component level. The continuous, cyclic, and iterative nature of space operations integrates within the JOPP and does not significantly differ from planning integration of operations in other domains. The JOPP also suitably leverages the processes which the communications and intelligence communities have established for requesting space capabilities.

US military space operations must be planned and executed not only in concert with national agencies, but also as part of a larger networked team of partner nations, international consortia, and non-governmental organizations. In addition, space capabilities are already being used across the ROMO by foreign partners and have become a critical enabler for their military operations and civil economies. Commercial space services and equipment provide access to satellite communications, space imagery, and positioning navigation and timing by even the smallest of nations. A number of nations are developing and orbiting their own indigenously produced space systems.

US military resources will be highly stressed during large-scale contingencies and combat operations, so the military may rely on civil, commercial, and foreign space assets to support surges in military operations. These space assets may be leveraged

through pre-established agreements, but often must be requested on an unplanned basis. As other nations provide and access space capabilities, the United States must consider integrating them into multinational operations. Non-military space assets provide alternatives to meet the military's operational needs and should be considered

POLICY CONSIDERATIONS

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Treaties and national laws, together with national and Department of Defense (DOD) policy, guidance, and strategy provide a framework for implementing actions in space and operating under established legal principles and constraints. The United States is committed to the right of all nations to explore and use outer space for peaceful purposes. The US use of space systems in support of its defense activities is consistent with the use of space for peaceful purposes. National Space Policy (NSP) states that "purposeful interference with space systems, including supporting infrastructure, will be considered an infringement of a nation's rights."

The NSP establishes goals to strengthen stability in space and promote safe and responsible operations. Increased emphasis is placed on assurance and resilience of mission-essential functions enabled by commercial, civil, scientific, and national security space systems. Airmen are directed to develop and exercise capabilities and plans for operating in, from, and through a degraded, disrupted, or denied space environment for the purposes of maintaining mission-essential functions. Options for mission assurance may include rapid restoration of space assets and leveraging allied, foreign, and/or commercial space and non-space capabilities.

LEGAL CONSIDERATIONS FOR SPACE OPERATIONS

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While Airmen focus on deterring and preventing aggression against space infrastructure that supports US national security, they must also prepare to defeat attacks should they occur. Hostile acts against space systems could generate effects beyond the space domain, to include disrupting worldwide services upon which the civil and commercial sectors depend. Therefore, the United States retains the right to respond in self-defense, should deterrence fail, in a manner that is consistent with longstanding principles of international law and treaties to which the United States is party.

Law applicable to space operations flow mainly from treaties and customary international law. The United States has signed and ratified four major space treaties: the foundational 1967 Outer Space Treaty (addressing exploration and use, including weapons and interference); the 1968 Rescue and Return Agreement (regarding astronauts and objects); the 1972 Liability Convention (addressing damage caused by space objects); and the 1975 Registration Convention (regarding objects launched into space).[1] Additionally, general principles of international law, including those embodied in the United Nations Charter and law of armed conflict, apply to the conduct of space operations. There are also several arms control agreements impacting military space activities including the 1963 Limited Test Ban Treaty which prohibits nuclear explosions in space.[2] In addition, the US is a member of the International Telecommunications Union which allocates international frequency assignments and associated orbital slots in geosynchronous orbit. Domestically, we must consider the impact of US laws and policies on our space activities. While the space legal regime imposes a few significant constraints, the bulk of this regime provides a great deal of flexibility for military operations in space.

[1] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 1967; Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space, 1968; Convention on International Liability for Damage Caused by Space Objects, 1972; and Convention on Registration of Objects Launched into Outer Space, 1975.

[2] **Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water, 1963.**

COMMAND AND CONTROL OF SPACE FORCES

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The Unified Command Plan establishes the US Strategic Command (USSTRATCOM) as the functional unified command with overall responsibility for military space operations, except as otherwise directed.[1] The Joint Functional Component Command for Space (JFCC SPACE) is a component of USSTRATCOM and is responsible for executing continuous, integrated space operations to deliver theater and global effects in support of national and combatant commander objectives.[2] JFCC SPACE coordinates 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.

Air Force space forces are presented by the commander of Air Force Space Command (AFSPC/CC), as USSTRATCOM's commander of Air Force forces (COMAFFOR) for space operations. The 14th Air Force (14 AF) is the Component Numbered Air Force (C-NAF) for space operations—Air Forces Strategic (AFSTRAT).[3] The commander of USSTRATCOM (CDRUSSTRATCOM) has designated the commander of 14 AF (AFSTRAT) as the commander of JFCC SPACE (CDR JFCC SPACE). The 614th Air Operations Center (614 AOC) forms the core of the Joint Space Operations Center (JSpOC).

Air Forces Strategic

Three C-NAFs designated in support of USSTRATCOM carry the suffix title "Air Forces Strategic (AFSTRAT)."

8 AF (AFSTRAT)

14 AF (AFSTRAT)

20 AF (AFSTRAT)

8th Air Force and 20th Air Force are organized under Air Force Global Strike Command.

CDRUSSTRATCOM has combatant command authority (COCOM) of all space forces as assigned by the Secretary of Defense (SecDef) in the *Forces For Unified Commands* memorandum. CDRUSSTRATCOM employs these forces to support worldwide operations. Typically, CDRUSSTRATCOM retains operational control (OPCON) of assigned space forces and establishes direct support or direct liaison authority (DIRLAUTH) relationships with other combatant

[1] The Unified Command Plan, DOD Directive 3100.10 *Space Policy*, and JP 3-14 *Space Operations* (Chapter IV, para 4.a) state "except as otherwise directed" or "as directed," generally referring to direction from the SecDef.
[2] JP 3-14, *Space Operations*, states in Chapter IV, para 5.a.(1) that JFCC SPACE responsibilities exclude spacelift and ICBMs.
[3] HQ USAF Program Action Directive 10-02, C-NAF C2 Restructure, dated 2 Jun 2010.

commands and external agencies. Exceptions can occur in situations where space forces are deployed in theater to enable localized effects and be more responsive to warfighter needs. In these situations, the SecDef attaches the required forces with specification of OPCON to the geographic combatant commander (GCC). OPCON, along with the space coordinating authority (SCA) to integrate space capabilities, is typically delegated to a component commander who executes space operations taskings through a theater operations center.

The following two command relationship sections distinguish between support to global operations or multiple theater operations and support to a single theater.

C2 OF GLOBAL SPACE FORCES

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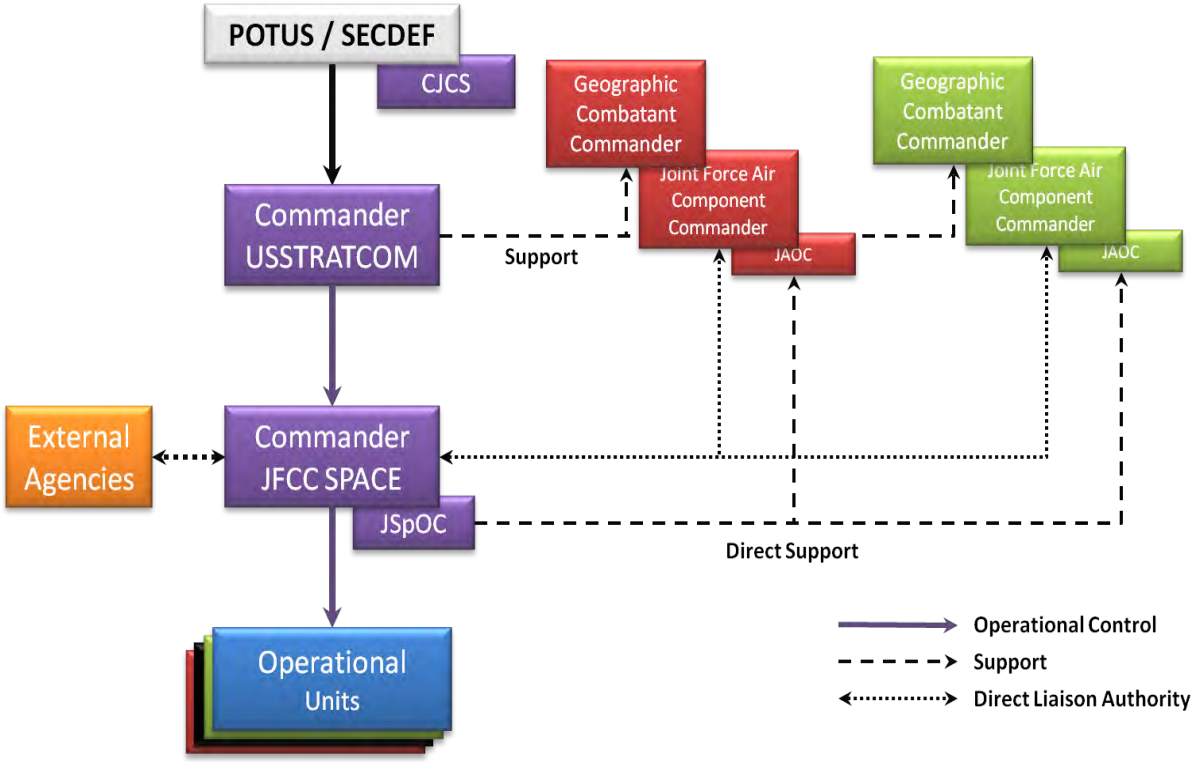
Many space assets support joint operations in more than one geographic area. Space assets may be used to fulfill single theater, multiple theater, or global objectives. Thus, the command and control (C2) structure established for integrating space assets and forces must be robust enough to account for these various operating areas. Employing space assets to meet global or multiple theater requirements normally requires a structure that bridges more than one theater and is capable of dealing with non-DOD agencies. In this case, USSTRATCOM usually provides such a structure (see figure Command Relationship for Global and Mutliple Theater Operations).



Command Relationship for Global and Multiple Theater Operations

C2 OF THEATER SPACE FORCES

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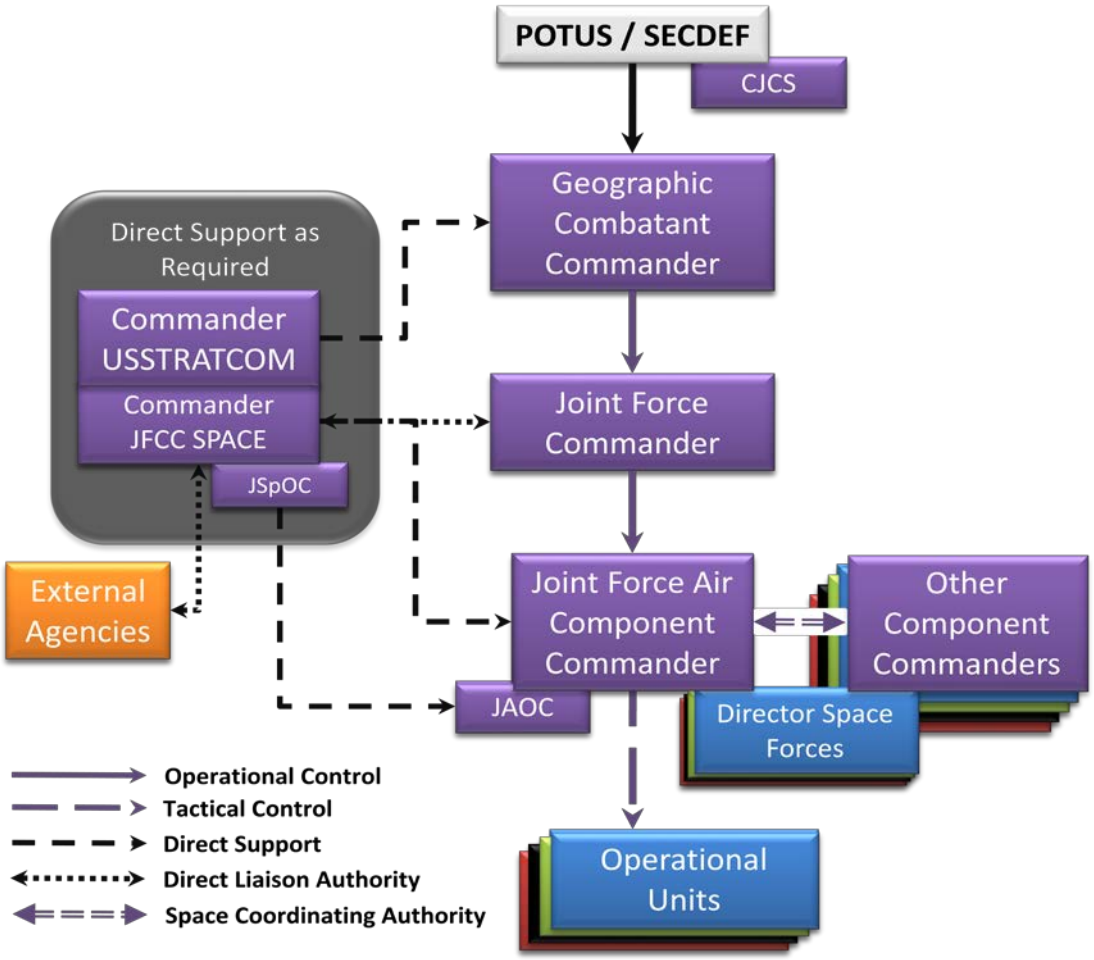
If the desired effects produced by space operations are focused primarily on a single theater, the Secretary of Defense (SecDef) may direct CDRUSSTRATCOM to attach space forces to the geographic combatant commander (GCC) of that theater. The SecDef will specify a command relationship (see figure titled Command Relationship for Theater Operations). The normal relationship for attached forces is tactical control (TACON), but a support relationship may be appropriate depending on the ability of the theater commander to command and control (C2) space operations as well as other factors like the nature and duration of the operation and the degree of integration (particularly timing and tempo) with non-space assets that is required.



Command Relationship for Theater Operations

When space forces are transferred with specification of OPCON from CDRUSSTRATCOM to a theater GCC, the GCC normally delegates OPCON to the appropriate Service component commander and TACON to the appropriate functional component commander, as required. The theater commander, Air Force forces (COMAFFOR) is the Service component commander for Air Force space forces. The functional component commander is usually the joint force air component commander (JFACC) in-theater. When the JFACC is designated in command relationships as the "supported" commander for space operations, the joint force commander (JFC) normally delegates space coordinating authority down to the JFACC to coordinate joint space operations and integrate theater and global space capabilities and effects. The COMAFFOR is normally dual-hatted as the JFACC. The COMAFFOR/JFACC is well suited to coordinate space operations because of the COMAFFOR/JFACC's ability to exercise C2 of space forces, theater-wide perspective, and expertise on staff. A director of space forces (DIRSPACEFOR) is assigned to the COMAFFOR's staff and serves as the senior space advisor to integrate space capabilities and effects. If the COMAFFOR/JFACC is delegated SCA, the DIRSPACEFOR will execute SCA responsibilities on behalf of the COMAFFOR/JFACC.

When the situation arises that there are no Air Force forces attached to a joint task force (JTF), the COMAFFOR to the GCC may be tasked in a supporting relationship to the JTF to integrate space capabilities and effects. For example, multiple JTFs in US Central Command's area of responsibility (AOR) required space-enabled effects. Dual-hatted as the theater JFACC, the COMAFFOR integrated effects for JTFs in Afghanistan, Iraq, and the Horn of Africa.

During Operation IRAQI FREEDOM, a defensive space control (DSC) unit was deployed to theater to respond to episodes of electromagnetic interference affecting critical satellite communications (SATCOM) frequencies. Since this interference was seemingly random and unpredictable, command relationships were established which allowed the combined air operations center (CAOC) to directly task the weapon system to dynamically employ real-time effects in support of combat operations.

Space experts on theater staffs facilitate space integration and operations. The Air Force embeds space expertise within its theater Service component staff and functional component (at the AOC) staff. Also, the Air Force may augment other theater staffs with space expertise to assist with tasking space operations in-theater and integrating global space capabilities and effects.

INTEGRATING GLOBAL SPACE FORCES

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When a theater requests global space forces to produce effects, the Secretary of Defense (SecDef) will specify a command relationship between CDRUSSTRATCOM and the combatant commander—normally a supporting/supported relationship. This will be employed at appropriate levels within both the supporting and supported commands. These support relationships fall into four categories: general; mutual; direct; and close support.[1]

For space forces providing effects via a support relationship, it is important for both supported and supporting commanders to document their requirements in an "establishing directive." The establishing directive should specify the purpose of the support relationship, the effect desired, and the scope of the action to be taken. Additional information includes:

- The space forces and resources allocated to the supporting commander's effort.
- The time, place, level, and duration of the supporting commander's effort.
- The relative priority of the supported commander's effort.
- The degree of authorities exercised by the supported and supporting commanders over the effort, to include processes for reconciling competing requirements and resolving emergency events expeditiously, as required.

To facilitate a support relationship, an appropriate level of coordination should occur between the involved commanders. This facilitates planning the detailed integration of space capabilities and effects with theater operations, and enables theater warfighters to coordinate directly at either the same or differing organizational levels.

Normally, CDRUSSTRATCOM retains control of global space forces. However, a theater commander may require a greater degree of command authority than specified by a support relationship. This assumes the requisite expertise and ability to command and control (C2) exist in theater. In those instances, SecDef may transfer control over specified global space forces conducting operations affecting an individual theater.

[1] JP 1, *Doctrine for the Armed Forces of the United States*, Chapter Four, Section A.

Because of the high operations tempo in the US Central Command area of responsibility (AOR) during Operations ENDURING FREEDOM (OEF) and IRAQI FREEDOM (OIF), a supporting/supported relationship was established between CDR JFCC SPACE and the commander of Air Force Central Command (AFCENT/CC). To codify this relationship, both commanders used an establishing directive to document the details of the supporting/supported relationship. In this relationship, the AFCENT/CC is the "supported" commander and the CDR JFCC SPACE is the "supporting" commander. (See vignette, Examples of Space Support.)

Examples of Space Support

General Support. During the major combat operations phase of OIF, USSTRATCOM provided general support from space operations to the Iraqi theater of operations. This support relationship helped the joint force integrate space capabilities, such as positioning, navigation, and timing from GPS, and space control-enabled effects.

Mutual Support. During the counterinsurgency phase of OIF, the combatant commander assigned the JFACC the task of space superiority. For this objective, the JFC designated the JFACC as the supported commander with other component commanders in a mutual support relationship for space operations.

Direct Support. During Operation ALLIED FORCE (OAF), a direct support relationship was established between the JFACC and 11th Space Warning Squadron (SWS). This relationship allowed the AOC to directly task 11 SWS personnel and exchange real-time information from the warning satellite for time critical actions like personnel recovery after aircraft shoot downs.

SPACE SUPPORT FROM NON-MILITARY ORGANIZATIONS

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Although not operated or controlled by USSTRATCOM, non-military US space assets also provide critical space capabilities for warfighters. Some assets belong to national agencies such as the National Aeronautics and Space Administration (NASA), National Reconnaissance Office, and National Oceanic and Atmospheric Administration (NOAA). International consortia such as Intelsat and Inmarsat own other space assets. USSTRATCOM has established coordination channels with some US non-military organizations. If not already established, a joint force commander (JFC) may request USSTRATCOM assistance in coordinating with these non-military organizations for integration of their capabilities. The Secretary of Defense (SecDef) and the combatant commanders (CCDR) develop processes to streamline discussions, policies, procedures, and rules of engagement for space forces. These assets are important in achieving space superiority for global and theater operations.

PRESENTATION OF SPACE FORCES

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Space forces are presented to the CDRUSSTRATCOM for global space operations. Air Force space forces are presented by the commander, Air Force Space Command (AFSPC/CC), as the commander, Air Force forces (COMAFFOR) to USSTRATCOM, through 14 AF (AFSTRAT) as the C-NAF for space operations. Air Force space forces conduct missions as directed by the CDR JFCC SPACE via the joint space tasking order (JSTO) developed by Joint Space Operations Center (JSpOC). During contingencies, theater support operations are conducted by forces presented in the same way; Air Force space forces are presented by the AFSPC/CC through 14 AF (AFSTRAT) to CDRUSSTRATCOM, again under the direction of the CDR JFCC SPACE via the JSTO.

In addition, the AFSPC/CC is responsible for presenting Air Force space forces to an air expeditionary task force (AETF) when they are tasked as part of a joint force or deployed to theater to conduct their mission. Within the AETF, space forces may be attached to an air expeditionary wing, group, or squadron. Attached space forces are commanded by the theater COMAFFOR who commands the AETF through an A-staff and controls forces through an air operations center (AOC). The AOC coordinates integration of space-enabled effects with the JSpOC for execution of operations by assigned, attached, or supporting space forces. Direct liaison authority (DIRLAUTH) should be authorized for coordinated planning between the AOC and 614 AOC/JSpOC.

THEATER SPACE OPERATIONS

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The joint force air component commander (JFACC) is normally delegated space coordinating authority (SCA) and designated the supported commander for space operations by the joint force commander (JFC). In cases where the JFACC is other than an Air Force officer, the commander, Air Force forces (COMAFFOR) will fill designated billets within the JFACC staff to ensure proper employment of space assets. If a JFACC is not appointed, the JFC may delegate SCA to the COMAFFOR or another component/Service commander, or opt to retain SCA.

SPACE COORDINATING AUTHORITY

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Space coordinating authority within a joint force aids in the coordination of joint space operations and integration of space capabilities and effects.[1] SCA is not a person; it is a specific type of coordinating authority delegated to a commander or individual for coordinating specific space functions and activities involving forces of two or more military departments, functional components, or two or more forces of the same Service. The commander with SCA has the authority to require consultation among the agencies involved but does not have the authority to compel agreement. The common task to be coordinated will be specified in the establishing directive without disturbing the normal organizational relationships in other matters. Coordinating authority is a consultation relationship between commanders, not an authority by which command may be exercised.

The commander with SCA serves as the focal point for gathering space requirements from the joint force commander's (JFC) staff and each component commander. This coordination provides unity of effort for space operations in support of the JFC's campaign. Space requirements may include requests for space forces (e.g., deployed space forces), requests for space capabilities (e.g., support to personnel recovery operations), and requests for implementation of specific command relationships (e.g., a support relationship between the joint force air component commander (JFACC) and CDR JFCC SPACE). The commander with SCA develops a recommended prioritized list of space requirements for the joint force based on JFC objectives. The sphere of influence and focus of SCA in theater is the joint operating area (JOA). While a commander with SCA can facilitate non-traditional uses of space assets, planning staffs should use the established processes for fulfilling intelligence and communications requirements.

Because component commanders normally execute operations, the JFC normally delegates SCA to the component commander level. Coordination should be done at the operational level because that is where requirements are prioritized to support the operations of the component commanders, which in turn support the overall campaign. Moreover, the commander delegated SCA should have a theater-wide perspective and thorough understanding of integrating space operations with all other military activities.

Delegation of SCA is tied to force assignment, and it is normally delegated to the functional component commander with the preponderance of space forces, expertise in space operations, and the ability to command and control (C2) space assets, including

[1] JP 3-14, *Space Operations*.

reachback. *Preponderance* of space forces is based on a component's space capabilities affecting the theater through the command and control (C2) of space forces assigned, attached, and supporting. Users of space capabilities are not a factor in the determination of preponderance. Preponderance is based solely on the ability to operate space capabilities and produce effects with space forces.

During contingencies, a coordinating authority for space is needed within the joint force structure to appropriately represent the space requirements of the joint force. With each component and many allies having their own organic space capability, it is necessary to integrate and deconflict among the space operations, redundant efforts, and conflicting support requests. By designating SCA for the joint force to a single commander, the JFC can optimize space operations in the JOA.

The JFC normally delegates SCA to the COMAFFOR/JFACC to facilitate unity of effort within theater space operations and with global space assets. There are several reasons for this delegation. First, the COMAFFOR /JFACC has space expertise embedded in its staff. Second, the COMAFFOR/JFACC has the ability to command and control space forces via the air operations center (AOC), including reachback to the Joint Space Operations Center (JSpOC). Last, by virtue of its air, space, and cyberspace expertise, the COMAFFOR /JFACC normally maintains a JOA, theater-wide, and global perspective. This multi-layer perspective is essential for coordinating space operations that also support the JFC throughout the theater.

Responsibilities Accompanying Space Coordinating Authority

- Recommend appropriate command relationships for space forces to the JFC.
- Establish, deconflict, prioritize and recommend military space requirements.
- Recommend guidelines for employing space capabilities, such as rules of engagement (ROE), for the joint force.
- Guide strategy development, operational planning, and space integration.
- Provide status of space assets that affect the JOA to key theater staffs.
- Maintain space situational awareness.
- Ensure optimum interoperability of space assets with coalition forces.

DIRECTOR OF SPACE FORCES

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To plan, execute, and assess space operations, the commander, Air Force forces (COMAFFOR) typically appoints a director of space forces (DIRSPACEFOR) who facilitates coordination, integration, and staffing activities. The DIRSPACEFOR is a senior Air Force officer with broad space expertise and theater familiarity, normally nominated by the commander, Air Force Space Command (AFSPC/CC) and appointed by the theater COMAFFOR.[1] In the preferred construct of a dual-hatted COMAFFOR/JFACC, the DIRSPACEFOR serves as the senior space advisor to the JFACC, in an appropriate capacity, to tailor space operations as part of the joint force commander's (JFC) campaign plan. Also, this position normally requires a support staff to coordinate requirements specific to the JOA and ongoing military operations. Because the intended scope includes coordination with both Air Force and other Service space forces, the DIRSPACEFOR accomplishes joint responsibilities, especially given the normal situation where the JFACC is delegated space coordinating authority (SCA) and designated supported commander for space operations.

When the situation arises that there are no Air Force forces attached to a subordinate joint task force (JTF), the COMAFFOR to the joint force commander may be tasked in a supporting relationship to the JTF to integrate and provide space capabilities and effects. In the situation of multiple JTFs, the DIRSPACEFOR should work for the theater COMAFFOR/JFACC, who normally is delegated SCA, to provide space-enabled effects to the JTF based on JFC priorities.

The Air Force organizes, trains and equips space forces for employment during military operations based on the construct of a COMAFFOR/JFACC. However, there may be exceptional circumstances which fall outside the bounds of this construct. First, for the rare instances when the JFACC is not delegated SCA (e.g., a JFC retains SCA or delegates SCA to another component commander), the DIRSPACEFOR will continue to work space-related issues on behalf of the COMAFFOR/JFACC. Second, for the special case when the JFC chooses to organize and employ military forces through service components and does not designate a JFACC, the DIRSPACEFOR works for the COMAFFOR, who is expected to be delegated SCA. In all these special circumstances, theater-wide coordination will be the responsibility of the component

[1] AFSPC Instruction 10-202, *DIRSPACEFOR Selection, Training, and Support*

commander delegated SCA, who will normally be aided by a senior space advisor. The Air Force recommends a senior space advisor handle day-to-day SCA responsibilities on behalf of the component commander delegated SCA.

Tasks of the DIRSPACEFOR

- Recommend appropriate command relationships for space forces.
- Advise on establishment, deconfliction, and prioritization of operational military space requirements.
- Recommend policies for employing space capabilities, such as ROE.
- Provide senior space perspective for strategy and daily guidance development, effects and target selection, and space integration throughout joint operations.
- Monitor status of space forces that affect the JOA and provide status to JFC staff and components.
- Maintain space situational awareness.
- Request space inputs from JFC staff during planning and operations.
- Coordinate optimum interoperability of space assets with coalition forces.
- Execute day-to-day SCA responsibilities on behalf of the JFACC or represent the JFACC's equities if SCA is retained by or delegated to another commander.
- Advise the COMAFFOR on command and control of Air Force space forces if another component is designated JFACC.

GLOBAL AND MULTIPLE THEATER SPACE OPERATIONS

Last Updated: 19 June 2012

USSTRATCOM executes space operations based on global requirements for national defense, requests from multiple theaters, and maintenance of on-orbit space assets. When forces are employed, execution of the JSTO is a dynamic undertaking that requires timely deconfliction and integration with other elements of the theater campaign. Integrating various space-related or space-based capabilities is accomplished through deliberate coordination processes between the theater air operations center (AOC) and the Joint Space Operations Center (JSpOC).

The Air Force's 614 AOC forms the core of the JSpOC. It includes personnel, facilities, and equipment necessary to plan, execute, and assess space operations and integrate space capabilities. The 614 AOC tracks assigned and attached space forces/assets and provides reachback support to organic theater space personnel. The JSpOC translates CDRUSSTRATCOM's operation orders (OPORDs) and CDR JFCC SPACE guidance into the JSTO. JSTOs task and direct assigned and attached space forces to fulfill theater and global mission requirements in support of national objectives. The Joint Space Tasking Order (JSTO) cycle is flexible in order to integrate with the theater's battle rhythm.

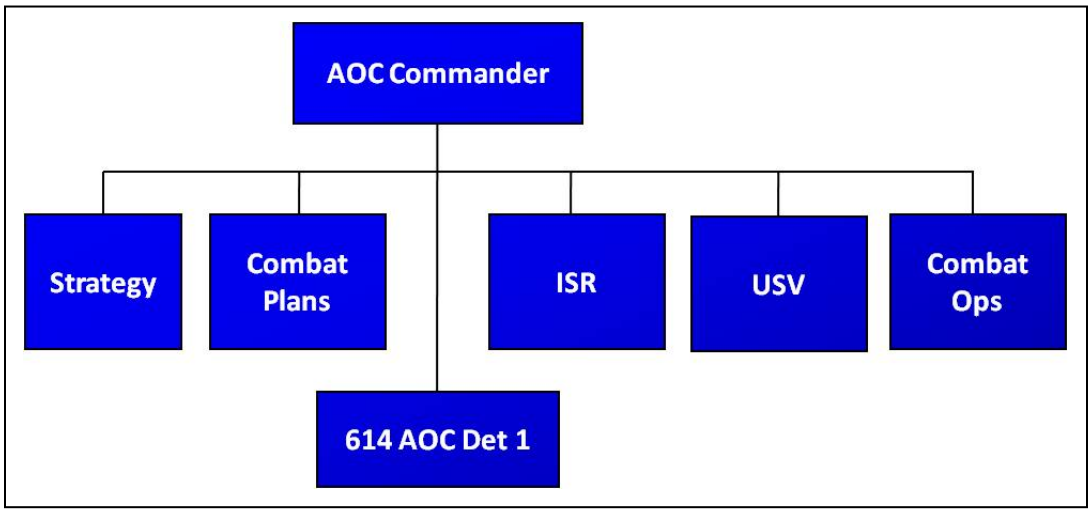
614TH AIR AND SPACE OPERATIONS CENTER

Last Updated: 19 June 2012

Because 14 AF (AFSTRAT) provides the preponderance of forces and has the ability to command and control assigned and attached forces through the 614th Air and Space Operations Center (AOC), CDRUSSTRATCOM designated 14 AF/CC as CDR JFCC SPACE. As a result, the 14 AF's (AFSTRAT) operations center forms the core of the Joint Space Operations Center (JSpOC). This section describes the 614 AOC structure, composition, and procedures which, in turn, form the structure, composition, and procedures of the JSpOC.

614 AOC/JSpOC is located at Vandenberg AFB, CA

The 614 AOC is a functional AOC that focuses on global and theater space operations. Organized along the structure of an AOC, the 614 AOC consists of five divisions (see figure titled 614 AOC/JSpOC Structure): strategy; combat plans; ISR; unified space vault (USV); and combat operations. There are also specialty teams, liaisons from other agencies and sister Service personnel to enable the 614 AOC to fulfill its responsibilities as the JSpOC. Collectively, they accomplish the main processes of strategy development, planning, tasking, collection management and intelligence analysis/production. The 614 AOC serves as the focal point for coordination and reachback support for regional space operations requirements.



614 AOC/JSpOC Structure

Strategy Division. The strategy division develops recommended long-term and short-term strategies to achieve USSTRATCOM and theater objectives by developing, refining, disseminating, and assessing strategy. This is normally presented through the joint space operations plan (JSOP) and space operations directive (SOD), which is used to guide tasking order development. During crisis action planning, it is expanded or modified to meet the crisis situation. The strategy division is organized into three teams: strategy plans team; strategy guidance team; and operational assessment team.

Combat Plans Division. The combat plans division performs operational planning to develop execution orders for joint space operations. The combat plans division builds the master space plan (MSP) and publishes and disseminates the JSTO. This document applies specific space capabilities and assets to accomplish tasks in fulfillment of global USSTRATCOM and/or theater missions. The combat plans division is divided into four teams: MSP team; JSTO production team; human space flight support; and the joint overhead persistent infrared planning cell.

ISR Division. The ISR division (ISRD) is focused on providing the strategic, operational, tactical, and technical knowledge about adversary capabilities necessary to effectively plan US operations. Since knowledge of adversary capabilities, tactics, strengths, and weaknesses is necessary to optimally plan and execute both offensive and defensive operations, ISRD personnel support all 614 AOC/JSpOC divisions. ISRD activities include conducting the intelligence preparation of the operational environment (IPOE), reporting and generating requirements on adversary orders of battle, enemy courses of action (COA), identifying and tracking critical indicators of pending foreign activity, recognizing and predicting foreign patterns and behavior, developing ISR strategy and plans for JFCC SPACE ISR assets, and providing target system analysis and target nomination lists. The ISRD is divided into four teams: analysis, correlation, and fusion; targeting and combat assessment; ISR operations; and senior intelligence duty officer.

Unified Space Vault Division. The USV division is the focal point for operational employment, protection, and C2 of space forces in support of joint and national special programs through all levels of conflict. The division exploits space situational awareness to formulate strategy, conduct planning, and execute offensive and defensive space control operations on behalf of CDR JFCC SPACE. The USV division is comprised of three branches: national systems; directed energy; and space control.

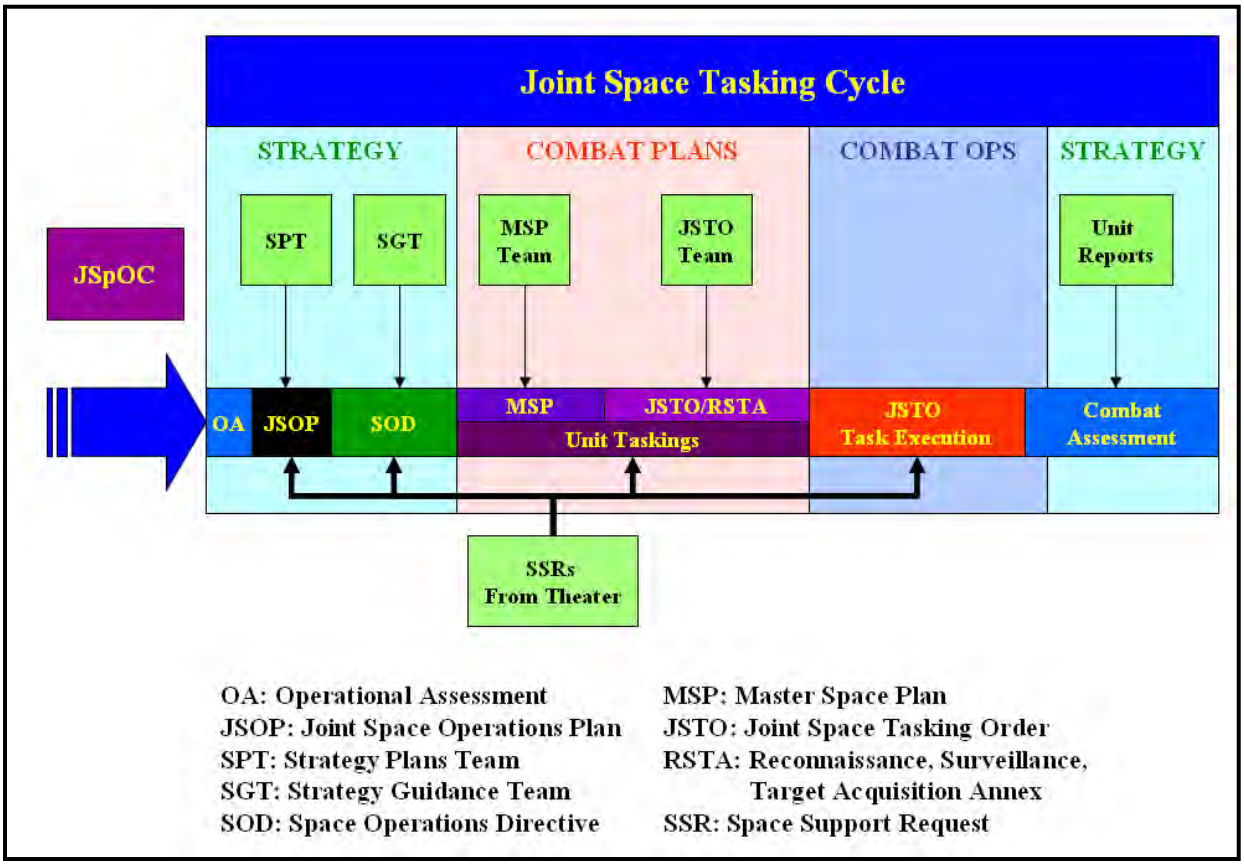
Combat Operations Division. The combat operations division (COD) monitors execution of the current tasking order and publishes any required changes. The COD maintains space situational awareness (SSA) and provides a 24/7 reachback interface for theater AOCs. Timely coordination between the COD and each tasked wing operations center (WOC) is essential for effective tasking order execution. Wing commanders and their squadrons receive orders, directives, and other guidance from the 614 AOC/JSpOC through the WOC. The COD is divided into four branches: current operations; force enhancement; SSA operations; and defensive operations.

614 AOC Detachment 1. Detachment 1 of the 614 AOC is located in Dahlgren, VA and known as the Distributive Space Command and Control - Dahlgren (DSC2-D) Detachment. DSC2-D monitors execution of the current tasking order and publishes any required changes. The DSC2-D maintains space situational awareness and, when required, provides a 24/7 reachback interface for theater AOCs. DSC2-D provides the COD a backup command and control capability during those instances when the JSpOC is unable to perform those functions.

SPACE TASKING CYCLE

Last Updated: 19 June 2012

The space tasking cycle (see figure titled Space Tasking Cycle)[1] follows an expanded Air Tasking Order (ATO) model and is based on the six-step tasking cycle described in Annex 3-0. Instead of a three-day product, a seven-day product is normally produced for execution. However, the cycle is flexible to integrate with the warfighter's battle rhythm requirements. For example, the Joint Space Tasking Order (JSTO) can be integrated into the ATO battle rhythm to support ATO execution.



Space Tasking Cycle

[1] JFCC SPACE C2 CONOP.

SPACE MISSION AREAS

Last Updated: 19 June 2012

Air Force Space Command identifies three overarching mission areas: global space mission operations (GSMO); space support (SS); and space control (SC). All three mission areas are supported by space situational awareness (SSA). In comparison, national policy, DOD policy, and joint doctrine identify four mission areas: space force enhancement; SS; SC; and space force application.[1] In Air Force doctrine, the mission area of space force enhancement is reorganized and renamed GSMO; and the Air Force's capabilities previously addressed under space force application are discussed in Annex 3-70, *Strategic Attack*, and Annex 3-72, *Nuclear Operations*. All mission areas and functional capabilities play a vital role in the ability of space forces to achieve space superiority and enable mission assurance.

Space superiority is a crucial first step in any military operation. Space operations attain and maintain a desired degree of space superiority by allowing friendly forces to exploit space while denying an adversary's ability to do the same (e.g., surveillance, protection, prevention, and negation).

The Air Force integrates space capabilities across the spectrum of military operations, whether as a single Service or in conjunction with other Services in joint operations. The US military as a whole is dependent on the use of space capabilities in all types of warfare to maintain an advantage over our adversaries. However, while US military capabilities are evolving rapidly due to the use of space, there are indications that potential adversaries are not only beginning to exploit space for their benefit, but also for purposes harmful to our national interests.

Space Mission Area Nomenclature

In Air Force doctrine, the change from space force enhancement to GSMO more specifically describes force-enhancing capabilities such as environmental monitoring, SATCOM, and missile tracking as global operations that extend to national interests beyond military operations.

Additionally, the capabilities normally associated with the joint doctrinal concept of space force application—ballistic missile defense and force projection—are contained in more appropriate areas of Air Force doctrine.

Today, we must assume that an adversary has access to the benefits of space and plan accordingly. The reality is that space capabilities, at one time limited to a few space-

[1] National Space Policy 2010, DOD Directive 3100.10, *Space Policy*, and JP 3-14, *Space Operations*. See the glossary and references for a description of these four mission areas.

faring nations, are now commercially available to any adversary who challenges our advantage. Additionally, since today's space infrastructure is largely unprotected, our space capabilities, as a center of gravity, could be prime targets for hostile exploitation and attack.

SPACE SITUATIONAL AWARENESS

Last Updated: 19 June 2012

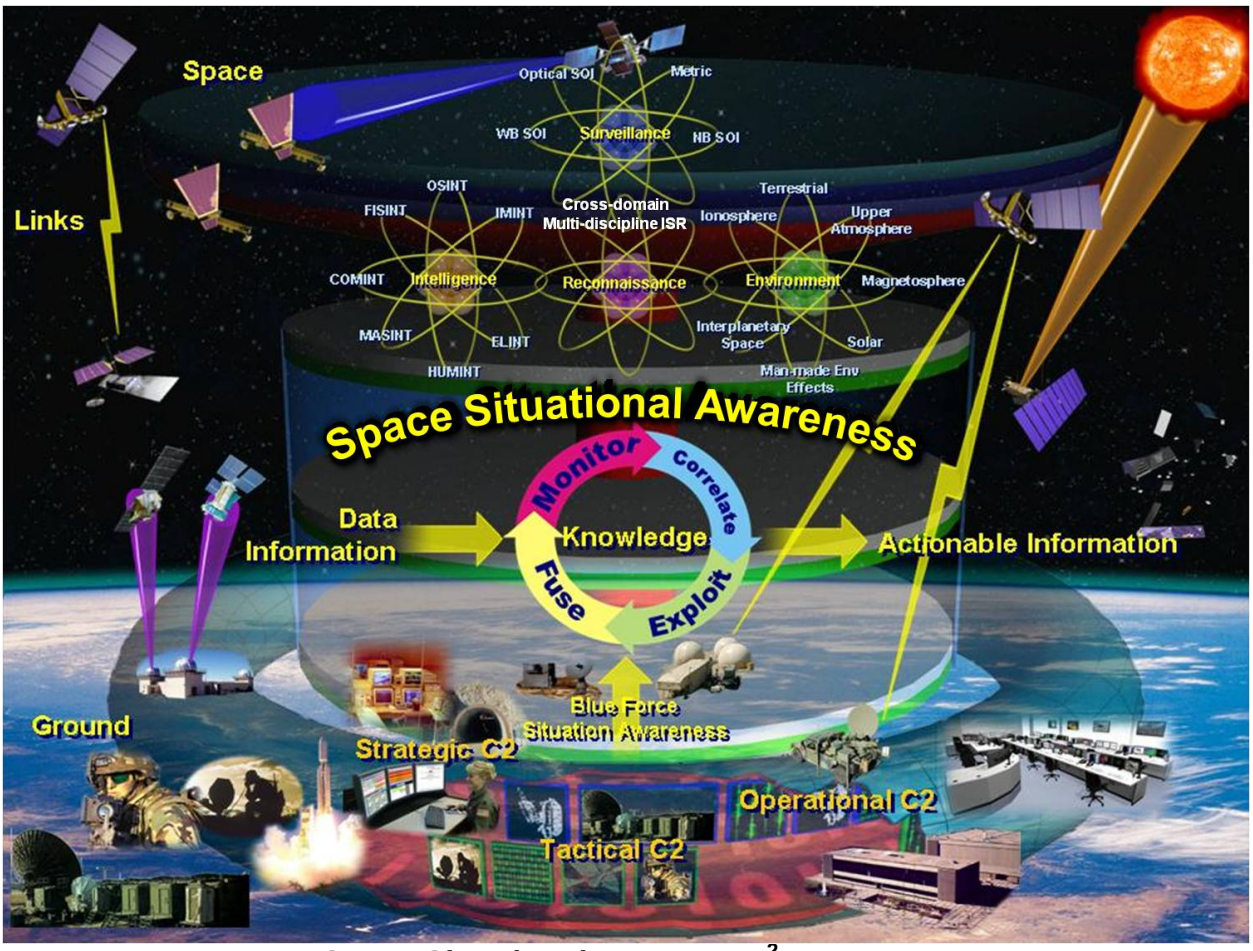
Space situational awareness (SSA) is vital to space superiority because it enables all other space operations. JP 3-14 defines space situational awareness as the requisite current and predictive knowledge of the space environment and the operational environment upon which space operations depend as well as all factors, activities, and events of friendly and adversary space forces across the spectrum of conflict.[1]

SSA includes components of intelligence, surveillance, and reconnaissance (ISR), space environmental monitoring, and space warning functions. An important distinction of these components of SSA is that they *focus on* space, so that they enable SSA of the space domain. The discussion later in this annex describes the mission area of global space mission operations (GSMO) discusses other components of ISR, environmental monitoring, and warning that *derive from* space, i.e., from space-based assets.

SSA leverages ISR capabilities and analysis of the space domain, including the status of US and cooperative satellite systems and US, allied, and coalition space readiness. Further, SSA integrates all-source intelligence to help characterize foreign threats to our space capabilities.

SSA supports several key objectives, including: ensuring spaceflight safety; protecting space operations and assets; implementing and verifying international treaties and agreements; enhancing terrestrial military operations; and supporting national security and strategy. See the figure title, Space Situational Awareness, for a graphic depiction of SSA, and see JP 3-14 for a more detailed description of SSA.

[1] JP 3-14, *Space Operations*.



Space Situational Awareness[2]

Space situational awareness contributes to overall battlespace awareness required for planning and executing operations. SSA provides knowledge of the space medium, intelligence on space systems, and correlation of effects—all of which are vital in protecting space systems. Accurate prediction of the space environment allows proactive asset management, such as turning solar arrays parallel to oncoming meteor showers to minimize damage or repositioning satellites to avoid collision. Space system information, combined with the ability to correlate effects, allows operators to predict and avoid electromagnetic interference and fratricide against friendly space systems. Likewise, SSA is necessary to predict and defend Air Force space systems from potential adversary attack. SSA is crucial to accurately determining space system failures, whether from environmental effects, unintentional interference, or attack, giving decision makers and commanders information needed to pursue appropriate actions. Finally, SSA provides detailed intelligence on adversary space systems and programs, enabling Air Force space control planning, execution, and assessment.

[2] Operational View 1 of Enabling Concept For Space Situational Awareness, Oct 2007

SSA Components: ISR

The ISR component of SSA is focused *on* the space domain itself, which differs from the space-based ISR function discussed later in this chapter. ISR is considered to be an indivisible and holistic process, but an understanding of the role of ISR in SSA requires a detailed discussion of the individual components.

Intelligence. Intelligence is the product resulting from the collection, processing, integration, evaluation, analysis, and interpretation of available information concerning foreign nations, hostile or potentially hostile forces or elements, areas of actual or potential operations, or other areas that may support our national security. The process used to perform this analytical function is called intelligence preparation of the operational environment.[3] Intelligence is a domain-neutral term. For SSA, intelligence provides the characterization and analysis of foreign (adversary and third-party) space order of battle and capabilities, to include foreign use of space systems to their advantage. Characterization may include how forces and assets operate, their impact upon military operations, their vulnerabilities and strengths, or their indications of hostile intent. Indications and warning (I&W) is an intelligence function to detect and report time-sensitive intelligence information on foreign developments that could involve a threat.[4] Characterization and analysis of space capabilities supports planning of defensive measures and targeting for offensive operations. Reliable, timely, and accurate intelligence also supports combat assessment.

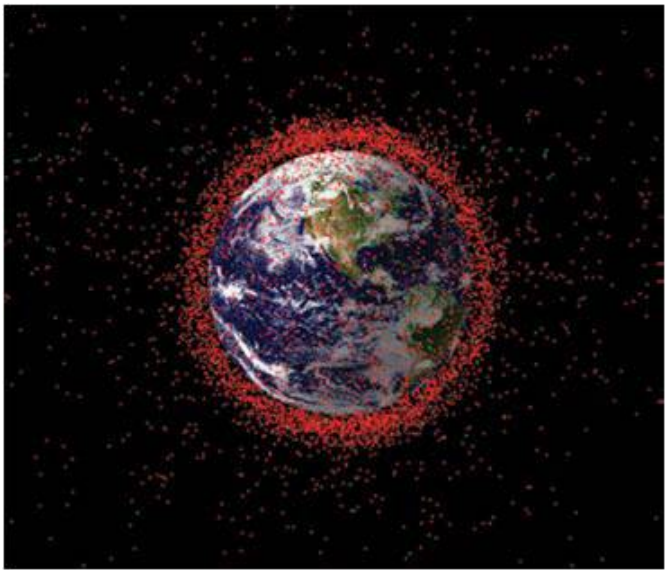
Requirements drive the production of all intelligence products. The intelligence community must be told what information space operators need so they can plan and execute ISR operations to meet those needs. Space operators must levy information requirements on the Air Force, Department of Defense (DOD), and national intelligence community to ensure timely and high fidelity intelligence is produced to feed SSA. Space operators must also define commander's critical information requirements, which in turn allow intelligence planners to develop priority intelligence requirements and essential elements of information. Properly defining these requirements will help guide the development of intelligence support to space operations. Intelligence operators, in turn, must be proactive in communicating with their space counterparts to ensure intelligence capabilities, options, and limitations are understood. See Annex 2-0, *Global Integrated ISR Operations* for more information.

Surveillance. Surveillance is a persistent or near-persistent observation. Surveillance, as a part of SSA, includes space surveillance and surveillance of other domains. Space surveillance is the systematic observation of man-made objects orbiting the Earth. Surveillance contributes to orbital safety, I&W of space events, and intelligence production.

Space events include satellite maneuvers, anticipated and unanticipated launches, reentries, and space weather. Space surveillance data is one source used to produce

[3] JP 2-0, *Joint Intelligence*.
[4] JP 2-0, *Joint Intelligence.*

the satellite catalog—a fused product providing locations of satellites and man-made space debris (figure on Space Debris). Satellite catalog information allows predictive orbital analysis to anticipate satellite threats and mission opportunities for friendly, adversary, and third party orbital activities. SSA also requires surveillance of other domains. By definition, SSA includes knowledge of ground and link segments as well as diverse factors such as adversary industrial base, related computer networks, and hostile intent. Surveillance of targets, such as launch facilities or adversary computer networks, can provide information that is useful in the development of SSA.



Space Debris

Reconnaissance. Reconnaissance provides detailed characterization of specific objects or locations needed to analyze and assess the operational environment. Like surveillance, reconnaissance for SSA can be divided into space reconnaissance and reconnaissance of other domains. Space reconnaissance is reconnaissance of objects or data in the space domain. Frequently, this reconnaissance takes the form of electro-optical, infrared, or radar imagery, but reconnaissance is not limited to just imagery intelligence or other forms of geospatial intelligence. Non-persistent signals intelligence of a space object may be space reconnaissance. Reconnaissance of terrestrial domains, such as human intelligence reporting on an adversary's counterspace capabilities, contributes important information to SSA. Reconnaissance data from an airborne platform imaging an adversary satellite ground station can aid in determining adversary capability or intent and provide actionable intelligence to counter enemy actions, if needed. Often, assets that perform reconnaissance are also capable of conducting surveillance.

SSA Components: Space Environmental Monitoring

SSA includes a characterization and assessment of space environment, such as solar flares, and its impact on space systems. This is done through space environmental

monitoring. This monitoring also helps predict impacts on communications links, terrestrial weather near related ground sites, and natural and man-made phenomena in outer space, such as orbital debris. This environmental information must be accurate, timely, and predictive to protect space systems and support space operations planning and execution. Predictions of natural environmental effects should be integrated with military commanders' courses of action (COA) to enhance military effects. Environmental monitoring is critical in space control operations, and is often integral to military commanders' decisions on friendly COAs. Accurate environmental monitoring improves SSA and can help operators differentiate between natural phenomena interference and an intentional attack on space systems—greatly enhancing decision makers' ability to respond appropriately.

SSA Components: Command and Control

The relationship between command and control (C2) and SSA is reciprocal. Command and control is "the battlespace management process of planning, directing, coordinating, and controlling forces and operations."[5] C2 enhances SSA by providing feedback on the status/readiness of forces and insight on how integrated space capabilities are contributing to military operations. Multiple sources of information, including C2 information, are combined to form a space common operating picture. In turn, the space common operating picture provides C2 nodes with SSA needed to plan, execute, and assess space operations.

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[5] Annex 3-30, Command and Control

GLOBAL SPACE MISSION OPERATIONS

Last Updated: 19 June 2012

The first mission area of space operations is global space mission operations. Global space mission operations (GSMO) is comprised of force-multiplying operations delivered from space capabilities to improve the effectiveness of joint military forces (air, land, maritime, space, and cyberspace) as well as support national, civil, and commercial users. GSMO capabilities include: Intelligence, surveillance, and reconnaissance (ISR); launch detection; missile tracking; environmental monitoring; SATCOM; and positioning, navigation, and timing (PNT).

GSMO increases the combat potential of the joint force, enhances operational awareness, and provides needed joint force support. GSMO also provides joint commanders access and persistence to denied areas, which are important characteristics not easily provided by air, land, or maritime capabilities. These GSMO capabilities are sometimes provided by national, civil, commercial, or foreign partners.[1]

[1] JP 3-14, *Space Operations*.

GLOBAL INTEGRATED ISR

Last Updated: 19 June 2012

Global integrated intelligence, surveillance, and reconnaissance (ISR) operations are conducted in, from, and through all domains, across the range of military operations (ROMO), in all phases of operations, and in complex uncontested, contested, and denied operating environments. Space-based sensors perform ISR operations that can contribute to battlespace awareness in all domains. ISR operations focused on the space domain were addressed in the preceding section on space situational awareness (SSA). This section discusses ISR operations conducted *from* space. ISR from space can be categorized as ISR operations in the space domain that support military operations in other domains. Space operations units typically operate military and national-level assets, including satellite payloads, ground-based radars, and other sensors which collect information to support strategic-, operational-, and tactical-level decision making. Forward units can access this data through tools and distributed operations.

Global integrated ISR is defined as cross-domain synchronization and integration of the planning and operation of ISR assets; sensors; processing, exploitation and dissemination systems; and, analysis and production capabilities across the globe to enable current and future operations.[1] ISR consists of separate elements but requires treatment as an integrated whole in order to be optimized. Whether space operations differ from air operations, the Air Force conducts global integrated ISR operations through the same five-phase process: planning and direction; collection; processing and exploitation; analysis and production; and dissemination.[2]

With proper planning and direction, ISR information can be collected, processed, exploited, analyzed, produced, and disseminated on such diverse subjects as indications and warnings (I&W) (to include ballistic missile attack), targeting analysis, friendly and adversary courses of action (COA) development, adversary capability assessment, battle damage assessment, or battlespace characterization. Types of data and information collected from space can include signals intelligence and full spectrum geospatial intelligence. The ability to dynamically re-task sensor coverage and integrate all-source ISR information is a force multiplier for military operations. Information collected from space-based sensors can be used by the space operations community, but it must also be made available to the entire ISR enterprise.

[1] Annex 2-0, *Global Integrated ISR Operations* per Core Function Master Plan for Global Integrated ISR, dated Aug 2010.
[2] Annex 2-0, *Global Integrated ISR Operations*.

For theater commands, embedded collection managers funnel intelligence collection requirements to a corresponding AOC for sensor tasking and collection. Collection requirements management (CRM) is the synchronization of timing of sensor collection with the operational scheme of maneuver and specifies what intelligence to collect. Intelligence analysts drive this process by providing theater collection managers with detailed intelligence requirements which are translated into intelligence tasking for collection assets. Collection operations management (COM) specifies how to satisfy the intelligence requirement and involves mission planning functions for sensors which the joint force commander (JFC) has operational control (OPCON). In theater commands, both CRM and COM functions typically reside at the corresponding AOCs for theater-assigned ISR assets. OPCON of military space-based ISR sensors belongs to USSTRATCOM, and the data from these sensors may service multiple theaters simultaneously. However, the concepts of COM and CRM also apply to space-based ISR sensor collection planning. The term requirements manager is used to identify those engaged in receiving, integrating, and processing requests for intelligence information and tasking and levying intelligence needs on organic, theater, and national collection systems.

Collection requirement management is primarily an intelligence staff function accomplished in conjunction with an all-source intelligence production organization. The CRM function begins with the collection plan and continues through the following tasks: (1) receipt and analysis of requirements; (2) determination of asset/resource availability and capability; (3) resource tasking or requests to task; (4) evaluation of reporting and user satisfaction; and (5) update of the collection plan.

Collection operations management is an intelligence staff function based on collection tasking and mission guidance developed in support of information requirements. The COM function relies heavily on supporting organizations that own and operate collection and exploitation assets or resources. The following tasks are associated with the function: (1) planning, scheduling, and control of collection operations; (2) execution of collection operations; and (3) exploitation and dissemination of results.

COCOM of military space-based ISR sensors belongs to USSTRATCOM, and the data from these sensors may service multiple theaters simultaneously. However, the concepts of COM and CRM also apply to space-based ISR sensor collection planning. The Defense Intelligence Agency is the defense collection manager and exercises collection management authority. TACON of some space-based ISR assets may be assigned to theater commanders. Translation of intelligence tasking to mission planning functions will still be accomplished by the units assigned to JFCC SPACE.

As with nationally-operated space-based ISR assets, juggling multiple theater intelligence tasking requests for military-operated space-based ISR assets is complex. Determining which intelligence needs are satisfied requires careful management using commonly understood ISR prioritization schemas. These prioritization schemas are intelligence discipline-specific within the entire intelligence community ensuring intelligence collection unity of effort. In general, space-based ISR sensor planning and

collection architectures now strive to use integrated, common ISR processes to ensure enterprise-level unity of effort.

LAUNCH DETECTION

Last Updated: 19 June 2012

Launch detection is accomplished by space-based and ground-based sensors to provide real-time and post-launch analysis to determine orbital characteristics and potential conjunctions with other objects in space. Detection of space launches is accomplished for both domestic and foreign launches. Launch detection data is used to evaluate events that could directly or indirectly threaten US or allied space assets. Similar to missile warning, this information is analyzed to determine potential impacts on assets so that timely warnings and recommendations for suitable countermeasures can be made. For domestic launches, this capability supports the characterization of nominal and anomalous space launch events.

MISSILE TRACKING

Last Updated: 19 June 2012

Missile tracking operations support missile warning and missile defense missions using a mix of space-based and ground-based sensors. (See figure titled Space-Based Infrared System and Phased Array Warning System for examples of space-based and ground-based systems.) These systems provide tactical warning and attack assessment information to operational command centers regarding nuclear detonations or adversary use of ballistic missiles. Tactical warning is a timely notification that a threat event is occurring or has occurred. An attack assessment evaluates component elements of the threat event including the country of origin and country(s) at risk and the type, size, and time of the event.[1]

There are two missile warning missions: strategic and theater. Strategic missile warning is notification to national leaders of a missile attack against North America, as well as attacks against allied and coalition partners. Theater missile warning is notification to geographic combatant commanders (GCC), allied and coalition partners, and forward deployed personnel. In some cases, the data or information derived from missile tracking is exchanged with other countries to provide shared early warning (SEW). Additionally, missile tracking is a major contributor to ballistic missile defense. Upgraded systems support multiple missions including missile warning, space surveillance, and missile defense.

Strategic Missile Warning.
Space-based systems usually provide the first level of immediate missile detection. Ground-based systems provide follow-on information on launches and confirmation of strategic attack. These ground-based systems include the ballistic missile early warning system, the phased array warning system, and the perimeter acquisition radar attack characterization system.

[1] JP 3-14, *Space Operations*.

Space-Based Infrared System and Phased Array Warning System

Theater Missile Warning.
The reaction time for theater forces to respond to incoming missiles is relatively short. Therefore, GCCs have adopted a strategy known as "assured" warning. This strategy weighs potentially false reports against the time required to obtain fully processed reports. GCCs have elected to receive quicker launch notifications understanding the warning could be ambiguous. The joint force commander should forward requests for theater missile warning to CDRUSSTRATCOM via approved procedures. The support request should clearly state their requirements and applicable objectives as appropriate.[2]

Shared Early Warning
The United States exchanges missile detection and warning information with its allies and coalition partners. This exchanged information is known as shared early warning. The objective of SEW is the continuous exchange of missile early warning information derived from US missile early warning sensors and, when available, from the sensors of SEW partners. Information on missile launches is provided on a near real-time basis. This information can take the form of data, voice warning, or both. The objective of SEW is to enhance regional stability by providing theater ballistic missile warning to combatant commanders (CCDRs), sponsored partner countries, and allies.[3]

Ballistic Missile Defense
Missile tracking is a vital contributor to ballistic missile defense. Voice and data information on ballistic missile launches is relayed in near-real-time to provide timely detection notification, support tactical decision-making, and provide executable data to the missile defense network. For further information on this subject, reference JP 3-01, *Countering Air and Missile Threats.*

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[2] JP 3-14, *Space Operations.*
[3] JP 3-14, *Space Operations* Appendix.

ENVIRONMENTAL MONITORING

Last Updated: 19 June 2012

Environmental monitoring is conducted *for* space and *from* space. Environmental monitoring provides data on meteorological, oceanographic, and space environmental factors that may affect military operations. Monitoring the space domain provides data that forms the basis for forecasts, alerts, and warnings on space environmental factors that may negatively impact space assets and space operations. Environmental monitoring of space, discussed earlier in this chapter, enables development of space situational awareness. Environmental monitoring from space enables development of terrestrial battlespace awareness.

A prime advantage of space-based environmental monitoring capabilities is their ability to gather data regarding remote or hostile areas, where little or no data can be obtained via surface reporting stations. For example, space-based environmental data is critical over most oceanic regions, where data can otherwise be very sparse. Environmental satellites typically gather data in the visual, infrared, and microwave spectral bands. Infrared sensors provide images that are based on the thermal characteristics of atmospheric features such as clouds and Earth features such as land masses and water bodies. This data can be used to calculate the altitude of clouds and temperature of ground or water surfaces. Thermal and visible images together provide the coverage and extent of clouds at various levels, as well as other physical features such as ice fields and snow. Current microwave sensors are used to measure or infer sea surface winds (direction and speed), ground moisture, rainfall rates, ice characteristics, atmospheric temperatures, and water vapor profiles.

Environmental monitoring capabilities from space-based assets include multispectral imagery and hyperspectral imagery which can provide joint force planners with current information on sub-surface, surface, and air conditions (e.g., trafficability, beach conditions, vegetation, and land use). Knowledge of these factors allows forces to avoid adverse environmental conditions while taking advantage of other conditions to enhance operations. Such monitoring also supports intelligence preparation of the operational environment (IPOE) by providing the commander with information needed to identify and analyze potential adversary COAs. The figure, **Defense Meteorological Satellite Program,** depicts a space-based environmental monitoring capability used for obtaining meteorological data. Environmental monitoring data may also be derived from non-DOD satellites, such as National Oceanic and Atmospheric Administration (NOAA) weather and National Aeronautics and Space Administration (NASA) research satellites, which are used by the Air Force Weather Agency and the Fleet Numerical Meteorology and Oceanography Center to support joint forces and Services.

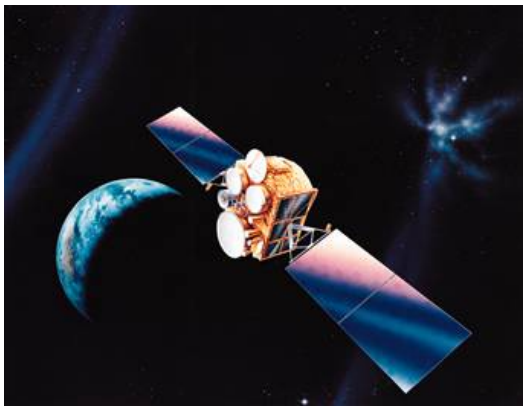
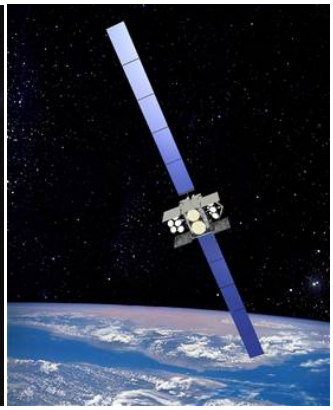
Defense Meteorological Satellite Program

SATELLITE COMMUNICATIONS

Last Updated: 19 June 2012

Satellite communication (SATCOM) provides the ability for people and governments around the world to communicate with certainty.[1] SATCOM, whether it is military, commercial, foreign, or civil provides global coverage which affords the United States and allied national and military leaders with a means to maintain strategic situational awareness and a means to convey their intent to the operational commander responsible for conducting joint operations in a specific area.[2]

Satellite communications offer many unique advantages that allow the joint force commander (JFC) and subordinate commanders to shape the operational environment. Using military SATCOM (figure Defense Satellite Communications System and Wideband Global SATCOM shows examples of military SATCOM satellites) and, in some cases, civil, commercial, and international systems, the JFC and subordinate commanders are provided a broad range of capabilities, including instant reachback to the global information grid, transmission of critical intelligence, the ability to tie sensors to shooters, and survivable communications in austere areas with limited or no infrastructure. While JFCs are apportioned SATCOM resources for planning, the actual allocation of SATCOM resources to JFCs for operations will be determined by the CDRUSSTRATCOM as the SATCOM operational manager.

Defense Satellite Communications System and Wideband Global SATCOM

[1] National Security Space Strategy, Pg i.
[2] JP 3-14, *Space Operations*.

SATCOM provides an essential element of national and DOD communications worldwide. They allow for information transfer from the highest levels of government to the theater tactical level for all matters to include operations, logistics, intelligence, personnel, and diplomacy. Frequency bands over which military satellite communications (MILSATCOM) operate are:

- Ultra high frequency for narrowband communications.
- Super high frequency for wideband communications.
- Extremely high frequency for wideband and protected band communications.

Protected band is defined as bandwidth that is specifically protected against solar/nuclear radiation using satellite hardening techniques and other threats using communications and transmission security techniques.

Commercial capabilities offer another avenue to satisfy DOD's growing information needs. Commercial systems currently support much of DOD's predictable, wideband, and fixed SATCOM needs when MILSATCOM is not available. Leasing commercial services also affords faster access to advanced capabilities and services than traditional government research, development, and acquisition programs.

There are several considerations for military use of commercial SATCOM systems. Communications may not be protected to military standards. There may be potential competition for access with other customers, including adversaries. Commercial SATCOM services may be owned by a non-US organization or controlled outside the borders of the United States. Commercial SATCOM capacity may not be accessible in areas to which the United States military may deploy, especially on short notice. Access and availability to commercial services are based on contractual terms which could be terminated at times not convenient to the military. Commercial SATCOM telemetry, tracking, and control (TT&C) links may be unencrypted, and vendors may lack the ability to identify, geolocate, and support DOD jamming or interference response.

POSITIONING, NAVIGATION, AND TIMING

Last Updated: 19 June 2012

Space-based PNT has grown into a global utility whose multi-use services are integral to US national security, economic growth, transportation safety, and homeland security, and are an essential element of the worldwide economic infrastructure. GPS is a key component of multiple sectors of US critical infrastructure.

Space-based PNT assets provide essential, precise, and reliable information that permits joint forces to more effectively plan, train, coordinate, and execute operations. Precision timing provides the joint force the capability to synchronize operations and enables communications capabilities such as frequency hopping and cryptologic synchronization to improve communications security and effectiveness. PNT also enables precision attack from stand-off distances, thereby reducing collateral damage and allowing friendly forces to avoid threat areas. JP 3-14 states “navigation warfare” ensures friendly forces have unfettered access to PNT, while denying adversarial use of the same.[1] Specialized military user equipment, signal spectrum, and security are key components of providing a navigation warfare advantage to US and allied forces. Of note, denial of the "navigation" signal may have a direct negative impact on joint systems that have nothing to do with "navigation." This is particularly true for communications systems that rely on PNT.

Space-based PNT systems, in combination with terminal units, provide the joint force with precise three-dimensional position capability, navigation options, and a highly accurate time reference. When conducting joint military operations, it is essential that PNT services be available with the highest possible confidence. PNT plays a key role in military operations in all domains. PNT capabilities are increasing across the space, control, and user segments (see figure **Positioning, Navigation, and Timing**).

[1] JP 3-14, *Space Operations*

Positioning, Navigation, and Timing

Examples of PNT Enabling Operations

PNT Enabling Land Operations. Minefields and obstacles can be accurately surveyed, emplaced, and recorded. The accuracy of artillery fire is improved through precise gun emplacement, precision gun laying, precision observer location, a reduction in adversary target location error, and precision guided artillery and mortar rounds. Armored units can travel "buttoned-up" and still maintain highly accurate position awareness.

PNT Enabling Maritime Operations. Ships and submarines can precisely plot their position, thereby allowing safe port operations and navigation through restricted waters. Coastlines can be accurately surveyed by using a combination of laser range finding and highly accurate position information. Mines can be laid and precisely plotted for friendly force avoidance and safe, efficient retrieval.

PNT Enabling Air Operations. Information on PNT enhances airdrop, air refueling, search and rescue, reconnaissance, terminal approach and recovery, low-level navigation, targeting, and precision weapons delivery. Air corridors for friendly return-to-force procedures can be set with greater accuracy, and aircraft have a greater capability to safely follow these corridors. PNT also enables near-real-time reallocation of airborne firepower for nontraditional ISR and dynamic targeting.

PNT Enabling Space Operations. PNT provides exact positioning to other satellites to enable their "position autonomy." PNT enables "orbital rendezvous" between space systems (e.g., space docking for the International Space Station). PNT also provides precise timing to communications satellites and to systems in geosynchronous orbits.

PNT Enabling Cyberspace Operations. PNT provides the timing signal that routers, data links, and a wide variety of telecommunications systems use to operate. PNT also provides the ability to geolocate other communication devices that are GPS enabled.

SPACE SUPPORT

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The second mission area of space operations, space support (SS), includes the essential capabilities, functions, activities, and tasks necessary to operate and sustain all elements of space forces throughout the full range of military operations. The SS mission area includes assured access to space, satellite support operations, and space support services.[1]

[1] While not effecting operational-level doctrine, space support services provides the following for the Air Force: space professional development; training; tactics development; logistics; acquisition; and test and evaluation.

ASSURED ACCESS TO SPACE

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Spacelift Operations. Spacelift operations are the ability to deliver satellites, payloads, and material into space. They are conducted to deploy, sustain, augment, or reconstitute space-based capabilities supporting US military operations and/or national security objectives. Spacelift operations begin with launch campaign generation—preparing the launch vehicle (LV), spacecraft and facilities for launch, performing the launch, and successfully completing the spacelift mission phases. Spacelift reconstitution of satellite constellations may require responsive spacelift, availability of replacement spacecraft, and properly trained personnel to launch and operate the systems. The figure on Wideband Global SATCOM Encapulsation and Mintaur 1 Launch, depicts encapsulation of a wideband global SATCOM satellite and lift-off of an Air Force Minotaur 1 space launch vehicle.

Wideband Global SATCOM Encapsulation and Minotaur 1 Launch

Both launch ranges are retained by the Air Force as a service administrative control (ADCON) function and therefore do not fall under the purview of USSTRATCOM. Air Force spacelift squadrons, squadrons with satellite mission control systems, and systems program offices coordinate and integrate their activities under the direction of Air Force Space Command (AFSPC) and 14th Air Force (AFSTRAT). These activities include preparing satellites and their mission payloads for launch, conducting launch and initial orbital positioning, and accomplishing on-orbit check-out. Once a satellite has passed the requisite trial period and is ready to conduct its mission, it is then presented by AFSPC to USSTRATCOM for assignment and use.

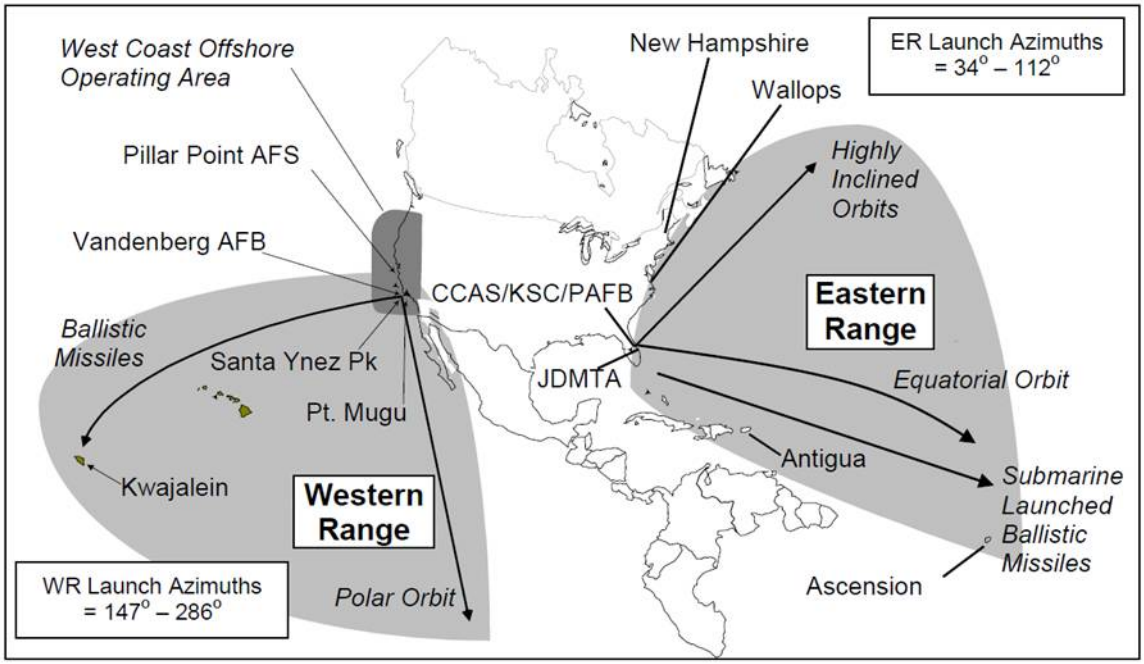
The use of commercial launch vehicles may be advantageous in certain instances to augment Department of Defense (DOD) launch capability. This aids the development of the US commercial space industry and supports the intent of the National Space Policy (NSP) to leverage alternative space capabilities. Space launches are planned well in advance (often years) and executed in accordance with the established space launch manifest (SLM). Planners must take into account long lead times involved with the SLM scheduling process.

Range Operations. Range operations are a key enabler of spacelift operations and include the capability to provide assured, responsive access to space safely and reliably. Space ranges provide operations support, launch traffic control (LTC), and scheduling services for spacelift operations, to include telemetry architectures, instrumentations sites, and flight safety systems. Launch ranges may also be responsible for planning and execution of spacecraft recovery operations.

LTC is provided via robust, responsive, flexible launch ranges and provides positive control of LVs during powered flight from lift-off to the horizon to protect the public and ensure safe passage to orbit. LTC also provides for the receipt and relay of LV mission/performance data. LTC supports the safe return of reusable launch/lift assets, such as the space shuttle follow-on and other proposed future launch systems, to designated landing sites. US Space Transportation Policy[1] states, "The federal space launch bases and ranges are vital components of the US space transportation infrastructure and are national assets upon which access to space depends for national security, civil, and commercial purposes."[2]

Air Force range operations are conducted from two launch ranges—the Eastern Range (ER) and the Western Range (WR) (see figure title **Eastern Range and Western Range**).[3] The ER supports most northern and eastern trajectory space launches with some excluded for safety restrictions. In addition to supporting DOD, National Aeronautics and Space Administration (NASA), and non-government spacelift operations, the ER supports Navy submarine launched ballistic missile (SLBM) tests as well as smaller test and evaluation operations such as the Department of Homeland Security Customs and Border Protection unmanned aerial vehicle program. The WR supports southern trajectory space launches capable of achieving polar orbits. The WR also supports intercontinental ballistic missile, Navy SLBM, and Missile Defense Agency tests.

[1] US Space Transportation Policy, 21 Dec 2004.
[2] US Space Transportation Policy, paragraph I.(6), 21 Dec 2004.
[3] AFSPC Launch and Test Range System Enabling Concept Update, 29 Sep 2009.



Eastern Range and Western Range

Routine launch capabilities are the backbone for assured access to space; however, operationally responsive space (ORS) is an emerging solution to satisfy urgent warfighter needs.[4] ORS seeks to place small class payloads into space within days-to-weeks of tasking to augment, reconstitute, or replenish critical space-based warfighting capabilities such as intelligence, surveillance, and reconnaissance (ISR) and communication. To assure delivery of space power that is operationally relevant to JFC needs, ORS will require a combination of responsive elements: spacecraft, launch vehicles, infrastructure, range support, command and control (C2), ground elements, and updated tactics, techniques, and procedures.

[4] AFSPC Functional Concept for Space Support, 29 May 2007.

SATELLITE SUPPORT OPERATIONS

Last Updated: 19 June 2012

Satellite Operations. Satellite operations are conducted to maneuver, configure, operate, and sustain on-orbit assets and are characterized as either spacecraft or payload operations. Spacecraft operations include TT&C, maneuvering, state-of-health monitoring, and maintenance sub-functions. Payload operations include monitoring and commanding the satellite payload to collect data or provide capability in the operational environment. Spacecraft and payload operations may be conducted by a single Service, multiple Services, or joint organizations. Satellite operations should include protection mechanisms to ensure access to space capabilities. This continued access is a critical service to combat support operations that enable the delivery of vital capabilities to the warfighter. Mission assurance may be achieved by a myriad of protection techniques and or technologies that may be incorporated into various parts of the satellite operations network. Additional information about protection measures can be found in the defensive space control (DSC) section of this annex.

Satellite Control Network. Department of Defense (DOD) satellites are monitored, sustained, and operated by Service component satellite operations centers. Globally-dispersed antennas for commanding satellites provide the necessary link between the satellite operations centers and the on-orbit satellites. Some systems use dedicated antennas for both mission data retrieval and routine satellite telemetry, tracking, and control (TT&C). The scheduling of this shared resource is centrally managed in order to provide optimal use of this capability to the DOD, National Aeronautics and Space Administration (NASA), and other mission partners.

On-Orbit Reconstitution. Reconstitution involves actions to restore operations following the loss of a capability. In the event of a system degradation or loss, on-orbit assets may satisfy or mitigate a capability gap by repositioning or reconfiguring other assets or by augmenting assets with civil and commercial capabilities.

Disposal of Space Vehicles. To minimize space debris and collision risk, spacecraft should be properly disposed of at their end of life. Potential options include controlled or uncontrolled atmospheric reentry, transfer to a disposal orbit, or direct retrieval. Planners should consider disposal options during life cycle development and on-orbit operations to ensure the viability of disposal at the spacecraft's end of life.

Rendezvous and Proximity Operations. Rendezvous and proximity operations (RPO) are conducted to support mission requirements such as on-orbit activities like assembly and servicing and include the potential to support a wide range of future US space capabilities. To minimize the risk of collision and the creation of orbital debris, all

RPO activities should ensure space flight safety. Rendezvous operations are specific processes where two space objects are intentionally brought close together in support of an operation. Proximity operations are on-orbit activities of a space object that deliberately and necessarily maintains a close distance from another space object for a specific purpose.

Servicing of space assets requires the capability to rendezvous, conduct close proximity operations, and/or dock with the space asset. On-orbit servicing capabilities enable inspection, repair, replacement, and/or upgrade of spacecraft subsystem components and replenishment of spacecraft consumables (e.g., fuels, fluids, cryogens, etc.). RPO may also be used to provide battlespace information on spacecraft events.

SPACE CONTROL

Last Updated: 19 June 2012

The third mission area of space operations is space control (SC). Air Force space forces execute space control operations to protect US military and friendly space capabilities while denying space capabilities to the adversary, as situations require. The National Space Policy (NSP) governs our conduct with regard to military operations in, through, or from space. The NSP charges the Department of Defense (DOD) to maintain the capability to execute the mission of space control. It further specifies: "The United States will employ a variety of measures to help assure the use of space for all responsible parties, and, consistent with the inherent right of self-defense, deter others from interference and attack, defend our space systems and contribute to the defense of allied space systems, and, if deterrence fails, defeat efforts to attack them."[1]

SC includes defensive and offensive operations. Both defensive space control (DSC) and offensive space control (OSC) operations are dependent on robust space situational awareness (SSA). Space control operations are conducted across the tactical, operational, and strategic levels of war by the entire joint force (air, space, land, maritime, cyberspace, and special operations forces). Space control operations include: protective and defensive measures to ensure friendly forces can continuously conduct space operations across the entire spectrum of conflict; and operations to deceive, disrupt, deny, degrade, or destroy adversary space capabilities.

Defensive Space Control operations preserve US/friendly ability to exploit space to its advantage. This is accomplished via active and passive actions to protect friendly space-related capabilities from enemy attack or interference. Friendly space-related capabilities include space systems such as satellites, terrestrial systems such as ground stations, and communication links. DSC operations are key to enabling continued exploitation of space by the US and its allies by protecting, preserving, recovering, and reconstituting friendly space-related capabilities before, during, and after an attack by an adversary. DSC operations may target an adversary's space control capability to ensure access to space capabilities and freedom of operations in space. Demonstrated DSC capabilities may deter adversaries from attacking US space systems by convincing them that an attack against a space system will be ineffective and will not significantly impair warfighting capabilities.

Offensive Space Control operations preclude an adversary from exploiting space to their advantage. OSC operations may target an adversary's space capability (space systems, terrestrial systems, links, or third party space capability), using a variety of

[1] National Space Policy 2010

permanent and/or reversible means. As adversaries become more dependent on space capabilities, space control operations have the ability to produce effects that directly impact their ability and will to wage war at the strategic, operational and tactical levels. Denying adversary space capabilities may hinder their ability to effectively organize, coordinate, and orchestrate a military campaign. For example, offensive space control operations may be employed against an adversary's use of satellite communications while precision bombing targets their ground-based communications network, resulting in the synergistic effect of reducing or eliminating their C2 capabilities to communicate with their forces.

Air Force space control operations support both the space control mission of USSTRATCOM and theater military operations. USSTRATCOM's space control mission includes: surveillance of space; protection of US and friendly space systems; prevention of an adversary's ability to use space systems for hostile purposes; and negation of adversarial capability, if necessary.

DEFENSIVE SPACE CONTROL

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Potential adversaries have access to capabilities that can deceive, deny, disrupt, degrade, or destroy US space capabilities. Defensive space control (DSC) operations preserve US and friendly abilities to exploit space to their advantage via passive and active actions to protect friendly space-related capabilities from enemy attack or interference.

DSC operations provide the means to deter and defend against attacks and to continue operations by limiting the effectiveness of hostile action against US space assets and forces. DSC operations include deterrence of attacks against our space systems, defense of our space systems as they come under attack, and where necessary, recovery of our space forces and assets. Given the distributed nature of space systems, a variety of forces and assets are employed to deter, defend, and recover our space capabilities from attack. Deterrence, with an emphasis on a demonstrated national policy of appropriate response to threats or attacks and the national will to respond to such threats or attacks, remains at the forefront of protection of our space system assets and forces. If deterrence fails, defense of US and friendly space capabilities from deception, denial, disruption, degradation, or destruction by an adversary is crucial to maintain space superiority. While many defensive measures are passive in nature, the ability to detect and characterize an attack on friendly space capabilities is critical for the initiation of most active measures.

The United States' space advantage is threatened by the growth in adversary counterspace capability and the adversary's increased use of space. In the past, the United States enjoyed space superiority through our technology development and exploitation, advanced information systems, and robust space infrastructure. The ability to sustain this advantage is challenging and may be eroding as our adversaries close the gap through technology sharing, materiel acquisition, and purchase of space services. Adversaries can conduct attacks against our space capabilities using multiple methods. Adversaries may have the capacity to develop counterspace capabilities or, in many cases, may simply acquire them from a third party.

Near and long-term threats include the following:

- Ground system attack and sabotage against terrestrial nodes and supporting infrastructure.
- Electromagnetic jamming equipment capable of interfering with space system links.

- Laser systems able to temporarily or permanently degrade or destroy satellite subsystems.

- Electromagnetic pulse weapons capable of degrading or destroying satellite and/or ground system electronics.

- Kinetic anti-satellite (ASAT) weapons capable of destroying spacecraft or degrading their capabilities. Direct ascent systems are best visualized as being "surface-to-space missiles," while orbital ASAT systems are also possible.

- Computer offensive cyberspace operations capabilities which can corrupt space-based and terrestrial-based computer systems used to control satellite functions and to collect, process, and desseminate mission data.

Adversaries do not need to be space-faring nations to exploit the benefits of space. Adversaries can purchase space products and services, such as imagery and communications, which may rival those available to US military forces. Adversaries may leverage US or friendly systems to their advantage as well. For example, an adversary may use the Global Positioning System (GPS) constellation for navigation. Adversary access to space decreases US advantage and increases the threat to friendly military forces.

DSC Passive Measures

DSC passive measures deter and mitigate adversary attacks against US and friendly space systems. Passive measures enhance the survivability of space systems by providing a layered defense to ensure critical space systems continue to operate both during and after attack. Known survivability measures may even deter an adversary from attempting to attack our space systems. Passive measures include the use of: camouflage, concealment, and deception (CC&D); hardening of systems; dispersal; redundancy; information assurance (IA); and operations security (OPSEC). All of these DSC passive measures are discussed below except for redundancy, which is covered later in the DSC section on recovery operations.

Camouflage, Concealment, and Deception. CC&D is most effective with terrestrial-based nodes. Certain types of ground-based components of space systems may operate under camouflage or be concealed within larger structures. These measures complicate adversary identification and targeting.

System Hardening. Hardening of space system links and nodes allow them to operate through attacks. Electromagnetic hardening techniques such as filtering, shielding, and spread spectrum help to protect capabilities from radiation and electromagnetic pulse. Physical hardening of structures mitigates the impact of kinetic effects but is generally more applicable to ground-based facilities than to space-based systems due to launch-weight considerations. Robust networks, aided by redundancy and the ability to reroute, ensure operation during and after information operations attack.

Dispersal of Space Systems. For space nodes, dispersal could involve deploying satellites into various orbital altitudes and planes. For terrestrial nodes, dispersal could involve deploying mobile ground stations to new locations. Dispersal not only applies to passive measures but also to active measures, as discussed in the DSC active measures section on maneuver/mobility later in this chapter.

Information Assurance. Information Assurance (IA) protects and defends information within our network of space systems. IA measures to prevent compromise of information include encryption and authentication of command links and encryption of data generated onboard space platforms. As with system hardening, IA measures include filtering, shielding, and spread spectrum techniques to prevent denial of information from electromagnetic jamming or interference.

Operations Security. OPSEC protects our space operations from compromise by reducing adversary access to critical information about our space forces and capabilities and indicators of activity.

DSC Attack Detection and Characterization

Effective attack detection and characterization rely on robust space situational awareness. Detecting and characterizing an adversary's attack on space systems and assessing the impact of these attacks enable DSC active measures and provide post-attack indications and warning for other space forces.

Detection. The process of attack detection confirms that a space system is under attack. The ability to quickly and accurately distinguish between hostile, unintentional, and natural events is critical to the ability to detect attacks on space systems. Without such confirmation, DSC active measures should not be undertaken. Given today's capabilities, attack detection involves the support of multiple organizations.

Characterization. Identifying the nature of the attack and the type of attack system facilitates locating the attacker and initiating COAs in response. Ideally, analysis should take place as close to the tactical level as possible, thus decreasing the amount of time between detection and identification. Analysis may often take time due to coordination between organizations involved, the need for certainty, and technological limitations. Detailed analysis may require the support of non-Air Force DOD agencies as well as non-DOD entities.

Impact Assessment. Impact assessment begins when an attack is detected. It provides an understanding of the effect an attack is having on the targeted asset, associated systems, and services provided. Accurate assessment is important, as it provides a basis for determining an appropriate response.

Location. The location of an attacker must be known to actively suppress an attack. Various support capabilities must be brought in synergistically to provide a geographic location and confirmation.

DSC Active Measures

Active measures for DSC may involve actions to avoid or remove hostile effects. Physical adjustments to the nodes and links of space systems, such as a maneuver or frequency change, may avoid hostile effects. Use of conventional or special operations forces may stop an adversary's counterspace attack. The key to these active measures is early detection and characterization of the threat in order to determine the most effective countermeasure.

Maneuver/Mobility. Satellites may be capable of maneuvering in orbit to deny the adversary the opportunity to track and target them. They may be repositioned to avoid directed energy attacks, electromagnetic jamming, or kinetic attacks from ASATs. Today, maneuver capability is limited by on-board fuel constraints, orbital mechanics, and advanced warning of an impending attack. Furthermore, repositioning satellites generally degrades or interrupts their mission. The use of mobile terrestrial nodes complicates adversarial attempts to locate and target command and mission data processing centers. However, movement of these nodes may also impact the system's capability, as they must still retain line of sight with their associated space-based systems. Though the use of mobile technology is expanding, many of today's ground-based systems are not mobile, making physical security measures essential.

System Configuration Changes. Space-based and terrestrial nodes may use different modes of operation to enhance survivability against attacks. Examples include changing radio frequency (RF) amplitude and employing frequency-hopping techniques to complicate jamming and encrypting data to prevent exploitation by unauthorized users.

Suppression of Adversary Counterspace Capabilities. Suppression of adversary counterspace capabilities (SACC) neutralizes or negates an adversary offensive counterspace system through deception, denial, disruption, degradation, and/or destruction. SACC operations can target air, land, maritime, space, special operations, or information operations in response to an attack or threat of attack. Examples of SACC operations include (but are not limited to) attacks against adversary anti-satellite weapons (before, during, or after employment), intercept of anti-satellite systems, and destruction of electromagnetic jammers or laser blinders.

DSC Recovery Operations

Recovery operations focus on restoring a disrupted space capability. Two techniques that apply to recovery operations are redundancy and reconstitution.

Redundancy. Redundancy may be incorporated into space-based or terrestrial capabilities, or within a link itself. Redundancy in equipment components allows continued operations of specific platforms in the event of onboard hardware or software malfunction. Systems may have redundancy through the use of on-orbit satellite spares or use of alternate commanding, tracking, and relay stations. Link redundancy can be achieved through the use of alternate frequencies for command or mission information along with data multiplexing techniques.

Reconstitution. Reconstitution involves actions to restore operations after an attack. It may also involve repairing equipment that has been degraded or deploying new space and terrestrial platforms to replace combat losses. Reconstitution of satellite constellations requires responsive spacelift, available replacement spacecraft, and properly trained personnel to launch and operate the systems.

DSC Resources and Forces

The following are some of the forces and weapon systems that could be used, if and when available, to support DSC operations.

Physical security systems provide security and force protection for critical ground facilities and equipment. A complementary mix of technology and security forces can effectively and efficiently mitigate specific threats in an ever-changing environment. When properly deployed and utilized, physical security systems can represent an effective deterrent and provide aggressive defense against terrestrial node attack and sabotage.

Air defense assets are capable of protecting launch and terrestrial nodes from air or missile attack. If threatened, commanders should consider deploying air defense assets such as aircraft, surface-to-air missiles, and/or antiaircraft artillery to protect critical space assets (e.g., facilities and infrastructure). A sound air defense may deter an adversary and most certainly will be instrumental in defending our forces and assets if an attack is attempted.

Attack detection and characterization systems detect space system attacks and provide information on the characteristics of the attack, especially if the source and/or capability of the attack is unknown or unexpected. These systems will support locating the source of the attack and the type of weapon used in the attack. They may be ground-, air- or space-based and either integrated with systems they protect or used in a stand-alone capacity. Having our adversaries aware of these capabilities may act as an effective deterrent and influence their decision.

Conventional and special operations forces may conduct defensive space control operations through their ability to attack adversary counterspace capabilities. A demonstrated capability and willingness to counter their space capabilities may deter an adversary from attacking US/friendly space capabilities.

OFFENSIVE SPACE CONTROL

Last Updated: 19 June 2012

Offensive Space Control Operations

Offensive space control (OSC) are those offensive operations to prevent an adversary's hostile use of US/third-party space capabilities or negate an adversary's space capabilities.[1] OSC entails the negation of adversary space capabilities through deception, disruption, denial, degradation, or destruction.

Potential adversaries have access to a range of space systems and services that could threaten our forces and national interests. Even an adversary without indigenous space assets may use space through US, allied, commercial, or consortium space services. These services include precision navigation, high-resolution imagery, environmental monitoring, and satellite communications. Denying adversary access to space capabilities and protecting US and friendly space capabilities may require taking the initiative to preempt or otherwise impede an adversary.

OSC operations preclude an adversary from exploiting space to its advantage. OSC operations may target an adversary's space capability (space system, forces, information links, or third party space capability), using a variety of permanent and/or reversible means. Deception, disruption, denial, degradation, and destruction, commonly known as the "Five Ds," are the possible desired effects when targeting an adversary's space capability.

OSC Targeting Considerations

OSC targeting operations mirror the Air Force's standard targeting process of find, fix, track, target, engage, and assess (F2T2EA).[2] The F2T2EA process is also fundamental to DSC and SSA. F2T2EA relies upon ISR all throughout the process.

Find, Fix, and Track. The ability to find, fix, and track space objects, signals, and terrestrial nodes is fundamental to attack the adversary, defend/preserve friendly space capabilities, assess collateral effects on third party space assets, or understand the operational environment. Radar and optical sensors find, fix, and track objects in space just as sensors find, fix, and track airborne objects within an area of interest.

[1] JP 3-14, *Space Operations*.
[2] Annex 3-60, *Targeting.*

An important aspect of find, fix, and track includes the ability to characterize space systems, signals, environment, and threats. Characterization builds knowledge of how systems operate, the signals they use, how they react to changes in conditions, the threats they pose to friendly/adversary operations, and other important factors. Understanding US space systems and the threats to them enhances our ability to preserve, withstand, or respond to an attack.

Target and Engage. Characterization data enhances our ability to target a space capability, often providing greater flexibility to achieve the desired effect. If we understand how the space system works, the decision and the trade-offs on how to affect the target will be easier. Deconfliction is just as important in space control operations as it is in other military operations. Electromagnetic spectrum and physical deconfliction must be accomplished to avoid "blue-on-blue" impacts and unintentional interference with other parties.

Assess. Assessment of the results of OSC or defensive space control (DSC) operations is critical. The ability to assess whether the environment or a threat is producing an effect, like interference, is crucial to ensuring proper response. Another major area concerning assessment is the ability to ascertain the effect these missions have on offensive and defensive operations. Effective ISR planning and execution are essential for accurate assessment. Today, our ability to characterize and assess a potential threat or target may be limited. Close cooperation with appropriate DOD and non-DOD agencies is critical to improve the availability of intelligence required to characterize and assess space systems, signals, environment, and threats.

OSC Targets

The targets for OSC operations stem from the nodes and links of adversary systems. When an adversary system is deemed reliant on space, OSC actions may target space nodes, terrestrial nodes, and/or communications links in order to affect the adversary system. Space nodes may include satellites, space stations, or other spacecraft. Adversary terrestrial nodes include land, maritime, or airborne equipment and resources used to deploy, enable, interact with, or otherwise affect the space node. Communication links tie nodes together and pass information between them. Understanding space capability as a system of nodes and links enables determining the best ways and means for affecting adversarial capability. The following paragraphs discuss examples of OSC targets.

On-Orbit Satellites. Satellites are on-orbit assets consisting of a mission sensor and a satellite bus. The mission sensor provides raw data, which is usually sent to a ground station for processing. The satellite bus carries the mission sensor and provides it power, thermal control, and communications. OSC operations may target the mission sensor or the satellite bus. For example, a laser may deny, disrupt, degrade, or destroy certain types of sensors. Kinetic ASAT weapons, on the other hand, usually target the satellite bus for physical destruction.

Communication Links. Space systems are dependent on RF and/or laser links to provide communication between space and terrestrial nodes (satellite to ground station or satellite to user) and between satellites (satellite to satellite). Links between terrestrial nodes (ground station to users) include fiber optic and traditional cable in addition to the RF and laser links. On-orbit satellites and ground-based satellite control stations/users send data up and down the link. In the up-link, command and control data tasks satellite mission payloads and subsystems. In the downlink, mission payload and satellite state-of-health data are sent to a ground station for processing. The ground station, after processing, often sends the mission data to the users via SATCOM for exploitation. In the case of SATCOM systems, data may be directly up-linked and then down-linked between users. Most space systems are ineffective without communication links.

Ground Stations. Ground-based systems perform satellite command and control and mission data processing. Ground stations are normally permanent structures that may represent a single point of failure in a space system. Mobile ground stations can also be used to command a satellite, but may have no ability, or a limited capacity, for processing satellite mission data.

Launch Facilities. The ability to place satellites into orbit is the first step to space access; fundamental to the ability to operate and maintain space-based capability. Whether this capability is indigenous, or provided by a third party, it is the only means to deploy satellites to space and represents a primary choke-point for interdicting an adversary's efforts to augment or reconstitute space forces.

Command, Control, Communication, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Systems. C4ISR systems are critical to the effective employment of forces and assets. Attacking such systems would substantially reduce the enemy's capability to detect, react, and bring forces to bear against friendly forces. Attacking C4ISR systems may contribute to OSC operations but may also contribute to other operations such as strategic attack or counterair operations, depending on the intended effects. Attacking these nodes can cripple the adversary kill chain by denying access to information or negating adversary leadership.

Third Party Providers. An adversary may gain significant space capabilities by using third party space systems. Using diplomatic or economic means to deny an adversary access to these third party (commercial or foreign) space capabilities will generally require the assistance of other US governmental agencies.

OSC Resources and Forces

The effectiveness of OSC operations to affect the array of targets previously listed depends on the availability and capabilities of certain resources and systems. The choice of system depends upon the situation, threats, weather, and available intelligence. To the greatest extent practicable, use systems and methods which minimize risk to friendly forces, civilians, and civilian property. For example, an aircraft employing standoff weapons may provide the same effect as a special operations team, with less risk to friendly forces. The following paragraphs discuss some of the forces and weapon systems that could potentially be used to conduct OSC.

Aircraft. Friendly aircraft provide non-kinetic and kinetic capabilities against surface targets associated with an adversary's space capabilities. For example, electronic attack platforms (manned and remotely piloted aircraft) could affect the links of an adversary's space system by employing stand-off and stand-in techniques. By attacking terrestrial nodes with electronic attack, bombs, or air-to-surface missiles, aircraft may disrupt, deny, degrade or destroy an adversary's ability to control their satellites or deliver space effects.

Surface-to-Surface Missiles. Missiles may be employed against a variety of an adversary's space capabilities including launch facilities, ground stations, and space nodes.

Special Operations Forces. Special operations forces (SOF) can conduct a wide range of special operations core operations and activities against terrestrial nodes. As examples, SOF may conduct a direct action mission against terrestrial nodes, provide terminal guidance for conventional air assets, or provide localized jamming against an adversary's links.

Surface Forces. Surface forces may include conventional land or maritime forces or SOF, as described above. Surface forces can achieve significant effects between the lethality of supporting surface fires and the ability to occupy and secure key areas. For example, surface forces can attack a ground-based satellite control station in order to disrupt, degrade, or destroy an adversary's space capability.

Offensive Space Control Systems. These systems are designed specifically for OSC operations, such as a counter satellite communications capability designed to disrupt satellite-based communications used by an adversary. Another OSC system is a counter surveillance reconnaissance capability designed to impair an adversary's ability to obtain targeting, battle damage assessment, and information by denying their use of satellite imagery.

Anti-Satellite Weapons. Anti-satellite (ASAT) weapons include direct ascent and orbital systems that employ various mechanisms to affect or destroy an on-orbit spacecraft.

Directed Energy Weapons. Directed energy weapons, such as lasers, may be land-, maritime-, air-, or space-based. Depending on the power level used, directed energy

weapons are capable of a wide range of effects against on-orbit spacecraft, including: heating, blinding optics, degradation, and destruction. Under certain circumstances, lasers may also be effective against space launch vehicles while in-flight.

Cyberspace Operations. Many OSC targets, particularly elements of the terrestrial node, may be affected by various cyberspace operations. Some techniques afford access to targets that may be inaccessible by other means.

Electronic Warfare Weapons. Electronic warfare weapons may include electromagnetic jammers, directed energy weapons as described above, and antiradiation missiles. Electromagnetic jammers, may be used to disrupt adversary links. Antiradiation missiles passively home on a radiation source and may be used to strike ground-based space surveillance radars or satellite control stations.[3]

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[3] JP 3-13.1, *Electronic Warfare.*

PLANNING (SPACE)

Last Updated: 19 June 2012

Space capabilities provide the US military asymmetric advantages needed when projecting power worldwide across the range of military operations. Consequently, space assets must be considered during all phases of campaign planning for major joint operations. Space operations should be integrated into the joint force commander's (JFC) deliberate and crisis action planning (CAP) to magnify joint force effectiveness. USSTRATCOM planning should be consistent with operation plans (OPLAN) and operation orders (OPORD) developed by the JFC. Moreover, space assets must be integrated throughout the plans developed and executed by all combatant commanders.

Multiple annexes in operation planning products contain space contributions to the overall effort. Development of these annexes is the supported commander's responsibility but requires coordinated effort between the JFC, USSTRATCOM, and component level staffs.[1]

Deliberate Planning

As a member of the joint planning and execution community,[2] the commander, Air Force forces (COMAFFOR) supports the combatant commander's campaign planning process through integrated theater operation planning, beginning with the deliberate planning phase. This effort should be conducted as a total process rather than separate processes. Theater planners normally incorporate space planning into theater OPLAN annexes. However, space requirements should be considered as part of the overall OPLAN, not simply limited to a single OPLAN space annex or phase of the OPLAN. Space planning must be embedded throughout the planning process so that space assets and capabilities are appropriately integrated into each phase of the combatant commander's operation plan. The primary annex for space operations is Annex N. However, space can also be found in multiple annexes (i.e., B, C, H, K, S and others). Planners integrating space operations should coordinate with other annex planners to ensure space is thoroughly integrated throughout the OPLAN.

Since USSTRATCOM controls much of the theater space forces, it needs to be consulted when developing and integrating plans. Reachback support may be requested to provide space-specific expertise or information to augment theater

[1] JP 5-0, *Joint Operation Planning* provides a list of joint operation planning products.
[2] The joint planning and execution community consists of those headquarters, commands, and agencies involved in the training, preparation, mobilization, deployment, employment, support, sustainment, redeployment, and demobilization of military forces assigned or committed to a joint operation (JP 5-0).

planning. Through this cooperation, theater-developed OPLANs should designate, organize, and task theater space forces and also provide realistic external support requirements for global space assets. In addition, space requirements and considerations should be included in other functional combatant commander's plans supporting theater operations. Planners should also ensure deployable space forces are included in the time phased force and deployment data.

Crisis Action Planning

Deliberate planning is essential to crisis action planning by anticipating potential crises and facilitating development of joint operation plans, in turn, to facilitate the rapid development and selection of a course of action (COA). Crisis action planning deals with emerging events and is conducted in time-sensitive situations with only actual circumstances that exist at the time on which to base their plans. Because of the time-sensitive nature of crisis action planning, it may be challenging to address space requirements if not previously identified. Certain space operations may need lead time for substantial coordination up to the Secretary of Defense level due to their political sensitivity or because they are controlled by other organizations such as USSTRATCOM, national agencies, civil organizations, or commercial enterprises. The end result of CAP produces OPORDs and fragmentary orders that can be executed to satisfy SecDef direction.

Space operations should be fully integrated into the development of all COAs. During COA development, planners should identify tasks for space assets in support of theater objectives and examine the role and contributions of space assets in the various phases of the OPLAN. During COA selection, the combatant commander should review space forces, along with cyberspace, air, intelligence, surveillance and reconnaissance (ISR), land, special operations, and maritime forces. Knowledge of global and theater space capabilities will enable the commander to make an informed decision.

Plan Development

Theater planning for space operations is also a crucial aspect to planning in order to integrate space capabilities and effects throughout the JFC's OPLAN. It is normally accomplished by the COMAFFOR/JFACC through an air estimate process that combines the mission activities and desired effects of air, space, and cyberspace platforms into a coherent plan to support the JFC's overall plan. The result is the joint air operations plan (JAOP). The JAOP should include the integration of all allocated and assigned theater space forces and all requests for theater support from global space assets. Planned space operations that enable theater operations and produce effects in theater are captured in the JAOP. Theater space capabilities and effects derived from deployed and organic theater space forces under the JFACC's operational control (OPCON)/tactical control (TACON) should be integrated through the air tasking order (ATO). The majority of JAOP development occurs within the air operation center (AOC); consequently, space expertise should be embedded throughout the AOC, to include ISR, combat plans, combat operations, and strategy divisions.

Joint Space Operations Plan Development

In concert with theater planning efforts, CDR JFCC SPACE plans internally for space support to the theater and to meet global space requirements. Joint space planning in support of the geographic or functional supported JFC's requirements occurs through the Joint Space Operations Center (JSpOC).

The joint space operations plan (JSOP) is the space equivalent to the JAOP. The JSOP details how joint space operations will support both global missions and theater requirements. The JSOP prioritizes space operations across all AORs and functions based on geographic and functional combatant commanders' requests and CDRUSSTRATCOM priorities. Each plan should contain a sustainability assessment and delineate specific procedures for allocating and exercising command and control (C2) of global space assets. In doing so, the JSOP allows for optimum integration of global assets supporting theater operations. The JSpOC will use the JSOP to guide the development of the JSTO.

Planning Factors

In an ideal world, every theater commander would be given OPCON of space resources allocated to their theater with the ability to plan, command, and control all aspects of operations. However, this paradigm may not always be possible due to fiscal constraints and space system limitations. Space assets are strategic in nature due to their complexity, cost, global access and sometimes multi-mission capability, yet provide tactical effects and capabilities. Additionally, because they operate in the space environment, satellites are subject to fixed orbital dynamics and may not always be available for use. As such, USSTRATCOM and certain national agencies typically exercise OPCON over them.

Just as weather impacts air operations, space and terrestrial weather can impact both the satellites and their communications links. Many organizations use data carried over satellites and are by design primary users of space capabilities. Due to the long-haul nature of communications with satellites, vulnerabilities are inherent in the system such as ground-based communication facilities and the uplink and downlink with the satellite.

The space operator might not be responsible for the operational planning of the provided space capability. For instance, the A2 community plans and employs space-based ISR capabilities, and the A6 is responsible for planning theater satellite communications. The A6, in particular, is responsible for planning the integration of network and mission architecture improvements to help ensure availability, continuity, and resilience of satellite communications.

Phasing

Phasing provides an orderly schedule of military decisions and indicates pre-planned shifts in priorities and intent. Phasing may be used to modify the prioritization of limited space capabilities to theater operations. Space operations often occur simultaneously and can be continuous throughout the OPLAN, sometimes leading to a sense that phasing is less relevant to space operations. Phasing remains a useful tool to communicate the JFC's concept of operations and the shifting of emphasis between ongoing space operations. For instance, space control operations may be emphasized

early in an operation and be de-emphasized once space superiority is firmly established. Some level of regional or temporal space superiority is likely to be a prerequisite to effective pursuit of other objectives.

Integration

Integration of theater space requirements must consider both a global and theater perspective. Global integration is the responsibility of CDRUSSTRATCOM. Theater integration is the responsibility of the GCC and the COMAFFOR/JFACC. The GCC and CDRUSSTRATCOM normally authorize DIRLAUTH between component commanders and formalize a support relationship as the situation dictates. The COMAFFOR/JFACC and CDR JFCC SPACE ensure space integration occurs throughout the process. DIRLAUTH is normally more applicable for planning purposes and does not allow for tasking. It carries with it the requirement to keep the commander granting DIRLAUTH informed. For additional discussion on support and DIRLAUTH, see Chapter Four, section A of JP 1, *Doctrine for the Armed Forces of the United States*.

Intelligence Preparation of the Operational Environment

Intelligence preparation of the operational environment (IPOE) is a process requiring detailed research, analysis, and knowledge of the adversary regarding topics such as force disposition, force sustainment, deployment of forces, weapon system capabilities and employment doctrine, environmental conditions, and courses of action. Thorough and detailed IPOE provides commanders at all levels with intelligence decision aids to effectively conduct space operations.

For space operations, IPOE guides and shapes planning, and enables the commander's multidimensional understanding of the operational environment. This knowledge of the operational environment, in concert with C2, permits commanders to anticipate future conditions, assess changing conditions, establish priorities, and exploit emerging opportunities.

Legal Considerations

The Air Force carefully examines US policy, domestic law, and international obligations when planning space operations. Lawyers participate in all stages of space operations planning and execution to address applicable legal considerations. The topic Legal Considerations for Space Operations identifies the legal framework associated with military uses of space. The United States is committed to the exploration and use of outer space by all nations for peaceful purposes and for the benefit of all humanity. Consistent with this principle, "peaceful purposes" allow US defense and intelligence-related activities in pursuit of national interests.

Civil, Commercial, and Foreign Space Assets

Many civil, commercial, and foreign organizations contribute space capabilities to military operations. As a part of a larger networked team, the Air Force should plan and execute in concert with those organizations, not just other Services and national agencies. Civil, commercial, and foreign space assets may be specialized and require unique procedures and equipment. Moreover, they may not have sufficient flexibility for

dynamic re-tasking and, therefore, may not meet the critical requirements for military operations. They can be leveraged through pre-established agreements but often must be requested on an unplanned basis. There may be instances where competing requirements must be balanced.

Foreign space assets provide alternatives to meet the military's operational needs. However, these space assets, even those provided by our allies, may not be easily integrated into military operations. In addition to tasking procedures, connectivity and interoperability are concerns, particularly when the US and partner nation forces function in mutual support during combat operations. Multinational operations are the norm for the US military, which makes information sharing and intelligence disclosure with partner nations a necessary concern. Processes should be developed to handle these concerns using pre-established agreements and existing policy.

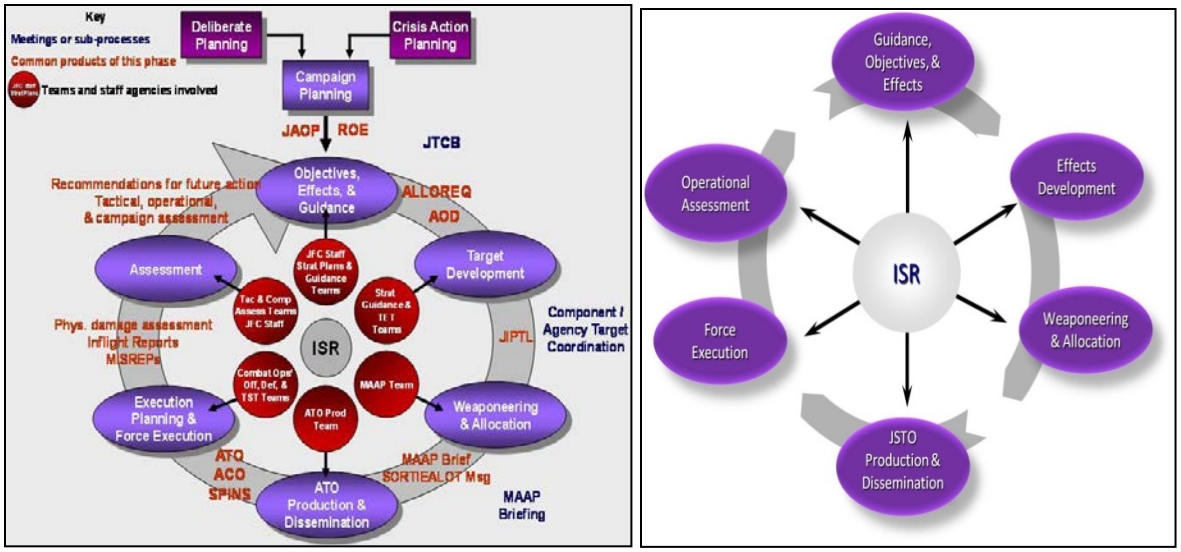
EXECUTION (SPACE)

Last Updated: 19 June 2012

Execution is a dynamic combination of global and theater operational processes requiring timely integration throughout the joint operation plan. Timely integration is especially critical for space operations.

Global Space Operations
USSTRATCOM executes operations based on global requirements for national defense, requests from multiple theaters, and maintenance of on-orbit space assets. Space forces are continuously employed and executing the Joint Space Tasking Order (JSTO). This requires timely deconfliction and integration with other elements of the theater operation. Integrating various space-related or space-based capabilities on behalf of USSTRATCOM is accomplished by the Joint Space Operations Center (JSpOC) through deliberate coordination processes with the theater air operations center (AOC).

The employment of space forces at the operational level is accomplished through tasking orders that deconflict and integrate the full range of space operations with theater operations. The space and air tasking cycles must be integrated. Figure 4.1 provides a comparison of the air tasking cycle and the space tasking cycle. The space tasking cycle approximates the air tasking cycle but is not identical. The depiction of the air tasking cycle shows theater AOC teams and products. See the figure **Air Tasking Cycle and Space Tasking Cycle** and the topic 614th Air and Space Operations Center for more details on the space tasking cycle and the comparable products that the 614 AOC generates.



Air Tasking Cycle and Space Tasking Cycle[1]

614 AOC/JSpOC

The 614 AOC/JSpOC tracks assigned and attached space forces and assets. It serves as the focal point for coordination and reachback support for organic theater space personnel and regional space operations requirements. The JSpOC translates CDRUSSTRATCOM's OPORDs and CDR JFCC SPACE guidance into the JSTO. JSTOs task and direct assigned and attached space forces to fulfill theater and global mission requirements in support of national objectives.

Theater Space Operations

There are space forces deployed to support theater operations. These forces are integrated into various levels of command within the joint force. Depending on theater requirements and the global situation, the Secretary of Defense may attach these forces to geographic combatant commanders conducting combat operations.

When deployed, Air Force space forces are normally attached to an AETF under the operation control (OPCON) of the commander, Air Force forces (COMAFFOR). When the COMAFFOR is dual-hatted as the joint force air component commander (JFACC), the JFACC is normally given tactical control (TACON) of other Service space forces in excess of their organic requirements. The COMAFFOR/JFACC should integrate and task assigned, attached, and sister Service forces into operations via the AOC and the air tasking order (ATO) process. Air Force space experts are matrixed across the AOC, ensuring space capabilities and effects are integrated into theater operations via the ATO for deployed theater space forces and JSTO for global space forces.

Integrating Global With Theater Space Operations

Properly generated and coordinated plans are key to successful integration of global and theater operations. Command relationships allow theaters to coordinate with

[1] Annex 3-0, *Operations and Planning* and JFCC SPACE C2 CONOP.

STRATCOM, as the supporting commander, to integrate space capabilities. An option for command relationships is to use an establishing directive between the JFACC and the CDR JFCC SPACE. If the theater COMAFFOR is dual-hatted as the JFACC, the DIRSPACEFOR serves as the JFACC's focal point for coordinating, integrating, and synchronizing global and theater space operations.

The JSpOC normally integrates its supporting operations with theater operations because the supported theater commander drives tasking requirements. If more than one theater is being supported, the JSpOC will provide prioritized support to all theaters.

ASSESSMENT (SPACE)

Last Updated: 19 June 2012

Commanders within the space operational environment should continually assess employment and support activities to determine the effects and implications of their actions while following the joint force commander's (JFC) overall intent. The ambiguities and limitations resident within the space environment require frequent adjustment of operational planning considerations to ensure desired effects are achieved while avoiding specifically designated or unintended negative consequences. The commander, Air Force forces (COMAFFOR)/ joint force air component commander (JFACC) is normally assigned with the responsibility to evaluate results of space operations along with air and cyberspace operations.[1]

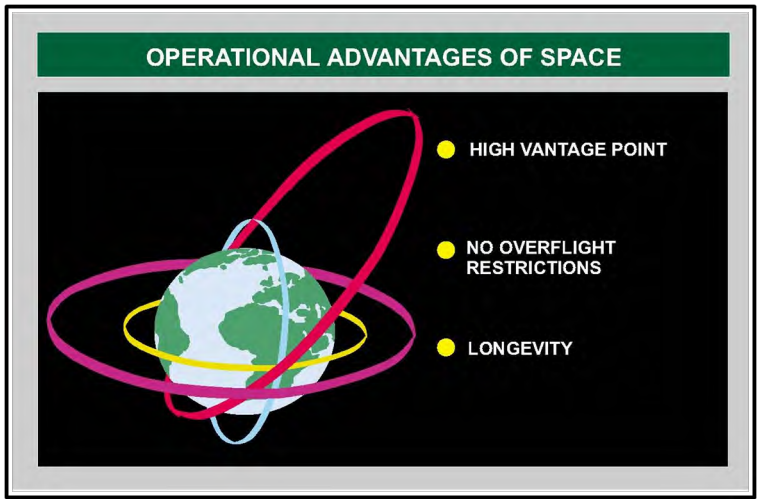
There are two primary types of assessments accomplished, operational and tactical. The operational-level assessment is usually executed within the strategy division of the theater AOC and JSpOC. The tactical assessment is generally performed by the ISR division of the theater AOC and JSpOC.

[1] JP 3-30, *Command and Control for Joint Air Operations*.

APPENDIX A: ORBITAL FUNDAMENTALS

Last Updated: 19 June 2012

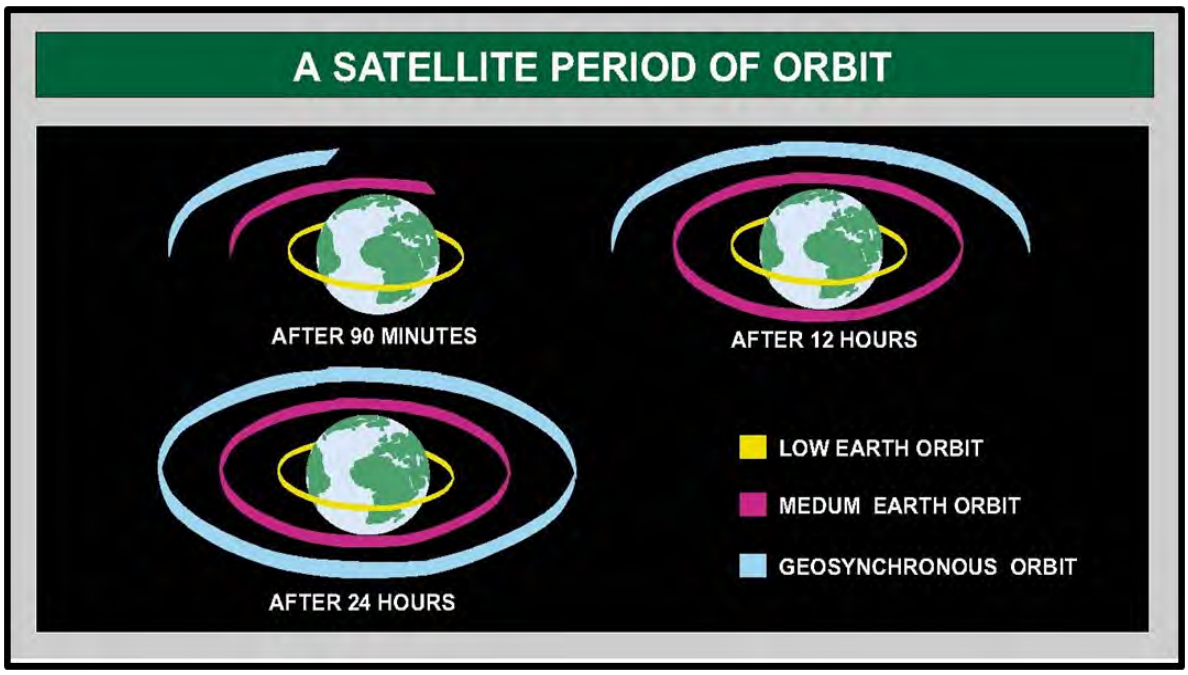
Because the constellation design and orbital characteristics of a space system can vary greatly, space operations' strengths and limitations must be considered. In general, space systems provide the ultimate high ground without overflight restrictions. The absence of significant drag and other natural opposing forces also allows space systems to have increased longevity, sometimes limited only by the reliability of the systems themselves (see figure Operational Advantages of Space). However, there are several forces at work that slowly degrade the accuracy of a satellite's location: atmospheric drag (air particles and atoms exist even at very high altitudes); gravitational attractions of the sun, moon, and other planets; the fact that the Earth is not a perfect sphere and the force of gravity varies; gentle pressure from solar radiation; and the interaction of solar radiation and the Earth's geomagnetic environment.



Operational Advantages of Space

SATELLITE ORBITAL PERIOD

The size of a satellite's orbit determines its period, or the time it takes to complete one revolution. The lower the orbital altitude, the shorter the period (see figure A Satellite Period of Orbit). Common orbits have periods ranging from about 90 minutes (low orbits just above the atmosphere) to 24 hours (geosynchronous orbits approximately 22,300 statute miles above the Earth's surface).



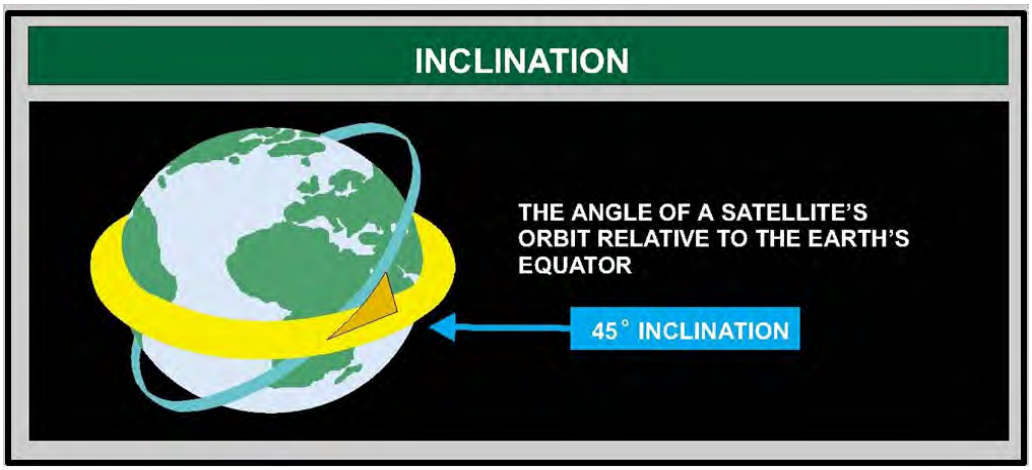
A Satellite Orbital Period

ECCENTRICITY

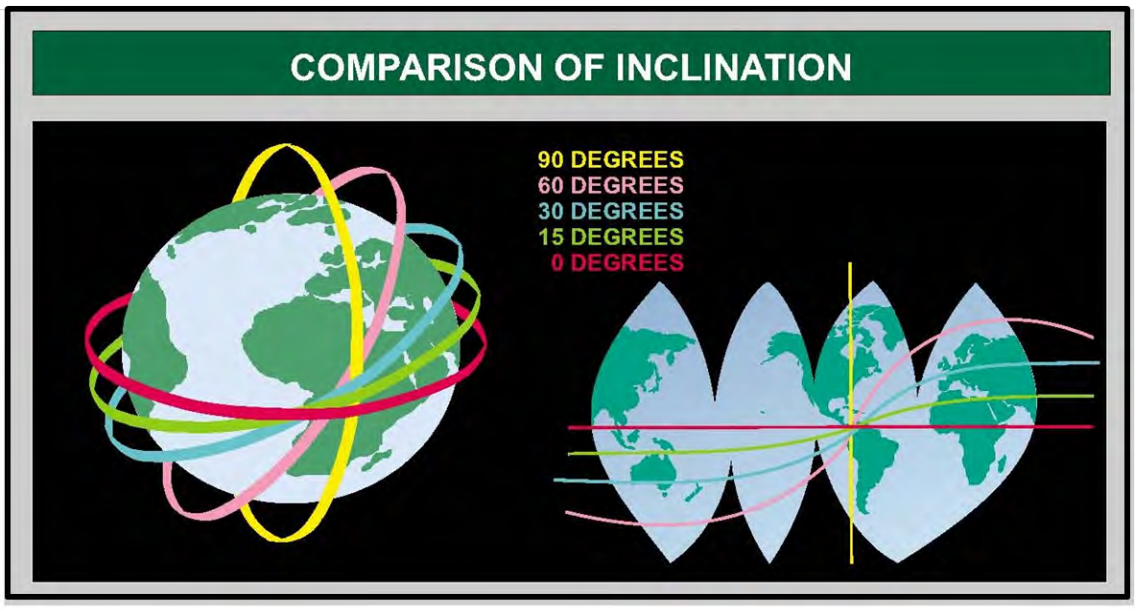
Eccentricity is used to describe how much an orbit's shape deviates from a circle. The figure ranges from 0 to 1 with a value of 0 for a circular orbit.

INCLINATION

A satellite's inclination is the angle between the Earth's equatorial plane and the satellite's orbital plane (see figure Inclination). The angle of inclination is measured counterclockwise from the equatorial plane to the orbital plane at the ascending node. The ascending node is the point where the satellite's path crosses the equatorial plane from the southern to the northern hemisphere. The angle of inclination determines the maximum north and south latitude a satellite will orbit over and, therefore, what part of the Earth's surface will pass directly beneath the satellite—a critical consideration in accomplishing its mission. See figure, Comparison of Inclinations, for a comparison of inclinations. Depending on the inclination, a single satellite may not provide coverage of a specific point on or region of the Earth. Other space assets in different orbital planes—civil, commercial, international, and foreign military—may be used to supplement the satellite's capability and provide continuous, non-intrusive coverage.



Inclination



Comparison of Inclination

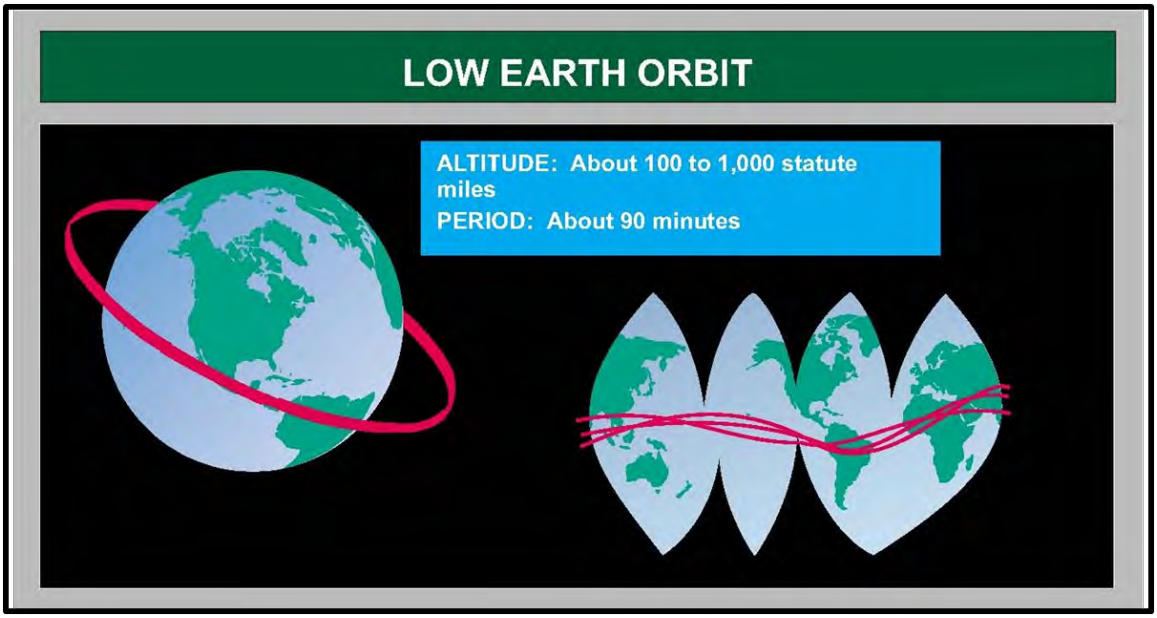
TYPES OF ORBITS

There are five types of orbits: Low Earth Orbit; Polar Orbit; Medium Earth Orbit; Highly Elliptical Orbit; and Geosynchronous Earth Orbit.

Low Earth Orbit

Low Earth Orbit (LEO) is the easiest type of orbit to reach, and the satellite's proximity to the Earth's surface provides the best potential for high-resolution imagery (see figure Low Earth Orbit). However, satellites in these orbits can only view a smaller portion of

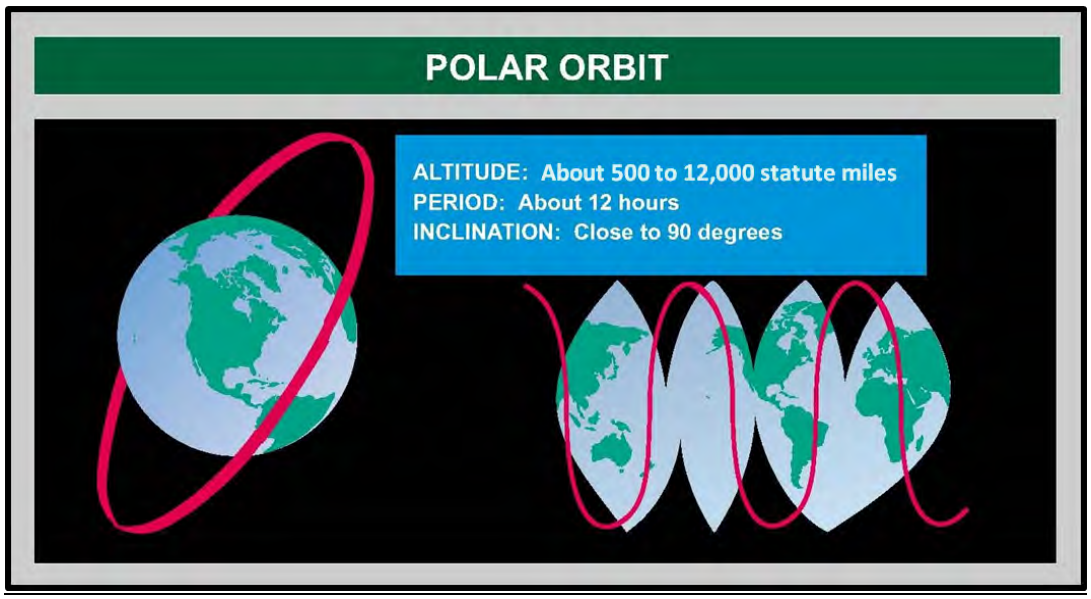
the surface of the Earth at any one time than those at higher altitudes. Atmospheric drag can shorten mission duration. LEO applications include manned flight, environmental monitoring and other ISR, and communication missions.



Low Earth Orbit

Polar Orbit

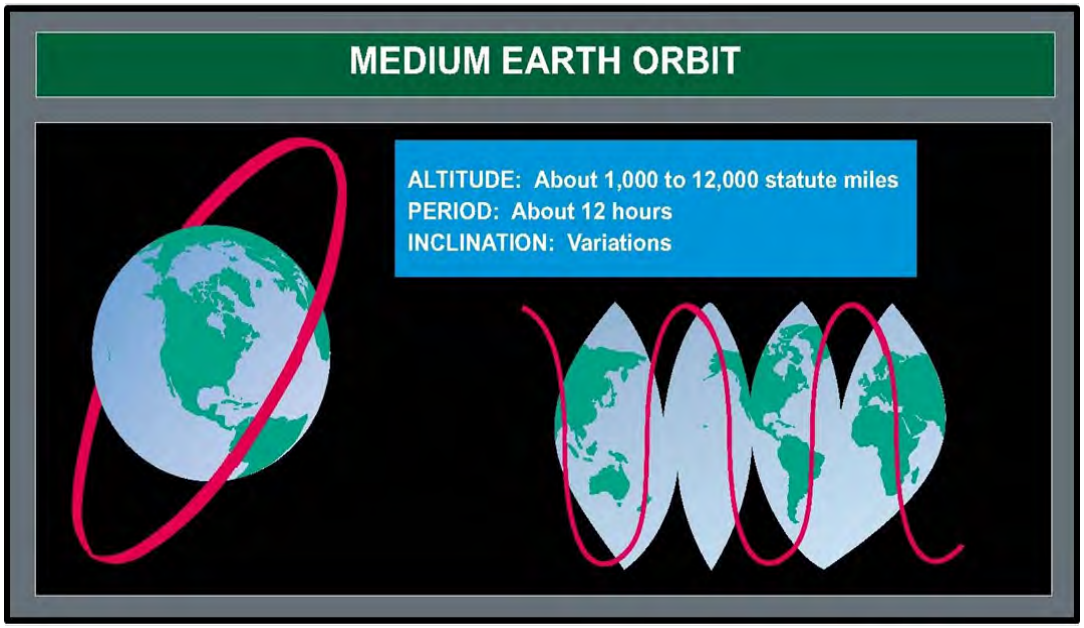
A polar orbit is one with an inclination near 90 degrees (see figure Polar Orbit). A satellite in a polar orbit will travel pole to pole, covering all or almost all the surface of the Earth in 12 to 24 hours, making this type of orbit very useful for environmental monitoring and other intelligence, surveillance, reconnaissance (ISR) missions. A particular type of near polar orbit is a sun synchronous orbit. It has an inclination of 90 to 120 degrees and maintains a constant orientation towards the sun throughout the year, resulting in similar lighting conditions every orbit and making it very useful to detect changes in environmental conditions or surface features of the Earth over time.



Polar Orbit

Medium Earth Orbit

Medium Earth Orbit (MEO) provides a satellite with a view of a larger portion of the Earth at any one time than LEO (see figure Medium Earth Orbit). While atmospheric drag is negligible, a lot more energy is required to place a satellite in these orbits. Current applications include navigation systems (e.g., GPS).

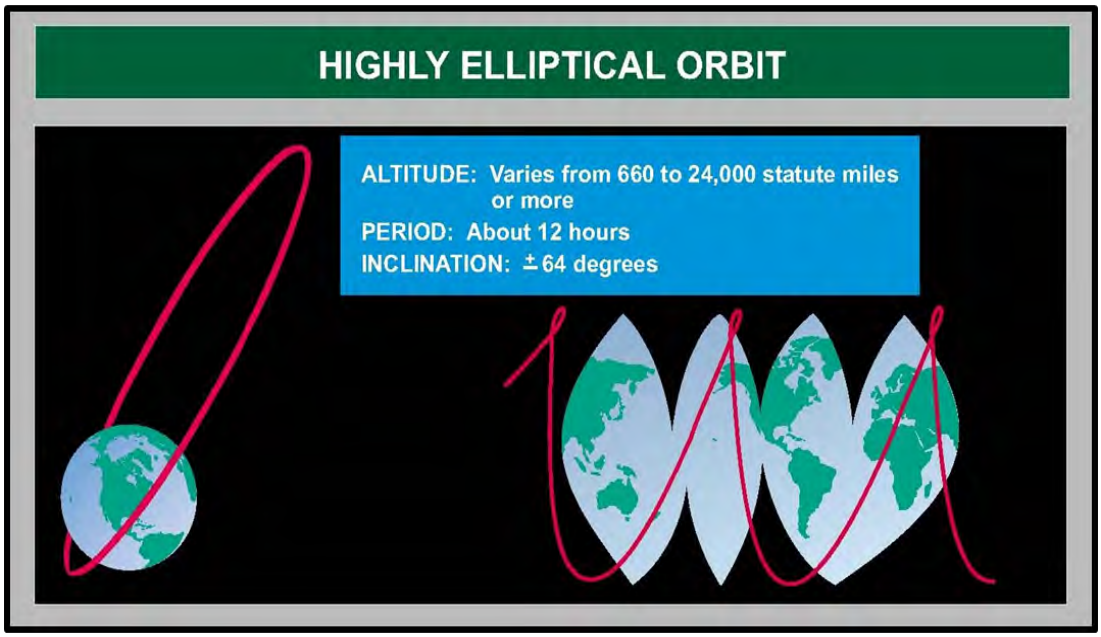


Medium Earth Orbit

Highly Elliptical Orbit

Highly Elliptical Orbit (HEO) is an orbit with a large eccentricity, and an orbit shape of an ellipse versus a circle (see figure Highly Elliptical Orbit). A useful feature of a satellite in a HEO is that the satellite travels relatively slowly when near apogee, giving a long

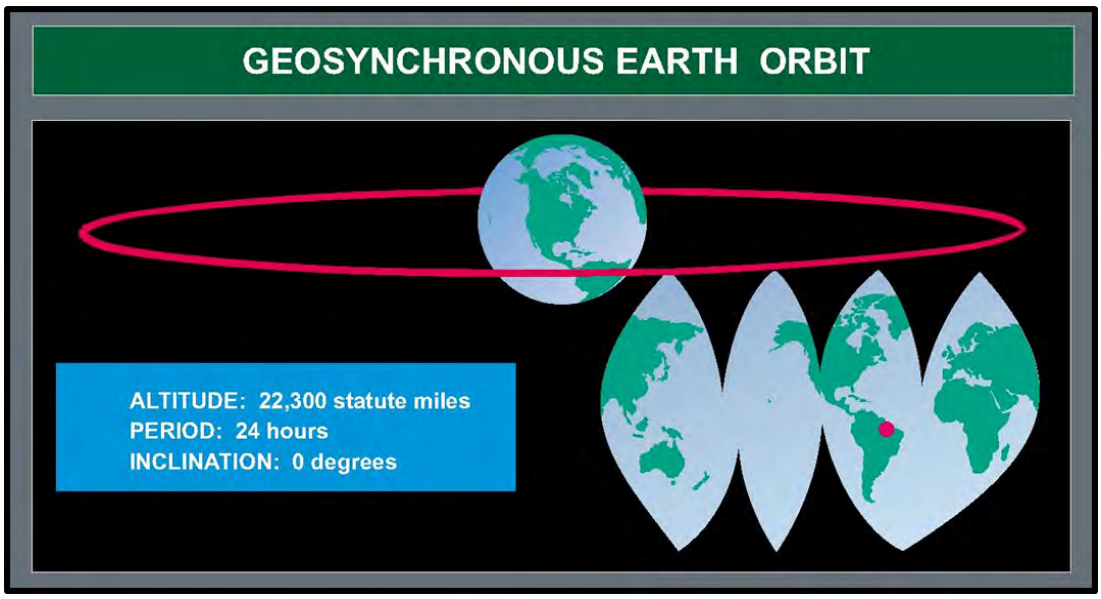
dwell time combined with visibility of a large portion of the Earth. HEO orbits are useful for communications and some ISR missions. The former Soviet Union made extensive use of a HEO called a Molniya orbit that has a period of 12 hours, an inclination of 63.4 degrees, an eccentricity of 0.7, and an apogee over the northern hemisphere. This particular HEO is very useful for providing communications or ISR coverage in the high northern latitudes, a region less well covered by satellites in geostationary orbits.



Highly Elliptical Orbit

Geosynchronous Earth Orbit

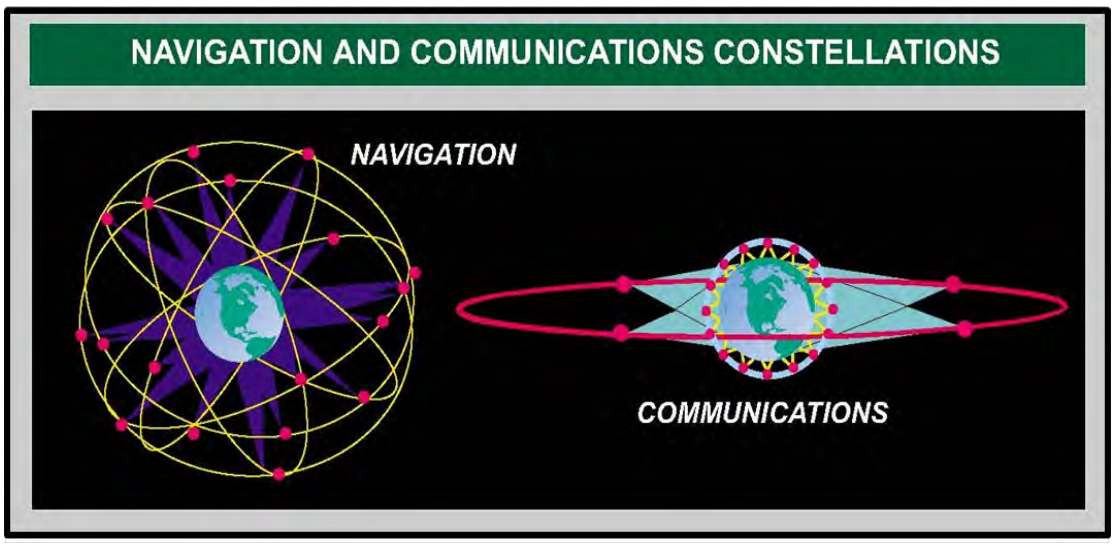
Geostationary satellites are in a near-circular, near-zero inclination orbit with periods exactly equal to the Earth's rotation of 24 hours (see figure Geosynchronous Earth Orbit). Hence, geostationary satellites remain roughly over one spot on the Earth at all times. Orbits that have a 24-hour period, but do not have a near-zero inclination or eccentricity, are called geosynchronous. All geostationary satellites are geosynchronous, but not all geosynchronous satellites are geostationary. The ground trace of a Geosynchronous Earth Orbit (GEO) satellite looks like a figure "8" pattern when traced onto a Mercator map of the Earth, which reflects the natural oscillations of the orbit as well as the degree to which the orbit is inclined to the Earth's equatorial plane. GEO orbits have an altitude of approximately 22,300 statute miles, are difficult to reach, and require launch vehicles with significant lift capability. Satellites in GEO orbit provide coverage of large areas of the surface of the globe with continuous visibility of these areas. Therefore they are very useful for persistent communications, weather monitoring, and certain ISR functions. Because of these advantages, an orbital slot in the GEO "belt" is highly desired, resulting in spatial congestion and electromagnetic interference. A specialized agency of the United Nations known as the International Telecommunication Union manages allocation of GEO orbital slots and electromagnetic spectrum.



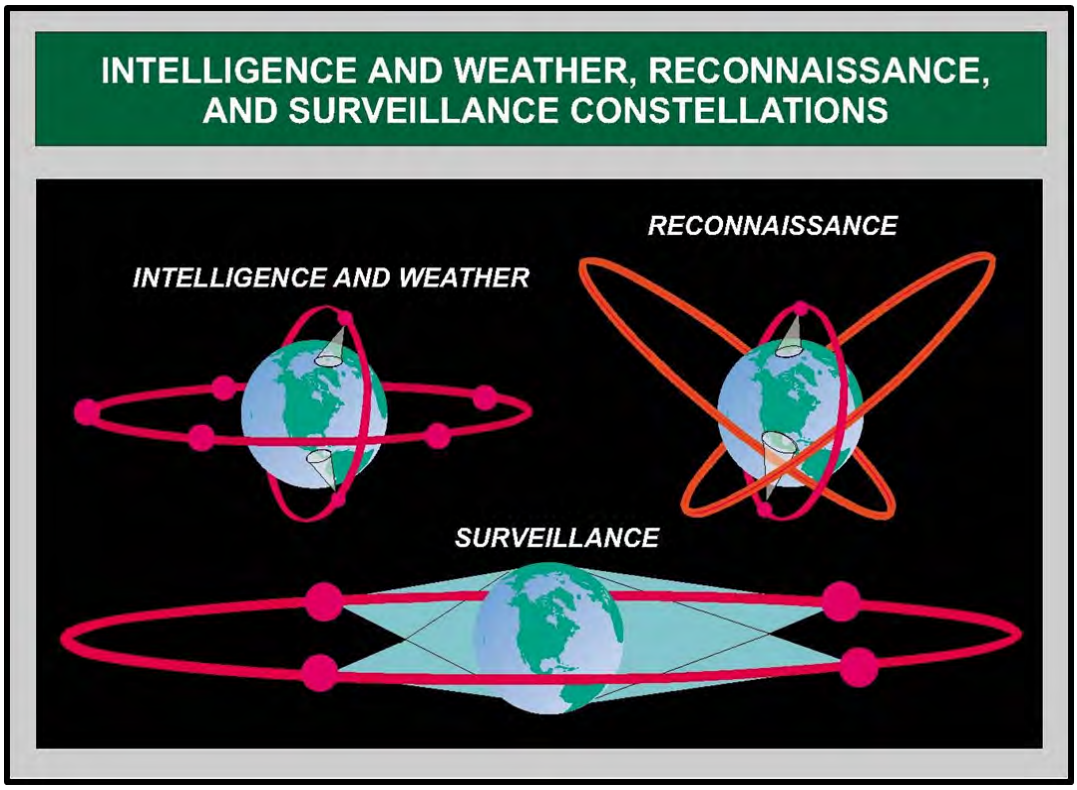
Geosynchronous Earth Orbit

CONSTELLATIONS

When a single satellite cannot provide the coverage necessary to accomplish a given mission, multiple satellites performing a single mission (a constellation) are used to provide global coverage or increase timeliness of coverage (see figure Navigation and Communications Constellations and figure Intelligence and Weather, Reconnaissance, and Surveillance Constellations). Navigation constellations (such as GPS) are designed to ensure that signals from multiple satellites can be simultaneously received at a location on the ground, improving the accuracy of the information coming from those satellites. In contrast, communications constellations are designed to ensure that at least one satellite is within line of sight of both ends of the communications link, and may include both equatorial and polar components. ISR constellations have satellites in both high and low altitude orbits, providing both wide-area coverage and high-resolution data.



Typical Constellations



Intelligence and Weather, Reconnaissance, and Surveillance Constellations

Weather and reconnaissance systems may require constellations that combine high and low altitude systems. This provides on-board sensors with the capability to acquire wide-area, low-resolution coverage and limited field of view, high-resolution coverage, respectively. Some ISR systems, on the other hand, need continuous access to the areas surveyed and usually rely on high altitude, long dwell time orbits.