3.0 Warfighter Space Mission Needs

3.1 Joint Mission Requirements

Future warfighting will be joint and space will be crucial to a successful conclusion. The effective use of space requires a space-knowledgeable cadre of dedicated and motivated military officers and civilians. The joint warfighter's space requirements for the exploitation of information available only from space spans the warfare spectrum from indications and warning to weapons on target. Future conflicts must be fought by a holistic force to leverage the synergism between integrated land, seas, air and space elements and depends on the type capabilities in which we now invest. Any information that is not readily available to the warfighter, the one with the ultimate responsibility, is irrelevant. The battlefields of the future, across the entire range of situations whereby military forces might be committed, will be ever increasingly dynamic, faster paced and of greater dimensions. There will be a requirement for continuous global, three dimensional positional situation awareness, under day/night and all weather conditions, with less than one meter accuracy and temporal data tethered to GPS time standard.

Space should act as the medium from which to acquire the information that can only be achieved from space or can be obtained more economically from space. Space provides broader area coverage than any other means for a plethora of sensors to support a wide range of missions. However, there is a pressing need to relax the classification of information harvested from space to better enable the satisfaction of a greater number of extant warfighter requirements and provided real-time support for mission planning and operations. Space systems of the future must be a part of a "system of systems" that can not only provide the joint warfighters, but coalition forces, with all of the information necessary for "information dominance" of a unified battlefield. This "system to system" architecture should be an integration of a wide array of space capabilities that includes, among other things; SAR imagery, multi-spectral imagery, GPS, and/or its successor, meteorological and oceanography information, ELINT, satellite communications, and the other potential space capabilities that awaits exploitation. There is a need for a "system of systems" space doctrine that contains existing and planned space capabilities that can be critically analyzed during joint exercises and through modeling and simulation to improve its architecture and effectiveness.

3.2 Ground Based Force Tasks

Space has become an integral component of the Army's technological and operational evolution. The Army is a leader in the use of space products and in the tactical applications of space systems. Today, the Army may be the largest user of space systems on the battlefield. Integration continues in all functional areas of space with modest investment in communications, positioning and navigation, intelligence , weather and environmental monitoring, terrain analysis target acquisition and missile warning. The Army is already critically dependent on the positioning and navigation assets in space with validated future requirements for 95,000 positioning and locating receivers, many embedded into aviation assets both current and planned During Operation Just Cause, tactical applications of space assets included the use by many widely dispersed small units of single-channel tactical satellites as the only reliable means of secure communications available. Commercial satellites were used to transmit still images and the Army's CONUS-based tactical intelligence production section transmitted intelligence overlays

directly to Panama, portraying targets for use in the commander's intelligence preparation of the Battlefield. During Operation Desert Storm, the Land Component Commander was dependent primarily on satellite communication to control the rapid movement of very large and widely dispersed armored formations. Defense against tactical ballistic missiles became an operational reality for land component commanders in 1990 before and during Desert Storm. That defense was thoroughly reliant on space based sensors and communications, both DoD owned and commercial, to operate. In Haiti, space products provided deployed forces with critical communications connectivity, timely intelligence reports and high resolution maps. Today, the Army's intelligence functional area is completely dependent on spaced based sensors and communications to gather, fuse, and disseminate the intelligence products necessary to command and control all ground operations.

In the future, space assets, capabilities, and products will critically affect the conduct of land military operations across the entire spectrum of those operations. Access to national, civil, allied, military and commercial space capabilities and products will be essential to successful land operations.

Employment of space products that meet land warfighter requirements will provide a force multiplier essential to a power projection land force, which will always operate jointly and more often combined with allied forces.

The use of space products and application of those products will be embedded in land force doctrine, training, simulations, wargames and plans, and will be part of all preparations for and conduct of assigned missions of land component commanders and warfighters.

This section provides a summary of the land warfare missions and tasks which create a demand for space products and places those products within a framework of performance requirements which will help define system design, ubiquity, survivability, reliability and robustness. This information in turn, provides Air Force planners the information to frame the future design, procurement and operations of space based systems and products to support the conduct of land operations.

The application of space products in the Army and Marine Corps, the forces which conduct operations on land, is in the main, a joint activity. This means that while the Air Force is the principal designer, deployer and operator of systems which reside in space or responsible for acquiring space products from a variety of non- DoD sources, the land components are the principle designers, deployers and operators of the systems which receive and use the products of space based systems. Therefore, the characteristics, products and operational modes of space systems must be developed in consonance with the ground systems which are designed to support the requirements of landforce warfighters. Space based products will normally be part of a large web of other products and resources from non spaced based systems which have been combined or used concurrently to create capabilities which satisfy the demands created by ground operation missions and tasks. In many cases, space based products will provide unique capability to support ground operations, but they will be used in a system of systems environment.

Space based capabilities in support of ground operations can be grouped generally into the following categories :

- Communications

- Provides reliable transmission of command and control information between and among formations conducting ground operations
- Provides long haul communications links for intra and inter theater combat and support activities
- Moves sensor data from spaced based and non spaced based sensors to support intelligence and targeting processing system

• Position, Navigation, and Digital Mapping
- Provides three dimensional position, location, and navigation
- Assists synchronized operations through precision timing and locating
- Provides information to determine precise enemy location and target acquisition
- Provides the digital terrain data to support the digital transmission and integration of topographic and feature data to one meter resolution for anywhere in the world

• Reconnaissance, Surveillance, and Target Acquisition
- Provides global and local observation of both friendly and enemy activity and facilities

• Weather, Terrain, and Environmental Monitoring
- Permits advanced knowledge of the environment and its effects on friendly and enemy soldiers, formations, and systems to support mission planning, situation awareness, and synchronized battle management

• Missile Defense
- Provides early warning of missile attack
- Cues tactical missile defense systems to missile attack
- Targets enemy launch systems
- Provides counter-proliferation surveillance

Warfighting Missions and Tasks. The U.S. Army will continue to be a power projection force which will be required to conduct decisive combat operations in support of regional contingencies anywhere around the globe from a continental base. It similarly must be able to conduct operations other than war around the globe with minimal warning and preparation time. The Marine Corps will continue to be primarily a forward deployed force afloat which can be employed quickly to conduct combat operations in regional contingencies distant from the continental base of support. Both forces must be prepared to conduct forced entry operations against a wide spectrum of forces from the best equipped and trained to those at minimal levels of capability. The requirements placed on space based capabilities for both forces should be designed to support the most demanding circumstances.

Project the Force Capability. Because the majority of Army forces will be located in the continental United States and a large support base will remain in CONUS, split based operations will be normal whenever a portion of that force is deployed. While in preparation for deployment and enroute, the force will require information to conduct intelligence preparation of the battle area of operations and begin rehearsals for mission execution. Global communication pathways will be immediately required to support the functional areas of movement, intelligence, command and control, force protection, .and logistical support. Joint and multinational connectivity will be necessary from the beginning of any force projection operation.

Force projection will require functional space based capabilities to:

- Provide en-route communication which have assured access, global coverage, large band width capacity, interoperability with other service and allied communications, and flexibility
- Disseminate intelligence to forces enroute by sea and air
- Provide terrain and weather data on the deployed area of operations and en-route
- Produce digital mapping information to construct maps, update systems embedded mapping data, and support mission rehearsals
- Provide capability to maintain total asset visibility

Protect the Force Capability. When a force deploys, it becomes vulnerable to a wide range of threats which can prevent or diminish the capacity of its individual members to operate effectively, its systems to function with high efficiency, and its organizations to maintain the ability to move, shoot, support and communicate. Deployed operating forces must protect themselves against hostile weapons such as tactical ballistic missiles, chemical and biological weapons, and the possibility of larger or more capable enemy formations especially during periods of forced entry operations and force build up. The need to minimize casualties and to return sick or wounded quickly to fighting capability will be more important in future land combat because of the continuing rise in battlefield lethality and the likelihood that the US ground forces will operate with reduced physical presence. In an information rich battlefield environment, situational awareness will be an increasingly important aspect of force protection because it enables the force to engage the enemy forces at greater depths.

Force protection will require functional space based capabilities to:

- Enable real-time weapons detection and launch notification
- Determine and report in real time launch point identification
- Determine and report impact point identification in real-time with direct broadcast force wide
- Maintain wide area multispectral sensor coverage to deliver data for the development of total situational awareness
- Provide the means to execute telemedicine operations from CONUS to theater
- Provide detection capability for chemical, biological agents and enable global broadcast warning messages

- Provide ability to distinguish friend from foe through combat identification capability

Control the Force Capability. The battlefield of 2010 will experience a revolution in the ability of ground commanders to command and control the forces conducting operations. The capability to collect, assess, and move information better than an opponent will be the principal determinant for successful, decisive ground operations. The competitive advantage will derive from the quantity, quality, and usability of the information. Tomorrow's ground forces must be able to observe the battlefield in real time, orient the force continuously, decide continuously, and act continuously. US ground forces must be able to execute, mount, and recover from operations ranging from war to peace keeping operations, orchestrate all of the battlefield operating systems faster than the opposing forces. US ground commanders must be able to control the environment, day and night, in all weather conditions, and deny the enemy the ability to control or use the environment to his advantage. .Commanders must be able to control the tempo of operations through all phases from early entry to decisive operations. They must be able to place the right force at the right place at the right time. Commanders must also be able to control the battlespace within which they are operating. They must have the capability to move faster then the enemy, overmatch the enemy's combat power at decisive points, and be able to operate inside the enemy's decision cycle. Force control requires real-time intelligence, total situational awareness and the knowledge to navigate anywhere, at any time.

Force Control will require functional space based capability to:

- Provide combat identification of friendly equipment
- Provide wide band communications for intra-theater dissemination of digital data to build common picture of the battlefield, real-time Intelligence development, and shared situational awareness
- Provide capability for satellite based position and navigation information for embedded navigational systems on vehicles, aircraft, and for individual soldiers
- Provide real time terrain and feature digital mapping data and disseminate on wide area direct broadcast for inter-theater intelligence support systems
- Sensors which develop real time battle damage assessment information about enemy forces

Maneuver the Force Capability. The ground component of a joint or combined force seeks to create decisive impact on the conduct of a campaign or major operation. This is done by either securing operational advantages of position before battle is joined or exploiting tactical success to achieve operational or strategic results. To create decision, operational formations must regroup, deploy, shift, or move within the theater of operations from less threatened or less promising area to more decisive positions elsewhere. Movement and maneuver can be by sea, land ,or air. Maneuver includes the functions for enhancing the mobility of friendly forces, degrading the mobility of enemy forces, and controlling a land, sea, or aerospace area. Maneuver and associated movement are defined in terms of time of occurrence, space of activity, and by speed of formations and the weapons and logistical support system associated with them. Central to all successful maneuver is a common view of the battlefield by all of the forces included in and supporting the operation. Shared situational awareness coupled with real-time forces

synchronization enables simultaneous application of combat power across the entire battlespace, by strategic, operational, and tactical assets. Total knowledge of enemy forces and capabilities, the environment, and joint and allied forces is required to control the tempo of maneuver and dominate the battlespace.

Force Maneuver will require functional space based capability to:

- Provide real-time weather data to ground force planners and commanders in wide area broadcast
- Position sensors to locate both moving and stationary targets from individual weapon size to large formations and maintain continuous observation of high value targets. Direct downlink of target data to individual shooters will be required
- Provide terrain and feature coverage to develop and update terrain digital data bases
- Provide capability for on the move communications from individual soldier to the largest ground formations

3.3 Sea Based Force Tasks

In support of our country's National Security and National Military Strategies, Navy's focus is on its inherent ability to conduct forward operations for peace time presence, crisis response, and regional conflict intervention, while maintaining a credible strategic deterrent. Navy has historically been a huge user of information from space and communications satellites to distribute this information to globally deployed ships and its future space requirements will multiply manifold. Over 70 percent of the Earth's surface is Navy's potential operating area. Navy has unique space needs, in areas where others do not, resulting in a lack of constituency for which to compete for requirements priorities, e.g. open ocean surveillance, charting and mapping of coast lines between low and high tides, bathymetry, etc. Understandably, commercial communications satellites, particularly the over crowded Ku and C bands, are focused over land and primarily high density, populated areas, limiting these communications satellites utility to Navy.

Sea based space requirements are linked to Navy's "From the Sea" strategy, which calls for naval expeditionary forces to operate in forward areas, and will be used to accomplish its warfighting objectives in a joint environment. Navy's operating environment includes all mediums, i.e. air, ground, sea, subsurface and space and depends on space for command, control, communications, surveillance, mine countermeasures, evacuation of civilians, search and rescue, battlespace dominance, power projection and force sustainment. Submarine communications requirements are especially unique and challenging as they must be low probability of intercept and low probability of detection and submarines frequently must operate in the polar regions where there is limited satellite communications coverage. These environments will not change, nor will Navy missions significantly change for the next 20 years, but there will be major increases in the support required from space. That space support must enable Navy to carry out its missions with shorter timelines and greater accuracy and lethality.

Navy in Space. Navy has been a leader in exploiting space since l960 and will continue to pursue every potential benefit from space. It will continuously identify long range naval

requirements, system concepts and technologies. Because of Navy's high mobility, naval space systems must be flexible, adaptable, scaleable, easily reconfigureable and be totally interoperable with a wide range of systems. Navy's warfighting necessities include imagery, rapid targeting, intelligence data base transfers, multiple netted voice circuits, myriad telephone circuits and video teleconferencing. Navy will enter the next millennium using its current suite of communications satellites, continue to field its UHF satellite follow-on program, with the latter satellites having an EHF capability and buy within the next two years all of its remaining EHF terminal requirements. The Situational Awareness Beacon with Reply (SABER) system, a satellite communications based beacon assembly, will mature and be expanded to become a global system that will provide highly accurate three dimensional situational awareness and prevent fratricide. Navy will continue developing its Lower and Upper Tier Ballistic Missile Defense systems.

Navy space policy is delineated in Secretary of the Navy Instruction 5400.39B of 26 August 1993. Space capabilities are to be fully integrated into Navy's innate and emerging capabilities and integrated into every facet of naval operations. Navy recognizes that its forces are heavily dependent on support from space and its primary focus is to provide space-based support to the warfighter. Navy depends on space derived information to perform these missions: surveillance, strike, battle group operations, operations other than war, logistics and maintenance, and special, air, submarine, surface, amphibious, and information warfare. Navy will continue to develop, acquire, and support the operation of, either alone or jointly, space systems which will satisfy its unique requirements.

Surveillance and warning. Navy's surveillance and warning requirements covers all of the ocean and littoral areas of the world and include the detection, tracking, and targeting of non-cooperative air and ground targets (aircraft, cruise and theater ballistic missiles, mobile launchers, etc.) in near real time. For theater missile defense a direct down link for IR data to warn and cue missile defense systems, a capability to assess raid count and maintain individual target tracks throughout missile's flight and the ability to determine with great accuracy the missile launch point is needed. There is a requirement for the ability to detect and locate underground, hardened targets such as nuclear, chemical and biological production facilities, as well as command and control centers. With the end of the cold war, Navy's indications and warning and surveillance focus has shifted from combating the Soviet Ocean Surveillance System (SOSS) to the threats posed by a large variety of littoral countries' threats, with the attendant diminishing response times. Navy uses space, aircraft and/or shipboard surveillance and warning sensors to gather information and provides that information to the shooter through either space or aircraft systems. Navy will continue to integrate space derived surveillance and warning information with information acquired from organic shipboard and aircraft systems and any other joint information sources.

Reconnaissance. Navy has a continuous , near-real time sensor and satellite coverage requirement for its areas of responsibility. Information from carefully tailored and profiled information domains needs to be provided via downlinks directly to operational commanders to support tactical threat warning, strike planning, BDA, and re-strike planning. Automatic target recognition techniques and algorithm development are needed to more quickly recognize the presence of targets. Improved sensor performance is needed to enhance the precision in geolocation of conventional radars, including the intercept and locating of unintentional modulation of non-military shipping. One of Navy's unique space reconnaissance requirements

is the location of mines. Multi-spectra imagery obtained commercially has proven to be helpful in locating mines in shallow water, but a SAR and/or LIDAR capability is required to detect sub-surface sea mines.

Communications. Navy communications are inextricably dependent on satellite communications for its every mission from peacetime forward presence to war at sea. SATCOM is the lifeblood of and the essential link to naval forces. The salient features required for naval SATCOM are high bandwidth, assured access, global coverage, interoperability, security, and an architecture that is flexible and easily reconfigured. Navy has and will continue to depend on satellite communications spanning the entire frequency spectrum, i.e. UHF, L-band (commercial INMARSAT), SHF, and EHF, and in the future higher frequencies, i.e. millimeter, infrared and optical wavelength. It uses both military and commercial (INMARSAT, INTELSAT, etc.) satellites, including commercial satellites that drift due to fuel starvation. In the UHF spectrum, Navy utilizes FLTSAT, LEASAT, GAPFILLER, and UHF FOLLOW-ON (UFO) satellites. In the SHF spectrum, it uses DSCS, NATO and SKYNET satellites and at EHF, Navy employs the FLTSAT EHF PACKAGE (FEP), UFO-E and MILSTAR satellites. To better exploit its communication network, Navy needs to develop an automatic and dynamic network control and management system that will adapt to demand, be media independent and invisible to the user. Because of a paucity of real-estate on ships, antenna sizes are limited, aggravating the power/aperture problem and restricting bandwidth. Navy' primary communications technological requirement is for a phased array high gain antenna that is electronically steerable and capable of accessing multiple satellites, operating in any frequency band, in different parts of the sky simultaneously. It must rid itself of the antenna forest aboard ships i.e. 120 antennas on a Nimitz class carrier. Navy's bandwidth requirements at sea will far outpace emerging technologies ability to satisfy. A conservative estimate is that 20 gbps will be required for flagships by the year 2015. Navy at sea commanders must have access to large reservoirs of information that contain information about friendly and enemy weapons systems, platform capabilities, enemy order of battle, satellite ephemerides, enemy signals, etc.

Navigation and Positioning. Precise navigation is essential for safe passage, exact positional information is the first factor in the calculus for any targeting solution and accurate geolocation is crucial for Navy's precision guided munitions. Every navy ship and aircraft should have GPS time and position information embedded in its navigation system and, if economically practical, in its weapons systems. In those weapons platforms, whereby it is cost prohibitive to integrate GPS into the mission computer, GPS should be used as the standard to enable their inertia systems to remain within extraordinarily accurate position tolerance.

Weather. Navy has myriad requirements for accurate and continuos weather information spanning the spectrum from evading storms and heavy seas to avoid ship damage, to making weapon systems more effective, to using winds and tides for economical steaming or flight operations. Navy must have accurate and timely weather information to achieve a strategic and tactical advantage. Weather is a major, if not a determining factor, in every dimension of naval warfare. The commander at sea requires information on sea surface topography, sea state, sea ice edge, ice thickness, bathymetry, sea surface temperature, sea surface wind vectors and velocity, sound velocity profile, and cloud opacity, bottom height, thickness and particle size and be able to observe, measure and record temperature, humidity and atmospheric pressure.

3.4 Airborne Force Tasks

Air warfare is the province of no single service, each has air components which may operate independently and in support of joint surface forces. What distinguishes the forces is the medium in which they operate, the territory over which they can range, and the timeliness with which they can respond. Air components can operate across the entire spectrum of conflict and have. While general US Air Force service issues have been addressed throughout the report, the joint air warrior's needs require specific discussion.

The medium in which they operate. The special risks of operating in all weather day and night conditions have challenged air warriors since the first day of military aviation. The three dimensional fluid in which they operate requires characterization just as the ocean must be characterized for forces afloat. Space based weather and climatology have long supported air operations. This support will be required into the foreseeable future. Additional requirements in defining air mass behavior to ensure weapons delivery accuracy are already being stated. Further requirements, in timeliness, accuracy, and access will grow as air operations without benefit of forward-basing become the norm.

The territory over which they range. Air forces range over the entire globe. Their area of operation is virtually unconstrained. This drives the situation awareness requirements for future air forces to very high levels. First they must understand the terrain over which they will operate. This implies a significantly expanded earth surface and cultural features data base. Cold War imperatives and space systems limitations during the era seriously constrained the amount of data collected, processed, and distributed. Most of the world today is mapped and charted to an accuracy insufficient to support the intrinsic capabilities of future air forces. The inability if the air warrior to correlate his tactics to the terrain will reduce effectiveness and increase losses. Second, they must understand the targets against which they are operating. The cold war conditions identified above have created a lopsided repository of information which lags the warfighters' needs. Classification boundaries have kept this information from those who need it to ensure mission success and their own survival in some instances. As weapons technologies allow us to move to general "one shot, one kill" operations such as demonstrated by F-117s in the Persian Gulf, air warriors must be afforded target situation awareness of comparable accuracy. Third, the essentially unlimited range of air forces implies a new concept for communications. As we learned in the Persian Gulf, no country in the world enjoys the communications infrastructure the US does. The ability to move the information required for acceptable situation awareness is fundamental to future air warfare. This implies not only requirements for masses of data into a theater which far exceed those we experienced in Desert Storm, it implies the ability to move situation awareness information directly into the cockpit. To a lesser degree, the air crew on the scene is an important part of the air component commanders' situation awareness; information out of the cockpit takes on a new meaning.

The timeliness with which they can respond. The ability of air forces to get to the target has outstripped the ability of the forces which support them to provide the information necessary to the successful conduct of operations. This leads to conservative tactics which allow our adversaries an opportunity to consolidate their forces and provide a substantially more hostile reception for US forces. Future air forces will require support which keeps pace with the overall tempo of the operation.

All of these point to an air warriors' requirement for information which is accurate, relevant, and timely and a concomitant requirement to interfere with an adversary's information such that, in varying degrees at various times, it is none of these. Space systems are uniquely suited to meeting these requirements. They can produce information of extraordinary accuracy. They have allowed access to denied areas. They can provide a universal infrastructure. And, they can be employed to interfere with information flows. These functions can be performed globally and virtually at will.

The natural extension of air into space leads to the natural opportunity to extend air operations into space. Doing so complicates the adversary's strategic, operational, and tactical challenges, and may afford an entirely new of projecting force.

3.5 Space Based Force Tasks

Force Enhancement. As can be deduced from the preceding sections, the historical and current focus for space force tasks is in the area of providing information to land, sea, and air components to enhance their operations. This information is either collected by space-based platforms or transmitted via space-related platforms in the areas of observing and characterizing the battlespace, organizing and executing the battle or enhancing and predicting conditions within which our forces must operate. Classically these capabilities have included reconnaissance and surveillance, navigation, communications and environmental sensing. The tasks to support these areas include all activities required to operate the individual systems, process the data collected and transmit the resulting information to the end user - the warfighter in his area of responsibility.

Future efforts in the force enhancement area will focus on placing higher dependence on space to support the warfighter, possibly by further integrating space into future battle. Implementing a space-based radar capability to take over the role of AWACS is one way of increasing this space involvement. Another would be in further integrating the selected information, such as GPS, into weapons delivery platforms. The inherent qualities of space in terms of wider field of regard and instantaneous access make these efforts very responsive and potentially very cost-effective when system trade-offs are made.

Space Force Support. Space force support includes missions carried out by terrestrial elements of military space forces. The objectives of space force support are to sustain, surge, and reconstitute elements of a military system or capability. These activities improve or sustain space vehicles in space, direct missions and support other government or civil organizations. Examples include spacelift, replenishment operations and satellite operations. Spacelift encompasses all activities necessary to launch, achieve initial operating orbit and reposition satellites already in orbit. Satellite operations provides the infrastructure required to command and control the DoD satellites once they are on orbit. It is worthy to note that the military, civil and commercial launch infrastructure within the U.S. is highly integrated and we are currently examining expansion of our satellite operations customer base to include support to commercial efforts.

Space Control. It is universally accepted that the warfighter must achieve and maintain air and space superiority to win. To ensure space superiority, control of space is mandatory. As access to space capabilities proliferates through the world the impact on the battlespace will be

felt in many areas. Future commanders can reasonably expect their adversary to have space based capabilities available to them and also to appreciate the value of space to the U.S. This necessitates a much greater emphasis on space control. Space control assures the friendly use of the space environment while denying its use to the enemy. The elements of space control include surveillance of the space environment, protection of U.S./Allied space capabilities prevention of adversarial interference with U.S. space exploitation, and the ability to negate our adversary's access to space.

Space surveillance capabilities are relatively mature. As satellite constellations proliferate, especially with proposals such as Teledesic, and the sizes of satellites decrease, the volume and complexity of the space surveillance job will increase. Means to expand our surveillance capabilities while maintaining cost effectiveness must be examined. Comprehensive space surveillance allows for overflight warning from potentially hostile satellites to units in the field, accurate assessments of payloads and targeting and Battle Damage Assessment in support of protecting U.S. assets or negating an adversary's.

Survivability of U.S./Allied space systems will be increasingly important as capabilities to disrupt and deny space data become common. Unintentional interference with space systems is commonplace, intentional interference only requires a focused intent and rudimentary capabilities. Additionally, vulnerabilities of our ground nodes to information warfare techniques must be examined in detail.

Negation of adversary space capabilities has long been frowned upon as 'weaponizing space'. However, potential methods to disrupt, deny, degrade or destroy an adversary's space capabilities could take many forms. Any segment of the space system (ground station, satellite, links or data distribution) could be targeted and many means could be employed to deny an adversary access to the space data. Denial methods span the spectrum from diplomacy to destruction.