COMMENTARY

Issues with the Integration of Space and Terrestrial Military Operations

Paul Szymanski

It is critical that military space operations become coordinated and integrated with the more traditional military planning conducted on Earth (air, land, sea, and Global Integrated Operations). In my experience, this integration of space and terrestrial military actions has frequently encountered many problems. Space mostly provides information: sensors (imagery, signals intelligence, navigation, weather, missile warning, and so forth) and transmission of that info (satellite communications). Thus, any space control actions are mainly to deny, degrade, delay, deceive, disrupt, destroy, and such the flow of this information. It is easier to evaluate the effects of taking out a bridge on the ground and how this action impacts the overall conduct of the current terrestrial battle. It is very difficult to assess how information denial affects the overall battlefield. Consequently, in the 15 different military exercises I have participated in with space components, the terrestrial commander ranks space actions as very low priorities (even actions against terrestrial space terminals) compared to other immediate needs. The commander generally does not truly understand space and its importance to the overall war effort. The commander knows space is important but cannot objectively measure this value or qualitatively rank space communication targets vs. sensor satellite targets, especially if the commander only controls a few antisatellite weapons. Conversely, adversary commanders probably understand less than the allied side of the importance of space to their own war efforts and may discount any blue force counterspace actions taken against them. Both the allied and adversary disjuncts prevent any meaningful evaluation of space and terrestrial targeting analyses, without first establishing common measures of merit for ranking information flow targets on the battlefield (fig. 1).

Space Warfare Political Consequences

Complicating this dilemma is the fact that military actions in space have much more severe political consequence than the more historically acceptable terrestrial war operations, even with the potential of no casualties in space. In my total experience, space war fighters do not take into account political consequences. I have been at many military exercises where space war fighters totally blew off the political and diplomatic consequences of their actions and sometimes believed

that this was not even their role, as more senior leaders would "catch" their mistakes later on in the approval process. In one simulated military exercise, the Chinese embassy was accidentally bombed again—mistaken for a satellite receiver station because the space war fighter in charge believed that people further up the command chain would catch this mistake, and it was late in the day anyway, and time to go home. I heard the same thing about space operators at the NORAD Cheyenne Mountain Complex going home at 5 PM during Desert Storm because that was their normal time to quit work, and space was not that important anyway. I have even heard general officer-level space leaders express their opinions that space war fighters under them would not be able to comprehend these complex issues so there was no sense including these political issues in space battle-management software currently being developed or even as part of military exercises. Contrast this attitude with how the Army is taught to always think of the political consequences when entering a high-threat village and to consciously monitor the probable effects of their actions.

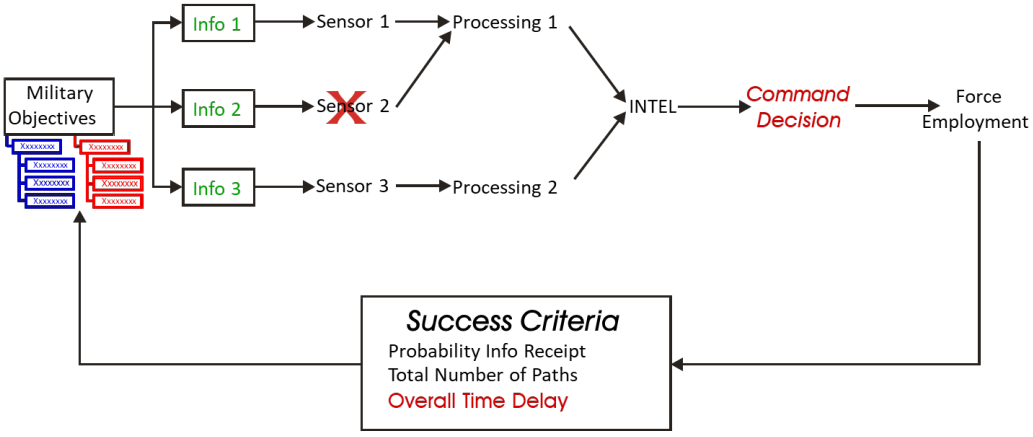

Figure 1. Flow of information on the battlefield

Possibly another complication to this attitude is the fact that space war fighters do not particularly have "skin in the game," unlike terrestrial war fighters. Much like Air Force personnel located in the United States who control drones over battlefields in Afghanistan and Iraq, space war fighters have a very low probability of being counterattacked by adversary weapon systems. This obviously leads to a different set of fundamental emotions and mind-sets than more traditional "war fighters" who can reach back to thousands of years of military

tradition and culture concerning the stress of warfare. The space operators have an even less tenuous connection to the battlefield than Air Force drone operators, as these Space Force war fighters have little worry about causing human casualties in outer space as a consequence of their military actions. Besides the financial, economic, political, and diplomatic effects of their operations against satellites in space, the scenario simply may possibly feel more like a video game to the space war fighters.

Space Supports Terrestrial Warfighters

Space war fighters forget that their main mission goal is to support terrestrial military actions. Until we have permanent settlements in space requiring defending, most space activities ultimately support terrestrial operations. There needs to be a common measure of merit for ranking space actions compared to terrestrial military courses of action. If the commander states he does not want an adversary imaging his preparations for surprise attacks, planners need to rank the following military actions:

a. Attack imagery satellites;

b. Attack ground receiver terminals supporting these imagery satellites;

c. Attack links from satellites to ground terminals;

d. Attack communications links from satellite ground terminals to adversary commanders;

e. Attack unmanned aerial vehicles providing the same imagery data; and

f. So forth.

Algorithms need to be developed for common target ranking between space and terrestrial targets. These algorithms ultimately would track the flow of information across the battlefield for both space and terrestrial systems and provide tools to determine optimum attack strategies that consider both space and terrestrial targets simultaneously.

Space vs. Terrestrial Military Terminology

Space war-fighting terminology needs to closely align with traditional terrestrial terminology and planning processes (see an example of this in fig. 2). Space battle-management systems completely ignore Joint Publication 5-0 *Joint Planning* when

it comes to war-planning principles. Because of this, space plans are more difficult to communicate and understand for theater commanders and cannot be easily compared and ranked in priority. Senior space officers I talked to about this see no problem with space planning being conducted differently than what JP 5-0 mandates, another indication of the mental separation between space and terrestrial military planning. This narrow-focus approach means the continuing isolation of space planners from the *real* battlefield on Earth. Senior Space Force leaders need to make changes to these attitudes and assure that we are all fighting the same war. Too many senior space war fighters firmly believe space missions and courses of action are in total isolation from the terrestrial battlefield and have no idea why they are denying a particular space system, how it fits into the overall terrestrial battle plan, how these actions ultimately support terrestrial war fighters, and in accordance to which critical timelines and acceptable conflict escalation risks. In addition, space war fighters should be made aware of how their actions may impact both space and terrestrial conflict escalation control (see table 1).

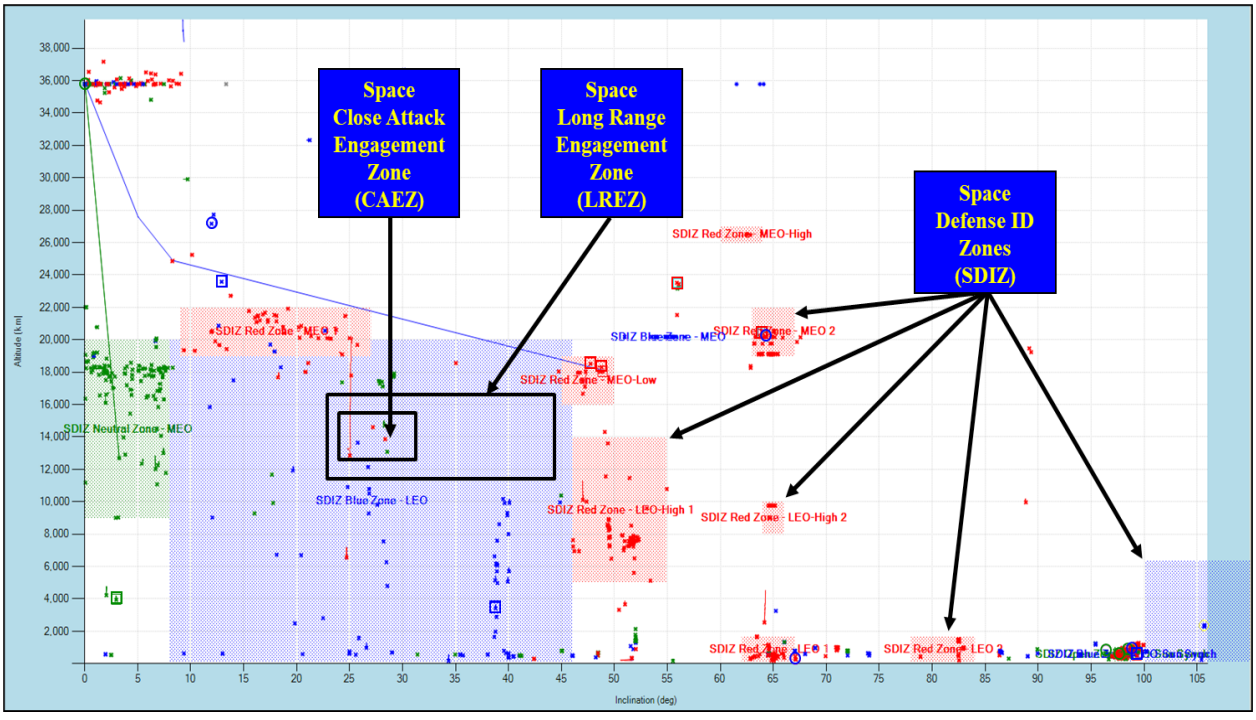

Figure 2. Extension of classical air defense terminology to space control engagement zones. (Contact author for additional space terminology alignments)

Table 1. Space conflict escalation ladder

				Campaign Phases					
Severity	WHS	ROE Domain	Conflict Phase	Terrestrial Campaign Phase	Space Campaign Phase	Weapon Type	Space Campaign Phase Full Name	Weapon Category	Comments
10	P.1.A.0	Space	Pre-Conflict	Phase 0: Pre-War Buildup (Shape)	1st Wave Attacks Phase A	Pre-Conflict Deter	1st Wave Attacks Phase A - Pre-Conflict Deter	Overt Weapons Testing & Deployment; Treaties; Saber Rattling; Space Alliances; Normal Space Surveillance; Trading & Reconnaissance Activities; Satellite Close Inspections	
9.4	P.1.B.0	Space	Pre-Conflict	Phase 0: Pre-War Buildup (Shape)	1st Wave Attacks Phase B	Persuade; Spying; Propaganda; Avoidance Maneuvering; Increased Space Surveillance & Close Satellite Inspections	1st Wave Attacks Phase B - Pre-Conflict Persuade	Diplomatic Requests & Démarches; Economic Actions; Embargos; Legal Actions; Administrative Actions; Transmitting Propaganda Broadcasts; Jamming Propaganda Broadcasts; Increased Spying & Surveillance; Unusual Increases in Space Surveillance and Tracking Activities; Threaten Allies of Your Adversaries; Maneuver to Avoid Attacks	Even though spying is normally a peacetime activity, discovery of a major spy network during times of heightened tension can increase the escalation ladder
8.8	P.1.C.0	Space	Pre-Conflict Crisis	Phase 0: Pre-War Buildup (Shape)	1st Wave Attacks Phase C	Hide; Covert; Cyber; Political Disruptions; Mobilize Forces; Increase Military Alert Level; Threatening Satellite Maneuvers; Increase Space Radiation; Initiate Satellite Defensive Measures; Employ Nation's Astronauts on International Space Station for Military Uses	1st Wave Attacks Phase C - Pre-Conflict Hide	Camouflage; Stop Activities; Mobility; Covert Technology Developments; Small Covert SOF Attacks; Cyber Attacks; Covert Actions in Violation of International Treaties; Cutoff Diplomatic Relations; Inspire Social Disruptions and Agitations; Employ Lethal Force Against Your Own Citizens; Mobilize Forces; Increase Military Alert Level (DEFCONs); Maneuver Close Enough to Adversary Satellites to Purposely Appear as a Threat; Reveal Covert Programs to Appear Threatening; Force Into War Reserve Modes (or Hide) for Critical Satellites; Hide Senior Leadership; Increase Radiation Environment in Orbits Used by Adversaries; Initiate Satellite Defensive Measures; Employ Nation's Astronauts on International Space Station for Military Reconnaissance and Surveillance; Spoof and Falsify World-Wide Distribution of Satellite Location Orbital Tracking Data	Covert actions in violation of international treaties risks discovery and a subsequent increase in the escalation ladder
8.2	P.2.A.0	Space	Trans-Conflict	Phase I: Deployment / Deterrence (Deter)	2nd Wave Attacks	Trans-Conflict Deter	2nd Wave Attacks - Trans-Conflict Deter	Provocative but False Attacks; Linked Attacks; Demo Attacks; Alternate Country Attacks; Blockades; Major Covert SOF Attacks; Terrorist Attacks; Summarily Execute Saboteurs; Seize & Sequester Suspected Terrorists; Alert Anti-Satellite Systems; Arm Satellite Self-Defense Mechanisms; Alert Anti-Missile Defenses; Alert Anti-Aircraft Defenses; Arm Allied Astronauts on International Space Station	
7.6	P.3.A.1	Space	Trans-Conflict	Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A1 – Grd Based	From Terrestrial Partial Temporary Kill	3rd Wave Attacks Phase A1 – Terrestrial-to-Space Partial Temporary Effects	Delay, Deny; Covertly Assassinate Adversary Diplomatic Ambassador; Blind Adversary Astronauts with Laser Dazzler; Openly Conduct Electronic Warfare Against Adversary Satellite Systems	
7.1	P.3.A.2	Space	Trans-Conflict	Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A2 – Grd Based	From Terrestrial Total Temporary Kill	3rd Wave Attacks Phase A2 – Terrestrial-to-Space Total Temporary Effects	Disrupt	
6.5	P.3.B.1	Space	Trans-Conflict	Phase III: Air Counter-Offensive (Dominate)	3rd Wave Attacks Phase B1 – Space Based	From Space Partial Temporary Kill	3rd Wave Attacks Phase B1 – Space-to-Space Partial Temporary Effects	Delay, Deny	
5.9	P.3.B.2	Space	Trans-Conflict	Phase III: Air Counter-Offensive (Dominate)	3rd Wave Attacks Phase B2 – Space Based	From Space Total Temporary Kill	3rd Wave Attacks Phase B2 – Space-to-Space Total Temporary Effects	Disrupt	
5.3	P.4.A.1	Space	Trans-Conflict	Phase IV: Joint Counter-Offensive to Restore Friendly Pre-Conflict Status (Stabilize Borders)	4th Wave Attacks Phase A1 – Grd Based	From Terrestrial Partial Permanent Kill	4th Wave Attacks Phase A1 – Terrestrial-to-Space Partial Permanent Kill	Degrade	
4.7	P.4.A.2	Space	Trans-Conflict	Phase IV: Joint Counter-Offensive to Restore Friendly Pre-Conflict Status (Stabilize Borders)	4th Wave Attacks Phase A2 – Grd Based	From Terrestrial Total Permanent Kill	4th Wave Attacks Phase A2 – Terrestrial-to-Space Total Permanent Kill	Destroy; Also Includes Destroying Space-Related Terrestrial Sites and Destroying Direct Ascent ASAT Missiles with Anti-Missile Weapon Systems	
4.1	P.4.B.1	Space	Trans-Conflict	Phase V: Joint Counter-Offensive to Capture Adversary Capitol (Enable New Civil Authority)	4th Wave Attacks Phase B1 – Space-Based	From Space Partial Permanent Kill	4th Wave Attacks Phase B1 – Space-to-Space Partial Permanent Kill	Degrade; Declare Martial Law; Bomb Adversary Populations	
3.5	P.4.B.2	Space	Trans-Conflict	Phase V: Joint Counter-Offensive to Capture Adversary Capitol (Enable New Civil Authority)	4th Wave Attacks Phase B2 – Space Based	From Space Total Permanent Kill	4th Wave Attacks Phase B2 – Space-to-Space Total Permanent Kill	Destroy; Threaten to Kill Adversary Astronauts on International Space Station	
2.9	P.5.A.0	Space	Trans-Conflict	Phase VI: Defend Against Adversary Counter-Attacks Against Friendly Homeland (Defend Friendly Citizens)	5th Wave Attacks	Space-Manned Permanent Kill; Kill Adversary Astronauts	5th Wave Attacks - Space-Manned Permanent Kill	Degrade, Destroy; Kill Adversary Astronauts on International Space Station	
2.4	P.5.A.0	Space	Trans-Conflict	Phase VI: Defend Against Adversary Counter-Attacks Against Friendly Homeland (Defend Friendly Citizens)	6th Wave Attacks	Space-to-Earth Permanent Kill	6th Wave Attacks - Space-to-Earth Permanent Kill	Degrade, Destroy	
1.8	P.7.A.0	Space	Trans-Conflict	Phase VII: Defend Against Adversary Use of Nuclear Weapons in Space (Defend Friendly Military)	7th Wave Attacks	NBC Use - Space	7th Wave Attacks - NBC Use - Space	Degrade, Destroy; Alert Nuclear Forces for Defensive Preparations	
1.2	P.8.A.0	Space	Trans-Conflict	Phase VIII: Defend Against Adversary Use of NBC Against Friendly Military Targets (Defend Friendly Military)	8th Wave Attacks; Phase A – Military Targets	NBC Use - Space & Terrestrial	8th Wave Attacks Phase A – NBC Use - Space & Terrestrial - Military Targets	Degrade, Destroy	
0.6	P.8.B.0	Space	Trans-Conflict	Phase IX: Defend Against Adversary Use of NBC Against All Friendly Targets (Defend Friendly Military & Civilians)	8th Wave Attacks; Phase B – Civilian Targets	NBC Use - Space & Terrestrial	8th Wave Attacks Phase B – NBC Use - Space & Terrestrial - Civilian Targets	Degrade, Destroy	
10	P.9.A.0	Space	Post-Conflict	Phase X: Post-Hostilities (Reconstruction & Stabilization)	9th Wave Attacks	Post-Conflict Deter	9th Wave Attacks - Post-Conflict Deter	Diplomatic Requests; Economic Actions; Legal Actions; Administrative Actions; Jamming Propaganda Broadcasts; Forced Population Resettlements	

In addition, one aspect of the genius of JP 5-0 is the requirement to define the conflict termination (surrender) criteria *before* any military planning commences. That way all military courses of action can be traced to ultimate battlefield goals. The terrestrial conflict termination criteria—such as regain territory, change adversary leadership, and so forth—may be more easily defined than space ones. However, space-war termination criteria are more difficult to express, since there is no "territory" to hold (much like air and sea warfare) and it is easier to hide space weapon systems inside innocent-looking commercial and civil satellite systems (see table 2).

Table 2. Possible space war surrender criteria

• The balance of power in space between Red and Blue is sufficient to deter Red from any near-future space attacks for the next 10 years.
• Red will and ability to continue fighting in space has been severely restricted.
• Red cannot image battlefield with less than 1-meter resolution.
• Red cannot recover major space capabilities in less than 10 years.
• Red space launch capabilities reduced by 50 percent.
• Red on-orbit military space assets supporting current conflict region (AOR) delta-v maneuvering capability reduced by 50 percent.
• Red on-orbit antisatellite (ASAT) capabilities reduced to 10-percent remainder (capabilities de-orbited).
• Red forced to negotiating table over ASAT weapons.
• Red provides war reparations for Blue and Gray space systems degraded/destroyed.
• Red develops program to clean up space debris caused by their military actions.
• Red surrenders some of their internationally-assigned geosynchronous orbital position slots.
• Red does not approach any Blue critical satellites within 100 meters.
• Red required to place tracking beacons on all future satellites. Blue establishes declaratory policy to immediately neutralize any Red satellites without these tracking beacons for the next 10 years.
• Red national leadership publicly declares they will no longer pursue space weapon development.

Joint Space Terrestrial Map Displays

There needs to be joint space–terrestrial battlefield map displays to better understand adversary actions and the effects of our responses. This would be a good first step toward integrated space and terrestrial war-fighting planning. When one visual representation allows senior planners to fully understand allied and adversary actions in space and how they impact the overall battlefield, then more rapid reactions to space–terrestrial timelines are enabled. I believe that all summary space situation displays should be readily readable and understandable to decision

makers, even those with little to no space experience, so senior general officers can better appreciate how space systems impact their battlefields. As part of this, there is a requirement to expand space icons to better align with the more traditional terrestrial military standard (MIL-STD-2525D *Joint Military Symbology*) for common situation displays (see examples in fig. 3). The current space icons in MIL-STD-2525D can only be described as weak and meek and do not include representations of all space objects currently in orbit. There is even confusion as to which parameters are important to display with each military icon, with the current MIL-STD believing that nonsensical satellite "speed" is an important number to display to map readers. All of this needs to be integrated into one space–terrestrial user interface concept and battle-management system. This will propel the United States into a new era of situational awareness beyond what our adversaries or even allies are currently capable of (see figs. 4 and 5).

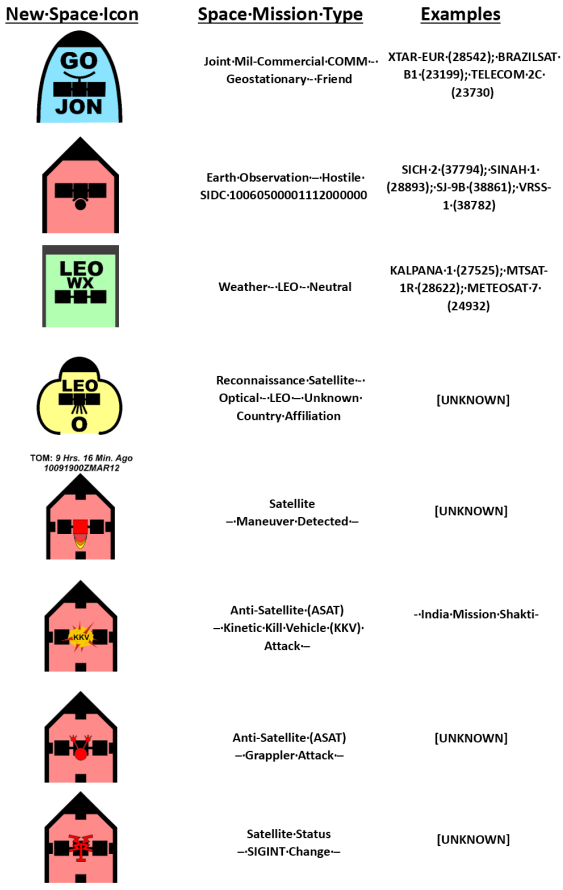

Figure 3. Some proposed MIL-STD-2525 new space icons

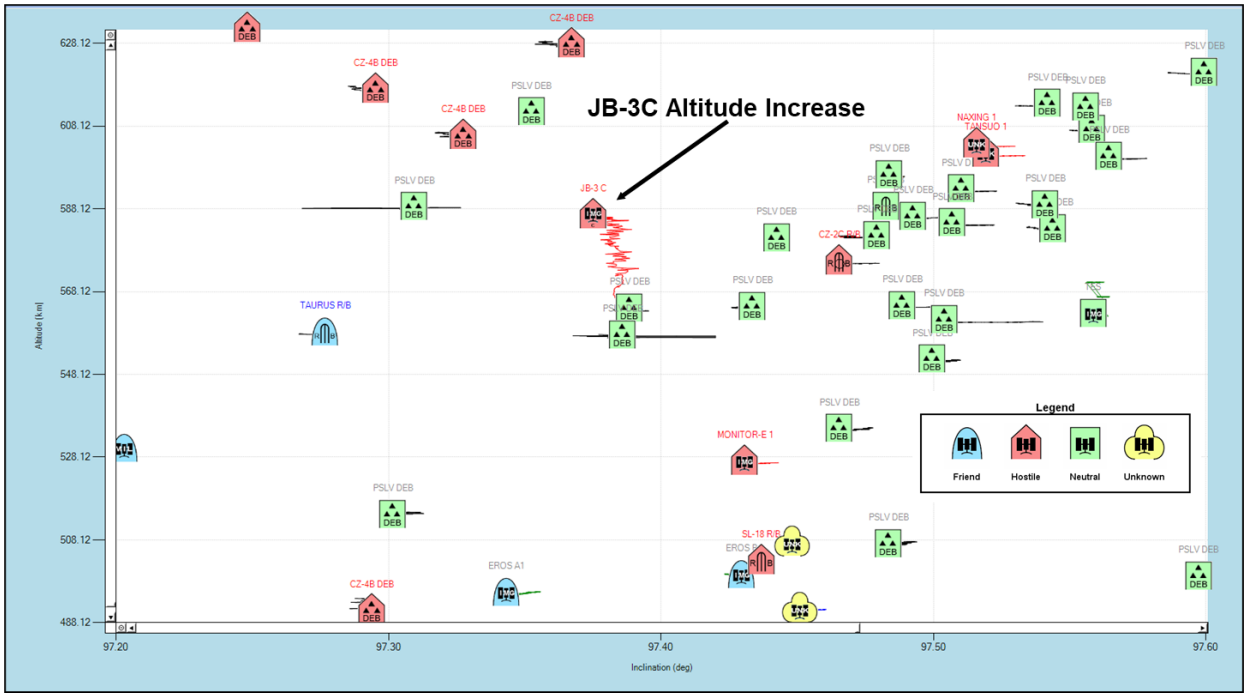

Figure 4. Example space situation map

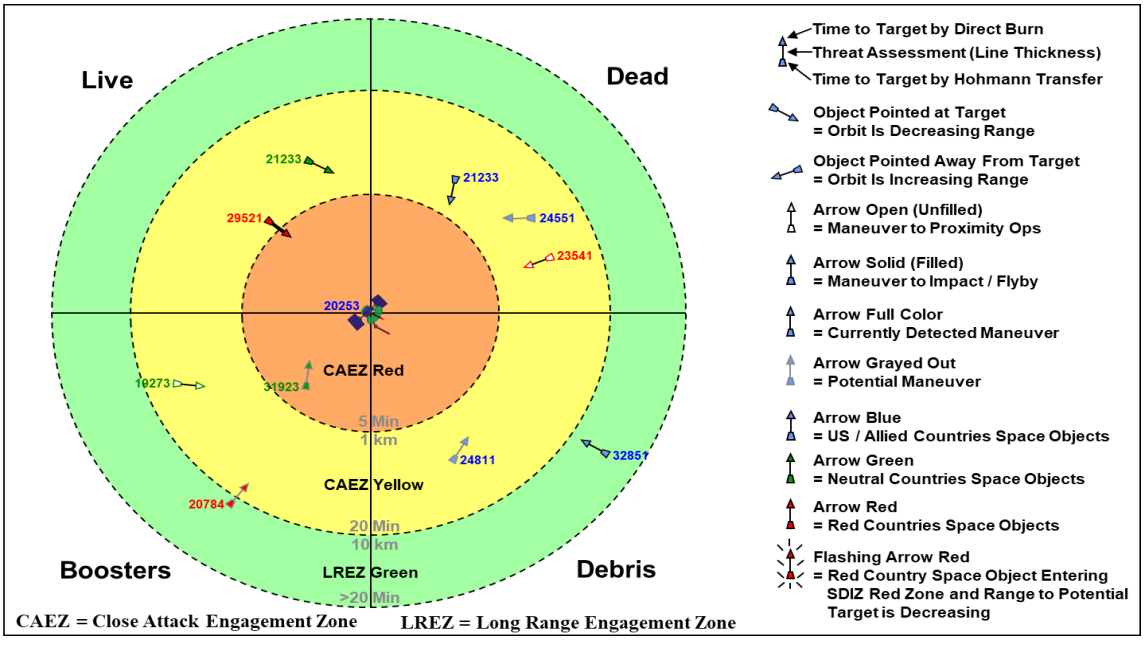

Figure 5. Alternate example space situation map

Overclassification of Space Systems Loses Wars

The overclassification of select space systems prevents their use on the battlefield. In my experience, senior battlefield commanders refuse to authorize space control systems they never heard of and never trained with, for the promise of unverifiable effects. Integration of these deeply buried space systems into normal planning processes is very difficult, especially with allied participation, in spite of what the current Space Force Chief of Space Operations is trying to change. This will be a continuing problem, especially with the political sensitivities of space weapons, their fragility to countermeasures, and their ability to surreptitiously show resolve and intent to potential adversaries without the general population understanding what is transpiring. In addition, potential allied support in specific space operations is doubtful. Besides allies probably possessing limited space weapon systems, the probability these systems are in the right place at the right time is low. If the United States requires space control measures in the Pacific, it is doubtful that NATO space systems would be in a position to support these requirements. Remember, due to the difficulty and high maneuvering fuel requirements of space systems, space wars need to be fought with whatever assets are at hand in the immediate combat area. The overall space war will be concluded before any additional offensive or defensive assets can be repositioned.

In addition, allies will have differing rules of engagement for employment of politically sensitive space weapons systems. For example, Europeans have different rules than the United States for authorizing potential loss of life simply to prevent damage to military equipment. In other words, would many NATO countries disallow an attack on a manned adversary ground station controlling a space weapon system, if this weapon system is only attacking an unmanned, but critical, satellite?

Space Warfighter Checklist Mentalities

Space war fighters are accustomed to conducting operations through checklists only (see fig. 6). This does not work well when a high-paced, never before experienced, space conflict takes place at the time when human imagination and creativity is most required. My calculations have shown that most major space wars will be concluded within 24–48 hours. Will an integrated space-air-ground Combined Air Operations Center (CAOC) be able to respond in a timely manner? Many space military actions may require National Command Authority (NCA) approval. Generally, the NCA will require validation as to who is attacking before military responses can be authorized. Due to the vast distances in space, verification is extremely difficult and time-consuming. For example, if we are in a war

with China over, let us say Taiwan, and one of our critical satellites covering the Western Pacific suddenly stops working, what are we to assume? Was it caused by natural events such as solar flares or meteor fragments, maybe just normal reliability failures, or intentional attack? One could easily assume that China had something to do with this, but we could not be sure, and it usually takes months to figure out how a satellite *possibly* failed. Maybe Russia caused this satellite failure just to be stirring the pot? Maybe we will self-deter in our responses due to excessive uncertainties before the space war is already concluded? Remember, Sun Tzu stated, "All warfare is based on deception."

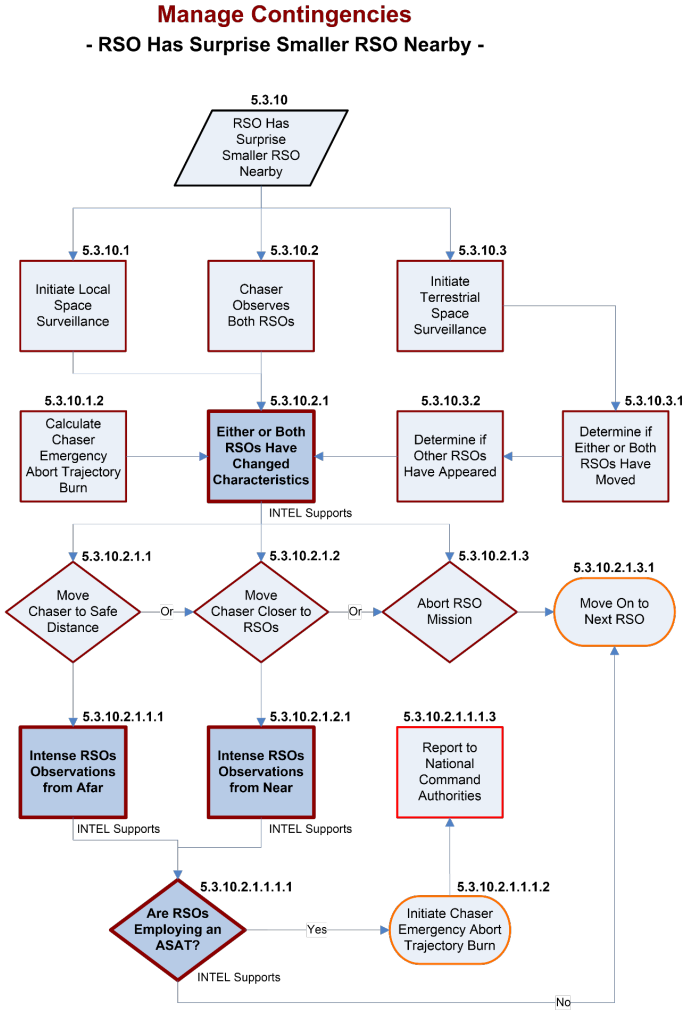

Figure 6. Example space battle-management checklist for a notional inspector satellite

RSO = Resident Space Object (Target)

One way to solve this is to develop a "fun" computer war game for notional space weapon systems that is realistic but easy to play. We could then have the students at military academies play these games and award a $100 prize every week to anyone who "wins" the game. This would then harness the imaginations and energies of young war fighters, who would develop all of the doctrine, strategies, and tactics for winning space wars. When they graduate and become satellite operators, they will then be attuned to the subtle clues of space attacks and be able to rapidly assess probable adversary goals and intents (see fig. 7). It is also important to make this war game available to all services to harness historical knowledge resident in the individual service's cultures, particularly non-space aware organizations with extensive terrestrial military experiences. Despite the futuristic qualities of space wars, all wars deal with human perceptions, biases, experiences, training, organizational structures, upper military and political managers, intelligence, and mental and emotional strengths, weaknesses, and endurances of the individual commanders. Ultimately these wars are in reality a contest between allied and adversary commanders' minds, and these commanders transmit messages to each other through the war fighters under them and employed military weapon systems. Another quote is appropriate here: "It is not the object of war to annihilate those who have given provocation for it, but to cause them to mend their ways"—Polybius, *History* (2nd century BCE).

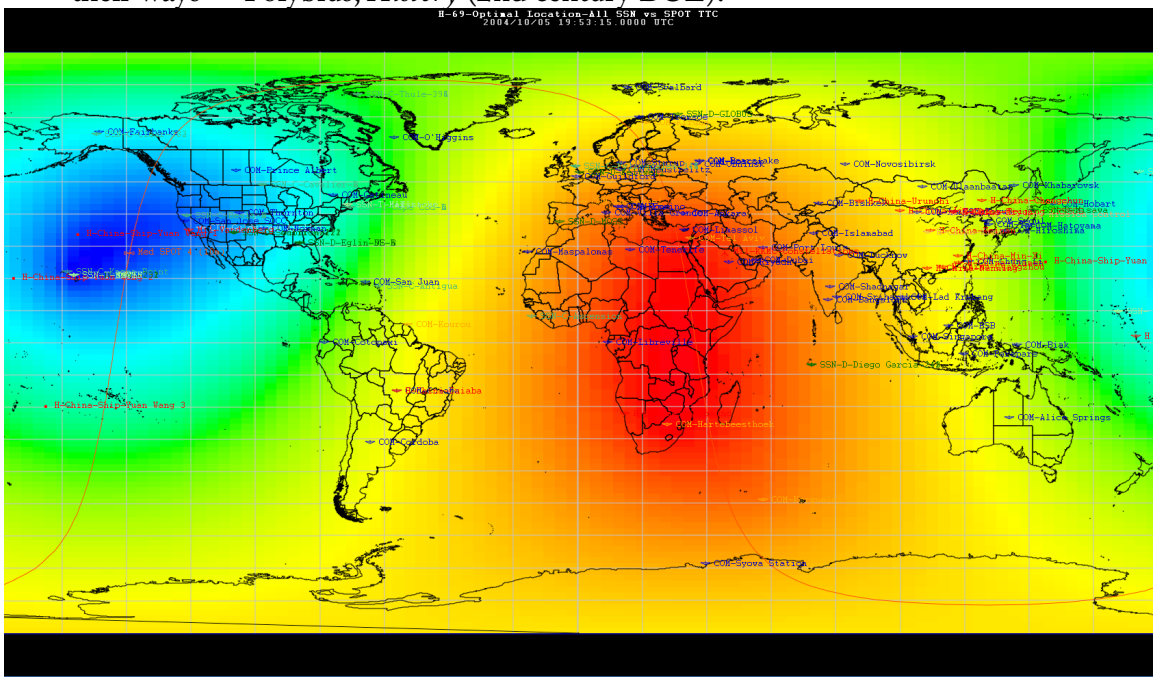

Figure 7. Example antisatellite attack probabilities map

Summary

In final summary, my most important point is that there are far too many examples in military history where one force that was supposedly inferior on paper was able to beat a much superior force, due to better doctrine, strategies, and tactics. Countries that are overly familiar with victory are particularly vulnerable to hubris. When was the last time the air war was in doubt for the United States? Maybe in the early days of World War II, almost 80 years ago. Since then we have produced many generations of military leaders who are far too accustomed to winning wars and doing things the good old way. Space is too new a conflict environment for lazy thinking about how to conduct decisive warfare. I experienced this kind of overconfident attitudes in the Air Force over the years, and that is why I think it is actually easy to beat the United States in any major conflict in space, despite our supposedly superior technologies. Technologies do not win wars—great thinkers do.

An example of this is in the beginning of World War II, when the Allies actually possessed 17 times the number of tanks that the Germans did, and the Allied tanks possessed superior technologies. Add to this correlation of forces the extremely expensive Maginot Line, and the Allies' overconfidence in their superior military hardware. The Germans succeed in pulling off the most dramatic defeat of the twentieth century with their superior strategies and tactics of Blitzkrieg warfare—not by implementing superior technologies. There are also some who theorize that, like the German grand strategy of WWII, the Chinese might feel inferior in space military technology and plan for a Blitzkrieg space war in the near future to catch the United States off guard and complete space control operations before the United States knows what hit it and be able to verify who the adversary was and what that adversary's strategic aims are. We will probably self-deter until it is too late, due to moral and political concerns.

In addition, it is easy to assume that a clever adversary will take out our eyes and ears in space before initiating terrestrial conflicts. There are key choke points in space at which this adversary must position his antisatellite (ASAT) forces, before initiating these surprise attacks. Good space domain awareness may detect this pre-positioning of ASAT assets and possibly prevent the terrestrial war from even starting, by frustrating the adversary's pre-conflict space battlefield preparations and confronting him in public diplomatic forums (see fig. 8).

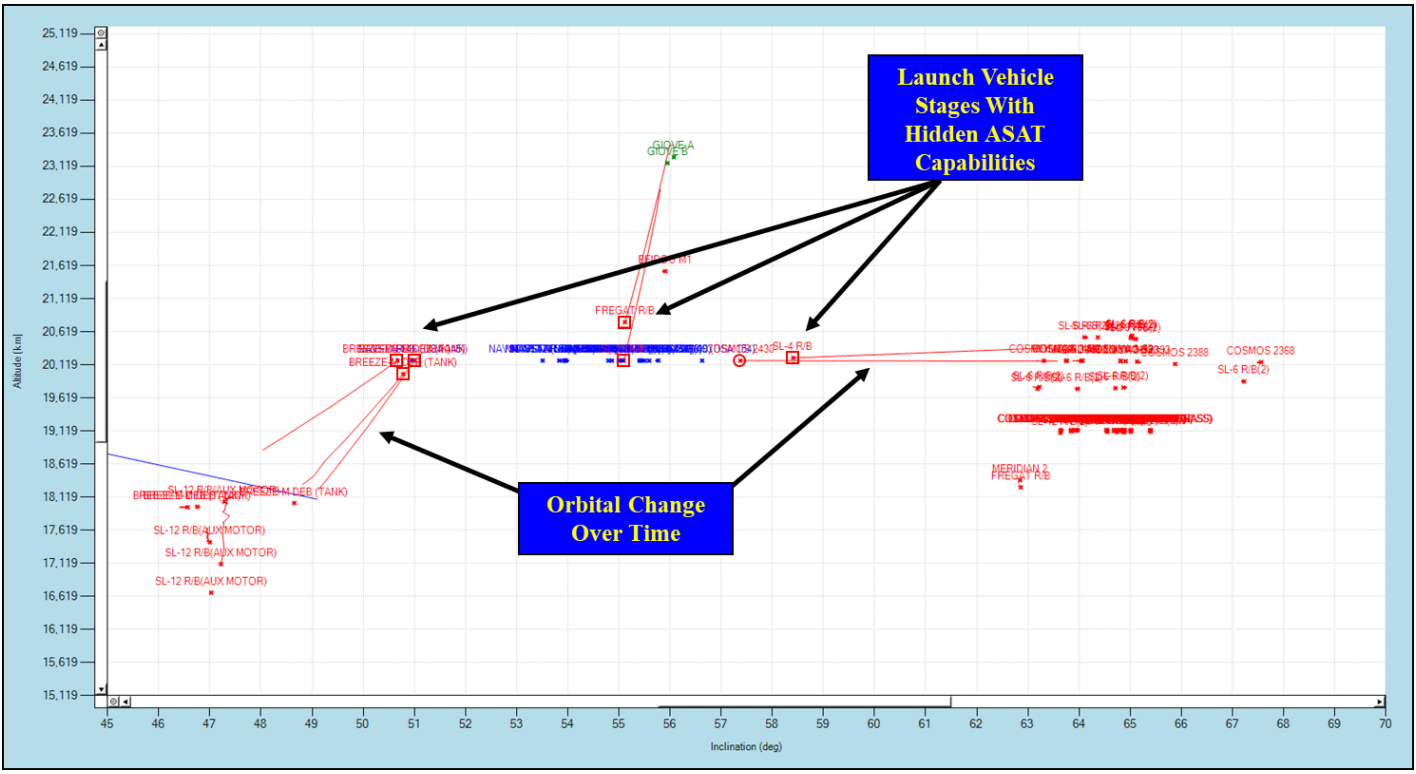

Figure 8. Notional attack on GPS

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He currently manages a private discussion group consisting of 15,372 hand-picked members of LinkedIn interested in space, with members including 1,429 general officers and admirals; 56 current and former Under/Assistant Secretaries of Defense (including one former Secretary of Defense); 238 from the Joint Chiefs of Staff (including two former Chairmen of the Joint Chiefs of Staff); past and current commanders of the 4th, 5th, 6th, Pacific, and Korea Naval fleets; 569 Congressional House and Senate staffers; 136 diplomats; 268 staffers from the White House and National Security Council; and 52 astronauts, among others.