How to Fight and Win the Coming Space War

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***Abstract*—**The importance of outer space satellites and their supporting systems cannot be overstated. Their use in the military, civil and commercial world to provide communications, weather, navigation, timing, imagery and Earth resources monitoring provides major advantages to those who employ the information generated by these systems. However, due to the global reach of these space systems, advantages are provided to both friendly and adversary militaries. Beginning with the use of space systems to support military operations during the Arab-Israeli conflicts, and in Desert Storm, both major and minor players are considering how denial of space capabilities of their adversaries will be a force multiplier on terrestrial battlefields.

Based on the author's extensive experience in this theoretical area, he has developed essential "Rules" by which he feels the next space war will be conducted. These are based on his unclassified analyses of past military history, and of classical Military Principles of War, [2] Sun Tzu's Art of War [1] and other concepts that are applicable to Space Warfare. Since a full-up space war has not yet occurred, all of these concepts are notional and unproven, much like air warfare doctrine was only theoretically understood prior to World War Two. Nonetheless, it is very important to better understand how a future space war might be conducted to ensure favorable outcomes for the more prepared country, and for better outcomes for the world, in general, post space conflict.

Note: The opinions expressed herein reflects the viewpoints of the author only, and are not represented as official policy of any governmental or military organization. The concepts developed here are based solely on the author's imagination concerning future space wars.

***Keywords*—**Outer space military warfare theory, outer space military doctrine, space policy, military space warfare, space Principles of War, space Centers of Gravity, how to fight and win the next space war.

INTRODUCTION

There is a lot of recent talk concerning a Space Force and the probability of space wars in general. I will not discuss the pros and cons of military space organizational structures. What I will talk about, though, are the foundational principles by which future space wars can be won. These may be derived from classical military thinkers such as Sun Tzu[1] or Clausewitz[2]. This is because all wars are fundamentally conducted by people, no matter how technologically sophisticated their weapon systems are. After studying military history for 50 years, I can only conclude that wars are fought between opposing commanders' minds, and not necessarily their machines of war. Military commanders are fighting their opposing commander's intelligence, education, culture, training,

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He currently manages a private discussion group consisting of 10,956 hand-picked members of LinkedIn interested in outer space warfare whose members consist of: 853 General officers and Admirals, 53 current and former Under/Assistant Secretaries of Defense (including one former Secretary of Defense), 180 from the Joint Chiefs of Staff (including the current and one former Chairman of the Joint Chiefs of Staff), past and current Commanders of the 4th, 6th, Pacific, and Korea Naval fleets, 412 Congressional House & Senate staffers, 75 diplomats, 172 from the White House and National Security Council staffs, and 26 astronauts, among others.

experience, doctrine, stamina, fortitude, fear, hatred, etc. The way commanders communicate to their opposite side is through their soldiers and weapon systems. This is why certain strategies such as surprise or application of mass attacks are just as applicable today in futuristic space systems, as they were 2,500 years ago in a Greek phalanx[3].

The second important concept I need to state here is that how one conducts war (military doctrine) is the most important aspect of winning conflicts. There are many, many examples in military history where one force that appeared superior on paper was summarily defeated by a much "inferior" force due to better doctrinal concepts and implementations. Going back to past history, using the World War II model, it's interesting how quickly the Germans developed the doctrine and strategies to execute the biggest military defeat of major powers in the 20th century. General Heinz Guderian, the proponent and leader of German armored blitzkrieg warfare, did not even ride in a tank until 1929, just 10 years before his tanks were starting to conquer Europe. His book, "Achtung - Panzer!"[4] on the theory of armored warfare, was not even published until 1937, just 2 years before his tanks invaded Poland. Due to the Versailles Treaty, Germany was not allowed to build major tanks. Germany's first tank, the very weak MK I, was not fully deployed to their troops until 1935, just 4 years before the start of World War II.

It's amazing that with so short a time period for development of armored warfare theory, doctrine, equipment and training before operational employment, that the Germans were so successful in knocking out the French and British forces so early in the invasion of France, especially since the Allies had 8 months to prepare defenses and train forces during the Phony War of September 1939 to May 1940. At the start of the invasion, the Allies had a 17 to 1 advantage in number of tanks over the Germans, and their tanks were better armored and had better armament than the Germans. They had the Maginot Line. So why did the Germans beat the Allies so soundly and so quickly? The simple answer was the Germans had the advantage of starting from scratch with developing armored warfare, due to being defeated in World War I, which required new, original thinking. They simply had better armored doctrine than the Allies at the beginning of World War II, which led to their spectacular victories over them.

Does all of this sound familiar for future space warfare where the strategies and tactics for massed combat in space have not yet been proven for any country? When was the last time the air war was in doubt for the United Sates (75-80 years ago?). Have we grown complacent in our thinking that we always ultimately win wars against major combatants? Do we always fight the last war in our military planning? These concerns are why I started developing foundational principles for outer space warfare. Some of the topics discussed in this paper are listed in **Table 1.** In addition, some of the fundamental questions that need to be answered for space warfare commanders by efficient Battle Management, Command and Control (BMC2) systems are listed in **Table 2.**

1. Space Principles of War
2. Space Conflict Termination Criteria
3. Sun Tzu's "Art of War" Applicability to Space Warfare
4. Top 40 Rules to Fight and Win the Next Space War
5. Space Conflict Escalation Control
6. General Space Doctrine

Table 1 Fundamental Space Warfare Doctrine Discussed

1. Will Space Systems be Under Attack in the Near Future?
2. Are Space Systems Currently Under Attack?
3. Who Is Attacking?
4. What is the Adversary's Attack Strategy?
5. What Damage Has Been Caused to Military Capabilities?
6. What Is the Optimal Blue COA Response?

Table 2 Fundamental Space Warfare Questions

PRINCIPLES OF SPACE WAR

A long time ago I conducted a study of classical military "Principles of War" (United States tri-service, British, Russian) that were then combined, summarized and updated for Space Warfare. This study was for the United States Joint Chiefs of Staff when they were trying to decide whether to establish a Space Command or a Continental Defense Command. These basic Principles are listed in **Table 3**:

1. Objective
2. Offensive
3. Mass
4. Economy of Force
5. Maneuver
6. Unity of Command
7. Security
8. Surprise
9. Simplicity

Table 3 Principles of Space War

Detailed discussions of space warfare implications for the Principles of War are given below:

1. **Objective**
   a) **Terrestrial:** *"Direct every military operation toward a clearly defined, decisive, and attainable objective with measurable effects"*
   b) **Space:** Are your objectives to take out an individual satellite or a total system capability that may be supported by both satellites and ground systems? Will taking out the satellite be decisive in denying that category of information? Does it have a measurable impact on the battlefield? Which military objectives does this system support? Is satisfaction of this objective achievable? Are there branches and sequels to space control operations plans if they fail or if they are successful?

2. **Offensive**
   a) **Terrestrial:** *"Seize, retain, and exploit the initiative"*
   b) **Space:** Is there political will to start a space war at the beginning of a terrestrial conflict and seize the space initiative, or is taking out ground sites supporting space sufficient to

achieve objectives? Are we setting the time, place and terms of the space battle? Does the battle tempo include space attacks on a continuing basis to keep the adversary off-balance? Can space weapon systems sustain continuous attacks? Is there a pre-approved ramp-up of space attack severity to exploit successes for further gain?

3. Mass

a) **Terrestrial:** *"Mass the effects of overwhelming combat power at the decisive place and time"*

b) **Space:** Are there sufficient weapons to achieve continuous, or sustained space control? Can the adversary re-configure his space systems to avoid attack? Are the space weapons overwhelming to the military function they are trying to deny? Is there political will to implement massed space attack? Can space weapons get into position at the decisive place and time? Do we actually know the decisive place and time for space weapons application? Can multiple space weapons be synchronized for employment simultaneously and coordinated with terrestrial attacks?

4. Economy of Force

a) **Terrestrial:** *"Employ all combat power available in the most effective way possible; allocate minimum essential combat power to secondary efforts"*

b) **Space:** Are all space control efforts and weapon systems integrated into one deployment/employment plan? Is the target list optimal with minimal weapons use? Are different phenomenology weapons attacks integrated (e.g. cyber-attack synchronized with laser combined-arms attacks)? Are the results of space control decisive to the battlefield? Are all space control systems employed purposefully at all times of the conflict, even in delay, limited or deceptive kinds of attacks that focus the adversary's attention away from the main space attack?

5. Maneuver

a) **Terrestrial:** *"Place the enemy in a position of disadvantage through the flexible application of combat power"*

b) **Space:** Have space weapons been deployed in optimal positions and time-space phasing? What is the effect on the adversary of space weapons use? Has the "high ground" of space above the battlefield been won? Are there critical orbits/time phasing/launch corridors/communications paths around the world contributing to the battlefield that need space superiority consideration? Has access to space been denied to the adversary and his allies, and optimized for the blue side and allies? Has blue freedom of action been maximized while minimizing red freedom of action in space? Are points of application of space control weapons constantly shifted to confuse adversary response, and avoid predictable patterns of operation, for survivability reasons? Have critical space superiority systems been serviced with maneuvering fuel prior to space conflict?

6. Unity of Command

a) **Terrestrial:** *"For every objective, seek unity of command and unity of effort"*

b) **Space:** Have space control, info war, and air/ground attack plans been integrated with each other and with intelligence collection requirements? Does the "classic" target allocation process give sufficient consideration of space/info targets? Is there adequate space/info war

delineation of chain of command and decision responsibility? Are space target lists traceable back to objectives (both red and blue)? Do blue and red terrestrial commanders appreciate the importance of space to their conduct of the war? Since space is global, have blue allies been part of the space warfare decision-making processes?

7. **Security**
   a) **Terrestrial:** *"Never permit the enemy to acquire unexpected advantage"*
   b) **Space:** Are space forces, including weapon systems, survivable in the battlefield environment? Have OPSEC (Operations Security) and fratricide concerns been met? Have blue space choke points (orbits/time phasing/launch corridors/communications paths), centers of gravity (TT&C - Tracking, Telemetry and Control, and launch sites), logistics, and command structures been identified and protected? Does blue have alternative space-related sensor, processing, command, and communications paths? Are red space strategies, tactics, doctrine, organization, commanders and intentions assessed?

8. **Surprise**
   a) **Terrestrial:** *"Strike the enemy at a time or place or in a manner for which he is unprepared"*
   b) **Space:** Are space control weapons existence known to an adversary, or does he know they have been deployed to the theater, or do they have covert war operating modes to surprise the enemy by their use? Are there a series of surprise space control weapons that can be alternated in use to maintain cover? Is the use of these weapons detectable or attributable to a specific country by an adversary? Timing and tempo of space weapon use can also surprise, even if their existence is known. Threats of weapon use, even if the weapon does not currently exist, can effectively surprise.

9. **Simplicity**
   a) **Terrestrial:** *"Prepare clear, uncomplicated plans and concise orders to ensure thorough understanding"*
   b) **Space:** How complex are space weapons, and are the effects of their use easily understandable by non-space blue and red commanders (do they know they've been hurt bad)? Are there branches and sequels to space control operations if they fail or if they are successful?

Other Military Considerations

- Have You Delineated the Definition of "Wining" the Space War?
- Do Space COA's Have Well-Defined Goals, End States, Branches, Sequels & Expected Action-Reaction Consequences?
- Does the Space COA's Vary Employed Space Weapon Phenomenology Types & Basing Locations?
- Has Space Strategy / Tactic Been Tried Before?
- Space COA's Ability to Surprise / Confuse, Shock & Awe Adversary
- What is the Ability of your Adversary to Frustrate Space COA Preparations, Execution, and Attack Verifications?

Other Political Considerations

- Is There Decisive Political Will to Execute Space COA's and Accept Potential Trans-Conflict & Post-Conflict Consequences?
- Can Space Weapon Employment Approval be Gained in a Timely Manner from Higher Authorities?
- What are Executed Space COA's Impacts on Space Alliances & Treaties (both Blue and Red)?
- Will Space COA Execution Re-Align Both Blue & Red Allies?
- Space COA Execution Impact on United States Population Attitudes About War in Space
- Space COA Execution Impact on Post-Conflict Commercial / Civil Use of Space
- Is the Intended Target Employed by Both Military & Commercial / Civil Users that May Require Surgical Targeting?

SPACE CONFLICT TERMINATION CRITERIA

Joint Publication 5-0, "Joint Operation Planning"[5] mandates that the first step of any Operations Planning is to delineate what the war termination (surrender) criteria must be. This success criteria informs later Operational Art including military Objectives, Effects, Tasks, Courses of Action (COA's), etc. For terrestrial operations, conflict termination criteria are more straightforward, such as: seize and hold territory, depose dictators, destroy military capabilities, etc. However, for space wars these criteria are not so obvious. Can one seize territory in space, or effectively deny employment of space weapons or restrict access to certain orbits?

Some example space war termination criteria developed by the author are given below, and a complete list is in **Appendix 1**.

Possible Space War Termination Criteria:

1. War political goals met
2. Red space force capabilities reduction goals met
3. Red space disarmament occurs
4. 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
5. Red maneuvers satellites outside immediate threat zones that endanger Blue critical space assets
6. Red cannot image battlefield with less than 1-meter resolution
7. Red open to inspection of space launch sites, rocket fuel production facilities and space research facilities
8. All Red terrestrial ASAT sites and programs revealed
9. Red provides war reparations for Blue and Gray space systems permanently degraded / destroyed
10. Red develops program to clean up space debris caused by their military actions
11. Control of Red inspector satellites handed over to Blue
12. Red surrenders some of their internationally-assigned geosynchronous orbital position slots
13. Red establishes a hotline connection between their space command centers and Blue space command centers
14. Red provides 30 days' notice of all planned future space launches
15. Red does not approach any Blue critical satellites within 100 meters

16. 80% of Red satellite refueling on-orbit depots and servicing satellites shut down
17. Embargo is established against Red import of sensitive space technologies and sub-systems
18. Red required to place tracking beacons on all future launched satellites. Blue establishes declaratory policy to immediately neutralize any Red satellites without these tracking beacons for the next 10 years
19. Red must formally state mission of each newly-launched space object for the next 10 years. Mission is subject to verification by Blue; and, neutralization if any satellites with surreptitious missions are discovered

PROPOSED MILITARY SPACE DOCTRINE

Military doctrine is the most important factor in winning individual battles and entire wars. Since wars are conflicts between human minds, those with the best minds and correct attitudes and execution authorities, usually win. This can be even more important for the space environment due to the unknown qualities of the vast distances involved, and lack of previous experiences in this futuristic new mode of warfare. The following charts illustrate some of the author's concepts for basic military space doctrine. They are simply extensions of current and historical terrestrial warfare doctrine, strategies and tactics.

Figure 2. *Space Defense Identification Zones* (SDIZ) employs classical Air Defense terminology to define regions of space with unique warning and command and control responsibilities. The specific definitions of these military space terms can be viewed in the attached appendix: "**Space Glossary List**". It is interesting that classical Air Defense terminology transfers well to the space domain. Also note that **Figure 2** illustrates a new way of thinking with space situation maps. Displays that show thousands of space objects orbiting the Earth are not too useful for planning purposes. These Altitude vs Inclination plots that the author invented 15 years ago illustrate the two most important factors concerning orbital maneuvering, and provide an essentially fixed map illustrating which space objects are close to each other, and could be potential threats. Specific regions of space, such as geosynchronous, sun-synchronous and GPS Medium-Earth Orbit (MEO) altitudes can be readily delineated on this space map, and segmented into differing battle management, command and control relationships.

Figure 1. *Strategic – Operational – Tactical Relationships* gives the author's first cut on possible space DEFCON (Defense Condition) strategic and tactical threat warning levels and how they relate to threat distances, and at what Level of War that planning occurs at.

Figure 3. *Space Defense Readiness Conditions* defines these threat levels more specifically. These charts are derived from traditional Air Force air doctrine, but have been modified for space warfare purposes. The author felt it was important to break these DEFCON levels into both strategic and tactical levels. A strategic DEFCON can be declared for a certain larger Space Defense Identification Zone (SDIZ) and/or declared for a specific smaller tactical Close Attack Engagement Zone (CAEZ), depending on the number of currently active threats and the overall DEFCON level on Earth.

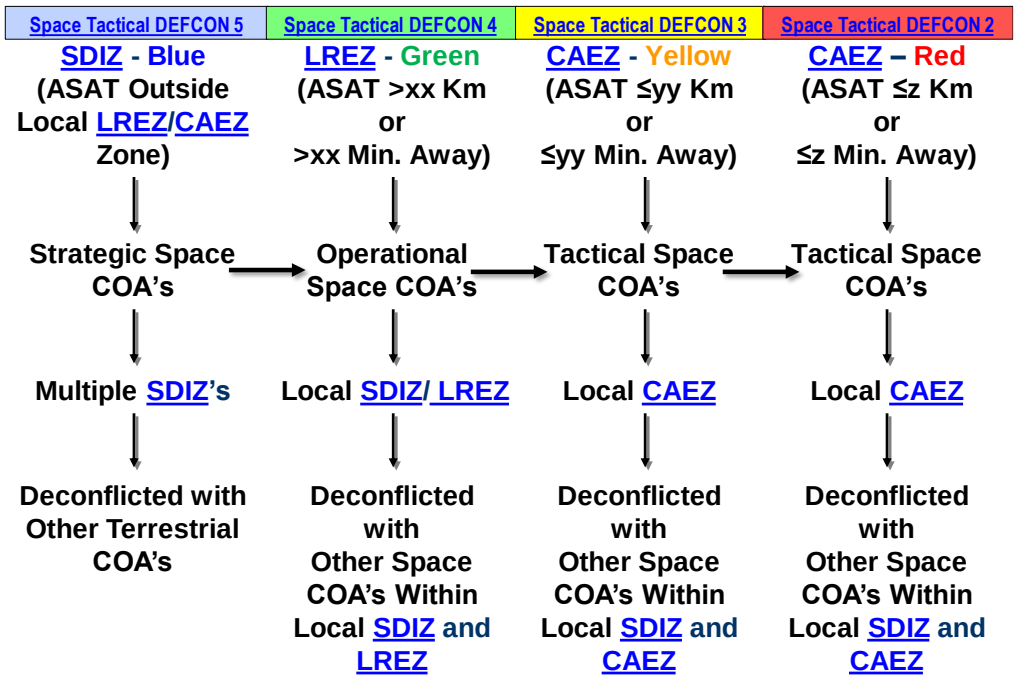

Figure 1. Strategic – Operational – Tactical Relationships

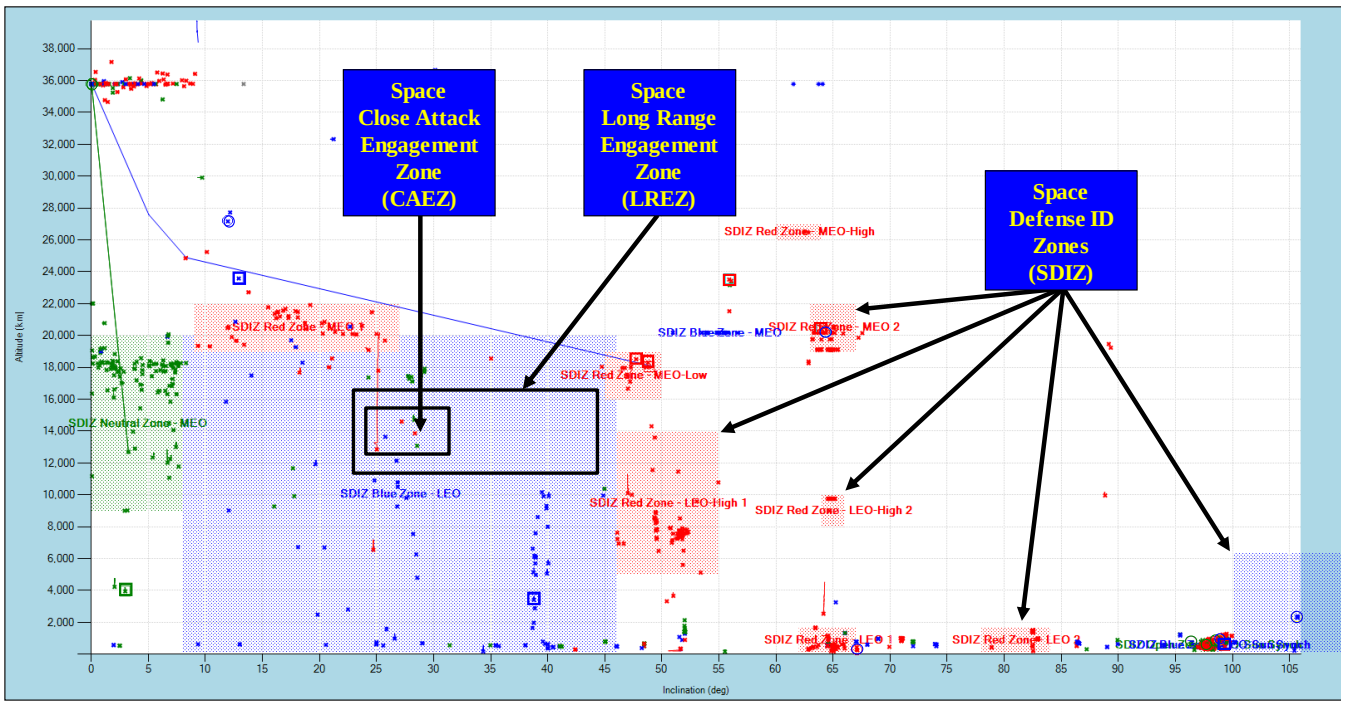

Figure 2. Space Defense Identification Zones

Defense Readiness Conditions for Space Systems - Strategic

Readiness condition	Exercise term	Description	Readiness
SPACE DEFCON 1	COCKED PISTOL	Global Space War is imminent	Maximum space readiness
SPACE DEFCON 2	FAST PACE	Preparations for multiple attacks in multiple regions in space have been detected	Terrestrial-based weapons ready to deploy and engage in less than 6 hours
SPACE DEFCON 3	ROUND HOUSE	Preparations for a single attack in space have been detected	Space-based weapons ready to maneuver for engagement in 15 minutes
SPACE DEFCON 4	DOUBLE TAKE	Increased intelligence watch and strengthened security measures for space systems	Above normal space systems readiness
SPACE DEFCON 5	FADE OUT	Lowest state of readiness	Normal space systems readiness

Defense Readiness Conditions for Space Systems - Tactical

Readiness condition	Exercise term	Description	Readiness
SPACE TACTICAL DEFCON 1	COCKED PISTOL	Multiple space attacks in local SDIZ are imminent.	Maximum space readiness
SPACE TACTICAL DEFCON 2	FAST PACE	Potential ASAT <z Km or <z Min. Away. Preparations for space attack against a single satellite have been detected.	Space-based weapons/defenses ready for target engagements immediately
SPACE TACTICAL DEFCON 3	ROUND HOUSE	Potential ASAT <yy Km or <yy Min. Away. Preparations for a single attack in space have been detected.	Space-based weapons/defenses ready to maneuver/prepare for target engagements in 15 minutes
SPACE TACTICAL DEFCON 4	DOUBLE TAKE	Potential ASAT More Than xx Km or xx Min. Away. Increased intelligence watch and strengthened security measures for space systems.	Above normal space systems readiness
SPACE TACTICAL DEFCON 5	FADE OUT	Potential ASAT Outside Local LREZ/CAEZ Zone. Lowest state of readiness.	Normal space systems readiness

Figure 3. Space Defense Readiness Conditions

SPACE FUNDAMENTAL LEVELS OF WAR

The next few charts give the author's interpretation of traditional definitions for segmenting individual levels of terrestrial conflicts, as extended to the space environment.

Figure 4. *Fundamental Levels of War* show this classical breakdown of the three Levels of War that are equally applicable to both terrestrial and space military operations. Note that during the author's extensive experience in the space warfare arena, it is his impression that space warfighters usually only consider the Tactical Level of War and ignore the Operational and Strategic consequences. The deep political nature of space war definitely requires that all operators be fully aware of the consequences of their actions outside of the tactical realm. Denying the capabilities of a single adversary satellite may also deny the intelligence community's ability to monitor that threat space system. Attacking an adversary satellite would directly reveal allied intentions, war plans, imply possible future operations, and reveal space capabilities previously unknow to adversaries. Even more of a critical consequence is the possibility that employment of space weapons will cause allied and adversary political re-alignments, post-conflict.

Figure 5. *Space Grand Strategy* gives a notional schema of the processes involved with developing planning (the space portion is called Space Operational Art and Design – SOAD – contact author for this fundamental document) at this level of space war.

Figure 6. *Space Operational Level* is an additional schema of the processes involved with developing planning at this level of space war. Notice that at this stage commanders and staff must assure de-confliction of space Courses of Action (COA's) with terrestrial ones. Also, this is where commander's intent, Rules of Engagement (ROE's) and the Laws of Armed Conflict (LOAC) come into review and certification.

Figure 7. *Space Tactical Level* is the final schema of the processes involved with developing planning for this level of space war. Notice that at this stage commanders and their staffs must assure de-confliction of specific space COA's with other space COA's.

Figure 4. Fundamental Levels of War

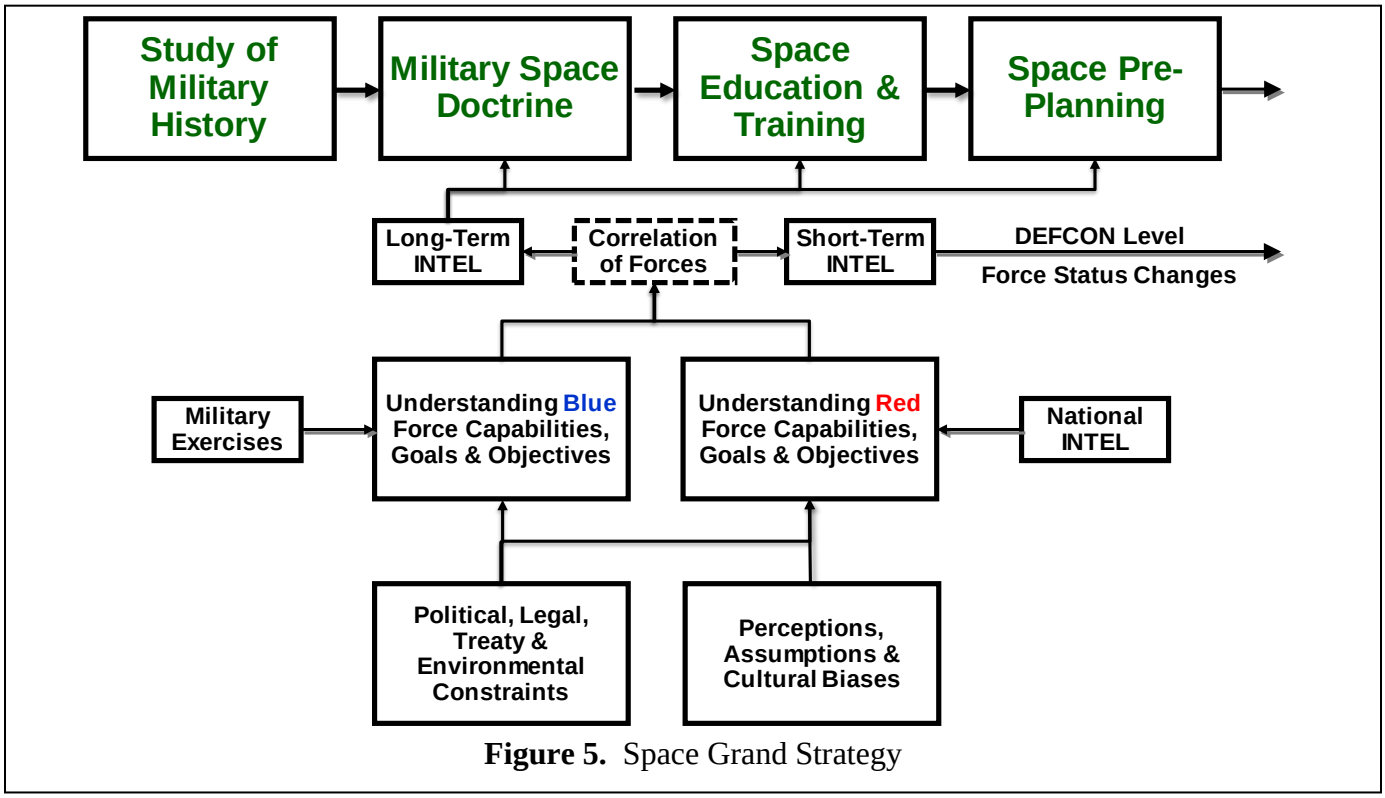

Figure 5. Space Grand Strategy

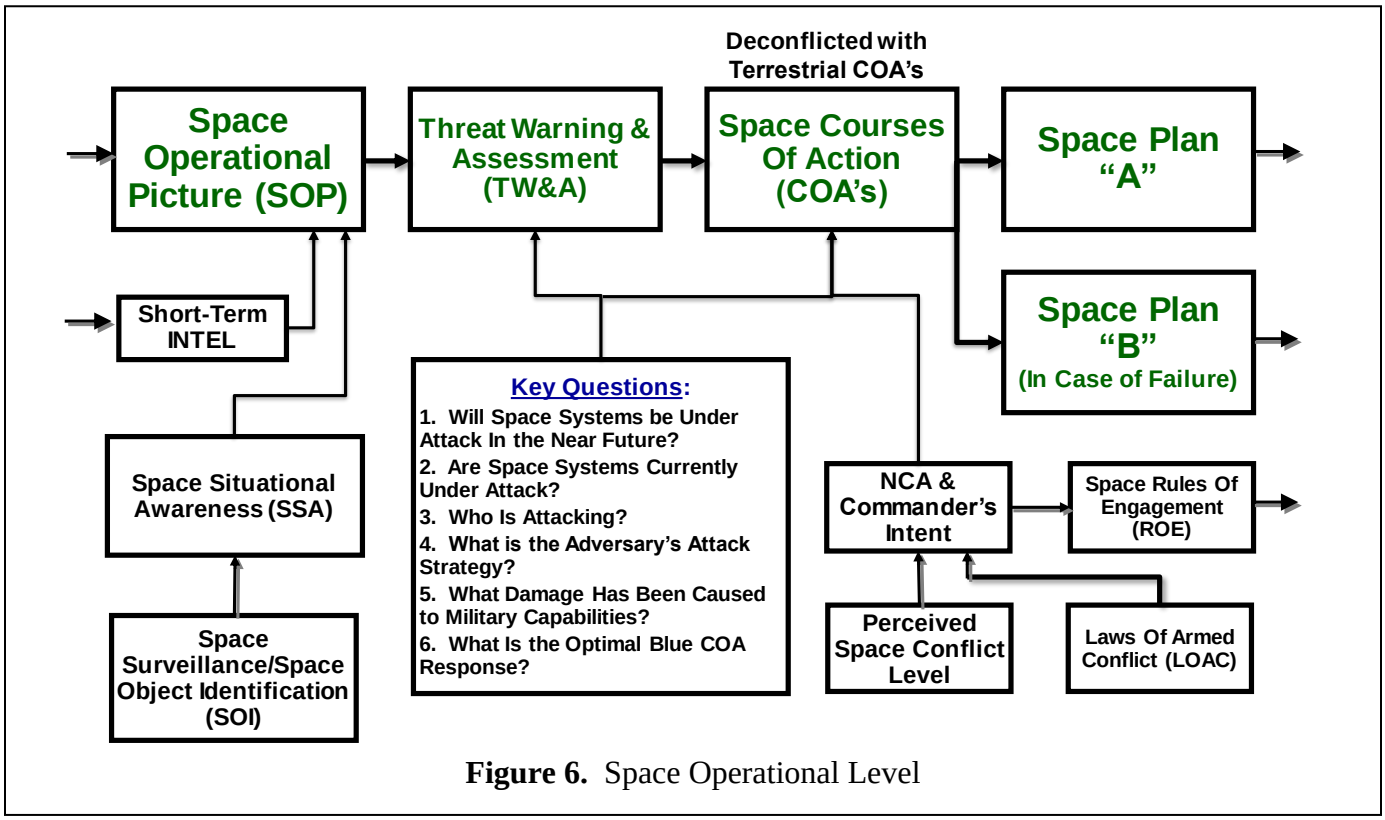

Figure 6. Space Operational Level

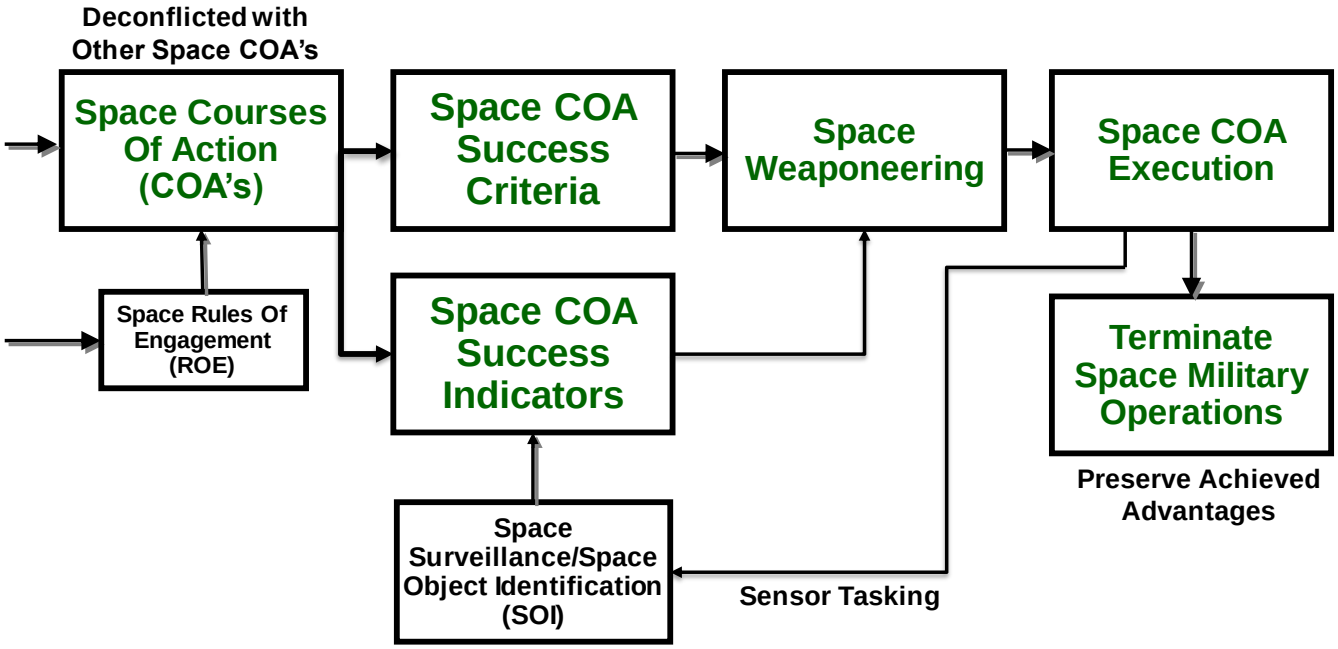

Figure 7. Space Tactical Level

SPACE CONFLICT ESCALATION CONTROL

A very critical aspect of outer space warfare is limiting the conflict to specific levels of weapons employment in specific theaters of operation. General escalation in space can also escalate or even initiate conflict on Earth.

For many years the author has been proposing that the State Department be included in any long-range architecture planning for theoretical space weapons technology and system architecture studies. The military can spend years and billions of dollars developing certain types of weapon systems, only to have the State Department nix its use in the end when it must be employed. Maybe if State is involved very early on in the development cycle, then any diplomatic sensitivities can be addressed early in the design or choice of weapon phenomenology before spending so much time and treasure. State can also recommend, as part of the architectural roadmaps, when new space treaties need to be addressed, and old ones re-negotiated. Past recommendations that State get involved in these space weapon studies, have always fallen on deaf ears.

The following charts give a preliminary basis as to which actions in space may cause potential adversaries to respond in an escalatory manner.

Figure 8. *Weapons Release Rules of Engagement* gives a first look at what kinds of attack may be permitted according to the current level of conflict. In other words, if potential adversaries are generally at peace with allied nations, then there are more restrictions on weapons types that can

be employed, then if conventional war has already broken out. Possibly only probing and reversible effects cyber kinds of attacks would be allowed in peacetime; but more permanent, damaging attacks, could be executed in general wartime situations. Note that the attached **Appendix 3**: "Space Glossary List" gives definitions of the differing levels of space attacks. Also note that there is a distinction in this chart between general terrestrial conflict and space conflict, as execution of space conflicts might be able to be hidden from the general population.

Figure 9. *Potential Conflict Escalation* shows notional Weapons Release Authorization Levels for different levels of conflict. An estimate of the potential for conflict escalation is given as probability percentages if more severe weapons are employed than is necessary for that particular conflict level. Note that these are perceived conflict levels and weapons severity of effects, and your adversary may be living by an entirely different rule book when it comes to space warfare. This is even more true for space conflicts, as the vast distances involved increase the ability to employ plausible deniability of any knowledge of what happened to some other country's satellite. Also note that in **Figure 9.** Weapons Release Authorization Levels are only for satellites that cover and support the area of Earth that is currently in conflict, making them legitimate targets. If other satellite systems are on the other side of the Earth, they would be under different Rules of Engagement, as illustrated in **Figure 10**.

Figure 10. *GEO Areas of Responsibility (AOR's)* illustrate the above discussed point as these satellites experience different Weapons Release Authorization Levels since they are not supporting the current conflict.

Finally, **Figure 11**and **Figure 12** show a potential Space Conflict Escalation Ladder that is linked to a terrestrial escalation ladder. This was developed by the author ten years ago to better illustrate how both space and terrestrial conflicts can influence each other, and possible spill over from one domain to another.

	Rules Of Engagement (ROE)				
Level of War	Deception	Disruption	Denial	Degradation	Destruction
Peace	Yes	Maybe	No	No	No
Space Crisis	Yes	Yes	Yes	No	No
Conventional Terrestrial	Yes	Yes	Yes	No	No
Conventional Terrestrial & Space	Yes	Yes	Yes	Yes	Yes

Figure 8. Weapons Release Rules of Engagement

	Weapons Release Authorization Level				
Level of War	Space Positive Control	Space Autonomous Operation	Space Weapons Hold	Space Weapons Tight	Space Weapons Free
Peace	0%	10%	20%	80%	90%
Space Crisis	0%	20%	30%	90%	90%
Conventional Terrestrial	0%	30%	50%	100%	100%
Conventional Terrestrial & Space	0%	20%	30%	40%	50%

Figure 9. Potential Conflict Escalation (Assumes Satellite **Does** Support Area Of Responsibility (AOR) of Current Concern or Conflict)

	Weapons Release Authorization Level				
Level of War	Space Positive Control	Space Autonomous Operation	Space Weapons Hold	Space Weapons Tight	Space Weapons Free
Peace	Yes	No	No	No	No
Space Crisis	Yes	Maybe	Maybe	No	No
Conventional Terrestrial	Yes	Maybe	Maybe	No	No
Conventional Terrestrial & Space	Yes	Yes	Yes	Maybe	No

Figure 10. GEO Areas Of Responsibility (AOR's) (Assumes Satellite Does **Not** Support Area Of Responsibility (AOR) of Current Concern or Conflict)

WBS	Conflict Phase	Terrestrial Campaign Phase	Space Campaign Phase	Weapon Type	Space Campaign Phase Full Name	Weapon Category
P.1.A.0	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, Tracking & Reconnaissance Activities; Satellite Close Inspectors
P.1.B.0	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
P.1.C.0	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 Agitation; Employ Lethal Force Against Your Own Citizens; Mobilize Forces; Increase Military Alert Level (DEFCON); Maneuver Close Enough to Adversary Satellites to Purposely Appear as a Threat; Reveal Covert Programs to Appear Threatening; Enter Into War-Reserve Modes (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
P.2.A.0	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

Figure 11. Space Escalation Ladder - 1

WBS	Conflict Phase	Terrestrial Campaign Phase	Space Campaign Phase	Weapon Type	Space Campaign Phase Full Name	Weapon Category
P.3.A.1	Trans-Conflict	Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A1 – Gnd Based	From Terrestrial Partial Temporary Kill	3rd Wave Attacks Phase A1 – Terrestrial-to-Space Partial Temporary Effects	Delay, Deny, Covertly Assassinate Adversary Diplomatic Ambassador
P.3.A.2	Trans-Conflict	Phase II: Halt Incursion (Seize Initiative)	3rd Wave Attacks Phase A2 – Gnd Based	From Terrestrial Total Temporary Kill	3rd Wave Attacks Phase A2 – Terrestrial-to-Space Total Temporary Effects	Disrupt
P.3.B.1	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
P.3.B.2	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
P.4.A.1	Trans-Conflict	Phase IV: Joint Counter-Offensive to Restore Friendly Pre-Conflict Status (Stabilize Borders)	4th Wave Attacks Phase A1 – Gnd Based	From Terrestrial Partial Permanent Kill	4th Wave Attacks Phase A1 – Terrestrial-to-Space Partial Permanent Kill	Degrade
P.4.A.2	Trans-Conflict	Phase IV: Joint Counter-Offensive to Restore Friendly Pre-Conflict Status (Stabilize Borders)	4th Wave Attacks Phase A2 – Gnd Based	From Terrestrial Total Permanent Kill	4th Wave Attacks Phase A2 – Terrestrial-to-Space Total Permanent Kill	Destroy
P.4.B.1	Trans-Conflict	Phase V: Joint Counter-Offensive to Capture Adversary Capitol (Enable New	4th Wave Attacks Phase B1 – Space Based	From Space Partial Permanent Kill	4th Wave Attacks Phase B1 – Space-to-Space Partial Permanent Kill	Degrade
P.4.B.2	Trans-Conflict	Phase V: Joint Counter-Offensive to Capture Adversary Capitol (Enable New	4th Wave Attacks Phase B2 – Space Based	From Space Total Permanent Kill	4th Wave Attacks Phase B2 – Space-to-Space Total Permanent Kill	Destroy
P.5.A.0	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
P.6.A.0	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
P.7.A.0	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
P.8.A.0	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
P.8.B.0	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
P.9.A.0	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

Figure 12. Space Escalation Ladder - 2

SUN TZU'S (544 BC – 496 BC) "ART OF WAR" APPLICABILITY TO FUTURE OUTER SPACE WARFARE

Many are familiar with the ancient Chinese military scholar, Sun Tzu and his "The Art of War" (544 BC – 496 BC), while studying classical military strategies and tactics. The surprising thing is, these ancient principles are still applicable today, even for outer space warfare. This is because all warfare, no mater the age or domain, involves decision-making by humans, who are vulnerable to such things as surprise, shock, confusion, fear, etc. Thus, they are easily steered into making wrong decisions by their opponents use of clever strategies and tactics. Eight years ago, I initiated a study of Sun Tzu's military principles to see if they are applicable to modern space warfare. I reviewed about one-third of Sun Tzu's principles and came up with 546 space strategies and tactics. Due to the infancy of space warfare thinking, I believe simply implementing one or two of these strategies could prove decisive on the space battlefield. Completion of this study has been on hold until a suitable sponsor is found. Some example space strategies derived from Sun Tzu are listed below. Contact the author for the full list of 546 space warfare strategies derived from Sun Tzu:

- Constantly or intermittently conduct small maneuvers to frustrate an adversary's ability to calculate precise orbital parameters to target allied satellites, and prevent them from understanding allied space plans, doctrine, strategies and tactics
- Only use space weapons if the effect is commensurate with the political and financial costs, loss of future surprise, and loss of future capabilities (weapon system magazines used up and consequences of adversary responses affecting Blue and Gray systems)
- •Study an adversary's space doctrine, strategies, tactics, organizations, and leadership personalities to discover his strengths and weaknesses so you may better catch him off-guard during space systems surprise attacks
- Continually harass your adversaries' fixed space systems defenses, so that they are constantly off balance, more hurried and less timely in fulfilling their mission objectives
- •Remember, you are not fighting an adversary's forces and machines as much as you are fighting an adversary commander's perceptions, biases, experiences, training, organizational structures, his relationships with upper military and political superiors, intelligence, mental, and emotional strengths, weaknesses and endurances. The weakest point in a space system may be the human element, including scientists, engineers, technologists and additional supporting staff
- Dangle out in front of your adversaries tempting space systems targets to draw out his space control resources, military plans, and intentions
- Those who start conflicts and attack first, best know the place and time of the coming space battle
- Due to orbital dynamics, and continual satellite movement, the place and time of the coming battle is constantly moving and changing. This unpredictability requires different strategic and tactical perspectives than terrestrial battles, and demands unique graphical solutions and highly dynamic computer processing to support battle planning
- Many times, those that get to the battle the quickest are the winners, not those who wait in order to concentrate the most forces

- A good space plan requires your adversaries to come at you, and use up their maneuvering resources more so than yourself, allowing allied systems to perform more aggressive attacks later on
- You may sacrifice some space assets to make your adversaries believe in your carefully falsified military objectives
- Periodically launch new space vehicles to keep your adversaries confused and off balance
- Launch or maneuver a new mysterious satellite that comes close to critical adversary satellites, to make your adversaries pause in their military execution plans, and to show resolve, and as a warning for them to back down
- Heavily defend certain orbits to force an adversary's spacecraft to other orbits of your choosing
- During space conflicts you may decide to trade orbital space for time - in other words you may give up key orbits and maneuvering room solely because it will take your adversaries some time to fill this void, or chase you down, or simply force him to use up valuable satellite fuel, while giving yourself more time to make better counter-attack preparations
- Initiate multiple false starts, threatening space and terrestrial maneuvers, etc. to induce your adversaries to begin constant satellite maneuvering, so as to waste their on-board fuel reserves before actual conflict starts
- The most easily accessed orbits might also be the best killing zones

SPACE CENTERS OF GRAVITY

According to Joint Publication 5-0[5] a Center of Gravity (COG) is "a source of power that provides moral or physical strength, freedom of action, or will to act". This concept applies equally to space warfare and terrestrial operational planning. I do not believe that this is a concept that is well understood with current space battle management planning. **Figure 13** is an attempt to evolve the Centers of Gravity model developed by Col. John Warden for Checkmate planning[6], and extend it to space warfare planning.

Figure 14 takes this one step further, and starts to delineate Space Political/Military Centers of Gravity along with will and intent as major factors in an adversary's ability to wage war. View a very detailed list of possible strategic, operational and tactical space Centers of Gravity in **Appendix 2**.

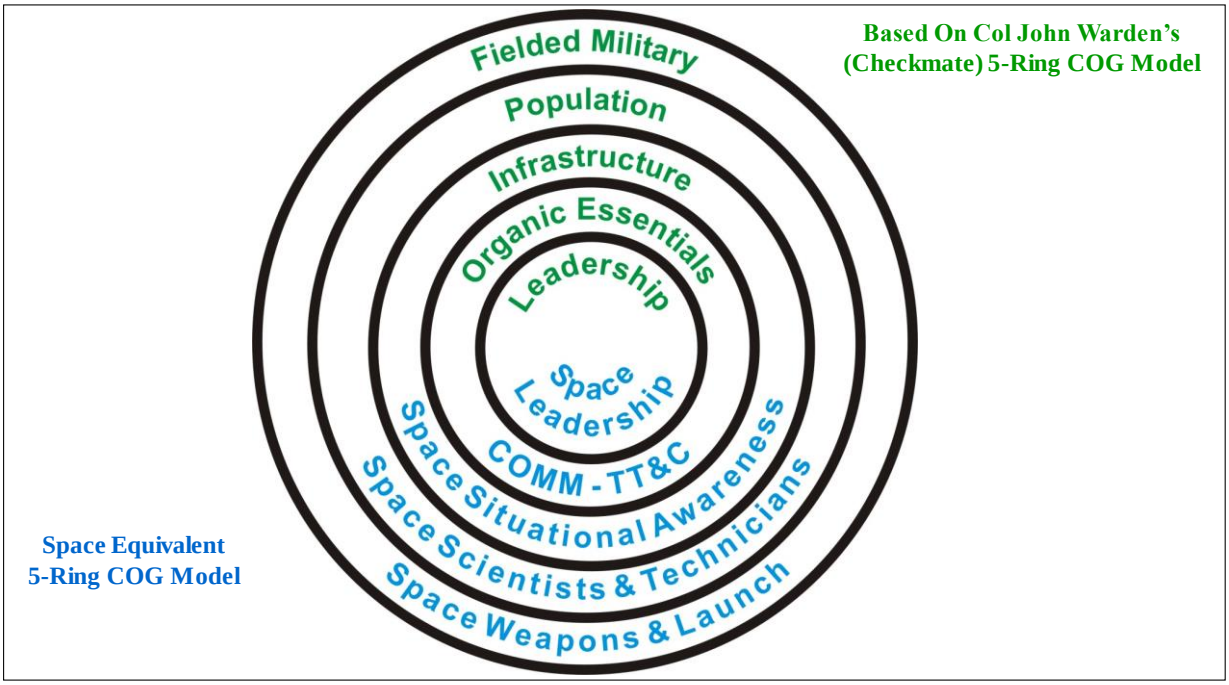

Figure 13. Space Centers of Gravity Model

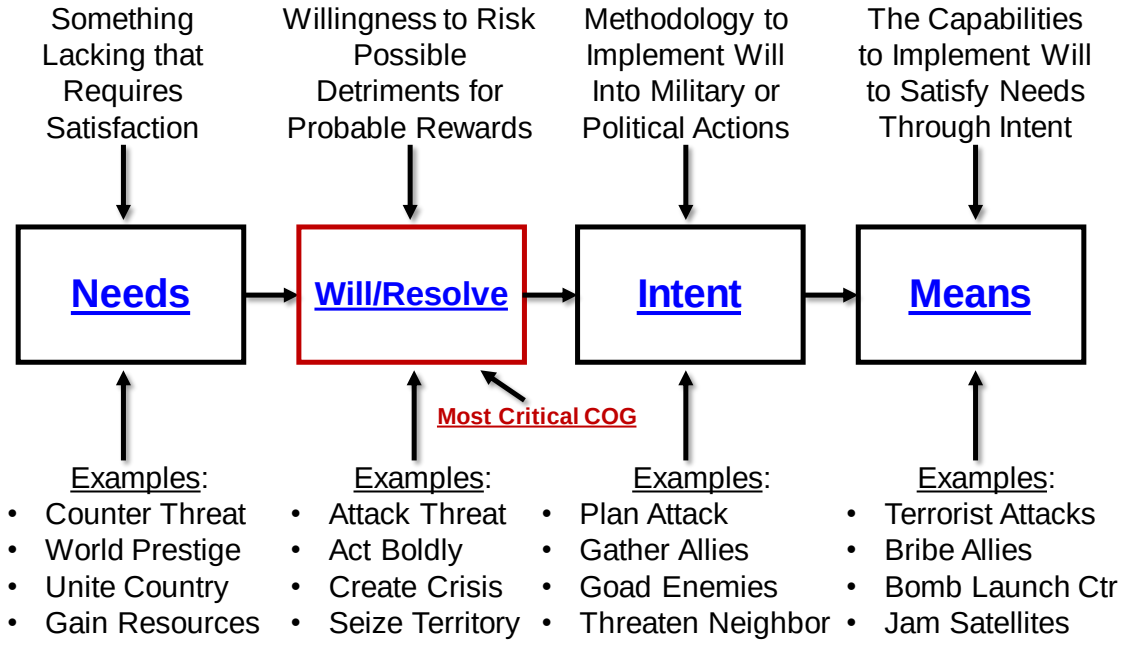

Figure 14. Space Political/Military Centers of Gravity (COG's)

TOP 40 RULES TO FIGHT AND WIN THE NEXT SPACE WAR

Based on the author's 45 years of military analysis, and over 50 years studying military history, he has developed the Top 40 Rules of how to fight and win the next space war.

Top Principles for Space Warfare:

1. ***First Top Principle of Space Warfare****:*
Dominating and Survivable Pre-Conflict Satellite Positioning, and Extensive Satellite On-Board Maneuvering Fuel is of prime importance.

2. Second Top Principle of Space Warfare:
Perceptive Space Situational Awareness (SSA) and Predictive Battlespace Awareness (PBA) will dominate any offensive weapons capabilities.

3. Third Top Principle of Space Warfare:
Effective Doctrine and Decisive Political Will is most necessary to counter adversary military actions in the space environment.

Additional Top 40 Rules for Space Warfare:

4. Maneuver:
A satellite's ability to frequently conduct large, small or continuous maneuvers, especially just before and during a space conflict, might be the best capability to keep your adversaries guessing as to your space control intentions and planning, besides complicating his targeting solutions, especially when they may lack world-wide space surveillance sensor coverage.

5. ***Unusual Orbits****:*
Unusual orbits increase the difficulty of your adversaries to determine your intentions or target you quickly.

6. ***Pre-Conflict Positioning****:*
Since it is very difficult to change orbits at the last minute (especially changing orbital inclination), immediate space combat can only be fought with the current resources on hand in the local area. There will be no trans-conflict redistribution of space forces to help those forces under immediate attack. Thus, pre-conflict positioning of space assets is possibly the most important aspect of space strategies. This principle is related to the other fundamental principle of maximizing high maneuvering abilities of space assets.

7. ***Value of Space****:*
Due to the newness of space warfare, your adversary probably does not fully understand the true value of space both to himself, and to his opponents. This complicates his ability to prioritize his targeting plans, and may contribute to him wasting precious maneuvering fuel

and limited "shots" from space weapons, along with ceding time and tempo advantages to the other side.

8. ***Political Consequences****:*
Due to the newness of space warfare, our adversary and probably ourselves do not fully understand the political, diplomatic, economic and international ramifications of employing space weapon systems, especially for post-conflict impacts.

9. ***Effective Doctrine****:*
Due to the newness of space warfare, our adversary and probably ourselves do not fully understand the best theory, doctrine, strategies, tactics and techniques for conducting optimized space warfare. Big mistakes will be made by both sides.

10. ***Mistakes Will be Made****:*
Due to the newness of space warfare, most carefully laid plans, doctrines, strategies, tactics, techniques, political, technological and correlation of forces assumptions will prove false and be immediately thrown out (or worse, be so dearly held, they lead to immediate defeat). This rule equally applies to both sides of the conflict, unless one side is lucky enough to have gotten space doctrine slightly more correct than the opposing side.

11. ***Vary Space Weapon Types****:*
Due to the newness of space warfare, it might be best to possess different phenomenology space weapon systems with varied basing options to increase the chances that you developed your pre-planning and space doctrine right for a type of conflict that has never occurred before. Remember, in all previous wars the first casualties are most, if not all, of the pre-conflict plans.

12. ***Define Winning****:*
The concept of "winning" in space warfare is not clearly defined. Its definition may be made by political leadership with limited technological, or military knowledge, and may be based on purely political, propagandistic or failed doctrinal principles. Your adversary will certainly have a very different definition of winning, which means both sides may perceive they have "won" the space conflict, and derive quite different conclusions that will dominate their military, political, diplomatic and economic (commercial and procurement strategies) thinking for decades to come. One's space strategies employed during the conflict should take this into consideration to place your nation into a favorable position, post-conflict.

13. ***Space Debris****:*
Creation of too much space debris during space conflicts may make losers out of all sides after the conflict; in the long term.

14. ***Future Political Impacts****:*
You may be assured that after the conduct of a major space war, national and international protocols, treaties, rules of conduct, and alliances will be radically changed for space. One's space strategies employed during the conflict should take these into consideration to place your nation into a favorable position, post-conflict.

15. ***Adversary Post-Conflict Reactions****:*
You may be assured that after the conduct of a major space war, your adversaries, and other nations, will learn from this war, and probably build up their own space weapon capabilities,

even if necessarily covertly. One's space strategies employed during the conflict should take these into consideration to place your nation into a favorable position, post-conflict.

16. ***Space Escalation Ladder****:*
Due to the remote nature of space systems, the world's populace may be kept in the dark (especially for low-level space conflicts) of what is truly happening, which provides additional, more subtle rungs, on the conflict escalation ladder, allowing nations to privately exhibit resolve and to send determined political messages.

17. ***Space Warfare Inherently Conflict Destabilizing****:*
Because a small, relatively inexpensive space mine can take out a large billion-dollar satellite critical to the conduct of your military operations, and actual satellite point defense is problematic due to possible ASAT hypervelocity closing speeds, then probably offense is better than defense in space warfare, making it inherently unstable for conflict escalation control.

18. ***Quick Space Attacks Possible****:*
Due to the remote nature of satellites in space, small-scale space attacks may be initiated, executed and completed before the recipient even knows he is under attack, who is attacking, what are their attack strategies and goals (end states), and when can an uncomprehending senior political leadership validate the attack and respond in a military, political, diplomatic or economic manner. Large-scale space attacks may be initiated, executed and completed within 24-48 hours. Without adequate and timely Space Situational Awareness (SSA) and decisive political will, an adversary can easily get within your Observe, Orient, Decide, Act (OODA) command and control loops for space, and subsequently shock and confuse you.

19. ***Space Exhibits Escalation Imbalances****:*
Due to the remote nature of satellites in space, and the difficulty for space surveillance assets to determine the true nature of space attacks, and because space attacks may be initiated, executed and completed within 24-48 hours, there is a good chance that the side who initiates space attacks first will be the side that wins the space war.

20. ***Covertness and Surprise of Prime Importance****:*
Due to the remote nature of satellites in space, and the difficulty for space surveillance assets to determine the true nature of space attacks, and because space attacks may be initiated, executed and completed within 24-48 hours, covertness and surprise will significantly contribute to winning the space war.

21. ***Joint Military and Commercial Space Use****:*
Mixing military and commercial systems on the same satellites increases the chances of space conflict escalation due to the general populace immediately becoming aware of the effects of

satellite loss, subsequently creating pressure on political leadership to take precipitous actions. Thus, the nuances of steady and reasoned escalation control are lost.

22. ***Space Only Benefits Terrestrial Systems****:*
Space conflict is all about denying satellite support to military forces or civilian populations on Earth; not simply the elimination of satellite systems for destruction sake or as a space war "score keeper."

23. Small Space Forces Can Beat Larger:
As in many other conflicts past and present, having space forces that appear superior in numbers and technological quality on paper does not guarantee a "win" under all circumstances. There are many examples throughout thousands of years of military history of numerically inferior forces beating their "betters." Many times, it is the forces with better doctrine, planning, morale (political will) or positioning that win. This can only be truer for a new area of conflict in space that has little, if any, past military examples and experiences.

24. ***Decisive Political Will****:*
Having space forces that are superior in numbers and technological quality are useless if there is not the decisive political will to fully and quickly use them. This principle may imply dictatorships are more at an advantage than democracies. Hesitation and uncertainty can rapidly lead to failure in outer space warfare.

25. ***Space Situational Awareness and Weapons Range****:*
It does not matter how plentiful or how brilliant your adversary space weapon systems are if they cannot find or reach your critical space systems. If you are constantly maneuvering so that he cannot find you, or your satellites are in hard to reach orbits, or have low observables, or you possess many believable satellite decoys, then he can never dominate you.

26. ***Public Opinion Will Limit Military Options****:*
Even though space wars entail very few, if any, human casualties, international public opinion values space wars as more politically unacceptable compared to terrestrial destruction and loss of human life from traditional warfare on Earth. In addition, space wars will fire the imaginations, good or bad, of your citizens, along with much of the rest of the World that is not actively participating in the conflict.

27. ***Allies Count Little Militarily for Space Wars****:*
Due to the limited number of countries with future space weapons systems and their attendant need for covertness along with international political sensitivities, each adversary will probably have to go it alone, and his allies cannot or will not significantly help him openly in the coming space conflict.

28. ***Space Treaties Will be Violated****:*
Most space treaties will be violated in the first few hours of the coming space war. International treaties have usually been violated in most previous major terrestrial conflicts, and due to the remoteness of space, treaties concerning the military use of space are easier to ignore, especially when the World populace may not even be aware of this ongoing space conflict, and treaty violation facts and truth will be hard to come by.

29. ***Data Relay Satellites Are Prime Targets****:*
Possibly the most important space targets will be those satellites that relay data and commands directly to other satellites in remote orbits, making them choke points for critical space

systems. This is particularly true for those countries without extensive world-wide satellite ground control stations.

30. ***Defense vs. Offense****:*
Those Nations that have more space systems being used by their military also have more space systems to defend, and probably must emphasize defense over offense in their technology developments and in their military planning. If your adversary has few space systems, then there are fewer targets for your offensive space weapons, and you must emphasize defense, unless you believe that you have perfect Space Situational Awareness, and you know all of your adversaries' and their allies' offensive space weapons and believe you can target and neutralize these early in the space conflict before he can fully implement his offensive space warfare plans. In past military history, overconfidence in the ability of your intelligence collections assets can lead to certain defeat.

31. ***Space Situational Awareness Is Prime****:*
Because of the inherent instability of offense vs. defense in space warfare, the most important tool for senior military and political space leaders is space surveillance and identification sensors with corresponding automated assessment algorithms, particularly those that provide Predictive Battlespace Awareness (PBA).

32. ***Space Warfare Systems Are Untested****:*
If your adversaries' space warfare systems are untested in real, sustained combat, then their true abilities against you are uncertain, and probably possess "cracks in their armor." Unfortunately, the same is probably true of your space warfare systems (whether you believe this or not), but the true vulnerabilities and failure points of both sides may not be obvious or believable. However, be assured, due to the new nature of space warfare, they do exist in plenitude.

33. ***Differing Cultures and Military Traditions****:*
Because your adversaries probably come from different cultures and military traditions than your own, their differing perspectives allow them to have a higher probability of detecting your space warfare systems' non-obvious "cracks in their armor" than you do, and vice versa.

34. ***You Are Always Vulnerable****:*
As in all military matters, since time immemorial, due to the cleverness of human beings, especially under stressful combat conditions, your adversaries will ultimately find your vulnerabilities and get through any defenses you may fool yourself into thinking are "invulnerable."

35. ***Decisive Commanders****:*
For those countries at war with roughly equal space warfare forces, the main decisive factor would be which country may be lucky enough to discover and believe in the one decisive commander who is a genius in space warfare organization, doctrine, strategies and tactics. This is especially true for the non-traditional nature of space warfare. In addition, those countries with the least meddling in military matters by their politicians might be the decisive factor in winning the space war (though possibly "loosing" the peace afterwards).

36. ***Little to No Human Casualties****:*
Because space warfare involves little to no human casualties, commanders can be particularly decisive and cold hearted in their planning and execution compared to terrestrial warfare. As

Maj Gen Roger G. DeKok (deceased) has previously stated: "Satellites have no mothers." In addition, morale and courage on the battlefield is of less importance, though command decisiveness remains a critical factor.

37. ***Low-Cost Offensive Weapons****:*
Due to the hyper velocities of space orbits, one cannot adequately armor your spacecraft, and a small, relatively inexpensive space mine can take out a large billion-dollar satellite critical to the conduct of your military operations.

38. Space "Fog of War"*:*
The potential for confusion known as the "Fog of War" is well documented for terrestrial battlefields - it will be even worse for space warfare due to the newness of this theater for conflict, the tremendous distances involved and the global nature of space.

39. ***Commercial Satellites Are on Their Own****:*
Commercial satellite operators whose expectations are that the military will protect their space systems during conflicts will have a rude awakening.

40. ***Checklist Vulnerability****:*
Operators who are trained to respond to unusual situations by "checklist" actions can be easily spoofed and manipulated by a clever adversary, especially in a contested environment with denied or degraded communications to higher headquarters (rule suggested by Paul Day[8]).

SPACE DOCTRINE THINK TANK

Concept:
Establish an organization that will develop advanced outer space warfare theory, policy, doctrine, strategies and tactics that will propel the United States as the premier world center for understanding the methods and techniques for conducting military operations in the space environment. What is required is a new theory on space power in the same manner as classical air and sea power theorists such as Mahan, Douhet, or Mitchell, or even Sun Tzu and Clausewitz.

Purpose:
There are many examples in military history where one military force that appeared superior on paper is defeated by a technically inferior force that is more flexible and with superior doctrinal concepts on how to conduct warfare. This concern can only be amplified by the remoteness of satellites that make it very difficult to verify what attacks are being set up, by whom, and for what purpose. In addition, this new region of warfare has yet to be proven as to what exactly are the correct doctrinal concepts for efficient execution of commander's intents.

Example Think Tank Study Topics:

1. What are the goals for fighting a war in space, and what would adversary surrender criteria be?
2. Are there critical "choke points" in space that require defending?
3. If we can detect adversary maneuvers in space to occupy key choke points, does this imply he is setting up for terrestrial conflicts, and can these conflicts be prevented by delaying, frustrating, or deterring him from occupying these choke points?
4. Does deterrence work for space warfare, and how does space impact the terrestrial conflict escalation ladder?

5. What are the conflict escalation "trip-wires" for actions in space?
6. Does space provide Flexible Deterrent Options (FDO's)?
7. What are example space Courses of Action (COA's)?
8. What are space Centers of Gravity (COG's)?
9. Can classical warfare doctrine be extended to the space environment?
10. What are the operational risks for space warfare?
11. What are the top principles or rules for conducting space warfare?
12. What is the political acceptability and legal regimes for employing space weapons, and how will this affect international relations post-conflict?
13. What are the Rules of Engagement (ROE's) for space warfare, along with weapons release authority levels?
14. For space warfare, is offense or defense better strategically, or tactically passive or active defenses for satellites?
15. Do future space wars favor the attacker or the defender? Is it true that whomever attacks first in space wins the space war, and provides a significant advantage to his terrestrial forces?
16. What are the long-term effects on world relations of the current arms race in outer space?
17. What are the benefits and pitfalls of developing international agreements for "traffic control" in space?
18. Does one particular phenomenology (lasers, jammers, impact weapons, painters, grapplers, etc.) for ASAT weapons work better for certain theaters, conflict duration, targeted orbits, adversary defenses, conflict phases, etc.?
19. Is it better to attack the satellite, the ground systems supporting the satellite, or the communications, data and Tracking, Telemetry & Control (TT&C) links from the ground to the satellite? Is this conflict level specific?
20. Is it better to defend satellites in orbit, or provide rapid replacements from the ground vs. on-orbit spares vs. terrestrial means to supplement/replace mission capability?
21. Does use of commercial satellite systems as part of the UAV kill chain (http://www.fas.org/irp/doddir/usaf/conops_uav/part06.htm) make these civilian operators legitimate targets for adversaries?
22. Is Trans-Lunar space a threat for space warfare? ASAT's (Anti-Satellites) can come screaming in from Trans-Lunar space and attack Geosynchronous targets with very little delta-v fuel burn. It actually takes more fuel to get to Geosynchronous orbits than to orbit the Moon.

Products:

The purpose of this new Space Doctrine Think Tank is to develop new theories, doctrine, strategies and tactics for outer space warfare. In order for these new concepts to be useful, they must influence the overall command and planning structures in the United States for both space and terrestrial warfare planning staffs. When the Think Tank General Officer steering group is selected well, they can take the finished products back to their previous commands to influence inclusion into current planning. Some suggested means to accomplish this task are:

1. Develop models and simulations that test new space doctrinal concepts

2. Sponsor lectures and symposia on critical space warfare subjects
3. Sponsor and fund further research on these topics by commercial contractors and other government agencies
4. Sponsor prizes for the best research papers on space warfare
5. Participate in and/or fund space-related wargames, including space impacts on terrestrial wargames
6. Provide teaching materials for military space courses
7. Publish papers in military and space journals (Air & Space Power Journal; Strategic Studies Quarterly; Naval Institute Press; Army University Press; etc.)
8. Fund space chairs at military schools
9. Sponsor student participation in space symposia
10. Provide analyses and briefing material for Congress
11. Support inclusion of space warfare concepts into military doctrine documents such as Joint Publication 5 (Joint Operation Planning) and Joint Publication 3-14 (Space Operations) – both are currently weak and meek on space warfare and require more decisive guidance
12. Become the space warfare think tank supporting the development of the new Space Force, much like Project Air Force has been supporting the Air Force since 1946 and the Arroyo Center has supported the Army since 1982
13. Assure allied participation in this organization for the maximization of new ideas, especially in a joint and combined environment, such as NATO

Organization:
This new Space Doctrine Think Tank can be small at first, and only requires admin, a core group of analysts, and some modelling and simulation staff. Prominent space and military experts can be temporarily engaged as consultants and part-time advisors. These advisors can be senior retired General Officers, Admirals and government administrators, such as State Department, intelligence staff, Congressional and other political experts, and possibly allied experts for combined operations. It is recommended to include not only space experts, but non-space personnel who have extensive experience with terrestrial combat operations to assure the widest possible free-thinking and integration with terrestrial planning. The core staff can develop new concepts and doctrine, and then the senior General Officer steering group can review and extend these based on their extensive experience.

Possible Locations:
It may be best to attach this Space Doctrine Think Tank to some existing analysis organization for admin and operations support services. Some possible examples of current organizations:

1. RAND Corp. (Santa Monica, CA and Washington, DC)
2. Institute for Defense Analyses (IDA) (Washington, DC)
3. LeMay Center for Doctrine Development (Maxwell AFB, Alabama)
4. Congressional Research Service (Washington, DC)
5. Air Force Academy or other Military Academies
6. National War College

SPACE WARFARE SIMULATION TOOLS

One idea of the author to help solve some of these issues is for some space-aware Government organization to contract with a team of physics-based space experts, military operations-based space experts, and some innovative consumer gaming developer to put together an interesting, but entertaining, space war game. We would then give this to the young officers at the Air Force academy, and have them constantly play this to establish space war doctrine, strategies and tactics, while training our future military leaders to be sensitive about space warfare issues. We could award the top winner of this fun wargame $100 every week to assure motivation at the Academy (only $5,200 per year, which isn't even in the noise in typical military budgets). They would approach playing this game with a fresh perspective, while applying their newly learned military history and doctrine knowledge. Then later, when they are part of some space watch center, they will be able to recognize certain adversary moves that would be similar to what they have already simulated in this space war game, and be able to react in an intelligent and quick manner.

II. CONCLUSIONS

The future of outer space warfare is upon us, but the theory, doctrine, strategies and tactics are uncertain. A quote from Leon Trotsky is appropriate here: "*You may not be interested in war … but war is interested in you.*" Whether you believe in outer space warfare, or are desperately trying to prevent it, conflicts in space will happen nevertheless, as space is way too important to remain a sanctuary while major military conflicts are raging on Earth. Space remains way too important to the ultimate outcome of the terrestrial battlefield and future space wars may indeed cause fewer casualties than extended conflicts on the ground.

Most importantly, before any major military conflict is initiated on the Earth, a smart adversary would position his space assets at key jumping-off points in space to better enable surprise attacks while minimizing maneuvering fuel requirements. If countries invest in Space Situational Awareness (SSA) sensor networks (RADAR and optical) on the ground and in space, then they can be pre-warned of impending space attacks, and are then presented with the opportunity to confront the adversary at the United Nations, and possibly prevent the ensuing terrestrial conflict.

The author's estimation of the uniqueness of space warfare compared to terrestrial warfare is:

1. Space warfare has global coverage;
2. Space warfare is responsive (hours to anywhere on Earth);
3. Space warfare has global consequences. Attacks might start or end over some neutral third-world country. Many third world country ground sites receive satellite data of military consequence (imagery, weather, GPS calibrations. Satellite communications distribution centers; submarine cable heads transmitting satellite data) that can affect distant battlefields, and these third-world countries may come under attack to prevent this data being used by adversaries;
4. Consequences of space war can affect other country space systems such as debris fields, pumped up radiation belts from nuclear detonations in space, and consortium satellites carrying multiple country communications, including those of adversaries that may be

attacked and have collateral damage. Many commercial and civil imagery and RADAR satellites are used by multiple countries;

5. Space wars can be conducted in total secrecy which civilian populations may not be aware of, whose subsequent heightened emotions may drive countries to terrestrial conflicts. Space provides additional rungs on the conflict escalation ladder enabling countries to show resolve in private;
6. Space is the penultimate expression of unmanned automated systems with possible weapons (like terrestrial UAV's);
7. Space is the most difficult of environments for verification of attacks with hostile intent and subsequent validation of which country or entity was responsible;
8. Space is the most difficult of environments for determining the impact of space attacks on the final outcomes of terrestrial battles and wars;
9. Space is not a target rich environment, where just about every target is strategic, and costs $100's millions (maybe Naval warfare is the same?);
10. The ability for an adversary to conduct surprise attacks is easier in space than with terrestrial attacks;
11. Space benefits all other military service arms, and the civilian section at the same time.
12. A significant difference between the space and terrestrial realms is that we have many concrete examples of warfare on earth, whereas a space war is too conceptual with no real experience on which to ground our frame of reference. In addition, real space warfare may seem simply like an elaborate video game to satellite controllers on the Earth. As a result, participants in a space war aren't as affected by the potential implications of their actions.

GENERAL LAST THOUGHTS

The future of outer space warfare is rapidly approaching. There is significant buildup of space warfare capabilities by some major countries who rely on space systems for their defense or perceive that their potential adversaries depend too much on space capabilities to conduct terrestrial warfare. Because of the lack of significant experience by countries in this new military domain, it is difficult to fully understand what the best doctrine, strategies and tactics are to win the next space war. Based on the author's study of military history for the past 50 years, and his direct involvement with space warfare programs for the past 42 years, he has developed general rules by which the next space war will be conducted. These concepts can be a start to development of a full set of space warfare doctrinal principles, rules, edicts and training.

If you read the chapter on China's PLA Space Doctrine in "Chinese Aerospace Power" by Andrew Erickson[4], it's interesting that Chinese space warfare doctrine closely resembles German strategic doctrine in the 20th Century. The Germans believed they were surrounded by neighbors who could ultimately beat them in any protracted conflict, so their doctrine emphasized quick, lightning

strikes to knock out their opponents before they could bring the full weight of their military upon them. That is why the very brightest military thinkers on the German General Staff spent whole careers devising optimized railway schedules for mobilization of their forces before World War I, and why they also embraced blitzkrieg warfare for World War II to force a quick end. The Chinese have the same strategic outlook, as they believe that the United States would beat them in any protracted conflict due to its superior technology. Thus, the stage is set for space blitzkrieg at the beginning of any major conflict between China and the United States. Would the Chinese strike our space assets in a lightning-quick surprise attack, or just position themselves to threaten our space assets so we hesitate in our responses and self-deter? If we also position our space control assets that threaten Chinese space systems, does this create a hair trigger strategic impasse, which can quickly, and in-advertently due to poor Space Situational Awareness (SSA), devolve into general space war? Does the side who attacks first generally win future space wars? Does all of this sound similar to nuclear war hair-triggers, but without the self-deterrence of mutual mass destruction?

The lesson to be learned here? The Chinese are starting from scratch in developing space warfare theory and doctrine, and are not hindered by long space traditions. There is a lot of writing on this subject in their open literature, but I see almost no discussions in the United States on these topics. We had the Program 437 nuclear Anti-Satellite (ASAT) on Johnston Island in the 1960's and the F-15 ASAT program in the 1980's, but over these last 50 years we have not yet felt the need to develop space warfare doctrine. The Germans developed their winning armored warfare doctrine in just a few years without much testing or training. They possessed mostly raw recruits for their soldiers. The United States might have better and more numerous space forces than any potential adversary, but if we lack the proper doctrine, strategies and tactics, then we are open to defeat by more agile forces who may be new to this subject area, and thus have more flexible and innovative attack plans, with the additional advantage of being able to conduct surprise attacks because of our poor Space Situational Awareness (SSA) capabilities. They also possess a more realistic leadership structure that does not worship "political correctness" dogma that encourages self-deterrence. The word I hear from senior leadership in Washington is they would require absolute proof of who the attacking country is when our satellites are destroyed before they would allow any counter-strikes. Since attacking anti-satellites (ASAT) systems do not have big red stars painted on their sides (and are probably constructed of mainly western parts), then quick verification is quite problematic, and will essentially cause self-deterrence and paralysis of national leadership decision making. Currently, if a satellite stops working it takes weeks and months for the cause to be determined, and many times this is only a big guess as to the root causes, since these space systems cannot generally be directly imaged, being tens of thousands of miles from earth sensors. The space war will be over with before we even know what hit us!

I can readily imagine a scenario where one nation takes a small portion of its space engineers and scientists, and devotes them to developing a covert space weapon. China currently has 100,000 people working in space. Taking just 5% of these, and devote these 5,000 engineers and scientists for 10 years to a covert project whose sole purpose is to fool a captain in a space watch center (e.g., Combined Space Operations Center – CSpOC) at 3 am into thinking that everything is all right, but he is about to lose billions of dollars of space systems. Who do you think will win this contest – 5,000 PhD scientists and engineers working for 10 years, or some poor captain not long

out of college who has little if any true space warfighting training, with no doctrinal support structure that has even attempted to sensitize him to fundamental space war issues?

ACKNOWLEDGMENT

I would like to acknowledge the great military thinkers of the last few thousand years, from ancient Greek and Roman generals, to ancient Chinese military philosophers such as Sun Tzu[1], for their continuing philosophies that inspired me to translate these concepts into theories and doctrine impacting present and future outer space warfare.

I will leave you now with two applicable quotes:

1. General George S. Patton: "*If everyone is thinking alike, then somebody isn't thinking*;"
2. General Hugh Trenchard: "*The great captains are those who think out new methods and then put them into execution. Anybody can always use the old method*."

APPENDIX 1

Possible Space War Surrender Criteria

Examples of Terrestrial War Termination Criteria:

- Country X's borders are secure
- Country Y no longer poses an offensive threat to the countries of the region
- Country X's national security force is sufficient to repress internal rebellion
- Percentage of US forces have redeployed with sufficient combat power postured in theater to support Country X's national army
- X capability destroyed / eliminated
- Legitimate Government restored
- Hostages returned
- Forces separated
- Agreement to start negotiations

Possible Space War Termination Criteria:

- Political goals met
- Red space force reduction goals met
- Red space disarmament
- 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 maneuvers satellites outside immediate threat zones that endanger Blue critical space assets
- Blue space assets and ASAT systems remain in ready strike positions to assure Red treaty compliance
- Red ceases production of space weapons
- 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%
- Red on-orbit military space assets supporting current conflict region (AOR) delta-v maneuvering capability reduced by 50%
- Red on-orbit ASAT (anti-satellite) capabilities reduced to 10% remainder (capabilities de-orbited)
- 90% of Red space assets have been visited by Blue inspector satellites and verified in compliance
- Red forced to negotiating table over ASAT weapons
- Red open to inspection of space launch sites, rocket fuel production facilities and space research facilities
- Red returns control of any Blue or Gray satellites held hostage / captured through cyber means
- Red mobile ASAT systems returned to garrison / storage
- All Red terrestrial ASAT sites and programs revealed
- 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

- Control of Red inspector satellites handed over to Blue
- Red ASAT technologies provided for inspection by Blue scientists
- Red space scientists provided for Blue interrogation
- Red dismantles terrestrial-based space surveillance RADAR's and optical tracking / imaging telescopes
- 50% of Red terrestrial space surveillance RADAR's, optical telescopes and space-based sensor systems are non-operational
- Red allocates / donates a portion of their remaining space launch, space communications and imagery capabilities to future UN disaster relief efforts
- Red surrenders some of their internationally-assigned geosynchronous orbital position slots
- Red establishes a hotline connection between their space command centers and Blue space command centers
- Red reveals communications frequencies and TT&C encryption schemes for their satellite control to Blue
- Red reveals orbital locations of all national space objects
- Red provides 30 days' notice of all planned future space launches
- Red deactivates / de-orbits all on-orbit space mines
- Red space-based lasers continue with nominal thermal profiles (no charging up to initiate immediate attacks)
- Red conducts no new shipments of reactive chemicals to terrestrial-based laser weapon sites
- Red does not approach any Blue critical satellites within 100 meters
- Red does not initiate any new missile launch development programs for 5 years
- 80% of Red satellite refueling on-orbit depots and servicing satellites shut down
- Red reveals all cyber codes used in previous space system attacks
- 50% degradation of Red organic navigation satellite capabilities and accuracies for those coverages over the AOR battlefield
- 50% degradation of Red organic imagery satellite capabilities and resolutions for those coverages over the AOR battlefield
- 75% degradation of Red organic military communications satellite capabilities and bandwidth for those coverages over the AOR battlefield
- 25% degradation of Red organic civilian communications satellite capabilities and bandwidth for those coverages over the AOR battlefield
- Embargo established against Red import of sensitive space technologies and sub-systems
- Red provides technical specifications of all their space systems to Blue
- Red provides technical samples of solar panels, bus structural materials and paint chips for all their space systems to Blue (helps in future Blue space surveillance, identification and treaty verification efforts, along with Red vulnerability assessments)
- Red required to place tracking beacons on all future launched satellites. Blue establishes declaratory policy to immediately neutralize any Red satellites without these tracking beacons for the next 10 years
- Red must formally state the mission of each newly-launched space object for the next 10 years. This mission is subject to verification by Blue; and, neutralization will ensue if any satellites with surreptitious missions are discovered
- Red key managers at ASAT research facilities be fired and moved to civilian pursuits

- Red national leader publicly declares his country will no longer pursue space weapon development programs
- Blue and Allied forces experience access and use of space for 90% of the time over the duration of the conflict
- Blue and Allied forces achieve absolute control and authority over the orbital space near its satellites, including the ability to maintain freedom of action in, from, and to space, sufficient to sustain mission assurance and deny the same to the adversary and its Red allies during the terrestrial conflict. Space superiority may be localized in time and space, over the immediate AOR, or it may be broad and enduring.
- Blue and Allied space sensors are able to predict pre-conflict buildup of adversary space forces, along with their maneuvering to key jump-off orbital positions. Blue and Allied intelligence agencies are able to detect and properly assess adversary intentions to initiate conflict, both in space and through terrestrial forces. Blue and Allied leaders possess the fortitude to address these threats in international forums.
- Diplomatic efforts have achieved agreements with some key allied and neutral countries that they will support most Blue actions during the ensuing space conflict, at least at the covert levels
- Diplomatic and legal efforts have achieved agreements with some key Red allied and neutral countries that they will not support Red actions during the ensuing space conflict. Also, some commercial satellite owners have agreed not to support Red military space efforts with imagery and communications satellite resources.
- Introduction of treaties in the international realm concerning limits to space warfare capabilities have induced some indications that Red and their allies have been deterred from committing some key space actions
- Blue and Allied space resources are positioned in key jump-off orbital locations (in accordance with future Blue space COA's), have sufficient fuel reserves, have on-board batteries fully charged, and appear to have avoided Red and their allies' space surveillance sensors detection.
- Threats and actions by Blue and its Allies against unlawful employment of space weapons by Red and their allies appear to deter them to some degree in causing space debris generation, and damage to neutral nation space systems. In addition, due to Red and their allies space attacks, many neutral countries are calling for new space treaties and enforcement mechanisms, such as loss of internationally recognized orbital location slots.

APPENDIX 2
SPACE CENTERS OF GRAVITY

Example Political/Military "Needs" COG's as Applicable to Space Warfare

- Enjoy Freedom of Navigation of Space / Celestial Bodies for Economic Opportunities
- Enjoy Freedom of Navigation of Space for Military Benefits & to Dominate the Space Arena
- Limit Adversary Use of Space / Celestial Bodies that Give Them Military & Economic Benefits
- Display Space Technological & Scientific Capabilities to Potential Allies to Enhance Prestige & World Leadership
- Impress Own Country Population to Enhance Internal Political Standing, Silence Critics, Inspire Youth & Stimulate the Economy
- Advance Country's General Technologies & Science & Provide Political / Economic Intelligence on Adversaries
- Understand Adversary Military Space Capabilities & Warn of Space Attacks
- Understand Adversary Military Terrestrial Capabilities & Warn of Terrestrial Attacks
- Understand the Space Environment to Predict Own Country Satellite Failures
- Understand & Predict the Terrestrial Environment for Benefit of Own Citizens

Example Political/Military "Will / Resolve" COG's as Applicable to Space Warfare

- Willingness to Adhere to Peaceful Norms, Treaties and International Relations Concerning the Use of Outer Space
- Willingness to Covertly Push the Boundaries of "Normal" Behavior in Space for Political / Economic / Military Gain
- Willingness to Overtly Push the Boundaries of "Normal" Behavior in Space for Political / Economic / Military Gain
- Willingness to Directly Attack Space Systems for Perceived Gains Outweighing Possible Downsides
- Willingness to Dominate Celestial Bodies for Political / Economic / Military Gain
- Willingness to Dominate Key Choke Points in Space for the Long-Term
- Willingness to Maneuver ASAT's for Pre-Conflict Buildup & Positioning as a Prelude for Massive Space Attacks
- Willingness to Risk Generating Space Debris from Attacks in Space
- Willingness to Risk the Lives of Astronauts Due to Collateral Effects of Space Attacks
- Willingness to Implement New Doctrine, Strategies and Tactics for Space Control Beyond Traditional Terrestrial Military Doctrine
- Willingness to Link Space Attacks with Terrestrial Political / Military Actions & Goals
- Willingness to Spy on Adversary & Neutral Countries' Space System Capabilities & Risk Public Exposure
- Willingness to Suffer Condemnation on the World Stage for Space Attacks
- Willingness to Lose Allies Over Space Attacks
- Willingness to Suffer from Potential Space Counter-Attacks
- Willingness to Accidently Attack the Wrong Satellite Due to Poor Space Situational Awareness (SSA)
- Willingness to Respond with Force to Possibly Mistaken Assessments of Who Conducted Space Attacks
- Willingness to Generate Political Unrest Internal to Country Over Initiating a Space War
- Willingness to Reveal Critical Technologies by Conducting Space Attacks
- Willingness to Employ Close Inspection Satellites that Risk Accidently Damaging Targeted Space Systems and/or Neutral Satellites
- Willingness to Employ High-Power Lasers in Space Attacks that Risk Collateral Damage to Neutral Satellites from Reflection "Splash"
- Willingness to Degrade / Damage Other Countries' Space Systems During Peacetime
- Willingness to "Blockade" Other Countries' Access to Space (by Cyber Means or Denying Space Launches)
- Willingness to "Hijack" Another Country's Satellites
- Willingness to Act as a Space "Policeman" in Investigating & Implementing International Agreements Involving the Conduct of Operations in Space
- Willingness to Attack Terrestrial Systems Supporting Space Assets

- Willingness to Insert Cyber Trojan Viruses into Adversary & Neutral Country Space Systems in Their Manufacturing Stages
- Willingness to Employ Economic and Diplomatic Means Against Adversary Space Capabilities
- Willingness to Lure Adversary Space Scientists Away from Their Countries' Employment
- Willingness to Conduct a Mis-Information Campaign Against Your Adversaries' Confidence in Their Space Capabilities
- Willingness to Deny Your Adversary's Ability to Import Critical Space Technologies
- Willingness to Drive a Wedge Between Your Adversary & His Allies Over Space Capabilities
- Willingness to Threaten Adversaries' Space Capabilities to Resolve a Dispute
- Willingness to Publicize Adversary Violations of International Laws Applicable to Space
- Adversary Country's Resolve to See the Current Conflict Through No Matter What the Costs

Example Political/Military "Intents" COG's as Applicable to Space Warfare

- Political / Military Adversary Intent
  - The Most Difficult Intelligence Collection Mission, Yet Also the Most Important
  - Many Conflicts Have Started Due to Mis-Reading Adversary Intents
  - Intent Estimation Can Only be More Difficult with the Remoteness of Satellites from Earth's Space Surveillance Sensors, the Novelty of Space Warfare, & Lack of Extensive Previous Space Warfare Experiences
  - Intent from One Organization May Not Reflect the Intent from Country Senior Leadership
- Space Warfare Intent Estimation Can be Categorized by:
  - Strategic Intent
  - Operational Intent
  - Tactical Intent

Space Warfare Strategic Intent Examples:

- Show Resolve and Willingness to Escalate Conflict
  - Can Range from Reversable to Non-Reversible Effects on Satellites
  - Can Include or be Limited to Attacks on Space Systems' Terrestrial Support Elements
  - Can be Linked to Some Conflict on Earth that Has Nothing to Do with Space Systems
  - May be Threats Only (e.g., Maneuver Close to Adversary Satellite to Appear Threatening)
  - May Inspire Adversary to Counter Space Threats with Terrestrial Counter-Threats
- Demonstrate One's Military Space Capabilities and Technological Superiority
  - Sows Doubt on Adversary Planning
  - Gives Pause to Adversary's Execution Timelines
  - May Inspire Your Adversary to Develop Future Counters
  - May Raise Terrestrial or Space Conflict Escalation Ladder
- Show Support to Allies
  - Demonstrating Willingness to Escalate Space Conflict Provides Solidarity with Current Allied Actions (Space or Terrestrial)
- Increases Status with Local Political Supporters

May Energize Political Support Both In-Country and With Allied Populations

- Force Internal Opponents to Come On-Board with Political / Military Objectives
- Show Displeasure with United Nations Sanctions and Prohibitions
- Energize and Inspire Own Military Forces and Industrial Base
- Demonstrate "Ownership" of Certain Regions of Orbital Space (e.g., Geosynchronous Belt Above Own Country)
- Change the Emphasis from Terrestrial to Space Warfare

Adversary May Perceive They be Better at Countering Adversaries in Space Rather than Terrestrial Warfare Means

- Attempt to Rebalance Worldwide Political Alliances by Defeating Major Space Players
- Make Certain Orbital Slots Unusable by the Western World Through Deliberate Debris or Radiation Generation
- Pre-Conflict, Have Very Visible, but Relatively Harmless, Space Control Development Programs, While the Real Space Weapon Systems are Covertly Developed.
- Adversary Threats and Actions in Space May Only be to Influence Space Control Agreements and Treaties

- Make a Lot of Noise About a Major Space Weapons Development Program that Ultimately is Never Built and Deployed, to Inspire Your Adversaries' to Waste Time and Resources Trying to Counter It.
- Attacks in Space May Only Serve to Redirect Public Opinion from Terrestrial Conflicts
- The Purpose of Space Attacks That are Very Dramatic and Complete in Their Destruction May be to Shock and Awe Their Adversaries, and Influence Them to Make Hasty, But Ill-Informed, Decisions in Response.

Space Warfare Operational Intent Examples

- Types of Operational Space Attacks:
  - Decapitation of Command Authorities (Anti-BMC3)
  - Deny Visibility of Terrestrial Battlefield from Space
  - Deny Positioning/Timing Information to Terrestrial Forces
  - Deny Weather Information to Terrestrial Forces
  - Deny Missile Warning Information to Terrestrial Forces
  - Spoof Perceptions of Actual Terrestrial and/or Space Events
- Provide a "Loud" Demonstration Attack in One Orbital Location to Draw Attention Away from the Main Attack Axis Occurring Elsewhere
- Employ Multiple Attack Points of Application to Confuse Adversary Perceptions of Your Actual Plans
- Isolate One Portion of the Terrestrial Battlefield from Space Support
- Isolate One Portion of the Space Battlefield from Space Actions and Support
  - Isolate One Space Defense Region (SDR) From Adversary Space Activities (Including Surveillance) for a Given Time Period
- Use of Certain Types of Space Weapon Systems That First Isolate an Adversary's Satellites from Terrestrial Control, and Thus Fixes the Target Into Inaction, Until More Effective, But Possibly Slower Responding, Space Weapons Can be Made to Close onto the Target
- Probing / Testing of Potential Adversary Space Defenses to Determine His Intentions, Plans, Doctrine, Strategies and Tactics
- Defending and Holding the High Ground of Space (Centers of Gravity and Choke Points) to Exclude Adversary Use, Thus Frustrating His War Aims in Space
- Intent to Conduct Surprise Attacks
  - Employ Orbits (Such as Highly Eccentric) that Make It Difficult to Track Threatening Space Objects and Enable Surprise Attacks (See Missing Satellites)
  - Conduct Multiple Fake Space System Maneuvers (and Terrestrial Mobility Re-deployments) to Draw Away an Adversary's Space Systems from the Main Point of Attack
  - Conduct Covert Information Dominance Attacks to Confuse Your Adversary and Inspire Him to Lose Confidence in His Space Systems
  - Start Maneuvering Specific Space Assets as Decoys to Draw Attention Away from Covert Assets that are Preparing for Separate Attacks
  - Constantly Maneuvering Towards Your Adversaries' Space Assets as if to Attack, But Then Not Attacking, Will Confuse Him and Also Mask Your Real Attacks
  - If Your Weapons Appear to be Particularly Effective Against Their Assigned Targets, Then These Targets May be Simply Baits or Decoys from Your Adversaries
- Employing Multiple Phenomenologies of Space Weapon Systems Against the Same Target to Foil Defense Measures and Increase Probability of Kill (Pk)
- Attack Space Targets with Multiple Anti-Satellites (ASAT's) Coming from Multiple Directions
- You May Sacrifice Low-Value or Aging Satellite Systems for the Sole Purpose of Confusing Your Adversaries Through Meaningless Attacks
- Demoralizing Your Adversaries' Operational Space Forces Can Lead to Their Divided Efforts and Leadership
- Deploy Space Systems in Unusual Orbits to Confuse Your Adversary as to Their True Missions and Purpose.

Space Warfare Tactical Intent Examples

- Reconnaissance of Targeted Satellite (RPO)
  - Antennae Characteristics and Frequencies
  - Sensor Aperture Sizes, Types and Shutters
  - Solar Panel Type, Size and Power

- Maneuvering / Attitude Change Capabilities
- Assessed Satellite Lifetime Left
- Self-Defense Capabilities and Reaction Timelines
- Covert War-Reserve Modes and Subsystems (Hidden Doors)
- Spacecraft Bus and Radiator Material Types
- Vulnerability Assessments
- Threat Assessments

Detection of Hidden Escort Satellites

- Probing of Targeted Satellite
  - Physical Response to Visiting Space Object (VSO)
  - Response to RF / Laser Injections
- ASAT Actions

Insert Cyber Code

Attach Space Mine

- "Paint" Sensors (Including Earth Limb and Star Sensors), Solar Panels, Radiators, Antennae
- "Tilt" or Attach Weights to Unbalance Satellite
- Force Maneuver of Satellite Outside Normal Orbital Bounds
- Drill, Cut, Bend, Mask, etc. Satellite Appendages
- Intent May Also be Determined by How VSO Approaches Target Satellite
- Intent to Conduct Surprise Attacks
  - Attacking a Space Target From the Direction Where the Satellite's Self-Defense Sensors are Pointing Towards the Sun, Moon, Earth, or Earth Limb, in Order to Blind Him (Similar to "Hun In the Sun" Attack for WWI Aircraft)
  - Attacking a Space Target When it is Out of Range of an Adversary's Terrestrial Tracking, Telemetry and Control Stations, in Addition to Not Being Within a Sensor Envelope of His Space Surveillance Assets
  - Employing Low-Observables Spacecraft for Close Approaches of Targeted Satellites
  - Attacking Satellite "Acting" Like Harmless Commercial Satellite or Space Debris

Example Political/Military "Means" COG's as Applicable to Space Warfare

- Terrestrial-to-Space Attacks
  - Direct-Ascent ASAT's (Anti-Satellites)
  - Directed Energy (Lasers, High-Power Microwaves)
  - Cyber, Spoofing, Jamming, Seize Control
- Space-to-Space Attacks
  - Kinetic Kill Vehicle (KKV) ASAT's
  - Directed Energy ASAT's
  - Satellite Inspectors
  - Reconnaissance
  - Insert Cyber Attacks
  - Mechanical Arm Manipulation (Cut, Change Attitude / Orbits)
  - Paint Sensors, Solar Panels, Antennas, Thermal Control Surfaces
- Terrestrial-to-Terrestrial Attacks (Space-Related)
  - SOF / Cyber / Bombing Attacks Against Space Ground Sites
  - Space Data Receiver Sites
  - Satellite Controller Sites
  - Space Launch Sites
  - Space Command Centers
  - Space Research & Development Centers
  - "Soft" Attacks
  - Economic
  - Diplomatic
  - Negotiations
  - Bribery

Detailed Political/Military Space Warfare Centers of Gravity
Strategic COG:

- Launch Corridors
- GEO Belt Sectors

Above AO
Atlantic/Pacific COMM Relay Points

- Sun-Synchronous LEO Orbits
- GEO Transfer Orbits
- Earth-Lunar Orbits
- Space Launch Facilities
- Petrochemical Facilities Producing Rocket Fuel
- Terrestrial-Based Space Telemetry & Control Systems
- Space-Related Command Centers
- Space-Related Commanders
- Terrestrial-Based Space Weapon Systems
- Space-Based Space Weapon Systems
- Terrestrial-Based Space Surveillance Systems
- Space-Based Space Surveillance Systems
- Space Weather Systems
- Terrestrial-Based Satellite Heavy Communications Terminals
- Space Technicians
- Space Scientists
- Electric Grid Serving Ground Space Facilities
- Roads, Bridges, Tunnels & Passes Serving Ground Space Facilities
- Space Design & Manufacturing Facilities
- Space-Related INTEL Centers
- Air Force Satellite Control Network (AFSCN)
- Leader's Confidence in Their New Space Technologies
- Blue & Red Side Political Will to Start & Continue a Space War
- Key Phases of the Battle
    - Pre-Conflict Use of Space War
    - Just Before Major Terrestrial Offenses
    - Just Before the End of the Conflict
- Space-Related Decision Cycle Times (OODA Loops)
- Knowledge of Classified Space Systems Existence or War Reserve Modes
- Status of Space Forces
- Attack on Alternate Country Space Systems
- Blue May be Self-Deterred from Attacking Gray Space Systems
- Space Alliances & Treaties

Operational COG:

- Low Delta-V/Transit Time Points in Space to Reach High Value Targets
- Points in Space with High/Low Coverage from Space Surveillance Assets
- Regions of Space & Time with Advantageous Solar Phase Angles
- Times of Solar Alignment Interference to Communications (Two Times a Year for 4-8 Minutes for Geosynchronous Satellites)
- Gravity Wells at GEO Disposal Orbits Where Dead Satellites Tend to Group
- Space Radiation Belts
- Times of High Solar Storm Activity
- Zones Outside a Satellite's or Constellation's Collective Sensors' Field of Regard
- Times When Adversary Military Is Concentrating on In-theater Actions, & Is Less Aware of Space-related Actions on the Other Side of the Globe
- On-Orbit Spares or Launch Replenishment or Ability to Reconstitute Space Capability with Terrestrial Systems
- Antipodal Nodes 180 Degrees from Launch Sites Around the World
- Other Satellites Being Launched on the Same Booster

- Manned Launch (Shuttle, Space Station) of Satellites
- Times When a Full Moon Degrades an Adversary's Ability to Optically Track Dim Space Objects from Terrestrial Locations
- Organizational Boundaries Between Competing Space Departments' Responsibilities (i.e., Air Force, Army, Navy, NRO, NSA, CIA). Similar to Attacking the Geographic Boundaries Between Two Different Infantry Divisions

Tactical COG:

- Space Tactics, Techniques & Procedures
- Initial Satellite Checkout After Launch or Orbital Insertion
- GEO Satellites Changing Orbital Position
- Periods of Solar Eclipse for Satellites
- Periods When a Satellite Has a Low Battery Charge
- Approach Trajectories Outside the Field of Regard of the Target's On-Board Sensors
- Approach Trajectories When the Sun/Moon/Earth Is in the Background of a Target's Sensors
- Approach Trajectories Outside Normally Employed Orbits
- Near a Satellite's Thrusters
- Near a Satellite's High-Power Antennas
- Anti-Satellite Launch/Attack Rate
- Just After Loss of Contact with Adversary Satellite Ground Controllers
- Just After Loss of Contact with Adversary Space Surveillance Assets
- Times of Cloud Cover/Weather/Natural Disasters for Terrestrial-Based Space Weapons Systems
- Times of Cloud Cover/Weather/Natural Disasters for Terrestrial-Based Space Surveillance Systems
- Times When the Satellite Passes Through Space Radiation Belts
- Communications or Telemetry Frequencies That Can be Jammed or Spoofed

Additional Space COG Examples:

- 3.5.1.1 Blue and Allied forces' ability to access space (launch services) to the maximum extent possible, especially for those Blue space assets critical to current Blue military operations in the AOR
- 3.5.1.2 Blue and Allied forces' ability to use space to support terrestrial forces to the maximum extent possible, especially for those Blue space assets critical to current Blue military operations in the AOR
- 3.5.1.3 Blue and Allied forces' ability to maneuver around in space to the maximum extent possible, especially for those Blue space assets critical to current Blue military operations in the AOR
- 3.5.2.1 Red and their allied forces' ability to access space (launch services) to the maximum extent possible, especially for those Blue space assets critical to current Blue military operations in the AOR
- 3.5.2.2 Red and their allied forces' ability to use space to support terrestrial forces to the maximum extent possible, especially for those Blue space assets critical to current Blue military operations in the AOR
- 3.5.2.3 Red and their allied forces' ability to maneuver around in space to the maximum extent possible, especially for those Blue space assets critical to current Blue military operations in the AOR
- 3.5.3.1 Blue and their Allied forces' perceptions of the existing space threat and their ability to counter it
- 3.5.3.2 Red and their allied forces' perceptions of the existing space threat and their ability to counter it
- 3.5.3.3 Blue and their Allied forces' perceptions of the value of their space systems to the terrestrial battlefield, and how to best implement that value
- 3.5.3.4 Red and their allied forces' perceptions of the value of their space systems to the terrestrial battlefield, and how to best implement that value
- 3.5.3.5 Blue and their Allied forces' perceptions of the value of commercial space systems to the terrestrial battlefield, and how to best implement that value
- 3.5.3.6 Red and their allied forces' perceptions of the value of commercial space systems to the terrestrial battlefield, and how to best implement that value
- 3.5.4.1 Blue and Allied beliefs in their ability and the value of achieving space supremacy, or at least control and authority over their orbital space near their satellites, including the ability to maintain freedom of action in, from, and to space, sufficient to sustain mission assurance and deny the same to the adversary and its Red allies during the terrestrial conflict. This Space Superiority may be localized in time and space, over the immediate AOR, or it may be broad and enduring.
- 3.5.4.2 Red and their allies beliefs in their ability and the value of achieving space supremacy, or at least control and authority over their orbital space near their satellites, including the ability to maintain freedom

of action in, from, and to space, sufficient to sustain mission assurance and deny the same to Blue and its Allies space forces during the terrestrial conflict. This Space Superiority may be localized in time and space, over the immediate AOR, or it may be broad and enduring.

- 3.5.5.1 Blue and Allied beliefs in their ability and the value of conducting space control operations that increase their space survivability and resilience, particularly localized tactical satellite defense and preservation of space-related terrestrial systems, and deny Red and their allies use of space systems that support their military objectives
- 3.5.5.2 Red and their allies' beliefs in their ability and the value of conducting space control operations that increase their space survivability and resilience, particularly localized tactical satellite defense and preservation of space-related terrestrial systems, and deny Blue and their Allies use of space systems that support their military objectives
- 3.5.6.1 Blue and Allied beliefs in their ability and the value of obtaining good situational awareness of their own space orbital elements, mission status, command relationships, and communications for both their satellites, and terrestrial space systems
- 3.5.6.2 Red and their allies' beliefs in their ability and the value of obtaining good situational awareness of their own space orbital elements, mission status, command relationships, and communications for both their satellites, and terrestrial space systems
- 3.5.6.3 Blue and Allied beliefs in their ability and the value of denying good situational awareness to Red and their allies for space orbital elements, mission status, command relationships, and communications for both their satellites, and terrestrial space systems
- 3.5.6.4 Red and their allies' beliefs in their ability and the value of denying good situational awareness to Blue and their Allies' for space orbital elements, mission status, command relationships, and communications for both their satellites, and terrestrial space systems
- 3.5.7.1 Blue and Allied beliefs in their ability and the value of their space sensors' ability to predict pre-conflict buildup of adversary space forces, along with their maneuvering to key jump-off orbital positions. This also includes a belief that Blue and Allied intelligence agencies would be able to detect and properly assess adversary intentions to initiate conflict, both in space and through terrestrial forces. Finally, this includes a belief that Blue and Allied leaders, while possessing verified intelligence data, would actually confront their adversaries' actions by addressing these threats in international forums, such as the United Nations.
- 3.5.7.2 Red and their allies' beliefs in their ability and the value of their space sensors' ability to predict pre-conflict buildup of Blue and Allied space forces, along with their maneuvering to key jump-off orbital positions. This also includes a belief that Red and their allied intelligence agencies would be able to detect and properly assess adversary intentions to initiate conflict, both in space and through terrestrial forces. Finally, this includes a belief that Red and their allied leaders, while possessing verified intelligence data, would actually confront the Blue and Allied actions by addressing these threats in international forums, such as the United Nations.
- 3.5.8.1 Blue and Allied beliefs in their ability and the value of organizing Blue inter-governmental space agencies and Allied space forces to develop a joint space warfare plan with delegated responsibilities
- 3.5.8.2 Red and their allies' beliefs in their ability and the value of organizing Red inter-governmental space agencies and their allied space forces to develop a joint space warfare plan with delegated responsibilities
- 3.5.9.1 Blue and Allied beliefs in their ability and the value of organizing Blue space and terrestrial military authorities into developing a joint space-terrestrial warfare plan with delegated responsibilities
- 3.5.9.2 Red and their allies' beliefs in their ability and the value of organizing Red space and terrestrial military authorities into developing a joint space-terrestrial warfare plan with delegated responsibilities
- 3.5.10.1 Blue and Allies' beliefs that diplomatic efforts can achieve agreements with some key allied and neutral countries that they will support most Blue actions during the ensuing space conflict, at least at the covert levels
- 3.5.10.2 Red and their allies' beliefs that diplomatic efforts can achieve agreements with some key allied and neutral countries that they will support most Red actions during the ensuing space conflict, at least at the covert levels
- 3.5.11.1 Blue and Allies' beliefs that their diplomatic and legal efforts can achieve agreements with some key Red allied and neutral countries that they will not support Red actions during the ensuing space conflict

- 3.5.11.2 Blue and Allies' beliefs that their diplomatic and legal efforts can achieve agreements with some key commercial satellite owners that they would not support Red military space efforts with imagery and communications satellite resources.
- 3.5.12.1 Blue and Allies' beliefs that their leaders making declaratory statements condemning Red and their allies' space warfare efforts, along with requiring counter-threatening new space force deployments, would actually deter Red and their allies from committing some key space actions
- 3.5.12.2 Red and their allies' beliefs that their leaders making declaratory statements condemning Blue and their Allies' space warfare efforts, along with requiring counter-threatening new space force deployments, would actually deter Blue and their Allies' from committing some key space actions
- 3.5.13.1 Blue and Allies' beliefs that efforts to introduce treaties in the international arena concerning limits to space warfare capabilities may actually deter Red and their allies from committing some key space actions
- 3.5.13.2 Red and their allies' beliefs that efforts to introduce treaties in the international arena concerning limits to space warfare capabilities may actually deter Blue and their Allies from committing some key space actions
- 3.5.14.1 Blue and Allies' beliefs that conducting information operations against the adversary and their allies' space systems so that their senior military and political leaders will lose confidence in the reliability and accuracy of those space systems, would actually be effective
- 3.5.14.2 Red and their allies' beliefs that conducting information operations against Blue and their Allies' space systems so that their senior military and political leaders will lose confidence in the reliability and accuracy of those space systems, would actually be effective
- 3.5.15.1 Blue and Allies' beliefs that conducting information operations against your adversary and their allies' space systems so that their senior military and political leaders will take confusing and non-sensical actions detrimental to their overall war effort, would actually be effective
- 3.5.15.2 Red and their allies' beliefs that conducting information operations against your Blue and their Allies' space systems so that their senior military and political leaders will take confusing and non-sensical actions detrimental to their overall war effort, would actually be effective
- 3.5.16 Blue and Allies' beliefs in their ability to shape the space battlefield during the pre-conflict phase to the advantage of Blue and Allied space systems by positioning space resources into key jump-off orbital locations (in accordance with future Blue space COA's), have sufficient fuel reserves, have on-board batteries fully charged, and appear to have avoided Red and their allies' space surveillance sensors detection
- 3.5.17 Blue and Allies' beliefs in their ability to shape the space battlefield during the pre-conflict phase to the disadvantage of Red and their allied space systems by influencing their Red space assets to be in poor orbital locations (according to future Blue space COA's), have significant loss of fuel reserves, experience poor communications with ground controllers, have unintentional revealed hidden war-reserve capabilities, and appear to be in a confused military command and control state with Red command centers, along with poor coordination with Red allied intentions and plans
- 3.5.18 Blue and Allies' beliefs in their ability to frustrate adversary abilities to improve military space capabilities and replenish space resources. This also includes Blue and Allies' beliefs in their ability to enable effective economic and technologies embargos against the adversary and their allies from importing critical space technology and systems. In addition, this also includes Blue and Allies' beliefs in their ability to ensure the adversary and their allies have limited options to replace and replenish space resources, including after the conflict ends.
- 3.5.19 Blue and Allies' beliefs in their ability to enforce international treaties associated with outer space, and whether this will have an ultimate effect on Red and their allies' behavior is space, both during and after the conflict

APPENDIX 3

Space Glossary List (Partial)

[Contact Author for a full list of space warfare glossary and dictionary terms derived from traditional terrestrial military doctrine]

Glossary	Definition	Source
Active Space Defense	Direct defensive action taken to destroy, nullify, or reduce the effectiveness of hostile space actions. It includes the use of anti-satellite weapon systems, defensive counter space weapons, electronic warfare, and other available weapons not primarily used in a space defense role. See also Space Defense.	Modified from Joint Pub 3-01.1
Space Control Operations	The employment of space forces, supported by air, ground and naval forces, as appropriate, to achieve military objectives in vital areas of concern to space systems. Such operations include destruction of enemy in-space assets, space-related ground systems and surface-to-space forces (launch), interdiction of enemy space operations, protection of vital space lines of communication (links from ground to space to ground), and the establishment of local military superiority in areas of space operations.	Modified from Joint Pub 3-01.1
Space Defense Action Area	An orbit and the space around it within which friendly spacecraft or surface-to-space weapons are normally given precedence in operations except under specified conditions. Also see Space Defense Operations Area.	Modified from Joint Pub 3-01.1
Space Defense Area	1.) A specifically defined orbit for which space defense must be planned and provided. 2.) An orbit and a region surrounding it of defined dimensions designated by the appropriate agency within which the ready control of spaceborne vehicles is required in the interest of national security during an space defense emergency.	Modified from Joint Pub 3-01.1
Space Defense Artillery	Weapons and equipment for actively combating space targets from the ground.	Modified from Joint Pub 3-01.1
Space Defense Battle Zone	A volume of space surrounding a space defense fire unit or defended area, extending to a specified orbital altitude and inclination, in which the fire unit commander will engage and destroy targets not identified as friendly under criteria established by higher headquarters. In other words, this would be a free-fire zone around a defended satellite.	Modified from Joint Pub 3-01.1
Space Defense Control Center	The principal information, communications, and operations center from which all spacecraft, anti-satellite operations, space defense artillery, guided missiles, and space warning functions of a specific area of space defense responsibility are supervised and coordinated. Also called space defense operations center.	Modified from Joint Pub 3-01.1
Space Defense Division	A geographic subdivision of a Space Defense Region. Also see Space Defense Sector.	Modified from Joint Pub 3-01.1
Space Defense Emergency	An emergency condition, declared by the Commander in Chief, USSTRATCOM, that exists when attack upon space systems of interest to the United States by hostile spacecraft, missiles or ground weapons, is considered probable, is imminent, or is taking place.	Modified from Joint Pub 3-01.1

Glossary	Definition	Source
Space Defense Identification Zone	Orbital space of defined parameters within which the ready identification, location, and control of spaceborne vehicles is required. Also called **SDIZ**. Also see Space Defense Operations Area.	Modified from Joint Pub 3-01.1
Space Defense Operations Area	An area and the orbital space around it within which procedures are established to minimize mutual interference between space defense and other operations; it may include designation of one or more of the following: Space Defense Action Area, Space Defense Area; Space Defense Identification Zone, and, or firepower umbrella.	Modified from Joint Pub 3-01.1
Space Defense Region	An orbital subdivision of a Space Defense Area.	Modified from Joint Pub 3-01.1
Space Defense Sector	An orbital subdivision of a Space Defense Region. Also see Space Defense Division.	Modified from Joint Pub 3-01.1
Space Sovereignty	A nation's inherent right to exercise absolute control and authority over the orbital space near its satellites. Also see Space Sovereignty Mission.	Modified from Joint Pub 3-01.1
Space Sovereignty Mission	The integrated tasks of surveillance and control, the execution of which enforces a nation's authority over the orbital space near its satellites. Also see Space Sovereignty.	Modified from Joint Pub 3-01.1
Space Deconfliction In the Combat Zone	A process used to increase combat effectiveness by promoting the safe, efficient, and flexible use of space systems. Space Deconfliction is provided in order to prevent fratricide, enhance space defense operations, and permit greater flexibility of operations. Space Deconfliction does not infringe on the authority vested in commanders to approve, disapprove, or deny combat operations. Also called combat space deconfliction; space deconfliction.	Modified from Joint Pub 3-01.1
Space Control Sector	A sub element of the space control area, established to facilitate the control of the overall orbit. Space control sector boundaries normally coincide with space defense organization subdivision boundaries. Space control sectors are designated in accordance with procedures and guidance contained in the space control plan in consideration of Service component and allied space control capabilities and requirements.	Modified from Joint Pub 3-01.1
Space Autonomous Operation	In space defense, the mode of operation assumed by a space system after it has lost all communications with human controllers. The space system assumes full responsibility for control of weapons and engagement of hostile targets, based in accordance with on-board surveillance and weapon system control logic. This automatic state may occur on a regular basis due to orbital movements outside regions of ground coverage and control.	Modified from Joint Pub 3-01.1
Broadcast-Controlled Space Interception	An interception in which the interceptor is given a continuous broadcast of information concerning the space defense situation and effects interception without further control.	Modified from Joint Pub 3-01.1
Space Centralized Control	In space defense, the control mode whereby a higher echelon makes direct target assignments to fire units. See also Decentralized Control.	Modified from Joint Pub 3-01.1
Close-Controlled Space Interception	An interception in which the interceptor is continuously controlled to a position from which the target is within local sensor range.	Modified from Joint Pub 3-01.1

Glossary	Definition	Source
Space Decentralized Control	In space defense, the normal mode whereby a higher echelon monitors unit actions, making direct target assignments to units only when necessary to ensure proper fire distribution or to prevent engagement of friendly spacecraft. See also Centralized Control.	Modified from Joint Pub 3-01.1
Passive Space Defense	All measures, other than Active Space Defense, taken to reduce the probability of and to minimize the effects of damage to space systems caused by hostile action without the intention of taking the initiative. These measures include camouflage, deception, dispersion, and the use of protective construction and design. See also Space Defense.	Modified from Joint Pub 3-01.1
Space Point Defense	The defense or protection of special vital elements, orbital positions (geosynchronous slots, and advantageous orbits, such as sun-synchronous) and installations; e.g., command and control facilities, space launch facilities, Tracking, Telemetry and Control facilities, space surveillance sensors, and high-value satellites.	Modified from Joint Pub 3-01.1
Space Positive Control	A method of space control which relies on positive identification, tracking, and situation assessment of spacecraft within a Space Defense Area, conducted with electronic means by an agency having the authority and responsibility therein.	Modified from Joint Pub 3-01.1
Space Weapon Engagement Zone	In space defense, orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with a particular weapon system. Also called **SWEZ**. 1.) **Direct-Ascent Engagement Zone (DAEZ)**. In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with a direct-ascent anti-satellite system of terrestrial launch origin. 2.) **Directed Energy Engagement Zone (DEEZ)**. In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with a directed energy (laser or microwave) ASAT or electronic warfare system of terrestrial location. 3.) **Electronic Warfare Engagement Zone (EWEZ)**. In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with an electronic warfare system of terrestrial location. 4.) **Close Attack Engagement Zone (CAEZ)**. In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with an ASAT system that is stationed within 10 kilometers of its target. 5.) **Long Range Engagement Zone (LREZ)**. In space defense, that orbital space of defined altitude and inclination within which the responsibility for engagement of space threats normally rests with long range space defense weapons, that are space-based, but are normally stationed at more than 10 kilometers from its target. 6.) **Joint Engagement Zone (JEZ)**. In space defense, that orbital space of defined altitude and inclination within which multiple space defense systems (from both terrestrial and space-based locations) are simultaneously employed to engage space targets.	Modified from Joint Pub 3-01.1
Space Weapons Assignment	In space defense, the process by which weapons are assigned to individual space weapons controllers for use in accomplishing an assigned mission.	Modified from Joint Pub 3-01.1
Space Weapons Free	In space defense, a weapon control order imposing a status whereby weapons systems may be fired at any target in orbital space of defined	Modified from Joint Pub 3-01.1

Glossary	Definition	Source
	altitude and inclination, not positively recognized as friendly. See also Weapons Hold; Weapons Tight.	
Space Weapons Hold	In space defense, a weapon control order imposing a status whereby weapons systems may only be fired in self-defense or in response to a formal order. See also Weapons Free; Weapons Tight.	Modified from Joint Pub 3-01.1
Space Weapons Tight	In space defense, a weapon control order imposing a status whereby weapons systems may be fired only at targets recognized as hostile. See also Weapons Free; Weapons Hold.	Modified from Joint Pub 3-01.1

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