

SFA MAGAZINE

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WHY THE SPACE FORCE NEEDS A RESERVE COMPONENT

BY REP. BRIAN BABIN

Rep. Babin is a member of the U.S. House of Representatives from Texas's 36th district

With increased adversarial investment in space, the United States should be making every effort to prioritize our edge over the ultimate high ground. The creation of the Space Force was a huge step in the right direction, establishing a military branch with a singular focus on space and no longer forced to compete for internal prioritization against fighters, bombers, and tankers.

While the Space Force has had a tremendous start, we unfortunately still have a problem. What do we do with the nearly 2,500 Airmen still performing space-centric functions in the Air Force Reserve or Air National Guard? I believe the answer is clear. Transfer them over to the Space Force - and do it now.

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WHY THE SPACE FORCE NEEDS A RESERVE COMPONENT CONT.

Here's why: currently, the Space Force sits at around 8,500 military personnel. The 2020 National Defense Authorization Act, which created the Space Force, did not give legal authority to the newest branch to stand up a reserve component. That means 100% of the 8,500 Guardians are active duty, and 30% of our nation's space warfighters (more if you include space-centric servicemembers currently in branches other than the Air Force) currently reside outside of the Space Force. This 30% creates a disproportionate effect for critical missions like missile warning and tracking, GPS, space-based electronic warfare, and more.

As all of you likely know, in citing the relatively small size of the Space Force, some have suggested plans to combine all active and reserve components into a new model of "full-time and part-time Guardians."

While I applaud the creative thinking, this proposal is cumbersome and will inevitably get caught up in bureaucratic red tape - and all for a concept that fails to demonstrate mission improvement or fiscal value for the manpower model it envisions.

First, this combined active and reserve space component model creates a single organization in name only, abandoning the active duty and reserve designators. Additionally, the Space Force and DoD have not been able to accurately describe to Congress the details associated with combining the historically separate and distinct organizations, how the idea avoids creating second-order effects in areas like Veterans and health care benefits, or how it protects Congress' long-held interest in ensuring the nation has a vibrant strategic reserve capability.

Second, this proposal does not have reservists joining active duty, but rather, both teams of manpower must join a new organization under an Inter-Service Transfer (IST) process. In other words, not only will today's reserve space operators have to go through an IST to join the

new "Space Component," but so will today's active-duty Guardians. For those keeping score, the same active duty that just went through an IST to join the Space Force over the past three years and underwent struggles such as disrupted pay, dependents getting dropped from DEERS, and so on will have to do this all over again.



A U.S. Space Force Guardian is aided in updating his uniform with the correct patches of the U.S. Space Force during an induction ceremony. Image credit: dvidshub.net/image/6519399/ "The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement."

And third, it is impractical to keep existing space missions in the Air National Guard and Air Force Reserve for several reasons. Space Force Guardians going through Basic Military Training at Lackland Air Force Base have a different training pipeline than their Guard and Reserve peers who they will soon work side-by-side. Additionally, transferring fully trained Space Force members into the Guard and Reserve has become wildly problematic. When Active-Duty members joined the Space Force (after going through an IST process from the Air Force), they incurred a service commitment of at least two years. For a brand new service, this shut down the trained member pipeline that makes the Guard and Reserve so beneficial - keeping highly trained Guardians on board in a part-time capacity. As these commitments are beginning to expire, Guardians wanting to join the Guard or Reserve will have to IST back into the Air Force, which is a significant disincentive. They must apply, be approved, and go through the headaches of the transfer. And even if the transfer is successful, they then transfer back into the space career field which is rapidly diminishing in the Air Force.

WHY THE SPACE FORCE NEEDS A RESERVE COMPONENT CONT.

Suddenly, this member's long-term competitiveness in promotion boards and growth within their organization becomes a huge challenge. Why would someone volunteer for that? This hasn't materialized in the form of noticeable problems in mission effectiveness - yet - but it's coming. Guardians are already calling it "the great reckoning."

So, what is the solution?

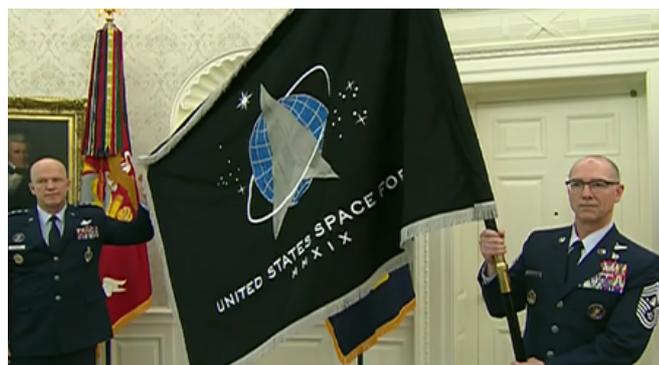
It's simple. Let's skip the "Space Component" and establish a Space Force Reserve Command as a field command within the Space Force and also create a Space National Guard. Let's model both components' scope and authority after the Air Force Reserve and Air National Guard. In order to keep them lean, steal a page from the Space Force and Air Force's relationship and have the new Space Reserve and Space Guard lean on their partner Air Force organizations for administrative support.

The affordable, effective, and expeditious solution is the same today as when the Space Force was created. We must establish Space Guard and Reserve missions in strategic locations where we already focus on space capabilities and have a highly-skilled workforce. If the Space Force were really thinking ahead, they would look for opportunities in the future to spread these units around the country into untapped congressional delegations who have an appetite to advocate for the branch - in fact, Texas is foaming at the mouth to join this effort. Arguments that the cost of a separate Space National Guard would be prohibitively expensive are based on false, and frankly bizarre, Office of Management and Budget projections of enormous growth and increases in manpower requirements that simply do not exist.

These steps are consistent with how Congress has organized the Guard and Reserve in other services. It would also be consistent with the Air Force's multi-year validations to Congress following the National Commission on the

Structure of the Air Force (NCSAF) which repeatedly and emphatically stated that the best design of the service includes three parts - an Active Duty, Reserve, and Guard. While I acknowledge that the Space Force is smaller and more agile than the Air Force, I see no reason why this validation of the traditional Air Force structure should be set aside.

As we approach the third anniversary of the creation of the Space Force, we are at a critical moment to decide the future of how we address our essential reserve components. Making the right decision at this moment will provide us with a cost-effective, competitive advantage over our adversaries. Establishing a Space National Guard is the single most practical and efficient organizational step we can take to achieve this goal.



Presentation of the U.S. Space Force flag. Image credit: dvidshub.net/video/752897/ "The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement."

I say all of this with the utmost respect for the branch in which I served and in recognition of its tremendous accomplishments throughout the years. Thousands of Air Force "legacy Guardians" have laid the groundwork for decades for our current Guardians to take up the guidon and lead us into the future. To steal a line from General Raymond, "the Air Force built the world's best Space Force."

Happy third birthday to the Guardians! I look forward to working aggressively with you and the Space Force Association to further your ability to move at speed and dominate the vital battleground of space. Your work is critical to protecting our nation and freedom-loving people everywhere. The sky is not the limit anymore - Semper Supra!

A MESSAGE FROM THE PRESIDENT

BY WILLIAM WOOLF

It's hard to believe we are celebrating our 3-year anniversary at The Space Force Association. Thanks to our tremendous group of volunteers, we have been able to accomplish our objective to inform, educate and advocate for a strong Space Force. I would personally like to thank all of our Sponsors, volunteers and our Board of Directors for their dedication and support of SFA and its mission.

Like every other military service, the United States Space Force deserves an organization solely dedicated to Guardians and their families. Some of the main issues SFA is advocating for include increasing the number of general officer billets in order to grow future Space Force leaders, creating a Space National Guard, acquisition reform, and workforce development. SFA's group of volunteers have been hard at work to ensure the USSF has the capabilities to achieve its space superiority mission.

At the beginning of this SFA journey, we knew the Space Force did not have the leadership billets necessary to achieve its mission. This holds true today with the current number of general officers in the Space Force at 23. 23 does not afford the Chief of Space Operations to grow the space expertise to run this critically important service. At a minimum, the Space Force should have at least 36 general officer billets to start to develop and manage expertise and grow the senior leader space expertise bench. SFA strongly believes the Space Force leadership billets needs to be right sized to ensure continued senior leadership development.

The Space National Guard has been at the forefront of our initiatives and continues to be. Please read the article written by Representative Brian Babin (R-TX), a co-chair of the Space Force Caucus (<https://spaceforcecaucus.org>)



"LIKE EVERY OTHER MILITARY SERVICE, THE UNITED STATES SPACE FORCE DESERVES AN ORGANIZATION SOLELY DEDICATED TO GUARDIANS AND THEIR FAMILIES."

who identifies the need to stop studying the problem and start fixing it. Please stay tuned for an upcoming interview with Dr. Babin in the very near future. Additionally, SFA is honored to have Gen. (ret) Joseph Lengyel on our Board of Directors to help us effectively advocate for this important initiative.

At the inaugural Guardian Industry Nights event in July, SFA had the opportunity to bring together Guardians and Industry to talk about current operational needs. The first night focused on Guardians and their biggest technological challenges. The second night was dedicated to examining how industry was working to solve those challenges. As this event is scheduled to coincide with TACDEV, STARCOM's tactics development conference it provides a unique opportunity to hear from some of the USSF's smartest warfighters.

A Message From The President Cont.

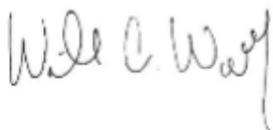
From an acquisition reform perspective, the conversation becomes simple. If we focus on what Guardians on the front lines need to accomplish their mission, like what the other services do, the priorities become very clear. For example, the priority of a realistic threat replication and simulator environment for effective training is still at the top of the list. Imagine if the F-22 was delivered to the Air Force without tactics manuals, a simulator and a realistic threat replication environment to train on. We would have pilots ill-prepared to execute their air superiority mission. This is the current dilemma for Guardians. We shouldn't expect them to effectively perform their space superiority mission without the help of these fundamental necessities.

Workforce development continues to be one of the most challenging missions facing the nation. SFA has been working diligently to ensure this country, our partners and allies have the necessary expertise to support the space superiority mission regardless of the sector they affiliate with. The launch of Global Space University (globalspaceuniversity.org) allows for individuals to be "on-boarded" into the space profession while also allowing current space professionals to be recognized for their expertise. There are several programs being offered at GSU to allow any individual to start and/or grow their space professional career. GSU has already certified more than 100 space professional (CSP) level 1 and 2's who are using their knowledge to better support USSF missions in industry.

Finally, we are excited to announce the development of the Space Professional Society (SPS) which allows both ROTC cadets and civilian students to grow their space expertise through guided programs. Look for more information about the SPS soon.

These are just a few of the many initiatives your SFA volunteers continue to work on to inform, educate and advocate for a strong Space Force. Feel free to reach out to me for additional information on any these or other SFA initiatives.

Semper Supra!



William Woolf, Col, USAF (ret)
President and Founder

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DC CHAPTER HOSTS FIRST GOLFING FOR GUARDIANS EVENT

BY STAFF WRITER

The Washington, D.C. Chapter of the Space Force Association held a golf tournament on October 3rd at the Ft. Belvoir Golf Club. The event, *Golfing for Guardians*, was the first major fundraiser held by the chapter, allowing them to give back to Guardians in the DC area.

"This is the first of what will be an annual event supporting our Guardians and helping to provide welcome packages for Guardians new to the area and the establishment of awards and scholarships for current and future (ROTC) Guardians. The D.C. Chapter is open to all who are interested in space operations and exploration," said Tim Adam, D.C. Chapter President.



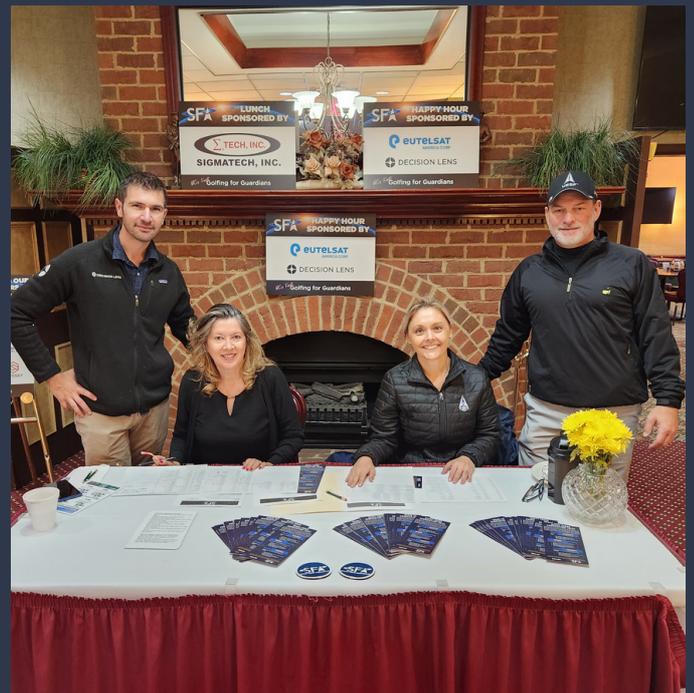
Golfers posing for a photo before teeing off at the first *Golfing for Guardians* event at Fort Belvoir Golf Club.



Participants load up their carts prior to heading out on the course.



Golfers take a picture with their sponsored hole.



DC Chapter members welcome golfers and sponsors to the event, sharing additional ways they can get involved with SFA to carry out the mission of advocating for our U.S. Space Force and its Guardians.

SENIOR ENLISTED PERSPECTIVE

FLY-BY WIRE OPERATING THROUGH THE OBSCURA

BY CHIEF MASTER SGT. JACOB SIMMONS,
SENIOR ENLISTED LEADER

Adapted from LinkedIn, Jacob Simmons, Senior Enlisted Leader, USSF, 2022, https://www.linkedin.com/posts/jacobsimmons_fly-by-wire-operating-through-the-obscura-activity-6979627162957950976-R9a-?utm_source=share&utm_medium=member_desktop. Adapted with permission. The views expressed are those of the author and do not necessarily reflect the official policy or position of the Space Force, the Department of the Air Force, or the U.S. Government.

As we necessitate and negotiate norms, China is experimenting at the edge of the envelope. They are pushing the power curve. They are doing more than catching up, their walk along the “red line” is beginning to breach containment.

We may have underestimated their version and vision of “Island Chain” strategy and the egregiousness of their eastern expansionism. Their advancement to overtake the second and third lines should be seen as but an initial instigation, a prelude of the extent of their effort to invade - install - invest - influence in the long game. While we have been betting on limiting their seizure of plots of longitude, they have been brokering to stake claim to points of lagrange. Their “One Belt” now loops through th LEO, MEO, and GEO belts, as they stretch their physical presence and establish power projection platforms upward to Cis-lunar. In lock step, a barrage of new “weapon grade” technologies besieged by new malicious motivations now co-exist with our “no-fail to the nation” assets and consistently encroach on our national command, control, and



communication capabilities in the space regime, placing our on-orbit bases of operations, previously considered sanctuaries, at risk. All as undisputed evidence of uncontested anti-satellite activity, and attributable adversarial attacks, continue to create collateral challenges for all constellations.

We can no longer “fly blind.” We are approaching rendezvous proximity of a single event upset. Static noise in space is no longer an acceptable status quo. Diminishing the instability and demonstrating instinct are in-style. Discerning intent and disseminating in-synch are now in-demand. Under the radar, the trajectory of some spacefarers’ (and spacefearers’) behaviors have swiftly and sharply taken a hypersonic 180 degree turn and burn and is now all thruster bank climbing toward a hyperbolic glide slope. This change in course adds an exponential factor into the crisis to conflict calculus. This delta V that is reshaping the parameters of our positioning and path, must not be simply admired ... it must be attributed and accounted for.

Read the full article, *Fly-By Wire*, on Chief Master Sgt. Simmon's LinkedIn Page:
<https://www.linkedin.com/in/jacobsimmons/>



Chief Master Sgt. Jacob C. Simmons

DART PAVES THE WAY FOR NEW SPACE FORCE MISSION

BY GERRIT DALMAN

Planetary defense just got real and that should mean new work for the Space Force. As the mission transitions from a theoretical necessity to a practical reality, the time has come to talk about the new service's role in the mission. Presently no legislation or funding explicitly assigns responsibility for redirection of impact threats. Since the ability to redirect objects in orbit can be offensive as well as defensive, it is clear the Space Force should be involved. The mission may be more urgent than many realize. While the probability of a natural disaster remains long, the odds of an artificial hazard grow every day.

NASA has been tracking asteroids and comets that might pose a risk to Earth for years, but nobody had even demonstrated an ability to do anything about them until last week. On 26 September, 2022, NASA's Dual Asteroid Redirect Test (DART) mission achieved a major milestone in planetary defense by deliberately changing the course of a celestial object. Data from this test will pave the way for much more specific conversations about planetary defense than were possible before. This includes what capabilities should be built to influence our celestial neighbors and who should operate them.

Planetary Defense

Though it is rarely in the public eye other than as cinematic hyperbole, planetary defense is serious business. Planetary defense is the collection of activities necessary to prevent an object from impacting Earth to devastating effect. Far from fiction, there is abundant physical evidence that such impacts happen frequently. While impacts severe enough to cause mass extinctions may occur only every few million years, those that could destroy

cities occur about once per century (source: Defend Earth primer). Indeed multiple objects that might have caused record-setting natural disasters have struck Earth in the 20th and 21st centuries. Only chance averted disaster as they arrived over sparsely populated areas.



It is now possible to influence those odds. As with every other form of natural disaster, technology eventually offers an affordable mitigation. We learned to conduct controlled burns to prevent forest fires, built levees against floods, and used satellite early warning to evacuate populations out of the path of hurricanes. It is once again time we wrestle some measure of control away from fate by implementing a permanent system for effecting Earth impactors.

Planetary defense broadly consists of finding, characterizing, planning, and affecting impact threats. NASA's Planetary Defense Coordination Office (PDCO), in cooperation with other agencies, international partners, and even private citizens, has been working on the first three steps for years. No agency, however, has been directed or resourced to operate and maintain an ability to act on a threat assessment.

The current inability to affect a threatening object isn't for lack of ideas. While "nuclear options" like those seen in movies have been generally dismissed, many valid approaches have been put forward, including directed energy, gravity tractors, and kinetic impactors. One of the easiest to implement is the kinetic impactor, the technique demonstrated by DART.

DART Paves The Way Cont.

DART

Kinetic impactors are slung directly into the target with sufficient mass and speed to bump it into a new orbit that is no longer a threat. NASA's 570 kilogram DART traveled 10 months to precisely ram into its target, 160 meter wide Dimorphos, in a collision that is estimated to adjust its orbit by about 1%. Though just a test, the success proves that a kinetic impact approach to threat deflection is practical and, if conducted early enough, even a 1% change can be sufficient to avoid catastrophe.

Beyond proving the concept, DART lessons will inform improvements in planetary defense sensor, automation, and spacecraft technology as well as refine models to generate exactly the right collision to achieve the intended change in the target's orbit. An operational system will apply this early work to be faster, more agile, and more effective.

PLANETARY DEFENSE IS A MILITARY MISSION

DART was planned before the Space Force existed, but the future of planetary defense must more directly include the Department of Defense. This argument has been made before, but so far contributions have been limited to planning and surveillance. It is vital that the job of actually deflecting objects rest with the Space Force.

INHERENT DUAL-USE

Any technology for deflecting asteroids is inherently dual use - meaning that despite peaceful intentions, it can inherently be used as a weapon. That most obviously means that some systems may be deflectors when pointed outward, but first strike weapons if pointed inward. Even if the capability itself were incapable of inflicting harm, the ability to steer an object away from a collision course



Illustration of the DART spacecraft flying towards the asteroids Dimorphos and Didymos. Image credit: NASA/Johns Hopkins/APL

with Earth comes hand in hand with ability to steer it toward an impact, making the celestial object itself the weapon and the deflection technology simply the trigger. Planetary defense capabilities are inherently dual-use as weapons and must be handled with great care. The military is already trusted thanks to relevant control frameworks including oversight, laws of armed conflict, international arms control enforcement, and coalition decision making.

NATURAL DISASTERS AND MAN-MADE HAZARDS

Planetary defense has previously been described as defense against exclusively natural hazards, but that definition is rapidly becoming insufficient. As vividly depicted in some science fiction, impact threats may also be posed by deliberate redirection of natural objects, as described above, or even spacecraft themselves. As the number of objects placed in space rapidly grows and the number of nations and businesses operating in orbit rises, so too does the probability of malicious, negligent, or truly accidental impacts.

The ability to forcibly redirect a hijacked spacecraft or an off-course mining asteroid may soon become a more absolute and urgent requirement than defraying the odds of an asteroid or comet impact. Every capability that could serve one purpose could serve the other.

DART Paves The Way Cont.

While many agencies are entrusted with combating natural disasters, only the Department of Defense is empowered and regulated to apply just force against foreign property, when so directed. Additionally, if the threat is posed by a man-made system, additional countermeasures could be brought to bear, including jamming and cyber effects already available to the military services.

THE RIGHT CAPABILITIES AND COMPETENCIES

In light of that expanded target set, other unique military competencies and capabilities become available to complement an effective planetary defense. While NASA and its partners resolve the detection of natural threats, it is the Space Force's Space Surveillance Network (SSN), operated by the 18th Space Defense Squadron, that actively detects and tracks maneuvering objects.

Though, DART effectively closed with an inanimate object, Delta 9's orbital warfare officers train to close with objects that may evade intercept.

THE RIGHT CAPABILITIES AND REFRAME THE PROBLEM TO GET THE POLICY RIGHT COMPETENCIES

The United States must embrace a broader definition of planetary defense that includes man-made as well as natural disaster vectors. The logical result is to assign responsibility for the redirection portion of the planetary defense mission to the United States Space Force. The impact clock is ticking, but for the first time in human history, we could both predict when it will chime and influence the outcome... if we chose to.

Apathy and inaction are now the only possible culprits of cataclysm.

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GUARDIAN INDUSTRY NIGHTS CONNECTS GUARDIANS AND INDUSTRY

BY STAFF WRITER

Space Force Association (SFA) held Guardian Industry Nights (GINs), July 27-28 at Peterson Space Force Base. The event served as an open forum for Guardians and the space industry to engage, and have a conversation on current and future USSF needs.

GINs was unique in the fact that it focused solely on space, and the Space Force mission to be lean, agile, and move faster.

SFA's focus areas are to research what is needed to maintain freedom of action in the space domain, remain informed on all aspects of space, and advocate on behalf of the Guardians to industry, and vice versa.



Lt Gen Whiting offers opening remarks.



SFA's Brandon Tripp moderates a panel discussion.



GINs attendees actively listening to panel discussions.



Guardians engage with industry, discuss their initiatives and see where industry can help streamline the process.

HOW TO RENDEZVOUS WITH ANOTHER SATELLITE

BY JACK ANTHONY, OPINION CONTRIBUTOR

Jack Anthony is currently a self-employed Space Systems & Operations Engineer. The views expressed by contributors are their own and not the view of SFA.

The process of rendezvousing with another satellite involves a “Chaser” Spacecraft (possibly a refueler servicing vehicle) arriving at the “Target” Spacecraft (the one who ordered the refueling). I use the terms Chaser and Target for planning and executing rendezvous. Once near the Target, the Chaser loiterers around the other spacecraft. That’s called proximity operations, and then the Chaser docks. Some call this ZPO, (zero proximity ops). This process involves maneuvering the Chaser. (Hopefully the target is cooperative and not maneuvering without communicating with the Chaser.)

To fully understand the terms Rendezvous and Proximity Operations (RPO) and Zero Proximity Operations (ZPO), further detail is needed. Rendezvous can be as simple as a “fly-by”, a fleeting visit to the Target; the Chaser may be within range for a short period of time and then continue on its way. If the Chaser performs maneuvers to stay in the vicinity of the Target,

a good term is loiter. This is referred to as transitioning to proximity operations. Finally, if the Chaser needs to connect with the Target, dock or grab onto it, it closes in on the Target in order to grapple or dock. ZPO is a great term to summarize that end state.

The Chaser’s orbital elements provide information into how the rendezvous mission is progressing. If one is unaware of the target, following this trend will help resolve the issue. It’s the change and matching of the Chaser’s elements to the Target’s elements that provide insight into how the process is moving along. In the end, if the Chaser is to dock with the Target, then the orbital elements must match.

There are three phases to completing a RPO and then ZPO. While the Chaser’s maneuvers may not always follow the expected flow of these phases, they provide a framework to follow along. The table below summarizes these phases.

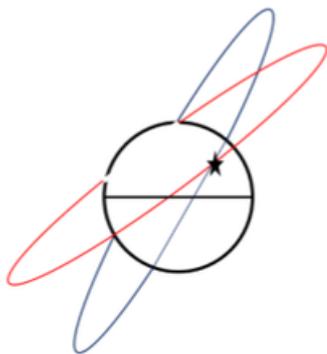
Phase	Orbit Elements to be Matched	Interesting things to know
Orbit Plane Match	Inclination & RAAN	Unless launching directly into the target's orbit plane, this phase can involve some large Delta-V maneuvers to "get into the plane." Plane matching is key to getting on course to complete an RPO and remain in a persistent position or pattern of positions with the target.
Orbit Shape & Alignment	Eccentricity & Argument of Perigee	This phase is very subtle, but matching the shape enables efficient maneuvering and aligning the orbit's line of apsides supports effective phasing maneuvering in the final phase.
Orbit Phasing & Position Match	Semi-Major Axis & True Anomaly	Matching semi-major axis enables station keeping and matching true anomaly or having it be darn close establishes the persistent presence to observe, dock or do whatever you are there to do.

How to Rendezvous with another Satellite cont.

Let's examine each phase to provide insight into what's going on:

Orbit Plane Matching: Plane matching usually occurs early in the planning and executing of a mission. The launch vehicle usually does this, launching the Chaser into the orbit plane of the Target. However, there can be errors in that insertion and orbit plane matching maneuvers may be needed. Below is a simple illustration that shows the red and blue orbits have different inclinations and RAANs. So, the task to match orbit planes would be to execute a Delta V where that star is and get the orbit planes matched to have the same inclination and RAAN. This critical step to ensure close proximity operations are not zig-zagging back and forth.

The Chaser can do a series of small orbit plane adjust maneuvers to incrementally align the orbit planes. The orbit plane is characterized by inclination and RAAN.

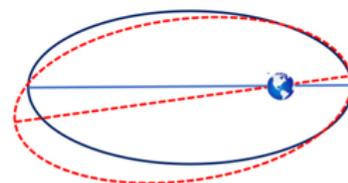


The amount of Delta-V to align inclination only gives us some basic rules of thumb; In GEO, 53 m/s of Delta-V is needed to change or correct 1 degrees of inclination, for LEO it's about 115 m/s. Remember, you must also get the RAAN lined up. This can be costly in propellant.

Example: You launched into a 97.4 degrees incline LEO orbit. Nailed the inclination, but the RAAN is not aligned, it's off by 1.5 degrees. How much Delta-V do you think is needed to fix this? Hummmm? Well, its 197.5 m/s. Wow! What if the inclination was 28 degrees? Is there a difference in what's needed to fix the 1.5-degree error in RAAN? Yes, it's only 97 m/s. Alt-hough, the orbit plane matching usually is the launch vehicles chore, if you need to tweak things to get the orbit planes aligned, it can cost you fuel.

Orbit Shaping & Alignment: Normally, mission planners like to have the long axis of the orbits matched, this is called the line of apsides.

It enables efficient maneuvering. This can be a very subtle stage. Typically the orbits are so near circular this phase may not occur. Orbit shaping is reflected in the eccentricity and argument of perigee matching. Hopefully, the launch vehicle did its job by getting things properly inserted into orbit. Of course, if the Target starts playing games and maneuvering, then this problem gets tougher. The illustration below shows the red dashed orbit and the blue orbit do not have their lines of apsides lined up. Some planners would want to execute a maneuver to get them aligned to support more efficient maneuvering.



Orbit Phasing: This is my favorite phase. This is where you get to close in on the Target and hang out with them or better yet, dock and refuel them. This phase is usually seen as where the Chaser orbit is being adjusted and we see changes in its orbit's apogee and perigee. They are fiddling with the semi-major axis and getting the approach going, perhaps slowing down the relative closer rate. As semi-major axis getting close to a match, chances are the true anomaly is also closing it. Match them up and you can reach out and shake hands or get set for the dock and refueling. Here's a cool rule of thumb. LEO Earth orbits, there is a 10:1 rule, my friend James Oberg at NASA/JSC came up with this. Here's what it means. If you are 1 Km below your Target orbit and you are plane matched and circularized, then you will advance 10Km forward each orbit period. Thus, the 10:1. Let's imagine you are 5 Km below and 150 Km behind and your orbit periods are really close and 90 minutes. When will you be right underneath the Target? Use the 10:1 rule. Each orbit you scoot ahead relative to the target 50 Km (5 Km times 10). So, we are 150 Km behind, and guess what? In 3 orbit or 4.5 hours we can look "up" and see the Target.

Well, there you have it. The 3 phases of RPO and some details as to what's going on. You may ask, how does Jack know this stuff? Well, two folks play a BIG role in helping me understand and get all enthusi-astic about RPO.

How to Rendezvous with another Satellite cont.

Dr. Chiold Epp helped me in the early 1980's. While at Johnson Space Center I'd meet with Dr. Epp and he'd share with me some of the interesting things the Shuttle was doing with regard to RPO. He helped me understand the math and art to all this.

Then Mr. A. Clark Keith III came along in 1989 as my Aerospace Corporation Advisor for a space test mission that eventually flew 1994-2000 do-ing "great things for America." I knew Clark well and one of his finest hours (or years)

was the XSS-11 RPO test mission that flew in space 2005-2007. Clark was the Flight Director and he wrote notes that comprised a "how to" handbook for RPO. Just before his battle with cancer took him from us in 2013, Clark completed his notes and gave them to his colleague Jim Baker to publish. I met with Clark just before he passed. He said "Jack's I'm writing everything down, make sure you read and live it." Clark's experience, insight, and ability to explain things was awesome. Clark Keith is the Father of Military RPO. He played a huge role in planning the ANGELS mission and many more space test missions. I miss Clark and thank him.



Clark and Jack at the USAF Academy FalconSAT Operations Center, 2011

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FALZARANO CHAPTER SPACE TAILGATE AND NASCAR NO. 42 CAR

BY STACEY SCARABELLO

In October Guardians and Airmen in Colorado Springs had a unique opportunity to get up close with the USSF No. 42 and USAF No. 43 NASCAR cars.

SFA's Chief Operating Officer, Col (Ret) Matt Anderson and General David "DT" Thompson, Space Force's Vice Chief of Space Operations were spotted in the No. 42 car at United's States Air Force Academy, prior to "Sink Navy Spirit Night".

On gameday, SFA Falzarano Chapter members hosted a space tailgate outside of Falcon Stadium, offering food, games, and great conversation around the support of the U.S. Space Force and its Guardians.



USAFA Class of 2027 Cadet Candidates from the Prep School admiring the Space Force No. 42 car.



Guardians, Airmen, and fans visit with SFA Falzarano Chapter members at Falcon Stadium.



SFA Chief Operating Officer, Col (Ret) Matt Anderson and General David "DT" Thompson, USSF Vice Chief of Space Operations driving in the No. 42 Space Force car.



SFA Chief Operating Officer, Col (Ret) Matt Anderson and Col Jeff "Cap" Greenwood (USSF), Commander, Delta 13, Detachment 1 at USAFA pose at the "Sink Navy Spirit Night".

U.S. SPACE FORCE SELECTS THE UNIVERSITY OF PUERTO RICO FOR PARTNERSHIP

BY SECRETARY OF THE AIR FORCE PUBLIC AFFAIRS

Adapted from U.S. Space Force News, Secretary of the Air Force Public Affairs, 2022

(<https://www.spaceforce.mil/News/Article/3153624/us-space-force-selects-the-university-of-puerto-rico-for-partnership/>). Reprinted with permission.

HOUSTON, Texas -- The U.S. Space Force and the University of Puerto Rico at Mayagüez signed an agreement Sept. 9, 2022, making them the 14th member of the service's University Partnership Program.

Chief of Space Operations Gen. John W. "Jay" Raymond joined UPRM Chancellor Dr. Rullán at the Johnson Center in Houston, Texas, to finalize the agreement and to learn more about the university's space initiatives and capabilities.



Chief of Space Operations Gen. John W. "Jay" Raymond and UPRM Chancellor Dr. Rullán at the Johnson Center in Houston, Texas

This partnership will leverage the space and technical prowess to enhance and encourage collaboration on science, technology, engineering and mathematic fields, build solutions for current and future research projects that further national security objectives in the space domain, and grow and develop a qualified, diverse, and inclusive workforce.

"The Space Force needs highly educated Guardians with STEM expertise to operate and develop advanced space systems," Raymond said.

"We need partners like the University of Puerto Rico because: space is hard! We need the best minds in the nation to help us solve problems, build solutions, and operate some of the most sophisticated platforms, systems, and networks anywhere on Earth.

"If we are going to keep our advantage in space and ensure space remains open for science and discovery, we need partners like the University of Puerto Rico at Mayagüez," he added.

Among other areas, the university's College of Engineering conducts research in satellite photography that tracks various earth phenomena, which directly supports the Space Force's mission.

UPRM has graduates have made a significant impact in various STEM career fields - including Orlando Figueora, the Director of Mars Exploration at NASA, as well as William Navas, Jr., a former Assistant Secretary of the Navy.

The University Partnership Program seeks to recruit, educate and develop subject matter experts that engage in world-class research and technology developments to secure the nation's interests and maintain an advantage in space.

The UPP's four goals are to establish opportunities for world-class research, advanced academic degrees, and workforce and leadership development for Guardians; identify and pursue areas of mutual interest with member universities, individually and collectively; establish scholarship, internship and mentorship opportunities for university students and ROTC cadets; and recruit and develop diverse officer, enlisted, and civilian Guardians with a particular focus on science, technology, engineering, and mathematics.

A FRAMEWORK FOR USSF SPACE LOGISTICS CONTRACTING

BY RYAN WESTERDAHL, OPINION CONTRIBUTOR

Ryan Westerdahl is the CEO & Cofounder of Turion Space. The views expressed by contributors are their own and not the view of SFA.

To ensure the USSF warfighter maintains superiority in the next warfighting domain, expanding the available capabilities towards a robust in-space logistics ecosystem will be essential. It can be argued that China is leading the pack with their SJ-21 mission last October, that successfully rendezvoused with one of their defunct GEO satellites and towed it to the graveyard orbit. Although the USSF capabilities might be lagging, they are in no way slowing down.

Last year the US Space Force established SPACEWERX, their innovation arm, to blend the best of commercial innovation taking place in the US market. Their first order of business was the Orbital Prime initiative which leverages innovative technologies being developed in the commercial ecosystem to speed up the advancement of the emerging in-space manufacturing and services (ISAM) market. As companies advance through Orbital Prime and the ISAM market opens for commercial and government sectors, a key problem remains: how will the US government contract these services while taking advantage of the US's key strength; private sector innovation, without making mistakes of the past where only a couple large incumbents are awarded the prime contracts,

and everyone else is phased out?

We at Turion have some ideas, but first, let's dive into one of the USSFs most essential tools; the Unified Data Library (UDL) and the SDA Marketplace.

Importance of UDL & SDA Marketplace

The Unified Data Library, or UDL, is the data layer for Joint All Domain Command and Control (JADC2), or simply a streamlined manner of connecting suppliers and consumers of data in the space domain. SDA Marketplace is the global marketplace where these transactions take place. This streamlined way of connecting data suppliers with data users is significant. The secure platform allows a standardized method for producers of various types of data to easily interface and sell their data in a way that feeds applications and end users at various classification levels and increases efficiency in how data is captured, stored, and disseminated to the US warfighter.

The marketplace includes many different data types, including earth observation (SAR, RF, and optical), state vectors, and ephemeris, to name a few. Most importantly, this system

levels the playing field by providing a straightforward method for nontraditional defense contractors to sell data to the US warfighter without the overhead complex process typical of the contracting process defense prime's typically use to sell to the government. By opening revenue streams to non-standard defense contractors, the USSF gets the best bang for its buck and incentivizes new and innovative data types while enabling dual-use-focused early-stage companies to access early revenue streams crucial for building their organizations. In other words, the SDA marketplace incentivizes America's #1 strength, the innovation ecosystem from the private sector and gives the best deal to the US warfighter.

Expanding the SDA Marketplace Capabilities to Space Logistics Services

The SDA marketplace lays out an exciting philosophy for taking advantage of the superior innovation ecosystem in the US. This framework for commercial companies to work with the US government ensures that when it comes to SDA data, end users have access to the full arsenal of innovative new data

A Framework for USSF Space Logistics Contracting Cont.

capabilities in a way that doesn't phase out new companies struggling to gain traction with selling to the US defense sector. So, the question we raise is, why stop with SDA data?

With next-generation space logistics missions like orbit relocation, debris removal, and life extension trending towards taskable services, we at Turion clearly see the benefit the USSF can gain from leveraging the framework laid out by the SDA marketplace to logistics services. The US warfighter could then both maximize their budgetary reach and capabilities. The alternative isn't great. Suppose only a select few organizations are responsible for all on-demand logistics services for the USSF. In that case, the US's key advantage, its innovation ecosystem, will be set aside, and eventually, these capabilities will stagnate and be surpassed by our adversaries. To be sure, there will be challenges and unique capabilities only applicable to some organizations and ensuring

the appropriate level of technical rigor for proposed services has occurred come online will have its own set of challenges. But these engineering and contractual challenges can be solved.

By expanding the SDA marketplace framework to next-generation space logistics services, the US warfighter will again ensure they are getting the best service for the best price while maintaining a flourishing US space innovation ecosystem.



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THE GLOBAL SPACE UNIVERSITY AWARDS FIRST 100 SPACE CERTIFICATIONS

BY RHONDA SHEYA

The Global Space University (GSU) is part of a new effort by the Space Force Association (SFA) to help the U.S. and its allies achieve superior national spacepower by shaping a Space Force that provides credible deterrence in competition, dominant capability in combat, and professional services for all partners.

Through academic and knowledge validation, GSU has awarded their first 100 Space Professional I and Space Professional II Level Certifications to students from all backgrounds and industries related to space research, exploration, military, and professional services.

Through the creation of the Global Space University, the Space Force Association provides online space training and certification programs under the National Spacepower Center (NSC) and its Space Education Training Center (SETC).

“By developing innovative space training, we raise the global standards of excellence for all space professionals,”

SFA president and founder Bill Woolf (Col, USAF, ret.) said.

He continued by stating, “GSU provides synergy, collaboration, and extraordinary opportunities for space professionals looking to advance their careers. This powerful partnership brings cost-effective, cutting-edge training to space personnel and enthusiasts worldwide.

The commercial and military space sectors have become more intertwined and vital to success in this critical warfighting domain.”

One of the first GSU Space Professional I graduates commented, “The course rounded out my understanding of the key issues with operating in space and building and operating spacecraft. The information complemented my previous knowledge of space. I feel confident I can speak knowledgeably on space and use the knowledge to expand business development opportunities.”

The mission of Global Space University is to raise and normalize standards for space professionals and validate knowledge, skills, and experience as a practitioner in the space domain. The Certification Programs verify credentials and establish credibility in a rapidly growing, exciting, and diverse field. GSU certifications provide clients and partners with the confidence that certified space professionals meet stringent professional standards and demonstrate commitment to continuous education, training, experiential learning, and interaction.

Certification for Space Professional I is an entry-level certification for those with up to 5 years of space domain experience. These professionals demonstrate their knowledge and understanding of the Space Environment: Orbital Mechanics, Spacecraft Maneuvering, Payloads, and Subsystems.

Space Professional II certification is the next-level certification of space domain experience. These professionals demonstrate their knowledge, understanding, and application as a Space Professional I and the Space Mission Design Process; Satellite Communication; Remote Sensing and Position; Navigation; and Timing systems.

Certification courses are available to individuals or through participating employers. To learn more about Global Space University courses, criteria, and other offerings, visit <https://globalspaceuniversity.org/>.



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