

US COMMERCIAL AUGMENTATION SPACE RESERVE

Integrating Commercial Capabilities for a Resilient and Flexible Space Architecture

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The recently announced Commercial Augmentation Space Reserve program, based on the long-standing Civil Reserve Air Fleet, provides a mechanism by which the United States can leverage the commercial space industry in support of military space security concerns. As Congress considers funding the program, key lessons from the structure and implementation of the Civil Reserve Air Fleet will bolster commercial interest in the program and ensure its success in future conflicts.

The character of space warfare is changing.¹ In 2022, the Russian war in Ukraine revealed just how influential the space domain is in war. Incredibly, commercial actors, not states, appeared to provide the most impactful space services to Ukraine at the start of the war. SpaceX's Starlink enabled Ukrainian leadership to not only communicate with its fielded military forces but also continue its strategic messaging to the outside world to garner support.² Earth imagery companies Planet and Maxar delivered near real-time intelligence detailing the order of battle and battle damage assessments.³

In a future conflict, the United States can leverage its commercial industry to quickly and effectively bolster or surge the national security space architecture. To accomplish this, the United States should model civilian-military cooperation in the

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1. Thank you to Gregory Johnson and Giles "David" Arceneaux of the Institute for Future Conflict, and Lieutenant Colonel Matthew Smith of the US Air Force Academy, Department of Political Science, for feedback on this project.

2. Kurt Vinion, "How Elon Musk's Starlink Became Invaluable to Ukraine's War Effort," Radio Free Europe, Radio Liberty, October 20, 2022, <https://www.rferl.org/>.

3. "Satellite Images Show More Russian Military Deployments in Eastern Ukraine," Axios, April 13, 2022, <https://www.axios.com/>; and Mariel Borowitz, "The War in Ukraine Shows How Important Private Satellite Companies Have Become—Especially in Times of Conflict," SatNews, August 16, 2022, <https://news.satnews.com/>.

space domain after the air domain's Civil Reserve Air Fleet (CRAF) framework. Leveraging the commercial industry enables the United States to become flexible and adaptable to evolving technologies, operational requirements, and commercial offerings.⁴ This effort aligns with the 2020 *Defense Space Strategy*, which states, "DoD will develop an agile space enterprise that can take advantage of emerging technological and commercial innovation in order to continually outpace adversaries' threats."⁵

Space is more than a warfighting domain. It is a strategic location, offering the United States exploration, prestige, and wealth. As US commercial companies seek the resources of the space domain, it is the duty of the US military to protect them.⁶ The CRAF model, which has proven successful in the air domain, would be well suited for the space domain. Specifically, certain aspects of the CRAF model are applicable to the space domain and will provide resilience and increased capacity for the United States' national security space architecture.

History has taught us that eventually, war is probable. In 2015, Harvard professor Graham Allison stated that the odds of the United States and China going to war were "much more likely than recognized at the moment."⁷ This sentiment has caused the United States to shift its focus from the Middle East and once again prioritize great power competition. Future conflict between the United States and China will include the space domain. To prepare for and deter conflict through and in the space domain, the United States needs a resilient and flexible space architecture.

Terms of Reference

For the purposes of this article, a reserve fleet consists of aircraft or spacecraft that are fully or partially functional and equipped for service but not currently needed for military operations. These assets may already be in the field or in a standby mode until called upon. Once activated, the reserve fleets complement existing organic military capabilities. Commercial assets are operated by commercial operators who agree to take tasking orders from US Transportation Command or US Space Command.

Increased capacity, sometimes referred to as flexibility, provides a surge capability of supplementary assets in times of humanitarian disaster, crisis, or conflict. These may include ground-based sites, launch vehicles, air-based assets, or space-based assets. Resilience is defined as "the ability to prepare for and adapt to changing conditions and withstand and rapidly recover from disruption." It also "includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring

4. "RFI/Sources Sought Commercial Augmentation Space Reserve (CASR) Framework," SAM.gov, accessed August 14, 2023, <https://sam.gov/>.

5. *Defense Space Strategy Summary* (Washington, DC: Department of Defense [DoD], June 2020), 7, <https://media.defense.gov/>.

6. Namrata Goswami and Peter A. Garretson, *Scramble for the Skies: The Great Power Competition to Control the Resources of Outer Space* (Lanham, MD: Lexington Books, 2020), 47.

7. Graham Allison, "The Thucydides Trap: Are the US and China Headed for War?," *Atlantic*, September 24, 2015, <https://www.theatlantic.com/>.

threats or incidences.”⁸ Space architecture resilience or mission assurance can be achieved by resisting attacks with defensive operations, surviving attacks with on-board protection, and the reconstituting of assets after an attack.⁹ As an example, Planet, a remote sensing company, achieves resiliency through its disaggregated systems in case of a failure.¹⁰ In wartime, having resilience makes adversaries’ decision-making processes more challenging.

The Military Space Domain

The space domain has been militarized since the Soviet Union launched Sputnik in 1957, and although it was nothing more than a transponder, Sputnik struck fear into the hearts of the American people as it demonstrated the ability to deliver Soviet capabilities to anywhere in the world.¹¹ By 1967, more than 100 countries signed the Outer Space Treaty to prevent the placement of nuclear weapons and other weapons of mass destruction into outer space.¹² Space had become a domain that could no longer be ignored, and countries started to discover how to use the ultimate high ground to create a security advantage.

In 1991, the US military leveraged GPS, intelligence, surveillance, and reconnaissance (ISR), and satellite communications (SATCOM) to outmaneuver Iraqi forces in what has been referred to as the first space war.¹³ While space warfare arguably had been conducted as early as the Cold War, Operation Desert Storm demonstrated how the use of space capabilities acted as a force multiplier and thereby cemented the United States’ reliance on space for military operations. US and Allied forces now turn to space to support Joint warfighting functions. Space capabilities support the Joint warfighter in the air, land, and sea domains, as well as protect and defend space from both kinetic and nonkinetic hostile actions. If space assets are attacked and degraded, ground forces will lose the force multiplier effects nominally provided.

Over the last 25 years, despite America’s desire to keep space a benign domain, civilian and military leaders have increasingly recognized space as a warfighting

8. *United States Government Compendium of Interagency and Associated Terms (A Non-official Guide to Department Dictionaries and Other Terminology Sources)* (Washington, DC: Joint Doctrine Interorganizational Clearinghouse, November 2019), 834, <https://www.jcs.mil/>.

9. *Space Domain Mission Assurance: A Resilience Taxonomy* (Washington, DC: Office of the Assistant Secretary of Defense for Homeland Defense and Global Security, September 2015), <https://man.fas.org/>.

10. Brad Townsend, *Security and Stability in the New Space Age: The Orbital Security Dilemma* (New York: Routledge, 2020), 158.

11. Paul Dickens, *Sputnik: The Shock of the Century* (Chicago: Bloomsbury Publishing, 2019).

12. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty), December 19, 1966, UN Res 2222 (XXI), <https://www.unoosa.org/>.

13. Larry Greenemeier, “GPS and the World’s First ‘Space War,’” *SciAm [Scientific American]*, February 8, 2016, <https://www.scientificamerican.com/>; and B. Chance Saltzman, “Remembering the First ‘Space War’: A Discussion with Lt. Gen. B. Chance Saltzman,” interview by Frank A. Rose, Brookings, March 19, 2021, YouTube video, 1:00:28, <https://www.brookings.edu/>.

domain. In 1997, Air Force Chief of Staff General Ronald Fogleman first described the need for an air and space service.¹⁴ In its 2001 report, the Rumsfeld Space Commission pushed even further and advocated for a separate Space Corps and eventually a Space Department.¹⁵ The Trump administration and Congress turned the latest page by creating the US Space Force in 2019.¹⁶ The Obama, Trump, and Biden administrations have emphasized space exploration and policy development that enable the burgeoning US commercial space sector to compete internationally.¹⁷ Space Force doctrine also emphasizes the need for unity of action and commercial space integration.¹⁸ Yet despite advances in policy and organizational structure, the space architecture itself is long overdue for modernization.

The current US military space architecture is made up of outdated, large, relatively immobile, and bespoke systems. The dated nature of these systems creates a risk for a wide range of military activities, including space command and control, intelligence collection and dissemination, and nuclear command, control, and communications (NC3). The commercial space sector is proving to be more adaptable to emerging technologies and has surpassed the US government in its number of capabilities in what used to be a civil- and military-dominated domain. The growing commercial space industry saw \$427.6 billion in revenue in 2022, up from \$396.2 billion the year before.¹⁹

In July 2023, the US Space Force identified the shortcomings in its own organic capabilities, and after consulting with industry, introduced a new concept known as the Commercial Augmentation Space Reserve (CASR) program.²⁰ This program is modeled after the Civil Reserve Air Fleet program, a cooperative and voluntary partnership between US airlines and the Department of Defense to augment military

14. *Hearing on the Fiscal Year 1998 Department of Defense Authorization Request, House National Security Committee*, 105th Cong. (1997) (statement from General Ronald R. Fogleman, chief of staff of the Air Force), March 5, 1997, accessed August 14, 2023, <https://irp.fas.org/>.

15. Commission to Assess United States National Security Space Management and Organization, *Report to the Commission to Assess United States National Security Space Management and Organization* (Washington, DC: Office of the Secretary of Defense, January 11, 2001), 81, <https://aerospace.csis.org/>.

16. Christina Wilkie, "Trump Floats the Idea of Creating a 'Space Force' to Fight Wars in Space," CNBC, March 13, 2018, <https://www.cnbc.com/>; and Elizabeth Howell, "Trump Launches US Space Command to Control the Warfighting Domain," Space.com, August 30, 2019, <https://www.space.com/>.

17. Barack Obama, *National Space Policy of the United States of America* (Washington, DC: White House, June 28, 2010), <https://obamawhitehouse.archives.gov/>; Donald J. Trump, *National Space Policy of the United States of America* (Washington, DC: White House, December 9, 2020), <https://trumpwhitehouse.archives.gov/>; and Joseph R. Biden, Jr., *National Security Strategy* (Washington, DC: White House, October 2022), <https://www.whitehouse.gov/>.

18. John W. Raymond, *Spacepower: Doctrine for Space Forces*, Space Capstone Publication (Washington, DC: USSF, June 2020), 14, <https://www.spaceforce.mil/>.

19. Loren Grush, Tyler Kendall, and Bloomberg, "The Commercial Space Industry, Led by Elon Musk's SpaceX, Is Expected to Blast Off with 41% Growth over the Next 5 Years," *Fortune*, July 24, 2023, <https://fortune.com/>.

20. "RFI/Sources."

aircraft capability during a national defense-related crisis. In return carriers are given preference in handling commercial peacetime military cargo and passenger traffic.²¹

The commercial space age has arrived, and according to Heidi Shyu, under secretary of defense for research and engineering, the United States must leverage the innovative commercial space industry.²² Commercial companies' programs are less likely to become technologically obsolete compared with government programs. Proliferated low-Earth orbit (LEO) constellations exemplify how commercial companies are creating a network of on-orbit processing and battlefield management flexibility. Market competition, supported through sound regulation, will likely cause more frequent innovative reinvestment in the commercial sector than the government sector. Unlike the Department of Defense, private industry constantly invests to keep its value in the market and maintain its competitiveness.²³

History of the Civil Reserve Air Fleet

For over 70 years, the Air Force has maintained a successful partnership with the commercial air industry for the air domain. Since the establishment of the CRAF in 1951, the Air Force has benefitted from additional capacity through the US airline industry.²⁴ This program has allowed the Air Force to surge its air fleet capacity in times of crisis. While not delivering combat forces directly into hot zones, the additional CRAF aircraft fly sorties in relative safety, disencumbering military aircraft and enabling them to fly into combat situations. The CRAF model is only implemented in extreme situations where the government cannot pull together sufficient resources to save lives. It is intended to be only short term. The US military is still required to be combat ready for wartime events such as Operation Enduring Freedom or Operation Desert Shield.

CRAF operates in three stages, with activation limited to stages I and II thus far. Stage I covers minor regional crises, humanitarian assistance, or disaster relief operations, while stage II covers major theater wars. Stage III, which has not been activated to date, covers national mobilization.²⁵ By activating these stages, the US

21. "Civil Reserve Airfleet," US Department of Transportation, accessed September 18, 2023, <https://www.transportation.gov/>; and David Graham, *Sustaining the Civil Reserve Air Fleet (CRAF) Program* (Washington, DC: Institute for Defense Analyses, May 2003), 6, <https://apps.dtic.mil/>.

22. Matthew Weinzierl and Mehak Sarang, "The Commercial Space Age Is Here," *Harvard Business Review*, February 12, 2021, <https://hbr.org/>; and Jaspreet Gill, "DoD Launches New 'Effort' to Rapidly Adopt Commercial Space Capabilities," *Breaking Defense*, April 18, 2023, <https://breakingdefense.com/>.

23. Clayton M. Christensen, *The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business*, 1st ed. (Cambridge, MA: Harvard Business School Press, 1997).

24. "Civil Reserve Airfleet."

25. "Civil Reserve Air Fleet," USAF (website), accessed February 22, 2023, <https://www.af.mil/>; and David C. Arnold and Peter L. Hays, "SpaceCRAF: A Civil Reserve Air Fleet for Space-Based Capabilities," *Joint Forces Quarterly* 64 (2012).

Transportation Command commander gains the flexibility to surge and respond quickly to emergencies.²⁶

The first call up of CRAF, utilizing stages I and II during the Persian Gulf War, not only showcased the effectiveness and importance of the program but also brought to light certain shortcomings.²⁷ Commercial airlines were responsible for transporting 67 percent of troops and 25 percent of air cargo to the Gulf during the conflict. In the aftermath, the airlines successfully redeployed 85 percent of troops and 42 percent of air cargo.²⁸

CRAF was activated for a second time during Operation Iraqi Freedom, and an informal survey of CRAF participants indicated positive outcomes from the program's implementation.²⁹ The second activation was also limited to stages I and II. Stage I was activated for the third time on August 22, 2021, for the evacuation of Afghan refugees as it was considered a humanitarian crisis.³⁰

These three implementations prove the effectiveness of a reserve fleet model and represent how this could be advantageous if executed in the space domain. The space domain is the largest of all the domains and yet the Space Force is the smallest of the US armed services. The number of resilient forces required to not only protect and defend orbital assets but also provide effects to Joint warfighters is beyond the capacity of the US government.

A Framework for Space

Advancements in space technology and increased military dependence on commercial space capabilities have created operational vulnerabilities that policy has yet to address. These vulnerabilities exist in the launch, space, and ground segments. The process by which the US government calls upon the space commercial sector to support its national security interests is as ad hoc and inefficient as those used at the beginning of the Global War on Terror. Yet, unrealized opportunities to quickly increase space resiliency and capacity exist amid these vulnerabilities. By utilizing commercial assets, a reserve fleet can offer needed resiliency and capacity to military forces.

As proven in the Berlin Airlift, there are many logistical challenges that must be addressed to produce the desired results of integrating commercial and organic

26. John A. Tirpak, "CRAF for the Future," *Air and Space Forces Magazine*, December 22, 2014, <https://www.airandspaceforces.com/>.

27. "Department of Defense Activates Civil Reserve Air Fleet," press release, DoD, August 22, 2021, <https://www.defense.gov>; and Heidi M. Peters, "Afghanistan Evacuation: The Civil Reserve Air Fleet (CRAF) and the Defense Production Act (DPA)," Insight 11731 (Washington, DC: Congressional Research Service, August 25, 2021), <https://crsreports.congress.gov/>.

28. Graham, *Sustaining*, 6.

29. Graham.

30. Peters, "Afghanistan Evacuation," 2; "DoD Activates"; and Dave Mistich "The Pentagon Is Calling on 6 U.S. Airlines to Help with the Afghan Evacuation Effort," National Public Radio, August 22, 2021, <https://www.npr.org/>.

military capabilities.³¹ The key sectors in the commercial space industry are launch services, the space-based sector, and the ground-based sector, and each can be used to augment military capability to increase capacity and resiliency. Similar to the airlift sector, the launch—spacelift—sector moves people and cargo. The space-based sector includes satellite communications, space domain awareness, and orbital servicing vehicles. The ground-based sector includes command and control sites and ground-based telescopes. For this article, the ground sector includes the electromagnetic links needed to operate satellites. Each of these sectors, although separate and unique, can contribute to a CASR program.

CASR: Improving Resiliency

A commercial space reserve would enhance the US national space security architecture by offering improved resilience and increased capacity. This would be accomplished by using disaggregated constellations, which are most common in innovative commercial applications. This approach goes further than purchasing additional commercial services, which aligns with the chief of space operation's interest in distributed, lower cost, commercial-type satellites to disaggregate critical systems.³² Commercial space reserve fleets can offer a swift backup capability to the legacy systems often operated by the US military and Intelligence Community.

Launch Sector

CASR will create a resilient launch architecture capable of delivering military and civilian satellites to orbit during times of crisis. Currently, the United States relies heavily on launch service vehicles, such as SpaceX's Falcon 9 and the United Launch Alliance's (ULA) Atlas V and Delta IV rockets. Yet if one of these launch vehicles were to experience a failure or capacity constraint, such as that which occurred while trying to resupply the International Space Station in 2022, the Space Force's ability to launch critical payloads into space could be severely impacted.³³ In a time of war, the United States' space resiliency will suffer due to its incapability to reconstitute space assets.

To overcome this challenge, CASR allows the United States to quickly tap into a larger pool of alternative launch services by including additional commercial space transportation providers. Pre-arranged contracts with launch providers will reduce logistical issues and time frames, thereby increasing the resiliency of both the spacelift and space-based sectors. The space-based sector requires launch services to be resilient, as the launch sector is responsible for reconstituting the space-based sector. A US

31. Graham, *Sustaining*, 26; Theodore Joseph Crackel, *A History of the Civil Reserve Air Fleet* (Washington, DC: Air Force History & Museum Program, 1998); and Peters, "Afghanistan Evacuation."

32. Sandra Erwin, "Space Force Nominee Sees Growing Threats to U.S. Satellites from Rival Powers," *SpaceNews*, September 13, 2022, <https://spacenews.com/>.

33. Stephen Clark, "Supply Chain Issues Delay Northrop Grumman's Next Space Station Cargo Flight," *Spaceflight Now*, July 19, 2022. <https://spaceflightnow.com/>.

Space Force payload could supersede any pending commercial payload and launch more quickly once CASR is initiated.

Space Sector

Orbital service vehicles are a growing commercial industry. Under CASR these vehicles would remove debris, refuel, and repair critical military satellites that are not fully mission capable. Companies like Astro Scale, Northrup Grumman, and Starfish Space are already hard at work developing and launching the first orbital service vehicle prototypes. These evolving technologies will eventually lead to capabilities the United States will rely upon for removing debris from orbit or providing satellite life extensions, thereby enhancing resiliency.³⁴ In a situation that requires dangerous debris to be removed, CASR could be activated more quickly than a traditional service contract and preempt other paying customers in support of national security. This is like CRAF, where aircraft are called up in short order, interrupting regularly scheduled services and redirecting assets to support a military operation.

CASR: Improving Capacity

Moving beyond resiliency, increased capacity is the second way national security architecture is enhanced by a space reserve. A commercial space reserve fleet provides surge capacity to support US space objectives. For example, a commercial reserve fleet could provide flexibility if the United States wanted to quickly expand its space presence or respond to emerging threats in space. This is different than adding a regular commercial contract service. The CASR program will shorten the timeline needed to mobilize assets, strengthen plans and wargames with expected available forces, and solidify the authorities required to act in a crisis or conflict.

The secretary of defense grants the US Transportation Command commander the authority to activate CRAF in times of crisis. Similarly, the US Space Command commander can be granted the authority to activate CASR. This gives the US military the capability to quickly mobilize its commercial reserve fleets to conduct military-related missions without having to rely solely on legacy government vehicles or begin the lengthy process of creating a new contract with a commercial partner and determining how to integrate the commercial assets.

Furthermore, technology in the space industry evolves rapidly, and spacecraft or satellite designs become outdated relatively quickly. Many of the operational military satellites are decades-old. The legacy MILSTAR (Military Strategic and Tactical Relay) program is the nuclear hardened, NC3 satellite constellation and was launched in the

34. SpaceLogistics, "Mission Extension Pod," Northrop Grumman (website), accessed February 27, 2023, <https://www.northropgrumman.com/>; "ADRAS-J," Astrocale (website), accessed February 27, 2023, <https://astrocale.com/>; and "Otter is There, On Call and Ready to Support," Starfish Space (website), accessed February 27, 2023, <https://www.starfishspace.com/>.

1990s.³⁵ It is made up of only five large satellites with fixed positions in geosynchronous orbit. A commercial reserve fleet adds flexibility in times of crisis as it is regularly updated or upgraded without the need for additional government acquisitions.

The United States has been leveraging commercial satellite communications for decades, but CASR would provide the means through which this could be done more successfully. During the height of the Global War on Terror, the United States determined it required more bandwidth than was organically available to effectively fight terrorism. The commercial industry provided the military with the surge capacity needed, but the ad hoc approach created inefficiencies that were avoidable. According to a 2011 Government Accounting Office report, the Department of Defense spent over \$1 billion on increased capacity by leasing commercial satellite communications bandwidth.³⁶ The report showed the Department was fragmented and inefficient in its approach to sourcing satellite communications.

In a 2014 report, the Department of Defense found the average cost of commercial satellite communication services not bought through the Defense Information Systems Agency (DISA) was about 16 percent higher than those purchased through DISA.³⁷ Similar to how all DoD air travel must take place on CRAF-participating airlines, all future commercial satellite communication for the Defense Department would be purchased from participating CASR companies. CASR provides a solution to these inefficiencies as all commercial satellite communications will be coordinated, purchased, and managed by a single government entity.

Today, satellite communication providers such as ViaSat, Amazon's Kuiper System, and SpaceX's Starlink and Starshield are principal communication providers with more bandwidth than the Department of Defense. As the United States faces attrition of its organic satellite communications capabilities during a conflict, the providers that agree to participate in the reserve fleet model will furnish reserve capacity. Additionally, commercial companies would be allowed to use the additional capacity until the reserve fleet is activated. As a bonus to US national security, the communication providers could be called upon to deny service to adversaries of the United States.

Moreover, this surge capability enhanced with modern commercial technology sends an important strategic message. By activating and calling up the space reserve in a time of conflict, the United States communicates to the entire world that it is mobilizing its forces and bringing a larger force to bear. This capability of strategic messaging provides a range of benefits, including increased clarity, improved understanding, enhanced persuasiveness, increased engagement, and improved outcomes. By effectively communicating a message in a way that resonates with the target audience, strategic messaging can help to achieve US goals and objectives. In short, without firing a

35. "Enhanced Polar System," Northrop Grumman (website), accessed August 14, 2023, <https://www.northropgrumman.com/>

36. "Defense Satellite Communications: DOD Needs Additional Information to Improve Procurements," GAO [US Government Accountability Office], July 17, 2015, <https://www.gao.gov/>.

37. "Defense Satellite Communications."

shot, the United States may be able to achieve its objective or prevent an adversary from achieving theirs.

Challenges to CRAF and Implications for CASR

While the CASR program is modeled after the successful CRAF program, it must incorporate the lessons learned from CRAF operations in the air domain to yield positive results for US space architecture. Aspects of the CRAF framework may be challenging to transfer to the space domain, including the physics of the domain itself, differences in industry sectors between the air and space domains, and programmatic challenges.

Domain Physics

In the air domain, commercial aircraft do not need to operate in contested areas, and crews avoid the risk of being shot down. In contrast, satellites must overfly contested environments due to orbital mechanics, which puts them at risk if they are supporting military operations.

Industry Sectors

The next challenge in transferring this framework to CASR is the additional industry sectors that are notably different from the CRAF program. As mentioned, the space domain has three distinct industry sectors instead of the one transportation sector of the air domain: launch, space, and ground. The concept of operations, rules of engagement, and other details on how resources will be allocated—including bandwidth, radio frequency bands, and geographical region—will depend on the sector and technology type, and will require further study.

Programmatic Challenges

While the CRAF program has been a success in providing US Transportation Command with additional capacity in times of need, three program management challenges have emerged that have possible implications for CASR. These challenges include the initial failure to implement the program incentives effectively, an overreliance on the commercial airlines for forward deployment, and the investment by commercial industry in the wrong type of aircraft.

Incentives. The first challenge to CRAF came as many military members were not using the prenegotiated airlines.³⁸ The CRAF program was designed to entice commercial airlines by offering preference in providing cargo and passenger services for the Department of Defense.³⁹ DoD employees use the City Pairs Program, a perk enjoyed by CRAF airline participants, which confers preferred status to the airlines for

38. Graham, *Sustaining*, 30, A-33–A-34.

39. Peters, “Afghanistan Evacuation,” 1.

government travel, resulting in monetary gains.⁴⁰ Without the commitment from the Defense Department to mandate its employees to use the City Pairs Program airlines, however, passenger travel volume eroded. This issue is compounded in peacetime when military personnel are not traveling overseas, thereby further reducing the ticket purchases from the airlines. Learning from the early mistakes of the CRAF program, the CASR program must offer and follow through with compelling incentives to entice the commercial industry to join CASR.

Overreliance on Commercial Airlift. While commercial airlines bring a great amount of additional capacity, operating in a military environment produces complications. For one, as a 2003 Institute of Defense Analysis report notes, civilian aircrews must volunteer for missions and may choose not to fly into hostile areas.⁴¹ The same report also found these crews often lack the training for military missions. Moreover, commercial airlines' radio systems were not designed to communicate with military equipment, which caused communication difficulties and lack of proper supervision of operations.⁴² The most recent activation of CRAF to support the Afghanistan evacuation in 2021 faced similar challenges as the all-volunteer aircrews struggled with the decision of whether to participate or not.⁴³

Additionally, the Air Force's overreliance on commercial partnerships led to a decrease in its own organic fleets' ability to respond to major military engagements. The commercial reserve fleets offered a false sense of capacity. During Desert Shield in 1990, Military Airlift Command relied heavily on the commercial fleet for several thousand airlift sorties and could not have achieved the movement of personnel and cargo without the activation of CRAF.⁴⁴

Like the CRAF program, CASR shares the risk of overreliance on the commercial industry and thereby of becoming dependent on factors beyond its control. For example, if SpaceX Chief Executive Officer Elon Musk suddenly decided not to support a particular conflict, he could remove SpaceX's spacelift service from the US Space Force. This would result in the service losing one of its two launch partners and crippling its ability to deliver assets to space.

To avoid the noted interoperability challenges of the CRAF program, the Space Force and US Space Command will need to conduct wargame exercises for CASR participants to enrich the commercial partners' understanding of military strategic thinking and the nature of future conflicts. These wargames can also be used to discover capability gaps, identify communication barriers, and decipher appropriate levels of command-and-control authorities. For example, an outcome from the

40. *Military Readiness: Civil Reserve Air Fleet Can Respond as Planned, But Incentives May Need Re-vamping*, GAO 03-278 (Washington, DC: GAO, December 30, 2002), <https://www.gao.gov/>.

41. Graham, *Sustaining*, 28.

42. Graham, 26; Crackel, *History*; and Peters, "Afghanistan Evacuation," A-32.

43. Joseph Hostetler, "CRAF Program Officially Activated: Big 3 Airlines and More Tapped to Aid in the Kabul Crisis," *The Points Guy*, August 22, 2021, <https://thepointsguy.com/>.

44. Crackel, *History*, 219.

2015 Schriever Wargame highlighted the value of commercial companies and their ability to bolster US resiliency.⁴⁵

Shortage of commercial aircraft. The third challenge for the CRAF program is insufficient passenger and cargo aircraft availability. The airline industry has often been encouraged to buy wide-body aircraft capable of carrying large cargo, but for the most part the airlines ignored these requests.⁴⁶ Commercial equities, not CRAF requirements, drive what sort of aircraft are needed. The historical trends illustrate the difference between the Air Force's desired number of aircraft for passenger and cargo delivery and the actual number of available aircraft from the commercial partners. The target requirement and actual number of aircraft rarely met, and at times the number of available aircraft fell short of the goals of the CRAF program.

Fortunately, the nascent CASR program has a major advantage over the CRAF program in that it can offer many more incentives to its commercial partners. This does not preclude CASR from the risk of a shortage in the appropriate number or types of space systems required for US space architecture. This risk may be mitigated only if US policymakers, Space Systems Command leadership, and the commercial space industry work together to offer the right kind of incentives to secure the right type of commercial assets required for national security. Combined, these additional benefits offer compelling financial and regulatory incentives for companies to participate in CASR and contribute to the overall success of the program.

CASR Industry Incentives

Priority for Future Contracts

First, the opportunity to gain priority for future DoD contracts is a significant incentive for companies to voluntarily join CASR, with priority source selection criteria being a key consideration. Source selections for DoD contracts are highly competitive and involve substantial capital, often leading to protests or lawsuits to contest the results, as exemplified by the recent legal action taken by SpaceX to claim a nearly billion-dollar contract.⁴⁷ With the potential to earn contracts worth billions of dollars, the allure of joining CASR may prove to be irresistible to companies.

Fast Pass to the Industry

Second, there are other potential areas that merit exploration, including the possibility of waivers to streamline licensing processes with the Federal Communications

45. Joan Johnson-Freese, *Spacewarfare in the 21st Century* (New York: Routledge, 2017), 98–99.

46. Graham, *Sustaining*, 229.

47. Alan Boyle, "SpaceX Files Lawsuit against the Federal Government—But Asks to Keep the Details under Wraps," *GeekWire*, May 17, 2019, <https://www.geekwire.com/>.

Commission and Federal Aviation Administration, as well as priority range scheduling and infrastructure support.

Early access to spectrum auctions through the National Telecommunications and Information Administration could serve as a significant motivator for participation. The organization plays a pivotal role in managing spectrum usage, including identifying additional spectra for commercial utilization. As space companies heavily rely on the radio frequency spectrum for bandwidth, which directly impacts revenue generation, having access to additional spectra becomes crucial to meet growing resource demands, avoid interference, and ensure reliable service. By joining CASR, smaller or newer companies could establish a stable revenue stream, provided they meet the requirements of the program.

Security Support

Third, there are supplementary advantages to be considered that may further entice prospective CASR members. Given China's lack of distinction between commercial and state actors, companies providing support to the United States through CASR would necessitate robust protection measures, including standard National Security Agency encryption support and intelligence information. CASR participants could be given security clearance and access to US Space Command's Commercial Integration Office, which offers classified intelligence and facilities.⁴⁸ As a result, commercial companies would have the information needed to help safeguard their assets from nefarious actors.

Participation in Safety Standards

Fourth, like ships traversing international waters, CASR participants could incorporate transponders on future CASR spacecraft. The space environment is becoming more congested each year. Objects in low-Earth orbit are traveling at 17,000 miles per hour and pose a significant navigational hazard to every other object in a similar orbit. The Space Force relies on its own external sensor for space situational awareness rather than transponders from the spacecraft.⁴⁹ The private sector has already shown interest in working together to develop norms for safe, predictable, and responsible space actions.⁵⁰ These transponders could function as a beacon and report satellite locations, thereby increasing situational awareness, safety, and attribution.

Additionally, CASR members could consider using modular bus designs for future spacecraft. Leveraging modular spacecraft designs could establish industry standards

48. Theresa Hitchens, "SPACECOM Plans New, Unified 'Commercial Integration Office' to Work with Private Firms," *Breaking Defense*, March 3, 2023, <https://breakingdefense.com/>.

49. *Space Situational Awareness: DOD Should Evaluate How It Can Use Commercial Data*, GAO-23-105565 (Washington, DC: GAO, April 24, 2023), <https://www.gao.gov/>.

50. Johnson-Freese, *Spacewarfare*, 146.

for refueling, upgrading, and servicing, thereby enhancing the Department of Defense's resilience.

Environmental Standards

Fifth, disposal considerations or complete exemption of liability could be granted to companies operating under the auspices of CASR. The Environmental Protection Agency regulates companies dumping pollutants into the ocean. Similarly, the US government regulates satellite service and orbital debris mitigation. Companies operating in space must plan to deorbit if in low-Earth orbit, maneuver to a stay-away orbit if in medium-Earth orbit, or super-sync if in geosynchronous Earth orbit, all before their satellites have reached their end-of-life.

In 2022 the Federal Communications Commission adopted a stricter five-year time frame for deorbit for satellites in low-Earth orbit.⁵¹ These new norms will inevitably begin a new global standard for space debris mitigation, increasing the cost to field a new satellite. CASR satellites should be exempt from the new five-year disposal rule if activated and utilized under CASR direction. Some exemptions may not be necessary since assets could be refueled, repaired, or disposed of by other CASR-contracted service vehicles.

Industry Recognition

Sixth, establishing goodwill, credibility, and a strong brand for a company is crucial in today's business landscape. As such, marketing costs are a significant part of many business strategies. At the 2023 CASR Forum, executives expressed that with the recent Russian invasion of Ukraine, patriotism is on the rise and companies want to work with the US military.⁵² To encourage companies to join the CASR program, the Department of Defense should provide recognition through public statements, media coverage, or other means. This prestige could generate greater awareness for a fledgling company seeking to enhance its marketing efforts compared to what it could achieve on its own. Moreover, larger companies could reallocate some of their marketing budgets, benefiting from the positive image and public support associated with touting their patriotic service.

Indemnification

Finally, and most importantly, indemnification must be included in the CASR program. Indemnification encompasses the contractual obligation of the government to

51. Jeff Foust, "FCC Approves New Orbital Debris Rule," *SpaceNews*, September 29, 2022, <https://spacenews.com/>.

52. Chad Malone, moderator, "Application of Launch Providers," presentation at the Commercial Augmentation Space Reserve (CASR) Forum, George Mason University, Arlington, VA, February 10, 2023; and Sandra Erwin, "Space Force Considers Public-Private Partnerships to Respond to Crises," *SpaceNews*, February 20, 2023, <https://spacenews.com/>.

cover the loss of a company's assets, including potential revenue loss. Fortunately, this is supported by precedent.⁵³ Commercial industry leaders at the 2023 CASR Forum, representing diverse space companies ranging from launch providers to satellite operators, concurred that the assurance of indemnification is critical and expressed eagerness to participate in CASR.⁵⁴

Conclusion

The policy implications of creating a Commercial Augmentation Space Reserve program are numerous. The United States will enhance its national security and defense readiness by increasing its resilience, capacity, and ability to respond to a crisis. Yet policy will determine if the program is successful. Policymakers will need to determine the extent to which the CASR program is exercised through wargames and include commercial partners to work out capability gaps, identify communication barriers, and decide appropriate levels of command-and-control authorities.

The Civil Reserve Air Fleet program struggled with managing the correct balance of its air assets. In implementing CASR, both policymakers and military leaders must determine the minimum and maximum resources required of each specific space sector: spacelift, space, and ground. This may include, but is not limited to, launch services, satellite communications, orbital services for debris removal or life extension missions, ground command and control, space object surveillance and identification, and space-based situational awareness. Additionally, policymakers and military leaders will need to carefully consider the incentives the CASR program may present to commercial partners. Incentives which offer advantages to commercial companies for future government contracts are likely to be fraught with disputes, which often end in lawsuits.

Next, the government agencies offering incentives will all require individual instruction. The National Telecommunications and Information Administration will require a policy to offer radio frequency spectrum incentives to CASR partners. Similarly, the Federal Communications Commission and Federal Aviation Administration will need policies to streamline the licensing process for space activities. The National Security Agency requires a policy directing them to adequately provide encryption protocol to CASR participants. The CASR participants may need an exemption from all the above agencies' debris mitigation standards, and policymakers should create a program to hire orbital debris removal companies if necessary.

Moreover, civilian and military leaders may need to develop public affairs guidance to openly praise commercial participation. Creating a unified approach will ensure the proper amount of goodwill is garnered for each participating company and praise is distributed fairly. Finally, and crucially, DoD policymakers should enact indemnification using the Department's CRAF regulation for indemnification as precedent.

53. DoD Federal Acquisition Regulation (FAR), 52.250-1 Indemnification Under Public Law 85-804, <https://www.acquisition.gov/>.

54. Malone, "Launch Providers."

If in the inevitable event that conflict extends into the space domain, the United States must be prepared. Just as the Civil Reserve Air Fleet program achieved success in the aviation realm, the potential implementation of the Commercial Augmentation Space Reserve program holds the promise of enabling the US Space Force to harness the strengths of the commercial space sector. This amplified collaboration between government and commercial industry will bolster US resilience and flexibility in and through space. The CASR initiative exploits the escalating technological landscapes and the ever-evolving array of commercial solutions. Policymakers and military leaders must work with the commercial space industry to harness the burgeoning technological landscape and create the CASR program needed to prepare for future space conflict. Æ

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