

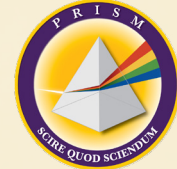
PRISM Perspectives

Orbital Data Centers Could Potentially Exacerbate the Risk of Escalation in Outer Space

By Akash Shah

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Akash Shah is a research officer at an Islamabad-based think tank, Strategic Vision Institute (SVI). His research focuses on the intersection of space and emerging technologies with nuclear strategy and security.



Orbital Data Centers (ODCs) is the latest buzz in the overall space technology ecosystem. With snowballing demand for computing due to Artificial Intelligence (AI), ODCs are pitched and actively pursued as a novel solution. Considering how resource intensive terrestrial data centers are, governments and societies are trying to navigate a workaround to reduce their environmental impact without having to compromise on the insatiable demand for AI. The commercial space industry is already working on solutions to overcome technical and policy challenges pertaining to ODCs, particularly [in the United States](#), which has the most extensive private sector in this domain. Companies like SpaceX, Blue Origin and Star Catcher are pitching extensive constellations of data centers in the orbits.

ODCs will potentially play a significant role in the [Golden Dome](#) architecture due to their ability regarding in-space data processing that drastically reduces latency, which is a key feature in relaying the tracking data to the interceptors for fast moving vectors like hypersonic glide vehicles. While adversaries like China and Russia have proven means of both kinetic and non-kinetic anti-satellite (ASAT) weapons, the sheer scale and redundancy of these constellations will render the existing options insufficient for adversaries to achieve decisive denial. The capability gap creates a novel and emerging challenge for strategic competitors which may incentivize the employment of extreme solutions such as detonating a nuclear device in space to create a strong electromagnetic pulse that wipes out thousands of satellites at once in the orbit.

Why are ODCs even needed?

The surge in the interest around ODCs is driven by the

terrestrial constraints and certain unique advantages of putting the data centers in the orbit. First and foremost is the resource challenge, particularly fresh water which is essential for the servers cooling operation in data centers. An AI-focused data center consumes as much as [a million gallons of water daily](#), equivalent to usage of a small town with 50,000 residents. As the planet has only a fraction of fresh water, it presents a serious public policy challenge, especially when a significant portion of population on Earth already lacks access to clean water. Similarly, data centers are [energy intensive as well](#), putting a strain on the mix of energy systems. Consequently, there is a growing resentment among people about construction of new data centers as more cities and states are putting out moratorium to [halt their construction](#).

What does space offer?

On the contrary, space offers an abundance of solar energy to alleviate the energy concerns pertaining to data centers. It would ease the massive energy demand and grid bottlenecks for the smooth operation while also putting off the public pressure lawmakers are currently facing against terrestrial data centers. ODCs are also expected to address the environmental concerns, and the proponents believe that despite the high initial cost associated with orbital launch of huge constellations, long term operational cost will be substantially lower compared to the ones on Earth. For military applications, an added advantage could be the space-to-space data processing. Instead of beaming the data back to Earth for synthesis, latency could be drastically reduced by in-orbit data processing leading to much faster response and coordination between systems, thus shortening the OODA (Observe, Orient, Decide, Act) loop. It is an enormously valuable functionality

particularly in the case of [missile defense systems like the Golden Dome](#).

The precedence of targeting data centers

Besides the commercial and civilian applications of terrestrial AI data centers, their critical role in the network centric warfare and military operations make them a potential target during a conflict. Although the data centers have been a target of espionage and cyberattacks in the past, the war in Iran has set a [new precedent of kinetic attacks on data centers](#) as important nodes of the enemy's hard power. Both Iran and the United States have targeted each other's data infrastructures during the war. Iran used shahed drones to target [Amazon Web Services](#) and Oracle data centers in the UAE, and the United States struck [Iran's State-run Bank's data center with a missile in Tehran](#). As the [most recent and extensive use](#), AI continues to be integrated in military operations against Iran. While it is not certain if the targeted infrastructures in the UAE actually housed and processed data that was eventually used for intelligence synthesis to determine targets inside Iran, the precedence has been set regardless.

Going forward, data centers are more likely to be considered legitimate targets, especially when the balance of utility is eschewed in favor of one warring party over the other. The cloud functionality serves a variety of functions across the civil, commercial, and military spectrum. The attacks on relatively undefended data centers could potentially be disruptive not only for the military, but also for other services rendered across the globe.

ODCs and the risk of escalation in Space

For the missile defense initiatives like the Golden Dome, ODCs potentially hold a key significance. The advantage of reducing the latency by processing the data in space offers enhances the efficiency of overall defense systems. Conversely, it also becomes the reason why these orbiting units are likely to become a primary target for interference and sabotage. Going back to the argument of mutual vulnerability, which acts as deterrent for an adversary to target such infrastructure, the United States' lead in this domain becomes a vulnerability. A throwback to the [first space age](#) during the Cold War when the U.S. had an edge in remote sensing and intelligence gathering from space, the primary concern was to protect the assets from being targeted by the Soviet Union. Since the latter did not have an equivalent capability in space, the United States feared that in case of a conflict, the Soviets were incentivized to attack the U.S. spy satellites. No other country has the technology and the capital bandwidth to bid for ODCs at the scale the private space

sector in the U.S. is proposing. While the constellation of thousands of orbiting nodes increases the redundancy in case of sabotage, there are already concerns in the U.S. of the drastic measures being considered by adversaries to overwhelm the satellites at the constellation scale.

Since 2024, the United States has raised concerns of a possibility of a [Russian nuclear armed ASAT](#) weapon allegedly being considered to target satellite constellations. While Russia has [officially denied these claims](#), the USA and UK have recently conducted wargaming exercises under the theme of a [potential nuclear anti-satellite strike in space](#) by Russia. Regardless of the Russian intentions, it appears that west is seriously considering the likelihood of such eventuality. As the ODCs become functional and central to the missile defense architecture, particularly in the Golden Dome program, the fear and probability of sabotage is only going to exacerbate. It becomes a matter of primary concern that the survivability of the ODCs is ensured, however, the deterrence is unlikely to work as the adversaries don't have an equivalent system vulnerability in space.

The other recourse is diplomatic engagement to instill a confidence that ODCs with their critical defense functionality would not be tampered with. Unfortunately, space diplomacy hasn't delivered a concrete framework or understanding in this regard in a long time. The Outer Space Treaty prohibits any state from placing nuclear weapons in space, but it lacks the requisite comprehensive verification regime to monitor compliance. The progress on Prevention of an Arms Race in Outer Space (PAROS) at the Conference of Disarmament (CD) has been stalled for years and there is no legally binding mechanism in place to prevent the escalation.

In conclusion, ODCs would be a technological leap as they offer solutions to the multiple problems faced by their terrestrial counterparts. Their role in strategic defense system like the Golden Dome will likely aggravate the risk of escalation by making them a potential target by adversaries. The gaps in the international space governance framework need to be addressed through a serious international effort to ensure their survivability and preserve strategic stability before these expensive systems are deployed in the orbit. Since United States has the largest stake in the endeavor, for its own interest, the onus is on the U.S. government to engage with countries like Russia and China to find a common ground. Otherwise, due to the integration of space technologies in almost every aspect of life on Earth, the impact of an escalation on this magnitude in space will be indiscriminate and catastrophic across multiple domains.