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# Multi-Domain Conflicts: Is US Success Contingent on Dominance in Every Domain?

A Virtual Think Tank (ViTTa)<sup>®</sup>  
Report



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## What is ViTTa®?

NSI's **Virtual Think Tank (ViTTa®)** provides rapid response to critical information needs by pulsing our global network of subject matter experts (SMEs) to generate a wide range of expert insight. For this SMA Contested Space Operations project, ViTTa was used to address 23 unclassified questions submitted by the Joint Staff and Air Force project sponsors. The ViTTa team received written and verbal input from over 111 experts from National Security Space, as well as civil, commercial, legal, think tank, and academic communities working space and space policy. Each Space ViTTa report contains two sections: 1) a summary response to the question asked; and 2) the full written and/or transcribed interview input received from each expert contributor organized alphabetically. Biographies for all expert contributors have been collated in a companion document.

<sup>1</sup> For access to the complete corpus of interview transcripts and written subject matter expert responses hosted on our NSI SharePoint site, please contact [gpopp@nsiteam.com](mailto:gpopp@nsiteam.com).

**Cover Art:** *US Army Graphic*

[https://www.army.mil/article/186118/smdc\\_seeks\\_technologies\\_and\\_concepts\\_that\\_will\\_enable\\_multi\\_domain\\_battle](https://www.army.mil/article/186118/smdc_seeks_technologies_and_concepts_that_will_enable_multi_domain_battle)

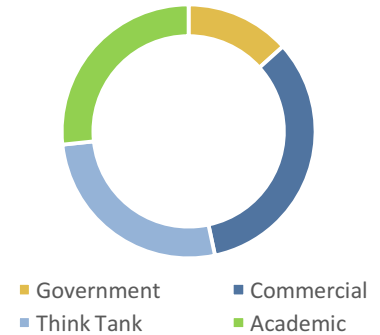
## Question of Focus

[Q17] As we move into multi-domain conflicts will our success hinge on being successful in every domain or can we lose in one and still be successful in the overall campaign?

## Expert Contributors

Major General (USAF ret.) James Armor<sup>2</sup> (Orbital ATK); Marc Berkowitz (Lockheed Martin); Dean Cheng (Heritage Foundation); Dr. Damon Coletta and Lieutenant Colonel (USAF ret.) Deron Jackson (United States Air Force Academy); Faulconer Consulting Group; Lieutenant Colonel Peter Garretson (United States Air Force Air Command and Staff College); Gilmour Space Technologies, Australia; Harris Corporation, LLC; Theresa Hitchens (Center for International and Security Studies at Maryland); Dr. John Karpiscak III (United States Army Geospatial Center); Group Captain (Indian Air Force, ret.) Ajey Lele<sup>3</sup> (Institute for Defense Studies and Analyses, India); Dr. Krishna Sampigethaya<sup>4</sup> (United Technologies Research Center); Dr. Cassandra Steer (Women in International Security-Canada); ViaSat, Inc.; Dr. Edythe Weeks (Webster University)

Q17: Contributors

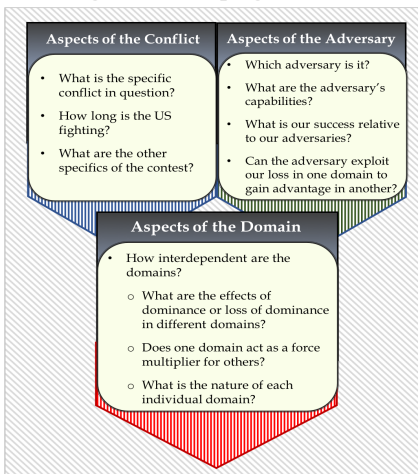


## Summary Response

Contributors were varied in their responses, with approximately half of the subject matter experts replying to this question with a variation of “it depends.” In other words, campaign success in a multi-domain conflict (MDC) is not solely a question of US need to dominate in all domains (or not), but instead

is contingent on contextual factors that are likely to vary from one conflict to the next. Broadly, these can be grouped into the following categories, which can be examined individually or in concert: a) *aspects of the conflict*, b) *aspects of the adversary*, and c) *aspects of the domain* (Berkowitz; Cheng; Harris Corporation; Hitchens; Karpiscak; Steer). Figure 1 presents a set of guiding questions derived from contributor inputs, which address these categories and demonstrate the range of considerations when engaging in a multi-domain conflict.

Figure 1: Guiding Questions for Factors Affecting MDC Campaign Success



Contributor responses as a whole focused on only one of these contextual factors—*aspects of the domain*. Specifically, expert discussions often emphasized the degree of domain interdependence. Multiple experts implied that space in particular is a crucial domain without which the US currently cannot “win” in any serious conflict (Cheng; Garretson; Harris Corporation; Hitchens; Steer; Weeks).<sup>5</sup> A loss or extreme degradation in the space domain is likely to significantly

<sup>2</sup> The subject matter expert’s personal views, and not those of his organization, are represented in his contributions to this work.

<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

<sup>5</sup> Contributors specifically emphasized US *dependency* on space, which in addition to the general utility of space as a domain, is what makes this domain so important to the US relative to its peers—highlighting a critical US vulnerability.

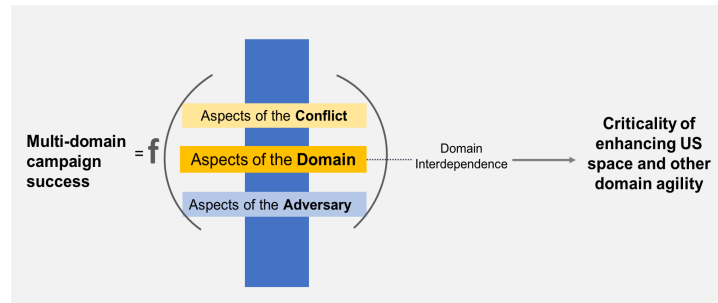
affect capability in other domains (though the opposite does not necessarily hold true, with the exception of cyber). At the same time, absolute dominance in space is not required<sup>6</sup> in order to maintain some degree of capability in other domains.

Within the context of this broader discussion of domain interdependence emerged a more concrete articulation of whether US campaign success in a multi-domain conflict necessarily hinges on success in every domain. The picture that emerged was that the US can lose in one domain—even if that domain is space—and yet succeed overall. However, this statement comes with important caveats. While the US can lose space dominance and prevail, given the degree of domain interdependence, the US cannot lose its entire capability in space and still prevail. The US *must* retain the ability to maneuver throughout space and other domains. However, continuing to operate (or “succeed”) in the face of partial degradation of space capabilities will come at a high cost (e.g., in national treasure or human capital) (Harris Corporation).

In order to continue fighting and ultimately succeed, the US will need to become more agile overall. (See Figure 2 for a graphic summary of the factors affecting MDC campaign success and the need for increased US agility.) This agility includes ensuring that there are appropriately robust plans and infrastructure in place to enable continued operation, whether conditions are ideal or suboptimal (e.g., domain degradation). **As such, the “answer” to this question can be reformulated as follows: Success is not required in every domain, as long as the US becomes and remains agile.**<sup>7</sup>

Several options were in turn derived from the expert inputs for *how* the US might increase its agility.

Figure 2: Domain as a Contributing Factor to MDC Success and the Need for US Agility



## Space is Different Than Other Domains and Critical to Campaign Success

The experts indicated that campaign success will depend in part on aspects of the domain(s) being invoked. These include whether any one domain is essential for the proper functioning of the others, as well as the more general interplay between and among the domains in a given multi-domain conflict. The ViaSat team underscored this interdependence, noting that:

Space systems that deliver communications, Earth observation, position/navigation/timing, missile warning, weather, etc. do not exist exclusively in space. Their delivery platforms, or infrastructure, exist in all domains including land, sea, air, space, and cyber. Thus, a network infrastructure loss in any of these domains equates to a loss in providing service or delivery to their customers that operate in the land, sea, air, space, [and cyber] domains. The inability to defend and protect systems in all domains leads to loss of service or operational capability in the operational domains of land, sea, air, space, [and cyber] (Follow-Up Communication, January 25, 2018).

<sup>6</sup> Moreover, as multiple experts argued, the goal of multi-domain dominance over time in fact may be impossible and thus inadvisable (Hitchens; Karpiscak; ViaSat, Inc.).

<sup>7</sup> Presumably, this agility would also enable the US to overcome some of the challenges posed by the other contextual factors influencing campaign success (viz., aspects of the adversary or conflict). However, the experts’ inputs as a whole did not emphasize this connection.

However, the specific effects of dominance or loss of dominance within different domains may vary. As Dean Cheng of the Heritage Foundation postulates:

“dominance in different domains will have different effects. For example, losing dominance in Domain A may or may not be as bad as losing dominance in Domain B. Where you start having more problematic issues is the synergies: If I have a 30% reduction in Domain A, does that mean I’m more likely to lose all ability in Domain B?”

A theme that emerged consistently from contributor inputs is that the cross-cutting nature of space makes it fundamentally different from other domains such as maritime or land. As Dr. Cassandra Steer of Women in International Security-Canada indicated, “space is...utilized in a unique way compared to all other domains” because it (as well as cyber) is an enabler to other domains, without which those domains could not function optimally (see Garretson; Harris Corporation; Steer). In the same vein, Lieutenant Colonel Peter Garretson of the USAF Air Command and Staff College argued that, given the US dependency on space for terrestrial command-and-control and targeting, losing space (or cyber) services would result in degradation spanning the entire joint force.<sup>8</sup> The Harris Corporation also emphasized this point, and added that, not only would the loss of space make successful military campaigns difficult or impossible, but that if a US victory were to occur, it would come at a much higher cost than it would have if space assets had been available. Taking a global perspective, Gilmour Space Technologies added that there would also be significant weakness in other defense forces if the allied countries were to lose space communication capability in a future conflict. Cheng most powerfully illustrates the danger of current US dependence on space, by noting that:

“it will have more far-reaching effects in both the military and civilian realms if we lose space because we are not as aware of how permeating space is.... We are de facto beyond dependent on space...we are 5-year heroin addicts mainlining every couple of hours on space without realizing it.”

## The Importance of Increasing US Agility

A conventional understanding of campaign success might emphasize overall US dominance. While the goal of campaign success in a multi-domain conflict might best be served by achieving dominance across all domains, as multiple experts (Armor; Berkowitz; Harris Corporation; Sampigethaya; Steer) implied, it may not be strictly necessary for the US to *dominate* in all domains in order to remain successful in the campaign. Instead, as Major General (USAF ret.) James Armor of Orbital ATK emphasized, the US might aim to “preserv[e] options across all domains.” Moreover, several contributors suggested that achieving, and especially maintaining, multi-domain dominance in every campaign is improbable, and thus an inadvisable goal. These contributors made the point that the US needs to be prepared for the fact that it may not be possible to succeed in every domain all of the time. The US may not always have the “home field advantage,” and thus needs to be prepared to think about trade-offs<sup>9</sup> among domains

*“Winning in a multi-domain conflict does not require attacks in all domains be defeated. A multi-domain conflict strategy and capability should enable the team to be resilient and continue fighting despite the non-availability of some domains or teammates.”*

- Dr. Krishna Sampigethaya, United Technologies Research Center

<sup>8</sup> It is important to underscore the distinction between losing in space overall and losing (i.e., not maintaining) dominance of space. The former implies a more pervasive loss of capability, which would likely preclude a “win,” while the latter implies that some degree of capability is maintained, if reduced. It is the latter scenario that enables the US to prevail and win overall.

<sup>9</sup> For example, in comparative areas of domain strength or capability that can be used to offset one another.

(Hitchens; Karpiscak; ViaSat, Inc.). At the same time, the domains are highly interdependent, and each domain is highly dependent on space, which implies a potential US vulnerability that must be resolved.

Together, these points converge around the need for the US to increase its overall agility, whether aiming to “preserve options” or “think about trade-offs,” in order to achieve campaign success. It may be sufficient for the US to retain the ability to maneuver throughout the various domains, in order to “deliver the desired effects at a time and place of our choosing” (Harris Corporation). Marc Berkowitz of Lockheed Martin<sup>10</sup> added precision to this line of reasoning by acknowledging that dominance in all domains should not be a prerequisite for victory if the US can offset disadvantages in one domain with advantages in another. However, he offered an important caveat that, “it is difficult to conceive how the US could achieve victory or terminate conflict on favorable terms if it cannot seize and maintain at least ‘*working control*’ (as opposed to absolute command) of the space, air, and maritime domains.”

Dr. Krishna Sampigethaya of the United Technologies Research Center similarly emphasized the ability of the US to continue fighting in the face of attacks, rather than the necessity of defeating attacks in all domains. He offered as an example a UAV conducting reconnaissance. If a UAV relies solely on satellites for navigation, timing, and communications, it may contribute to mission failure if space is attacked. In contrast, a UAV that can fall back on other domains in the case of a space attack can continue to operate and complete the mission. Dr. Steer made a different but compatible point, noting that success in the space domain may entail preventing escalation, even if this means loss in another domain. Moreover, she argued that the waging or winning of an armed conflict in space may not be necessary to ensure the successful *use* of that domain to enhance other domains.

However, even partial loss of space capability could mean losing total effective capability in a second domain, and/or degradation in the space domain can have follow-on effects in other domains if those systems are not sufficiently resilient. As one example, Steer noted that, “the US [currently] lacks sufficient redundancy in many of its terrestrial systems to deal with a loss of satellite services.” Theresa Hitchens of the Center for International and Security Studies at Maryland made a similar point, indicating that the US generally has not secured Plan(s) B to reduce space system reliance, as “protection and resiliency aren’t sexy; they aren’t ‘pointy edges’ that get funding.” She elaborated that, “We have to be prepared to have various domains suppressed or even rendered unusable for a specific conflict...including space.” Doing so would enable the US to continue fighting in the face of adversary attacks.

The current gap in preparation leaves the US with a core vulnerability. The challenge of 21<sup>st</sup> century US defense thus points to the importance of enhancing US agility, including an emphasis on building resilience into new and legacy systems and developing and exercising contingency plans—“Plans B”—to enable the US to withstand suppression or loss of capabilities in space or any other domain.

## Options for Enhancing US Agility

From the contributor discussions, several options were derived for how the US might increase its overall agility and ultimately prevail in a multi-domain conflict.<sup>11</sup> These ideas were categorized into three types

<sup>10</sup> See also contributions by Major General Armor, the Harris Corporation, Dr. Sampigethaya, and Dr. Steer.

<sup>11</sup> It should be noted that these ideas are not universally offered as recommendations, but instead arise in some cases from contributor discussions of the various options available to the US.

of options: a) those focused on *resilience*,<sup>12</sup> b) those focused on *deterrence*,<sup>13</sup> and c) those focused on *offense*. Collectively, these options support the central goal of enhancing US space and other domain agility. Specific examples for each of these categories are captured in the Table below.

**Table: Options for Enhancing Agility to Enable the US to Prevail in Multi-Domain Conflicts**

Contributor(s)	Options for Enhancing Agility
	<b>RESILIENCE</b>
Hitchens; Lele	Develop plans to reduce reliance on certain critical space systems; consider near space systems technologies as part of a “Plan B” if there is a major challenge out in space
ViaSat, Inc.	Distribute warfighting capabilities across as many domains as possible (e.g., commercial or private sector Satcom assets can be used as alternate PNT sources)
	<b>DETERRENCE</b>
Harris Corporation	Establish a clear deterrence policy for space, communicate it through the appropriate security channels, and integrate it at the strategic level with other deterrence policies going forward
Jackson	Maintain ability to fight through whatever adversaries deliver and sustain credibility that US can inflict pain on or deny enemy objectives. Doing so is essential to disrupting the enemy’s calculus when considering whether to interfere with US space assets
Hitchens; Steer	Deter aggression of any kind/avoiding conflict, in order to ensure continued access to and use of space (cf. seapower doctrine)
Armor	Ensure that space domain remains <i>unpredictable</i> to adversaries: “We want them to worry about all domains, all the time, everywhere for deterrence and warfighting”
Lele; Steer	Increase collaboration and transparency so that states become more fully interdependent in space—may thus be less likely to act in an undesirable way
	<b>OFFENSE</b>
Jackson; Steer	Suppress enemy systems; including focusing on crippling adversary ground stations rather than on attacking their space-based assets directly
Jackson	Consider US willingness to escalate horizontally—and demonstrate this willingness to would-be adversaries
	<b>MISCELLANEOUS</b>
Harris Corporation	Articulate requirements for space as a war-fighting domain; ask for industry’s help to meet requirements (e.g., offensive/defensive counter space, suppression of enemy space defenses, etc.)
Harris Corporation	Build up infrastructure and other elements required for operators who are responsible for bringing new technologies and capabilities to bear (cf. training in the air domain)

<sup>12</sup> Per the National Security Space Strategy, resilience incorporates avoidance, robustness, reconstitution, and recovery. See: [https://www.defense.gov/Portals/1/features/2011/0111\\_nsss/docs/DoD%20Fact%20Sheet%20-%20Resilience.pdf](https://www.defense.gov/Portals/1/features/2011/0111_nsss/docs/DoD%20Fact%20Sheet%20-%20Resilience.pdf)

<sup>13</sup> For a broader discussion of deterrence in space, please see the NSI Space ViTTa Q14 report on how space should feature in US deterrence strategy: <http://nsiteam.com/space-feature-deterrence-strategy/>

## Subject Matter Expert Contributions

### Major General (USAF ret.) James Armor<sup>14</sup>

Staff Vice President, Washington Operations (Orbital ATK)  
7 August 2017

#### WRITTEN RESPONSE

- Of course we can lose in one domain but prevail, but we want that domain to be *unpredictable* by an adversary. We want them to worry about all domains, all the time, everywhere for deterrence and warfighting.
- We are dependent on all domains, and must preserve options in all. A focus should be rapid reconstitution of space-based systems
- Example: we may lose the space segment of a global conflict, but we will undoubtedly need space for treaty verification and conflict remediation after the conflict.

### Marc Berkowitz

Vice President, Space Security (Lockheed Martin)  
12 June 2017

#### WRITTEN RESPONSE

It depends on the adversary and the specifics of the contest. In general, it should not be a prerequisite for victory to dominate in every domain if it is possible to leverage advantages in one domain to offset disadvantages in another. In geopolitical terms, however, the United States is a “Rimland” power that must cross transoceanic distances to project power and mass effects around the periphery or into the “Heartland” of the Eurasian landmass. It is difficult to conceive how the US could achieve victory or terminate conflict on favorable terms if it cannot seize and maintain at least “working control” (as opposed to absolute command) of the space, air, and maritime domains.

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<sup>14</sup> The responses here represent the sole views of Major General (USAF ret.) James Armor, and are not intended to represent the position of Orbital ATK.



## Dean Cheng

Senior Research Fellow (The Heritage Foundation; Asian Studies Center,  
Davis Institute for National Security and Foreign Policy)

2 August 2017

### INTERVIEW TRANSCRIPT EXCERPT

**Interviewer:** [Q17] Okay. So, it sounds like you're emphasizing the need to have a multi-domain focus and approach to things, rather than just solely focus on space. This segues into the next question that I was hoping to ask you, which is: As we move into multi-domain conflicts will our success hinge on being successful in every domain or can we lose in one and still be successful in the overall campaign?

**D. Cheng:** [Q17] Well, first off, you have to define what the objective is in order to define success. From there, you can then look in the various domains, because I think the answer is going to be different, and dominance in different domains will have different effects. For example, losing dominance in Domain A may or not be as bad as losing dominance in Domain B. Where you start having more problematic issues is the synergies: If I have a 30% reduction in Domain A, does that mean I'm more likely to lose all ability in Domain B?

[Q17] Another thing to consider here is how long it's been since we fought without dominance in all domains. We have not fought a war since 1942 where we did not pretty much have air superiority, if not, outright air dominance. We have not fought a war at sea, period, since 1944-45. We have not fought a war in the space age where we did not have access to space for whatever purposes we needed at the time. So, we don't actually know what effect would occur if we were to lose 50% of our space capacity.

**Interviewer:** [Q17] So, in your opinion, how do think the space domain fits into that overall calculus? If an actor has a significant disadvantage in their space domain capabilities, do you think that, given the changing nature of conflict and rapidly evolving technologies, is more detrimental than maybe if that actor had the same level of disadvantage but in another non-space domain?

**D. Cheng:** [Q17] I think that it will have more far-reaching effects in both the military and civilian realms if we lose space because we are not as aware of how permeating space is. Our methods of command and control and our methods of information security are both terrible. We are de facto beyond dependent on space—I mean, we are 5-year heroin addicts mainlining every couple of hours on space without realizing it.

[Q17] I think that there are people who recognize that not having air superiority is bad. We have some people who at least are getting back in the habit of thinking about, how can we maintain dominance at sea in the face of non-naval threats (e.g., anti-ship ballistic missiles, air-launched cruise missiles, etc.)?

[Q17] We talk a lot about a day without space, but you never have somebody say, "I'm just going to stop training pilots because I know we'll have air superiority." But we stopped doing shooting the sun and land navigation by map and compass, which gives you an idea of how we just assumed it would always be there. That's the level of the blitheness that the Navy and the Air Force on their worst days have not had.

## Dr. Damon Coletta and Lieutenant Colonel (USAF ret.) Deron Jackson

United States Air Force Academy (USAFA)  
 Damon Coletta, Professor of Political Science  
 Deron Jackson; Director, Eisenhower Center  
 8 August 2017

*Note: Enclosed here are responses bearing on question 17, as well as any surrounding responses that provide the necessary context to interpret direct responses to question 17.*

### INTERVIEW TRANSCRIPT EXCERPT

**Interviewer:** [Q14] [Q17] Okay, great. That actually brings me to the next question I was hoping to ask you, which has to do with deterrence. How should space feature in US deterrence strategy, and what changes to US deterrence thinking are required to incorporate the rapidly evolving space domain?

**D. Jackson:** [Q14] [Q17] Well, we are the ones that originated the concept of layered deterrence back in 2009 that went into the 2011 National Security Space Strategy. However, their spin on it was slightly different than ours, so Damon and I can provide a slightly different perspective to it.

[Q14] [Q17] The basic thing we came up with was that the traditional thinking about deterrence in terms of purely rational cost benefit analysis based on threats of retaliation is not adequate or well-matched to the space domain, because even with asymmetrically invested actors, it might not be credible that we would go kinetic, for example. Your last resort for assuring deterrence is not your threat to wipe out everything the other side has, because, again, you may be in an asymmetrical relationship where you don't have as much of a target set for them as they have for you. What you want to demonstrate for credibility—which goes back to thinking from the Cold War—is that whatever they try will not deny you the ability to continue to operate and achieve your objective, presumably the terrestrial objective.

[Q14] [Q17] They're not simply going after space for space's sake; and you don't simply want space for space's sake. Ultimately, the benefits that operations in the space domain have are for terrestrial military operations and achievement of objective, so you want to be able to demonstrate a multiplicity of phase to sustain your military operations, if you're thinking about military concept. So, that last phase of denial, or the ability to fight through whatever the other side throws at you, is essential to maintain the credibility that you are going to be able to inflict pain on them or deny them their objective (i.e., you're still going to be able to fight), and that's essential to deterring their calculus about wanting to mess with your space assets in the first place, because they're just one part of a larger suite of capability.

[Q14] [Q17] So, again, the idea is not to deter space just for space—it is to sort of set space aside so that other actors are deterred from going after it because the cost of going after space is the consequence of entanglement (i.e., dragging other actors into the conflict when they may want to keep it limited), all to see at the very end that it didn't prevent you from maintaining the continuity of operation that they were hoping for, and fit together in this layered suite of concepts that ultimately kept space sort off the table and deterred hostile action against our assets.

**D. Coletta:** [Q14] [Q17] So, that report that Deron mentioned was submitted to OSDP, and we also published a copy of it in our small peer reviewed journal titled *Space and Defense*.

I have a follow up question for Deron. That work on space deterrence is probably one of our most high profile pieces over the years, and it was criticized, wasn't it?

**D. Jackson:** [Q14] [Q17] Well, we encouraged criticism in the journal. So, we ran competing views about space deterrence in the same journal where we offered our solution, because that's the way we work as an academic entity here within the Academy—the idea being that getting that criticism fosters a better understanding of the subject. We're not a policy studying organization, but we do study policy, so we think it is useful to loft an idea out there and then have other people criticize or critique it—we try to represent one point of view and all the reasonable competing points of view.

[Q14] [Q17] I think one of the basic criticisms that I remember from that time was the whole notion of calling out space as a separate area of deterrence, rather than just seeing space as part of the larger continuum of deterrence (i.e., in the general deterrence theory). The idea was that you don't want to say that space alone is an area where you deter operation, rather you want to say that you want to deter a hostile actor from doing something at any level of conflict—which is a harder challenge to meet and also wasn't what we were charged with doing. We were charged with looking at the idea that if you can't really actively defend space satellites and space systems, how could you at best deter using other aspects?

[Q14] [Q17] One of the criticisms that I think we took the most flak for was, as Ambassador Harrison used to say, people probably thought we were bedwetting communist sympathizers of fellow travelers because we put norms up there as the first layer of deterrence. The idea there was not that norms were sufficient to deter an adversary, but that as an initial layer, we thought that norms provided a useful feature for the government in seeing who's on board. This goes back to the rules of the road idea—the people that are basically on board with you and basically adhering to standards of behaviors, you don't have to worry about them because they are self-deterred because they want to comply with these steps of international behaviors. So, going through that first layer lets you know who your outliers are, which should get your attention. If there is an actor that is not deterred by normative arrangements for space, then they need to have other pressure put on them, and that's where you start building your alliances—either with the commercial side or with other likeminded partner nations or outright allies—because the adversary will be deterred by the fact that now they have to go against not just the United States but a whole constellation of players (i.e., if we tread into this area and mess with one of the other space systems, we'll not only have the first layer of international scorn heaped upon us, but the second layer will actually have offended and disrupted people that maybe we needed to partner with on other areas).

[Q14] [Q17] That process ought to take care of another layer of bad actors. So, by the time you've got through those first couple of layers, it should be only a small number that are now worried about outright retaliation in kind, in some other domain, or through some sort of horizontal escalation. That ought to deter yet another group, and it's only the, hopefully, single hard case that burns through those first three layers, which you now have to worry about demonstrating your capability to continue to fight no matter what they've thrown at you.

[Q14] [Q17] So, these increasingly hard layers that you get through were part of an overall package designed to whittle down competitors or those that want to contest the space domain. And, eventually, the idea is that the last layer takes care of even those if you can demonstrate a willingness to put up a resistance at each layer. So, for example, if someone blows through an

international norm and you don't call them out for it, then the lesson they're going to learn is that "hey, this really was nothing." Or, if something happens and you're on your own and you have not entangled them in a wider coalition that shows, "hey, you're not just messing with us. You're messing with the commercial side, our allies, our partners, etc. and it's a much bigger fight," then your deterrence is not going to work there. So, you're already two steps into failure if you let those softer layers be compromised without response. Rather than taking a kind of a soft and squishy, kinder, gentler arrangement for deterrence, we envisioned something that requires a lot of activity and engagement from the very, very beginning so you're sending warning signs as to what you're not willing to tolerate, before you even get the necessary steps of maybe needing to retaliate or activate other alternative systems to ensure you can prevail.

**D. Coletta:** [Q14] [Q17] If I can, I just want to add a different line of inquiry. I helped out on this layered deterrence paper as a research assistant, so I like the paper but I'm also willing to be sympathetic with the criticism, and not so much the criticism that Deron was just talking about with norms being the first layer, but, and I'm going to be flippant here to try to make a point and contrast, I think of the layered deterrence report as 'The Princess and the Pea' version of deterrence where the pea is that satellite and you've got all these mattresses and layers of deterrence, with the top layer being norms.

[Q14] [Q17] I think the criticism that the paper didn't take into account space as part of a general deterrence scenario is a legitimate criticism, and I think it takes you to another line of work that's being done on cross-domain deterrence and multi-domain deterrence. From what I can tell, the Joint Staff, the Services, and the OSD are all interested in this possibility—the idea that you could have operations that are tied to the same conflict of interest that are crossing over domains, and how to try to manage that in a way that would shore up general deterrence (i.e., deterring attacks against your interests in general).

[Q14] [Q17] So, there is the Eisenhower Center paper, but there's also this line of research that's coming out by different names (e.g., cross-domain deterrence, multi-domain deterrence). I'm thinking you've probably already come across some of these folks and efforts, but an example like the Gartzke and Lindsay cross-domain deterrence project at UCSD that is being funded by Minerva (OSD AT&L OSDP) incorporates the space domain, cyber domain, and nuclear domain. Basically, there seems to be a lot of talk currently that I think is really a complementary line, and not really contradictory line, to what the Eisenhower Center said head to head. So, this is certainly something else to think about when you think about space deterrence—what happens if you're involved in a conflict in the South China Sea, for example, and one of the responses is an attack against a space asset? In this scenario, it is no longer the princesses and the pea—you're no longer trying to protect the pea, you're trying to keep that attack against the space asset as part of a larger conflict from putting the United States in a position where they have to fire off everything at once and approach Armageddon or concede. You're back to this question of managing escalation and escalation dominance.

[Q14] [Q17] So, to answer your question, I think there's layered deterrence as a proposal, which, again, is the princesses and the pea situation where you're trying to protect the pea (i.e., protect the satellites). Additionally, there's this other complementary line that you have to think about where space becomes part of a larger regional conflict with escalatory potential. So, is part of space deterrence being able to manage escalations in multiple domains at once? That's a pretty hard question for most of the bureaucracy to figure out because each element of that bureaucracy is typically responsible for just one piece of that conflict—getting all of them to think on the same page at speed in real time is a difficult problem, which is one of the reasons why I think OSDP and OSD AT&L have been so interested in it.

**D. Jackson:** [Q14] [Q17] This raises the concept of what space contributes to deterrence? That was something we came across in the year we were working on our report, but it was not really relevant from the question that had been queued up to us. But, I think it's very significant when you start thinking cross-domain, because it ties back into the idea of the mattress level where you're trying to protect a particular space asset through these different layers of padding and support. The idea is that space is your vehicle at the earliest stage of a crisis to make the other side aware that you know what they're up to and that they've lost the element of surprise, or your vehicle to share that fact of what they're doing in some level of detail so that you can then build a coalition (at the government level) of those willing to resist that action, assuming that the hostile actor is going to be denying that they're up to anything bad in the first place.

[Q14] [Q17] A good example—and analogy for the challenge of dealing with space assets—of this would be if you think about the Cuban missile crisis, at some point, to call out to Cubans and the Soviets, the US presented pictures from surveillance from flights over the island to say, “well, look here Mr. Ambassador, here's what you have on that island, and we're ready to wait until hell freezes over for your answer to explain why you have these systems on that island.” Well, the US has to be capable and willing—capability probably isn't the issue, but willingness probably is—to share that type of evidence at the early stages of a crisis to build up some deterrent effect against an adversary.

[Q14] [Q17] This, I think, loops back to your relationship with the commercial side—if we could, by some other means than a US government asset, attribute behavior either in space or on the ground to a country that was about to do something that we wanted to deter them from doing, then that would be advantageous for the US government. Essentially, we could use the space resource to contribute to deterrence without burning sources and methods or capabilities that you might otherwise want to put on hold for anything short of all out nuclear war.

[Q14] [Q17] The great challenge in taking deterrence literature and applying it to the space domain is that for all the bad economic, societal, and military impacts that hostile activity in space might have over the long-term, it doesn't affect the terrestrial outcome in the same way that a total nuclear exchange would. So, we had to figure out what was credible for the US to threaten in response to something that could be extremely bad, maybe even economically and militarily devastating, in space that didn't have the corollary physical destruction for society as a whole. That was a big problem, and still remains a problem today.

**D. Coletta:** [Q14] [Q17] It's a problem both in protecting the asset itself and in escalation management. Because you can imagine scenarios—and these kinds of scenarios are being published now (e.g., “The Case for US Nuclear Weapons” by Brad Roberts)—where you could imagine an adversary thinking that an attack in space that causes destruction in space without physical destruction on the ground would be a way for that adversary to signal to the United States their seriousness, the asymmetry of resolve, and perhaps get the United States to back down. Essentially, the attack on a space asset is part of a larger conflict, and makes the management of escalation more difficult.

**D. Jackson:** [Q14] [Q17] We have to consider our willingness to escalate horizontally (i.e., be cross-domain in our respect). If the US were to face a disabling attack on one of its space assets, is it credible to think the US would use kinetic force on the ground as punishment for that action? If the effects were truly confined only to space, or the debilitation of US capability to retaliate—which comes down to, “well, shame on you for being so reliant on that particular asset or resource—then the burden is then on the US to demonstrate its willingness. It really comes down to willingness, not capability, to respond for that.

**[Q14] [Q17]** So, again, you have a relationship where if responding in kind and taking out something of that aggressor state's own constellation isn't there as an option, and our only option is to escalate into another domain (i.e., land, sea, air, or something that's tangible and kinetic), then the credibility just doesn't measure up in a lot of scenarios.

**D. Coletta:**

**[Q14] [Q17]** So, Deron and I are playing off each other here, but if this is something of interest to your SMA effort, then I think academia could help you, because academia is interested in different models of conflicts. For example, in the classic deterrence literature, you have: 1) the chicken game or the competition in risk; 2) the escalation management, crisis management, and escalation dominance games, where you have enough capability so that you can respond to whatever the other side is throwing at you (i.e., rather than concede or end the world, you always have a response at the ready); and 3) the frozen conflicts game, which has received less attention but is something that I think could also be going in current situations like Ukraine, the US relationship with Iran, and potentially with China as well.

**[Q14] [Q17]** The frozen conflicts game relates to situations where the adversary is able to break something off of value, and the defender has a heck of a time trying to tie that morsel, if you will, to larger interests in the way that the Berlin Brigade tied little Berlin to larger interests of the West. If you get involved in something like that, where the situation looks more like a war of attrition, then that's where things aren't really escalating, but the adversary is kind of hanging in, hanging in, hanging in until the United States let's go of the morsel—that's the game of attrition.

**[Q14] [Q17]** So, if you get interested in space deterrence as part of multi-domain conflict or multi-domain operations, it's going to be important to know, as you're figuring out policies, what kind of game you're preparing for—because in each of those games, depending on which one of the games is applied, I imagine that you get different policy outcomes. My point is that there might be a nice way to draw from the way in which academia models see scenarios with the way in which you all are modeling the scenarios when you're thinking about policy.

**D. Jackson:**

**[Q14] [Q17]** So, Damon, with respect to the terrestrial example of attrition that you were outlining, would you agree that Crimea and Ukraine is kind of an example of this? In this case, the Russians managed to break off Crimea, there wasn't much the West could do about it, and now Russia continues to grind away in eastern Ukraine. There also seems to be a level of fatigue for the United States, the European Union, and NATO, which has provided Russia with the opportunity to continue on in these efforts. Though, I'm not sure what the space counterpart to that would be, but it is illustrated ...

**D. Coletta:**

**[Q14] [Q17]** Yes, the potential space counterpart that you mention here would have to be something about a position in space or a new space capability that could be broken off from the expected escalation chain. And that might be a type of play that the US government isn't prepared for, but they could end up losing because the other side would win the war of attrition (i.e., if the adversary can break something off that the other side, the defender, can't easily tie back to larger interests). Because if you can't tie it back, the escalation management never happens because it never becomes credible. So, our concrete examples for this are Crimea or the reefs in the South China Sea, but I think it remains unclear what that might look like in the space domain in particular. Space is involved because you wonder if the game of attrition is multi-domain, because a lot of the times the way in which we respond to Crimea is in other domains—though, I don't think we responded in the space domain in this particular case, but I would say the economic sanctions enacted in this case illustrate the multi-domain approach.

**[Q14] [Q17]** A game of attrition and multi-domain operations are connected, have been connected, and it's certainly feasible that multi-domain operations involving space could eventually get wrapped up in a game of attrition—for example, either some morsel has been broken loose in space itself or space operations are part of imposing very minor costs to stay in and hold on to something else that is not in space.

**[Q14] [Q17]** Another example that just came to mind would be another ASAT test. The Chinese ASAT test caused debris and it caused a lot of protest, but it really didn't cost the Chinese too much. So, you can imagine something like that happening as part of a game of attrition, just to say, “hey, we're not going to let go of the reefs, and here's an example of how we're not going to let go, so you either let go or you're going to have to pay costs in other domains.” This might be something that could come back into play—something that's annoying but doesn't lead to major crisis or escalation management. You could see space getting involved in that way.

**Interviewer:** Okay. Great. Well, thank you both for the robust and insightful response to these questions. I think this is actually a good time to open it up to my colleagues on the line, who I imagine have some additional deterrence-specific questions. So, Lt Gen (ret.) Dr. Elder, do you have any further questions for Damon and Deron?

**D. Coletta:** **[Q14] [Q17]** Well, let me ask you a question. When you're thinking about space as a warfighting domain, do you use concepts like “offense dominant” or “defense dominant”? At the unclassified level, do you talk about the idea that things are nearly impossible to defend so we have to escalate in some other domain? Is that the line of thinking that you're at, or is it possible to develop new technologies to make satellites either able to run away or ride out attacks? Is that something that's feasible given the limited budget?

**D. Jackson:** **[Q14] [Q17]** Well, just to add in one other element here, one way to defend satellites would be to suppress enemy systems preemptively. So, if you're weak on the defensive side in terms of up-armoring or inserting a whole lot of maneuver without compromising service life, then you would want to go ugly early and suppress what the other side had.

**D. Coletta:** So, are those talked about as technologically feasible options?

**Interviewer:** I will defer to Lt Gen (ret) Dr. Elder here on this question.

**R. Elder:**<sup>15</sup> **[Q3] [Q14] [Q17]** So, you're getting into the crux of the issue here. Realistically, you do have some thoughts that the preemptive approach might be required to be effective, and, by the way, I think that's partially what's driving this line of thinking that we need to start thinking about space as a warfighting domain, and in the way that we would of a conventional type domain. For example, if we thought that someone was posturing to take out our ability to defend ourselves, then we would feel compelled to take some kind of action. I think there's some reason to that, but that is still actually a little bit different than the way we would treat a warfighting domain. The fact that we would take action to defend ourselves is one thing, but once we start talking about preemptively operating that space, that's where it gets a little murky, I think.

**[Q3] [Q14] [Q17]** So, I'm just pointing out what I think could be the issue. The reason we're having these conversations is to try and help us better understand the issues, and one of the things that we're looking at is the implications on the United States of treating space a warfighting domain. So, we're trying to understand all aspects of this, and my earlier question comes from the standpoint of enabling us to start thinking about the preemptive-type activities

<sup>15</sup> Lieutenant General (ret.) Dr. Robert Elder of George Mason University (GMU).

for defense that work well. If we inadvertently do something that leads an actor to think that we're about to take away something of theirs, how does the escalation control work? We haven't really talked that through, so I don't know if you guys have thought about that.

**D. Jackson:** [Q14] [Q17] This was actually part of the first about 15 years of debate within the nuclear strategy community, when they were trying to grapple with all these ideas that we now come back to look on as being deterrence theory. There is an article by Glen Snyder from the 1960s that contrasts deterrence and defense, and points out a dilemma that as you are building up your force structures, there are some things to help you defend and then there are some things to help you deter, but they're not the same systems, they're not interchangeable.

[Q14] [Q17] The dilemma is: at what point do you need to have capabilities that don't have any defensive value (i.e., capabilities that are purely offensive), and then how do you manage that mix, and then also how does your adversary see that as they are building up, and then can this relationship in any way be construed as being stable? I think for the first at least 15 years, the scholars of that time were trying to wrestle with these problems, just as we now are trying to apply them in space, because there's not a uniform continuum of have options for people. It comes down to, at some point we may need to be preemptive. This was on the table in the early ages of the nuclear confrontation. So, ultimately, this problem is new in this domain, but it's not a new problem—the classic dilemma emerges, and the relationship between states goes through a certain phase.

**D. Coletta:** [Q14] [Q17] On the nuclear side, the way it gets resolved is that you end up moving towards launch on warning and the so called hair trigger strategy, so it makes the whole thing I guess less stable—you have lower crisis stability. I guess one of the things that you're liable to run in to if you're responsible for treating it as a warfighting domain is, at what point is it worth it? How unstable are you willing to go, and how unstable is the other side willing to go, because they have voice in this too?

[Q14] [Q17] Just the recognition that if you can't harden satellites, if you can't build the technology to allow them to run away, and if you start moving toward preemption, then you're starting to change the level of stability, and you're probably going to enter a competition in risk taking there. In the nuclear domain, you have agreements to kind of stop that competition—you have moves to reduce crisis stability on both sides, and then recognition that it's probably not a good idea, at least in the nuclear realm (it would probably also not end up being a good idea in the space realm, either). Then, eventually, you come to some kind of verifiable agreement to keep that instability in check. So, that's where that eventually goes.

**D. Jackson:** [Q3] [Q14] [Q17] [Q15] So, to come back to Lt Gen (ret.) Dr. Elder's example of the home game for space, cities were the early targets and they couldn't be hardened or moved, so they had to come to the grips with that dilemma.

[Q3] [Q14] [Q17] [Q15] Space was essential in providing stability in that area, because it gave you some idea of what the other side's capability was when the early reconnaissance programs came on board. In the domain of attacks on aerial reconnaissance, the space domain was a necessary evolution for awareness of the other actor's capability, deployment patterns, and ultimately warning of launch, so you weren't blind and, therefore, stuck not being able to identify an attack before it was really too late to do much about it. So, maintaining that role for space in space itself, and circling back on the idea of situational awareness and surveillance and maintaining a good picture of what's going on will, like it was during the nuclear era, probably be absolutely essential to maintaining some sort of stable relationship amongst powers in the space context.



**D. Coletta:** [Q14] [Q17] Just to dovetail on that, space was part of moving toward that so called verifiable agreement, and “verifiable” being one of those ambiguous terms, but space was the key element of that. So, if you're going to defend assets in space, treating space as a warfighting environment by reducing crisis stability, then the next step, as long as the adversary also feels the heat, is moving towards some kind of verifiable agreement, not to eliminate instability but to somehow hold it in check. There's only so far that can go before it's against the interests of both sides. I guess, looking back at the nuclear era, that's where we would see that dynamic going over time.

**R. Elder:** Great. Thank you for the insight. I'm glad to hear you talking this way because most people do not have that level of understanding that you have, so I appreciate you speaking with us.

### Falconer Consulting Group

Walt Falconer  
President

Mike Bowker  
Associate

Mark Bitterman  
Associate

Dan Dumbacher  
Associate

15 August 2017

#### WRITTEN RESPONSE

War gaming and analysis is necessary to answer this question.

### Lieutenant Colonel Peter Garretson

Lead, Space Horizons Research Group | Instructor of Joint Warfighting, Department of Research  
(United States Air Force Air Command and Staff College)  
10 August 2017

#### WRITTEN RESPONSE

There is a hierarchy. Cyber-Space-Air-Surface, and SubSea-Sea-Land. If a surface campaign, either on land or sea, lacks Air Superiority, they will be crushed by sea. If the US loses Space or Cyber services it will be tremendously degraded, as will be the entire joint force because command, control, and targeting are so dependent upon Space and associated beyond line of sea coms.

## Gilmour Space Technologies

Adam Gilmour  
Chief Executive Officer

James Gilmour  
Director

13 July 2017

### WRITTEN RESPONSE

I firmly believe if the allied countries lose space communication capability in a future conflict there will be significant weakness in the other defence forces.

## Harris Corporation, LLC

Brigadier General (USAF ret.) Thomas F. Gould  
Vice President, Business Development, Air Force Programs

Colonel (USAF ret.) Jennifer L. Moore  
Senior Manager; Strategy and Business Development, Space Superiority

Gil Klinger  
Vice President; Senior Executive Account Manager for  
National Security Future Architectures

15 August 2017

### WRITTEN RESPONSE

Success will be defined by our ability to achieve effects from any domain and the ability to C2 the delivery of those effects quickly. Thought of through a “maneuver” mindset, we don’t need to necessarily dominate in every domain simultaneously, but will need the ability to maneuver throughout them, in an effort to deliver the desired effects at a time and place of our choosing.

The impact of losing in one domain and its relationship to success in others depends on a wide variety of circumstance related to both us and our adversaries. Does the one domain act as a force multiplier for the others? Does our adversary have the ability to exploit our loss in a particular domain in an effective way and to the benefit of other domains?

Having said this, losing the ultimate high ground in Space or Cyber, with an enemy that can operationally exploit either, would make success in other domains far more challenging and make success in an overall campaign difficult if not impossible. At a minimum, the costs of victory...in national treasure or human capital goes way up.

*Note: Enclosed in the interview transcript below are responses bearing on question 17, as well as any surrounding responses that provide the necessary context to interpret direct responses to question 17.*

#### INTERVIEW TRANSCRIPT EXCERPT

**Brig. Gen. Gould:** [Q14] So two points. One, if we're going to make it a war-fighting domain, we have to have a well thought out deterrence policy. That deterrence policy then needs to be communicated through the appropriate security channels. That policy needs to be integrated at the strategic level with other deterrence policies and other domains going forward. The second thing is, now that we've called it a war-fighting domain, we need to take the gloves off and treat it like a war-fighting domain.

[Q14] [Q17] Jen might be able to talk to this better, but we are so, stove piped with our space programs that we don't don't harness synergies from across the enterprise. The reason we're effective on the ground, in the air, and on the sea is because we've been able to unlock the synergies across all the mission areas in the joint effort. In space, for whatever reason—and I didn't grow up in the space community—in space, we compartmentalized or stovepiped everything. To be truly effective in any domain requires all of our capabilities within that domain to understand each other's mission areas and to leverage them in support of their own mission area. Until we can do that, we take on more risk and we will not be as effective as we could be going forward.

[Q14] [Q17] With regards to space as a war-fighting domain, if we're a war-fighting domain, then let's set out the requirements of operating in that war-fighting domain. We know what the mission areas are, many will be similar to the other domains. Space superiority will require offensive and defensive counter space, suppression of enemy space defenses, and other misc missions all supported with space intelligence surveillance and reconnaissance. We need to embrace these concepts, articulate the requirements and conops, and seek industry's help to move out towards meeting those requirements.

Jen, anything to add to that?

**Col. Moore:** [Q14] [Q17] The one thing I would is you take a big leap by saying space is now war-fighting domain without necessarily, I think, considering the cost of preparing the people to fighting in that domain. We seem to think we can create very high-tech capable space systems and that the value from those systems is intrinsic in the good technology, where it truly comes from the people who operate these things. I think right alongside pushing for a new technology and new capabilities in space, we have to build up the infrastructure and the capabilities for the operators who will actually be responsible for bringing the capabilities to bear. We haven't done that traditionally. Those are the first things that generally get cut from programs, a lot of times in the last minute.

[Q14] [Q17] I would say that that's a very different approach in the air community. There's a great focus on preparation of the pilot. It's another point that I think we have to take into account.

**Brig. Gen. Gould:** [Q14] [Q17] Yeah that is a good observation and to Jen's point, there's a whole organize train and equipped aspect of operating in a domain that's a war fighting domain versus operating in a domain that's a support domain. Jen is actually leading an effort to operationalize the training for our operators in space. In many ways, it mirrors what we did in the air domain or have been doing in the air domain.

## Theresa Hitchens

Senior Research Scholar (Center for International and Security Studies at Maryland)

19 July 2017

### WRITTEN RESPONSE

This seems to me to be a rather odd question, because “success” is relative and conflict specific. But we do have to think about trade-offs—I don’t think the U.S. can “dominate” every domain in every conflict. (If that were true, we would not be still in Afghanistan or Iraq.) The idea is to avoid conflict if you can, and win a conflict if you sadly get into one, and even more importantly, know when you have “won enough” to get the heck back out. We have to be prepared to have various domains suppressed or even rendered unusable for a specific conflict (think about the limits to urban warfare, for example), including space. The problem with space is that we have NOT moved to ensure Plan B(s) to reduce reliance on certain critical space systems. This is not because of anything other countries have done, it’s because WE have been short-sighted in our investments—protection and resiliency aren’t sexy; they aren’t “pointy edges” that get funding.

## Dr. John Karpiscak III

Physical Scientist (US Army Geospatial Center)

2 October 2017

### INTERVIEW TRANSCRIPT EXCERPT

**Interviewer:** [Q17] You emphasized the importance of integration. So, as we move into multi-domain conflicts, will our success hinge on being successful in every domain or can we lose in one and still be successful in the overall campaign.

**J. Karpiscak III:** [Q17] That’s a good question, but it’s also a rather open question because it will depend on who you fight, how long you fight, what the adversary’s capabilities are, etc. I can tell you, though, that you can’t cover all of the bases adequately forever—something eventually is going to fail, and something will arise that we think we have covered but actually isn’t. We’re always going to be dealing with situations like that.

The more complicated that we make our surveillance or our other various domains, the easier it is for somebody to exploit a weakness and use that to their advantage. Though, I do think that the loss of one domain would lead to some kind of degradation. Again, though, it depends on who it is you’re fighting and for how long. Somebody with a sat phone, or a small terrorist cell with sat phones, could easily run rings around a slightly larger force because they’re operating outside of a military domain and using systems that are outside of things that are normally monitored by the military in a tactical environment. There are limitations as to what we can do. But, as I said, it depends on who you fight and for how long. That’s a difficult question to really provide a solid answer to simply because it really depends on context.

## Group Captain (Indian Air Force, ret.) Ajey Lele<sup>16</sup>

Senior Fellow (Institute for Defence Studies and Analyses, Center on Strategic Technologies)

9 August 2017

### INTERVIEW TRANSCRIPT EXCERPT

**Interviewer:** [Q17] Sure. So, you mentioned the United States' dependence on the space domain and how actions in the space domain can impact other domains that are sometimes not considered, which segues into the next question I was hoping to ask you. As we move into multi-domain conflicts, will our success hinge on being successful in every domain or can we lose in one and still be successful in the overall campaign?

**A. Lele:** [Q17] I think that there will be a challenge overall. The US is interdependent on each of the domains. From that point of view, one really has to look at the holistic picture.

**Interviewer:** [Q17] Okay. So, how big of a factor do you think the space domain is in the overall equation if you look at the overall campaign or mission of the United States, and how important do you think the space domain is in comparison to some of the other more traditional domains?

**A. Lele:** [Q17] I will speak to three issues.

First, you need to have a good amount of jointness as far as space is concerned globally. Internationally, the interests of each country are not dependent on other countries, so if that jointness is missing, then you face the possibility that somebody might test the waters or act in an undesirable way. So, I think more collaboration plus a certain level of transparency is the key to success in the future.

So, from that point of view, there have been a lot of arguments that the Outer Space Treaty should be reexamined and that a certain amount of new mechanisms are required, because there is currently a mechanism for a code of conduct but it does not really work. Now, Russia and China are also helping with the Treaty on the Prevention of the Placement of Weapons in Space (PPWT), and I think one has to look at that without bias. There is no harm in discussing those treaty mechanisms, and either accepting, rejecting, or simply debating them. However, taking the point of view that you will not look at the treaty mechanisms just because they have been presented by China and Russia is not good practice; if you want to have a certain amount of co-existence, then you have to look at *all* sides of these issues.

Also, one area that needs slightly more attention is near-space systems (i.e., blimps, balloons, etc.). If those kinds of systems are aimed at serving a purpose at the tactical level or within a reasonably wide geographical area, that could help people. From that point of view, if there is a major challenge in space and we need to figure out a Plan B, we need to look at these technologies.

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<sup>16</sup> The responses here represent the sole views of Group Captain (Indian Air Force, ret.) Ajey Lele, and are not intended to represent the position of the Indian Air Force, Indian Space Research Organization, or Government of India.

**Dr. Krishna Sampigethaya<sup>17</sup>**

Associate Director for Cyber Security (United Technologies Research Center)

8 September 2017

**WRITTEN RESPONSE****Success in Multi-Domain Conflicts**

As we move into multi-domain conflicts will our success hinge on being successful in every domain or can we lose in a domain and still be successful in the overall campaign? Multi-domain conflict is not yet a well-defined term. We assume a multi-domain conflict features: ability to coordinate at least two domains simultaneously to attack assets in a domain; entities in all domains together form a single team in planning stage itself; and, command-and-control, situation awareness, and decision making capabilities span all domains and integrate to a tactical level of execution in each domain.

Conventional, cyberspace, and space domains are traditionally interdependent on each other, but in a multi-domain conflict—assuming the above features exist—this dependency is well understood, and made robust and resilient. Winning in a multi-domain conflict does not require attacks in all domains be defeated. A multi-domain conflict strategy and capability should enable the team to be resilient and continue fighting despite the non-availability of some domains or teammates.

For example, a mission can fail when military capabilities used in it are dependent on one domain. An example is a UAV conducting reconnaissance, but relying solely on satellites for navigation, timing, and communications. An attack in the space domain alone can lead to this UAV's mission failure in the air domain. But, if the UAV is designed to fall back on another domain, i.e., air, land, sea, or cyberspace, for its navigation, timing, and communication capabilities, it can continue in the presence of the space domain attacks and complete its mission. In this simple example, despite losing in the space domain, success can likely be achieved in a multi-domain conflict.

**Dr. Cassandra Steer**

Executive Director (Women in International Security—Canada Inc.)

Interim Executive Director, Center for Ethics and Rule of Law, University of Pennsylvania

1 September 2017

**WRITTEN RESPONSE****Success in Multi-Domain Conflicts**

The question has been posed: “As we move into multi-domain conflicts, will our success hinge on being successful in every domain or can we lose in one and still be successful in the overall campaign?” It should be noted that today nearly all conflicts can be considered to be multi-domain, at least for the most technologically advanced States such as the U.S., due to the high dependency on space-based assets. Although armed conflict may not take place in space, the extent to which space is integrated into terrestrial navigation, telecommunications (including internet), drone operation, intelligence, surveillance and reconnaissance, GPS-guided weapons, and more, means that space is implicated as a domain of conflict. Space is already a joint warfighting domain, it is just utilized in a unique way compared to all other domains. The question as to what amounts to “success” may depend upon the nature of each

<sup>17</sup> Any opinions, findings, conclusions, or recommendations in this contribution are those of Dr. Krishna Sampigethaya, and should not be interpreted as of the United Technologies Research Center.

domain. It is not necessary, for example, to wage or win an armed conflict in space, in order to maintain successful use of that domain for the benefit of all other domains. In fact, the parameter of “success” in the space domain may entail prevention of an escalation – in some circumstances, even if this were to mean a loss in another domain. This is because the U.S. and some allied States have the most dependency on space-based assets, and would therefore stand to suffer the most from any kinetic armed conflict in space, due to the problem of space debris and continued or unpredictable interruption of satellite services.

When it comes to non-kinetic methods and means, loss of satellite services could lead to a loss in other domains, again due to the high level of dependency on space-based assets. The U.S. currently lacks sufficient redundancy in many of its terrestrial systems to deal with a loss of satellite services. In this respect, protection of space-based assets is a priority, however the means by which this is achieved must be considered very carefully.

The US Air Force has developed a Space Enterprise Vision for 2030 with a mission statement to “deter aggression within the space domain and, when necessary, prevail in a multi-domain conflict that extends to space.” The first part of this statement is as important as the second part. Deterring aggression of any kind is critical to ensuring continued access to and use of space. Should a conflict extend into space in a more physical sense, that is through kinetic or directed non-kinetic attacks on satellites, it is critical for the survivability of all space services, and the terrestrial architecture which depends upon those services, that it is brought to a speedy end with as little escalation and as little damage in space as possible to the U.S.’s own space infrastructure and to non-U.S. satellites.

Given the number of dual-use satellites, and the fact that the U.S. government depends upon commercial providers for many services, the impact of a conflict that extends into space would be potentially catastrophic for civilians and the military alike. It may be not only possible, but also preferential, to “prevail” in space by focusing on crippling an adversary’s ground stations rather than on attacking their space-based assets directly. Without the full ground-based architecture, satellites are useless. It is easier to guarantee a successful target of a ground-station or a terrestrial-based service provider than it is to guarantee successful targeting of a satellite. It is also likely cheaper. And any negative knock-on effects for civilians, neutral parties and allies can be much more easily mitigated.

Because of the specificities of the space environment, and the high dependency the U.S. and its allies have on space-based technologies, a unique approach to space power may be needed when compared with other domains. Traditional doctrines of sea power and air power are focused on domain control. This includes area denial for adversaries while retaining the ability to access and dominate that domain; leading to the freedom from attack while maintaining the freedom to attack (Sloan, 2016, pp. 13, 37). However, just as area denial is impractical for the high seas, it is near impossible when it comes to space. In the early 21<sup>st</sup> century a collaborative and co-operative strategy emerged in seapower doctrine: prevention of warfare became as important as winning a war (Sloan, 2016, p. 14). For space, preventing a war may be even more critical than winning one. A similar approach should be the basis of considering conflict in space. If the U.S. takes on a traditional stance of attempting to control space and deny adversaries freedom to act in space, we cannot expect China and Russia to refrain from the same policy, thus leading to exactly the kind of escalation that needs to be prevented for the U.S.’s own interests (Hitchens & Johnson-Freese, 2016; Steer, 2017, p. 13). Space power should not be based upon striving for space control, precisely because competition to control it would be catastrophic for all. It is an inherently joint domain that must be shared with many other actors.

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15 August 2017

**WRITTEN RESPONSE**

From a purely statistical perspective, depending on success in every domain is almost certainly a recipe for failure. Given the advances of near-peer adversaries, and the posture where the United States is capable of projecting force into regional conflicts anywhere on Earth, it is very likely that a conflict will occur with the adversary having the “home field advantage,” with potentially more resources and infrastructure. Considering terrestrial communications, Satcom, ISR, Indications and Warnings, Cyber Warfare and Electronic Warfare, it is likely that an adversary will have an advantage, or even dominance in one or more domains.

The key to an effective strategy is to distribute warfighting capabilities across as many domains as possible. For example, commercial or private sector Satcom assets can be used as alternate PNT sources; they can perform geolocation of adversary jammers and radar installations, and even provide Space Situational Awareness and other Indications and Warnings.

**Dr. Edythe Weeks**

Adjunct Professor (Webster University)  
16 August 2017

**INTERVIEW TRANSCRIPT EXCERPT**

**Interviewer:** [Q17] Okay. So, let’s transition into the last question I was hoping to ask you. As we move into multi-domain conflicts, will our success hinge on being successful in every domain or can we lose in one and still be successful in the overall campaign?

**E. Weeks:** [Q17] So, that was the craziest of all the crazy questions for me. Do you know why someone would ask such a question? What’s the background of this question? What do you think about this question?

**Interviewer:** [Q17] Well, I think the idea is to sort of get an idea on how important the space domain is to our success overall, and how the space domain might compare to some of the other traditional domains in terms of overall importance to our success. So, for example, one might argue that the United States is far more dependent on space than any other actors, so if something were



to happen in space, then it would seemingly have far more significant impact on United States than, say, maybe the adversary that initiated the situation.

**E. Weeks:** [Q17] This seems like a strange question to me. But, I love the way you interpreted it there because you gave me a whole new zone to focus on. For example, many countries in the world are not yet as dependent upon the Internet as we are in America. The majority of Americans have become dependent on using the Internet for everything now. Even something like banking is done online, and people don't even keep bank statements anymore. We are totally dependent on the Internet and cellphones to get to the Internet in the United States. There are some countries who are still dragging behind in terms of jumping on this bandwagon—they haven't jumped on board fully yet—so a disruption of the Internet or cellphones would not impact those countries that are still using older technology that is not yet fully reliant on the Internet, so they may still be able to function while the US is not.

**Interviewer:** [Q17] [Q16] So, how reliant on space are some of the United States' adversaries in comparison to the United States?

**E. Weeks:** [Q17] [Q16] Let's use China, Russia, Iran, and North Korea as examples. A disruption of space technology would not affect them and their people in the same way it would affect the United States and its people. In those countries, people would still be able to function, except for the people whose livelihood depends on the international community because they would need the internet. But, the majority of people in those countries would just continue life just as nothing had happened. But, this is not the case in the United States.

[Q17] [Q16] It's frightening to me how much the US would be impacted by a space disruption. If you have a mule and that's how you get around and you make your money from cultivating herds, and you don't even have a cellphone or the Internet, then you are not going to get distracted—you won't be writing letters to your Congressperson just because the Internet gets wiped out. But, if you're the typical American who needs to text to pick up your kids from their soccer game and needs to check your bank statement and all the stuff, and the Internet is off and broken, then everybody loses track of what's in their bank account and huge problems ensue. Just the thought of that could spur mass hysteria.

[Q17] [Q16] So, that's why I would say that the US has a great risk in this case. But then, the beautiful thing is that as America moves forward and as it has moved forward with satellite communication and its reliance on the Internet, most of the world is following that. There are Internet cafés in most countries now and people are increasingly reliant on the Internet, but it is still not to the extent that Americans rely on the Internet, cellphones, etc. But, still, people want that. People want the cellphone. They want the internet. I was in China in 1986 and back then it was difficult to make international phone calls—you'd have to make a special appointment and it was really expensive. But now, I went back there a few years ago, and people have cellphones just like in the US, and the same is that case in the Middle East, Africa, Europe, etc.

[Q17] [Q16] So, people like the things that the United States has popularized or created. If we say, "Oh, the United States is relying on cellphones and the Internet," it makes us sound vulnerable and makes us sound weak, but the truth is that that's America's great strength—people throughout the world want that technology. They want to be able to take online classes. They want to have access to a computer so they can apply for a job at the United Nations. And that's the great draw of the United States—people want to mimic the US, they want to have what the US has, etc. Even people labeled as "extremists" seem to rely on satellite telecommunications via the internet, social media, cell phones, etc. I remember seeing online

video clips surrounding issues regarding the Arab Spring uprisings and, in the video, people were concerned about losing access to their social networks.

**[Q17] [Q16]** So, it's messy, and we can either look at this in a negative way or a positive way. We can either look at this thing in a negative way and imagine that enemies are going to do all these things, and that can become a self-fulfilling prophecy. Or, we can look at this in a positive way. For example, look at the Cuban Missile Crisis. In that case, we could have either cooperated or blown each other up. We decided to cooperate. So, perhaps nothing is scheduled to occur and maybe people just want to partner with the United States and be like the United States, but they are not accepted by the United States. That rejection sometimes can fuel potential conflict, and there are numerous historical examples. So, perhaps it's time to embrace some of the people who have been labeled as enemies, because the truth of this is that there is a history. I'm not just being naïve about political adversaries partnering in commercial ventures in outer space. The establishment of the massive global satellite Internet industry is proof that that partnering is possible. For example, cooperation with Russia has happened in outer space, historically.