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Taking Up (Outer) Space: An Exploration of Definitional Issues

A Virtual Think Tank (ViTTa)® 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.

[1] 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.

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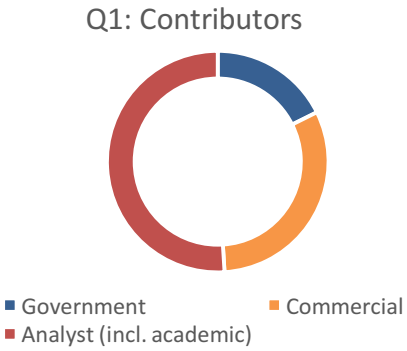
Question of Focus

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

Expert Contributors



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[2] The subject matter expert's personal views, and not those of his organization, are represented in his contributions to this work.
[3] Ibid.

Summary Response

Operationalizing or defining terms is an important first step to understanding concepts, including their boundaries and how they are distinguished from other, potentially related ideas. Similarly, clarity in communication is an essential condition for ensuring that the message or information that is transmitted is as close as possible to what is received. Within the DoD, definitions matter because they are a necessary component for the establishment and application of doctrine. Given the breadth of the space field as a whole, establishing precise definitions may become an even more pressing task, as coordination is sought over a broad base of space sub-communities (e.g., national security space, civil space, and commercial). Each field as a whole and each sub-domain within it naturally has its own terminology, which tends to evolve over time. To best advance coordination within and across the various US and allied space communities, we must be capable of fruitfully combining the work that is being done in various commands, DoD offices, and other agencies and organizations. This can be best achieved when we identify those terms for which precise definitions are required in order to move forward. Doing so also enables the US to avoid any unintended responses from our adversaries. This coordination begins by getting a broad view of the terminological landscape and any terms for which there is current contention.

Drawing on a wide variety of space expert opinions, we identified three different ways in which terms could be contentious. These include: 1) explicitly acknowledged contention, disagreement, or variation in terminology (inherent contention), 2) contention that was not explicitly acknowledged by respondents but discovered through comparison across contributors' definitions and commentary (emergent contention), and 3) ambiguous terms, which make contention more likely (potential contention). We refer to these different forms of contention collectively as "contentious space terminology." This assessment is accompanied by an examination of how membership in a given community of space professionals—government, commercial, and analysts[4]—relates to the kinds of space terms thought to be in contention.

These terminological issues are not necessarily only epistemological in nature, but instead can have important implications for the space field. While not every term in contention will have an obvious or detrimental effect on the ability of the US to operate in or maintain security in space, other terms in contention—such as "space weapons"—may prove problematic for long-term US security interests. As Michael Sherry of the National Air and Space Intelligence Center notes, "Due to the confusion in terminology and misalignment with DoD regular terminology, we have found it difficult in the space community to build systems clearly aligned to a mission." As such, this report provides a deeper exploration of a set of space terms whose contention may present major security concerns for the US.

[4] For classification purposes: Government includes individuals working in the military, defense (in DoD, not in military), civil space, and civil space regulatory. Commercial (or industry) includes old space, new space, satellite industry, launch, and space or data systems. Analysts include academics, attorneys, and traditional analysts. Within the analyst grouping, academics include individuals with a variety of backgrounds, including expertise in law, security, commercial, military, and international studies. Also within the analyst grouping, attorneys include those working in IGOs, private practice, and think tanks. Each of the three groups of subject matter experts possess specific area of expertise, which introduces some potential cross-over in expertise with their colleagues working in other areas. For example, space professionals classified as analysts can focus on issues of security, law, international studies, commercial sector, etc. Thus, academics, military professionals, and analysts all may focus on issues of security even though they work in different areas.

Do experts perceive that there is contention in space terminology?[5]

The original question posed began with the assumption that there are common space terms used by different communities of space professionals. To address this, we began by first examining whether there is commonality or variation overall in the terminology that is used, and whether variation occurs as a function of our experts' professional affiliations.

The majority of subject matter experts (67% overall) indicated directly or indirectly that there is space terminology that is either inherently or potentially contentious. Those working in an analytic capacity (69%)[6] or in the commercial domain (69%) more frequently indicated that there is contentious terminology than did subject matter experts working in government. As Colonel David Miller of the US Air Force indicated, "We have tried to come around to using DoD Joint Doctrine as the basis for our terminology, and I think within the Defense Department, we're pretty good there." Despite this organizing doctrine, 56% of government respondents (who tended to focus on security) nonetheless indicated that there is contentious space terminology.

> *"Overall I would say the biggest issue we have is there are NO common understandings nor use of space-related terms, definitions, classes, and typologies of infrastructure and access. This is true within the US (NASA versus a university versus AFSPC) as well as outside of the US (our use of terms versus the UK or Russia)."*
>
> *Michael Sherry, NASIC*

Among the current contributors, the most frequent issue contributing to terminology being contentious is its inconsistent use—both *across* the national security and commercial sectors and *within* each of these sectors. The variation in use of space terms within the USG is not really surprising given that, as Major General (USAF ret.) James Armor[7] of Orbital ATK indicates, the US emphasizes the separation of space into civil (e.g., NASA, NOAA, and USGS) and national security space (e.g., NRO, DARPA, Services) sectors—sub-communities that we might expect would utilize terminology in different ways. On the other hand, Dr. John Karpiscak III of the Army Geospatial Center suggests that differences in the application of a given term could be due to the differences between military branches that primarily 'own' versus those who most actively use assets in space (such as the Air Force and the Army). Those working outside of government also observed some variation in the use of terms within the DoD. Referencing Joint Publications and the US Space Policy, Marc Berkowitz of Lockheed Martin noted that,

> the most authoritative DoD documents defining the US national security space lexicon (DoDD 3100.10, Space Policy, JP 1-02, Dictionary of Military and Associated Terms, and JP 3-14, Space Operations) frequently have been inconsistent over the past few decades. Even the definitions of the basic defense space missions have changed frequently.

Ultimately, we cannot assume that everyone—even within a given sub-community working on space—is using the same set of definitions or has the same perspective on space issues given the segmentation inherent to the organization of the US space enterprise, as well as the variation in expertise, topical focus,

[5] 8% of subject matter expert responses did not touch directly on this topic, but instead considered other issues of terminological importance.

[6] Notably, 90% of the lawyers within this analyst group indicated that there is contentious space terminology (typically, in the form of ambiguous—and thus *potentially contentious*—terminology).

[7] Note: Major General (USAF ret.) James Armor's statements represent his own views and are not intended to represent the views of Orbital ATK.

and concerns of the diverse US space communities.[8] This is problematic because it can impede the application of military doctrine, as implied by Sherry's comments. Moreover, it can potentially hinder collaboration between the US and its prospective allied or commercial partners, leading to inefficiencies.

Contributors in fact offered several specific examples of terms that are contentious. These inputs address both inherent and potential forms of definitional contention, as described above. Additionally, several terms demonstrated emergent contention when variation was observed across the breadth of space expert contributors. To provide an overview of findings, all contentious terms are captured in the table at the end of this summary response. As can be seen from the table, contentious space terms related to security are most numerous, though contention also arises in other instances, such as legal/regulatory. Not all of these terms are necessarily problematic, however. This report thus will focus on examining two terms whose contention has particularly significant implications for national security.

When do contentious terms become problematic?

In many cases, contentious terminology may not matter—or ambiguity may even be desirable

A small minority of experts indicated that variations in terminology simply may not matter. In general, these contributors argued that any discrepancies that might occur could be easily overcome with communication. In addition, some operations may not require precise definitions of terms and/or individuals can resolve or work around them if necessary. Terminological ambiguity might even be desirable as it preserves options, and has, as several current contributors note, been useful to the US in the past when it comes to space issues. Moreover, David Koplow of Georgetown University suggests that attempting to achieve terminological consistency across national lines, public and private lines, and among different space sectors may be misguided; instead, he argues, the focus should be on clearly indicating how terms are being used when they come up, with the understanding that others may use or interpret these terms differently. Though this is likely to be true in many cases—and in particular when working within the US space community or operating alongside allies with whom we would expect this type of coordination—in other cases, it may not be sufficient to wait until an event (e.g., an ASAT test) invokes a potentially related concept (e.g., space weapons) over which different parties may have varying viewpoints.

In other cases, the stakes are high: space weapons and armed attacks

Broadly speaking, contentious terms become problematic when they have the potential to negatively affect the US and its security and other interests. At the more benign end of this spectrum, contentious terminology can lead to inefficiencies and impede collaboration, as noted above. However, at the other end of the spectrum, the stakes are higher, as contentious terminology can lead to misperception of US capabilities or actions among our adversaries, with unintended downstream consequences including escalation and retaliation. There is also the possibility that the US itself will miss or misinterpret its adversaries' intentions.

[8] Similar types of definitional and coordination issues have been addressed in the previous SMA Gray Zone effort. For an overview and access to the downloadable Gray Zone Integration Report, please see: http://nsiteam.com/integration-report-gray-zone-conflicts-challenges-and-opportunities/

To illustrate how this might be so, this report focuses on two examples[9] of terminology identified as being contentious—one of which can be broadly categorized as a capability or object (*space weapons*) and the other which can be categorized as an action (*armed attack*).[10]

In her discussion of space weapons, Victoria Samson of the Secure World Foundation provides an example of when definitional contention can become important: "…when you talk about security issues, of course the concept of what is a space weapon comes up all the time. The way it could be defined, it could be defined so generally that everything is a space weapon or so strictly that nothing is a space weapon." This matters because, in the absence of a clearly specified and commonly agreed upon definition, different states may perceive the same capability or object in very different ways based on the way that they are defining a space weapon.

This subjective interpretation contributes to a cognitive bias known as *naïve realism*—the belief that our perception of the world is the true or correct perception of the world,[11] and that others must necessarily see things in the same way (Jones & Nisbett, 1987; Robinson, Keltner, Ward, & Ross, 1995; Ross & Ward, 1996).[12] Where one state sees a benign use of a capability, another can see a looming threat—and infer that the other side must therefore intend that threat. The wide application of dual-use space technology[13] makes inferring intent from capabilities alone particularly difficult. Unlike the US space sector, in most other states, the private and public space sectors have more permeable—or no—boundaries at all, and neither are there separate civil and military government space sectors.[14] Both the organization of space operations and the nature of the technology itself thus increase the possibility that a given state's intentions can easily be misconstrued. This in turn increases the potential for escalatory or retaliatory behavior when no threat was intended.

This potential for unintended escalation may not yet be fully anticipated in the case of space weapons or weaponization of space, as most experts did *not* recognize that space weapon (or relatedly, weaponization) was a contentious term. Rather, it was identified as contentious primarily due to the variation in definitions offered by the subject matter experts. Jonty Kasku-Jackson of the National Security Space Institute draws on work by Vasani (2017), noting that the weaponization of space "includes placing weapons in outer space or on heavenly bodies as well as creating weapons that travel from Earth to attack targets in space… [in other words], outer space itself emerges as the battleground." Brian Weeden of the Secure World Foundation emphasizes the key aspect of space weapons as being *intentionally* designed to damage, degrade, or destroy another object in space or something on the ground. The type of variation that can be observed here was also indicated directly or indirectly by several contributors (Pollpeter,

[9] Though deterrence was also identified as a contentious term, this report refrains from addressing deterrence, as this topic is covered directly in the report for Q14 on how space should feature in US deterrence strategy.

[10] This report focuses on the contentious term, "armed attack" [action] as a point of illustration, as it is consistent with the more aggressive implication of the use of a (perceived or actual) "space weapon" [capability/object]. Alternatively, the report could have focused on the (perceived or actual) use of space for peaceful purposes [action]—which would have examined this issue from the opposite end of the continuum.

[11] Here, the world includes objects and by extension, people, for whom evaluations are thought to be inherent (i.e., characteristic of those objects or people—and thus static) as opposed to being a reflection of the internal and thus subjective perceptions of the observer. Furthermore, these subjective perceptions are influenced by beliefs and expectations.

[12] This idea (from social psychology) not only has deep roots in philosophy, but can also be seen in discussions within and across this and other disciplines, including under the mantles of attribution and social inference, the mirror image fallacy, and subjective construal—or in contrast to the concept of intersubjectivity.

[13] As Brigadier Gen. Gould notes, "the same rocket engines used to boost satellites into orbit can deliver the conventional or nuclear warheads." Samson and Cheng make similar observations.

[14] See the Q7 (actors poised to use commercial) executive summary for a brief discussion.

Samson, Spies, B. Weeden). For example, Michael Spies of the UN Office for Disarmament Affairs indicates that the term space weapon is contested internationally. He discusses the definition of space weapon offered in Article 1 (b) of the draft treaty on the prevention of placement of weapons in outer space,[15] noting that the definition does not address terrestrially-based anti-satellite systems (which would, incidentally, be covered under the prior two definitions above). Though there is some cross-over in the definitions offered by the respondents, there is also enough variation among these definitions to suggest that there is not overall coordination among the US space community on this important topic. This is not to say that any one definition is right or wrong—simply that the definitions vary and that this variation has implications. For example, an overall lack of coordination within the US space community on what constitutes a space weapon decreases both the likelihood of coordination with allies and of averting unintended consequences with adversaries.

Similarly, the definition of a space weapon is also likely yoked to the definition of what constitutes an "armed attack," or relatedly, "[harmful] interference" or the "use of force" in space. As Jack Beard of the University of Nebraska College of Law queries, "Is making a satellite wobble out of its projected orbit an illegal 'use of force?' Is it 'interference'?"[16] Having different concepts of where the boundaries of each of these terms lies once again opens up the potential for conflict, and as Beard notes, "what constitutes an armed attack justifying an armed response is a really controversial topic." At the same time, as Moriba Jah of the University of Texas at Austin indicates, actors such as Russia are strongly in favor of defining terms such as harmful interference, given its interest in invoking "self-defense" in space. As such, the US must balance the need for precision in terminology with the previously indicated utility of ambiguity in serving US interests.

How space weapons and armed attacks are defined also dovetails with another contentious term—outer space. Maintaining ambiguity in the definition and delimination of outer space has generally been strategically useful to the US (B. Weeden). However, defining outer space may matter for security in terms of designating lines of authority, planning, and response. As Patrick Stadter of the Johns Hopkins University Applied Physics Laboratory notes,

> if you start to have adversary deploying access that transcend different domains, is it a missile? Does it go into space? At that point, those things become very very important relative to integrated strategic plans and OPLANs and command authority and how that's reflected in policy. That will matter. It already matters a lot, and it's a challenge.

Variations in the use of terminology and potential misperception are likely to increase with the widening gap in assumptions, norms, or ideologies that might be observed when different countries come to the table. For example, Dean Cheng of the Heritage Foundation and Asian Studies Center at the Davis Institute for National Security and Foreign Policy, provides some initial insight into how other states may view the issue of space weapons, indicating that the Chinese ultimately think about space and military impact on

[15] "…presented to the Conference on Disarmament by China and the Russian Federation in 2014, [which] defines this term as 'any outer space object or component thereof which has been produced or converted to destroy, damage or disrupt the normal functioning of objects in outer space, on the Earth's surface or in its atmosphere, or to eliminate human beings or components of the biosphere which are important to human existence, or to inflict damage on them by using any principles of physics.'"

[16] As Beard further notes: "'Interference' is a hugely debated and controversial term because it appears to be prohibited, but there is no definition of it—there is no authoritative definition of 'interference' in any international agreement except in the context of radio communications. And there's a real problem between where interference ends and something allowing an armed response occurs."

space as *anything that affects the entire holistic space structure*.[17] The breadth of this classification of course leaves the door wide open for the perception that the use of a given capability may constitute use of a space weapon, and thus require a response. Thus could begin an escalatory cycle that could be avoided if a common agreement instead is reached regarding what does and does not constitute use of a space weapon or weaponization of space. As it is, Kasku-Jackson notes, there are already some concerns that the US will fold under its definition of "peaceful purposes" (National Space Policy, 2010) both the militarization *and* the weaponization of space for national and homeland security activities. This fear may make others more likely still to misperceive the use of certain kinds of US capabilities in space as being intended as a space weapon—and thus execute their perceived proportional response.

Conclusion

The true power of definitions lies in their ability to facilitate communication within and across groups and states operating in space and, ultimately, in their ability to facilitate the achievement of US goals, including the maintenace of stability in space. As Brigadier General Thomas Gould (USAF ret.) of the Harris Corporation indicates, the US should aim to provide leadership in the definition of norms (and presumably, associated space terms). This view was echoed by Samson, who notes that norms and international cooperation may be the best route by which to achieve stability and predictability in space, with reliable access to space assets. In the case of space weapons, a failure to establish common definitions and associated norms can result in misperceptions that can leave the US and other space actors in a precarious position. Samson cautions, however, that by talking about space weaponization, the conversation is led down a road that may not be necessary or helpful. Instead, she argues, it may be more helpful to talk about stability, which is "a broader concept that contextualizes the domain and allows you to talk about anything that destabilizes the space domain." Thus, by having a broader understanding of the array of things for which space is actually used, she argues, we might more readily disambiguate some of these points of confusion or contention.

Table: Categories of Contentious Terms

In this table, terms are organized in five categories: *security* (e.g., space weapons, space security), *legal/regulatory* (e.g., global commons, space faring states), *Outer Space Treaty* (e.g., harmful interference, peaceful purposes), *commercial* (e.g., classes or sizing of satellites), or *cross-topic* (i.e., those terms that would otherwise bin into multiple categories such as space user).

Security	Legal/Regulatory	Outer Space Treaty	Commercial	Cross-Topic
Weaponization / cf. militarization	Hard law	Province of all mankind (Article I)	Private human spaceflight	Space capability
Space weapon*	Soft law	Free for exploration and use (Article I)	Commercial / cf. private	Sustainability
Self-defense	**Global commons**	For the benefit of all mankind (Article I)	Classes or sizing of satellites	Space industrial base
Resiliency	Norm	Common heritage of all mankind (Moon Agreement)	Space industry	Space activities
Deterrence	Space traffic / space traffic management or control	[Prohibition on] national appropriation (Article II)		Space actors

[17] This commentary is particularly interesting given China's own ASAT test in 2007, resulting in extensive and harmful space debris.

Armed attack / laws of armed conflict		**Space faring states***		Weapons of mass destruction (Article IV)			Space vehicles vs. aircraft vs. space object
Act of aggression		Use of force (UN Charter)		**Peaceful purposes / uses (Article IV)**			Uplink
First strike		**Outer space**		Celestial bodies (all articles)			Downlink
Space security / cf. space safety				Personnel [astronauts] (Article V)			Electromagnetic spectrum
Proportionality				Authorization and continuing supervision (Article VI)			Stability
Contested (context of conflict)				**Harmful interference (Article IX)**			**Space user***
Space control							
Space situational							
Battle space management							
Strategic use of space							
Space object identification / cf. situational awareness							
Order of battle rules							
Red versus gray							
Spacecraft categorization							

Table Notes:

(1) Bolded items indicate that this term was nominated by three or more subject matter experts (SMEs). Multiple terms are listed within a cell when an individual term was noted by some SMEs but also discussed by other SMEs in the context of a comparison of two terms with one another. All terms used in this table have as their context a current application in space.

(2) While individual experts did not consistently indicate that there was *contention* about the definition of terms noted with an asterisk (*), an examination of the individual definitions offered for these terms revealed that the experts had varying ideas about what, specifically, constitutes either a space-faring state or a space weapon—though there was also some degree of overlap. As such, these terms are also considered to be contentious from a definitional standpoint.

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Subject Matter Expert Contributions

Roberto Aceti

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9 September 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** I want to start with first question that's not on the email I sent you but it's more with the other question that we like to ask on all experts. I want to know if you've encountered any gap in language and terminology across different states, communities, or other any specific contentious terms and definition that you encountered when you talk to states communities in the US or within the government, military, in the commercial industry, is there significant gap in language?

R. Aceti: **[Q1]** I actually don't think so. Our community is actually a rather small community. I think we have several occasions to meet for business, for conferences to exchange views, and I think we share a common jargon. It's unconceivable for me that you talk a certain language when you do certain kind of activity more scientifically oriented and then you change language as soon as you turn into activity associated with security or commercial ventures. I don't see anything that I can classify or refer as gap in terminology. No, I think we all understand pretty well. We have a common jargon. No, I don't think this is a concern for my side.

Adranos Energetics LLC

Chris Stoker
Chief Executive Officer

Brandon Terry
Founder and Chief Technology Officer

11 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay, good. So Chris, we'll start off with… not the first question from the list here but I want to ask you if there are contentious terms or terminology and definitions of space that you've encountered in the commercial sector that you have found to be different across different space communities. So let's say you're in touch with your counterparts and the military or the civil space domain or across the commercial sector in different countries. Do you often encounter contentious space definitions or terminologies that vary across these communities or any specific terms that you could have an issue of definition at all?

C. Stoker: **[Q1]** I haven't. Brandon, have you?

B. Terry: **[Q1]** Not really, no.

C. Stoker: **[Q1]** Okay.

Interviewer: **[Q1]** Okay, great. So language isn't a concern, or is that much of a concern in your experience?

C. Stoker: **[Q1]** No, not necessarily. I mean just for context. I mean the groups that we've interacted with, they're more on the small set launch site. Since it's so new I think it entered the military and the government space are kind of growing together a little bit. So I haven't noticed a big difference in terminology.

Brett Alexander

Director of Business Development and Strategy (Blue Origin)
14 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** I'll go ahead and just read them over again. We'll actually start with a question we want to ask all the experts we speak to and that is if you have encountered any contentious terminology and definitions related to space across different space communities? So, do you find that there is a gap in the language or a lack of standardized terms when you interact with, let's say, the civil space domain or with the government and military, and is that a common problem of language?

B. Alexander: **[Q1]** I've worked across different domains, so I'm familiar with most terminology. But there does seem to be a difference in terminology partly due to how people use terminology between the national security and commercial sectors.

Interviewer: **[Q1]** And how wide spread is this issue? Is it a big concern? Is it something that needs to be looked at in much more detail?

B. Alexander: **[Q1]** I do not think it's a big concern. I think it's something easily overcome by having people talk to each other.

Anonymous Commercial Executives

24 August 2017

WRITTEN RESPONSE

[Q1] What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

Currently the space community exists in these missions and users:

1) **International Space Station:** Global, multi-nation cooperation for the International Space Station (ISS). Countries including Russia, the United States, Japan, Canada and the 11 member states of the European Space

Agency. The collective group works in collaboration to keep astronauts and experiments running and is the most public action in space at the moment. The infrastrcuture and technology of the ISS and access is done jointly among the participants.
Terms in use: space-faring nation, often just the name of the country is used

2) **Private companies:** Other planetary or lunar missions are done within respective countries, that include building spacecraft for long-duration missions. Space companies, in conjunction with NASA, are also exploring and gathering data from other planets. Private companies are also pursuing missions like space tourism, and making traveling to space a more fiscally available option for average citizens.
Terms in use: space tourists, space tourism

3) **Technology:** Science and technology, via GPS data, weather satellites and other commercial applications and users.
Terms in use: These are often private companies who might not have a space-function in their names, but large corporate entities making profit off satellite and other uses.

4) **Military**: Military assets, intelligence gathering and classified missions and spacecraft.

There is no governing body overseeing these entities or ventures. Within the military realm, it is assumed that a space-faring nation and potential adversary to the United States could and would leverage U.S. assets in space, targeting that access to technology and information on board.
Terms in use: a mix of Air Force and Navy vocabulary.

[Q1 SUPPLEMENT] How might definitions of these terms vary from the commercial sector to the military/government space domain?

There is some overlap and military terminology does at times translate to its space counterpart.

Anonymous Launch Executive

17 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** First of all, we like to start off all our interviews with just asking… especially in the commercial sector. We want to ask you if there's any points of contention in relation to terminology, whether it be the points of contention with the civil space domain or in the military, in the government or in academia. Are there any terms or any common misunderstandings in language that are space-related that you encounter a lot in the commercial sector?

Anonymous: **[Q1]** Well, I'm sure there are. I don't know. I don't know off the top of my head what I would be worried about but yeah, they do have different languages. I'm probably one of the guys that knows them all. So I don't notice them this problem that much.

Major General (ret.) James B. Armor, Jr.[18]

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

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

- There are two equally important broad trends in the space enterprise:
    - 1 – Normalization of space as a medium equivalent to conventional terrestrial mediums. "Earth facing" or "Earth centric" objectives in national security (military & intel), civil (resource and disaster management), and commercial sectors
    - 2 – Space as a frontier for mankind – "Outward facing." Exploiting the Solar System for human industry.
    - BOTH are affected by blossoming new technology in electronics that enable smaller spacecraft and lower cost launch.
    - BOTH are essential/foundational to current and future geo-political power of the US and the West. In both it is essential for the US to set and enforce positive *precedents of behavior*.
- Lots of intellectual energy in US defining what is commercial as opposed to the various roles of government. It is important to define these roles & responsibilities and legal standing over the various activities, and important to decide "inherently governmental" functions. Important because we are competing with others and we need to be efficient and effective.
    - Preference: 2010 National Space Policy: "the term "commercial" refers to space goods, services, or activities provided by private sector enterprises that bear a reasonable portion of the investment risk and responsibility for the activity, operate in accordance with the typical market-base incentives for controlling cost and optimizing return of investment, and have the legal capacity to offer these goods or services to existing or potential nongovernment customers."
    - Source of investment – USG vs. private. I think this is at the core of any definition
    - Government can use commercial business practices to obtain commercial goods & services, but often doesn't use the best ones (like purchasing satellite comm on spot market instead of long-term plan)
    - USG at this point is on halting (fits & starts) transition from self-development and operation of space systems to use of commercial service. Regularly use commercial satcom and imagery. Others, like weather are "resisted" for several reasons. (Bureaucratic inertia, perceived requirements, budget constraints, Congressional engagement, etc.)
    - Commercial applications of USG provided space service (e.g. GPS, and weather).

[18] The responses here represent the sole views of Major Gen (USAF ret.) James Armor, and are not intended to represent the position of Orbital ATK.

        - Note, there are Civil government applications of NSS (National Security Space = military and intelligence) systems, too. (FAA, DHS, state & local governments all use GPS.)

    - Source & ownership of Intellectual Property (IP) is also a criteria in the definition of "commercial".

- US from inception (Eisenhower) developed sectors, separating Civil (NASA, later NOAA & USGS [US Geological Survey]) from National Security Space (NSS)(NRO, DARPA, Services). Other countries have not.
    - NSS has diverged, too: intelligence (NRO primarily), military (USAF primarily), S&T (DARPA, labs)
    - Other countries do not distinguish – "dual use" pertains

- "Spin offs" – technology that was developed for space activities that was used for other applications. (See Space Foundation (SF) Technology Awards over the years.)

- "Space Industrial base" has also been difficult to define. There is commonality across all sectors, and new players, too
    - Space technology is widely available to creative forces of free enterprise, and is becoming more so as technology advances and space access (launch) drops.

    - However, some traditional space industry firms hold exquisite technology that offer critical military/intelligence "competitive advantage" that continues to advance using USG budgets (S&T, R&D)

- Space Foundation annual Report. SIA annual state of the industry report. Several others like AIA, think tanks (and commercial news services (NewSpace Global (NSG), Northern Sky Research, many more)

- Space faring states: arbitrary definition but include

    - Development capability (design & manufacture)

    - Launch (build, launch from managed territory (e.g., their own or allied country), operate)

    - Spacecraft (design, build, operate) from their territory

    - Ground infrastructure (T&C network, SSA-tracking, spectrum allocation)

    - Government financial support (R&D, other incentives like spectrum, tax, etc.)

    - Do they sell any space services to others? Financing? These I would not consider space-faring.

- T&C is telemetry and control (or TTC, telemetry, tracking & control). There are networks of antenna (ground terminals) and their communication links – both government (e.g., AFSCN, NASA DSN) and commercial (e.g. SSC Space US, and IntelsatOne Terrestrial Network) – around the world for commanding satellites from their respective mission control centers (MOCs). TTC networks are "shared" infrastructure, so de-conflicting the contacts with the various satellites as they continually orbit is a skilled discipline.

- SSA-tracking = Space Situational Awareness tracking. Implies both passive (watching with telescopes on the ground or in space, or listening to the signals coming from the satellite to locate it; and active (illuminating with a laser or RF signal to get a return or ranging signal). I put "tracking" to distinguish from "characterizing." Tracking just determines the orbit, like for a catalog. Characterizing describes the attributes of the satellite (shape, size; is it operating or dead-debris; what's its mission; can it maneuver; fuel type on-board; life-time; who's the owner; etc.).

- <u>Bottomline: Space is normalizing & maturing.</u> Many users don't know they are users. Almost everyone is a user of space technology but most don't realize it. (PNT, mobile comm, imagery for agriculture, resource management & disaster response.) Many firms develop space segment as an incidental to their data business.

- Space is expanding outward tapping into new space resources. There are totally new space functions, like tourism, lunar and asteroid mining, space-based solar power, satellite servicing and assembly that are attracting private funding and leveraging the space industrial base (IP, manufacturing, operations, and spectrum).

Marc Berkowitz

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

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

There are few common understandings of space-related terms, etc., within the US Government, among the US Government space sectors (defense, intelligence, and civil), between the US public and private sectors, or between the US and other nations. Indeed, there is inconsistent terminology internal to the Defense Department. The most authoritative DoD documents defining the US national security space lexicon (DoDD 3100.10, Space Policy, JP 1-02, Dictionary of Military and Associated Terms, and JP 3-14, Space Operations) frequently have been inconsistent over the past few decades. Even the definitions of the basic defense space missions have changed frequently.

Nonetheless, there generally is consistency regarding fundamental terms for: classes of orbits (LEO, MEO, HEO, GEO); classes of launch vehicles (small, medium, heavy) based on throw weight to orbit; classes of spacecraft (micro, nano, small, medium, large) based on dry weight mass; and space system segments (launch, ground, orbital, link(s), and user).

Brett Biddington

Principal (Biddington Research Pty, Ltd.)
9 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. However, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

B. Biddington: **[Q1]** That's a very good question. Recently, I started to read Joan Johnson-Freese's new book, *Space Warfare in the 21st Century: Arming the Heavens*. She has a very interesting conversation about the words "contested," "congested," and "competitive." which ultimately, goes to the question of US exceptionalism, so to a much bigger question than just space. Ultimately I think

that she is asking, “What sort of accommodations is the United States prepared to make to others with space ambitions, if any, in the context of space development and space utilization going forward?” US space policy has waxed and waned on these matters over the years, Joan’s discussion relates more to a philosophical point about how the United States sees itself in the world and has seen itself in the world since the Monroe doctrine.

Of course, we have had the disturbance—if I may call it that for the moment—of the current Trump presidency, which is not so much breaking rules, as simply ignoring that they exist in terms of norms of behavior nationally and internationally. And that leads now to the situation we have in Korea, which ought to be deeply concerning to us all.

Interviewer: **[Q1]** Okay. So, what about a term like "space" itself or a term like “outer space?” Are there any differences in how Australian policy and US policy define “space” or “outer space?”

B. Biddington: **[Q1]** That’s a really good question, too. I’ve talked quite a lot about this. At the senior political level in Australia, the word “space” is basically a dirty word. The reason for that is because over many, many years, the agenda in this country for space has been fundamentally set in two places.

[Q1] The first place is in the classified domain and the Department of Defense. Since the 1940s, space has been at the heart of Australia’s national strategy. In the 1940s and 1950s and into the early 1960s, it was basically the relationship between Australia and the United Kingdom around the activities of the Woomera test range. When the Brits withdrew, that’s when the Americans basically came in and said, “Have we got a deal for you," and that has led of course to the joint facilities that are so important. That’s really the long pole in the tent of the Australia-US alliance. And I don’t see that changing, actually, but it’s something that our government in Australia finds very difficult to talk about because they don’t want to say anything that might in any way compromise the capabilities that are supported.

[Q1] The second place is the civil and commercial aspect where that agenda has been largely set by scientists, and their view has been to go to the government with their hands out for money for pet projects that have not necessarily been in the national interest but have been in their own particular research interests. So, there has been a lack of coherence in that approach for a long, long time.

[Q1] There is some evidence that this may be changing quite rapidly, but the past is still with us in terms of this over-emphasis on science and under-emphasis on the economic importance of space to not just the national economy but the global economy, as well. That economic argument has not been well-articulated. If I lift this one level, this means that there is no coherent national narrative in Australia around space, and that’s what I’ve certainly been trying to create for the last decade.

Bryce Space and Technology

Carissa Bryce Christensen
Chief Executive Officer

Brigadier General (ret.) Ian Dickinson
Chief Operating Officer

Phil Smith
Senior Space Analyst and Artist

26 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** We want to start by asking you if there's any contentious space turns or variants in terminology that you encounter across different space communities. I think in your capacity as CEO of Bryce Space and Technology, you probably have very good access to different communities and you might have a good idea if there is any general misunderstanding or gap in language in terms of space terminology. So, are there any contentious space terms that you commonly encounter?

C. Christensen: **[Q1]** That is such an interesting question and it's such a good question. There are not terms that I can immediately think of where there is dramatic disagreement or fundamental contention. The question of commercial norms of behavior or existing norms of behavior in space, I think is a topic where there are different perspectives.

C. Christensen: **[Q1]** Generally, our answer is we don't have any big answers on the contentiousness question.

Caelus Partners, LLC

Jose Ocasio-Christian
Chief Executive Officer

24 August 2017

WRITTEN RESPONSE

"Open Source SMA input WRT US Security Interests in the Space Domain"

In the commercial space, especially for the investment community, terminology has to be kept simple. As an investor, there are five categories of companies for investment. We categorize by technology type after identifying the type of business they are first.

- Government non-dilutive investment / project: Either NASA or DoD through a grant provide funding for a company to create or develop the intellectual property that the government wants to own or be serviced from. Depending on the project and the type of technology being used, the government connection can constrain the company in its ability to do business with entities in foreign nations.

- Contractors or Prime Companies: These are the contractors to the US government. Normally, they are publicly traded companies whose stock value is based on trading as well the size of government contracts they receive for new technologies. Contracts with these companies are greater than $15MM.
- NewSpace Companies: These are privately held, not publicly traded companies that are developing technologies focused commercial customers rather than nation-states. These companies primarily provide a service for Earth-based markets. Some of these private companies provide services to the US government for small contract amounts (<$15M), but these contracts are short duration with termination agreements set during the service of the contract. The contracts are beneficial for the company for both revenue and valuation, which provide dividends yearly for investors.
- Non-profit or philanthropic opportunities: These are the educational, youth-focused opportunities in the space industry that provide the pool of talent to support the projects or companies listed above.
- Joint ventures: These are companies (either publicly traded or private) that are created from two or more entities that are going to provide a service or generate revenue to improve a particular economic market. This may include an investment from a nation-state government, contractors or primes.

Elliot Carol[19]

Chief Financial Officer (Ripple Aerospace)
7 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Before we get to those questions I want to start off the interview by going over a question we ask everyone we have been interviewing so far and it is just go over some space terminology and definitions. What we want is to gear this question towards someone like yourself, in the commercial industry… Do you encounter any contentious space terms or terminology and other definitions that you find are significantly different across space communities? So when you work with your counterparts in the government space domain, in the civil space domain etc., if you found there is a gap in terminology there and what those terms are.

E. Carol: **[Q1]** Understood.

Interviewer: **[Q1]** A couple of examples of that could be common space domains; it could be also what is outer space, global space comments, stuff like that. Do you often encounter contentious terminology like that?

E. Carol: **[Q1]** I'm sorry, yes I do. I didn't realize that was the question. All right, yes I experience those terminology every day.

Interviewer: **[Q1]** This may be a little off the cuff here, but is there a specific terminology or a certain area where you encounter a lot of contentious definitions?

E. Carol: **[Q1]** Yes, mainly dealing with colleagues from other countries or companies whose business is not space or focused on different aspects of space.

[19] The responses here represent the sole views of Elliot Carol, and are not intended to represent the position of Ripple Aerospace.

Interviewer: **[Q1]** Is there a way that you've been able to deal with that? Is there a standard set of definitions that you refer to that you're working with to overcome that obstacle?

E. Carol: **[Q1]** It depends on the level of sophistication the person is dealing with. For example, earlier today I was on the phone with an academic institution and the conversation was referencing was the moon, so it was understood when I said LEO or when I said landers, that we were specifically talking about moon based assets. When I'm dealing with unsophisticated parties, for example, commercial partners that focus more on bio systems versus space systems I will be very clear in trying to tell them what body I'm talking about and just make it as clear as possible.

Interviewer: **[Q1]** Could you expand a little bit on the gap between US terminology, and European terminology and Australian terminology as well as, is it significant or is it roughly equal and just a few points of disagreement?

E. Carol: **[Q1]** It is significant enough that if you're going over technical designs or developing a commercial contract that it does need to be defined. For example, I am CFO of Ripple Aerospace. We are signing a new contract with a European propulsion company. The definition of certain aspects of the vehicle are different. As well as things often get miscommunicated when you are translating from meters to feet. Does that help?

Interviewer: Yes, yes, absolutely.

E. Carol: Just so it is on the record, these are my personal views. These are not the comments of Ripple or any other company I'm dealing with, so they are my personal views alone.

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: **[Q1]** Okay. Let's start with the first question from our list, which has to do with definitions and terminology. So, one of the things that we have been asking everyone as part of the interviews is whether or not there are any sort of contentious space terms or definitions. Basically, from your perspective, are there any noticeable disagreements amongst the space communities about appropriate terminology or appropriate definitions for that terminology?

D. Cheng: **[Q1]** I don't know whether if the issue is terminological or not, but you absolutely have differences of opinion about, for example, "is space truly the common heritage of all mankind," and all of that sort of thing versus natural security imperatives. I mean, we have the treaty issues of "liability" and all of those sort of things, but the folks who were thinking of that back in the 1960s are somewhat different from the people who are thinking about it today as we start looking at things like space tourism and constellations with thousands of satellites. So, we do have a couple of different communities—I don't know how contentious they are and I don't know that it's necessarily "terminological," although certainly that is going to be part of it.

Interviewer: **[Q1]** Do you think that it is problematic that different communities might be using different terminology?

D. Cheng: **[Q1]** Well, that depends on how willing you are to be constrained by it. I mean, I think the Chinese and the Russians demonstrate that hypocrisy is a virtue, not a vice, in their view. We, in the United States, on the other hand, are often hoist on our own petard, saying, "Well, we want everyone to have the right to access space." Well North Korea is basically taking that great chicken home to roost by saying, "Okay. Well, we want to put satellites into space." Now, the fact that there also has to be a test program for an ICBM is a separate issue, but how do you say, "No, you can't do that," if we also go around saying, "But every nation has the right to peaceful uses in outer space."

Again, is this a fundamental problem? Well, it's a fundamental problem if you allow it to be. Now, I think most people around the world—most—would say North Korea is different from China or Switzerland or even the United States. But, unfortunately, that's not how we allow ourselves then to try to find our way out of this problem.

Interviewer: **[Q1]** Sure. So, let's take a step back a little bit with respect to definitions. For a term like "space" itself or "outer space," there could be some ambiguity when trying to define it. So, I'm wondering, do you think that these terms—"space" and "outer space"—are appropriately defined universally right now? If not, do you think they need to be?

D. Cheng: **[Q1]** Are they defined commonly? No. The Chinese, I'm pretty sure, go with anything 100-miles up and beyond is outer space. I don't read Russian but I think the Russians have a similar definition. I think the US is actually a little more ambiguous. There are, of course, scientific explanations of exactly when you escape the macro effects of gravity, etc.

Though, again, does it constrain us? Well, how willing are you to be constrained? I mean, yeah, if you're an arms controller, you want as broad of a definition as possible for "space" and as restricted of a definition as possible for "what is allowed." If you're more focused on national security exploitation in space, you are going to have the opposite desires.

Sure, scientists probably can reach a definition, but scientific definitions aren't always the most militarily nor politically useful.

Interviewer: **[Q1]** Okay. One last definition question. From your perspective, what would constitute a "space weapon?" How would you define the term "space weapon?"

D. Cheng: **[Q1]** Anything that affects a space enterprise. That includes anything that affects satellites, anything that affects terrestrial and ground-support facilities, and anything that affects both the data links and the tracking, telemetry, and control links. Any of those. So, yes, that means that a special operations team going in to blow up Vandenberg is a space weapon. Now, is that a useful definition? Well, that again depends on what it is you are trying to do. But, I will say that my focus is on China, and that is how the Chinese think about space and military impact on space. It's not just about affecting the satellites—whether with kinetic or directed energy or even cyber—it is what affects the entire holistic space structure.

Interviewer: **[Q1]** Okay. So, how do you think we should define different classes of space users?

D. Cheng: **[Q1]** With respect to the different categorization concept, it's not "terminological," but it's more sort of like "baskets." Basically, you have three broad categories.

First, you have those states that have a full set of space capabilities, meaning that they have satellites, they have space launch capacity, and they have satellite and space manufacturing capabilities.

Below that, you have states that have perhaps some satellite manufacturing capability, but they possess satellites. For example, Canada and Australia.
Then, the third category would be states that only possess satellites. For example, Bolivia, Pakistan, and Venezuela.

And then you now have non-state actors, which typically only possess satellites—though that may change over time as we watch certain folks like Bezos and Musk also develop space launch capabilities, and therefore space manufacturing capabilities.

[…]

Interviewer: **[Q1] [Q2] [Q10]** Okay. How would the Chinese define "space security" or "a secure space domain?" Does the Chinese definition and perspective on this differ from, say, that of the US of the EU?

D. Cheng: **[Q1]** Well, to begin with, the Chinese are not that interested in space security. This is part of what we are getting at here. The Chinese focus is on national security, which is defined by core interest, which begins with territorial integrity and sovereignty, the preservation of the Chinese Communist Party's rule, and the preservation of economic development. Space is a tool to obtain that, but there is not "space security," per se, any more than there is "oil security." When you talk about "oil security," you are not talking about preserving oil rigs in Libya—you are saying, "Can I, country X, get enough oil to keep my economy running?" So, the Chinese, if they are going to define "space security," are going to say, "First off, what do I need space for?" (note that those requirements for China are very different than those requirements for the US) and then, "What do I need to do to make sure that those missions are fulfilled, which may not have to be by space?"

So, consider that China does not at the present time have any space-based missile early warning capability. That was one of the first things the United States developed. That was one of the first things the Soviet Union developed. But the Chinese, 47 years after going to space, have yet to deploy space-based missile early warning. That should tell us that the Chinese has a very different view of the strategic role of space, and, therefore, how they think about something like "space security."

Matthew Chwastek

Director of Product Management, Public Sector (Orbital Insight)
22 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay, great. I'd like to ask you from a commercial perspective in your capacity as director of product management in Orbital Insight, if there's any contentious space terms, any gap in terminology in terms of your counterparts at the government/military or in civil space. For example, what is a Nano satellite or global space commons… anything along those lines? Do you often encounter terms like that where you find different use of terminology across Space Communities?

M. Chwastek: **[Q1]** Sure. On the talk about terminology, I would say that's been much better in the last few years. I would say there's still a disconnect for many not directly in the space industry on what a nano, micro, and full satellite are in terms of size. The actual terminology for nanosat versus microsat is contingent on a number of things because some people use that terminology differently depending upon their application. So in terms of communications (aside from remote sensing), different understanding exists on these topics.

Dr. Damon Coletta & Lieutenant Colonel (ret.) Deron Jackson

United States Air Force Academy

Damon Coletta; Professor of Political Science
Deron Jackson; Director, Eisenhower Center

8 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay, great. However, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

LTC Jackson: **[Q1]** That's a good question because as we all teach cadets, if you can define the term then you are halfway to winning the debate. I'm trying to think about the collisions and contestation I've seen in literature between terms that came up, but nothing is jumping to mind. Damon, have we seen anything different appear in the journal articles that are for review?

D. Coletta: **[Q1]** Well, I don't know if this is exactly what you are looking for, but one of the things that I've run into recently is, what does it mean to have a "capability." If you are talking about the unclassified academic discussion, you can find some pretty wide variation in what the status of the Chinese ASAT capability is for example. If we are talking about deterrence, one of the terms would be capability, and depending on whether you are talking about the near future, the medium-term future, or the present, it's not always clear—so, essentially, what you have is different meanings of a very important term. In discussions about deterrence, we sometimes run into things like that.

LTC Jackson: **[Q1]** I think "contested" is an elegant term because you don't have to be as explicit on the threat level. I see "contested" having to do with challenging things and challenging the established order, which allows you to consider a whole range of things, from the operational to say the institution. General Kehler sort of popularized the term "contested" by putting it into his framework, and he should be complimented for having chosen a very sophisticated word that allows a lot of things to fit under the umbrella of contested, again ranging from just challenging norms in institutions, all the way up to deploying potentially aggressive capabilities.

D. Coletta: **[Q1]** I had "contested" in mind as well, and I'll also throw in "deterrence," in terms of our discussions and again emphasizing that we are not making policy here, we are just discussing it and trying to find patterns and policy making. Deterrence sometimes means coercion and it

sometimes means that you are involved in a game of chicken where you could escalate to a point that both sides would suffer catastrophe. Those are two very different models, but deterrence is spoken of regardless of which type of conflict your protagonists are involved in.

D. Coletta: **[Q1]** I would agree with that. I mean, the term "deterrence" seems to get overused in this context, and in some cases what people are really talking about is escalation dominance--to get back to using more traditional terms from price management theories. Everything gets referenced as deterrence because I think it's a politically and socially acceptable word. However, when you actually get into a crisisand things are broken down, then you are trying to accomplish something else which is to reduce the risk of escalation. That's, not necessarily deterrence.

Interviewer: **[Q1]** Okay. So, I am sensing a theme here with respect to some levels of ambiguity surrounding some of these terms—in particular, you mentioned "contested" and "capability" and "deterrence." Taking a step back a little bit to think about this question at an even higher level, this point about ambiguity is something we have also heard regarding a term like "space" itself or "outer space." These terms— "space" and "outer space"—are obviously going to have some inherent ambiguity with them, but do you think they are currently appropriately defined universally? If not, do you think they need to be?

LTC Jackson: **[Q1]** I think the term "space" is pretty clear. I mean, the ambiguity might be with respect to the uplink, downlink, and electromagnetic spectrum component. But, if the thing you are interested in is in orbit, I'm not sure that I've seen a whole lot of debate about the validity of expanding the definition of space to being something near space sub-orbital. The whole Bernoulli versus Kepler idea really works as an effective definition. But, once you get in to a displacing of lines (i.e., how many miles is it in that space), I don't think that's helpful.

[Q1] Going back to the use of the term "ambiguity," in some respects ambiguity is useful, and if you push for overly rigid clarity to get rid of those ambiguities, it might cause you more problems. If you are comfortable with a certain degree of ambiguity—just in the definition of what space is, how far it can extend, and/or what is included in it—then I think dealing with that ambiguity is a healthier situation to be in.

D. Coletta: **[Q1]** To quickly add to that, over here at the Eisenhower Center we are not very much involved in the debate about whether there should be a separate space service. So, I'm also not very sensitive to that ambiguity. If I want to talk about where something is happening, I would specify whether it was lower Earth orbit or geosynchronous orbit, and I feel like I am being clear. I, personally, don't face the same ambiguity as someone that is trying to divide responsibilities and say what's the space responsibility and what's an air responsibility. That might get into a different conversation; it's not one that we typically have here.

Faulconer Consulting Group

Walt Faulconer
President

Mike Bowker
Associate

Mark Bitterman
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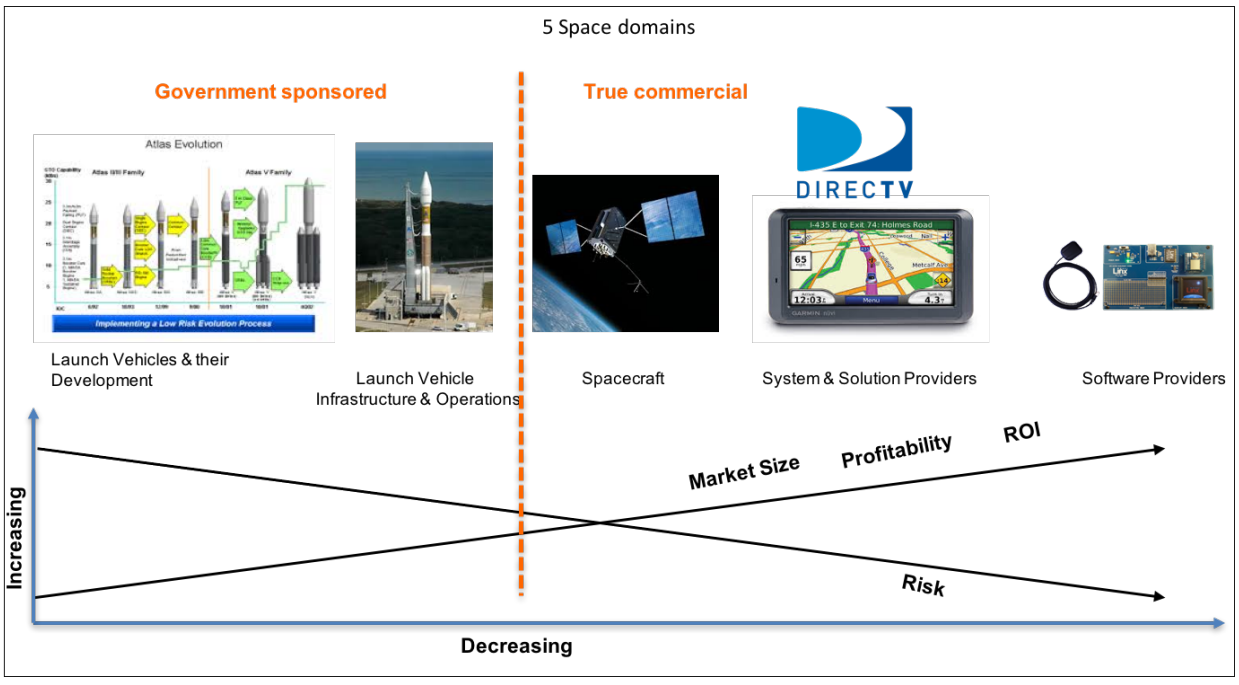
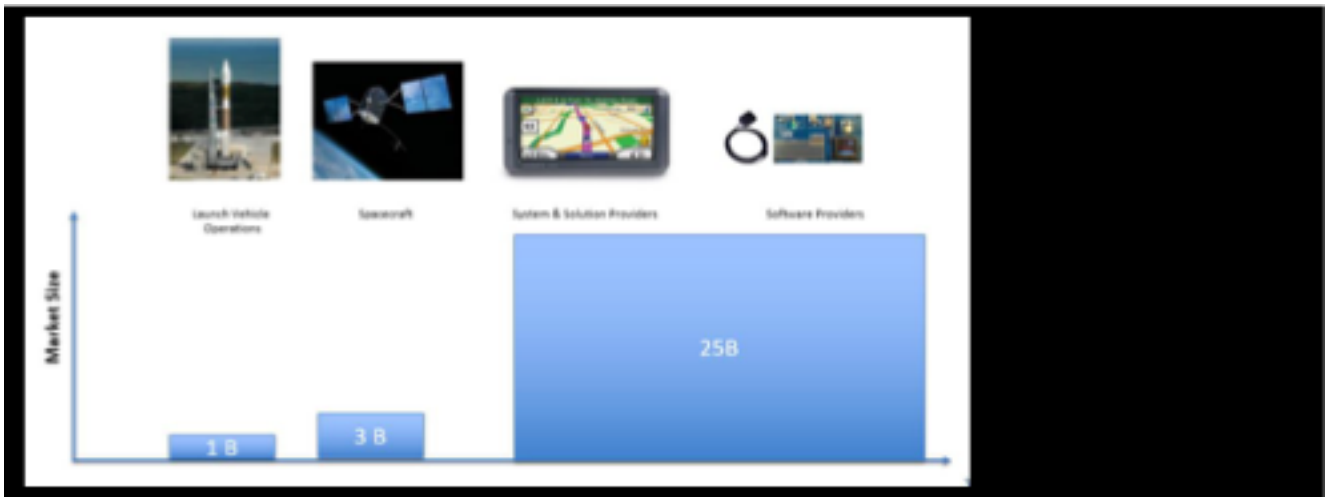
Dan Dumbacher
Associate

15 August 2017

WRITTEN RESPONSE

A paradox exists in the space sector wherein the riskiest part of the value chain has a very high capital demand and provides a lower ROI. Without government sponsored development/revenues the highest cost/highest risk elements of the space domain in almost all cases would not exist. The only true commercial space enterprises are from the spacecraft (telecommunications) through software providers. One exception of note is Blue Origin who can self-fund launch vehicle development due to Bezos' wealth.





A Case in Point: Building and launching GPS is/was a good core business for Lockheed Martin, but pales in comparison to the overall global positioning system market.

	Launch Vehicles	Launch Infrastructure	Spacecraft	Systems/Solution Providers	Software & Applications
Iran	**e.g., List of LV capabilities**				
Russia					
India					
North Korea					
Brazil					

To define different classes of space users we recommend the best approach is developing a weighting systems based on the 5 space domains. Depending on the score, a nation would be placed in specific category. A "scoring system" will have more utility by:

- Provide a common empirical approach to definitions
- Placement of a country in a specific category becomes unambiguous
- Allows dynamic updating as capabilities change over time

We recommend a follow on study to provide developing such a catalog and a scoring system.

Jonathan Fox

Strategic Foresight Practitioner and Forecaster
(Defense Threat Reduction Agency Global Futures Office)
6 October 2017

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

The fundamental issue of defining with certainty the legal and regulatory compliance obligations of various classes of spacefaring parties will have to be addressed before long if we are to avoid a bureaucratic morass. There is one class, the spacefaring nations and entities proper, who have the ability and means to place both crew and cargo beyond the atmosphere in both civilian and military applications. To such parties must adhere of necessity the greatest burden of law and regulation as they stand to gain the greatest profit and advantage. They are best able to absorb and defer to the market or to the taxpayer the cost of doing business exo-atmospherically and beyond. The risk and reward are both commensurate with normal and somewhat traditional cost/benefit calculations.

Then there is the second class in the equation, those who use space assets but do not themselves either transit space or have more than rudimentary and unreliable means of reaching orbit. While they may have access to it and take advantage of it, these parties are dependent on the services of third party spacefarers (whether state or private sector in nature) for the employment and operation of such space assets as they may have. They may rent, they may purchase, they may share space-lift or satellite capacity, but they are best considered as users and customers. They may be states, NGO's, academic, commercial or transnational entities. The only thing certain is that there can't be any "one size fits all" solution to the question of apportioning legal or regulatory burdens between spacefarers and their customers. Uniform application of the full extent of such obligations between customers and carriers would of necessity result in a regulatory and financial burden that would restrict access to all but the richest of customers. Any state that would insist upon a blanket application of the full financial, legal and regulatory burden to all who benefit from space activities without distinction between the degrees of use and occupation would ultimately be rendered non-competitive in the marketplace. Such of their industry dependent upon any aspect of space activities would be placed at risk of eventual extinction.

This risk is highlighted by the recent legislative initiatives of Luxembourg designed to maneuver that country into the eventual "Flag of Convenience" for commercial spacefaring activities. Any spacefaring country not prepared to apportion the cost and burden associated with space activities in a market share enhancing manner will find themselves and their corporate charges at a grave competitive disadvantage.

A similar delineation challenge is discernable in the Gray Zone area of aggressive state economic conduct. At what point do highly competitive commercial practices (particularly in those countries where the space industry is heavily state sponsored or subsidized), in the unique and singular area of space utilization, cross the line into predatory state practice or outright economic warfare? And what is the demarcation line between economic warfare and hostilities? Considering the national security implications and sensitivities associated with the space domain, does one state's manipulation of market forces to the disadvantage of another's space launch and systems capacity implicitly invite sanction, militarily or diplomatically? There is little in the way of international agreement in this regard, and the situation is only likely to worsen in the coming years.

Joanne Gabrynowicz

Professor Emerita (University of Mississippi School of Law)
16 August 2017

NOTE: This interview was not recorded, so a transcription could not be created. However, this document presents key points from the discussion of question 1.

- Contentious terms are commonly found in treaties and other bodies of law.
    - Issues arise when people want to do something, but others don't, so they go back to the treaties and come up with various types of interpretations based on what they'd like to achieve
    - One term in particular that is currently raising issues comes from Article 9 in the Outer Space Treaty
        - "Harmful interference"
            - Avoiding harmful interference means that the US and other space nations have to conduct thier own space activities to avoid potential harmful interference to other countries' space activities
            - Has environmental meaning. (The 1961-1963 West Ford experiment showed copper needles in space cause significant debris), Article 9 is a product of this mishap.
            - Historically, "harmful interference" has applied to environmental and related issues, not commercial activities. Recently, attempts have been made to have the term defined as an economic concept. This idea was introduced for the first time in 2014 bill that was defeated. Expert testimony: applying to property rights is a novel use.

        - Space is a "global commons" (Article 1 & 2 of OST) like the high seas, Antarctica, and the seabed
        - All nations have a non-exclusive right to use and explore space
        - No nation can prevent another from using space
        - Strategic reason for choosing this definition traced back to Cold War. In the Cold War, when the Soviet Union and the US were adversaries, there was a lot of emphasis on getting to places first
            - Did not want arms race extending into space
            - Each side had no way of knowing what the other could or could not do
            - Negotiating the Outer Space Treaty, they had a few options: res communis principle: space belongs to all; or, res nullius principle: space belongs to no one one.
                - Res communis eliminated the incentive to get there first
                - Protect yourself by ensuring that not getting there first doesn't mean you can be excluded
            - So, "global commons" decided because it disincentives the need to be first (no exclusion for arriving second)
    - Issue of definition of a Space farer
        - How do you define? Indigenous launch capability?
            - But this excludes very active and innovate space nations, Canada for example. (Canadarm on international space station)
        - In the 90s the Air Force Space Command Long Range Plan recommended establishing a Space Faring Nations Treaty that would define "spacefarer", among other things. Didn't happen.
            - See: http://www.worldcat.org/title/long-range-plan-implementing-usspacecom-vision-for-2020/oclc/39127082
    - Note that the U.S. is not participating in the Law of the Sea Convention,, the rest of the world is dividing up the the seabed without us

Dr. Nancy Gallagher

Director (The Center for International and Security Studies at Maryland)
Research Professor (University of Maryland School of Public Policy)
10 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. However, before we do jump in to those national security-specific questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terminology and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

N. Gallagher: **[Q1]** I think even the word "space" is contentious. How exactly do you define space? Where does space start and end? Whether or not you refer to space as a "global commons" is another major point of contention. If you do define space as a global commons, then what does that mean? So, yes, there are a number or contentious space terms and I could go on and keep listing words, but I try to not get too caught up in definitional disputes.

Interviewer: **[Q1]** Yeah, it's funny that you mention the term space itself because one of the follow up questions I've been asking to this question is, "what about the term 'space' itself?" It seems like there is some clear ambiguity, and also some contention, surrounding the term space, so do find this to be problematic?

N. Gallagher: **[Q1]** No, I don't find it particularly productive to talk about the term itself in the abstract. If it were to come up in the context of a specific disagreement, then I would deal with it. Sometimes the definitional disputes really boil down to power struggles or turf battles or that kind of thing; sometimes they boil down more to which analogy for thinking about space is the most useful. So, I focus more on trying to figure out why it is that people are disagreeing about what the words mean, and how to best try to address the root of the disagreement, as opposed to getting hung up on semantics.

Gilmour Space Technologies

Adam Gilmour
Chief Executive Officer

James Gilmour
Director

13 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. We like to start off with the definitions and terminology question, but keep in mind this is all individually tailored to each subject matter expert that we speak to. If we get a little bit off topic, that's totally fine. But, as far as question one, what I'd really like to discuss is the use of space-related terms, definition, classes, typology. I would like to know if you are aware of any

miscommunications, any point of contention or lack of understanding between space domains. In other words, does the commercial industry define space in one way, but the military and the government or the civil space agencies use it in a different way? What divides exist, if any, that you might be aware of? Does that make sense?

A. Gilmour: **[Q1]** Yeah, we're really… Of this stuff, of my own perspective, I'm pretty simple about this. I look at **manned space flight**, which is the domain of only a few countries. Then, I look at **commercial space flight**, which is the domain of countries that have satellite capability and launch capability that extends even beyond that. The countries that can purchase satellites and purchase launches and operate them, like Australia, currently, only does that. Then, I look at **military** as all the other stuff that… surveillance, GPS, whatever else is classified that I don't even know about, I'm sure it's out there, but that's the three main sectors that we look at.

Interviewer: **[Q1]** Okay. Now, did you find that there's points of contention on current terminology when you're looking at those different sectors or is it—

A. Gilmour: **[Q1]** No, but most of the conversations we have with defense people, there's a good understanding that the primarily defense assets in space and primarily commercial assets in space, and the military sometimes uses commercial satellites for their own purposes or bypath the capability. The civilians use GPS satellites for a lot of work. There's often a blurring of mandate, but I understand it.

Interviewer: **[Q1]** Okay so as far as terminology goes, there exists a broad consensus. You would agree?

A. Gilmour: **[Q1]** I think so.

J. Gilmour: **[Q1]** Yes.

A. Gilmour: **[Q1]** Yeah.

Harris Corporation

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

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay, great. We are going to go through the questions here. Towards the end of the interview I'll open up the floor to the questions from my colleagues if they have any. All right. I'd like to begin by asking a general question about terminology and definitions in the space

domain. As experts in the commercial industry do you often encounter contentious language and terminology as you communicate with other space communities and is there specific gaps in the language that need to be addressed.

Brig. Gen. Gould: **[Q1]** Well certainly we would agree that there is an absence of commonly agreed upon terms, I guess, what we'll call a glossary of terms and definitions. Frankly, it's probably the biggest hurdle to the development of a coherent space policy, strategy, or regulatory process. As you can imagine, and have probably experienced yourselves, there's a limited understanding of space related terms. Terms that will eventually serve as the legal basis for any space policy that is developed. It's resident not only on the commercial side but is also a challenge in the national security, intelligence,, civil, and scientific communities as well.…and applies to all space-faring nations. Participants in conversations about space and space-related matters, whether discussing space management or On-Orbit proximity operations rarely stop to confirm that they are using a common set of definitions for key terms. I recall a conversation I had with some folks' a while ago when I was going through the USAF executive space course out in Colorado about using maritime terms and law as a foundation for space. The maritime domain developed common terms and norms of behavior as a foundation to maritime policy…without it, it would have been impossible to establish policy that means the same thing and serves as a legal baseline going forward.

Jen, do you have anything else? I'm just looking at some of the notes I had with Gil.

Col. Moore: **[Q1]** I think any time that you have such a varied group of individuals working on a medium from so many different angles you are bound to have contention regarding definitions. It would be helpful if we were able to establish some common understanding so that we do not have to reestablish that every time you have a conversation with a new group or a new organization.

Brig. Gen. Gould: **[Q1]** Then one last thing I'll throw on and I think this group knows it better than any is, that unless we move out on defining these terms, someone else will define them for us. I would suggest that while we have the preponderance of assets in space, that we do just that. It is sort of like how the US established a lot of the norms associated with flying and the FAA. Many of the Europeans and the Asian countries adapted what we established as a standard. So in the absence of consensus, we should probably just move out and lead…define them and hope that the rest of the space-faring nations adopt them as their standards as well.

Dr. Jason Held

Chief Executive Officer (Saber Astronautics)
22 August 2017

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

I wouldn't use the term contentious per say but there are a couple of areas I've noticed that can create some confusion. First is the term 'space traffic control' which can be problematic because 'space control' is used in military

circles to describe a range of capabilities. Most major and minor space nations will balk at admitting the level of military space capability. Defining space traffic, without the 'control' also has implications. We're still in back end of the barnstorming stage of space industry as a species so for the most part everyone controls their own satellites and there really is very limited infrastructure in place to practically support deconfliction when it occurs. Space traffic is also an interesting term because nobody was saying it two years ago. Some people see it as deconflicting space for easier launch. Some view it as an extension of airspace (hence the FAA involvement). However space traffic includes aspects well beyond a regional environment so this is still under debate.

In the commercial world the term 'space industry' is being phrased increasingly to include downstream products and services. "Are you a space company?" now includes anyone using a space product, everything from mining to agriculture to pizza delivery. In this case such a broad definition has national importance. Australia for example has a ~$3bn/year revenue for its space industry, a figure mostly derived from these downstream services.

Dr. Henry R. Hertzfeld

Research Professor of Space Policy and International Affairs
(George Washington University)
2015

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

"How simple terms mislead us: The pitfalls of thinking about outer space as a commons"

https://swfound.org/media/205285/how-simple-terms-mislead-us-hertzfeld-johnson-weeden-iac-2015.pdf

Theresa Hitchens

Senior Research Scholar (Center for International and Security Studies at Maryland)
19 July 2017 (Written Submission)
30 June 2017 (Interview)

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

- Advanced space-faring states have the ability to launch, develop, manufacture and operate satellites in LEO and GEO, including for military use if they so choose.

- Space-faring states have the ability to develop, manufacture and operate satellites in LEO and GEO.
- Emerging space actors have the ability to operate satellites built and launched by others for them.
- Space users have satellites that are operated by others for them. These are primarily communications and remote sensing satellites.
- Satellite infrastructure: broadcast, remote sensing, weather, PNT, optical intelligence, signals intelligence, satellite inspection. In future, internet connectivity.
- Industry sectors: satellite servicing, satellite manufacturing, satellite launch and ground equipment.

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** However, just really quickly before we do get into that question, I was hoping I could ask you a quick question about one of our other questions—in particular, question 1 from the list, which has to do with definitions and terminology.

T. Hitchens: **[Q1]** Alright.

Interviewer: **[Q1]** So, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

T. Hitchens: **[Q1]** Not really. Thinking more specifically about defining different classes of space users, there are solid definitions for a term like "advanced space-faring states," which normally refers to people who can launch and develop and manufacture and operate satellites both in LEO and GEO—including for military use if desired, but this is a fairly small population overall. So, the term "space-faring states" is typically used to include both those military-capable actors as well as people who can develop and manufacture and operate satellites.

Generally, when you are looking at "emerging state" actors, you are talking about people who are having satellites launched and operated for them, by either commercial providers or other states.

[Q1] Then, "space users" refers to pretty much everyone that has downlinks.

[Q1] The space industry, if you look at the SIA's annual report or the Space Foundation's annual reports, is broken down by industry sectors like servicing and manufacturing of launch and ground equipment, and then you can also break down the infrastructure sector into things like broadcasting, sensing, weather, PNT, intelligence optics and signals, etc.

[Q1] So, these terms, while I have never seen a specific bibliography or set definition of them, are fairly non-contentious and widely used without any real disagreement or problem.

Interviewer: **[Q1]** So it seems like there's pretty uniform agreement for those terms you mentioned?

T. Hitchens: **[Q1]** Yeah.

Jonathan Hung

President (Singapore Space and Technology Association)
23 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. However, before we do jump in to Q2, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

J. Hung: **[Q1]** Honestly, I don't think so, at least not that I have come across. Though, honestly speaking, I do not think it really matters. But, I personally have not come across anybody that seriously contested anything in terms of terminologies.

Interviewer: **[Q1]** Okay. So, what about with respect to a term like "space" itself or "outer space?"

J. Hung: **[Q1]** No. Again, I don't think so. I am looking at this more from a Singapore perspective, and in Singapore we think about space more from a pure economic point of view, so that really doesn't matter to us.

Dr. Moriba Jah

Associate Professor (University of Texas at Austin)
3 October 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. So, let's start with Q1 on our list, which has to do with space terminology and definitions. Are there any contentious space terms or definitions out there? Basically, are there any noticeable disagreements amongst space communities about appropriate terminology or appropriate definitions for that terminology?

M. Jah: **[Q1]** Yeah. I would say that, in general, the global community feels a little bit of a rash towards the US regarding things like "space control," "space situational awareness," etc. The global community recognizes that the US has pretty much been in the lead seat for a lot of this even though the current climate in space has changed drastically, especially over just the past five or so years. So, the global community recognizes that things like "SSA" and "space situational awareness" and "space control" pretty much came out of USSTRATCOM and Joint Doctrine like Joint Publication 3-14, which kind of lays out "SSA," "space control", "offensive space control," "defensive space control," and those sorts of things. People recognize that that's the thing that has been leading the way, and they feel that there is a certain amount of inertia with regards to some of those terms because they are very US DoD-centric. As such, I think people have been trying to re-massage those sorts of things.

[Q1] When people talk about "strategic use of space," they feel like that's an overloaded term, and, again, something that has been dominated by US defense. A term like "battle space management" is another DoD-centric kind of thing as well.

[Q1] One of the things that people are very much interested in is the idea of "threats." "Threats" in a space sense is kind of a contentious thing as well because it's not carefully defined nor is there a standard across the community.

[Q1] So, there have been activities within ISO to help define international standards for things in space like "space debris" and that sort of stuff, and my guess is that when it comes to "space situational awareness" and "space traffic" and those sorts of things, getting those things into an ISO standard would probably be quite beneficial.

Interviewer: **[Q1]** Okay. So, it sounds like the US has sort of led the charge in defining a lot of these terms, but now there increasingly seem to be some contentions from the international community, and there are ongoing efforts now to develop more robust, multi-perspective definitions for some of these space terms?

M. Jah: **[Q1]** Yeah. I mean, some people feel a little bit appalled that when the US is talking about "space traffic management" it just kind of says, "Yeah. Okay, so let the FAA lead in this sort of thing." Other people feel that, "Well, that might work for the US, but this is an international problem. So, why isn't it an international entity looking at solving this sort of thing?"

Interviewer: **[Q1]** Okay. You mentioned a term like "threat" as well, and defining the term "threat" seems like it could be a very perspective-dependent. So, it sounds like the US might have been the one that has led the charge in defining what a "space threat" is, and I'd guess that effort was driven largely from a US military-perspective, but now the international community is taking initiative to try to work together to develop some sort of more universal definition for "threat?"

M. Jah: **[Q1]** Well, that's certainly something that is desired. In fact, Russia is very keen on wanting to define what "harmful interference" and what "harmful behavior" in space means, and Russia also have an interest in being able to invoke "self-defense" in space.

Interviewer: **[Q1]** Okay. So, to sort of take a step back, I guess, to a more general term, one of the other questions we've been asking as part of these interviews has to do with the term "space" itself or "outer space." Do you see these terms, "space" and "outer space," as currently being appropriately defined universally, and do you think they need to be?

M. Jah: **[Q1]** Yeah, I think the world in general has a good idea of "space." I think the whole thing about roughly 100 kilometers in altitude above as kind of the definition for "space" is what is being adopted and accepted internationally, so I think that's good enough.

Dr. John Karpiscak III

Physical Scientist (US Army Geospatial Center)
2 October 2017

WRITTEN RESPONSE

[Q1a] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

Nothing I would describe as contentious but perhaps ill-defined. Within the DoD I have not noticed any particular disagreement with space terminologies per se, except perhaps for those relating use and exploitation of space. That is, I have noticed some disagreement within DoD with what is meant by 'space user.' The reason for this is that people are not thinking through this idea perhaps as well as they should.

The terms 'space user' and 'space exploiter' may seem to be synonymous to many, but perhaps may actually be better understood as two different matters coming from two differing perspectives. For example, many people consider the Air Force to be the single greatest user of space, due to the fact that they are more associated with developing expensive, strategic systems space systems; along with some launch and on-orbit maintenance responsibilities of the same. At the same time, due to the distribution of personal and weapons-mounted space exploitation systems (such as GPS receivers), as well as the collection, receipt, and distribution of remote sensing data, it is in fact the Army that is the 'greatest' user of space, if anything, by the sheer volume of fielded devices (that utilize space capabilities of various sorts), and associated volume (that is, occurrences and durations), of use; add to this receipt, analysis, and distribution of remote sensing data to ground forces, and of course the use of SATCOM (voice and data); those activities being more associated with tactical and operational level missions.

The differences that I can see in the application of this term have more to do with greater program money and 'ownership' (in the case of the Air Force), on the one hand, and, on the other, greater active use (in the case of the Army). So the question is in what context are these terms applied? This leads to the second question.

[Q1b] What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

I'm not sure that we can ever have complete agreement here. Some space related terms (particularly those that describe some physical descriptive aspects of the space-environment, as well as those of launch and delivery), will remain fairly static; at the same time, the rate of technological development and globalization of businesses make the idea of some terms such as 'a space-faring state' less important a consideration than the recognition of individual 'space-faring companies,' or even simple third party/proxy-access to space via other countries, companies and individual citizens. Perhaps the term 'space-fostering' state may be more appropriate?

In the stone age of space travel, a space-faring nation was one that accomplished and utilized all elements of access to space. Today, that notion has shifted forever. Many nations, private companies and even schools, hitch rides on available payload margins or even pooled dedicated launch assets. To be space-faring does not mean to be able to 'do it all,' any more- this is no longer a requirement for space access. Today, space-faring is more about space asset control and utilization (including the surreptitious use of space assets without the knowledge or consent of the asset owner), rather than having to be inclusive of space asset development and lift to orbit.

With rare exceptions of reclusive nations (or groups of reclusive nations), that tend to be 'do it all,' this new reality makes any space definitions relating to national culture and technology capabilities difficult, dynamic and temporal in nature as the environments of space access, production, launch and sustainment are constantly changing and no longer tied to one or even a small group of nations. A multi-national company for example that launches at various points on the earth (or out at sea), to meet customer demand breaks the rule about what a space-faring state may be.

It may be easier and perhaps more beneficial from a policy standpoint, to consider space in an aggregate sense—that is, we (the Earth) are a space-faring culture. Access, use and exploitation in both the public and private sectors cuts across virtually all economic, political, and cultural groups I can think of. Anyone with a smart phone (considering its GPS [and similar capabilities from other sources]), XM satellite radio, DirecTV (or even internet and cable TV at home), is already a direct space user, perhaps without even realizing it, taking this capability for granted, making most of the planet users of space in some fashion. The day the link margins are such that smart phones (without

augmentation [such as the currently available INMARSAT interface], and rather than just dedicated satphones), can routinely access any one or website via satellite/ satellite network may make state-level distinctions of space-faring impossible or even irrelevant.

This latter point also complicates any proactive or response to space usage, as many parties utilize the same systems at the same time. I recall that during Gulf War I (1990), both the US and Iraqis were using the same INMARSAT satellite for conducting military operations. An adjunct consideration is also the glacial pace at which the US Government adjusts to new realities, always playing 'catch-up' to changes in technologies, and with that seemingly always behind the times on adequate definitions (and policies).

Jonty Kasku-Jackson

Space 300 Geopolitical Lead (National Security Space Institute)
10 October 2017

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

There are three major space-related terms where there is disagreement about the exact meaning of those terms and which could impact US space operations. Those terms, "outer space," "peaceful purposes," and "national appropriation" are found in the Outer Space Treaty (OST). (Outer Space Treaty, 1967).

"Outer Space"

There are four major outer space treaties, none of which define the term "outer space." They are the Outer Space Treaty (1967), the Rescue and Return Agreement (1968), the Liability Convention (1972) and the Registration Convention (1975). At the beginning of the space era, the United States had a strong interest in establishing the right of overflight by satellites over the territory of other sovereign nations. This is the opposite of air law, which recognizes sovereignty over a nation's territory (Kasku-Jackson & Waldrop, 2009). The intent is to prevent the overflight of aircraft without impinging on the ability to conduct space activities. Since the launch of the first satellites, there has never been an agreed upon delineation between airspace and outer space. The US view has been that there is no real need to establish such a delineation since no major problems have resulted from the lack of an official boundary between airspace and outer space. However, others, such as the Russians, have desired an official delineation. This is reflected in the fact that there has been an agenda item, to define the boundary at 100km, on the United Nations Committee on Peaceful Uses of Outer Space (UN COPUOS) agenda for the last 40 years. This 100km boundary has often been proposed by the Russians and has been continually opposed by the United States who favors a different approach.

Basically, there are two approaches regarding the question of where outer space begins. The first approach is functionalist and suggests space starts at the lowest altitude an orbit can be made. Essentially, if the activity occurring is aeronautical then air law applies; if it is orbital then space law applies. This approach illustrates the actual practice of states performing space flight activities and preserves legitimate interests of subjacent states (Goodman, 2010). The second approach, the spacialist approach, delineates a bright line, typically at 100km above the surface of the earth. Currently there is a debate as to whether 100km is where lift fails to support aircraft and therefore a functionalist line could end up below that given sufficient advances in technology. These two approaches

result in different altitudes for the delineation between outer space and airspace (between 52 and 90 miles) and impact the altitude at which an object may legally overfly another nation's sovereign territory. It is unlikely the United States will agree to a bright line demarcation between airspace and outer space, nor should it as the functionalist approach better protects US interests since there has never been a question that satellites are operating in space and are therefore not subject to the overflight restrictions of air law.

A third, newer approach leverages the Law of the Seas Model and would extend the vertical limit of state sovereignty by some distance (either the 12 nautical miles of the territorial seas or the 200 nautical miles of the exclusive economic zone) or infinitely (as claimed by a number of Chinese scholars). However, Articles I and II of the Outer Space Treaty expressly oppose any concept of vertical sovereignty. Article I states outer space, including the moon and other celestial bodies, are "the province of all mankind," which has been universally understood to mean that "all nations have a nonexclusive right to use and explore space" (Bellflower, 2010). Furthermore, Article II prohibits any "national appropriation by claim of sovereignty, by means of use or occupation, or by any other means." Clearly, the OST allows all uses of the space domain short of an appropriation by claim of sovereignty but prohibits any claim of vertical sovereignty in space (Bellflower, 2010).

"Peaceful Purposes"

According to international space treaties, space is to be used for peaceful purposes and strictly prohibits the establishment of military bases, installations and maneuvers on celestial bodies (Outer Space Treaty, 1967). However, the term "peaceful purposes" itself is not defined in any of the treaties. Historically, there was a question whether the interpretation of peaceful purposes included the concept of non-militarization or non-weaponization of outer space. The weaponization of space includes placing weapons in outer space or on heavenly bodies as well as creating weapons that travel from Earth to attack targets in space. (Vasani, 2017). Weaponization of space is different from the militarization of space. The militarization of space assists armies on the conventional battlefield, whereas in the weaponization of space, outer space itself emerges as the battleground (Vasani, 2017).

UN Resolution no. 1148 (XII) was adopted on 14 November 1957, stating that "outer space shall be exclusively for peaceful and scientific purposes." In 1958 that term was changed to "used for peaceful purposes only" (Diederiks-Verschoor, 1999). NASA was created to conduct space activities except those associated with weapons systems, military operations or defense of the United States; so it is clear that at the time those types of activities were considered to be peaceful purposes (Dideriks-Verschoor, 1999). Additionally, military use of space seems to fall into the definition of peaceful as many/most space faring nations have placed military-use satellites into orbit.

Although there seems to be a general acceptance of the militarization of space, there is great concern about the weaponization of space. The United States defines "peaceful purposes" to allow for space to be used for national and homeland security activities although some fear that includes both weaponization and militarization (National Space Policy, 2010).

"National Appropriation"

Article II of the Outer Space Treaty states that "outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means" (Outer Space Treaty, 1967). According to one view, this means that the possibility of appropriation of outer space and celestial bodies by means of private property is prohibited (Hermida, 2004). However, contrary to that view, recently both the United States and Luxembourg have made the argument that portions of the celestial bodies may be appropriated via mining (US Space Act, 2015). There is precedent to support that view in maritime law, which notes that resources such as fish can be appropriated from the sea without appropriating the sea itself (Smith, 2017). Furthermore, when the Moon Treaty was negotiated in the 1970s, the US delegation to UN COPUOS, stated that private property rights apply to extracted resources (Gangale, 2009). There is also precedent under customary international law, as ownership of Lunar samples by the United States and the Soviet Union/Russia has never been seriously contested (Gangale, 2009).

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Dr. T.S. Kelso

Senior Research Astrodynamicist (Analytical Graphics Inc.)
4 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. However, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

T.S. Kelso: **[Q1]** In going through the materials that you sent me, I didn't really see anything that we would consider to be an issue. Given my military background and the fact that we work pretty closely with USTRATCOM and JSPOC on a number of the SSA issues, we tend to try to stay in sync with their terminologies so we don't cause any additional problems, and we try to get our customers that we represent to understand that terminology as well. So, I didn't really identify anything with respect to terminology from your questions that would really be a problem for us.

Interviewer: **[Q1]** Okay. So, it sounds you and your organization present a good example of a commercial space entity that has worked closely with government entities to ensure that is following the lead of the government sector regarding terminology and definitions for that terminology.

T.S. Kelso: **[Q1]** Right.

Interviewer: **[Q1]** Okay. Great. So, just out of curiosity, do you think a term like "space" or "outer space" is currently appropriately defined universally? If not, do you think it needs to be?

T.S. Kelso: **[Q1]** For the kind of stuff that we're working with, probably not—I mean, when you start getting into issues like where space begins or referring to different regions of space in different ways, we don't tend to get into that. Though, I can see areas like trans-atmospheric flight where you would have to have these conversations, but, at least right now, none of our customers or none of the stuff that we're working with involves that type of operations.

[Q1] If anything, we'll run into occasional issues where somebody will say something like, "Well, tell me how many of a particular type of satellites are in LEO or GEO," or something like that. With this, of course, right away you will have to define the parameters of LEO and GEO. So, when I define something like this with anybody that asks the question, the first thing I do is actually define in a specific analytical way what we're using for that particular term before we start actually giving specific numbers. Now, whether they decide to hear that definition or ignore it or whatever, is obviously up to them.

[Q1] Overall, though, it's not a major factor for what we're doing in defining those types of terms (e.g., LEO, GEO, etc.).

David Koplow

Professor of Law (Georgetown University)
15 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** I want to begin by asking you if you've encountered contentious space terms and definitions. I think you have a unique perspective on this due to your background in law and your experience in public policy, but do you often encounter a gap of language across space communities, and are there specific terms and definitions that vary from commercial space to government space and so forth?

D. Koplow: **[Q1]** That's a good place to start, and as a lawyer, what I'd say is that *all* the terms are ambiguous and *all* the terms are susceptible to multiple interpretation depending upon context and on the community within which they are being addressed. I'm not sure that the ambiguity is fatal or that it's necessarily the place to begin, but that's a good acknowledgement that even terms like "deterrence" and" proportionality" and "norm" are terms that have mixed definitions in different communities.

Interviewer: **[Q1]** Speaking of communities, which sector of the space domain and space community would you look to lead and set a standardized set of definitions?

D. Koplow: **[Q1]** I'm still having a little trouble hearing you. Let me try putting you on speaker and see if I can get it clearer that way. Okay. Try it again?

Interviewer: **[Q1]** Yeah. I was just asking if there's specific communities, which specific communities in space should set the standard for definitions and help bridge a gap in language?

D. Koplow: **[Q1]** I don't think that is the task of any one particular community. I think that is the task of whoever is using the vocabulary in a particular document. If you're talking about negotiating a treaty, the treaty drafter is going to have to define the terms, but that will define the terms for the use in that instrument. Presumably, if you write up **a** report of some sort, you have to be clear about the way you're going to be using the terms but you cannot expect to achieve commonality on those kinds of terms across the entire universe because different users are going to continue to use the term in their own ways.

Interviewer: **[Q1]** Okay. Great. Perhaps we can come back to this question as we go through the rest of them, if a contentious term comes up in the conversations.

D. Koplow: **[Q1]** I think that is inevitable in each conversation. The content of what we mean by particular terms is going to have to be discussed.

Group Captain (Indian Air Force, ret.) Ajey Lele

Senior Fellow (Institute for Defence Studies and Analyses Centre on Strategic Technologies)
9 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. However, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

Group Capt Lele: **[Q1]** I don't think so. You're asking about definitions with respect to space security, right?

Interviewer: **[Q1]** Sure. Or any terms in which there might be disagreement over how they're being defined currently.

Group Capt Lele: **[Q1]** No. Right now currently, if you see the entire debate, I think people are still trying to get a feel of what each other are defining the terms, so there's no fixed definition which I've come across.

[Q1] But, broadly, everybody agrees that there is a thin line between the militarization of space and the weaponization of space. So, when one is talking from security point of view, it is essentially against the weaponization of space. When I'm talking about the militarization of space, I'm essentially saying that navigation, communication, and remote-sensing are agreeable to everybody, but using space to damage somebody else's assets is definitely not agreeable to anybody. And to ensure that these sorts of damages do not happen, and that space is not just being militarized by anybody, you need to have a certain amount of common understanding, and I think that common understanding essentially speaks of "space security."

[Q1] So, it could be a roundabout thing, but essentially everybody thinks about "space security" more from a perspective to ensure that 1) the assets in space are secured and 2) your interests in space also are secured.

Interviewer: **[Q1]** Okay. So, do you think there is general agreement about how the terms "space" itself and "outer space" are defined, and also how maybe the proximity of space, the area of space, and the limits of space are defined?

Group Capt Lele: **[Q1]** Normally there is a general agreement that we view an "astronaut" as somebody who touches about 90-100 kilometers. So, from that point of view, there's a broad agreement about what we call "outer space," but I think this will surely come up in a major way when you're talking of space tourism or something along those lines—if somebody takes a flight to the suborbital region, then can we talk about that as space tourism, and if it is space tourism, are the rules and regulations applicable at that level also?

[Q1] So, I think there is still work to be done with respect to developing a certain amount of common understanding about the region from where the stratosphere ends and space starts.

Dr. Martin Lindsey

Aerospace Engineer (US Pacific Command)
7 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. However, before we do jump in to Q2, I was hoping I could ask you another question from our list, which has to do with definitions and terminology. One of the things that we have been asking everyone as part of the interviews is whether or not there are any sort of contentious space terms or definitions. Basically, from your perspective, are there any noticeable disagreements amongst the space communities about appropriate terminology or appropriate definitions for that terminology?

M. Lindsey: **[Q1]** I'm not really aware of any particular ones that are contentious. It seems like at least a lot of the European countries that I talk to follow the US space doctrinal terms—they are pretty good at following these space doctrinal terms, and probably follow them better than we do, sometimes. So, in that regards, I wouldn't say there is much contentiousness.

[Q1] On the technical side, there's still no consensus definition for classes of small satellites—you'll see people interchange terms like cube satellites, small satellites, micro-satellites, nano-satellites, etc. Nobody has really come up with a singular definition or characterization of small satellites that everybody agrees to. So, that often leads to confusion when people are intermixing with those terms, but I wouldn't say that that's particularly contentious terminology.

Interviewer: **[Q1]** Okay. So, are people sort of broadly grouping together small satellite terminology?

M. Lindsey: **[Q1]** Yeah, and especially because you'll see "small satellite" used in policy documents or doctrinal documents, or part of documents, without a definition of what they mean by "small satellites." So, case in point, I am with the Navy and I work a lot with the Army, and when they use the term "small satellite," they often mean something that's not a cube satellite (i.e., 3U or 6 U or 12 U), which is a technical designation, but if you look at Air Force documents for what they consider a "small satellite," they typically mean satellites that can be as heavy as like 500 kilograms, which they will call a small satellite. And, obviously, there's orders of magnitude difference between those even though they're using the same term.

Agnieszka Lukaszczyk

EU Policy Director (Planet)
18 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. However, before we do jump in to Q2, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

A. Lukaszczyk: **[Q1]** Are you asking for any sort of terminology that comes to mind, or you have some specific things in mind?

Interviewer: **[Q1]** Anything that comes to mind. We're just sort of trying to get an idea about areas of contention across the spectrum.

A. Lukaszczyk: **[Q1]** Sure. So, a lot of this has to do with languages, too. The language factor comes across especially in the kind of multi-lateral gatherings that occur at the UN or the EU, where everything is translated into various languages so there is often a bit of confusion regarding the difference between "security" and "safety," for instance. In some languages, that distinction is not quite there—in some cases there is just one word and, depending on the context, then the word is defined if we're talking about space or if we're talking about security. For instance, if you have a document or a speech or whatever that is in English, sometimes it's difficult to translate that to get exactly the same message that was initially intended.

[Q1] So, I think the "security" versus "safety" thing is sometimes confusing, and then the same kind of situation arises when talking about "sustainability." We talk a lot about the long-term sustainability of outer space or the sustainable use of space, but when we use the word sustainability, it kind of gives an idea of sustainable development, and this is especially the case in the developing world. And "sustainability" is not really meant to be used that sort of way when it comes to the long-term use of some things or the secure use of something. So, sometimes there is confusion.

[Q1] Of course, those that are working in the field and speak English well will understand the extensive use of these nuances. But if you're talking to policy makers from other countries who are not used to these sort of space terms, then that sometimes gets a little bit confusing or problematic.

Interviewer: **[Q1]** Okay. What about with respect to the term "space" itself or "outer space," and maybe in the sense of the proximity in which "space" is sort of defined? Is there universal agreement amongst European countries about the definition of "space" or "outer space?"

A. Lukaszczyk: **[Q1]** Well, sort of, but it's not official. I think the general agreement would be that "outer space" or "space" starts 100 kilometers up. So, anything above 100 kilometers would be considered to be in "outer space." But, this delineation is more of a kind of gentlemen's agreement rather than anything that is on paper anywhere or legislated.

Elsbeth Magilton

Excecutive Director of Space, Cyber, and Telecommunications Law Programs
(University of Nebraska College of Law)
29 August 2017

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For

example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

Abstract Bullet Points:

- Hard Law, Defined in the Space Realm
- Soft Law, Defined in the Space Realm
- Private Human Spaceflight
- Sub-Orbital Space Flight Participants v. Airline Commuters
- In-Orbit Space Flight Participants
- Diffcultly in using standard defintions in the U.S. patchwork of space regulation

One of the most interesting and important definitional divides in this area, as in most international venues, is the difference between "hard law" and "soft law."

Generally speaking "hard law" can be described as "legally binding obligations that are precise (or can be made precise through adjudication or the issuance of detailed regulations)" and that "hard law" ought to specifically delegate authority for interpreting and implementing the obligations.[20] It has been argued that all international laws by their very nature lack a strong centralized authority ensuring that parties are functionally legally bound via specific consequences for violation.[21] This argument, in light of the stated definition, makes "hard law" an impossible standard in the international space realm. That said, many in the field argue that documents such as the 1967 Outer Space Treaty or the 1972 Liability Convention constitute hard law by dictating legally binding obligations applicable to the conduct of states in space.[22] It can be inferred then, boiling this down to the simplest level, that hard law requires some concept of consequences, a stated duty to implement the agreement, and a specific obligation to delegate the authority. Under this more refined definition of "hard law" most policy experts would be hard pressed to consider most of the international space agreements[23] anything but "hard law."

So then, what precisely is "soft law?" "Soft law" has been described as "non-binding principles, norms, standards or other statements of expected behavior in the form of recommendations, charters, terms of reference, guidelines, codes of conduct, etc."[24] "Soft law," in essence, depends on the spirit of cooperation, collaboration, and alliances. While this may be a powerful tool diplomatically, "soft law" further lowers the bar in regards to consequences, specific obligations, and required implementation. It seems that "soft law" attempts to solve critical issues in space, such as space debris mitigation or arms control, have generally failed.[25] Useful or not, the definition of "soft law" can be summed up at its most basic core as non-binding standards of behavior.

Another interesting definitional debate in the field is in regards to private human spaceflight. From a jurisdictional perspective it is imperative to determine who-is-who as the private sector bounds towards making regular human

[20] Kenneth W. Abbott & Duncan Snidal, Hard and Soft Law in International Governance, 54 INT'L ORG. 421, 421 (2000).
[21] Gregory C. Shaffer and Mark A. Pollack, Hard vs. Soft Law: Alternatives, Complements, and Antagonists in International Governance, University of Minnesota Law Review, 2011
[22] Beard, Jack M., Soft Law's Failure on the Horizon: The International Code of Conduct for Outer Space Activities, University of Pennsylvania Journal of International Law, Vol. 38, No. 2, 2016
[23] Generally referring to: The 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the "Outer Space Treaty"), the 1968 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the "Rescue Agreement"), the 1972 Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention"), the 1975 Convention on Registration of Objects Launched into Outer Space (the "Registration Convention") and the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Treaty").
[24] Beard, Jack M., Supra 3, quoting Marco Ferrazzani, Soft Law in Space Activities – An Updated View, in soft law in outer space: the function of non-binding norms in international space law 99, 100 (Irmgard Marboe ed., 2012)
[25] Id.

space flight a possibility.[26] My colleague, Frans von der Dunk, details that "'Private human spaceflight should be defined as 'flights of humans intended to enter outer space (a) at their own expense or that of another private person or private entity, (b) conducted by private entities, or (c) both.'"[27]

The largest groups that may be broken down within private human spaceflight scope are space travelers that are traveling to sub-orbital destinations[28] and those who are planning to travel in-orbit. In-orbit travel would likely constitute the occasional commercial tourist who visits the International Space Station[29] or Bigelow Aerospace's plans to create an in-orbit hotel as a vacation destination.[30] The distinction between sub-orbital and in-orbit may seem trivial, but it matters significantly as we dive into further definitional considerations such as, aircraft v. space vehicle v. space object. This is notable because many companies pursuing sub-orbital travel are not just looking at it from a tourist perspective; they are potentially imagining commuter air travel taking place at such an altitude to dramatically decrease flight times international. Are these commuters to be considered sub-orbital human space flight participants or fall under the standard jurisdiction put upon air travelers? Stretching this thought process further, when multinational agreements (such as with the International Space Station) aren't established for a vehicle or location, what jurisdictional authority should apply? In the absence of a larger, more encompassing, space act the United States is forced to individually define actors and vehicles to determine how they fit into our patchwork space regulations and authorities.

Defining space activities, actors, and vehicles is still an act in progress, as evidenced by projects such as this one. It is simple to find textbook definitions for lists of words, but determining how and if those definitions fit the needs of our international obligations, as translated into our regulatory scheme, is the larger task at hand.

Colonel David Miller

Commander, 460th Space Wing (US Air Force)
7 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** So, question 1 from our list has to do with definitions and space terminology. This question, as presented in the list, seems a bit broad, but I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

Col. Miller: **[Q1]** So, just to start with a quick caveat, my focus will be mostly on military space and national security space.

[Q1] As a result, I don't know, frankly, if there are contentious terms in the commercial industry—I can't speak to that domain.

[26] One such example is SpaceX efforts as described by The Guardian. Yuhas, A. (2017, February 28). SpaceX to send two people around the moon who paid for a 2018 private mission. Retrieved August 29, 2017, from https://www.theguardian.com/science/2017/feb/27/spacex-moon-private-mission-2018-elon-musk
[27] Von der Dunk, Frans, Journal of Space Law 40:1–2 (2015–2016), pp. 147–185 quoting Frans G. von der Dunk, Legal Aspects of Private Manned Spaceflight, in HANDBOOK OF SPACE LAW 266-67 (ed. Frans G. von der Dunk 2015)
[28] 100 to 120 km above the Earth's surface, generally considered an "up and back" trip.
[29] Von der Dunk, Frans, supra 7.
[30] Bradley, R. (2016, April 08). Can Billionaire Robert Bigelow Create A Life For Humans In Space? Retrieved August 29, 2017, from http://www.popsci.com/can-billionaire-robert-bigelow-create-a-life-for-humans-in-space

[Q1] With respect to how we do space and how the national security space enterprise, as we call it, those agencies within the US government that have a vested interest in either launching, operating, exploiting or acquiring space capabilities, principally for national security mission sets, I don't know that there's a whole lot of disagreement on basic terminology. We have tried to come around to using DoD Joint Doctrine as the basis for our terminology, and I think within the Defense Department, we're pretty good there. There are terms at times you will hear that might be of relevance to this question. In the past, in Air Force terminology we've used terms like "offensive counter space" or "defensive counter space" whereas the term in the DoD dictionary or DoD doctrine is "space control." But I think that speaks more to the history of how we've used "air" and "counter air," "land" and "counter land," and "maritime" and "counter maritime operations" trying to be specific to the domain as opposed to a focus on joint warfighting terminology and concepts. Insofar as we use it for joint planning or joint operations, I don't think there's a lot of disagreement within the national security space community regarding major substitute terms, but I really couldn't speak to the commercial-use piece that much.

Interviewer: **[Q1]** Okay. So, on the military side it seems that there is sort of uniform alignment with respect to space terminology?

Col. Miller: **[Q1]** I think, generally, in the past several years, particularly in the Defense Department, as we have tried to get our governance structures better aligned and as we have endeavored to normalize space as a war fighting domain, which is the terminology you hear mostly lately, I think that people have largely come around to the terminology spelled out in Joint Publication 3-14, which our joint publication that governs space operations. JP 3-14 is freely available on the joint electronic library. It's kind of outdated in the sense that its four years old now, but it is currently under re-write. And I think you'll see some evolution of terminology there, but nothing that I would say is controversial necessarily.

Dr. George Nield

Associate Administrator for Commercial Space Transportation (Federal Aviation Administration)
1 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Before we get started with those questions, I wanted to ask you something we start off all our interviews with. We want to start with the first question, not off of the list we came up with together but the original list that has to do with contentious space terms and definitions. You're in a unique capacity in the FAA, office of commercial space transportation. Do you often encounter specific contentious terms or terminology when you're dealing with different space communities? What are those terms and why do you think that gap of language exists, if at all? So, we'll begin with that.

G. Nield: **[Q1]** I don't consider that a major issue or problem. Our community is pretty small and so we talk a lot together and we communicate well together. There are some slightly different sectors like the COMSAT community and so forth, in which they have different terms or a different language. Of course, we also deal with NASA and the DOD, and each of them has their own acronyms and missions, but they are not really considered an issue. There are no particular terms I would flag as contentious.

Kevin Pollpeter

Research Scientist (CNA)
8 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. So, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

K. Pollpeter: **[Q1]** Well, let me think about that. I've never been asked that question before in relation to China. Offhand, I cannot think of where there is a contentious difference in, let's say, definitions between the way China maybe views or defines some aspects of space terminology in comparison to the US. There's always the issue of what is a "space weapon" but that isn't inherent to China—that's sort of an issue that has always plagued space arms control and negotiations for some sort of treaty against space weapons. That's always been there. It's not really something that's China-specific.

[Q1] China's view of orbits in the sense of low, medium, and high Earth orbits are all pretty much the same. With respect to where space begins or doesn't, there's really a large agreement, much like in the US and the rest of the world, that you have to put space at the dividing line where space begins and that's usually at the Karman Line, 100 kilometers up into space. That's pretty much standard in Chinese writings.

[Q1] Yeah. I'm just trying to run through the list of what may be contentious, but unless you can give me some examples of maybe what other countries view as contentious terms, I can't really think of anything where definitions may differ. Even with something like "space superiority," it's pretty much interpreted really along the lines of the US Air Force concept of "space superiority" (i.e., being able to really use space and deny the use of space to others).

[Q1] So, right offhand, I can't really think of anything that is too contentious.

Interviewer: **[Q1]** It's interesting you mentioned the proximity of space, which I think is an important factor for defining a term like "space" itself or "outer space." I think defining proximities is particularly interesting from the Chinese perspective, given some of what has been going on with defining areas and proximities in the maritime domain where there have clearly been some contentions. But, it sounds like in terms of the space domain, the Chinese are sort of in agreement with the rest of the international community regarding defining the proximity of space?

K. Pollpeter: **[Q1]** Yeah, but the Chinese aren't really trying to define it in that sense. It's not like the Bogota Declaration where a number of equatorial countries stated that their territory goes from the ground all the way up to infinity. I don't see anyone in China really arguing that the outer space above China is Chinese territory. I think they realize that at this point, their space program is so large that if they start making territorial claims in outer space, it really only harms them.

Victoria Samson

Washington Office Director (Secure World Foundation)
22 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. So, let's start off with the first question I listed, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

V. Samson: **[Q1]** When talking about security issues, of course the concept of what is a "space weapon" comes up all the time. The way it could be defined, it could be defined so generally that everything is a "space weapon" or so strictly that nothing is a "space weapon." Yet, people still like to talk about space weapons, because I think it gives them the tool to deal with the problem. Traditionally, when you look at security issues, you deal with security threats by using weapons. I don't find that helpful. I think it's more important to talk about stability, because I think that gives you a broader concept that contextualizes the domain and allows you to talk about anything that destabilizes the space domain. But, people do like to talk about space weapons.

[Q1] Another thing that I see come up a lot—not so much in the national security community but more in the disarmament community and general public—is whether space has been "militarized" or "weaponized," and I think people tend to conflate those two when they're not familiar with security issues. For example, some people say "militarization" when they actually mean "conflict" or "weaponization." When I talk to a group that is new to space issues, the first thing I usually do is I say, "look, the question of whether space has been militarized is moot—that horse is out of the barn. Space has been militarized from the very get-go." Weaponization, on the other hand, has not exactly happened yet. So, it's helpful just to kind of give people a sense of the historical setting so they get a proper understanding of what space is being used for because I think a lot of people, even those in the national security community, are not always aware of everything it's used for.

[Q1] Another issue that I think is contentious is the idea of space being a "global commons." I think people like to use that terminology to describe how you really can't put geographical boundaries in space, and that space is a common use asset, and that one person's ability to utilize space can affect other people's ability to utilize space. But, for some, particularly the State Department and its legal community, the concept of global commons brings up very specific legal requirements, issues, and concerns, so oftentimes talking about space as a global commons will cause the State Department to kind of tighten up, and it doesn't help to have an open conversation that way.

[Q1] Another issue that I think is contentious is that there's lack of clarity in terms of what "self-defense" in space means. I think we are just at the beginning of that discussion. I constantly hear people say that some actors seem to be more aggressive in space, versus talking about the concept of what self-defense means. Is it being proactive because you think you're being threatened? Is it only when you've been attacked, and you're responding in return? Those concepts, they've been pretty well thought out for other domains, but I don't know that there have been a lot of open, unclassified discussions about them for the space domain, which can

be frustrating because I think it really limits the discussion and what you can actually accomplish when you're talking policy issues.

[Q1] As an aside, I used to work with nuclear weapons issues, and it just blows my mind that it is so much easier to talk about nuclear deterrence and strategy and doctrine than it is to talk about space deterrence and strategy and doctrine. Space is so over-classified, I think, in a knee-jerk way.

[Q1] Another contentious issue has to do with the ideas behind laws of armed conflict and how they apply to space. I have been told that the Air Force has thought through some of those, but there's not a lot of open, unclassified discussion.

[Q1] And the reason why I keep harping on the open, unclassified discussions is to provide an idea of transparency. A lot of countries are very worried that they are either going to be left behind or that the United States is already doing something that they should be aware of or that they should have as well. If there could be any kind of transparency within reason—acknowledging national security concerns and intelligence concerns—then I think it's helpful just to kind of give a tip of the hand that it's not as bad as they probably think. I always point to the X37B as an example where other countries look at something that's not entirely clear what's happening and they assume the worst. And some of the concern is probably justified, but there are probably also very legitimate non-aggressive uses of X37B, but because the United States hasn't talked about it, people tend to fill in the blanks.

[Q1] So, with respect to ideas like space deterrence, laws of armed conflict, etc., I think it's helpful to have as open a discussion as you can just to get the conversation going to indicate what the United States is thinking, and then also I think that would kind of guides other countries along—if they understand where the United States is going, they don't feel that they have to automatically have an aggressive use of space or something along those lines.

Interviewer: **[Q1]** The transparency point is one we've heard throughout these discussions, and the same goes for the global commons point. So, going back to what you said about the terms "space weapons" and "stability," I'm wondering: Is the interpretation and definition of these terms—"space weapons" and "stability"—different between the US commercial space sector and the US government sector?

V. Samson: **[Q1]** That's a really good question. I haven't seen a lot written or spoken about by the commercial sector about space weapons. The commercial sector is typically of the mindset that space weapons are a national security concern so the military should handle them.

[Q1] But, with respect to the idea of stability, I think you present a good point. What the commercial sector would see as being a stable domain may not necessarily be the same thing as the military would see as stable domain, but I feel those two definitions would overlap quite a lot. And that's one of the arguments I make for commercial entities and why they should be interested in security and stability issues—because they've got a huge investment up in this domain, and it's to their benefit to make sure they get continued access to their investment and that their investment can continue to work in as a reliable manner as possible without outside interference. And having a stable predictable domain is one way to go about doing that.

[Q1] With respect to the military, it's along the same lines. Our infrastructure depends upon space. Our national security depends upon space. Our commercial sector depends upon space. The military's responsibility is to ensure that the US interests in space are being protected, and having a stable and predictable domain with reliable access to those assets, I think is a really

good way to protect that infrastructure and allow the United States to continue to get the benefits of space over the long-term because, really, what it comes down to is just reliability and predictability. When we talk about space weaponization, you don't care necessarily about how it's being launched because of the hardware, or what have you. You care because you depend upon that asset and you rely on that asset, so how do you make sure that reliability and predictability is there? That's what's really important.

[Q1] I think there are a lot of ways to get that capability, and that's why I don't think talking about just weapons is the way to do it—I think this automatically puts you on a confrontational perspective, and that's not necessarily the way to do it. The right way to go about it might be by doing norms and international cooperation. Maybe there is a way to have more offensive space capabilities, or maybe that's not part of the picture, but I think by talking about space weaponization, you guide the conversation down to a road it may not necessarily have to go or is may not even helpful to go down.

Interviewer: **[Q1]** Okay. So, taking a step back, what about terms like "space" itself or "outer space?" Is there universal agreement about how these two terms are defined?

V. Samson: **[Q1]** You do have the lawyers who love to still argue about where space begins, but that's something in which people have been arguing about for what's going on 60 years now. You have the UN Committee on Peaceful Uses of Outer Space (COPUOS), which deals with the civil side of space issues. COPUOUS has three meetings a year: the Science and Tech Subcommittee in February, the Legal Subcommittee in March or April, and the General Group Plenary in June. And every year the Legal Subcommittee still has a section for talking about where space begins. In my opinion, after a certain point, these discussions are not helpful. I understand that there are reasons why it's important, but I think these discussions basically become theological discussions about how many angels are dancing on the head of a pin.

That's just not where we are today in terms of use of space. We're looking at other things. We're looking at new actors. We're looking at commercial entities taking on previously government abilities. We're looking at small satellites. We're looking at a tremendous space traffic management concerns. We're looking at changeover regarding who's in charge of SSA capabilities. We have all these things coming on, and to just keep arguing about where does space begin, it just not super helpful.

Interviewer: **[Q1]** Okay. So, it sounds like you are saying that there's agreement, but of course there's going to be ambiguity with those terms, and just belaboring arguments about getting perfect definitions seems to not be worthwhile?

V. Samson: **[Q1]** Right. And, again, some of those legal arguments still continue as well. There are still even some countries on the equator that still argue that they should have priority access to the geostationary orbit above them. Ecuador and Columbia are examples of this. Again, these are discussions that they've been having for decades. I don't think they're going to solve these arguments anytime soon, and I think it kind of distracts from the real legal concerns facing the space domain today.

Interviewer: **[Q1]** Okay. So, just one last definitional question. The last part of this question asks, how do we define different classes of space users?

V. Samson: **[Q1]** Sure. There are a couple of ways you can go about doing this. You can talk about space launching states or states with ability to launch assets. You can look at countries that have their

own satellites. You can look at countries that can make their own satellites—which is not necessarily the same as countries that have their own satellites.
[Q1] You can look at countries that have SSA capabilities. You can look at countries that are users of space technology. The entire world is basically a user of space technology, but there are different, I guess, levels of sophistication in how those countries use space technology.

[Q1] I think if you're looking at just kind of a broad stroke, I would look at 3 primary classifications: 1) countries that can launch space assets versus those that cannot, 2) those that can build and monitor their own satellites versus those that cannot, and 3) those that actually have satellites and those that do not.

[Q1] The other possible classification is looking at whether countries have their own space policies. There are countries with satellites that do not have their own space policies. Australia is one of them. India actually does not have a national space policy, which blows my mind because India has been in space since like 1962—though, India does have things like remote sensing laws, but that's about it. I think it's very interesting to look and see what kind of guiding national legislation countries have to define what they want to accomplish in space and how they go about doing it. However, I don't think a lot of people look at the national space policy division, but if you're looking for different ways to go about space power classification, that could be another one of them.

Matthew Schaefer and Jack Beard

University of Nebraska College of Law

Matthew Schaefer
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16 August 2017

Note: Enclosed here are responses bearing on question 1, as well as any surrounding responses that provide the necessary context to interpret direct responses to question 1.

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[…]

J. Beard: **[Q20] [Q1]** I'd also add, of course, that the US is a party to the UN charter, which, by definition, tends to space because international law is applicable.

[Q20] [Q1] Then we also have the Law of Armed Conflict too. One of the great debates going on right now between space law people and other people is whether or not the law of armed conflict trumps space laws. Those are lex specialis—they are subsets of international law—but almost everyone practicing in the law of armed conflict field believes that when there's an armed conflict, it trumps space law and every other law during the armed conflict. But that is a contentious point with some space people.

[Q20] [Q1] Then, of course, there are also some international agreements that extend to space, like the Partial Test Ban Treaty, which would ban nuclear explosions in space.

[Q20] [Q1] So, there are the big space treaties that Matt mentioned, and then there are others that also apply, but then the question is when do they apply and how do they apply? The big question there, when talking about aggression in space, is what constitutes an "armed attack" or "the use of force" in space? Whether it's certain temporary disabling of satellites or interference with satellites, the idea of large levels of armed attack justifying an armed response is a really controversial topic.

[Q20] [Q1] In fact, each one of your questions could fill large amounts of paper with the expansive responses that could be written about them, so I will try to provide you with some short answers today, but boy there is a lot behind the answers to some of your questions.

M. Schaefer: **[Q20]** So, the other half to your question is, what specific limitations and constraints are placed on space operations? If I stick to the four space law treaties that the US is party to (OST, Return and Rescue, Liability, and Registration), there's not really a ton of constraints in those. OST starts by maintaining freedom of exploration and use of outer space. There's some basic principles and norms like "show due regard" in Article 9, and "consult in advance if an activity you're planning would cause potentially harmful interference"—which doesn't necessarily mean to not go ahead with it, but just consult in advance.

J. Beard: **[Q1]** And "interference" is not defined there. "Interference" is a hugely debated and controversial term because it appears to be prohibited, but there is no definition of it—there is no authoritative definition of "interference" in any international agreement. And there's a real problem between where interference ends and something allowing an armed response occurs. So, that's a problem, too.

M. Schaefer: **[Q20]** Yeah, there are other constraints in OST as well. You have to allow free access to all areas of celestial bodies. And then when we talk about some of the commercial activities with respect to some of the basic OST norms, there are a couple on one side and there are a couple on the other side.

In short, the Liability Convention is only going to apply when you have a space asset of one country landing in the territory of another or harming the nationals of another or colliding with another space object. There hasn't really ever been a claim under the Liability Convention—although this is a little bit debated because in the late 1970s when the Russian nuclear powered satellite crashed in Canada, part of Canada's diplomatic note to Russia did mention the Liability Convention, but that doesn't come up very much.

Return and Rescue doesn't come up very often either. There have been cases where, I think a US government satellite or portion of a massive satellite crash landed in South Africa, and the satellite was eventually allowed to be put in a South African museum rather than be returned. But those issues don't creep up very much.

The shorter story from the point of view of the four space treaties is that we have some pretty basic norms in the OST, but there's not significant limitations—they're not overly constraining, and, in other words, they're minimally burdensome.

J. Beard: **[Q1]** Well, let me also add that a key term in the Outer Space Treaty is referring to "peaceful uses" of outer space. "Peaceful uses" is not defined. Originally, the United States took a broad approach and the Soviets took a narrow approach; however, as time has passed on, the major

powers have all agreed that "peaceful uses" has one definition, yet there are others who suggest that it's neither the US nor Russian definition, but rather that "peaceful uses" means you can do anything in space as long as it's not aggressive. There's even another definition that has all sorts of advocates that would suggest "peaceful uses" means non-military activity, but that isn't really a good position inside the Outer Space Treaty because it specifically makes allowance for military activities as long as they are peaceful.

So, the Outer Space Treaty, and in effect the four treaties that Matt has mentioned, really don't do much to regulate military activity in space. And please, please, please don't for a moment think that any of the non-binding, so-called "Codes of Conduct" have any legal applicability to US space activity—they don't. Advocates are always trying to say that there are all sorts of norms of behavior, but they are arguing for norms—the norms are not legally binding in that case. And, there is currently a European Union effort to create an International Code of Conduct for Outer Space Activity, but it is pretty much going nowhere right now. Advocates are always trying to make the point that the norms are binding, they are good, and they are what civilized countries should do, but they are simply not legally binding on the United States.

[…]

M. Schaefer: [**Q22] [Q23]** With respect to the question of, can international agreements effectively protect high-value space assets in time of crisis and/or conflict? I agree with Jack's comments. International agreements are a tool to use to help protect space assets, but you can't rely just on those alone. The international agreement can help assist technology that's developing in other things—it's a tool in the toolbox to use—but to totally rely just on an international agreement, particularly given the problems with verification, it obviously can't be done.

With respect to your questions about the Outer Space Treaty, "Fifty years of space has seen much change. Which aspects of the Outer Space Treaty of 1967 are still valid and which need updating? Is it better to add to/amend the 1967 Treaty or to establish a new framework for the 21st century?" I actually had the opportunity to provide testimony in front of the Senate Commerce Space Subcommittee in late May. I think the US should stay in the Outer Space Treaty. The US should not withdraw from the Outer Space Treaty. The US also shouldn't seek to re-open the Outer Space Treaty. There are a lot of nations that have very similar viewpoints with us, and there are some that do not, and I believe that we won't get a good result out of re-opening the Outer Space Treaty. We should do other things on the sideline—bilateral and trilateral if circumstances arise.

The Outer Space Treaty is minimally burdensome. It allows for commercial activities. There are a few restrictions, but, by the way, we would want those restrictions, those minimally burdensome set of restrictions, in place even if we were to do something new today. In other words, the Outer Space Treaty strikes a pretty good balance. Yeah, sure we're frustrated at times because it's not more limiting of others' actions, but, on the other hand, we don't want our actions overly limited either. So, I think the Outer Space Treaty has mostly good stuff in there, and I think our best bet is to use bilateral negotiations and trilateral negotiations, as circumstances arise, to flesh out some of the details for things like due regard, free access to all areas of celestial bodies, etc. For example, Article 12 of the Outer Space Treaty is about visits to other space stations, and that currently has some of our commercial companies worried, but I think that there's sufficient wiggle room in there—and if you look at the purposes of it, it doesn't have to be a costly or negative thing for commercial actors.

J. Beard: **[Q23] [Q1]** Let me echo those remarks, and add a couple of additional nuances here. There's always someone suggesting a great idea to add to the Outer Space Treaty—there's always someone. And, you know, you could try to re-negotiate what the term "interference" means,

but, in the real world, and this was my challenging world in DoD General Counsel, whenever you do this to multilateral agreement, you are opening it up for discussion. This would be particularly risky with respect to the Outer Space Treaty because, unfortunately, a good number of the countries that signed the Outer Space Treaty feel screwed over by the Outer Space Treaty.

[Q23] [Q1] The Outer Space Treaty was signed in 1967. And, of course, Verizon, AT&T, cable television, etc. didn't exist in the world when the big guys—the Russians and the Americans—set up a regime that was basically favorable to them, to their space industries, to their national security interests, etc. And, basically, the United States and the Soviets said it was all being done in the name of peace, but, realistically, the United States and the Soviet Union were getting great deals for their advanced space industries at the expense of other emerging space powers. So, this is one of the major problems—I don't think you can open up the Outer Space Treaty without dealing with all the unhappy countries, and particularly those that are along the equator because the ideal placement of certain types of satellites is right around the equator and hovering right over these states at the equator. Notably, there was an international declaration at Bogota, Colombia between these states suggesting that the placement of Verizon's, AT&T's, and all these other countries' communication satellites at the equator, hovering over their countries, represented a taking of their national resources because that space above them is so valuable.

[Q23] [Q1] So, there are other countries now that have other interests and various emerging space law programs that don't feel like the Outer Space Treaty represented a very good deal for them now. It may have been in the past, but they just didn't know what technology was going to become today.

[Q23] [Q1] My last comment about this, and it really applies to all your topics, is that anytime you try to regulate future technology and you're the United States of America, you're going to be screwed. We are so dependent and focused on the latest, greatest new technology to solve our problems, that eliminating different avenues of technological approaches to problems in space in advance, is extremely dangerous. For instance, everyone wants us to restrict a certain type of space vehicle, but, who knows, at some point that might be the ideal way to remove space debris. The United States got burned once, and I don't think it will ever get burned again, when it signed up to a statement in the ABM Treaty in which the Russians asked us to prohibit any future technology and any physical principle that would serve as an anti-ballistic missile system wherever it was located. And we signed up with that, but then in a few years, the United States wanted to build a Strategic Defense Initiative ("Star Wars"), and the Russians properly noted that it probably violated our own agreement about extending the ABM Treaty to any possible new technical physical principle, which included space. And the Russians were probably right there, and we were foolhardy in signing that agreed statement.

[Q23] [Q1] So, regulating future technology is probably not good for the US Department of Defense, and it is unlikely that the Americans are going to sign up for it. A continuing example of that is with the Russians and Chinese continuing to demand we define where space begins—what the outer limits of the atmosphere are and where space begins. And the United States always resists doing this, because we have no interest in disadvantaging ourselves—if we have some new technology that operates in that area in between space and the atmosphere, we're going to take it because, remember, someone's airspace is completely under their jurisdiction control, so as soon as you cross into outer space, they leave "American space." So, why would we want to define that place? There are a lot of interesting geopolitical strategic treaty negotiations that have been going on here.

[…]

Interviewer: **[Q1]** So, I have a more general question about definitions and terminology. You have mentioned a number of somewhat contentious and/or ambiguous space terms. One of the questions we've been asking everyone as part of these discussions is, are there any contentious space terms or definitions? I know you have already mentioned the terms "armed conflict," "norms," "interference," "peaceful use of outer space," "attack," and "first strike," to name a few, but are there any other key contentious space terms or definitions?

J. Beard: **[Q1]** Okay. "Interference" is a hugely contentious term. Then, there are two very specific UN charter terms that have to be included: "armed attack" and "use of force." What is a "use of force" in space? Is making a satellite wobble out of its projected orbit an illegal "use of force?" Is it "interference?" Is it an illegal "use of force?" Is it an "armed attack?" I mean, we've got to answer those questions. "Act of aggression" is something else you could worry a little about, but it's not as important legally as defining an "armed attack" or "use of force."

M. Schaefer: **[Q1]** But, for all of these, we have to carefully think about whether we benefit more from the lack of definition and ambiguity, or whether we benefit more if there was more detail or flesh added? And, a subset of that is, or do we wait for specific situation to occur to put flesh on these definitions. So, for example, the term "outer space" has, as Jack mentioned earlier, a limitation issue—where does air space end and outer space begin? We have to genuinely think about whether it is in our interest to keep that limitation line not completely defined to an exact level. For something like "harmful interference," do we wait for specific scenarios to try and define this a bit better, rather than try and do it in the abstract? So, for each of these, that's the calculation that has to be made in terms of both national policy and interpretation, as well as do we try and do something internationally to create a clearer definition? But, it can be a different calculation for each of those terms.

J. Beard: **[Q1]** Those are great points. And, to illustrate one of them, remember also that what's good for the goose is good for the gander here. The United States has had an opportunity to protest some things which are pretty hostile to our satellites. Recall, there is a Russian satellite that has orbited right up next to some of our satellites where it can absorb all of the information from our satellites non-stop for like a month. This Russian satellite has rotated from a couple of spy satellites acting as a maneuverable vehicle. Is that "interference" with the satellite? It's certainly dangerous. Is it "partial interference?" Well, guess what, United States is absolutely keeping its mouth shut about these incidences. I mean, we may say it's provocative, or destabilizing, or unfriendly, but we don't call it illegal because we might do it, too.

So, for all of these categories, do you want to preserve the ambiguity? Generally, for the United States, the answer is, yes we do, and you can see that by our failure to describe as illegal all these hostile, unfriendly things the Chinese and Russians are doing to us, because we may do them too.

Michael Sherry

Senior Intelligence Analyst for the Space Analysis Squadron
(National Air and Space Intelligence Center)
10 October 2017

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

I'm assuming your team is fully up-to-speed on the policy and treaty issues associated with space, or lack-there-of, so I'm not going into those areas unless you need the additional perspective. Overall I would say the biggest issue we have is there are NO common understandings nor use of space-related terms, definitions, classes and typologies of infrastructure and access. This is true within the US (NASA versus a University versus AFSPC) as well as outside of the US (our use of terms versus the UK or Russia). This plays all the way through the aspects you referenced in the questions.

Here are a couple of specific items:

1. Space Operations terminology and rules are not standardized and agreed upon:

1.a. Rendezvous and Proximity Operations (RPO): There are currently no globally recognized operating parameters that clearly define a types of RPO. In general, terms of operation for future maneuverable spacecraft is not defined.

2. Space Situational Awareness (SSA) and Space Object Identification (SOI):

2.a. These terms do not align with traditional ISR and I&W which makes integration of 'Space' into traditional US DOTMLPF structures specialized. Best example is to read Joint Pub 2 series of documents and try to find SSA, SOI, and in many cases 'space'.

2.b. These terms are often confused with each other and there is no clear definition when transitioning from basic awareness and tracking to positive ID.

2.c. Due to the confusion in this terminology and misalignment with DoD regular terminology, we have found it difficult in the space community to build systems clearly aligned to a mission. For example, the difference between an MQ-9 and an RQ-4 is clear and well known with the back-end processing, exploitation, and dissemination mechanism also well-defined – this is not the case with "SSA systems".

3. Order of Battle (OB) Rules are ill-defined:

3.a. There is no clear definition of what it means to be in-garrison versus out-of-garrison in space and thus there is no clear definition of who is responsible for maintaining OB for operational DoD purposes.

3.b. There is no clear definition of red versus grey in space and, where there is, it does not translate to equivalent OB rules for the air or sea domains.

3.c. Many spacecraft have multiple payloads and thus multiple missions that serve a wide variety of purposes thus making it more difficult to clearly attribute the purpose of the spacecraft which in turn furthers the confusion on red versus grey.

3.d. The very nature of developing a system in space makes every spacecraft 'Scientific' to some degree. This in term drives ambiguity with trying to categorize a spacecraft.

These three things along with amplifications at higher levels trickle into almost every area with regards to transitioning this into a domain equivalent to land, sea, and air.

Brent Sherwood

Program Manager (NASA/Jet Propulsion Laboratory Solar System Mission Formulation)
13 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** However, before we jump in to those questions, I wanted to quickly get your insight on one of our other questions, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

B. Sherwood: **[Q1]** That's an interesting question. I haven't really thought about that too much. Nothing comes to mind that would be a sort of a conflict of terminology.

Interviewer: **[Q1]** What about for something like the term “outer space” or just “space” in general? Are there universally agreed upon definitions for these terms? If not, do you think there needs to be some sort of universal definition?

B. Sherwood: **[Q1]** Well, my own view is that the term “outer space” is an outdated term. It's in the title of the treaty, but there is no alternative to outer space, so it's just space, right? So, to me, it's just a redundant adjective. But, overall, there seems to be pretty common public usage of the term “outer space.” Though, I just don't think much about this because my work is focused on planetary science and human spaceflight, so everything is focused in outer space.

Interviewer: **[Q1]** Okay. So, within like the US government, is there an agreed upon definition, or clearly defined parameters, for what space is or what outer space is?

B. Sherwood: **[Q1]** I don't know that there is a standard formal definition. Scientifically, people tend to think of about 100 kilometers in altitude as the sort of boundary between the upper atmosphere and space. But, as you know, there is still atmosphere up where space stations orbit, so I think this is an arbitrary threshold. But for the kind of work I do, it doesn't really make a difference.

Michael Spies

Political Affairs Officer, Strategic Planning Unit (UN Office for Disarmament Affairs)

10 October 2017

WRITTEN RESPONSE

[Q1] Are there any contentious space terms or definitions, or are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms? What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access? For example, how do we define different classes of space users (e.g., true space-faring states, users of space technology)?

In the area of disarmament and international security several terms and concepts remain contended.

One such concept is the application of the right to self-defence in outer space, as this right is reflected in Article 51 of the United Nations Charter. There does not appear to be dispute that the right of self-defence is applicable to activities in outer space. It has been rather argued that the unqualified and direct application of this right must be understood in light of the unique, fragile and sensitive nature of the outer space environment. International deliberations have focused on, inter alia, restricting or prohibiting the use of force against objects in outer space,[31] prohibiting the placement of weapons in outer space,[32] developing principles for instances in which the use of force against outer space objects may be permitted (e.g. on the grounds of public safety or for the active removal of space debris).[33]

Another key area of contention relates to the definition of an outer space weapon. Article 1 (b) of the draft treaty on the prevention of placement of weapons in outer space, presented to the Conference on Disarmament by China and the Russian Federation in 2014, defines this term as "any outer space object or component thereof which has been produced or converted to destroy, damage or disrupt the normal functioning of objects in outer space, on the Earth's surface or in its atmosphere, or to eliminate human beings or components of the biosphere which are important to human existence, or to inflict damage on them by using any principles of physics".[34] The term "outer space object" is defined in the draft as "any device placed in outer space and designed for operating therein". A primary concern expressed related to the scope of these terms is that they do not address terrestrially-based anti-satellite systems.

The term peaceful use of outer space also has various interpretations. Some governments regard so-called passive military uses of outer space as falling within the meaning of peaceful use. Proponents of this view note that various

[31] Pursuant to Article II of the draft treaty on the prevention of placement of weapons in outer space, presented to the Conference on Disarmament by China and the Russian Federation in 2014, States Parties would undertake "not to resort to the threat or use of force against outer space objects of States Parties to the Treaty", United Nations document CD/1985.
[32] CD/1985, Article II
[33] Pursuant to Article 4.2 of the draft International Code of Conduct for Outer Space Activities, circulated by the European Union in May 2015, Subscribing States would resolve, in conducting outer space activities, to, inter alia, "refrain from any action which brings about, directly or indirectly, damage, or destruction, of space objects unless such action is justified: by imperative safety considerations, in particular if human life or health is at risk; or o in order to reduce the creation of space debris; or by the Charter of the United Nations, including the inherent right of individual or collective self-defence; and where such exceptional action is necessary, that it be undertaken in a manner so as to minimise, to the greatest extent practicable, the creation of space debris." The United Nations Committee on the Peaceful Uses of Outer Space is consideration a guideline on criteria and procedures for the active removal of space objects and for the intentional destruction of space objects, specifically as applied to non-registered objects, United Nations document A/AC.105/C.1/L.354/Rev.1.
[34] CD/1985, Article 1(b)

outer space objects operated by militaries are dual purpose and have civilian applications. Examples of passive military uses include reconnaissance, early warning, communications and navigation.

Dr. Patrick A. Stadter

Program Area Manager - Assured Space Operations Programs
(Johns Hopkins University Applied Physics Laboratory)
9 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** So, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

P. Stadter: **[Q1]** Well, that is a religious question. One example is that people spend days arguing what "resiliency" means in the space domain, so "resiliency" has certainly been a contentious term. I know that US Space Command has tried to resolve that but, again, those are rather challenging days spent getting to something that I think we understand.

[Q1] On the lighter side, there is the discussion of "orbital dynamics" versus "orbitology," but the term "orbitology" doesn't actually exist.

[Q1] I think that's probably it from my perspective, but I will mull this question as we discuss more. Though, there is potentially something with respect to a blurring of the lines between what constitutes commercial space in the traditional red, blue, and gray sense if you start to look at DoD national security, whether it's Title 10/Title 50 functions over commercial, through commercial, or with commercial. So, that ends up blurring the lines, but I think this gets into policy issues—it's not so much a definition issue, but it will come down to definitions when one starts to try to address the policy concerns.

Interviewer: **[Q1]** I imagine there's similar issues with this blurring of the lines between commercial and government when you start to think more towards international commercial space entities, particularly countries where there's large government ownership over what we might consider to be commercial entitles.

P. Stadter: **[Q1]** Correct. And this is especially true when you get into what amounts to the economic free trade zones relative to the transfer of parts to be integrated. My background is in national security space Title 10/Title 50 but I've done a lot with commercial, and I am currently leading one of the programs that is a military program on a commercial satellite. So, we have dealt with this a lot.

Interviewer: **[Q1]** So, taking a step back, do you think terms like "space" itself or "outer space" are currently appropriately defined universally? If not, do you think they need to be?

P. Stadter: **[Q1]** I'm not convinced that they need to be. Well, let me back up on that. Speaking from a national security space perspective, there is a challenge in lines of authorities and OPLANs as it

pertains to overlaps between missile defense and space and different domains (i.e. the different COCOMs and MAJCOMs relative to authorities). If you start to have adversaries deploying assets that transcend different domains—is it a missile, does it go into space, etc.—then, at that point, those things become very important relative to integrated strategic plans, OPLANs, and command authority and how that's reflected in policy. That will matter, and it already matters a lot and is a challenge.

[Q1] From my perspective, when you talk about the terms "outer space" and "space," I think in terms of cislunar space (i.e., basically the Earth-Moon system, if you will). I tend to view that entire domain as something in which we should be operating effectively—we should be doing position navigation timing, communication, etc. all throughout cislunar space. If you wanted to expand further into outer space, then you can certainly start talking about planetary where we start to add the outer bodies, Mars, the other planets, etc.

[Q1] From the perspective of national security space, one thing I would caution or note is that if you define outer space to say above GEO and assume that national security space is primarily not operating in outer space, then you have a major problem because there are tremendously easy things you can do—taking advantage of the entire libration point system—with respect to national security space. So, we should not consider GEO, or even the GEO graveyard above, to be the boundary of where we're doing national security space operations—in no way, shape, or form should we do this. Rather, we ought to consider the entire cislunar system as being a domain for consideration of national security space. Just to provide you with an example for this point, it's easy to show how we typically get to GEO by going to GTO and then getting to GEO, but there are even easier ways to do this by using the Moon, and we've already successfully done so on the civil side.

Stratolaunch Systems Corporation

Steve Nixon
Vice President for Strategic Development

Melanie Preisser
National Systems Director

18 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** I want to begin with a question of actually not on the list. It's more of a general question about terminology. From your perspective, do you often come across contentious space terms and typologies that vary from different space communities. Is there a gap in language from the government sectors, to the commercial sector, to the civil space sectors, etc.? What are specific terms that need to be more universally defined? If any.

S. Nixon: **[Q1]** Yeah. Okay. I'll give you my impression and sense of this and that's probably true of all these questions, of all these. I think speaking for Stratolaunch, we are very much attuned to the things that DOD is thinking about in terms of resilience and contested space. It has to do with our business model and where we're taking our particular style of launch that is driving us this way. I feel like we are pretty attuned to that and even attentive to the various ways that you could attain resilience and deal with the contested space environments.

[Q1] My impression having talked to commercial companies or other commercial companies and several agencies is that there's not nearly that kind of awareness or understanding of what's going on in this world. Just leaving that to DOD and the military to think about and they're all doing their own thing without much regard to it.

Interviewer: **[Q1]** The gap and language is then pretty much one sided on the government domain. In other words, they're playing catch up in their terminologies, develop prior to commercial sector. Is that what you're saying?

S. Nixon: **[Q1]** I'm saying that the thinking and terminology that DOD is developing right now in this domain is probably not largely not understood by the commercial industry.

Interviewer: **[Q1]** Okay. A lot of exceptions.

S. Nixon: **[Q1]** There are exceptions, obviously. There are commercial companies that we're working on, especially on national awareness. There's companies like ours that are promoting ourselves for resilient launch. We're very much attuned, but if you go to your average… and we do a lot with the small satellite industry and small launch industry. Fellow guys aren't really thinking about this too much for the most part.

S. Nixon: **[Q1]** I'll clarify that even further. We are involved in and actually founded and run something called the next generation launch coalition. This includes the small launch companies like Rocket Lab and Virgin Orbit and other companies like that. Through our leadership of this forum, we've been helping our little piece of the industry understand some of the challenges we have and we are collectively pitching our small launch to DOD as a mechanism and dealing with the problems connected with space and resiliency. So our little industry that would otherwise be the commercial thing is thinking more and is along these lines, mostly because of some stuff that we're doing. It's probably next generation launch coalition.

Dr. Mark Sundahl

Charles R. Emrick Jr.- Calfee, Halter & Griswold Professor of Law and
Director, Global Space Law Center
(Cleveland State University, Cleveland-Marshall College of Law)
19 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Great. So, question 1 from our list has to do with definitions and space terminology. I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

M. Sundahl: **[Q1]** Yeah, I can rattle you off a list of terms. If there weren't uncertainties, there would be nothing for us lawyers to do. I'm glad to let you know what comes to mind. What first comes to mind, of course, is the international treaties, and the Outer Space Treaty in particular. There are all kinds of questions and ambiguities regarding the Outer Space Treaty.

[Q1] In Article I, it talks about "free use of outer space," but what exactly does "free use" mean? I can unpack any of these. There's a list of them. With respect to "free use," does that include, for example, the right to mine asteroids? What does "for the benefit of all countries" mean? It says, "space activity shall be the province of all mankind," but what does that mean?

[Q1] In Article II, what does this prohibition on "national appropriation" mean? These are all things that come up particularly in the case of asteroid mining recently, but also any kind of installation or presence on the moon or other celestial bodies—at what point does it amount to "national appropriation" that's prohibited?

[Q1] Article IV, here we go, this is the military one, so this is of particular interest to your study. It's clear that you're not supposed to put nuclear weapons in orbit, but are there other weapons of mass destruction, and what does "weapon of mass destruction" mean? What if there was an electric pulse of some kind that caused massive damage to our electricity grid or communications infrastructure? Would that be considered a weapon of mass destruction? It says that the moon and celestial bodies shall be used only for "peaceful purposes," but what does "peaceful purposes" mean? The United States, as you probably know, interprets "peaceful purposes" as a non-aggressive use, but you can otherwise engage in all kinds of military operations in space as long as you're not being aggressive. The establishment of military bases, installations, and fortifications are prohibited on celestial bodies, but the military can use celestial bodies for scientific research or any other "peaceful purpose." Now, what is a "peaceful purpose?" Could you maybe use the moon for self-defense reasons, non-aggressive self-defense? That's a peaceful purpose under the US perspective. What is a "celestial body?" We see that phrase a few times—you can't appropriate a "celestial body" and you can't have the military installation on a "celestial body," but what is a "celestial body?" It's pretty clear it includes the moon, but does it include asteroids, even very small asteroids?

[Q1] We have Article V, which talks about rescue and return of astronauts, and it actually uses the word "personnel" in a later treaty. Does that includes private entities or are we just talking about government astronauts? Will private entities be rescued under the rescue and return treaties? If a private spacecraft goes astray into some foreign country and lands in distress, is that country subject to the duty to return it to the launching state or does this obligation only apply to the return of governmental space objects?

[Q1] Article VI has been a big question of debate. To what extent are countries required to authorize and continually supervise the activities with their national? What exactly does "authorize and continually supervise" mean? What degree of regulation is required by that? That's a debate that has been going on in Congressional hearings over the past couple of months. Some people say, "we don't need much regulation at all," while other people go as far to say, "we really believe that international obligations don't apply to private entities." I'm not one to believe that.

[Q1] So, those are just some examples of contentious and ambiguous terms.

Interviewer: **[Q1]** Yeah, that's really helpful. Just out of curiosity, what about a term like "space" in itself or "outer space?" Do you think these are appropriately defined universally? It seems like there could be a lot of ambiguity here. If they're not properly defined currently, do you think they need to be?

M. Sundahl: **[Q1]** Yeah. You're right. You put your finger on it. The most elusive debate, most elusive question in space law is where does space begin? Where does air law end and where does space law begin? Because they're quite different regimes. For example, in air law, you need consent to fly

over another country's territory. In contrast, once you're in space, you can go put a satellite right over Moscow and no one can say a thing.

[Q1] When does space begin? That hasn't been settled internationally. The rule of thumb is the Karman line of around 100 kilometers (62 miles), but it really hasn't been established. Some countries have established parameters—I think Australia established it at 100 kilometers for international laws. But really, at the end of the day, this hasn't been an issue. It has been clear that if something is in orbit, it's in space. If something is flying to the moon, it's in space. The question is when you're straddling that line—where does the line begin and end? I think that has come up again now in the course of sub-orbital space travel when we have suborbital space planes that are designed to fly just beyond the boundary of outer space. But, really, where does that begin? It's less clear. I tend to think that at around 100 kilometers, you're kind of on the cusp there. Does air law or space law apply? The same questions arise with respect to when exactly the rules of space law regarding limits on militarization begin. It's a big debate with a lot of literature and different theories.

John Thornton

Chief Executive Officer (Astrobotic Technology)
11 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Before we start with the questions here, we start all of our interviews by asking our experts if there is any particular definitions or terminology in the space domain that are contentious. So if you're dealing with, let's say, your counterparts in the civil space domain or in government or military or in different nations, have you encountered different terminology or undefined terms or specific definitions that lack a universal definition?

J. Thornton: **[Q1]** I guess it's possible, but without a specific example, it's hard to think of one or to point to one.

Interviewer: **[Q1]** Okay. In your experience, language isn't too much of a concern.

J. Thornton: **[Q1]** Yeah, it's pretty universal.

ViaSat, Inc.

WRITTEN SUBMISSION:
Richard A. VanderMeulen
Vice President of Space & Satellite Broadband

Ken Peterman
President - Government Systems

Shannon Smith
Executive Director of Strategic Initiatives

Fred Taylor
Vice President - Space and Cyber Applications at ViaSat – Government Systems

Bruce Cathell
Vice President - Government Operations

15 August 2017

INTERVIEW:
Richard A. VanderMeulen
Fred Taylor
Shannon Smith

21 August 2017

WRITTEN RESPONSE

[Q1] What are the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access?

"ViaSat Responses to SMA of Contested Space Operations"

Commercial and Private Sector Industry Characterization

There are two broadly different structures within the commercial or private sector, one that seeks government investment and one that invests its own funds. Within these two structures, the common understandings and uses of space-related terms, definitions, classes and typologies of infrastructure and access, as they relate to the military/government sector, can vary widely.

One commercial or private sector structure is characterized by companies that bid to implement the systems the military/government sector defines. This group of tier 1 and lower tier private sector companies respond to Request for Proposal or Tenders (RFP or RFT) that implement space systems envisioned by the military/government sector. The source of funding for the eventual programs typically relies on RDT&E and/or Procurement funding from within the government sector. In this private sector structure there is relatively strong alignment in common understanding since the military/government sector leads the market and establishes the space-related terms, definitions, classes and typologies of infrastructure and access.

The other commercial or private sector structure is characterized by companies that develop space systems with private sector capital investments and achieve a return on invested capital by offering services on these space systems. This sector includes tier 1 and lower tier commercial or private sector companies offering a range of services

including Space Situational Awareness (SSA); Earth observation, including but not limited to Electro-Optical Sensors (EO) and Synthetic Aperture Radar (SAR); Position, Navigation & Timing (PNT); and satellite communications (Satcom). Due to differences in number and types of business model and technological inputs private sector companies in this structure often develop a different set of understanding and uses of space-related terms, definitions, classes and typologies of infrastructure and access. Since multiple entities may develop capabilities independent of one another, there is often diversity both between the government/military and the private sector, and among the private sector definitions.

It is important to note that private sector companies can exist in both of these structures, further complicating a common understanding. ViaSat is one such company. We have been traditionally known as a lower tier supplier in the market defined by the military/government. This business includes designing, implementing and/or constructing ground stations, modems, networking, and security solutions for commercial, military and government Satcom, as well as space-based solutions for crosslinks and other specialized applications. More recently we have become known for being a tier 1 satellite owner/operator and service provider. In this role, we have four (4) satellites on-orbit with more communication capacity than anyone--government or industry. We are extending our market leadership with the production of the next generation of communications satellites, ViaSat-3. ViaSat-3 satellites will redefine the state-of-the-art in satellite communications. Each ViaSat-3 class satellite will have more communication capacity than combined fleets of all commercial, military and government currently in use. The mere fact that a single satellite system could provide more capability than over 400 on-orbit satellite systems, illustrates the significant degree of private sector investment on-going in the commercial or private sector, while the dramatic differences in capabilities illustrates why there can be such divergent understandings of terms, definitions, and classes.

At ViaSat our focus is on providing space-based *ecosystems* that maximize the value provided to end- users. These users include consumer, business or enterprise users, commercial airlines and their passengers, maritime platforms and their passengers, and military and governments customers. From this perspective, the concept of true space-faring states becomes less relevant. There are simply different classes of end-users with sets of similar and dissimilar needs.

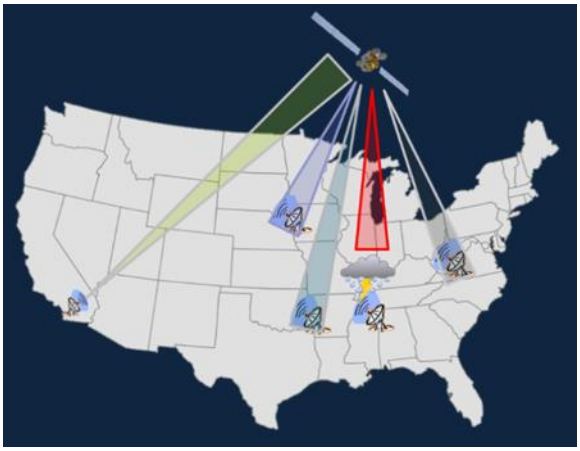
Common Understandings among Commercial and Private Sector Industry

The military/government sector views their Space systems as a separate component existing in Space or in the Space domain, with independent (and often separately developed) components that operate in the terrestrial, cyber, and management domains. Each component is designed and acquired separately, with interfaces that allow interoperability. This approach stifles progression and innovation, since a change affecting an interface between components would require a costly and complicated redesign of multiple components—almost certainly involving multiple acquisitions across multiple services, program offices and vendors. This can increase vulnerabilities as warned by Gen. Hyten "There's no such thing as war in space; there's just war. There's no such thing as war in cyber; there's just war."[35]

The contrasting view from the commercial or private sector is that private sector systems, including SSA, EO, PNT, and Satcom, do not exist exclusively in Space or the Space domain; instead, they are complex ecosystems that exist in multiple domains. They exist in the subterranean domain with fiber and power, the terrestrial domain with teleports and gateways, the space domain with satellites and debris, the cyber domain with cloud computing and user devices, and finally the land, sea, air, and space domains with platforms and end-users. Today's private sector ecosystems are able to create exponential performance increases by considering systems holistically, allowing simultaneous trades and optimizations across ground, space, cyber and management domains. Treating the network

[35] http://www.defensenews.com/smr/space-missile-defense/2017/08/08/hyten-focus-on-adversary-not-domain/

as a single entity allows enhanced performance, better situational awareness, and superior agility with much faster development, update and maintenance cycles.



ViaSat's gateway diversity concept is an example of the benefits available from considering the entire ecosystem simultaneously. Instead of providing a static bent pipe transponder, which simply passes a signal unchanged from end-user to gateway; data is now split by the satellite in a changing pattern and shared among multiple gateways at once. This approach adds flexibility to the network, allowing for dynamic surge capacity, improves availability, provides resilience against individual gateway failures, reduces individual gateway cost, mitigates weather and interference effects, and improves the security/confidentiality of the network. Implementing this concept required changes to the space segment, the gateway architecture, the terminal, the over the air waveform and network management simultaneously. These innovations improve performance across multiple dimensions in ways that are not possible when individual components are designed separately and integrated together. These two different views not only color the "common understanding", they also color the SMA questions which reflect a singular focus on space, versus the private sector's focus on the entire ecosystem.

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** All right, great. I wanted to begin our discussion today by actually asking a question that we like to ask all our contributors that is not on this list of questions. Is there anything from the list of questions that we sent you that we didn't ask, but that you think should be included and is important considering the scope of this project? Or anything that you would like to emphasize, or a particular point that the questions failed to address.

R. VanderMeulen: **[Q1]** Well, that's a pretty big question. Obviously, these questions are pretty interesting, very thoughtful and from a different perspective than we've seen in the past. We think maybe that was tied to the purpose of the assessment which seems to be contested space operations. Maybe the only opening comment that we would make is that, space systems leading up to and during the 1995-2005 period the DOD was the leader of the technology and in funding the innovation. DOD lead WGS designs, had advanced **EHF** designs, had the TSAT program that was trying to further advance Satcom. Similar in Earth Observation sector and other space sectors, the government was the big innovator. Since 2005, our perspective is the commercial or private sector industry, is now leading the innovation by any measure, by performance or by the number of dollars being committed. DOD should anticipate even more rapid change and impacts on space capabilities moving forward.

Interviewer: **[Q1]** Great. That is actually the perfect segue into my first question. It's interesting that you bring up that date in particular because this is something we've heard. Considering the date of 2005, we've often encountered the term old space and new space and when we ask this definition question. This is an important distinction I think you guys make when you're talking about the different structures. One that seeks government investment and one that invests its own fund. First of all are you familiar with the term old space, the new space, have you heard that before?

R. VanderMeulen: Yes, we are.

Interviewer: I assume this is loosely what you're referring to, correct?

R. VanderMeulen: [Q1] Loosely… Obviously, there's no hard definition for old space versus new space, Webster's doesn't define them. So, if you use that term, in different people's minds it might mean different things. If you're using the term loosely, then yeah, we sort of agree with it. Right now the term new space is really referring to all these startups. ViaSat was a startup; we were founded by three people in 1987, which are still with the company. Today we have over 4000 employees, we are a publicly traded company, we have more capacity or communication capability on orbit than any other provider (commercial or government), and we are producing a new global constellation of communication satellites where each individual satellite will surpass the total capacity of all of the existing on-orbit satellites combined. So, we do not know if we fall into new space. It's like what's the term old space, versus new space, versus the concept we were trying to define in this response. Specifically, those people in the private sector that are actually investing their own money to provide a disruptive space service.

Interviewer: I think that's another important distinction you just made as far as startups go. We wouldn't consider the Boeings or the Lockheed Martins or the Northrop Grummans as necessarily startups in that sense, correct?

R. VanderMeulen: Right. Those companies tend to pursue programs that the government has defined with government RDT&E, or procurement money. Today there's a big opportunity with what the government calls the Space Enterprise Vision, which they have rebranded into the Space War-fighter Construct. Essentially, the Air Force Space Command and the equivalent on the DNI side are developing a construct for their next layer of what we would call purpose-filled satellites. This means solutions that are funded out of RDT&E for their development and procurement money for their production. So those are being defined today in companies like Boeing and Raytheon, Lockheed Martins and Raytheon. There's a lot of companies including some parts of ViaSat that will pursue these Programs in a tier one or a sub-tier role.

Dr. Frans von der Dunk

Professor (University of Nebraska College of Law)
25 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay, great. However, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

F. von der Dunk: **[Q1]** Well, yeah, I'm afraid to say, there are number of those. For example, the oldest treaty, the Outer Space Treaty, which is generally seen and recognized as providing the basic legal framework for space and is generally accepted by all space faring countries, is in itself very general and broad. Its nickname is the Principles Treaty, and the consequence of that is that there are a number of terms that have been or are still subject to considerable debate.

[Q1] I will give you two examples of this. First example: in the Treaty, there is a reference to the use of space for peaceful purposes. Though, over time, the nations of the world have come together and converged on a conclusion that peaceful uses can even include military uses as

long as these are non-aggressive and do not amount to the actual use of weapons, because then other rules may apply. So, defensive military use is now allowed. However, in the old days, the Soviet Union claimed that defensive military use was not part of peaceful purposes.

[Q1] Second example: in one of the Treaty's articles, outer space is qualified as the province of all mankind, which is a unique term in international law. By some, this is interpreted to refer to something like a global commons, which I guess is becoming the leading interpretation. However, there's still a number of countries that claim, by contrast, that it should be interpreted more as something like a common heritage of mankind, which is another legal term in international law that leads to much more profound consequences in terms of the legal possibility of individual nations to do what they want in outer space.

[Q1] So, those are just two examples. There are more. Unfortunately, overall, there are a number of issues in which there is no clear understanding about meaning of certain terminology and language.

Interviewer: **[Q1]** Okay. So, it sounds like there are some contentions over various interpretations of terminology. Interestingly, it seems like there are even contentions over a term like "outer space" in itself. So, I'm wondering, do you think that this type of contention is okay, or do you find it problematic? Do you think there is a need to work towards a universally agreed upon definition for a term like "outer space?"

F. von der Dunk: **[Q1]** Well, the definition of outer space has been subject to debate for half a century and countries haven't been able, on the international level, to agree on a single definition. As an academic lawyer, I would always prefer to have clear definitions, because then we know what we're talking about. But, at the same time, I'm obviously aware of the less than perfect way in which the international community is organized. Sometimes, it's simply necessary to accept that there is a general understanding of a range of where the appropriate interpretation lies, without the need to actually come to a conclusion on a specific definition. If you talk about outer space, it has always been one of my key points in discussion, and I think that it would be good to define outer space in a geographical sense, if you will. A clear definition for outer space would translate into a clear definition of a boundary between airspace, which is always subject to the sovereignty of the underlying nation, except when we talk about the airspace above the oceans.

[Q1] On the other hand, for outer space, where there's no territorial sovereignty, I agree that so far the absence of a clear boundary line or acknowledgement and acceptable clear boundary line hasn't created major problems; however, I think that this is about to change, particularly if you look at space tourism or discussions on high altitude vehicles, which could be used for a number of purposes, certainly not all of them being friendly. So, I think at some point we need to establish a clear borderline that also goes back to the fundamental and general international legal approach of states—if states have territorial sovereignty over a particular area, they ideally want to be fully aware of the extent of that sovereignty, and if they don't have this level of full awareness, then they will likely look for ways to try to establish it. Of course, as you already know, numerous wars have been fought over where exactly a terrestrial borderline or boundary is supposed to be, and that includes conflicts over maritime boundaries as well. So, from my perspective, I think we should, at some point in the future, write a clearer definition for outer space, including specifically a boundary vis-à-vis air space.

Dr. Brian Weeden

Director of Program Planning (Secure World Foundation)
31 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Great. However, before we do jump in to those questions, I wanted to quickly get your insight on one of our other questions, specifically Q1 from our list, which has to do with space terms and definitions. More specifically, I am wondering if you can talk a little bit about whether or not there are any sort of contentious space terms or definitions out there. Basically, are there any noticeable disagreements amongst space communities about appropriate terminologies and/or appropriate definitions for terms?

B. Weeden: **[Q1]** Well, the plain answer is, yes. I don't know whether that speaks to the maturity of the space field in general, but there is tons of terminology that is either contentious or has no agreement on.

[Q1] Just a couple off the top of my head. The term "global commons" is one that carries a lot of baggage. You will find this term occurring in quite a bit of military writings on space and a little bit also in the general public stuff; however, where you will not find this term is in the State Department writings on space or in any of the writing from economics people that are looking at space—and this is partly because the term "global commons" has kind of become over used a bit and also because there is some political baggage with the term "global commons," which stems from some of the stuff around the "common heritage of mankind" language in the Moon Treaty. So, that's one example.

[Q1] The term "space traffic management" is another one that has a lot of debate over what it actually means, and "space situational awareness" is part of that. This is a field that I have worked in quite a bit, and I have heard probably 5 different major versions of interpretations of the terms "space situation awareness" and "space traffic management." There is even a debate over whether the term used should be "management" or "control." So, yes, this is a huge area of debate.

[Q1] Then there is debate about the terms "weaponization" and "militarization," which are terms that get thrown around a lot, but there is not a lot of clarity about what is meant by those terms or even agreement on definitions.

[Q1] So, yes, in general, the space field is rife with terms that are either not well defined, or that have multiple definitions depending on who you talk to, or that have various degrees of political contentiousness.

Interviewer: **[Q1]** Yeah. That's something that we've certainly been hearing. Another thing we have been hearing, along these lines, is about ambiguity surrounding some of these terms, which I think sort of applies to a term like "space" in itself. So, do you think terms like "space" and "outer space" are currently appropriately defined universally? If not, do you think they need to be?

B. Weeden: **[Q1]** I would use the term "strategically ambiguous," and this stems from some of the original origins of space. You go all the way back to when the Eisenhower administration was debating space, and they came up with the term "peaceful uses of outer space." That term has a few different definitions to mean different things to different people, right? Some interpret

"peaceful uses of outer space" as non-military, others, including the United States, have historically defined "peaceful uses of outer space" as meaning non-aggressive uses of space. So, why the different interpretations? Well, if you think of the early origins of the space world, so much of it was revolving around national security and military applications of space, a lot of which was heavily classified at the time and some of it is still classified today. So, they are referring to things that they can't talk about in public domain, or they use euphemisms to refer to classified programs, or in the case of the phrase "peaceful uses of outer space," it's coming from the more politically strategic ambiguous terms—the idea of "peaceful uses of outer space" was basically a branding and messaging campaign that the US came up with—starting with the Eisenhower administration—as a way to enshrine the freedom of overflight and the ability to use space for intelligence collection as a core aspect of international space activities and international space law.

[Q1] Some of the people involved in that debate knew exactly what was going on, but the public didn't really catch on to it and the media didn't really catch on to it. They were able to basically package it within this context of scientific application, benefiting all mankind, and NASA and all the civil space stuff, but the real core national interest behind all of that was intelligence done through space and national security issues.

[Q1] So, I think that's a perfect example of a trend that continues today, where a lot of the core terminology was intentionally left ambiguous in the very beginning, because it was part of political messaging or because it was related to classified national security activities.

[Q1] I think that as the space domain evolves towards becoming more normalized, like other domains, that will change. Going forward, you are going to have more commercial applications and you are going to have a lot more openness about what is going on, and that will drive a whole new set of conversations and users that might crystalize some of the ideas. But, in my sense, overall, that's kind of the reasoning as to why some of this ambiguity persists.

Interviewer: **[Q1]** Okay. So, given that we have more users getting involved in the space domain, and some definitions are possibly evolving as a result, in your opinion, how would you best define "space" as a term?

B. Weeden: **[Q1]** So, I will refer back to some work I did a couple of years ago on this in relation to the term "space traffic management." At the time, the question was, when should something be licensed as an aircraft versus when should it be licensed as a spacecraft? That's not an easy thing to figure out—it's kind of related to this whole definition of when does space begin. The methodology that I used was actually derived from something that Professor Henry Hertzfeld at George Washington University had talked about, which was to kind of think about three terms: orbital, sub-orbital, and trans-orbital.

[Q1] So, for example, if it's below let's say 100 kilometers, that would be sub-orbital, because that is certainly not going to be in orbit and it's kind of that gray zone between aircraft flying and hot air balloons, but if something stays in that area, you probably want to consider it to be largely in the realm of aviation air space. If something is to do a complete orbit around the Earth, then that's pretty clearly in space. Then you have this weird category of ballistic missiles—they are fired from the Earth and they go up way high into space (hundreds and thousands of kilometers). If you look at the North Korean tests from last week, which had an apogee of something like 3,000 kilometers or 4,000 kilometers at least and then came back down. So, that's that weird sort of trans-orbital sort of thing.

[Q1] So, to me, that's kind of how I break it up. I know it's probably not going to answer the questions you guys are looking for, but I will say that I am part of a group that is sort of struggling with the same definitions—we are trying to put together a manual on international humanitarian law of armed conflict in space, and we are defining it as how international law relates to military activities in outer space. And we have spent the last 3 months trying to define what military activity in outer space means, and what's included or not included in that. So, for example, if you have a cyber-attack directed at a satellite control station on the ground, is that an activity in outer space or not? Yes, it impacts satellite operations, but is there anything really special about it that you wouldn't get from just calling it a cyber-attack. I use this example just to illustrate that this is not an easy job, and if you can't come up with a great definition, it doesn't mean you don't know what you are doing. It's a really difficult question.

Interviewer: **[Q1]** Okay. So, along those same lines, I am guessing the answer to this is probably pretty ambiguous and difficult as well, but what do you think constitutes a space weapon?

B. Weeden: **[Q1]** To be honest, I really haven't tackled that too much because a mantra of mine and our organization over the last several years has been that you really shouldn't focus on classifying things, but rather you should focus on talking about behavior. With that said, I think the clearest definition for a space weapon would be something that is deliberately designed to damage, degrade, or destroy another object in space or something on the ground. That's probably the clearest bright-line definition, with the distinction being "intentionally designed," which separates it from something that is narrowly used (i.e., I could pick up a pencil and then use the pencil as a weapon to stab someone, but it's clearly not designed with that in mind; whereas a fire arm is clearly designed with being a weapon in mind).

Interviewer: **[Q1]** Okay. One last question about this, just to make sure I am understanding it right. So, it sounds like you believe that something like a cyber capability or cyber threat, or something along those lines, should be classified as a space weapon?

B. Weeden: **[Q1]** Again, it depends. If I was making a list of threats, then yes, cyber capabilities against satellite infrastructure, or even satellites themselves, would be on that list; but, if I was trying to put together a list of things to ban, I would not put it on the list, because it's a cyber weapon, not a space weapon.

[Q1] By the way, there has been a very similar debate in the cyber world about how you define a cyber weapon. I would suggest looking at the Tallinn manual, which is something that NATO has worked on for the past several years and is essentially the law of armed conflict manual for cyber. The Tallinn manual presents quite a bit of work that has been done by a group of international lawyers trying to figure out how to actually define "cyber weapon" and "cyber-attack."

Charity Weeden

Senior Director of Policy (Satellite Industry Association); Former Assistant Attaché, Air & Space Operations (Canadian Defence Liaison Staff, Washington, DC)
24 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** All right, perfect. You said you have the list of the questions in front of you. Really with question one, we just want to see if there is any variance in terminology or any specifically contentious terms that you encounter in your capacity and that you think there is a lot of misunderstanding or miscommunication with specific definitions. I'll see off with that Charity.

C. Weeden: **[Q1]** SIA classifies the satellite industry into four segments. One is services. The second is ground equipment. The third is launch and the fourth is manufacturing. When we talk about a satellite service we would mean telecommunications, observations or science or national security services. For example, DoD purchasing SatCom from the commercial industry.. One thing that you might find a difference in opinion across the world is the definition of commercial versus private.

[Q1] It's my understanding that in Europe "private" means more commercial and the US private means the academic community, NGO community and the commercial community. There might be some differences in what we're talking about there. When SIA compiles its report, and something is classified as a commercial service, it doesn't matter who purchases, so long as you are able to exchange funds and that's defined as a commercial purchase. For example, we include the manufacturing of GPS satellites in the commercial manufacturing revenues for the year for example.

Joanne Wheeler

Partner (Bird & Bird)
26 July 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Great. Before we jump in to those questions, we like to ask all of our space experts a question before beginning the interview regarding general space definitions and terms. Are there any sort of contested space definitions or terms or noticeable disagreements amongst space communities with regards to any definition or terminology that you are aware of?

J. Wheeler: **[Q1]** Yes. Briefly, one is the definition of what "space" is and where it starts and the delimitation between air space and outer space. Other disputed terms include what a "space object" is and what the term "peaceful" uses means. A more contentious one is whether space can be militarised and for what purposes.

Interviewer: **[Q1]** Okay.

J. Wheeler: **[Q1]** We didn't answer these points in the recent UK space bill, the Draft Spaceflight Bill.

Deborah Westphal

Chief Executive Officer (Toffler Associates)
17 August 2017

INTERVIEW TRANSCRIPT EXCERPT

Interviewer: **[Q1]** Okay. Great. Deborah, I actually want to begin the interview with a question that's not on the list or not on the calendar invitation. It's more of a general question regarding terminology and definition in the space domain. I'm wondering, I think you would be able to provide a rather unique insight. Is there a gap in the language between different space communities and other contentious terms and definitions that you often encounter from looking into the commercial sector or the government space domain or across the international actors? Is there any different significant difference in the language?

D. Westphal: **[Q1]** I don't think there's a gap in language. I do think that commercial space is pretty broad and it's changing. Some would say there's old space and new space. There's defense aerospace companies that are trying to do commercial-like-ventures. Then there's strictly commercial startups, companies that are focused on solving a different set of market problems.

[Q1] I also think the definition is changing, as new players enter into the space market or into this industry. there is a shifting value chain of players that play in commercial space. If you think about the satellite side, the network side, the equipment, the boxes, the apps… I think there is a broader definition of space industry that some don't necessarily include when they think about space.

Interviewer: **[Q1]** Okay. I think that's interesting. You brought up the old space and new space. When would you say that definition evolved and entered in the mainstream?

D. Westphal: **[Q1]** Probably close to ten years ago. In the late 90s, the Air Force had a big initiative around using commercial space to address mission needs. If you may recall there was a rush to build broadband satellites and there was a bunch of start up satellite companies that were going after a global broadband space archiecture. That was probably the beginning of the shift. Some of those companies were successful, some of them we were not. The same thing was happening in launch. The focus and success of these companies ebbed and flowed for the last 10-15 years. I believe what we are seeing now is just an evolution of the business model envisioned for commercial space many years ago with many of the technologies matured.

[Q1] So I think we passed that inflection point. But that dynamic is still probably there in the industry… We're still in the process of transformation.

Interviewer: **[Q1]** Okay. If I could maybe dive a little bit deeper into that term... New space could be defined as the area or the sector of the commercial industrial that is pure commercial, as you said. So, businesses that don't rely on government space for their businesses survival or growth. Do you agree with that?

D. Westphal: **[Q1]** Yes. I think there are rapidly growning commercial needs to be addressed from space. There's commercial needs to survey the world for oil or human migration or climate change, or supply chain security, or protection of critical infrastructure, or whatever the systems and processes to monitor and assess movement of people, products, and resources. That's what's driving the capability growth on the commercial side. There is a commercial business that others are trying to solve that is different from national security space. However, there's a lot of overlap in the systems and technologies being used.