THE BATTLE BEYOND

Fighting and Winning the Coming War in Space

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INTRODUCTION

War versus Warfare

> He who exercises no forethought but makes light of his opponents is sure to be captured by them. Thus, what enables the wise sovereign and the good general to strike and conquer, and achieve things beyond the reach of ordinary men, is foreknowledge.
> —Sun Tzu, *The Art of War*

Like so many elements of contemporary war, the word *war* itself comes into the western lexicon from the German. It is related to the Old High German words *werren*, meaning "to confuse," and *werra*, meaning "strife."* Whatever else war might be—the continuation of politics, hell, a "disease," an "act of murder," or a "defeat for humanity" †—confusing strife seems to be as good a definition as any. In the twenty-first century, war follows the decision of the state to employ available military means to achieve its policy objectives. It is an acknowledged hostility that involves various government agencies as well as the various military arms.

Warfare, in contrast, is the application of military means to the war effort. It is the practitioners' business—both of the generalists and specialists—and its practice includes knowledge and experience unique to the multitude of tribes. In land warfare, the tribes are the infantry, armor, artillery,

* *Merriam-Webster,* s.v. "war," accessed March 12, 2021, https://www.merriamwebster.com/dictionary/war.

† Clausewitz, Sherman, Saint-Exupery, Einstein, John Paul II

logisticians, and others. In maritime warfare, the tribes are surface warfare, subsurface warfare, and naval aviation—to name a few. Marines constitute their own tribe. In air warfare, the tribes include fighter pilots, bomber pilots, and transport pilots. In space warfare, the tribes are emerging. The list may include groups of experts in missile warning, electronic warfare, communications, intelligence, cyber warfare, and orbital warfare. Their skill sets will remain simultaneously unique to their domains and complementary to the skills of the other groups with whom they engage in joint and combined arms efforts.

As in land, maritime, or air warfare, the various disciplines of the space domain may be used independently, but the options available to friendly forces expand greatly when multiple disciplines coalesce into a common effort (i.e., in joint combined arms operations). In the same way, the effectiveness of the entire military increases when the means of multiple domains coalesce (conceptually, multidomain or all-domain operations). As governments strive toward their policy objectives, their own effectiveness will likely increase when national leadership aligns its various means from across the whole of government (doctrinally, this is the definition of unified action). It follows that if governments are not understanding of the space environment or not decisive in the employment of space forces, the effectiveness of military operations—and by extension, the attainment of policy objectives—may suffer.

Within the context of the space domain—a domain that includes not just orbital space but also the ground stations and radio signals operating to and through space—the terms *war* and *warfare* carry significant implications. If war involves all elements of national power, then nonmilitary entities that develop or employ space systems on the nation's behalf require consideration and depending on their function, may be subject to enemy action in a conflict. Organizations as diverse as the National Reconnaissance Office (NRO) and the National Oceanic and Atmospheric Administration (NOAA), along with commercial companies, academic institutions, and think tanks come into play. With this perspective in mind, it may be appropriate to ask (if only in private), "How is NASA contributing to the war effort?" Through human spaceflight, for example, NASA may provide a bridge by which to maintain

relations throughout a period of international conflict. The question of how NASA is contributing to space warfare would be less interesting. True, space technologies developed for scientific applications may readily transition to military uses, but NASA is a civil government agency dedicated to space science and exploration not to warfare. Space warfare, then, is primarily a military problem and thus requires an application of military thought.

For the uninitiated, the words *military thought* may ring oxymoronic. After all, don't soldiers and sailors simply follow orders, leaving the brainwork to their betters? In the twenty-first century it is time to abandon this vestigial stereotype once and for all. The conflicts of the future will require the critical and creative thought of every person involved and the best-trained and most educated service members ever produced.

The ability to win the "battle beyond" will depend upon ideas that are only now beginning to emerge. Fortunately, a rich body of military thought—history, theory, and doctrine—exists as a font of knowledge for both the novice and the experienced practitioner, for the warfighter and the civil servant, for the concerned citizen and the casual observer. This corpus enjoys entrenched principles that can provide an abundance of inspiration, but a danger also lurks just beneath the surface: the tendency to ingrain ideas into the soldiery, no matter how useful for historical armies, is also likely to deter originality. In the quest for military effectiveness, the opportunity for misapplication of ideas is everywhere, either in applying the wrong idea to a given situation or in applying the right idea in the wrong way. A third pitfall lies in failing to apply an idea at all—perhaps for lack of ideas or for a lack of determination and resolve. The first two mistakes may be excusable; let us never allow the third mistake.

In this discussion of space warfare and how to succeed in the endeavor, then, ideas are the primary aspect to consider. Fortunately, the history of military thought is rife with them, and many ideas link readily to space warfare. We do run the risk of misapplication, but we also have an opportunity to apply old ideas in new and creative ways. For example, the doctrinal principles of war—derived largely from the military theory of British Colonel J. F. C. Fuller a century ago—remain useful. Similarly, the doctrinal elements of operational art mostly hearken back to the multidomain theorist (née the

naval theorist) Sir Julian Corbett. The problem then is not that there is a lack of military thought to apply to space warfare. The problem is that, given a military establishment with a mandate for all-domain synchronicity—but one that is largely unfamiliar with space operations—a large gap exists in the translatability of space operations into terms understandable across the entirety of the institution. A related problem is the need for specific space warfare language when existing language will not do. In a word, the fundamental problem—the most essential ingredient for winning the coming war in space—is language. Soldiers, sailors, airmen, marines, and guardians may not know what questions to ask about space, and space experts (even if they are soldiers, sailors, airmen, marines, or guardians) may struggle to explain their answers in commonly understandable terms. In this effort, established military language is a more useful tool than trying to use the technical language of an esoteric discipline. Using already familiar military language, principles, and symbols therefore will help nonspace personnel coordinate better with space planners and prepare for the space conflicts of the near future.

If space is a warfighting domain, as US policy now states, then it requires a language—to the greatest extent possible—that is familiar to other warfighters. This language draws from doctrinal sources, which draw from historical and theoretical sources, and is as much a visual language as a verbal one. The planning and execution of operations—regardless of the domain—requires visualization, especially for the three-dimensional complexities of outer space. To visualize, one must both know the terms and be able to communicate them through graphic representation. Icons on a map are as valuable to space operations as they are to land operations; it is only the map that changes or the lens through which we choose to view it.

One may choose to approach space warfare through a variety of lenses—policy, technical, institutional, ethical, and warfighting, to name a few. While these lenses are certainly interrelated, the primary audience for this discussion is the military practitioner. As a part of war, the first portion of this work considers aspects of grand strategy and military strategy in their relation to space warfare. A consideration of tactics and the necessary language (both extant and proposed) follows. Tactics combine to achieve objectives.

If these objectives are strategic in nature, we may speak of operational art as the process that links the tactical to the strategic. Theorists from Jomini to Fuller may have called this approach "grand tactics," an intuitive term if one approaches war from the bottom. With a working lexicon of tactics, we may next consider how to combine tactical action to develop operational concepts or more holistic courses of action. Command and control in, from, and through space is a significant hurdle in this endeavor because—although there are analogues in other-domain operations—the space domain poses unique challenges that, like operations in the cyber domain, are outside the common experience of most military personnel. Only through a language that enables a discussion of means, ways, and ends do we have the tools to visually depict—and therefore to manage—space warfare as a part of war.

A thought process that begins with a discussion of strategy and works its way downward may arrive at unique insights due to the path chosen. By first addressing strategy and then addressing tactics and building upward, we strive to construct a system that is flexible enough to contribute to any type of warfare (large-scale combat, counterinsurgency, network-centric, or whatever new model that may emerge) while also supporting whatever strategic approaches serve the interests of a nation. If the tacticians, operational artists, and strategists of the future are creative, they may even be able to contribute to multiple types of warfare and support multiple strategic approaches simultaneously and with the same set of limited yet globally dispersed means.

This is the ultimate challenge of space warfare and what will be required for the fight ahead.

Vignette: Russian Navigation Satellite (GLONASS) and Ukraine

In February 2014, Russian paramilitary forces invaded the Crimea to "destabilize the situation and, if possible, convince the new Ukrainian government to accept a federalization scheme that would reduce their power nationwide

and allow Russia to have substantial influence over individual regions."* The grand strategic aim of the Russians—to gain authoritative influence over a neighboring country's government—necessarily involved a subordinate military strategy that employed both overt and covert means and extended into the space domain. In mid-March, Russia accused Ukraine of jamming a Russian communications satellite—a disruption attack that Russia claimed was in violation of the International Telecommunications Union charter.† Around the same time, the North Atlantic Treaty Organization (NATO) headquarters in Brussels, Belgium, experienced multiple cyberattacks.‡ Two weeks later, on April 2, Russia experienced a systemwide failure of all twenty-four of its navigation satellites (GLONASS, the Russian analogue to the United States' Global Positioning System) for a period of thirteen hours—a possible denial attack.§ Eight more satellites failed on April 14 for approximately half an hour, once again calling into question the integrity of the constellation.¶

The exact times and sequences of the possible denial attack on April 2, as reported in open-source media, hint at more than just an accidental occurrence. The outages began after midnight Moscow time and followed a numerical sequence—first GLONASS 9, then 10, 11, 12, 13—suggesting that Russia's explanation of a technical system failure may not be the only possible one.** Indeed, the data suggests the possibility of a deliberate sequencing of tactical actions to achieve a strategic effect (an example of operational art), in this case, possibly messaging the Russian government that it was

* Michael Kofman et al. *Lessons from Russia's Operations in Crimea and Eastern Ukraine* (Santa Monica: RAND Corporation, 2017), xii.

† Bill Gertz, "Moscow Accuses Ukraine of Electronic Attack on Satellite," *Washington Free Beacon*, March 17, 2014, accessed September 19, 2020, http://freebeacon.com/nationalsecurity/moscow-accuses-ukraine-of-electronic-attack-on-satellite/.

‡ Ibid.

§ Staff Writers, "Satellite Navigation Failure Confirms Urgent Need for Backup," *GPS Daily*, April 8, 2014, accessed September 19, 2020, http://www.gpsdaily.com/reports/Satellite_Navigation_Failure_Confirms_Urgent_Need_for_Bac kup_999.html.

¶ "The System: GLONASS Fumbles Forward," *GPS World*, May 1, 2014, accessed September 19, 2020, http://gpsworld.com/the-system-glonass-fumbles-forward/.

** "GLONASS Suffers Temporary Systemwide Outage; Multi-GNSS Receiver Overcomes Problem (Updated)," *Inside GNSS*, April 3, 2014, accessed September 19, 2020, https://insidegnss.com/glonass-suffers-temporary-systemwide-outage-multi-gnss-receiverovercomes-problem-updated/.

being watched and that it could be subject to military as well as economic consequences for its actions in Ukraine. A line-of-sight analysis based on the known outages and the known orbital locations of the GLONASS satellites at the times of their outages suggests a possible location for this denial attack—Alice Springs, Australia.*

Figure 1 depicts the three orbital planes of the GLONASS constellation (in light blue and purple loops). On April 2, 2014, a ground station in the middle of Australia would have had visibility of and line-of-sight access to the affected GLONASS satellites. Interestingly, if the site is moved two to three degrees west or east from Alice Springs, horizon constraints prevent access to the proper GLONASS satellites at the proper outage times. If this was indeed a deliberate interference with GLONASS, these actions were not subtle, possibly reinforcing the theory of a deliberate message to the Russians. Had a belligerent wanted to attack the GLONASS constellation in a more clandestine manner, it could have taken advantage of the constellation's geometry and accessed the constellation from nearly anywhere in the world, even possibly from a ship at sea or from an airplane flying over a remote area. A more dispersed approach or an approach that did not attack in numerical sequence would have provided the advantage of making attribution nearly impossible.

* Paul Szymanski, "United States Loses First Global Space War to Russians" (Albuquerque: Space Strategies Center, 2014), 3.

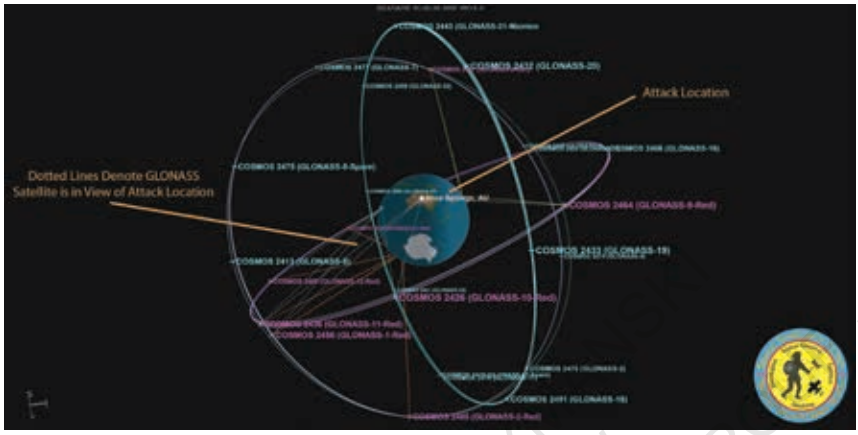

Figure 1: An Analysis of the 2014 GLONASS Outages. The Visual Shows that Satellite Accesses were Possible from Australia. *Source:* Graphic created by Paul Szymanski using the Satellite Orbit Analysis Program (SOAP) from The Aerospace Corporation and orbital data from https://www.space-track.org.

Over the next six months, several additional events occurred that further raise the specter of possible military action. In addition to their GLONASS troubles, Russia's missile warning satellite COSMOS-2479 failed on orbit in April, its $200-million communications satellite Express-AM4R exploded atop a Proton-M launch vehicle crash on May 16, their communications satellite Yamal-201 failed on June 6, and they temporarily lost control of their research satellite Foton-M4 on July 19.* These events followed additional US economic sanctions and the threat/suggestion of Deputy Prime Minister Dmitry Rogozin, head of Russia's defense industry, that "the United

* "Russia Loses Its Last Early Warning Satellite," DefenseTalk, July 1, 2014, accessed September 19, 2020, http://www.defencetalk.com/russia-loses-its-last-early-warning-satellite-59992/#ixzz3BnZMVvuP; "Third-Stage Engine Glitch Causes Proton-M Accident," Space Travel, May 21, 2014, accessed September 19, 2020, http://www.spacetravel.com/reports/Third_stage_engine_glitch_causes_Proton_M_accident_999.html; "Failure Occurred in the Operation of the Russian Communications Satellite 'Yamal-201,'" RIA Novosti, June 6, 2014, accessed September 19, 2020, https://translate.google.com/translate?sl=ru&tl=en&js=y&prev=_t&hl=en&ie=UTF8&u=http%3A%2F%2Fria.ru%2Fscience%2F20140606%2F1010895493.html; Abby Phillips, "Updated: There Is a Lizard Sex Satellite Floating in Space and Russia No Longer Has It Under Control," *Washington Post*, July 24, 2014, accessed September 19, 2020, http://www.washingtonpost.com/blogs/worldviews/wp/2014/07/24/there-is-a-lizard-sex-satellitefloating-in-space-and-russia-no-longer-has-it-under-control/.

States delivers its astronauts to the [International Space Station] with the help of a trampoline"—an example of the ties of space to diplomatic and economic aspects of grand strategy.*

While the GLONASS constellation, the COSMOS-2479, and the Yamal-201 all had obvious military uses, the Express-AM4R would have provided multiband communication coverage over the Eastern Ukraine (Figure 2).† To add to Russia's embarrassment, the loss of the Proton-M and its payload came just before Vladimir Putin visited Shanghai to sign a multibillion-dollar deal to provide natural gas to China—an issue that helped tip China's neutrality over Ukraine in Russia's favor.‡ The failure of two European Galileo navigation satellites to reach orbit (launched on August 22) may have been a response in-kind to the previous spring's attacks against GLONASS and to Europe's condemnation of Russian actions. It is worth noting that the failure of the Galileo satellites to reach orbit resulted from the failure of a Europeanized Soyuz rocket's upper stage.§

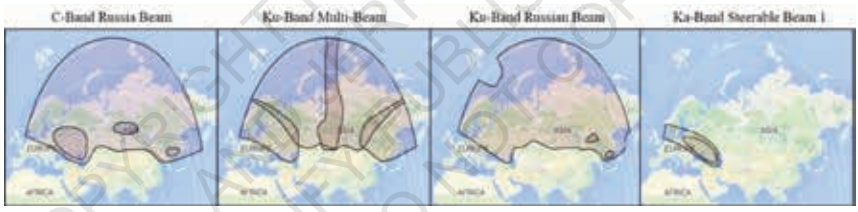

Figure 2: Satellite Communications Coverage that was Lost from the Destruction of *Express-AM4R*. *Source:* "Express AM4R," *SATBEAMS*, http://www.satbeams.com/satellites?id=2502

While it is possible that some or all of these satellite failures resulted from natural causes or human error, it is also possible that the string of Russian

* "US Astronauts Should Use Trampolines to Get into Space, Russian Official Says," *Fox News*, April 30, 2014, accessed April 11, 2020, https://www.foxnews.com/science/us-astronautss-hould-use-trampolines-to-get-into-space-russian-official-says.

† "Express AM4R," *SATBEAMS*, accessed September 19, 2020, http://www.satbeams.com/satellites?id=2502.

‡ Jane Perlez, "China and Russia Reach 30-Year Gas Deal," *New York Times*, May 21, 2014, accessed September 19, 2020, https://www.nytimes.com/2014/05/22/world/asia/china-russiagas-deal.html.

§ Peter De Selding, "Galileo Launch, Initially Hailed as Success, Is a Failure," *SpaceNews*, August 23, 2014, accessed September 19, 2020, https://spacenews.com/41650galileo-launchinitially-hailed-as-success-is-a-failure/.

failures—or some part of it—was a deliberate attempt to degrade Russian military space capability, impose economic cost, and create room for diplomatic maneuvering. Furthermore, if some or all of these actions were deliberate, they follow a course beneficial for managing conflict escalation: temporary and reversible damage to the military GLONASS constellation, destruction of a missile warning satellite, and the loss of two communications satellites—the destruction cases being difficult to attribute to hostile action. None of these actions would have risked outright confrontation between Russia and the United States, but each had the potential to contribute to the grand strategy of the belligerents.

A discussion of which actions were part of a grand strategy to counter Russian activity in Ukraine remains, therefore, highly speculative. Regardless, the events of the spring and summer of 2014 provide useful examples of what *could* occur during a space conflict and are therefore useful as a springboard to further discussion on a host of topics. The brief discussion of Russian space losses during its actions in Ukraine highlights the intertwined nature of military activity with aspects of strategy, operational art, and tactics—all in relation to space warfare. These topics each require discussion in turn, but the first discussion must be one of strategy, the prime mover of the levels of war. To discuss strategy or the strategic level of war as it pertains to space operations first requires a baseline agreement of those terms. With deliberate explorations of both grand strategy and military strategy, it is then possible to explore their relationship to the other levels of war and their applicability to space warfare.