Shaping the Joint Fight in AIR, SPACE, and CYBERSPACE

By C. ROBERT KEHLER

The game is unified action up and down the floor.

—Jack Ramsay[1]

September 18, 1947, marked the birthday of the U.S. Air Force as a separate Service. Less than a month later, Captain Chuck Yeager broke the sound barrier, and since then America's Air Force has continued to push the envelope as the Nation's sword and shield over its own skies, while serving heroically in locations around the world. In addition to flying and fighting, the Air Force has maintained a credible nuclear deterrent, exploited space, and is now tapping the potential of cyberspace as a warfighting domain. In short, the Air Force has transformed itself for over 60 years in the face of dramatic world change.

The Service's missions now extend past the Earth's atmosphere and across a boundless virtual landscape. Today's Air Force operates in three domains: air, space, and cyberspace. As a result, Airmen bring distinctive perspectives and capabilities to influence targets and actions anywhere around the globe as a multidimensional maneuver force. While the Air Force must continue to develop capabilities in its three operating domains, it must also transform and exploit shared, cross-domain attributes as it continues to provide decisive options for national leaders, combatant commanders, and joint forces. Maintaining a future joint military advantage in an era of exponential change requires a more concerted effort to integrate these domains. Airmen who are experts in the space domain will play a key role in that integration as they build upon a proud heritage to meet the challenges of a dynamic future.

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U.S. Air Force (Jack Braden)

F–16 pilot flies close air support training mission over Korea

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Early Integration and Synchronization

When the Air Force celebrated 60 years as a Service in September 2007, one of its major commands, Air Force Space Command (AFSPC), marked a quarter century of service in joint military operations. The establishment of AFSPC in 1982 signaled the Air Force's recognition of the importance of space and the need to mature capabilities within this separate warfighting domain.

Even a quarter century ago, space capabilities were impressive. The realm above Earth's atmosphere had become the strategic *high ground* in the Cold War between the United States and the Soviet Union. Air Force intercontinental ballistic missile (ICBM) forces provided the Nation with a powerful strategic deterrent. Defense Support Program satellites were poised to provide advanced warning of adversary ICBM launches; the Defense Satellite Communications System enabled worldwide command and control of U.S. forces; and Defense Meteorological Satellite Program systems provided global weather coverage. Moreover, a constellation of prototype Global Positioning System (GPS) satellites was already demonstrating the benefits of precise timing and highly accurate, space-based geolocation.

Although several brief contingencies in the late 1980s furnished tantalizing glimpses of how space systems might support forces at the theater level or in tactical situations, it took the first Gulf War to highlight their true benefits to the joint warfighter. In early 1991 during Operation *Desert Storm*, space enabled a wide range of U.S. and coalition capabilities including missile warning, communications, weather, surveillance and reconnaissance, as well as positioning, navigation, and timing—all in a major theater combat environment. Defense Support Program satellites and a reworked ground infrastructure proved sufficiently sensitive to detect Scud missiles launched from Iraq, and military satellite communications permitted transmission of voice alerts and warnings to forces in the area of operations. Military and commercial satellite links carried 90 percent of all communications into theater and most of General Norman Schwarzkopf's intratheater command and control communications. Weather satellites supported strike planning and weapons selection, aerial refueling operations, and detection of flood plains while a young GPS constellation helped troops maneuver across a featureless desert.

Capitalizing on the *Desert Storm* experience, the Air Force focused its efforts on enabling warfighters to leverage space capabilities by creating the Space Warfare Center in 1993.[2] This led to the rapid exploitation of space capabilities such as GPS, satellite communications, and national space systems to enhance joint warfighting tasks. Space capabilities allowed quicker recovery of downed pilots, fostered the development of extremely precise GPS-aided munitions, and enabled a Global Broadcast Service to pump previously unimagined amounts of data to and from theater warfighters. Air operations in the Balkans would later validate that GPS could dramatically enhance the precision and lethality of weapons systems—effectively revolutionizing the American way of war.

U.S. Air Force (United Launch Alliance/Karl Ronstrom)

Next-generation communications satellite readies for launch

The Air Force continued its efforts to bring space to the fight by establishing the Space Division at the U.S. Air Force Weapons School in 1996 (now the 328th Weapons Squadron). This effort was a seminal event for space integration. The Air Force has since worked hard to place these Weapons School graduates into joint theater organizations to develop key relationships between theater-based and continental U.S.-based space organizations and to integrate space at the operational level of war. The school continues to train tactically focused, space-experienced Airmen to better integrate with combat and mobility air forces and to deliver world-class space expertise to theaters worldwide.

At the same time, the national Intelligence Community made great strides in delivering space products to warfighters. Not only did the national intelligence team deliver space products sooner, but also joint warfighters became more influential in the tasking, processing, exploitation, and dissemination process. As a result, warfighting responsiveness went up.

The ever-increasing synchronization of military space capabilities, coupled with heightened theater demand, also drove the need to develop a capability to operationally command and control space forces. Recognizing that space forces are inherently global in effect, earlier versions of what is now the Joint Space Operations Center (JSpOC) worked to plan, task, orchestrate, and deliver space capabilities for theater commanders around the globe. Today, the 614th Air and Space Operations Center comprises the core of the JSpOC and is the primary command and control center for space operations supporting all combatant commanders.

After the 9/11 terrorist attacks, U.S. forces set and surpassed even higher benchmarks for the use of space systems and synthesis of space-savvy personnel with other warfighting experts. During the early stages of both Operations *Enduring Freedom* and *Iraqi Freedom*, U.S. forces, aided by space systems and people, decisively engaged and defeated enemy military capabilities with unprecedented speed, precision, and minimal collateral damage.[3]

Space Today: Effective Synchronization

Although the Air Force operates essentially the same kinds of space systems that it did 25 years ago, the way the joint force uses them is very different today. Space forces are now inextricably embedded in combat operations and play a key role in providing global vigilance, reach, and power for the Nation's civilian and military leaders.

Space capabilities have shaped the American way of warfare in the late 20th and early 21st centuries and, in many instances, have become essential elements of modern weapons networks.[4] Oft-cited examples include myriad combat capabilities enabled by the Air Force's GPS constellation. For years, GPS navigation and timing signals have enabled an ever-growing arsenal of precision munitions such as the Air Force and

Navy's Joint Direct Attack Munitions, which for relatively little cost effectively turned what had been *dumb* bombs into *smart* munitions. Today's operational environments have driven the military to produce even more precise lower-yield weapons to destroy targets with minimal collateral damage. Recent examples include the Air Force's 250-pound-class Small Diameter Bomb, the Army's Guided Multiple Launch Rocket System, and the new Excalibur guided 155mm artillery round. GPS also supplies the brain within the Joint Precision Airdrop System (JPADS), a revolutionary mobility system that permits aircrews to deliver supplies with pinpoint accuracy from higher, safer altitudes. Using GPS navigation and steerable parachutes, C–130 and C–17 aircrews precisely deliver JPADS bundles to ground combat units in otherwise inaccessible forward operating bases. Furthermore, GPS features add fidelity to aircrew survival and personnel recovery radios, essentially taking the *search* out of *search and rescue*. GPS also guides forces through all terrains and allows field commanders to track ground and air forces equipped with cutting-edge Blue Force Tracking devices.

GPS is not the only space capability embedded in weapons networks. Satellite communications (SATCOM) also plays a major role feeding digital information to a 21st-century military. Connecting decision-makers and combat forces across the globe, SATCOM enables information-sharing at all levels of warfare. For instance, space-enabled communications links transfer a host of information including threat data, intelligence information, and tasking orders. It even enables remote command and control of unmanned aerial systems such as the MQ–1 Predator and MQ–9 Reaper flown half a globe away from Creech Air Force Base, Nevada. It also returns telemetry and targeting information to enable warfighters to fight with a smaller deployed footprint.

In addition to these capabilities, the Air Force, along with other Services, provides space forces to combatant commanders. Counterpart strategists, planners, and executors of these tailored space capabilities reside at Combined Air and Space Operations Centers (CAOCs) around the world. For example, in addition to providing airpower to enable and support all operations in U.S. Central Command's area of responsibility, the CAOC in Southwest Asia is the primary conduit for that command's space operations.[5] Therefore, the CAOC acts as a clearinghouse for theater integration, deconfliction, and synchronization of air and space capabilities and is supported by the JSpOC.

Another level of support to the joint fight comes by way of space-experienced Airmen. Today, the Air Force injects this expertise from the start of operational planning through employment. On average, more than a dozen uniformed space experts reside in CAOC divisions that are responsible for developing air and space strategies, mastering air attack plans and air tasking orders, and assisting with execution and effects assessment. As combat integrators, these deployed Air Force and joint space experts take space capabilities down the last tactical mile.

A theater Combined Forces Air Component Commander (CFACC) is typically designated as the Space Coordinating Authority (SCA) and is responsible for orchestrating the use of space capabilities from various national and military organizations and strengthening integration and planning across all components. In most areas of responsibility, CFACCs are supported by the Director of Space Forces. This key senior, space-experienced Airman often executes day-to-day theater space coordination duties on behalf of the SCA and interfaces with Soldiers, Sailors, Marines, and Airmen positioned in key operational and tactical echelons with responsibilities to merge space capabilities into combat operations.[6] In addition to leveraging space expertise throughout the theater, these directors also reach back to the JSpOC to provide synchronized, tailored space capabilities.[7]

GPS features add fidelity to aircrew survival and personnel recovery radios, essentially taking the search *out of* search and rescue

Airman loads GBU–38 JDAM onto F–16 for combat mission over Iraq

U.S. Air Force (Beth Holliker)

The Next 25 Years

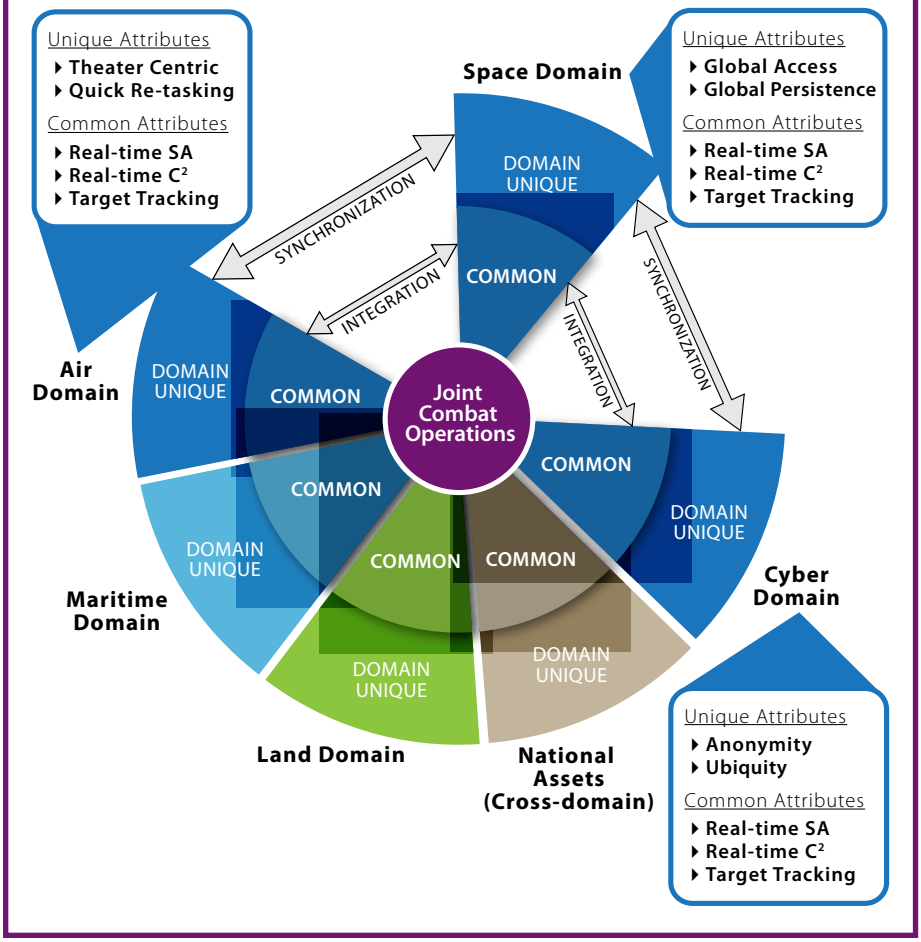
No one knows what the security environment will look like 25 years from now, but the United States will likely continue its heavy reliance on space capabilities for its national security and economic well-being. For the most part, the Air Force knows what capabilities it will have in the year 2033. Strategic planning processes provide a roadmap for what space capabilities the Service will have in the future. Space systems will continue to evolve from those used today and provide far greater capabilities. The Air Force is recapitalizing and modernizing an aging space force to keep pace with warfighting requirements. For example, next-generation GPS satellites will include better inherent antijam and enhanced civil capabilities. The Transformational Satellite Communications System will provide terrestrial forces with on-the-move communications at 100 times the capacity offered by the military SATCOM systems today. Space-based Infrared System satellites will offer far more sensitive, persistent missile warning coverage and battlespace characterization capabilities unavailable to current legacy systems. America's national security

space development and launch infrastructure will have better means to respond to warfighters and augment or replenish orbital assets in time of crisis or war. Space- and ground-based assets will fill gaps in our Cold War–era space surveillance architecture to provide the Nation and its allies better space situational awareness needed for tomorrow's increasingly congested and contested space domain.

The successful Chinese antisatellite test on January 11, 2007, unambiguously confirmed that space is not a sanctuary and will not be one in future conflicts. By using one of their aging weather satellites for target practice, the Chinese dramatically demonstrated their capability to hold low Earth orbiting systems at risk. The event also released over 2,400 pieces of potentially deadly debris into orbits transited by spacefaring nations all over the globe—to include flight paths used by the space shuttle and International Space Station. Above all, this event focused attention on the urgent need for the U.S. military to protect America's space capabilities.

However, obliterating a satellite with a kinetic kill vehicle is only one conceivable form of attack. Others include physically attacking worldwide ground stations, jamming GPS and communications links, and conducting cyber attacks on command and control nodes. Potential adversaries have witnessed U.S. military successes, and they understand our doctrine. They see that space is interwoven within the fabric of the Nation's economy and military infrastructure, and they realize that denial of space services could disrupt and destabilize that infrastructure. Adversaries will continue to study U.S. reliance on space capabilities as well as analyze and exploit vulnerabilities. Accordingly, the Air Force is shifting its space mindset to one of operating in a contested environment with an increased emphasis on space protection. Enhanced space situational awareness will be necessary to warn not only satellite operators but also the Intelligence Community and joint users about adversary actions against friendly space capabilities and services. To develop this ability, elements of air, space, and cyber power will need to work interdependently to render sufficient protection and response.

Attribute Exploitation Model



The Challenge

While the Nation's space forces can be proud of their contributions to the joint fight, increased demand and corresponding threats require the U.S. Air Force to continue to transform the way it delivers space capabilities. Many people have talked about integrating space forces, but it is arguable that what has occurred up to this point is *synchronization*. In the past, capabilities have been synchronized at the point of the spear, with domain-specific effects forged together in theater by our joint warfighters. In the future, the Air Force must *integrate* from the start.[8]

the Chinese antisatellite test confirmed that space is not a sanctuary and will not be one in future conflicts

Fortunately, the Air Force is uniquely positioned to make this transformation. Its ability to provide global vigilance, reach, and power is buttressed by three pillars of excellence—air, space, and cyberspace—all with complementary attributes. The Air Force must reconstruct the pillars in a way that will better enable and support joint combat operations in the future. The time is ripe to overcome tendencies to develop concepts, to plan, program, acquire, and operate capabilities within stovepipes, and then to synchronize in theater. Instead of synchronizing at the *point* of the spear, the Air Force must start to integrate capabilities at the *handle* of the spear.

One way for the Air Force to do this is to take a hard look at the attributes afforded by operating in the air, space, and cyberspace domains and to leverage them accordingly. The figure depicts a conceptual model for exploiting common domain attributes and provides a helpful way to think about how attributes interact across joint warfighting domains. The goals should be to integrate where appropriate and to synchronize where integration is not feasible.

For example, common attributes shared by the air, space, and cyberspace domains include real-time situational awareness (SA), command and control (C^2), and enhanced target-tracking capabilities. Properly integrated and exploited, these common attributes can help build interdependent networks and inform planning decisions that can produce data for joint forces. At the end of the day, it is all about the data, which are independent of the domains

from which they originate. A thorough analysis of each domain will likely yield higher-order attributes that contribute relatively little to a particular weapons system and yet are useful in an interconnected weapons network. Those attributes that are not common (that is, those that are unique to a particular operating domain) should be synchronized.[9] Modern technology increasingly blurs the lines between domains and may offer tremendous opportunities to better leverage joint capabilities.[10]

Intelligence, surveillance, and reconnaissance (ISR) activities present an opportunity to begin this effort toward enhancing integration and maximizing joint operational capabilities. ISR already cuts across every joint warfighting domain. Traditional platforms such as reconnaissance aircraft, ISR satellites, and ground-based elements have one thing in common: they all collect data. Nontraditional ISR sources such as fighter aircraft targeting pods, Aegis cruisers, air- and ground-based radars, and cyber platforms also collect and produce data. Unfortunately, these discrete systems develop and operate within individual Service or domain stovepipes. This approach produces data with incompatible formats that flow within insulated networks and noncommon link architectures. Information from these systems presents "low hanging fruit" that can be leveraged, integrated, and disseminated within an ISR web of interconnected data. If Google can consolidate the world's Internet data into one access portal, the world's most capable military should be able to do the same with ISR data.

U.S. Navy (William S. Parker)

Marine sets up satellite communications during relief operations in Bangladesh, 2007

Properly executed, a refocus on ISR may push a joint targeting approach from a linear, find-fix-track-target-engage-assess-kill chain to a multidimensional *influence web*. Within this web, data are no longer relegated to a command-oriented architecture, but are transformed to a demand-oriented network available to all authorized users (for example, commanders, analysts, targeteers, and execution assets) to help them *see and engage*. The challenge to this vision is that no organization currently funds the influence web, and no one owns its effects. Organizations need to focus on the whole picture from the start of developmental processes with an influence web as the integration goal, not simply an artifact of disparate capability stovepipes.

True integration is more than combining and disseminating data among interrelated architectures. Key players from each operating domain need to develop shared strategic plans, operational concepts, system architectures, and doctrine, as well as tactics, techniques, and procedures for the next conflict—a conflict in which emerging technologies in air, space, and cyberspace domains can be leveraged and mutually supported. Today, space and cyber capabilities typically support operations in the traditional land, maritime, and air domains. In the future, commanders in space and cyber domains will likely be supported commanders. Indeed, the future may necessitate a type of Air-Space-Cyber Battle doctrine, requiring even closer coordination across all three Air Force pillars as well as the joint community.

Developing the New Airman

Regardless of the domain, delivering global vigilance, reach, and power requires Airmen who can decisively operate in air, space, and cyberspace. The Air Force must continue to organize, train, equip, and develop expertise within each domain but must expand opportunities for cross-domain interaction, such as planning, education, and training. The product of this cross-pollination is a *New Airman*, who will have in-depth expertise in at least one domain and be skilled in the integration of all three.

The Air Force needs to develop, train, and educate Airmen with a cross-domain perspective as an intellectual endstate. Today's air warriors are trained and knowledgeable on the application of airpower—and they continue to hone doctrine and tactics, techniques, and procedures. From intelligence analyses to professional military education, most of the Air Force comes to work to expand its knowledge base on airpower. The same mindset has not always applied for spacepower, and if left unchecked, the Air Force may miss opportunities to develop the budding cyberspace mission.

The next generation of America's warfighters is living in a digital culture. Information surrounds them daily in their homes, schools, and cars, and they are able to sort and digest it. Tomorrow's Airmen will not be able to recall life without computers and the Internet. They will be technically savvy at early ages and will be eminently comfortable with communicating and exchanging information within a virtual domain. All will have high expectations with respect to information, including access, connectivity, and bandwidth. The Air Force must plan *now* to defend tomorrow's America by meeting those expectations and leveraging the New Airman's natural skills to turn *e-citizens* into *e-warriors*. Whether using satellite communications to pass combat orders or sharing information with wingmen in the skies, tomorrow's Airmen should not be yoked with antiquated machines and cumbersome networks. America's adversaries are calibrating themselves to operate across the span of warfighting mediums as well, with a timing and tempo defined by the speed of light. Airmen must likewise be equipped in thought and deed to address tomorrow's threats.

For the past 60 years, the Air Force has provided dominant capabilities as the Nation's global, multidimensional maneuver force. While the Service will remain steadfast in providing space capabilities for joint operations, it must continue to evolve to operate in an increasingly contested space domain with more emphasis on protection. To better serve tomorrow's joint force, the Air Force must also build on its legacy of providing synchronized effects and expand to an era where it develops and exploits even more integrated capabilities across domains. As a result, a more integrated *Air Force* will enable a more effective *joint force*. **JFQ**

NOTES

[1] Former coach in the National Basketball Association.

[2] To better exploit space capabilities, the Space Warfare Center was officially dedicated on November 1, 1993. It was redesignated as the Space Innovation and Development Center on March 1, 2006.

[3] Space capabilities enhance military operations equally across the spectrum of conflict—from peace to crisis and war. For example, the response of U.S. joint forces to natural disasters such as the Indian Ocean tsunami in 2004 or Hurricane Katrina in 2005 depended heavily on space-based capabilities—especially communications satellites, GPS, and remote-sensing platforms.

[4] Attributes that define the *American way of warfare* today include a global focus; interconnected expeditionary forces with an increasingly smaller footprint using reachback; swift, overwhelming, and decisive action followed by rapid reconstitution; and precise effects with minimum collateral damage.

[5] The commander, U.S. Central Command, delegated Space Coordinating Authority (SCA) to the CFACC; thus, SCA resides under the CFACC's purview at the CAOC.

[6] One example is the joint space support team assigned to the Marine Expeditionary Force (MEF) in Camp Fallujah, Iraq. This team is comprised of at least three Army space officers and enlisted space professionals, one Air Force space weapons officer, and often a Marine Corps space expert. These space experts understand the specific needs and requirements of MEF and appropriately plan for and provide a variety of space capabilities for use in western Iraq's unique cultural and operating environment. They count on the SCA and Director of Space Forces to coordinate the delivery of global space capabilities to meet their tailored operations.

[7] For instance, with global space assets, theater space operators provide unblinking space-based theater ballistic missile warning for coalition forces; ensure space support to personnel recovery operations; characterize, geolocate, and report on interference to satellite communications links; and inform the CFACC about the status and capabilities of space systems and space-related services.

[8] There is a subtle but important difference between synchronization and integration. *Synchronization* involves operating disparate parts in unison, simultaneously timing the effects produced by individual capabilities for mutual benefit. *Integration*, on the other hand, involves bringing those parts together early on to produce a seamless, compounded effect.

[9] For instance, airpower's support of current ground schemes of maneuver is only effective when synchronized in a supporting-supported construct.

[10] For example, the ROVER system provides ground-based forward air controllers the ability to receive full motion video from overhead unmanned aircraft systems and demonstrates the ability to link elements automatically between air, cyber, and ground domains.