A New Era for Command and Control of Aerospace Operations

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The AOR will become a CAOC.

Gen "Hawk" Carlisle
—Commander, Pacific Air Forces

Control of the aerospace environment is a fundamental prerequisite to successful operations in the physical domains of air, sea, land, and space. Once established, such control facilitates the freedom of action and movement for all joint forces. Accordingly, command and control (C2) of aerospace operations are critical functions that must be a priority for the Department of Defense.

Our ability to C2 air and space forces will be affected by three major interrelated trends: emerging threats, new technologies, and the velocity of information. The changes in these three areas since the design, establishment, and operation of the air and space operations center—the AN/USQ-163 Falconer—have been dramatic and are accelerating. Therefore, it is time to determine whether we can achieve success in future operations by evolving our current concept of operations (CONOPS), organizations, and acquisition processes for modernization—or if we must seek fundamental change to each of these elements that affects our theater air control system (TACS). Before providing an answer, let's take a brief look at each of the trends affecting our ability to C2 our aerospace operations effectively.

Emerging Threats

The organization, size, and configuration of the AN/USQ-163 Falconer have basically remained the same since its inception. Furthermore, we have essentially been on a holiday from large-scale C2 airpower activities; for over two decades, we have had the luxury of not being contested in the air and space domains. Those days are rapidly changing. According to the Department of Defense's report on *Military and Security Developments Involving the People's Republic of China, 2014*, the People's Liberation Army Air Force "is pursuing modernization on a scale unprecedented in its history and is rapidly closing the gap with Western air forces across a broad spectrum of capabilities including aircraft, command and control (C2), jammers, electronic warfare (EW), and data links."[1] Such developments present a fundamental threat to the current American C2 construct. Additionally, other potential adversaries have studied the American way of war and have determined that it would be most advantageous to keep us out of their neighborhood rather than face our combat power.

Operations such as Desert Storm, Allied Force, Enduring Freedom, Iraqi Freedom, and Odyssey Dawn have repeatedly demonstrated the overwhelming prowess of American airpower. Therefore, possible adversaries are adopting (and proliferating) antiaccess and area-denial (A2/AD) expertise—new generations of cruise, ballistic, air-to-air, and surface-to-air missiles; antisatellite weapons; and cyberspace capabilities intended to deny US forces freedom of action. Failure to respond with new C2 thinking to these evolving A2/AD threats will force us to operate with greater risk and farther away from our areas of interest.[2]

A2/AD threatens our ability to C2 air and space operations in three ways. Near-peer adversaries can employ kinetic and nonkinetic weapons to deny us communications and intelligence, surveillance, and reconnaissance (ISR) from our space-based assets, thereby isolating our forces and blinding our leadership. Cyber attacks—now evolving beyond mere hacking or denial of service—are becoming more sophisticated and may be used to intentionally disrupt operations at the combined air and space operations center (CAOC). Accurate, long-range cruise and ballistic missiles are growing in their potential to threaten large, fixed, and exposed CAOCs.

As the most senior organizational element of the TACS and the factory for generating the air tasking order—the administrative vehicle for translating the combatant commander's air strategy into executable plans—the CAOC becomes an extremely lucrative target. This situation poses a question that challenges our conventional approach to C2. Can we deliver information to the war fighter at the tactical edge without having to rely on the traditional C/AOC model of hundreds of people organized in stovepiped divisions around segregated mission areas? The answer will have cascading effects on the architecture that we build to organize and operate C2 in the future—and the degree to which we enjoy operational success.

New Technologies

Innovative technologies, which enable new capabilities, will require novel ways to C2 as a means of optimizing the production of desired effects. We need to think beyond the constraints that traditional culture imposes on new technology. For example, fifth-generation aircraft are termed “fighters,” but, technologically speaking, F-22s and F-35s are not just fighters—they are F-, A-, B-, E-, EA-, RC, AWACS-22s, and -35s. They are flying “sensor strikers” that will allow us to conduct information-age warfare inside a contested battlespace whenever we desire—*if* we fully exploit their “nontraditional” capabilities in a fashion that becomes the new “traditional.”

Doing so will demand leading-edge networking capabilities and different approaches to solving our data-bandwidth issues. For example, to accommodate the explosion in data growth from new sensors, instead of building bigger pipes to transmit all the collected information, we should process it on board and transmit only the data of interest to the users. This approach inverts our current ISR processing methodology.

Existing service-component *integrated* capabilities could enable advanced joint operational concepts. For example, fifth-generation sensor strikers—F-22s and F-35s—could be used to cue Aegis fleet missile defense batteries to engage adversary antiship ballistic missiles launched against US carrier strike groups. Fully capitalizing on these capabilities calls for an innovative way of designing our force. As we bring a new long-range ISR/strike aircraft into the Air Force inventory to capitalize on the impact of long-range precision effects, we must amplify those effects through integration with the array of other forces by means of networked sensor/shooter capability from seabed to space.

Velocity of Information

Significant advancements in telecommunications, sensors, data storage, and processing power are emerging every day. As a result, the targeting cycle has evolved from months to weeks to days to minutes, and from multiple, specialized, and separate aircraft assigned to separate commands, to “finding, fixing, and finishing” from one aircraft in minutes.

Consider just one example from Operation Iraqi Freedom. A Predator piloted from Nevada by the Air Force successfully spotted and identified a sniper who had pinned down a Marine ground force. The remotely piloted aircraft delivered video of the sniper's location directly to an on-site Marine controller who used it to direct a Navy F/A-18 into the vicinity. The Predator laser-designated the target for the Navy jet's bombs, eliminating the sniper. The entire engagement took less than two minutes. That is the synergy of precision and information we must achieve routinely. With an MQ-9 Reaper, the engagement could have been shortened further by combining the ISR sensors, designator, and weapons on one aircraft.

Although the increase in information velocity dramatically enhances the effectiveness of combat operations, we must contend with a downside. As a result of modern telecommunications and the rapid transmission of information to, from, and between various levels of command, we have many examples of "information age" operations in which commanders at operational and even strategic levels usurp tactical-level execution. This devolution of the construct of centralized control / decentralized execution to one of centralized control / centralized execution has reduced effectiveness in accomplishing mission objectives. We need discipline to ensure that "reachback" does not become "reachforward." Centralized control / centralized execution represents the failed Soviet command model that stifled initiative, induced delay, moved decision authority away from execution expertise, and bred excessive caution and risk aversion. The results of such a model against a more flexible command structure were evident in 1991, when Soviet-sponsored Iraq unsuccessfully applied similar C2 constructs against the US-led coalition.

Higher-level commanders who are unwilling to delegate execution authority to the echelon with the greatest relevant situational knowledge and control suffer from their remote perspective, create discontinuity, and hamstring the capability of commanders at the tactical level to execute a coherent, purposeful strategic plan. Growing accessibility to information requires the restructure of C2 hierarchies to facilitate rapid engagement of perishable targets and capitalize on our technological advantage. Information synthesis and execution authority must be shifted to the lowest possible levels, and senior commanders and staffs must discipline themselves to stay at the appropriate level of war.

As described earlier, advancing threats demand that we move beyond large, centralized, and static C2 facilities. Replacing them with a mobile, distributed C2 structure that can handle the same volume and diversity of information as today's regional CAOC will call for a reappraisal of how we deal with information flow. The "art of command" will morph to realize Metcalfe's Law network values while the "science of control" will continue to demonstrate Moore's Law by expanding technology to extend human capacity.[3] The path for optimal growth of both is found through a focus upon gaining and maintaining a decision-cycle advantage as the critical path guide.

Elements of a New Architecture for Aerospace C2: Novel Concepts of Operations and Organizational Change

Concepts of Operations

The US military is now at a juncture where the velocity of information, advances in stealth and precision-engagement technologies, sensor developments, and other technologies will permit it to build completely new CONOPS from those based on legacy "combined arms warfare" models that simply align segregated land, air, and sea operations. We now have the potential to link information-age aerospace capabilities with sea- and land-based means to create an omnipresent defense complex that is self-forming and, if attacked, self-healing. Such a complex would be so difficult to incapacitate that it would possess a conventional deterrent quality that would exert a stabilizing influence wherever it is deployed. The central enabling idea is cross-domain synergy, which refers to the complementary, as opposed to merely additive, employment of capabilities in different domains such that each enhances the effectiveness—and compensates for the vulnerabilities—of the others. This combined-effects approach deals with integrating existing and future air, space, and cyber capabilities within an agile operational framework guided by human understanding.[4] It is an intellectual construct built on a technological infrastructure.

Developed with the idea of creating an ISR, strike, maneuver, and sustainment complex that employs information-age technologies to enable highly interconnected, distributed operations, this "combat cloud" will usher in an entirely different architecture for the conduct of warfare. Adoption of the combat-cloud concept and the resulting CONOPS will deliver accurate, decision-quality information to all relevant information nodes to produce the desired effect, regardless of service, domain, platform, or level within the command hierarchy.

The combat-cloud concept is somewhat analogous to "cloud computing," which is based on using a network (e.g., the Internet) to share information rapidly across a highly distributed, self-evolving, and self-compensating network of networks. However, instead of combining the computing power of multiple servers, the combat cloud combines the war-fighting power of combat systems by capitalizing on C2 and ISR networks to quickly exchange data derived from any source across an all-domain architecture of sensors and shooters to increase their effectiveness and attain economies of scale.

If enabled by sufficiently secure, jam/intrusion-resistant connectivity, a viable combat-cloud construct—compared to legacy operational concepts—would permit the employment of lower numbers of current and future-generation combat systems to produce higher levels of effectiveness across larger areas of influence. For example, instead of assembling traditional strike packages of massed fighters, bombers, and supporting aircraft to attack individual targets, the combat cloud could integrate complementary capabilities into a single combined "weapons system" capable of conducting disaggregated, distributed operations over a dynamic, fluid operational area.

The combat cloud requires equipping all platforms as sensors as well as "shooters" (defined as an ability to achieve a desired effect) and—even more importantly—employing them to that purpose. It demands a C2 paradigm that enables automatic linking analogous to today's cell-phone technology (i.e., moving from one cell zone to another is transparent to the user) as well as seamless data transfer, without the need for continual, deliberate human interaction within and/or between the air combat cloud nodes.

Organization

Although we need to realize and exploit the advantages of modern aerospace and information-age technology to build new CONOPS, we must also recognize that innovation can be applied *to* organization as well as *from* technology. The Operation Desert Storm air campaign was an inflection point that highlighted the need to reform and modernize our C2 processes to catch them up with the precision, stealth, and effects-based planning methodology that led to the campaign's success. Our AN/USQ-163 Falconer CAOCs and associated planning and execution processes were the outcome of the C2 lessons learned from that air campaign. They have served us well in the past, but we face a much different future—one that will be defined by the new threats, new technologies, and increasing velocity of information described previously. Our combat C2 organizational architecture, processes, and organizations must evolve and advance at least at the same pace as these trends.

For example, our current 1990s-designed CAOC organization is built around separate tasking processes for ISR (Planning Tool for Resource Integration, Synchronization, and Management [PRISM]) and force application (Theater Battle Management Core Systems [TBMCS]). However, we are now operating in an era when the platforms that PRISM and TBMCS were designed to manage can now perform either mission—or both. During the last two years of Air Force F-16 combat operations in Iraq, those aircraft were tasked nearly 100 percent of the time to conduct ISR activities using their targeting pods. Meanwhile, MQ-9 Reaper remotely piloted aircraft were equipped with laser-guided bombs to strike selected targets, including those discovered by the Reapers' own sensor suite. Despite such overlap, the Reapers were tasked through PRISM, and the F-16s through TBMCS. However, evolving technologies now afford us the opportunity to ensure that most of the aircraft in the Air Force's inventory can efficiently and effectively act as both sensors and shooters. It is time to end the segregation inherent in the current CAOC organizational and process design and move to a much more integrated planning and tasking function.

The fundamental C2 tenet of centralized control and decentralized execution has guided aerospace operations since World War II. Although that principle remains sound, emerging technologies and concepts permit us to consider evolving in the direction of a "centralized command, distributed control, and decentralized execution" construct. It is an appropriate progression towards more agile, flexible C2 in an era of increasing threats and accelerating information velocity. During the Desert Storm air campaign, aircrews were assigned the vast majority of targets to be attacked before they took off. Today, over Afghanistan, the vast majority of such targets are not specified to the aircrews delivering the effects—and often remain unknown to planners—until well after the sensor/shooter aircraft are airborne.

We now operate in an era of increasingly precise target discrimination and effects delivery. However, we can apply force more adeptly than we can assess its effects. Never has so much accurate firepower been placed on an adversary in such a compressed period of time. During Iraqi Freedom, for example, more than 600 coordinates for mobile targets were processed per day. Our challenge now is to skillfully C2 the rapid employment of precision systems, assess the effects, and react in the most productive way, all while operating in an efficient, distributed fashion.

A recent CONOPS innovation emerged in the design of the "Rapid Raptor" concept, which involves deploying a flight of four F-22s and one C-17 on short notice and being ready for operations at several distributed locations.[5] How will we carry out centralized command, distributed control, and decentralized execution when (not if) connectivity is severed? Deployed detachment commanders need to be an integral element of a new TACS—as do our wing commanders—fulfilling a role much more integral to a distributed C2 system than simply their historical force-provider role.

We have to think outside the organizational constructs that history has etched into our collective psyche. The days of strategies and plans based on unchanging divisions, wings, and fleets are coming to a long-overdue end. Network-centric, interdependent, and functionally integrated operations—performed by the right mix of available forces, regardless of service or nomenclature—are the keys to future success in war fighting.

Although General Carlisle's message at the beginning of this article specifically concerned his area of responsibility (AOR), his insights apply in all theaters. In the future, we need to invert the paradigm of large, centralized theater C2 nodes and develop a system that issues specific direction to particular elements of combat power according to a paradigm of multiple nodes responding in parallel to guidance designed to produce desired theater-wide effects. Determining how to do that should be the focus of the time, effort, and resources we spend on C2. This is how we should prepare for the next war rather than rely on the methods we used to fight the last one.

Conclusion

The challenges of emerging threats, new technologies, and the velocity of information demand more than a mere evolution of current C2ISR paradigms. We need a radically new approach that capitalizes on the opportunities inherent in those same challenges. We cannot expect to achieve future success through incremental enhancements à la CAOC 10.x upgrades—that method evokes an industrial-age approach to warfare that has lost its currency and much of its meaning. We cannot meet the requirements of information-age warfare with "spiral development"; rather, we must have modular, distributed technological maximization that permits and optimizes operational agility. That kind of agility calls for dramatic changes to our C2 CONOPS; our organizational paradigms for planning, processing, and executing aerospace operations; and our acquisition processes. It also demands a determined effort to match the results to the three critical challenges and opportunities while simultaneously fitting them seamlessly into the context of joint and combined operations.

We will not meet future national security issues in a fiscally constrained environment by simply buying less of what we already have. We must embrace and invest in innovation, creativity, and change—a charge that applies not only to the systems we procure in the future but also to the ends, ways, and means that we command and control them. ✪

Notes

1. Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, 2014* (Washington, DC: Office of the Secretary of Defense, 2014), 9, http://www.defense.gov/pubs/2014_DoD_China_Report.pdf.
2. Air-Sea Battle Office, *Air-Sea Battle: Service Collaboration to Address Anti-Access and Area Denial Challenges* (Washington, DC: Air-Sea Battle Office, May 2013), 3, http://www.defense.gov/pubs/ASB-ConceptImplementation-Summary-May-2013.pdf.
3. Metcalfe's Law states that the value of a telecommunications network is proportional to the square of the number of connected users of the system. For more information, see "Metcalfe's Law," Princeton University, accessed 16 June 2014, http://www.princeton.edu/~achaney/tmve/wiki100k/docs/Metcalfe_s_law.html. For an expanded discussion of Moore's Law, see "Moore's Law," accessed 16 June 2014, http://www.mooreslaw.org/.
4. Ervin J. Rokke, Thomas A. Drohan, and Terry C. Pierce, "Combined Effects Power," *Joint Force Quarterly* 73 (2nd Quarter 2014): 26–31.
5. SSgt Blake Mize, "Rapid Raptor: Getting Fighters to the Fight," Pacific Air Forces, 20 February 2014, http://www.pacaf.af.mil/news/story.asp?id=123400928.

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