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AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

COMMAND AND CONTROL ENABLING THE EXPEDITIONARY AEROSPACE FORCE

by

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Preface

Working at the Airspace Command and Control & Intelligence, Surveillance and Reconnaissance Center at Langley AFB during its first two years of existence provided me with a unique perspective on command and control in today's Air Force. Having sat in meetings with the Chief of Staff and Secretary of the Air Force, it was readily apparent the importance C2 holds for the future of the Air Force. When the EAF was introduced in the summer of 1998 I began to develop the idea for this paper, that C2 would be the single most important enabler for the EAF. In the last 18 months, the EAF has come to fruition, and significant advances in C2 have been realized. The contents of this paper outline, in my opinion, how both the modernization of the Air Force and C2 should be perused congruently. The most important thing to take away from this paper is the understanding that possessing the most modern C2 processes and systems and highly trained C2 warriors is the only way for the Air Force to succeed in the expeditionary environment.

At this point I would like to acknowledge Major General John W. Hawley (USAF Ret), commander of the AC2ISRC during its first two years of existence. As his aide-de-camp, he spent many hours teaching me the C2 business and how to be an inventive and effective leader. Also, no acknowledgment would be complete without recognizing my devoted wife, Janelle. Without her support, none of this would be possible.

Abstract

As the Air Force enters a new century, it finds itself modernizing it two areas. First, it is reorganizing into an Expeditionary Aerospace Force (EAF) capable of rapidly delivering a tailorable capabilities based aerospace force to anywhere on the globe. The Air Force is also actively modernizing its ability to command and control (C2) its forces, by leveraging modern technology to enable commanders at every level of war to better prosecute a conflict. For the EAF to succeed in realizing its vision, it must create a light, lean force prepared for expeditionary operations and tailorable throughout any spectrum of conflict. What, then, should a modernized global command and control network consist of if it is to link expeditionary aerospace operations from the tactical level to the strategic level, and provide information to the EAF through the spectrum of conflict?

Both of these modernization efforts are currently being pursued, however, inadequate effort is being placed on the coordination between the two. Only by analyzing the EAF structure, outlining its unique and new requirements, and applying the people, processes and systems of a new C2 structure can congruent modernization efforts be realized. This yet to be realized congruent effort will be the key in the success of the EAF.

A modern C2 system designed around the unique expeditionary nature of the EAF will be its key enabler. This modernized C2 structure requires seamless worldwide, instantaneous connectivity. It must possess trained C2 warriors capable of using the modern systems to reachback to fixed air operations centers to obtain the vital information needed to conduct a war.

The inherent nature of the expeditionary force will produce a requirement to rapidly modernize C2 systems, attainable only through the implementation of spiral development. By embracing these concepts, the EAF will possess the people, processes and systems to conduct expeditionary operations around the world.

Part 1

The 21st Century Air Force

> *"…we will remain loyal to our core purpose as a military institution—to be a dominant fighting force, to guarantee the security of the United States in peace and her victory in battle."*
>
> —General Michael E. Ryan, Chief of Staff, USAF

As the Air Force enters the 21st Century, it finds itself a force tasked to do more with less. From its height during the Cold War, the Air Force is now one third the size, with 66 per cent fewer permanent bases. At the same time, the current world environment dictates that the Air Force deploy four times as much as just 10 years ago.[1] This increase in operations tempo has created the need to search for better ways to go to war. To maintain its status as the best and most capable air force in the world, the United States Air Force (USAF) has gone down two paths of modernization to meet the challenge of this new century. At the same time the Air Force is transitioning to a capabilities-based Expeditionary Aerospace Force (EAF), it is investing in the modernization of its command and control (C2) capabilities.

To meet the national security challenges of the new century, the Air Force will become an Expeditionary Aerospace Force. In this way, it will "organize, train, equip, and sustain itself by creating a mindset and cultural state that embraces the unique characteristics of aerospace power – range, speed, flexibility, precision."[2] By doing this, the EAF can provide a responsive, tailored, task organized force to warfighting commanders to meet challenges of the global security environment across any spectrum of conflict.

The Air Force is also pursuing an answer to how best to command and control its forces in this expeditionary environment. Major strides are being made to modernize C2 for the Air Force. The global nature of today and tomorrow's security environment dictates that we possess the ability to "see" the battlespace, no mater where it occurs, in real to near real time.[3] This creates the need for the most advanced C2 capability for war fighters at any level of conflict, from the national level to the "guy in the fox hole." Modernizing C2 is about leveraging modern technology, adapting process to this new technology, and training our people to use this technology. C2 is about "the *right* information, at the *right* time, disseminated and displayed in the *right* way, so commanders at all levels can do the *right* things, at the *right* time, in the *right* way"[4] (emphasis original).

As the Air Force proceeds down these two paths of modernization, it is imperative that it do so in a coordinated fashion. The inherent nature of the EAF, one of highly mobile operations scattered around the world, lends itself to a greater requirement for connectivity between command elements and execution elements. The only adequate answer for this challenge is a robust C2 capability. Therefore, it is imperative these efforts are conducted in coordination, and important the Air Force realizes that *C2 will enable the EAF*.

Notes

[1] *EAF Concept Brief,* HQ USAF/XOP Briefing, September 1999, slide 8.

[2] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 2.

[3] The ability to quantify real time or near real time is directly dependent on technology and the requirement for timely information. For the purpose of this paper, "real time" will be a generic term meaning "of negligible delay."

[4] *AC2ISRC Mission Brief,* HQ AC2ISRC Briefing, 4 May 1999, slide 12.

Part 2

Looking to the Future: C2 and the EAF

The vision for the Air Force is to create a light, lean, and lethal force prepared for expeditionary operations and tailorable throughout any spectrum of conflict. The glue that holds the Expeditionary Aerospace Force together is Command and Control.[1]

Framework for the EAF

> *EAF is a journey, and we have many more steps to take along this path as we transform the Air Force from a forward-based, Cold War force to an expeditionary force able to respond to crises around the globe.*
>
> —F. Whitten Peters, Secretary of the Air Force[2]

The EAF vision is a concept for organizing, training, equipping, and sustaining the 21st Century Air Force, to meet the challenges of the new global security environment across the spectrum of military operations.[3] This concept addresses two major challenges for the future Air Force: 1) providing a theater CINC with a responsive, trained and tailorable force for the prosecution of war and contingency plans, and 2) a more efficient use of the active duty force combined with an effective integration of the Total Force. To meet these challenges, the EAF has organized itself into 10 Aerospace Expeditionary Forces (AEFs) and 2 Aerospace Expeditionary Wings (AEWs) providing the national leadership the ability to leverage aerospace

power's inherent versatility and responsiveness, and match power to the needs of any crisis or contingency.

The AEF is the fundamental element of the EAF. The AEF is a blending of fundamental capabilities, equipment and people consisting of a cross section of Total Force aerospace capabilities. An AEF consists of geographically separated but operationally linked units that can be organized and tailored for any warfighting operation. By overlaying the 10 AEF structure onto the current organization of the Air Force, a pre-identified, capability based force structure is available to meet the Theater Commander in Chief's (CINC's) warfighting requirements. A 15-month rotational cycle combines the 10 AEFs (with their respective lead wings) with 5 Mobility Lead units and 2 rapid response Air Expeditionary Wings (Figure 1). AEFs in total do not

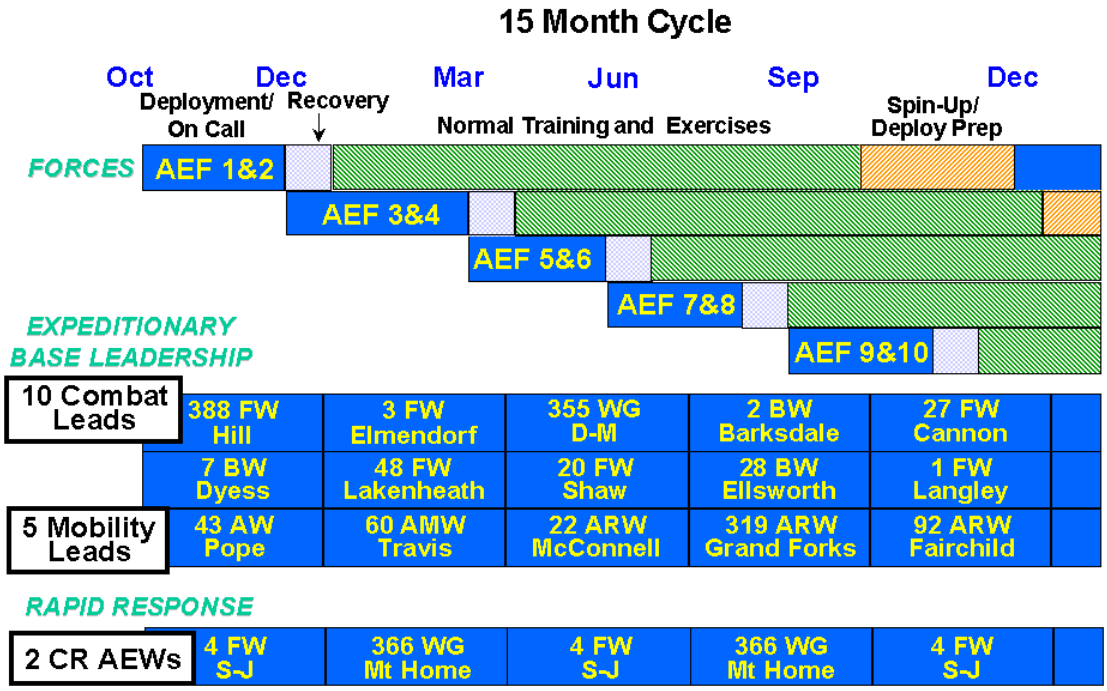

Figure 1. AEF Rotational Cycle[4]

deploy, rather response Air Expeditionary Wings, Groups, and Squadrons (AEWs, AEGs, and AESs) will comprise the deploying forces during the AEF employment phase.

The deployment phase is only one of four phases that an AEF will proceed through. Figure 1 shows the total rotational cycle, consisting of the deployment period, the recovery period, normal training and exercise period, and the preparation for deployment phase. During the deployment phase, (3 months) only the tasked units within an AEF will deploy (to fulfill the CINC's requirements). These units will fill scheduled combat and combat support deployment requirements worldwide. Following their return from the deployment, the units will enter a recovery period (1-2 weeks). The normal training and exercise period follows and is designated for normal home training, training and Joint Chiefs of Staff (JCS) exercises, and ordinary leave for personnel. The 2-month deployment preparation period focuses unit activities on area of responsibility (AOR) specific events required (if known) for the 90-day on-call/deployment eligibility period which follows.[5]

Complementing the AEF rotation cycle are five Lead Mobility Wings (LMWs) and two Contingency Response (CR) AEWs. The LMWs (each responsible for a 90 day period) provide trained leadership and assessment teams for short notice taskings such as humanitarian deployments or disaster response, while coordinating with the assigned AEF units to accomplish required planing and preparation tasks.[6] Additionally, when deploying into a theater without established facilities, LMWs will be responsible for opening and running the airfields AEFs deploy into. Finally, there exists two CR AEWs, alternating every 90s, pre-identified and on-call to meet "pop-up" contingency power projection. The two standing wings contain an array of warfighting assets and are able to respond to any worldwide crisis. The Air Force will meet its day-to-day steady-state and deployed operational commitments with forces assigned to the two scheduled AEFs, one on-call AEW, and available enabler forces (LMWs, C2 elements, etc.). Any substantial or sustained commitment of forces beyond this level will constitute a surge for

the Air Force, [7] and requires a reshuffle of assets to meet the warfighting requirements of the CINC.[8] These specifically tailored forces will be presented to the JFC in the form of Aerospace Expeditionary Task Forces (ASETFs).[9] No matter what the situation, or whether in steady state or surge operations, the EAF is organized, trained and equipped to respond to global conflicts.

Modernization of Command and Control

> *We have to put command and control into perspective; he who is able to control will command not only his own forces, but those of an adversary.*
>
> —General Michael E. Ryan, Chief of Staff, USAF

Over the last three years, the Air Force has taken great steps to modernize its command and control. The first big step was the stand-up of the Aerospace Command and Control & Surveillance, Intelligence and Reconnaissance Center (AC2ISRC, or the C2 Center) at Langley Air Force Base, Virginia.[10] Responsible for modernization planning, operational requirements, configuration control and Air Force experimentation, the AC2ISRC provides the vision for the future of C2 and coordinates all activities for Air Force and joint C2 modernization. The modernization of C2 revolves around several key concepts; developing a global grid of information, standardizing Aerospace Operations Centers (AOCs), and the people and processes within the C2 system.[11]

The concept of the global grid (Figure 2) is a "plug and play" C2 environment providing warfighting commanders worldwide access to information. The idea behind the grid is an intranet for DoD use, based on C2 Link,[12] that establishes a protected and seamless information environment. Using C2 hardware, software and processes (tied together by the Integrated C2 System or IC2S),[13] the grid affords any commander, anywhere around the world the global connectivity and instant access to information needed to fight a war. This global network of

information is the backbone which will support aerospace operations and operations centers around the world. This creates an environment where *place doesn't matter*, i.e. commanders can be anywhere around the world, or warfighters can be in cockpits or AOCs, and obtain the right information to conduct the mission.

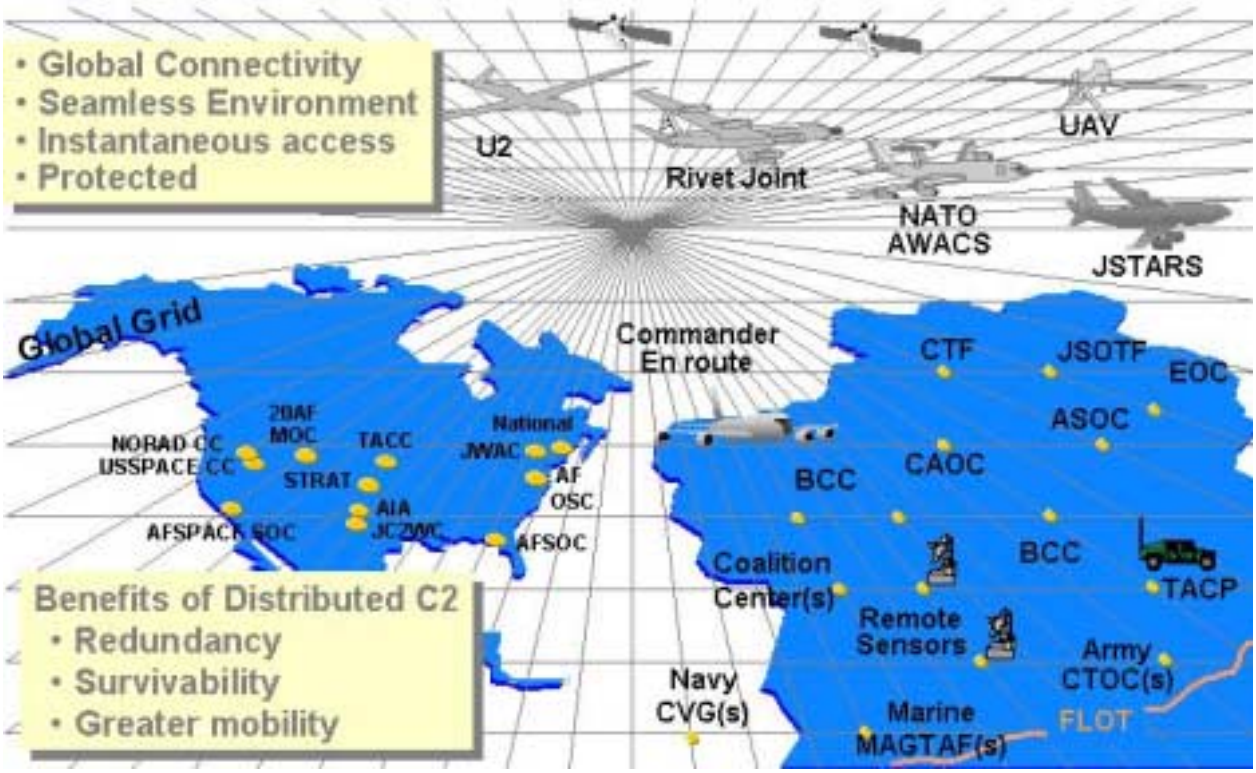

Figure 2. The Global Grid[14]

Having established the backbone on which global communication can be realized, the next step is to enhance the nodes on the Grid. The efforts for modernizing AOCs involve creating highly connected, standardized, and streamlined operations centers for commanding and controlling aerospace operations. In an expeditionary environment, having command centers and processes configured in the same way at every level of C2 allows the flexibility required by a light, lean and lethal force. From fixed stateside or theater level AOCs, to fixed or airborne operational level centers, to tactical level field C2 nodes, a standardized C2 capability will allow

seamless and congruent aerospace operations. An integral part of the success of baseline, or standard AOCs is the people and C2 process used within the operations centers.

Having developed the information environment and operations centers in which to operate, the next factor in the equation delivering superior C2 for the EAF is C2 people and processes. The people who work in the command centers must be experts at C2 processes and equipment. To accomplish this task, the Air Force has begun training not only its senior leadership, at the Joint Forces Commander (JFC) and Joint Forces Air Component Commander (JFACC) level, but also the men and women working in the AOCs. This program, called C2 Warrior,[15] will provide trained C2 professionals, experts in every aspect of C2 warfare and C2 processes, to the warfighting staffs at all levels. C2 processes under development, that will benefit the EAF, revolve around concepts called reachback and collaborative virtual working environments.[16] C2 warriors in command centers around the world are experts on the C2 processes and equipment that connect into the global grid and obtain information. Having C2 warriors, trained on the latest C2 technology and processes used in standardized AOCs and able to plug into a global information environment for their warfighting needs, will allow the EAF to realize its vision of creating the light, lean, and lethal force tailorable throughout any spectrum of conflict.

Notes

[1] Bearden, Bryan, Major, USAF. *Command and Control Supporting the Evolving EAF*. White Paper, ASC2 Agency, 1998

[2] Peters, F. Whitten, "Commentary: EAF is a Journey, Not an End State," 5 Nov 1999, Internet 6 Nov 1999, available from http://www.af.mil. He also goes on to stress that the EAF is completely different way of looking at how we do our business; a fundamental change in the way we operate.

[3] *EAF Concept Brief.* HQ USAF/XOP Briefing, September, 1999, slide 10.

[4] Ibid., 10.

[5] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 4.

Notes

[6] Ibid., 11.

[7] Ibid., 2.

[8] A more detailed explanation of the AEF structure can be found by further examining AFI 10-400 and the XOP brief. This rough outline of the AEF structure, however, provides the framework for the application of future C2 capabilities, which are discussed in later chapters.

[9] AFDD 2 provides a detailed doctrinal guidance for presenting forces to the JFC.

[10] The AC2ISRC headquarters is located at Langley, AFB, VA. Under its command are 14 field units scattered across the United States, the largest of which is the Command and Control Training and Innovation Group, located at Hurlburt Field, Florida. In total, the Air Force has invested in over 1000 people who work C2 and ISR people and process issues on a daily basis.

[11] By no means are these three focus areas for modernization the only ones being pursued by the AC2ISRC. These areas best apply to the thesis of the paper which is C2 and the EAF.

[12] *AC2ISRC Mission Brief*, HQ AC2ISRC Briefing, 4 May 1999, 32. The origin of C2 Link is Intel Link, a shared intelligence data environment developed by the Air Force intelligence community after Desert Storm. C2 Link provides warfighters with access to multiple C2 and Intel data sources using web browser and data mining technology.

[13] Ibid., 14. IC2S is a software suite that is overlaid on the global network allowing access by a vriety of users. IC2S, supported by this network, provides the opportunity for worldwide collaboration and C2 flexibility.

[14] Ibid., 35. The reader need not concern himself with the many acronyms used here, rather know that each stands for a node on the Global Grid capable of both obtaining information from and inputting information into the shared data environment called the Global Grid.

[15] *USAF Command and Control Concept of Operations*, Synergy, Inc (Washington D.C., 1 Sept 1999), 1-4.

[16] Both reachback and collaborative/virtual environments will be discussed in Chapter 3.

Part 3

C2 Applications and Processes for the EAF

C2 includes both the processes by which the commander decides what action is to be taken and the system which monitors the implementation of the decision.

—AFDD 1

As described in Chapter 2, the EAF force structure is organized to provide warfighting CINCs an aerospace fighting force. Providing the capabilities from which force packages are developed and tailored to meet mission requirements are the 10 AEFs and the 2 standing AEWs. Along with providing logistical support, the LMWs provide trained leadership to support short notice taskings such as humanitarian relief operations (HUMROs) or noncombatant evacuation operations (NEOs).[1] The ASETFs responding to the full spectrum of conflict will be comprised from this EAF force structure. From a major theater war (MTW) to military operations other than war (MOOTW), response packages will be tasked organized and deployed to support any level of conflict with the inherent lethality that aerospace power brings to warfighting.

Rapidly responding to conflict is only one of the functions of the EAF. As mentioned, the EAF is structured to fulfill both steady state and crisis response requirements. Organized for the task and trained to theater requirements, AEFs deployments into an established theater for steady-state contingency operations, although no less important as crisis response operations, can prove to be routine. A significant challenge for an AEF (or another expeditionary warfighting unit), however, is to deploy into a theater without an established command and control

infrastructure and conduct combat operations. This is where the requirement for a robust C2 capability is found. An expeditionary unit that deploys into an austere environment challenged by a capable adversary will require the right kind of preparation, instant access to C2 through the global grid, trained C2 professionals, the ability to reachback to established AOCs for information, and the most modern, up to date C2 equipment. Providing the right kind of C2 to the EAF will ensure the right kind of response with the right force to arrest, or even deter, an enemy's aggression.

C2 in the EAF

To ensure the success of expeditionary forces, they must not only possess the ability to command and control their own forces, but also be connected with the command structure above them. The construct of the EAF provides significant C2 challenges. From the operational level of conflict, requiring coordination with the Unified Commands, to the tactical level, supporting the AEF/AEW/LMWs, fully supported, and yet to be realized, C2 capabilities are required that horizontally and vertically link, throughout the chain of command, all aerospace forces.

C2 and the AEF Center

Designed to facilitate EAF operations is the AEF Center (AEFC), a cross-functional, centralized management team subordinate to Air Combat Command (ACC). The AEFC is responsible for AEF force package preparation for contingency steady state rotations and on-call AEW operational requirements, and integrating trained aerospace forces to meet theater CINCs' requirements across the full spectrum of operations. [2] Although not in a warfighting chain of command, the AFEC is the lead unit who aids the aerospace force providers by performing such tasks as theater war planning, time phased force and deployment data (TPFDD) development,

aerospace asset and unit scheduling, expeditionary combat support (ECS) requirements, and readiness monitoring.[3] Critical to the success of this level of the EAF is a fully integrated C2 capability.

With the exception of mission execution, the AEFC is an integral part of every aspect of the EAF, and requires C2 connectivity throughout the warfighting continuum. To coordinate with the USAF components following initial requirement development and assist in translation of CINC course of action into TPFDDs, the AEFC requires full purview into force status and joint standard operating procedures, requiring adequate interoperable C2.[4] Essential to the deployment of forces in support of operations is the connectivity between the AEFC and the theater command structure (AOCs or the JFC's command center). This not only gives the "force provider" the ability to task organize the aerospace forces to meet CINC apportionment requirements, but also provides the force commanders in the field with information on the units deploying into theater. At the tactical level, the AEFC assists the AEF/AEWs during the spin-up phase of their rotational cycle, by providing theater information, intelligence, and current operations plans. This information, obtained through the global grid, can be organized and disseminated to units who are training through C2 networks, ensuring the right tools to training for maximum readiness. By leveraging the available technology and the available information that C2 networks provide, the AEFC can help ensure only the best informed and trained aerospace forces are presented to the joint warfighting commander.

C2 and the AEF

The goal for the EAF is to meet the theater joint warfighting commander's requirements by presenting him with tailored and responsive ASETFs, which create the required strategic, operational, or tactical effects.[5] One tool designed into the EAF to accomplish this objective is

the AEF. The AEF rotational cycle, designed with four phases (described in Chapter 2), leads to AEF forces ready for worldwide deployment.[6] Commanding this deployment is the AEF Commander (AEF/CC, currently the ASETF/CC), most probably the lead wing commander, who possesses a day-to-day C2 capability with an established Expeditionary Operations Center (EOC).[7] During each period of the rotational cycle, robust C2 allows constant information flow to the commanders, throughout the AEF and above, and to the units that are training. There are yet to be realized C2 requirements unique to each period, which can maximize objectives during that period in the cycle.[8]

Normal Training Period. During this period, the AEF assets (AESs, ECS units, etc) train both at home base and during training deployments, under the supervision of assigned wings. During this period, the C2 structure established between the AEF units, AEF/CC, and the AEFC gives the commander and the AEFC constant visibility of the readiness of the AEF units while under their normal peace time "force provider" chain of command.

Deployment Preparation Period. Still located at their home bases, AEF assets begin preparing for deployment or on-call status. With the help of the AEFC, the AFE/CC and his staff can conduct distributed training throughout the AEF.[9] Also, C2 links will expedite passing theater information (special instructions, current intelligence, rules of engagement, AOR orientation) from the CINC, AEFC, or AEF/CC to the AEF units. Established C2 links will also allow distributed mission training (DMT),[10] allowing AEF units to train together, in a simulated/virtual environment, on theater scenarios and ATOs.

Deployment Period. The AEF is task organized for the required mission in a theater, and deployed. The AEF could deploy its forces into either an established theater (possessing an in-place C2 structure) or into a theater where no structure exists. Distributed C2 gives the AEF/CC

and his forces with the same connectivity during this phase as during the spin-up period. Whether the AEF/CC is the temporary JFACC, Commander Air Force Forces (COMAFFOR), or simply the deployed unit commander, robust C2 provides the capability for aerospace forces to be employed anywhere in the world with adequate information and connectivity to the CINC and his objectives.

Recovery Period. Although during this period AEF units revert to peacetime chains of command, AEF connectivity is maintained to exercise the communications links and prepare for the training period.

Establishing a C2 network linking the geographically separated units is the key enabler for success during the AEF rotational cycle. During each phase of the cycle, robust C2 allows constant information flow from the CINC or AEFC to the AEF/CC to the AEF units. The reason that the AEF is not currently tasked to train and deploy as a unit is due to the lack of the described C2 requirements. Modern C2 will enhance each phase by connecting it to the global grid of information, and providing the maximum ability to prepare for, and conduct warfighting.

C2 and the AEW

Complementing the AEF in the EAF structure, which provides the CINC with aerospace power, is the AEW. The AEW, a tailorable and highly mobile force, also possesses organic C2. As a force used primarily for crisis response (which is also capable of responding to a MTW), the AEW requires the ability for worldwide connectivity, which enables the most expeditious response to crises. Providing the C2 for the AEW is the EOC. Similar to the AEFs, the EOC C2 capability allows daily exercise of C2 during training, C2 during build-up for the AEW alert status and connectivity to Air Force and theater leadership during the alert period. Currently, the AEW also possess an airborne EOC capability.[11] This allows not only the AEW/CC to remain

fully connected during deployments, but also the dynamic retasking of AEW assets while airborne. In this case, the CINC can retask AEW assets while enroute to the theater, mission planners aboard the EOC under the supervision of the AEW/CC can conduct mission planning, and the new mission plans can be data linked to the aircraft prior to target attacks.[12] This robust enroute capability, along with the daily C2 needs, creates a substantial C2 requirement. These requirements for the AEW, as with the AEFs, are based on connectivity to a global network which in turn gives the expeditionary forces instant access to the information needed for the execution of the assigned mission.

C2 and the LMW

An integral part of the EAF rotational cycle is the Lead Mobility Wing. The LMW provides trained leadership and assessment teams for short notice taskings such as humanitarian missions, disaster response, and non-combatant evacuation, and maintains coordination and direct liaison authority with the AEFC and AEF assigned units to accomplish required planning and preparation tasks.[13] Designated by Air Mobility Command, the LMW must remain connected to the Tanker Airlift Control Center (TACC) in order to coordinate the tasking of mobility assets. Although the TACC possesses a robust C2 capability,[14] the LMWs, in order to communicate with the TACC, AEFC and AEFs, must possess the ability to tie into the communications network in order to effectively coordinate and plan expeditionary operations.

Other Expeditionary C2 Requirements

The EAF also possesses other assets requiring access to the global grid to accomplish expeditionary missions. Expeditionary Combat Support elements, who are typically part of a lead wing, are required for the rapid creation and sustainment of aerospace forces who are in the on-call status.[15] However, ECS planning considerations are applicable to all phases of EAF

operations (preparation, deployment, employment, sustainment, redeployment, and reconstitution), and require a robust C2 capability. Also in need of C2 connectivity are the Air Force's Low Density/High Demand assets (U2, E-8 JSTARS, E-3 AWACS, RC-135 RIVET JOINT, SOF, CSAR, etc.).[16] Although playing a critical role in expeditionary operations, these assets will probably not deploy with an AEF/AEW. To communicate with the AEF/CC or the JFACC, these units will need the same connectivity to the grid as the other units described. These special case elements of the EAF play a significant part in all expeditionary operations, and require no less than a full suite of C2 capabilities. Allowing the connectivity for all these EAF units will be the C2 tools each possess.

C2 Tools

Based on the above outlined requirements for C2 in the EAF, there must exist a C2 suite of equipment in each unit allowing connection into the global grid, and the command of the expeditionary forces. The backbone for the EAF C2 is Theater Battle Management Core Systems (TBMCS). Developed in compliance with joint common operational environment requirements, TBMCS is a common C2 system that connects the warfighters at all levels in the joint environment.[17] Functionalities designed into TBMCS include CINC, force, and tactical level C2 tools and applications.[18] TBMCS brings together all levels of warfare into a single tool and when connected to the global grid, allows distributed C2 operations. Enhancing distributed operations is a collaborative environment where real time collaboration on expeditionary operations can occur. Collaborative tools (CT) provide warfighters with a web browser based tool that allows C2 and intelligence, surveillance, and reconnaissance (ISR) collaboration in real time.[19] Viewing TBMCS as one of many web pages in CT creates a virtual environment where distributed and collaborative operations provide expeditionary warfighters at every level real

time information, in the form of a common operational picture, to achieve the desired warfighting effects. These tools, along with others, and new C2 processes derived from this technology, provide the command and control that fulfills the requirements of the EAF.

Although adequate command and control of expeditionary forces throughout EAF operations will guarantee the success of the EAF, it has yet to be realized. AEF/AEW/LMWs all possess unique C2 requirements. However, the requirements are all based on adequate connectivity both laterally and vertically to the echelons of command above them. Providing these C2 capabilities are the C2 tools being developed and connectivity through the global grid. The full development of this combination will provide the EAF with the right information at the right time enabling it to conduct worldwide expeditionary operations.

EAF and C2 in Action

> *The Air Force is committed to providing the integrated global and theater air, space and surface picture of the battlespace to the 21st century joint force commander.*
>
> —Global Engagement

Command and control people, processes, equipment, and infrastructure provide the ability to build a picture of the battlespace. Whether viewing a picture of the threat, friendly forces, space forces, or logistics movements, this global capability creates an environment where "place doesn't matter." From anywhere in the world, commanders can obtain information or the picture of the battlespace, make time critical decisions referencing this information, and direct warfighters in the field in a seamless, real time manner. From fixed stateside or theater level AOCs, to fixed or airborne operational level centers, to tactical level field C2 nodes (see Figure 2), a standardized C2 capability will allow congruent, expeditionary aerospace operations.

Operations Centers

To provide congruent support for expeditionary operations in peace and war, a networked series of 24-hour command centers is required, which are manned with small cross-functional staffs at each level of command. This network is vital to support the important function of providing decision-makers with accurate situation assessments and military response options not only in the early hours of a crisis, but also throughout a conflict.[20] During each phase of the EAF rotational cycle, deployment preparation, deployment and sustainment, redeployment, and reconstitution, this linking of networked AOCs acts as a virtual command center, supporting the engaged warfighters. Currently the Air Force has 14 different worldwide 24-hour operations centers that have been networked together.[21] This network of operations centers, although not currently operating in concert, possesses the collective capability to build, through distributed collaboration, a real time picture of any battle space around the world. It is this linkage of operations centers via the global grid that will provide C2 support to the EAF at every level of operations.

Networked operations centers, underscored and connected by the Integrated C2 System and the global grid, can greatly enhance expeditionary warfighting. By combining the information of the standing operations centers with expeditionary operations centers (those assigned to AEF/AEWs both fixed and airborne), a constant operating picture can be provided to commanders at every level of operations. Limited only by the information input to the network, EAF readiness can be instantly assessed by displaying the constant status of AFE/AEW/LMW at any given instant. Real time theater intelligence can be obtained for use not only in military operations in progress, but also in preparing expeditionary units for deployment. From issuing warning orders or training ATOs to providing enroute visibility of deploying units or global reach missions, the network of operations centers enhances expediency and lethality in the

expeditionary environment. The greatest benefit of networked operations centers is realized by implementing a concept called reachback.

Reachback

Inherent to the ability to conduct light, lean and lethal expeditionary operations is the requirement for a reachback capability. Reachback is the process of accessing, from a forward location, warfighting information and assistance from operations centers and data bases located in rear operating locations. By doing this, some warfighting functions within a forward operations center can be preformed in an operations center located safely away from a crisis location. Having a robust network of operations centers located in rear locations (like in the United States) provides the capability to assimilate and process information and assist warfighters, in forward locations, with daily operations.

Enabling reachback is a secure and assured connection to the global grid of information. In this virtual/collaborative environment, where "place doesn't matter," normal functions of operations centers, whether AOCs or EOCs, can be performed in rear locations. Reaching back through a global network for information results in putting fewer people in harm's way and having a smaller deployment footprint in forward locations (in an AOC, reduction by an order of magnitude, i.e. 200 people instead of 2000[22]). For EAF operations, this means rapid deployments by AEF/AEWs into austere locations can be fully supported, both enroute and once established, by information and warfighters located in rear areas. This creates the capability for the JFC or JFACC to remain in the rear area, and still prosecute the war, until a full C2 capability is established in the forward area. This also would allow the commander to deploy forward (remaining fully connected by flying on a JFACC Enroute equipped aircraft[23]) while the majority of his support staff remains in the rear to produce the ATO.[24] To maintain an expeditionary

force capable of worldwide actions, real time information is a requirement for commanders and warfighters throughout the spectrum of conflict, and can be obtained through reachback.

Sensor-to-Decision Maker-to-Shooter

The same network environment that enables reachback provides the ability to obtain information (through various means like ISR platforms) and rapidly integrate it in the battlespace. The concept of Sensor-to-Decision Maker-to-Shooter[25] (SDS) takes the information available within the operating network and provides real time information to the warfighter. The Air Force currently has the capability, much like the Navy's Network Centric Warfare,[26] to integrate the common air picture (provided by the Global Command and Control System) and provide it in real time to airborne aircraft. The capability also exists to obtain images of threats and transmit them to attack aircraft (sensor to shooter). SDS would fuse not only the air and ground threat pictures, but also enable the commander in an operations center (who is not facing threats while flying in a combat zone) to view the total battlespace in real time. This fused information of the battlespace would allow the JFACC to make time critical targeting decisions and exploit this situational awareness of developing threats with precision engagement.

Through the connectivity and the distributed/collaborative environment provided by command and control, SDS provides the capability to react to emerging targets throughout the battlespace. Images from ISR assets like the AWACS, JSTARS, or Predator can feed real time information through data links to both command centers and shooters (shooters being combat aircraft with the ability to destroy targets). The concept of SDS creates the capability to prosecute an air war with minimal pre-mission planning for the combat aircraft. Rather, the aircraft would be tasked, while airborne, to destroy time critical or emerging targets (by receiving real time information in their cockpits - RTIC), with a high degree of confidence (by

the commanding authority) in the target information they receive. In the expeditionary environment of the future, "we have to find a way to deal with emerging targets…"[27] The answer is a robust C2 network, that fuses together battlespace information, which allows SDS operations, and network capable aircraft to precisely eliminate real time threats in that battlespace. (See Appendix A for more on SDS)

Figure 3. EAF C2 Architecture[28]

Command and control people, processes, equipment, and infrastructure provide the ability to build a picture of the battlespace (Figure 3). By connecting standing operations centers, with their capability to collect, exploit, and disseminate a ISR information, to airborne command nodes, to expeditionary C2 nodes in forward areas, a shared data environment is created which provides information to commanders at all levels. Having the C2 tools to connect to a global network, expeditionary operators, located in tailored and scaled operations centers, are able to reachback to standing centers to obtain real time battlespace information. In this manner, the

JFACC can deploy forward with only a few critical staff members, and direct combat operations with the support of rear operations centers. This same network allows real time information from sensors to be viewed by commanders and pushed to the cockpit of shooters for the real time prosecution of emerging targets in the battlespace. This ability to reachback to standing operations centers from airborne or fixed forward centers and retrieve real time battlespace information is key to worldwide expeditionary operations. These C2 process and systems provide national authorities with a lethal warfighting capability. Integral to this capability are expeditionary warriors trained on these processes and systems.

C2 Training

Although C2 processes and systems are key to an effective global command and control capability, it is the people, the operators, shooters, and commanders, who are essential to prosecuting a war by utilizing a global network of information. To ensure operators and commanders are able to maximize the potential of a shared/fused data environment for warfighting, the Air Force has created command and control warriors who are the keepers of the network and executors of the mission. Also, through robust communications networks, the Air Force is developing a Distributed Mission Training (DMT) environment providing its shooters with the capability to train with the latest C2 capabilities. Adequately training our expeditionary forces with the latest C2 process and systems will provide the most lethal aerospace warriors capable of worldwide expeditionary operations.

C2 Warrior

A C2 Warrior[29] is educated, trained, and certified in the aerospace operational art, and is the primary operator in AOCs.[30] The Air Force views its operations centers at all levels as a weapon

system, much like an F-16 or a C-17. In this case, the operators of the AOC weapon systems are trained like pilots, receiving initial qualification and mission qualification training. This provides the C2 professionals who are experts at the systems and processes in an AOC. C2 Warriors are chosen from other disciplines across the Air Force (space, fighter and bomber operations, intelligence, mobility, logistics, communications, etc.). Bringing a certain expertise to the training, they are then trained on the systems and processed in the command and control environment. Once certified "mission ready" on the C2 supporting the AOC system, they then work as the operators in operations centers around the world. Training C2 professionals integrates tactical expertise with operational art maximizing effective employment of air power.

By training C2 professionals, the Air Force ensures it possesses the enabling factor for warfighting AOCs. Commanding these AOCs are senior leaders who are also provided training at the C2 Warrior School. This training, for the AOC directors (typically Colonels or Brigadier Generals) and JFACCs (Major or Lieutenant Generals) provides the senior leadership of the Air Force the knowledge of how to leverage the complex C2 systems and operations architectures located in today's AOCs. Armed with this training, a JFACC can arrive in an AOC anywhere in the world and seamlessly transition to from peacetime to wartime operations. Possessing trained C2 Warriors at the operational and tactical level operations centers, the EAF can meet the demands of a full spectrum of global conflicts.

Distributed Mission Training

Not only does the latest technology require that we train our operators of the AOC, it also provides us the opportunity to better train the operators of our airborne weapons systems. Linked through the robust network of the global grid, DMT links capable and realistic aircraft simulators at different bases.[10] This network of simulators, from fighter and bomber aircraft to

C2 platforms like the JSTARS or AWACS, enables operators to practice large force employment while geographically separated.[31] Also, by integrating a command structure (AEF/AEW/ASETF or JFACC commander) and leveraging the information available on the global grid, concepts like SDS and RTIC can be practiced on a daily basis. This not only benefits the operators at the tactical level, but also the commanders who make decisions regarding emerging targets in the battlespace. By integrating training at all levels, through the connectivity of DMT, the EAF will be fully prepared to conduct operations around the globe.

Modernization of C2

As technology continues to make remarkable and rapid advances, the modernization of C2 for the EAF must keep pace. C2 based on the technological backbone of a global network of information, operations centers, and sensors is currently obtaining the capability to rapidly fuse data into a cognitive battlespace picture for commanders. To continue this progress, however, it is imperative that every node on the global network maintains pace with technological advances. This is being accomplished through several efforts. The Air Force in currently fielding the Integrated C2 System (IC2S)[32] to standardize the most current capabilities for command and control across the Air Force. To ensure that IC2S remains on the leading edge of technology, the Air Force uses the concept of Spiral Development for modernization of its C2 processes and systems.

To formalize the modernization of the IC2S, the Air Force has implemented a "Block" system much like what is used for aircraft. To stand up a global network that links data bases, operations centers, sensors, and shooters (as described with in this paper) the Air Force is fielding IC2S "Block 00." This command and control block design standardizes equipment in operations centers, databases, and message formats used throughout the Air Force. Block 00

links AOCs, provides for information protection, employs collaborative tools, implements TBMCS, and is based on C2 Link.[33] More importantly than finally producing an integrated C2 system, is provides a starting point for the continued modernization of not only each system, but also the system of C2 systems as a whole. The continued modernization of IC2S will be based on spiral development.

Spiral development is a process that can rapidly take an idea from just a concept to an operational capability ready for fielding (Figure 4). It is a forum where developer, tester and

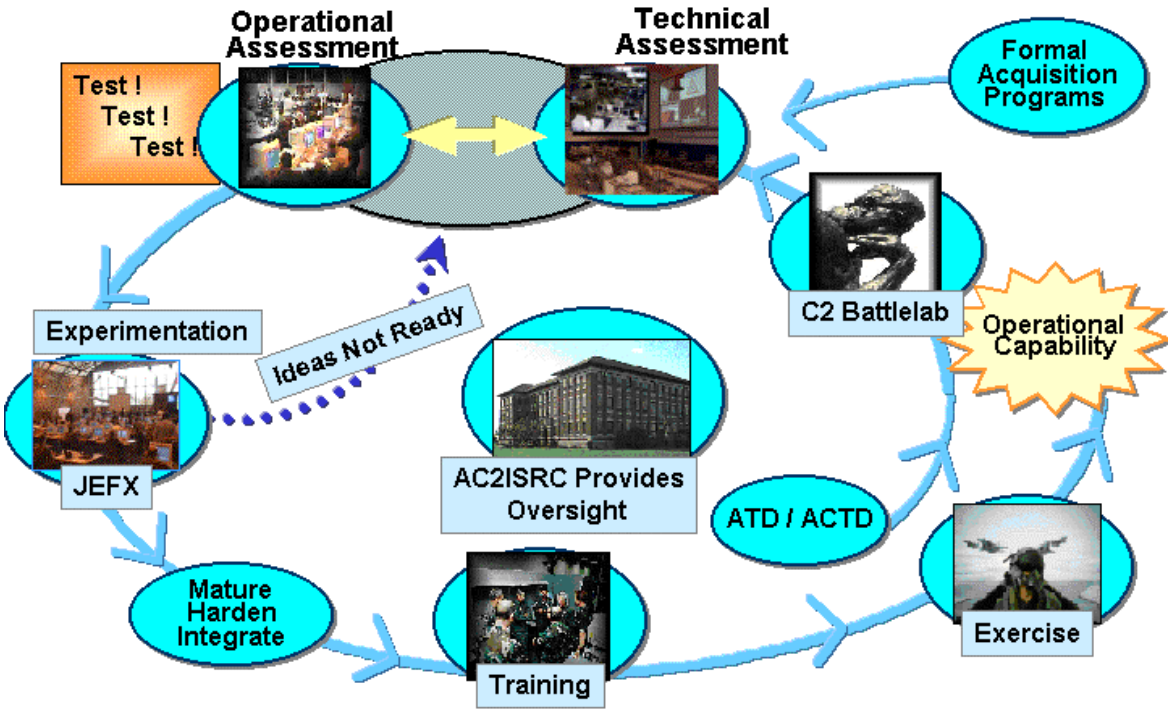

Figure 4 The Spiral Development Process [34]

user can devise new ideas or refine old capabilities for warfighting needs. Unlike the traditional acquisition processes, spiral development can take an idea and field it to the warfighter within 18 months.[35] Spiral development delivers the method for continually upgrading IC2S (a system based on technology), providing the means for the modernization of the IC2S Blocks.

It is critical to implement spiral development to enable the most rapid modernization of C2 processes and systems. The process begins with an idea, from advanced technology demonstrations, advanced concept technology demonstrations, USAF C2 Battlelab ideas, or within the formal acquisition process. From here, the developer, tester and end user begin a process of assessments, both technical and operational. A series of test validate the concept's technical ability and operational capability. Once an idea is ready for application, it is integrated into an experiment that links it with other systems and stress tests it in an operational environment. After a period of maturing, hardening, integration, and training, the developed concept is implemented into warfighting exercises and fielded to the warfighters. Spiral development is key in ensuring the most modernized IC2S is fielded to our warfighters.

An integral step in the spiral process is experimentation. The Air Force conducts the Joint Expeditionary Force Experiment (JEFX) on a biennial basis that takes the latest C2 and other warfighting technologies from the test phase to an operational environment for system validation and process development. JEFX creates a realistic warfighting setting by seamlessly combining live-fly and simulations. This environment enables new operational concepts and technologies to rapidly evolve and mature for delivery to the warfighter. With JEFX as its crown jewel, spiral development provides the ability to rapidly advance both command and control systems and processes.

The process of using spiral development to modernize C2 has only begun to realze its full potential for rapidly implementing C2 systems. What has yet to be realized, however, are the full effects that conducting modernization in this manner will have on funding modernization. What can be gleaned from this discussion is that by fully embracing spiral development for the modernization of the EAF, the Air Force will expedite building the 21st Century EAF.

Conclusion

An expeditionary unit that deploys into an austere environment challenged by a capable adversary will require the right kind of preparation, instant access to global network, trained C2 professionals, the ability to reachback to established AOCs for information, and the most modern, up to date C2 equipment. ASETFs and AEFs will be asked to deploy into theaters without established C2 capabilities to respond to the full spectrum of conflict, and they must possess the capability to train, deploy, and employ their warfighting abilities. Command and control will enable the EAF to respond to the needs of a CINC in a light, lean and lethal manner. Providing the right kind of C2 to the EAF will ensure the right kind of response with the right force to arrest, or even deter, an enemy's aggression.

Notes

[1] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 2.

[2] Ibid., 13.

[3] Ibid., 14-16. A more detailed explanation of the roles and functions of the AEFC is located in AFI 10-400

[4] Interoperable C2 throughout the joint environment is a significant challenge. Continual modernization of the Air Force C2 capabilities is in full compliance with joint standards and requirements.

[5] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 5.

[6] Ryan, Michael E., "Expeditionary Aerospace Force for America," 14 September 1998, Internet 6 Nov 1999, available from http://www.af.mil. General Ryan originally laid out a vision for an AEF where it is a geographically separated, operationally linked unit consisting of active duty, Guard and Reserve units possessing a wide range of aerospace capabilities. In this vision, the AEF commander will work with his assigned AEF units facilitating some of the training during the deployment preparation phase (working with the units' assigned wings) and command the AEF while deployed. Currently, the Air Force is not utilizing the AEFs in this manner. It is using the AEF as a scheduling tool by where it provides geographically separated units to an AEF commander who is established in a steady state theater of operations. Although this provides trained forces to a theater commander, these forces have not trained together, and possess no AEF unity (until reaching the theater). Also under the current scheduling plan are two AEWs. The Air Force plans on using these units, who are fully integrated and train together on a daily basis, for crisis response. It is my opinion that the Air Force should train the AEFs in

the same manner as it trains the AEWs. From this point on, I will refer to the AEFs as geographically separated, operationally linked units as originally envisioned and will develop C2 requirements accordingly.

[7] Bearden, Bryan, Major, USAF, *Command and Control Supporting the Evolving EAF*, White Paper, ASC2 Agency, 1998, 3. The EOC resembles a wing operations center, but it is equipped with an advanced C2 capability. The EOC, which remains with the AEF/CC while not deployed, provides the connectivity with the AEFC nd the geographically separated units.

[8] Ibid, 2. Each period's C2 requirements are referenced from this paper.

[9] For example, the AEF/CC can publish weekly ATOs that exercises not only the C2 process between his assigned units within his AEF, but also allows the units to transition from peace time training to thinking about war fighting.

[10] *USAF Command and Control Concept of Operations*, Synergy, Inc (Washington D.C., 1 Sept 1999), 2-4. To summarize the capability, DMT is a network of aircraft simulators where, in a virtual environment, standard aircraft simulators (F-15, F-16, AWACS, etc) are linked together providing the capability to "fly threw" a simulated ATO based on theater plans and threats.

[11] *AC2ISRC Mission Brief.* HQ AC2ISRC Briefing, 4 May 1999, 18. This concept, originally developed by the 366th Wing supported by the AC2ISRC, was developed in conjunction with the AOC enroute discussed later. The EOC is a "roll on, roll off" suite of equipment configured for the KC-135s assigned to the AEW.

[12] *Joint Expeditionary Force Experiment '99*, HQ AC2ISRC Briefing, October 1999, 25. In JEFX '99 the En Route EOC successfully demonstrated the capability to conduct mission planning, direct mission execution, plan and implement retasking, monitor and affect force deployment, and maintain situational awareness while en route to the AOR.

[13] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 11.

[14] *TACC 2000*. HQ Air Mobility Command Briefing, November 1999, slide 74. Although possessing a robust communications capability, AMC is pursuing digital a communications network between the TACC and all mobility aircraft.

[15] Air Force Instruction (AFI) 10-400, *Aerospace Expeditionary Force Planning*, 1 Oct 1999, 26.

[16] Ibid., 2.

[17] *Joint Expeditionary Force Experiment '99*, HQ AC2ISRC Briefing, October 1999, 20.

[18] *AC2ISRC Mission Brief,* HQ AC2ISRC Briefing, 4 May 1999, 28. The Joint Aerospace Applications designed in TBMCS include: CINC level – global awareness, strategy determination, and for organization, tracking and directing tools; Force level – situation assessment, plans development, and force control tools; Tactical level – tools that match crews, missions, aircraft, weapons, and airspace requirements.

[19] Ibid., 31.

[20] *USAF Command and Control Concept of Operations*, Synergy, Inc (Washington D.C., 1 Sept 1999), 1-2.

[21] *Joint Expeditionary Force Experiment '99*, HQ AC2ISRC Briefing, October 1999, 17. The opeartions centers that are currently linked together: AFSPACE AOC, Vandenberg AFB; AFOSC, Langley AFB; TACC, Scott AFB; AFWA, Offutt AFB; AIA, Kelly AFB; JWAC, Dalgren, VA; 1ST Air Force, Tyndall AFB; NORAD/USSPACE, Cheyenne Mountain &

Notes

Peterson AFB; DAOC, Hickam AFB; DAOC, Ramstein AB; JTF-SWA, PSAB; JTF-NW, Incirlik AB; CAOC, Vicenza; and HTACC, Osan AB

[22] Ryan, Michael E., "Expeditionary Aerospace Force for America," 14 September 1998, Internet 6 Nov 1999, available from http://www.af.mil.

[23] *Joint Expeditionary Force Experiment '99*, HQ AC2ISRC Briefing, October 1999, 24.

[24] Ibid., 29. Although this concept is currently not widely approved of in the Air Force, it has succeeded during EFX 98 and JEFX 99. As the EAF continues to respond to crisis around the world, this way of operating should become more reliable and accepted.

[25] The Air Force is struggling to find a name for this concept, whether is should be called Dynamic Battle Control or simply Command and Control. For the purposes of this paper, I will refer to this concept as SDS.

[26] "Network Centric Warfare," 4 Jan 2000, Internet 25 Jan 2000, available from http://www.navy.mil.

[27] *Joint Expeditionary Force Experiment '99*, HQ AC2ISRC Briefing, October 1999, 20. A quote from Lt General Lanny Trapp, JFACC for JEFX 99.

[28] *C2 Warrior Vision*, Air Force C2 Training and Innovation Center Briefing, October 1999, 2.

[29] The C2 Warrior School is assigned to the C2 Training and Innovation Group, Hurlburt AFB, Florida. The school trains C2 professionals at all levels.

[30] *C2 Warrior Vision*, Air Force C2 Training and Innovation Center Briefing, October 1999, 4.

[31] DMT will be the key to AEF training in a geographically separated but operationally linked environment. While in the deployment preparation phase, simulated ATOs, large force deployments, SDS scenarios, etc., can be conducted by linking aircraft simulators, EOCs, and real time battlespace information to maximize AEF training and deployment preparation.

[32] *AC2ISRC Mission Brief*, HQ AC2ISRC Briefing, 4 May 1999, 42.

[33] Ibid.

[34] *AC2ISRC Mission Brief*, HQ AC2ISRC Briefing, 4 May 1999, 45.

[35] This is a nominal time period for implementing a piece of technology. With the rapid increases in the ability to produce new technologies, spiral development will enable the Air Force to keep pace with advances.

Part 4

C2 Solutions and Conclusion

> *What the Warrior Needs: a fused, real time, true representation of the battlespace – an ability to order, respond and coordinate horizontally and vertically to the degree necessary to prosecute his mission in that battlespace.*
>
> —Joint Pub 6-0

As the Air Force enters the new century, it has organized itself into an expeditionary force capable of responding to any crisis worldwide. The only solution for guaranteeing the success of this new fighting force is robust and responsive command and control. Being the key enabler for expeditionary operations, C2 ensure connectivity at every level of warfighting. Proceeding down two paths of modernization, reorganization into an EAF and building a robust C2 capability, it is imperative that the Air Force do so in a congruent fashion.

The success of the EAF concept is directly based on command and control. The basic nature of the EAF is a highly mobile force scattered across the globe for response to any crisis. Without instantaneous worldwide connectivity providing the battlespace picture to warfighters at all levels, the EAF will be unable to effetely prosecute real time expeditionary operations. Providing this connectivity is the connection into the global grid of information created by C2 Link. Ensuring a seamless C2 environment are modernized C2 applications like TBMCS and collaborative tools, which produce a distributed/collaborative warfighting environment, enabling commanders to prosecute a war. Processes such as reachback and SDS provide the capability to

find, fix, track and engage emerging targets any where in the world in real time. C2 training will provide an educated C2 warrior who will be able to leverage the latest technologies for warfighting purposes. And finally, spiral development will provide the EAF with the most modern C2 capability. By embracing these concepts, the EAF will possess the people, processes and systems to conduct expeditionary operations around the world.

As yet, however, the Air Force has not fully integrated the modernization efforts of the EAF and C2. The Air Force must align its modernization efforts to those described in this paper, which realize C2 requirements from EAF requirements. Only then can robust expeditionary C2 be expeditiously and efficiently acquired for expeditionary operations.

The single most important enabler for the EAF is a robust C2 capability. Without the capability to adequately communicate with and command and control its expeditionary forces, the EAF will be unable to respond to the needs of the warfighting CINCs. By modernizing C2 with respect to the requirements posed by the EAF, the Air Force can produce an aerospace power capable not only of full integration into the joint warfighting environment, but also of being the first force called upon to react to any situation in the world.

Part 5

Recommendations and Implications

> *Know the enemy and know yourself; in a hundred battles you will never be in peril.*
>
> —Sun Tzu

Command and control is about the right information at the right time disseminated and displayed in the right way so commanders at all levels can effectively prosecute a war. Not only is it important that an accurate picture of the threat is built and displayed, but also an accurate picture of friendly forces must be maintained and constantly updated in order to provide the right amount of aerospace forces to the CINCs. In an expeditionary environment there is no greater enabler than C2. With modernized, robust C2 systems and processes, and the C2 warriors to operate the systems and constantly improve the processes, the EAF will be a tailorable and rapidly responsive force able to project aerospace power to any point in the world with a seamless transition from peace time operations to war. With this in mind, there are several recommendations for the modernization of both the EAF and C2 that will ensure the most lethal force may be brought to bear on an enemy.

Recommendations

The following list of recommendations can provide guidance by which the Air Force can leverage the EAF and C2 to provide the most capable expeditionary aerospace forces to the CINC.

Senior Air Force leadership must embrace the concept of reachback and commit to conducting warfighting operations in a true distributed operations environment. By taking a "top down" approach to implementing reachback, the Air Force can more rapidly integrate this concept of warfighting. This can be accomplished by educating senior leaders on process and capabilities that C2 brings to the fight, and normalizing reachback in every day operations. This education will provide the confidence that JFCs and JFACCs need in order to embrace concepts like heavy rear/light forward operations, and ATO production in the rear instead of forward locations.

DMT must be adequately developed and funded. For the EAF to succeed with a force structure that is geographically separated but operationally linked, distributed training must occur. With the capability for integrating real time threat data, aircraft simulators, and command and control nodes, concepts like large force employment and SDS can be practiced on a daily basis by units of an AEF. This link between units of an AEF provides the ability to create AEF unity and greatly benefit its ability to prepare for a deployment.

Continued modernization of C2 capabilities must occur. By embracing spiral development as the means for modernizing our C2 force structure, the Air Force can ensure the most modernized, equipped forces are presented to the CINC.

Increased C2 capabilities can create a situation where too much information is presented to commanders and warfighters. Critical to the success of C2 operations, the fusion of ISR

information and C2 process must be managed as to prevent the situation where warfighters are overloaded with information. Joint information management standards for operations centers must be developed and implemented in order to effectively leverage all the information available to our warfighters.

Implications of Advanced C2

There are several implications that advanced C2, as described in this paper, will have on the way the Air Force and the EAF are currently doing business.

Spiral development will create a new way to budget for the modernization of our forces. Because of the rapid nature of the improvements in technology, a requirement exists for obtaining transition money for rapidly providing the latest technology to the warfighter. This is a fundamental difference in the way the acquisition process has been funded in the past, and will have significant implications on future modernization programming.

Increased C2 capabilities for the EAF will provide the ability to command and control the force structure with increasing ease. Applying advanced C2 to the AEF will create an easily tailorable, rapidly responsive capability that currently exists only with the AEWs. The AEWs, as they are currently organized, possess a high operating budget due to the diversity of assets belonging to one wing. With the increased connectivity to an AEF commander provided by C2, the EAF may rethink maintaining AEWs for a rapid response force when the AEFs, possessing the increased C2 assets currently in the AEWs, can perform the same function.

In a fused data environment where real time information of the battlespace is visible to commanders in the AOCs, there exist an increased possibility for commanders, who are not flying the aircraft, to effect close control on the shooters operating in the battlespace. Commanders must use this increased visibility to enhance aerospace operations rather than

inhibiting them. The only way to ensure commanders do not overstep certain boundaries is through intense education on C2 capabilities and processes.

By integrating these recommendations and addressing these implications of C2, the EAF will be able to realize its full potential as an aerospace force capable of responding to any crisis anywhere in the world. Command and control is vital to the success of the future Air Force, and is truly the key enabler for the EAF. By creating the C2ISR environment shown below, the EAF, through advanced and robust C2, will prevail in any conflict.

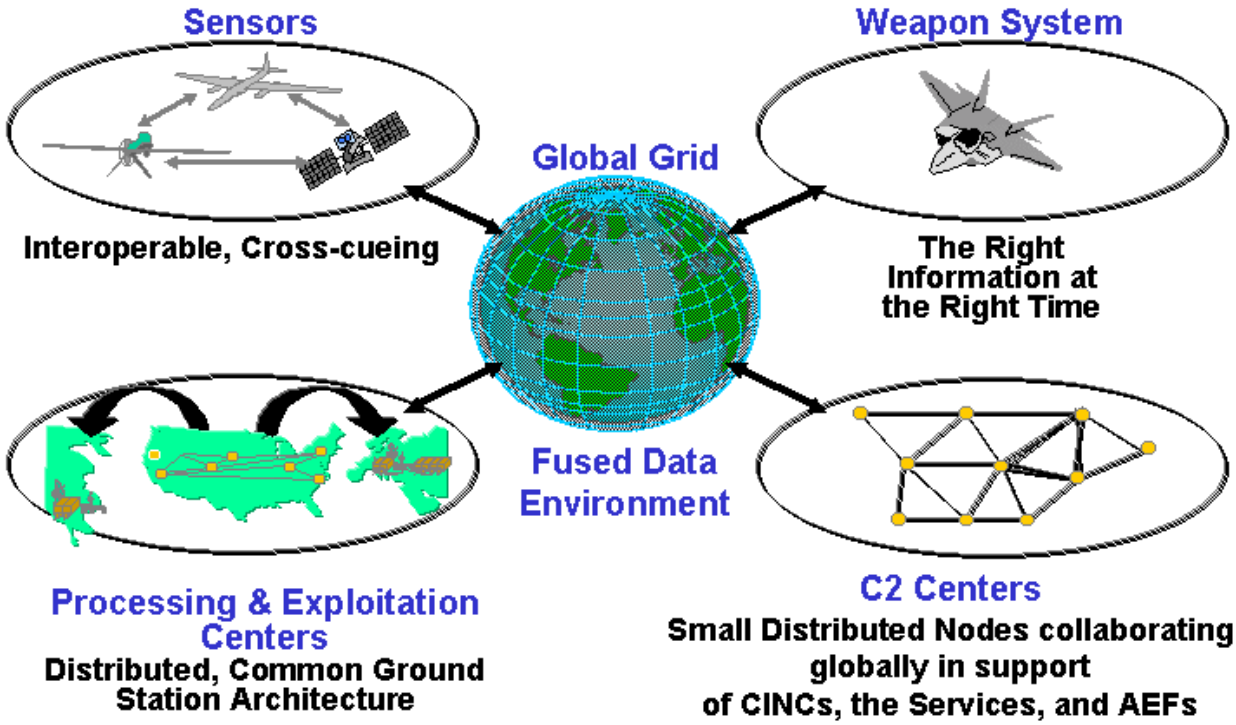

Figure 5. Future C2ISR Operations

Appendix A

SDS and the OODA Loop

John Boyd argues that strategic paralysis of an enemy occurs when you can operate inside of his observe-orient-decide-action (OODA) loop. This can be accomplished by either tightening friendly OODA loops and/or loosening an enemy's OODA loops.[1] OODA loop speed and accuracy are essential to establishing an advantage over one's enemy. Sensor-to-Decision Maker-to-Shooter (SDS) provides the best capability to effect the OODA loop of an enemy. A comparison of the OODA loop, SDS, and current functions and tools is shown in Figure 4.

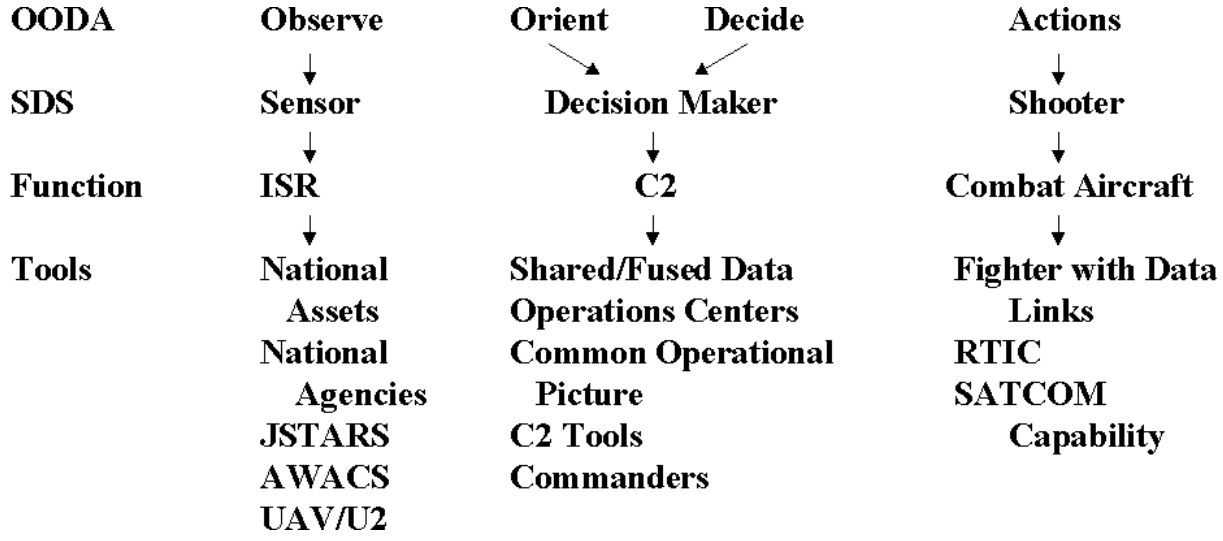

Figure 6. The OODA Loop and SDS

No better way exists to achieve tightening one's OODA loop than through the combination of C2 and air power. In this environment, ISR data is fused together, presented to commanders for decisions and linked to combat aircraft, or shooters. When SDS is compared to the OODA

loop, ISR assets provide the **observation**, the "O," of the battlespace. Command and Control provide the **orientation** of the battlespace and decision capability for the commander (JFC, JFACC, ASETF commander, etc.). In a shared/fused data environment provided by a global C2 network, real time battlespace information is analyzed, **decisions** are made, and the right information is then data linked to the shooters. It is here that air power provides the "shooter," or the **action** that closes the OODA loop. From detecting an emerging target, to analysis between distributed operations centers, to target destruction by airborne aircraft (Figure 5), SDS provides the functions and tools to tighten our OODA loop to real time.

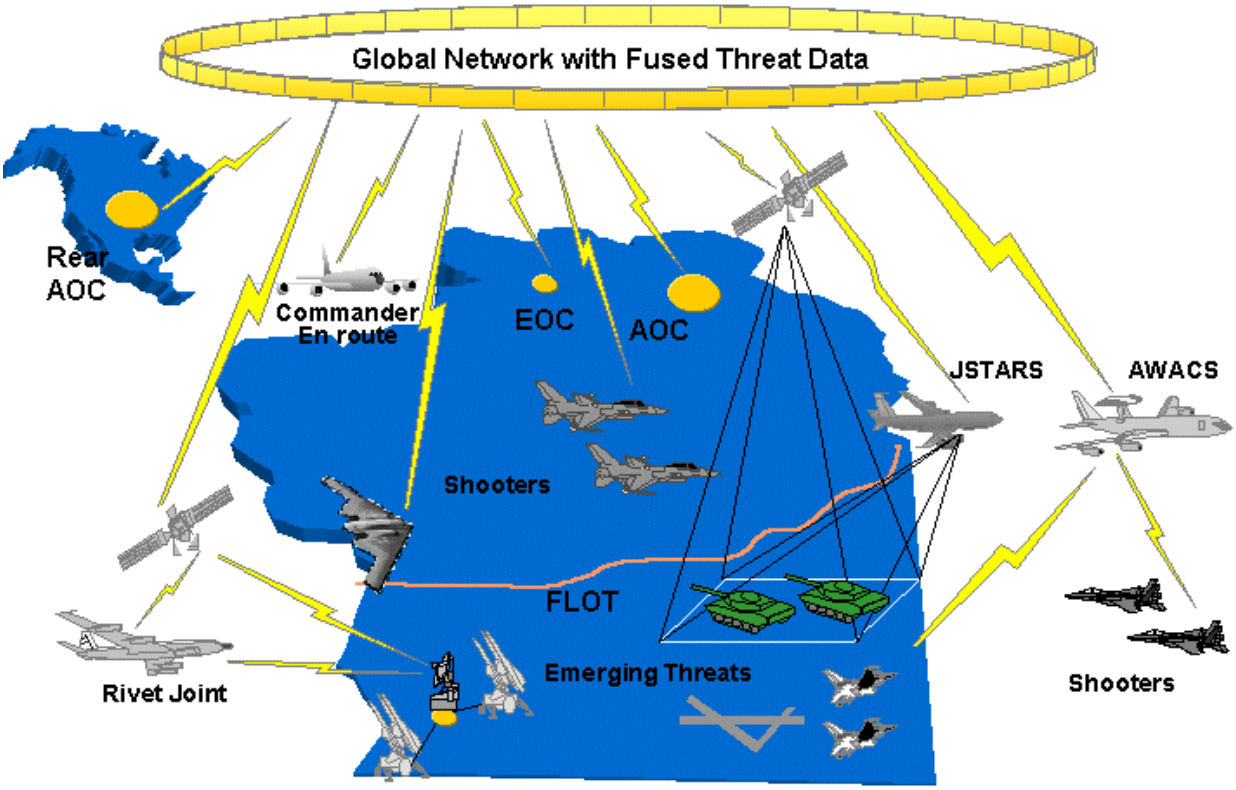

Figure 7. Sensor-to-Decision Maker-to-Shooter Architecture

Notes

[1] Fadock, David S., Major, USAF, *John Boyd and John Warden, Air Power's Quest for Strategic Paralysis* (Maxwell Air Force Base, AL: Air University Press).

Appendix B

Centers of Gravity for a Network War

When looking to the future and examining warfare conducted with the use of networks, it becomes apparent that information networks utilized for the command and control of warfighters will play a significant part of any conflict. Referencing Warden's five strategic rings,[1] one can devised centers of gravity for warfare centered on a network of information (Figure 8). Examining these centers of gravity, it is important to realize that the U.S. may not face an opponent with these capabilities. It may be, however, that this idea be of better use when thinking how best to defend our networks.

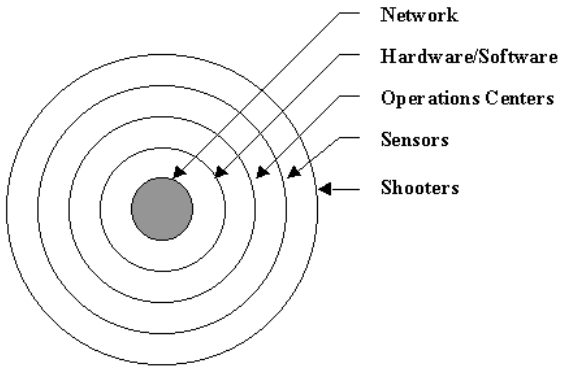

Figure 8. Centers of Gravity for a Network War

Network. Eliminating the network of an opponent that depends on it for its warfighting ability, or access to it, will cut all communications from the commander to the warfighter. With the network eliminated, C2 will return to telephones and faxes (at the best case), or no communications from commanders to warfighters at all. Included in this COG are the

communications links utilized by the network. This will in effect cause the "strategic paralysis" of the network, rendering it unusable.

Hardware/Software. If unable to eliminate an adversary's network as a whole, attacking the applications used on the network can significantly degrade his warfighting capability. The network will be accessed using various software applications located on different hardware equipment. By attacking these capabilities, through the introduction of viruses for example, one could selectively degrade or destroy certain capabilities of an adversary's C2 capability.

Operations Centers. Operations Centers are critical nodes on the network (Reference Figure 2). By eliminating, or destroying, a node on the network, one can decrease the effectiveness and efficiency of operations. However, AOCs are only nodes on the network, and information can still be obtained or passed via other nodes.

Sensors. The global network of information is fed by numerous sensors throughout the battlespace (e.g. AWACS, satellites, JSTARS, UAVs, or any other intelligence-gathering source). By attacking a certain sensor, one can selectively reduce an adversary's ability to gather information in selected area, reducing his warfighting capability in that area. However, a capable adversary will probably possess numerous sensors for adequate back up of the loss.

Shooters. In a network environment, the shooter is the precision tip of a warfighting capability made possible by a vast information network. Although "C2 has never killed anyone," the ability to precisely engage an enemy with advanced shooters is made possible by the C2 network. By eliminating the adversary's shooters, one can be safe from a "hard kill" of C2 assets, but that doesn't protect him form other capabilities to attack the network.

Notes

[1] Fadock, David S., Major, USAF, *John Boyd and John Warden, Air Power's Quest for Strategic Paralysis* (Maxwell Air Force Base, AL: Air University Press).

Glossary

AC2ISRC	Aerospace Command and Control & Surveillance, Reconnaissance Center
AEF	Aerospace Expeditionary Force
AEFC	AEF Center
AEW	Aerospace Expeditionary Wing
ACC	Air Combat Command
AMC	Air Mobility Command
ASETF	Aerospace Expeditionary Task Force
CINC	Commander in Chief
C2	Command and Control
DMT	Distributed Mission Training
EAF	Expeditionary Aerospace Force
EOC	Expeditionary Operations Center
ESC	Expeditionary Combat Support
HUMRO	Humanitarian Relief Operations
ISR	Intelligence, Surveillance, and Reconnaissance
JCS	Joint Chiefs of Staff
JFC	Joint Forces Commander
JFACC	Joint Forces Air Component Commander
JSTARS	Joint Surveillance and Target Attack Radar System
LMW	Lead Mobility Wing
MOOTW	Military Operation Other Than War
MTW	Major Theater War
NEO	Noncombatant Evacuation
RTIC	Real Time Information in the Cockpit
SDS	Sensor-to-Decision Maker-to-Shooter
TBMCS	Theater Battle Management Core Systems
TPFDD	Time Phased Force and Deployment Data
USAF	United States Air Force

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