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C2 Constellation

Integrated network of combat capability will create a new, network-centric approach to air warfare and achieving battlespace effects.

By Skip Liepman

The Air Force, along with all of our nation's warfighting forces, is changing. The impetus for change is the explosion of information available to commanders. During World War I, telephone traffic allowed transfer of about 30 words per minute (wpm) of information. Radios doubled this rate during World War II, and the rate continued to expand to 100 wpm in Vietnam.

The advent of battlefield computers led to today's ever-expanding surge in information. During the Gulf War, information transfer rates were approximately 192,000 wpm. Projections of 1.5 trillion wpm by 2010 could result in a near "information paralysis" of sensors, deciders and shooters. Warfighters need immediate access to actionable information. Today's challenge is data-overloaded warfighters operating in a "camouflaged" information environment.

Turning this information explosion into increased combat capability is a central goal of both Secretary of the Air Force John G. Roche and Chief of Staff General John Jumper. The path they

have outlined for the Air Force's transformation to information-age air warfare can be summed up in two words—integration and networks.

The medium for change is the integration of the distinct capabilities of Air Force command and control, intelligence, surveillance and reconnaissance (C2ISR) in the Command and Control Constellation built on the ConstellationNet network. This new integrated network of combat capability will create a new, network-centric approach to air warfare and achieving battlespace effects for the joint force commander (JFC).

This constellation of sensors, platforms and command centers will comprise legacy systems, new technologies and new ways of managing enormous volumes of data. Turning the potential of this constellation into combat capability will be the task of Battle Management Command and Control (BMC2) people, executing C2 processes. These C2 warriors will employ the constellation's technology to plan and direct execution of air operations for the JFC. BMC2 will, much like a human brain, make decisions based on information relayed by the constellation's central nervous system.

The Air Force presents the Space and C2ISR Task Force and its core, the C2 Constellation, to the joint force commander as the air and space component of joint command and control. BMC2 and the constellation will provide the full range of space and C2ISR capabilities demanded of this, enabling the Air Force task force to achieve the information superiority goals of Joint Vision 2020.

The C2 constellation creates warfighting capability by enabling network-centric operations. Warfighting capabilities achieved through network-centric operations include shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability and self-synchronization. The C2 constellation network-centric infostructure, ConstellationNet, enables the predictive battlespace awareness and effects-based operations required by the six Air Force Concepts of Operations and Joint Vision 2020.

Vertical/Horizontal Integration

Networks are not in short supply in today's air combat operations. The problem is that today's many diverse networks only pass information up and down, between sensors and airborne platforms and operations and intelligence centers. This is known as "vertical integration," and it will remain critically important to successful planning and executing of air operations.

Jumper describes the producers and users of these separate networks of sensors and deciders as "tribes." Nowhere is the problem of "tribal warfare" more apparent than in an Air and Space Operations Center (AOC). Each network stovepipe produces a separate "picture" of the battlespace. Only members of that tribe can decipher and explain their hieroglyphics to members of other tribes.

Forcing information through these stovepipes is far too time-consuming to meet the challenges of today's battlefield. Information flows from multiple sensors back to the deciders in the AOC. Information from these diverse, unconnected sources is correlated, fused, turned into a target

folder and forwarded to shooters. Often, fleeting targets are already gone before the kill chain "find, fix, target, track, engage and assess" process can be completed.

The Air Force goal is to accelerate this process through both vertical and horizontal information sharing: vertically between sensors and command centers, and horizontally among the sensors and platforms, which both collect and use the information for targeting. The constellation network will be a constantly updating combat library, available to all—a single source of battlefield information.

Today, a human almost always reviews this battlefield information. Realizing the full potential of the constellation will require direct "machine-to-machine" information exchange. The "machines" are the sensors that produce information and command and control systems that process it.

These real-time machine conversations can quickly enable BMC2 to turn the vast amounts of information that C2ISR sensors produce into "knowledge" about the battlespace. Machine-to-machine exchanges can also speed the flow of information from sensor to decider, to shooter, and even directly from sensor to weapon. Because machines communicate faster and without "human error," these exchanges will increase both the accuracy and velocity of combat information and lay the basis for precision engagement and information superiority for the JFC. Battlespace knowledge is the basis for precision engagements on the battlefield.

Industry Role

A great deal of industry development is currently underway attempting to bridge this information/knowledge gap. Industry's role is critical to successfully meeting Air Force goals for the Constellation. Industry innovation will create the technology necessary to fully network all Air Force C2ISR. While the goals of horizontal integration and machine-to-machine information exchange are clear, the path to fielding is still being developed.

Roche has summarized the objectives of the constellation this way: "We will network these systems in ways that enable us to find, fix, track, target, engage and assess in timelines unimaginable just a few years ago. It is our goal to have consistent, persistent intelligence, surveillance and reconnaissance. And, once a decision to attack is made, we will attack instantaneously."

Achieving this vision requires full networking and horizontally integrating the manned, unmanned and space-based systems, platforms and command centers that create the "persistent ISR" capability described by Roche. Technology, however, is not the only challenge facing the Air Force's constellation vision. C2ISR combat capability requires more than technology, since only people and processes can turn technological advances into combat capabilities.

A renewed focus on the men and women who execute Air Force C2ISR is a fundamental requirement for achieving true transformation. Preparing the C2 warriors of tomorrow will require significant training improvements, from positional training approaches to greater fidelity of simulations and advanced distributed mission training. Nearly as important, the processes

needed for harnessing the information explosion the Air Force is currently experiencing must be developed. The Air Force's concept for meeting this challenge is BMC2. Combining the BMC2 people and process vision with constellation technology summarizes the C2ISR requirements challenge facing the Air Force and industry.

The constellation is not a single solution to today's C2ISR problem set. Nor is it a single program approach to fielding the capabilities required to achieve tomorrow's desired effects. Rather, BMC2 and the constellation will leverage both legacy systems and emerging technologies, recapitalizing those systems that cannot comply with the architecture and standards that define the constellation.

The aggregate capabilities of a still-developing family of advanced technology centers and systems will provide the baseline for the constellation. This approach requires current legacy systems to meet the standards required to create the constellation. Using a "best of breed" approach to system selection, only those legacy systems that can operate in the constellation environment will remain.

The current constellation is a system of systems that operate in discrete data enclaves and are often unable to share information. Providing this information across the entire combat air forces and the entire joint force today requires Herculean technical workarounds. These enclaves constitute distinct networks designed to directly support discrete air warfare core mission areas such as counter-air, close air support and special operations.

These networks and supporting data enclaves were often developed as stand-alone systems and applications. Subsequent air warfare developments made data created within these mission area systems useful across the entire joint force. However, the data structures, formats and standards supporting these enclaves were not developed to be shared. Each group has different standards, objects, information structures and protocols. This lack of standards resulted in today's stovepipes and tribes and has led to far too many people in today's expeditionary AOCs.

Two critical "tools" are necessary to overcome these problems: architectures and standards. Three stages will mark the development of the constellation. First, architectures will define the current distinct networks and the technology and standards necessary to share information across all existing networks. This network of networks will create a single network-centric architecture evoking ultimate constellation objectives. The second stage of constellation development will bring current systems into compliance. Next-generation "advanced technology" command centers, aircraft and sensors will be developed in the third stage, leveraging advanced concepts and technology development by industry.

Family of Systems

The constellation architecture will establish the network standards and protocols for both current and future systems integration and information exchange. Current discrete networks will be directed to conform to this architectural schema. Networks unable to conform will "die" and be replaced. Architectures, through air staff oversight and governance, will create the common data standards and protocols necessary for the constellation's network of networks.

This will create a family-of-systems approach to establishing and implementing interoperability standards and connectivity protocols. Through standards and protocols, next-generation advanced technology C2 centers and ISR sensors will create a peer-based, network-centric solution to achieving horizontal integration. As future capabilities approach fielding, the constellation concept requires that each fielded system support both Air Force and joint interoperability and connectivity standards.

To achieve the potential power of the constellation, for both air operations and the entire joint force, it is necessary to understand the power of networks and network-centric warfare. Metcalfe's Law states that the power of a network increases in proportion to the square of the number of nodes on the network. Constellation power is a function of networks of integrated information produced by sensors, platforms and centers and applied by the people and processes of BMC2, enabled by Constellation technology.

The constellation family of C2ISR systems shares information through a grid of peer-based, networked sensors, platforms and nodes. In peer-to-peer networks, each party has the same capabilities, and any party can initiate communications. Constellation execution capabilities will be fielded in BMC2 suites common to all next-generation advanced technology command centers, and manned, unmanned and space-based intelligence, surveillance and reconnaissance aircraft and systems.

Future airpower execution will be accomplished by next-generation manned and unmanned aircraft, and advanced technology space, mobility, intelligence and operations centers. All will require a BMC2 suite that supports effects-based operations (EBO) and predictive battlespace awareness (PBA) and fully leverages the power of the networked constellation. This suite, the constellation's "brain," must meet commonality requirements for user interface and data objects to create a shared, intuitive decision-making environment.

This BMC2 suite environment will be common to all C2ISR nodes and platforms and will provide all constellation operators with the same "look and feel" through standardized objects and graphical user interface. Each suite will be capable of being "missionized" to support the particular operational C2ISR function being performed.

The operators sitting at each of these BMC2 suites will be at the information nexus of theater airpower. From commanders to airmen, C2 warriors will fully employ BMC2's transformational attributes. These attributes result in intuitive, effects-based operational decisions. These decisions will be based on decision-quality PBA provided through airpower's "central nervous system," the constellation. This network-centric infostructure will ride on the Global Information Grid (GIG).

Links to the GIG

The ConstellationNet capability will provide the critical network-centric infostructure linkage to the GIG. ConstellationNet will support horizontally integrated C2ISR through machine-to-machine interfaces and information exchange, deployable connectivity, standards-based

commonality of hardware and software suites and toolsets, and an open-systems architecture. Future industry advances and innovations will fully mature the ConstellationNet.

ConstellationNet provides a conceptual framework for the capabilities required to achieve the C2 Constellation vision. The ConstellationNet infrastructure will enable PBA and EBO processes and capabilities to allow the joint force to achieve network-centric warfare (NCW) warfighting capabilities. ConstellationNet will network sensors, decision-makers and shooters in a combat information environment that provides the capability baseline for transformation of air and space operations.

There is not yet a widely accepted definition for either NCW or network-centric operations (NCO). The working hypothesis behind ConstellationNet is that NCW capabilities will result from NCO capabilities derived from the C2 Constellation's infostructure capability set, which is ConstellationNet. These three levels of capability are required to illustrate the role of ConstellationNet in achieving NCW capability.

The top level is the warfighting capabilities believed achievable through NCW, including shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability and self synchronization. The second or NCO level provides air and space operations capabilities and will be achieved in at least five dimensions: extent of networking of air and space power; level of data interoperability; collaborative communications connectivity; shared awareness; and integration and acceleration of kill chain execution through reduction of human interfaces in machine-level information exchanges.

Initial NCO capability to be achieved by 2008 includes: sensors, shooters and deciders, all separately networked; data interoperability through XML and data tagging; portal access for C2ISR nodes; Blue Force Tracking Common Operational Picture inputs; double-digit-minutes kill chain execution and assessment; and machine-to-machine information exchanges.

By 2012, full NCO capability will include: a single network of sensors, deciders and shooters; on-demand combat information query, push/pull (publish/subscribe); IP addressable warriors, weapons and sensors; commanders' shared awareness and knowledge through collaboration and a common operational picture; single-digit-minutes kill chain execution and assessment; and end-to-end machine-to-machine kill chain execution.

To achieve these air and space network-centric operational capabilities, and thereby enable NCW warfighting capabilities, the ConstellationNet infostructure is built on a third level of capabilities. The foundation for ConstellationNet capabilities is derived from JTRS software programmable radios enabling communications and collaboration across all kill chain nodes and platforms; JTRS-enabled advanced LPD/LPI waveforms capable of putting target quality information in the cockpit; roadmaps charting our course for tactical and wideband datalinks, satellite communications and future transformational communications; standards and protocols providing common computer network services and required systems security; and GIG Enterprise Services to support combat information management and advanced warfighting applications.

Voice, data, imagery and video reside on and are transported by the ConstellationNet, which serves as the C2 Constellation interface to GIG information transport, processing and storage capability. ConstellationNet will enable horizontally integrated C4ISR and machine-to-machine information exchanges providing greatly increased speed of command and the precise control of fully networked capabilities. ConstellationNet will provide warfighters expanded information sharing, situational awareness, information protection and enhanced combat lethality capabilities.

The C2 Constellation infostructure is a knowledge network characterized by highly distributed information sharing and collaboration that is enabled by a seamless and robust computing and communications infrastructure. ConstellationNet enables the C2 Constellation by providing: global communications connectivity and full spectrum comm; GIG Enterprise Services; common standards and protocols; network operations doctrine; and tactics, techniques and procedures. These attributes will provide the infrastructure capabilities to achieve machine-to-machine information exchanges and horizontal integration.

This GIG-based operational information environment will enable PBA, which Jumper has described as "crime-scene forensics, before the crime." The first condition for successful PBA is full knowledge and understanding of the enemy and the battlespace. PBA will be built on optimized collection through control of sensors, including ISR, space and UAV systems, building visualization of ISR products leading to combat identification and mensurated target identification and locations.

PBA will enable our transition from focusing on killing targets to achieving effects that support the joint force and achieve victory. EBO will be executed through the battle management mission functions of airborne early warning and control, space and air to ground surveillance, information operations and dynamic execution.

Decision-Quality Information

By ensuring that both current and future Air Force C2ISR systems meet constellation objectives, this family of systems will ensure that all joint, Air Force and other service C2ISR systems can share the constellation's decision-quality information environment for BMC2 intuitive decision-making. The constellation will leverage the network-centric solutions of machine-to-machine exchange of horizontally integrated C2ISR to increase today's airpower capabilities, and achieve tomorrow's Air Force Transformation Flight Plan vision while fully supporting Joint Vision 2020.

As it evolves, the constellation will enable airmen to synchronize airpower objectives to all of the joint mission area capabilities required to achieve joint forces command's joint command and control capabilities. The Air Force goal for the BMC2 constellation is to achieve interoperability and connectivity and define the Air Force's C2ISR transformation pathway. The transformational attributes of the BMC2 Constellation will place Air Force C2ISR at the forefront of the Defense Department transformation initiatives because the constellation directly supports the secretary of defense's interoperability and connectivity objectives.

Constellation technology will enable BMC2 to build decision-quality information. This intuitive decision environment will support warfighter collaboration by creating full information access for all BMC2 centers, platforms, sensors and all combat aircraft from F-22s to C-17s, “smart tankers” and satellites. Through the constellation and BMC2 execution of EBO, supported by PBA, the constellation’s network-centric infostructure will support the entire joint force.

Jumper’s challenge to the Air Force is straightforward: “We are going to figure this out. We are going to figure out how to have conversations between airborne platforms, unmanned, on the ground, in the air. We will build a constellation that marries up the manned and the unmanned, perhaps control the unmanned platforms from the manned platforms to put them in the right position so you can triangulate for precise target location, precise identification. Create that network in the sky that will pass the information around.”

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Integration Commander

Major General Tommy F. Crawford

Commander, Air Force Command and Control, and Intelligence, Surveillance and Reconnaissance Center

Major General Tommy F. Crawford is commander, Air Force Command and Control, and Intelligence, Surveillance and Reconnaissance (C2ISR) Center, Langley Air Force Base, VA. He is responsible for integrating command and control, intelligence, surveillance and reconnaissance for the Air Force to reduce duplication of effort, increase commonality and enable the Expeditionary Air Force, and is also the implementing agent for Air Force experimentation. The 780-person center defines C2 and ISR requirements and operational concepts, develops open architectures, and manages C2 and ISR systems and budgets.

Crawford was commissioned a second lieutenant through the Air Force ROTC program at New Mexico State University in May 1972. He has staff experience in Air Force plans, special weapons and as assistant to the supreme allied commander Europe. The general has served as an instructor pilot, squadron weapons officer, F-111A flight commander, A-7D and F-117A Nighthawk weapons and tactics officer, wing weapons and tactics chief, assistant operations director and major command inspector general. He has commanded at squadron, air operations group and wing levels, and is a command pilot and Desert Storm veteran with more than 3,000

hours in fighter aircraft. Prior to assuming his current position, the general served as the deputy chief of the Central Security Service, National Security Agency.

Crawford was interviewed by MIT Editor Harrison Donnelly.

Q: Could you start by giving our readers an overview of the Air Force Command and Control, and Intelligence, Surveillance and Reconnaissance Center?

A: Our mission is pretty clear from the unit's title—when there's an issue with Air Force C2ISR, we get the call. We're approximately 600 people, at 18 locations from Massachusetts to Florida to Colorado to California. We work side by side with every major command and all the other services, as well as national agencies and Joint Forces Command.

We work for Lieutenant General Tom Hobbins, the deputy chief of staff, warfighting integration, AF/XI, and all the Air Force major commands, with the simple charter to "modernize, improve and seamlessly integrate Air Force C2ISR capabilities." The words are simple, but the task is incredibly difficult. In fact, the center was created in 1997 because the chief of staff wanted a single organization to "get their arms around" this incredibly complicated set of warfighting capabilities we call C2ISR.

If you asked me how we're doing, I'd have to say our sight picture is correct—we understand the C2ISR problem set much better than we did in the past. The center is focused on executing [Air Force Chief of Staff] General [John] Jumper's vision embodied in General Hobbin's C4ISR Flight Plan. We're tackling very important mission on three fronts.

First, we're executing the CSAF's Combined Air and Space Operations Center [CAOC] Weapons System vision. Combined with the Distributed Common Ground System [DCGS], the CAOC provides the Air Component's personnel the tools to collect, exploit and develop targets, and then plan, execute and assess the Air Tasking Order. Achieving machine-to-machine exchanges across the AOC-DCGS interface will result in more accurate and timely kill chain execution.

We work with the C4ISR Architecture Framework [CAF], MAF and space communities to ensure we're developing the right set of tools that meet their warfighting requirements. As operational requirements lead, we're working with the acquisition community to provide the warfighter sight-picture-to-development programs aimed at creating C2ISR capability supporting the entire range of Air Force Concepts of Operation. Many of the technology initiatives we're working on will greatly enhance our ability to leverage existing sensors to improve target accuracy, timeliness and combat identification.

Our second thrust area is developing the C2 Constellation's ConstellationNet. We are working to achieve a revolution in our ability to control airpower through the Joint Tactical Radio System CONOPS, the Tactical Data Link Roadmap and supporting waveform advances like the Tactical

Targeting Network Technology. We will demonstrate the potential of the C2 Constellation and ConstellationNet vision during Joint Expeditionary Force Experiment [JEFX] '04 this summer.

Third, we are actively engaging the joint warfighter. It is very important that we remember that we're not doing this in isolation. We're developing a strategic partnership with Army, Navy and Marine Corps C4ISR commands through our Tidewater C4ISR Integration Working Group. As Air Force lead for the JBMC2 board of directors, we ensure that Air Force C4ISR supports JFCOM's development of Joint C2 Capability. Also integral to JFCOM's JBMC2 mission, AFC2ISRC is chair of the Family of Interoperable Operational Pictures Multi Service Management Team.

And I am confident our vector is headed toward the real goal: transformed and fully integrated command and control, intelligence, surveillance and reconnaissance. This center's role in that goal is primarily ensuring that everyone on the battlefield sees the same "picture" and has exactly the information they need when they need it to achieve the joint mission.

Let me make that a little clearer: Our goal is ensure that every soldier, sailor or Marine who needs air power gets it. Our core focus is developing the C2ISR toolkit that will provide the Combined Forces Air Component Commander actionable information and accelerate the kill-chain timeline for these joint warfighters. Whatever stands in the way of achieving our joint mission, airmen must find it and kill it, fast.

Q: With the rate of change within the information technology area, how are you able to stay ahead of the developmental curve?

A: I don't think it's possible anymore or, for the Air Force even desirable, to get out in front of the explosive rate of change in information technology. We're really trying to stay only a few steps behind, and we're doing that in two major ways: leveraging the private sector's research and development while using spiral development internally.

We don't really want to be at the "bleeding edge" of laboratory technology. That requires lots of costly trial and error, and fielded capability is far more important than having the newest technology. We are interested in fairly mature technologies that can show military utility via Advanced Technology Concept Demonstrations [ATCD]. Adaptive Joint CISR Node [AJCN] and Network Centric Collaborative Targeting [NCCT] are two examples. We want to spiral proven technologies into our weapons systems to add capability. We use our biennial JEFX to prove emerging technologies and once we're sure of the capability, we transition those new capabilities to fielded systems.

Q: What would you consider your three or four top developmental programs?

A: Our two principal C2ISR weapons systems, the Falconer Air Operations Center Weapons System and the Sentinel Deployable Common Ground Station, are fielded and at war as we speak. Each is also in "development," and we are continually spiraling capability into both systems. Capabilities currently in development, combined with the Falconers and Sentinels, will enable us to achieve the network-centric operations promised in the C2 Constellation. Three of

the most important of these programs, in terms of added capability for the warfighter, are the Joint Tactical Radio System [JTRS], the Multi-Platform Common Data Link [MP-CDL] and the E-10 Multi-Sensor Command and Control Aircraft.

Q: How has September 11, and the OPTEMPO since then, affected the way you do business?

A: Prior to 9/11, we were very focused on the future and our Air Force's C2ISR requirements for that future. On 9/12, and ever since, our number-one priority became the warfighter. Our personnel have a spent a significant amount of time deployed in the Middle East to ensure their C2ISR systems were the very best this nation could provide. We also have paid a significant amount of attention to observing the course of the war, learned lessons and changed our system requirements to better meet the needs of our warfighters.

One of the residual effects of 9/11 is that it has forced us to find quicker, cheaper and more responsive ways of filling warfighter needs. We no longer can spend years studying a problem. The warfighter needs fielded capability and they want it as soon as we can get it to them. Many of the tools we've developed in the C2 Battlelab and experimented with in JEFX were quickly integrated and fielded, and we've made important strides in reducing both manpower and hardware requirements.

Q: What are the key components to the C2 Constellation?

A: The centerpiece of everything we're doing to achieve Air Force Transformation and network-centric capability is the Command and Control Constellation. The C2 Constellation is our Air Force future and provides a conceptual framework for thinking about the capabilities we're going to provide our warfighters in that future. This C2 Constellation concept has three important areas: ConstellationNet, Effects Based Operations [EBO] and Predictive Battlespace Awareness [PBA].

ConstellationNet is the Air Force's capability network sensors, decision makers and shooters throughout the joint force's air component. This network will provide our information gateway to the Global Information Grid and the rest of the joint force and enable EBO and PBA. EBO is a process for obtaining a desired strategic outcome or "effect" on the enemy. It is a shift in focus from "weapons on target" to shaping the enemy's behavior. PBA is a multidimensional understanding of the battlespace in time, space and effect, regardless of the adversary, location, weather or time of day. PBA is continuous—24 hours a day, seven days a week. General Jumper said it best: "PBA is crime scene forensics, before the crime."

Q: How difficult is it coping with bandwidth issues, especially in the operational areas?

A: Like any finite asset, bandwidth must be managed and optimized to ensure high-priority information gets to the right organization at the right time. We're working this issue from the warfighter's perspective. They really don't care which "pipe" an image of their target comes through, only that it gets to them in time to support killing it.

Many of today's legacy systems were not designed for and aren't capable of performing up to the standards being developed for our network-centric future. Numerous manpower, planning and technology solutions are being executed to allow us to better manage our existing bandwidth and add additional bandwidth capability. JTRS, along with advances such as Multi-Platform Common Data Link [MP-CDL] and Family of Advanced Beyond Line of Sight-Terminals [FAB-T], will allow full use of the entire available spectrum and take us a long way toward meeting the warfighter's ever-increasing bandwidth requirements as we reach our network-centric goals.

Q: You currently interact with various UAV platforms. Will you at some point have the ability to utilize the sensor capabilities on micro UAVs at the very tactical level?

A: As our network operations capability increases, information from numerous types of unmanned sources throughout the battlespace can be accessed and fused with information from other sources to present a more complete picture of the battlespace either at the tactical or operational level of operations. If we maintain our current modernization efforts for our DCGS systems, we will have an infrastructure that can be expanded to support data coming from any sources, even the "very tactical level." Just because we have an infrastructure that is postured in such a manner, however, doesn't mean we can instantly take on the added responsibility without additional investment.

More data means more storage and throughput, so we have to make things more robust. Additionally, there are manpower costs associated with extracting useable information from this additional data. This is kind of like building a fleet of aircraft—once the first one is designed and built, we can replicate it to increase capability based on the need, funding and number of pilots. Our modernization efforts are positioning us to attack this problem, but we still need to proportionately increase the funding and manpower associated with the DCGS each and every time we add more "data"—read sensors/platforms—to the equation.

Q: Do you see a need for a manned reconnaissance platform to perform missions similar to those of the U-2 and formerly the SR-71?

A: This issue isn't really within my current portfolio, so I'll caveat my answer with a big "one airman's opinion" qualifier. I believe we'll always need airmen performing all of our core Air Force missions. There are certain decisions that need to be made by a human and be made immediately. Those decisions are almost always formed through the years of training that lead to "an airman's intuition." UAVs and off-board sensor capabilities will greatly reduce the requirement we've faced in the past to put airmen at risk, and that's a phenomenally welcome change. However, I doubt that we'll every get to the point where we are not ultimately reliant on the courage and training of our airman to execute all of the missions of our Air Force.

Q: As compared to the recent past, do you foresee an expansion of the function and role played by your Experimentation Office?

A: I'm not sure how our Joint Force Expeditionary Force Experiment could get any more important. Right now this is the "graduation exercise" for our most promising new technologies. We purposely limit the number and type of initiatives we look at to ensure we assess them

adequately and then, when the technology measures up and the warfighters say it meets their needs, we put it on track to be fully tested in the Air Force Transformation Center and fielded as rapidly as funding allows. We also use JEFX to ensure military utility. NCCT, an ACTD, will get a hard look this summer prior to full development. This year, JEFX '04 will focus on the C2 Constellation and take a hard look at the technology needed to make that network-centric future a reality.

I tend to think of our Transformation Center, C2 Battlelab and AF Experimentation Office as a single enterprise dedicated to making concepts like "rapid prototyping" and "spiral development" a reality. A great example is the Master Air Attack Plan Toolkit. It was developed as a C2 Battlelab initiative, then experimented with and given an "operator test" in two JEFXs. After this rapid development and experiment, we bring the capability to CAOC-X in the Transformation Center.

The Transformation Center's mission, in part, is to ensure the capability can be fully integrated into the Falconer and test the capability before we turn it over to the acquisition community. This operational "wring-out" combined with their configuration-control task enables the Transformation Center to prevent the "drive by" fieldings that have plagued C2ISR warfighters for decades.

Q: If you were to view challenges as opportunities, what are the biggest opportunities facing AFC2ISR in the coming year?

A: First off, if I didn't view challenges as opportunities, I'd be in the wrong job. The very complicated system of systems we have today was in large measure built over many years by forcing separate programs to make their stovepipes talk. One of our greatest challenges is breaking through the programmatic barriers and laying out and executing a sound plan to accurately architect, design, program, procure, test, field and sustain a streamlined C4ISR enterprise.

Our conceptual framework for this result is a C2 Constellation that more efficiently supports command and control of air and space power within the ever-shrinking timelines our warfighters require. This integrated C2ISR capability must have two core attributes. The information provided the warfighter must be accurate—to ensure today's problems of fratricide and fleeing targets are overcome—and fast—so we kill those time-sensitive targets before they can move.

The Air Component Command has three principal systems of systems to enable air and space power execution: the Combined Air and Space Operations Center; the Distributed Common Ground System; and systems that support the Air Force forces commander in his sustain/train/equip role as commander, Air Force Forces [COMAFFOR]. We're close to solving the CAOC puzzle with the AOC Weapon System. We've done the same thing for ISR with the DCGS weapon system. We're now also addressing the third part, Air Force Forces [AFFOR]. The AFFOR covers the entire Air Force enterprise, and we'll need support from across the depth and breadth of the Air Force to work the problem. We've established within the Air Force Transformation Center agile organizations to turn good ideas into capability, CAOC-X and

DGS-X. The next step is establishing an AFFOR-X to lead the way towards meeting this important challenge.