The Miracle of Operation Iraqi Freedom Airspace Management

How the skies over Iraq were kept safe

....and what we need to do to keep them that way

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Introduction

The air campaign that danced over Iraq was an intricate ballet conceptualized, designed, and executed by the men and women of the Combined Air Operations Center (CAOC). In all, 1801 total aircraft flew 41,404 sorties in a 720-hour period between 19 March and 18 April 2003.[1] The sheer number of instructions necessary to keep the skies safe was staggering. This is the story of that seemingly insurmountable job and what future war fighters and airspace designers can learn from that experience.

The technical term is airspace management. It encompasses everything from coordinating the use of the airspace to designing routes and procedures for the aircrews to fly that will keep them from trading paint with each other. The subject is as huge as the airspace above us, but five key areas from Operation Iraqi Freedom (OIF) illustrate successes and areas that need improvement: (1) the role and magnitude of the air refueling tankers; (2) the coordination and interaction of the war fighters; (3) the complex airspace management challenge of unmanned aerial vehicles and missiles; (4) our mobility assets' unique set of challenges; and (5) the systems and equipment used to design, deconflict, and execute the airspace management plan.

In the end, there must be a vision of the possible. The goal is to elevate the level of visibility of the possible and energize the entire warfighting community to demand the possible as opposed to accepting the current pace and direction of change.

Airspace management begins at the top

Airspace management in a combatant environment begins with the combined force air component commander (CFACC). During OIF, Gen Tommy R. Franks, the Joint Force Commander (JFC), designated (then) Lt Gen T. Michael Moseley Joint Forces Air Component Commander (JFACC), establishing his authority, command relationships, and responsibilities. One of his many responsibilities was to be the Airspace Control Authority (ACA). As the ACA, he assumed overall responsibility for the airspace system, including developing broad policies and procedures for airspace control.[2] That begins with negotiating the use of airspace with all the countries that we might fly to, from or over.

It's not our airspace

The first sortie, and almost all sorties, launching an attack on Iraq had to be flown from some point outside of Iraq; from airfields inside our coalition partners' sovereign airspace. Sixty-six countries supported OIF in some form or another.[3] Some countries would allow us to base non-shooting aircraft on their soil (refuelers, airlifters). Others gave us almost carte blanche to operate as required. All of these details were ironed out before the CAOC could actually begin designing the battlespace.

One of the last countries to permit coalition aircraft on their bases in support of OIF was Saudi Arabia, perhaps the most important piece of the puzzle. Sharing the longest geographic border with Iraq, Saudi Arabia also has some of the largest operating air bases in the Middle East. Above it lies huge amounts of air space and below it is a tremendous resource that proved indispensable in the execution of OIF: fuel for the tankers, fighters, airlifters and command and control (C2) assets that flew in this ballet. Ultimately, Saudi Arabia only allowed unrestricted use of one of their air bases, but at least we were able to use their airspace, which proved invaluable.

Another key piece of the puzzle was Turkey, historically a staunch ally. Turkey shares a border with Iraq and would have provided a northern entry route. Although the planners had assumed Turkey would be cooperative, in February the Turks ultimately denied access, less than two months before the offensive was launched. This serves as a stark reminder that assuming can be a costly course of action.

After coordinating with our coalition partners and those non-participating countries whose airspace may have been flown in or encroached upon during OIF, General Moseley's staff established the broad guidelines for air operations. Even European countries had to be consulted regarding the political ramifications of transiting their airspace with war fighting aircraft.

Practice makes perfect

There are four good news stories here. The first is the CFACC was dual hatted as the Commander US Central Command Air Forces (COMUSCENTAF) and as the CFACC. His day-to-day job as COMUSCENTAF was to establish relationships with those contributing countries that are within the Central Command's (CENTCOM) area of responsibility.* Military practitioners call this process of relationship building *security cooperation.* The Office of the Secretary of Defense (OSD) defines security cooperation as those interactions with foreign defense establishments that include any and all that: 1) build defense relationships to promote specific US security interests, 2) develop allied and friendly military capabilities for self defense and coalition operations, and 3) provide US forces with peacetime and contingency access and enroute structure.[4]

> *CENTCOM is the Unified Combatant Command assigned operational control (OPCON) of US Combat Forces operating in twenty-seven nations located throughout the Horn of Africa, South and Central Asia, and Northern Red Sea regions, as well as the Arabian Peninsula and Iraq.

The second good news story is the primary airspace managers for OIF had just worked together and executed Operation Enduring Freedom (OEF). They took that experience and imported the lessons learned from OEF directly into OIF. Unfortunately, they never had a chance to document and institutionalize the lessons learned from OEF. The impact of not institutionalizing OEF

lessons learned may now be minimal; however, if we fail to capitalize on the knowledge gained from OIF, we will be severely remiss in our responsibility of providing future war fighters the benefits of their experience.

The third good news story was time. The OIF team had plenty of time to prepare - almost a full year between the initial planning conference and execution. A significant major event that took place during that period was Internal Look 03. In early December 2002, 600 officers from Central Command (about a quarter of the staff) and an additional 400 from subordinate commands reported under the command of Combined Task Force Commander General Franks. Their mission was to test the ability to deploy a headquarters rapidly in a crisis and carry out a war game. Internal Look is a very complex computer-based and assisted Command Post Exercise (CPX) that does not involve combat forces.[5] It allowed the CENTCOM battle staff and military personnel to participate in realistic but fictitious military scenarios. As General Franks would later say "The simulations allowed my component commanders and me to fight a vividly realistic, but bloodless, campaign."[6] This was the precursor to OIF. One small subset of Internal Look 03 was to test the ability of the CAOC to produce and execute, on paper, the air campaign. A critical element of success of the CPX was drawing out all the airspace requirements of the many unique users vying for airspace. Once the airspace requirements were determined, planners focused particular emphasis on basing options and airspace utilization.[7] This served to expeditiously eliminate several significant conflicts and provide a much more cohesive plan.

The fourth major good news story was how the CFACC's staff switched the airspace plan from Operation Southern Watch (OSW) to OIF. OSW had been in effect for quite a while, however major changes were required for OIF. One option would have been to "flip the switch" and transition immediately from OSW to OIF, requiring all the aircrews to forget all the rules for OSW and immediately start flying the 1800 new rules for OIF. They chose to transition in smaller iterations, the first of which was the "Parkway" structure, designed to funnel all assets through the international airway structure and into/out of Kuwait-Iraq. The parkways will be explained in greater detail later in this paper. Several other iterations followed and the transition worked well.[8] This should be documented as a positive lessons learned for future war fighters.

The dirty work

Once General Moseley developed the broad guidelines, Major Mike Grogan* coordinated with every embassy and finalized the airspace control plan (ACP), which General Franks approved. The ACP provided specific planning guidance and procedures for the airspace control system. Major Grogan then developed the 1800 airspace control measures (ACMs) required to build the daily airspace control order (ACO) that instructed every pilot operating in the battlespace on how to get to their objective area, accomplish their mission, and maintain separation from the other aircraft tasked in the ATO.

*Major Grogan was a member of the 609th Combat Plans Squadron and was a permanent member of the CENTAF staff as well as a veteran of Operation Enduring Freedom.

The importance of airspace control measures

In the peacetime aviation world, “positive control” aircraft separation is provided by air traffic controllers who have either visual or radar identification of the aircraft operating in their airspace. Over oceanic routes, or other routes where visual and or radar coverage is not available, “procedural control” separation is maintained by assigning unique routes, altitudes and times. During OIF, military aircraft transitioned from positive-control by the International Civil Aviation Organization (ICAO) air traffic control structure into the largely uncontrolled airspace over Iraq, where separation between aircraft, UAVs and missiles was almost totally dependent on the precise execution of the ACO and ACMs.

Another indicator of the importance of airspace control measures (ACMs) is their use in identifying the Air Defense Identification Zones (ADIZ) of every nation’s airspace.[9] Since each nation “owns” it’s own airspace, it would be perfectly within rights to shoot down any aircraft inadvertently crossing the ADIZ without proper clearance, as was the case of the Korean Airlines (KAL) civilian airliner shot down over Soviet territorial waters 1 September 1983.

Planning starts with the big boys

The tanker crew saying, “Nobody kicks a-- without tanker gas” (NKAWTG) was never truer than in OIF. One of the biggest factors to consider in designing the airspace is the large amount and layout of the airspace to be dedicated to air refueling. Most of the 1800 aircraft supporting OIF flew missions covering great distances and required long loiter times over their targets, requiring more fuel than their internal fuel tanks would allow, and necessitating air refueling. Additionally, operating from airfields with high temperatures reduces takeoff performance, requiring a reduced fuel load on takeoff, further increasing the requirement for air refueling. During OIF, tankers flew 9064 sorties[10] and refueled over 29,000 receivers.[11] The tanker tracks were established in boxes 30 nautical miles (NM) wide and 70 NM long. After accounting for the required separation between the tracks, only seven air-refueling tracks fit along the 420 NM Iraq/Saudi Arabia border. There were tanker tracks along most of the smaller borders, and tracks in most areas were also stacked on top of each other. Tankers formed a gas wall along the border and virtually every aircraft that flew into and out of Iraq flowed through that gas wall.

Figure 1: Tanker Tracks.[12] (Not drawn to scale and does not reflect actual tracks, illustrates the concept of tanker refueling tracks)

There had to be “driveways” for the aircraft to approach and depart the air refueling tracks, allowing aircraft of varying speed capabilities to use the same route without positive control. This concept was initially conceptualized during OEF and then perfected in OIF.

Figure 2: Driveways[13]

A significant tanker and air refueling operational issue was whether or not to use the Traffic Collision Avoidance System (TCAS). TCAS gives tankers greater situational awareness and allowed them to fly cell formations but could also possibly provide an electronic signature to the enemy. The final decision was to operate in the "On" mode.[14]

Another concept that was perfected during OIF was establishing a Command and Control & Intelligence, Surveillance, and Reconnaissance (C2ISR) corridor between the refueling tracks and the kill boxes.[15] Specific offsets and track design allowed the C4ISR assets continuous and immediate access to fuel, and minimized the potential for conflicts with all the other air assets transiting to and from the refueling tracks.

All the CFACC's War Fighters

The CFACC does not own all the assets operating in his airspace and one of the most challenging aviation units for the planners of OIF to work with was the Joint Special Operations Air Component (JSOAC). It's unique mission and specialized assets often require that it plan and operate in a vacuum. To maximize coordination between the CAOC and the JSOAC, a Special Operations Liaison Element (SOLE) is attached to the CAOC staff to integrate the JSOAC's requirements into the airspace plan. The SOLE provides real time mission support coordination with the JSOAC, with special emphasis on airspace deconfliction.[16]

When possible, Special Operations Forces Operating Areas are established to provide a dedicated area for the JSOAC to operate. At times, the JSOAC's ability to operate clandestinely can cause problems as well. One particular incident involved the flight path of several sea-launched long-range, subsonic Tomahawk Land Attack Missiles (TLAMs). Planners were unaware of the JSOAC assets operating directly in the flight path of the TLAMs.[17] Although this did not result in a fratricide incident, it is cause for concern. As the JSOAC and the JFACC share a common battlespace, it is imperative that to the degree possible, SOF forces are integrated into joint aerospace planning and execution to prevent fratricide, duplication of effort, and airspace conflict.

The Marine Expeditionary Force (MEF) is another group that historically operates autonomously. Traditionally USMC doctrine has the MEF retaining control of all airspace within its area of operations. USAF and USMC planners reached a historic agreement at the CENTAF War Fighter Conference held in August 2002 enabling the integration of the MEF's airspace into the CFACC airspace control plan, ensuring C2 consistency across the battlespace.[18]

The Army's rotor wing aircraft have unique operating parameters and there are numerous ACMs designed to separate them safely from the rest of the battlespace. One example is the

coordination altitude that separates fixed- and rotary-wing aircraft. Normally rotary-wing aircraft stay below the coordinating altitude and fixed-wing aircraft stay above it, with a buffer zone for small altitude deviations. The coordinating altitude also has lateral boundaries which usually extend from the forward edge of the communications zone to the forward line of own troops.[19]

What about the non-human players?

The battlespace is becoming saturated with non-human actors such as unmanned aerial vehicles (UAVs) and stand-off missiles. Some UAVs have direct line communications (VHF or UHF radios) between the UAV operator, command and control assets, and other aircraft operating in the battlespace so minimal deconfliction can be maintained in the normal manner. But many UAVs lack communications, making real time separation is much more difficult. One technique for providing separation from UAVs is to assign them to operate within restricted operations zones (ROZ), a block of airspace with defined lateral boundaries and altitudes, allowing flexibility in mission changes by not restricting the UAV and other aircraft that also must operate in the area, i.e., close air support (CAS) and reconnaissance. Aircraft penetrating the UAV ROZ to accomplish their missions will fly under see-and-avoid principles and accept the risk.[20]

Other players in the battlespace include the Conventional Air Launched Cruise Missile (CALCM) and the Army Tactical Missile System (ATACMS). CALCMs are a standoff weapon fired from a launch point on a pre-programmed flight profile to a designated target capable of having both their flight profile and targets reprogrammed after launch. ATACMS provide the JFC with a capability to strike deep targets, using a high-flight profile well above other aircraft operating in the battlespace. Both CALCMs and ATACMs have a small radar cross-section and are very difficult to track with normal radar units, making positive control ineffective. It is imperative that ACMs be used for this deconfliction. This could include establishing a ROZ from the launch point to the target, or using time deconfliction by employing the weapon at a time when the area from launch point to target is free of friendly aircraft.[21] This deconfliction methodology uses huge amounts of airspace, a precious commodity in the already crowded battlespace. Furthermore, preplanned ATCAM launches are rare and normally originate during the execution phase of the ATO requiring an enormous amount of coordination to maintain a safe airspace.

Here comes the chow

After air superiority is established and ground forces have gained control of the enemy's territory, mobility assets begin delivering beans and bullets to the fight. Now C-5s, C-130s and C-17s must be integrated into the airspace plan as well. A major portion of the OIF planning effort concentrated on the air battle, at the expense of preplanning for the airlift flow. This is an important consideration for future war planners.[22]

When Air Mobility Command (AMC) nominated this research topic to Air University, it stated these concerns:[23]

1. Differing altitude and airspeed for ingress and egress proved complicated and too complex at times.

2. Host nation restrictions and assigned host nation airspace and departures on filed [Form]1801 flight plans and flights to tactical points increased Hazardous Air Traffic Report (HATR) potential.

3. Many changes to egress / ingress routes were distributed via e-mail not via ACO/ATO/SPINS.[3]

4. Planning staffs often briefed changes as crews were stepping out the door to fly resulting in confusion that often-complicated departure routings from host nation fields.

*SPINs are Special Instructions to aircrews.

Understanding the nature of intertheater airlift can help explain why the above issues exist. The Tanker Airlift Control Center (TACC), at Scott AFB, Illinois, retains operational control of inter-theater airlift. These mobility assets may depart for the battlespace from airfields anywhere around the world and many are capable of delivering their cargo directly to the fight. In many cases, changes were made to the ATO and the ACO after the mobility aircraft had departed upon their mission, requiring those changes to be passed in flight from the CAOC's Air Mobility Division (AMD), through the TACC, to the crews.

CAOC airspace managers indicate AMC crews were not adept at deciphering the ACO and ATO and the electronic interface between the TACC and the CAOC requires improvement. The system TACC uses for command and control is not architecturally compatible with the CAOC's systems. During the early stages of OIF, TACC mission data was manually input into the ATO. Eventually a patch was built and then the airlift input module allowed four data points to be input: the ALSCHED (shows separate leg multi day missions), ALARR (arrival messages), ALDEP (departure messages), and ALADV (advisory messages).[24] While this was an improvement, the system must be melded into a seamless, coexistent C2 structure that talks back and forth without requiring human manipulation.

According to CAOC planners, the biggest problem with AMC is their inability and unwillingness to operate in a classified environment.[25] The CAOC eats, sleeps, lives and breathes classified, most of it above the secret level, while the TACC executes primarily unclassified. The systemic difficulty in distributing and coordinating mission taskings in classified format to aircrews scattered throughout the world is dictating operating modes. Overcoming this problem will require investment in secure communications capability for mobility aircraft.

The system

Theater Battle Management Core System (TBMCS) is the system that provides the Combat Air Forces (CAF) and the Joint/Combined Forces with an automated and integrated capability to plan and execute the air battle plan for operations and intelligence personnel at the force and unit levels. It provides the air commander with the means to plan, direct, and control all theater air operations in support of command objectives. It also coordinates with ground and maritime elements engaged in the same operation. TBMCS can be tailored to large-scale or small-scale

operations in varying intensities of warfare. It implements interoperable functionality with other Command, Control, Communications, Computer, and Intelligence (C4I) systems involved in theater air warfare during military operations.[26]

The Airspace Deconfliction System ("ADS") module within TBMCS is the computer system that designs the airspace. Once the airspace master plan is built, the ACMs designed to operate within it are injected into TBMCS. For OIF, there were so many ACMs they initially bogged down the TBMCS systems. Technical representatives from Titan, the contractor responsible for configuring, maintaining, and operating the TBMCS hardware systems and software applications in the CENTCOM CAOC, were called in they rapidly installed a patch expanding TBMCS' operating capacity.[27]

Those ACMs are only the bits and pieces that eventually go into transitioning the airspace into battlespace. The airspace managers must arrange those ACMs to set the flying rules for not only US aircrews, but those of our coalition partners as well.

The ACMs are arranged to provide the safest possible battlespace every day through the ACO, published either as part of the air tasking order or as a separate document. The ACO is often very similar from one day to the next, but even the subtlest changes must be identified by the pilot and flown precisely. An average of 1,200 ACMs were used to produce the ACO on a daily basis, and it was changed an average of 12 times every day.[28]

Another TBMCS function is to produce the air tasking order, more commonly referred to as the ATO. The ATO tasks and disseminates to components, subordinate units, and command and control agencies projected sorties, capabilities and/or forces to targets and specific missions. It also provides specific instructions to include call signs, targets, controlling agencies, etc., as well as general instructions. Once the ATO is loaded, TBMCS performs a rudimentary deconfliction analysis, based on estimated launch times and routes. Some events such as ATACMS launches that will potentially occur in the battlespace are unpredictable or cannot be loaded into TBMCS. Another limiting factor of the deconfliction capabilities of TBMCS is the sheer number of deconfliction alerts that must be resolved on a daily basis to produce the ATO, making it virtually impossible to deconflict every alert.

One of the innovations resulting from OIF was providing the aircrews with a visual depictation of the ACO and ACMs. The ACO and ATO are the documents that aircrews use for mission planning. The ACO ends up being a stack of pages containing longitudes and latitudes in text format. Most pilots can relate to visual depictions much better. The CAOC staff started pulling the images of the ACMs from Falcon View, a part of the Air Force Mission Planning Support System that provides a user-friendly ability to mission plan with a visual presentation overlaying map databases. Through their innovation, the staff started cutting and pasting the images to emails, SIPRNET web pages, and by whatever other methods they could to get better information to the crews.[29] Although this effort was one of the complaints listed by AMC in requesting this study (presumably because the emails and SIPR access were not available to mobility crews operating from bases throughout the world), this process was indispensable for most aircrews and needs to be a functional by product of TBMCS.

Transitioning to positive control

About the time the mobility assets start arriving at the secured battlefield in force, air traffic controllers start providing positive control in the battlespace. Special tactics teams (STTs) are normally the first air traffic controllers. After the battlefield becomes more secure, US Air Force Deployable Air Traffic Control and Landing Systems (DATCALS) relieve the STTs. The purpose of DATCALS is to support large-scale operations at bare-base or host-nation locations, but a DATCALS package can also be tailored to small unit and/or single-mission deployments.[30]

Reports from the battlefield indicate there were not enough properly trained air traffic controllers to replace the STTs, resulting in the controllers working far beyond mandated crew duty days. This becomes a safety of flight issue as their crew duty days are mandated to protect the safety and lives of the aircrews for which they are providing positive control. Headquarters Air Force Personnel Center has verified that air traffic control manning for DATCALS is presently a challenge. Recruiting air traffic controllers is easy but retaining mid-level and senior controllers is difficult in the face of greater financial opportunities in the civilian sector. Another challenge to the career field is providing adequate and realistic training for the undermanned career force. Our system does not generate truly "combat ready" controllers proficient at operating in a global CONOPs role. Using the combat communications group at Tinker Air Force Base as an example, the terminal environment does not provide a challenging mix of aircraft for the controllers to maintain combat ready proficiency. Furthermore Tinker uses US Federal Aviation Administration (FAA) air traffic control procedures rather than ICAO procedures. During OIF, Australian controllers in the tower at Baghdad International Airport provided air traffic control at the airport while US Air Force controllers in the mobile radar units (TPN-19s) provided approach control services. The Australian controllers used ICAO procedures and the US Air Force controllers used FAA procedures. This arrangement worked poorly at first, but over time, human perseverance overcame the lack of proper training and now they are working together efficiently. Additionally, virtually all the DATCALs equipment is outdated. The TPN 19 is 1970s technology and virtually unsupportable logistically.

Where do we go from here?

The success of airspace management in Operation IRAQI FREEDOM is a story of professionalism and perseverance triumphing over an archaic and technologically deficient command and control system. It is archaic because many of the major players in the battlespace environment are still operating in a stove-piped and self-centric mind set rather than the network-centric environment envisioned in Joint Vision 2020. It is technologically deficient because it fails to utilize the complete power of information management to produce a reliably deconflicted battlespace.

The future vision of airspace management must be the embodiment of network-centric warfare (NCW) as envisioned in Joint Vision 2020, whose focus is information superiority. The DoD is transforming itself based on the concept of NCW in which the information domain is as important as the physical domain. NCW is predicated upon the ability to create and share a high level of awareness and to leverage this shared awareness to rapidly se1f-synchronize effects.[31] This has direct applications for improving the current airspace management system. It will allow

us to apply all available information and assets to greatly increase combat power and provide a safer operating battlespace.

Future systems such as the Single Integrated Air Picture (SIAP), Joint Mission Planning System (JMPS), Joint Airspace Management and Deconfliction (JASMAD), must be correlated with current systems such as the tactical digital information links (TADIL) and various radar systems so the JFACC can see where every aircraft is and where it is planning to go or the area in which it will be operating. The goal must be to require each and every platform flying in the battlespace to provide the same level of information. Once that level of information is available, the console operator must have the ability to fast forward the battlespace. The console will generate flight paths based on the correlation of the filed flight plans updated by the correlated real time positions as reported by the various C2 systems throughout the battle space. Where real time updates are not available, predictive analysis will be used to predict where the aircraft are based on the last validated position.

As a specific example, every ship in the warfighting fleet knows how many TLAMs are onboard and their flight capabilities (speed, maximum delivery distance). They should also know their launch rate and the time it takes to reload their launch pods. Each TLAM has to be programmed for launch and can be reprogrammed in flight. In accordance with NCW, this information must be interfaced with TBMCS and given to the combatant commander. Properly designed software will enable the combatant commander to preplay the flight paths of those TLAMs prior to actual launch. The software should be able to take the present position of all the other assets (as updated through the various command and control systems), predict their flight paths (based on the loaded Joint Mission Planning System data) and provide highly refined deconfliction analysis. Further, the console will allow an operator to fast forward the battle scenario to simulate events such as the launch of multiple TLAMs, provide deconfliction alerts, and present deconfliction resolution options. Those launch events also need to be able to be preloaded into TBMCS and deconfliction alerts provided as real time updates (projected aircraft takeoffs updated by actual takeoffs, or projected launch of TLAMs updated automatically by the actual launch) are fed into TBMCS.

With the appropriate NCW interfaces in place and the full capabilities of flight path simulation of all the assets operating in the battlespace, there will be a capability to vastly improve deconfliction during the planning and execution phases. The planning phase will become a tool of the execution phase.

This requires a fundamental change of mindset. The era of combatant forces operating autonomously in a vacuum and not sharing mission information has to come to a close. Each force has unique capabilities and mission sets and the combatant commander must be able to utilize those skill sets effectively. We must now evolve to a NCW mindset where mission-planning information is shared early in the process to prevent fratricide and ineffective or redundant mission planning. Once the mindset has evolved, proper system design can begin.

The end result is, the OIF airspace management system worked, but a few unique factors contributed to the success, including: 1) We just had OEF to practice and work out a lot of the kinks, 2) There was an inordinate of time to prepare 3) the available airspace was huge, and 4)

fuel resources were abundant and readily available. It is imperative to recognize the opportunities for improvement and the systematic changes that can and must be made to continue our legacy of success for future war fighters!

Notes

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