In a freak accident during the seventh inning of an Arizona Diamondback's spring training game 24 March 2001, pitcher Randy Johnson throws a fastball to the San Francisco Giants' Calvin Murray that strikes and kills a dove at then Tucson Electric Park in Tucson, Arizona. The bird swooped across the infield just as Johnson was releasing the ball. (Screenshot from Youtube video)

Big Sky, Little Bullet

Tackling the Army's Airspace and Joint Fires Integration Problem

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On 24 March 2001, Major League Baseball pitcher, Randy Johnson, threw a fastball during a spring training game that hit and killed a dove. The poor bird happened to fly between home plate and the pitcher's mound at the exact moment in time and space for it to collide with a ball roughly three inches in diameter. Video of the collision between bird and ball can be seen on the internet today, and if social media and viral videos existed then, as they do now, it would have been internet gold.

Airspace Collision Zones

What does Johnson's infamous pitch have to do with joint fires integration you might ask? It is certainly an example of how the concept of "big sky, little bullet" can go terribly wrong. What if our military had the right procedural controls and situational awareness to execute this concept of joint fires integration? This article analyzes the pitching incident to illustrate the utility of using collision zones to orchestrate joint fires processes to be more efficient and clearer.

(Figure by author. Photo taken by author at a Las Vegas 51's game 25 August 2017 at Cashman Field in Las Vegas)

Figure 1. Example of Airspace Collision Zones During a Baseball Game

Let's examine the pitching incident for a moment (see figure 1). The odds of a bird being hit and killed by a baseball in most places on planet Earth is close to zero. So, we could consider the airspace outside of a baseball diamond as having a low probability of midair collisions with a baseball (i.e., low collision zone). If the bird dives into the confines of a baseball diamond (during a game or practice), the odds of colliding with a baseball somewhat increase as there are more chances the bird could be struck by either a hit or thrown ball. We could classify the general airspace within the baseball diamond (during a game or practice) as a medium probability of collision zone (i.e., a medium collision zone). Although the bird now has an increased risk being struck by a baseball, the odds are still in the bird's favor. However, if the bird likes to live dangerously and flies in between the pitcher's mound and home plate during a game, the odds of a midair collision increase exponentially. During an average major league baseball game, pitchers throw approximately 150 times, catchers throw the ball back to the mound, and batters can rocket a ball into the air off of a good pitch. This small sixty-plus foot patch of airspace, during a game, could be classified as a high probability of collision zone (i.e., high collision zone). If the bird flies into this high collision zone, it exponentially increases the risk of being struck by a baseball. Those collision zones define a specific volume of airspace as it pertains to the odds of being struck by a baseball.

Airspace Planning and the Use of Collision Zones on the Battlefield

Now that we are clear on the baseball analogy, let's translate it into a military area of operation (AO). We assign maneuver commanders, at various echelons, an AO that encompasses a geographic region, to include the

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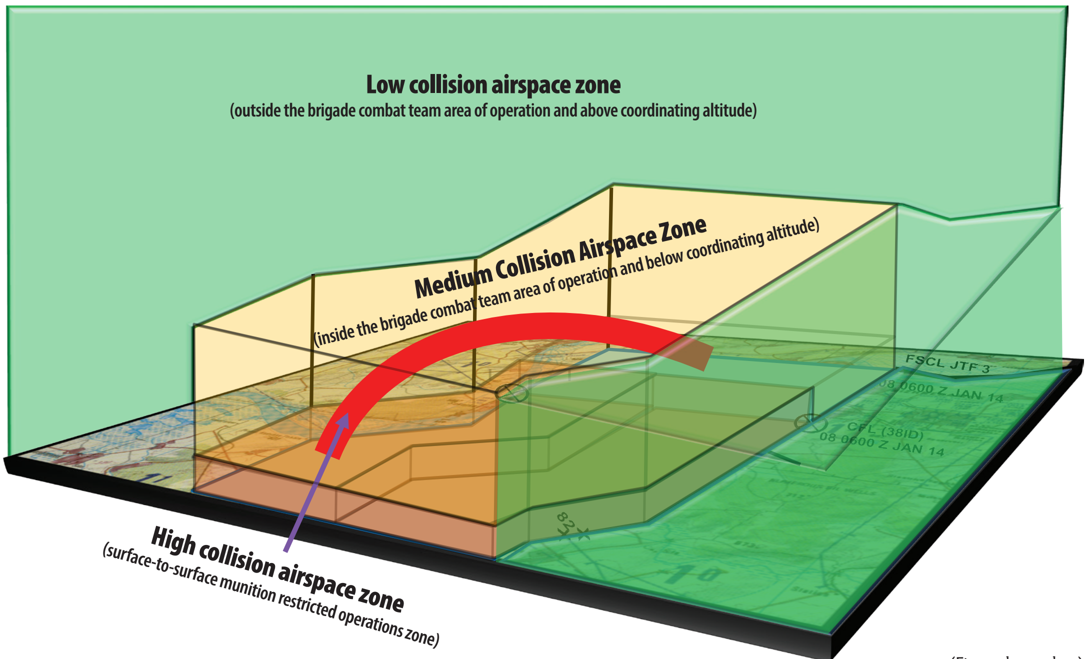
three-dimensional block of airspace when delegated that responsibility from the airspace control authority. Current joint and service doctrine uses maneuver control measures, airspace coordinating measures (ACM), and fire support coordination measures (FSCM) to plan for and manage joint fires and airspace. Generally speaking, fires and airspace planners design unit airspace plans using ACMs and FSCMs to define specific three-dimensional blocks of airspace for aircraft (fixed and rotary wing) to safely operate. This is done through the use of airspace coordination areas, restricted operations zones, and air corridors.

Additionally, a coordination level and coordinating altitude is established to separate and delineate entire blocks of airspace. Coordination level is used to separate fixed and rotary-wing aircraft by determining an altitude below which fixed-wing aircraft normally will not fly.[1] Coordinating altitude is an ACM that uses altitude to separate users and defines the transition between different airspace control elements.[2] Airspace coordination areas are defined as "a three-dimensional block of airspace in a target area, established by the appropriate commander, in which friendly aircraft are reasonably safe from friendly surface fires."[3] A restricted operations zone (ROZ) is defined as "airspace reserved for specific activities in which the operations of one, or more, airspace users is restricted."[4] Lastly, an air corridor is "a restricted air route of travel specified for use by friendly aircraft and established for the purpose of preventing friendly aircraft from being fired on by friendly forces."[5]



(Figure by author)

Figure 2. Airspace Collision Zones in a Brigade Combat Team Area of Operation

What about surface fired projectiles? Joint fires planners often forget that artillery projectiles are airspace users just like aircraft, although the flight path (ballistic solution) cannot be controlled like an aircraft once fired. One could argue this makes planning airspace for fires easier than aircraft. With the exception of precision-guided munitions, conventional cannon and rocket artillery generally follow a very predictable flight path and/or trajectory. There is a relatively unknown doctrinal ROZ called a surface-to-surface munition (SSM) ROZ that is "airspace of defined dimensions established specifically for surface-to-surface munitions route of flight and launch and impact point."[6] A variant used in United States Message Text Format (USMTF) 2004, and compatible with our digital systems, is a special use airspace (SUA) ROZ called a Surface-to-Surface Missile System (SSMS).

The SUA/SSMS ROZ is used to identify airspace requirements for firing guided multiple launch rocket system munitions, Army tactical missile system munitions, and cannon artillery. Only the SUA/SSMS ROZ is compatible with USMTF 2004 used to communicate between Army mission command systems and the Air Force's Theater Battle Management Core System. One

A B-1 bomber from Ellsworth Air Force Base, South Dakota, performs a show-of-force flyover 16 November 2016 near Belle Fourche, South Dakota, as part of joint exercise Combat Raider 1701. U.S. and international participants in Combat Raider 1701 train to maintain interoperability between air support and ground troops. (Photo by Airman 1st Class James L. Miller, U.S. Air Force)

reason that the ROZ SSM / SUA SSMS is addressed here is that its implementation requires coordination between the fires cell and the airspace element. Army airspace users need to identify the most appropriate ACMs that closely correlates to their airspace requirement and integrate those measures into a clear, concise, and understandable unit airspace plan.

Now on to airspace collision zones and why understanding levels of collision risk could facilitate a better airspace plan. In planning, an airspace collision zone could be designated by the calculated probability of an aircraft being struck by surface fires (high, medium, or low) after analysis of all variables. This probability would be linked to defined levels of risk underwritten by a commander for specific blocks of airspace during specific time periods. The level of collision risk for a particular block of airspace would be inversely proportional with the level of restrictions placed on artillery and/or other indirect fire units assigned to an AO.

For instance, low collision airspace zones would be most restrictive to surface fires, while high collision airspace zones would be least restrictive. In keeping with the baseball analogy, we will use a brigade combat team's (BCT's) AO as our baseball diamond (see figure 2, page 3). Anything outside the BCT's AO and above a particular altitude (the coordinating altitude) could be defined as a low collision airspace zone because we determine that the majority of our surface fires will not travel outside of the BCT's AO (baseball diamond); therefore, limiting the risk to transiting aircraft. Our medium collision zone (inside the baseball diamond) could be defined as everything below the coordinating altitude and inside the BCT's surface boundary. The medium collision airspace zone is crucial because it requires detailed planning and synchronization of airspace in order to expedite joint fires. Our high collision airspace zones would equate to three-dimensional air corridors (ROZ

SSM / SUA SSMS) between firing unit locations and enemy targets. This would expedite fires through airspace that we have planned for a high volume of fire. In order for this concept and methodology to work, a staff must understand where surface fires will shoot from (i.e., the pitcher and/or pitcher's mound), where the majority of enemy targets will be (i.e., the catcher and/or home plate), and a pretty good estimate of the types and number of aircraft that will be operating in the AO.

Firing Unit Restrictions (Further Mitigating Risk while Expediting Fires)

Back to baseball for a moment. What if we helped manage and/or mitigate the risk of a pitcher hitting a bird with a baseball by implementing some pitching restrictions as well? We could do this by using a simple green, amber, and red pitching status (red being the most restrictive). If we gave the pitcher a green pitching status, because we observe that no birds are flying around the ball field (or we predicted this during planning), it would allow him or her to pitch freely. This would expedite pitching efforts and the risk would be relatively low because we do not see any birds in the medium or high collision airspace zones (or we have a way of keeping birds out of the medium or high collision zones through coordination and control measures).

If we see some birds fly into the ball field's airspace, we may tell the pitcher that they are now in an amber pitching status, which means they must look around before making a pitch to ensure no birds are heading towards their location. This would slow up the play a bit but would mitigate the risk of any pitches hitting a bird. Now, let's look at the red pitching status. In this scenario, we will say that there are a lot of birds flying around the baseball field, especially near the pitching mound and home plate. To help mitigate risk, we employ bird "spotters" who we could equate to as the airspace control element. Before the pitcher is allowed to throw a ball, there must be a thumbs up from the spotters that the pitching lane is clear from the pitcher's mound to home plate; then and only then can they release a pitch. This would significantly slow down play, but would ensure that no birds get hit by a baseball.

Table. Matrix of Firing Statuses in Airspace Collision Zones

Firing status	Details	Airspace collision zone
Green fire	• **Firing status:** Procedurally clear airspace; notify all airspace users on common net and **fire immediately** unless someone calls "check fire" • **Airspace:** Permissive for surface fires; restrictive for aircraft	High collision airspace zone
Amber fire	• **Firing status:** Procedurally clear airspace; notify all airspace users on common net and **fire 1 minute after notification** unless someone calls "check fire" • **Airspace:** Balanced	Medium collision airspace zone
Red fire	• **Firing status:** Additional airspace clearance required; notify all airspace users on common net and **fire only when given clearance of air** by appropriate airspace control element • **Airspace:** Permissive for aircraft; restrictive for surface fires	Low collision airspace zone

(Figure by author)

This same concept could be applied to firing units to help mitigate risk (see table). A *green fire status* could be defined as: procedurally clear airspace; notify all users on a common net and fire immediately unless someone calls check fire. This would produce the most responsive fires and could be paired with a high collision airspace zone that has been built as an SUA/SSMS ROZ (high volume of surface fires). This would make the airspace permissive for surface fires but restrictive for aircraft.

An *amber fire status* could be defined as: procedurally clear airspace; notify all airspace users on a common net and fire one minute after notification unless someone calls check fire. This would slow fires slightly and could be paired with a medium collision airspace zone as long as it is complemented with the appropriate coordination and control measures. Note, the time of one minute is an estimate and could be adjusted in accordance with a command's risk tolerance (shorter or longer). Theoretically, one minute would give all airspace users adequate time to ensure they are not in the wrong place at the wrong time. The point is to keep it long enough for a quick check but short enough not to stifle the fire mission timeline. We must be confident in our unit airspace plan, but to be confident, we must have personnel who understand how to construct that plan. This would take a balanced approach to the airspace when talking permissive versus restrictive.

Lastly, a *red fire status* could be defined as: additional airspace clearance required; notify all airspace users on a common net and fire only when given clearance of air by the appropriate airspace control element. This is the most restrictive firing status for a unit and could (by default) be paired with a low collision airspace zone. This would make the airspace permissive for aircraft but restrictive for surface fires. The firing status is fluid and could always be adjusted if the unit has a clear picture of its airspace. The air defense artillery community already employs a similar form of firing unit control via a Weapons Control Status; though it is designed around the enemy and not airspace. Their weapons control statuses are *free*: fire at any target not positively identified as friendly, *tight*: fire only when targets identified as hostile, and *hold*: fire only when ordered or in self-defense.[7]

The good thing about aircraft is that they are much more predictable than a bird. That is, if we published the collision zones and unit firing statuses to all pilots and/or operators, then they would do their best to avoid certain airspace collision zones at certain times. New guidance would also need to be developed for aircraft operations within airspace collision zones. For instance, avoid high collision airspace zones as they correlate to a high volume of surface fire, and adhere to published ACMs and FSCMs inside medium-risk zones to reduce the risk of midair collision with a surface projectile. Good news is that we already have several venues to publish this information to include the Airspace Control Order, Special Instructions, Notice to Airman, and operations orders.

Simplifying Airspace Plans and Management

Could this perspective of airspace be used in joint fires planning to identify risk zones and help expedite clearance of fires, and/or could it be integrated into current joint fires and airspace planning procedures to simplify the overall plan? In this complex and ever-changing battlefield we must be bold yet cognizant of risk. Let me pose a simple question: Do we really need to go beyond a quick procedural clearance in a "high collision" airspace zone that is clearly defined and articulated to all airspace users? I have witnessed, first hand, units painfully try to clear airspace in an area that we knew, with a high level of confidence, that there were no aircraft present. During my time at the Joint Readiness Training Center as a fires support observer, coach, trainer, clearance of fires was the thorn in everyone's side. Maneuver commanders complained that it took too long so they eventually reduced their use of surface fires. We, the military, have published tactics, techniques, and procedures, standard operating procedures, and doctrinal manuals to address the problem to no avail. We have created the Joint Air Ground Integration Center concept with some recent success, but it is far from perfect and located at the division level.

"Do we really need to go beyond a quick procedural clearance in a "high collision" airspace zone that is clearly defined and articulated to all airspace users?"

If airspace collision zones were developed and published properly, aircraft could avoid high collision zones (i.e., SUA/SSMS ROZs), therefore reducing the time to shoot surface delivered munitions. The crux of the problem has to do with planning and the ability not only to accurately develop a coherent airspace plan but also manage that airspace after the plan is in place. Even with current doctrine, we hardly have enough trained personnel who understand how to make it all work. There are very few staff officers (and commanders) across the Army who fully understand airspace planning and management. We have maneuver planners who only think about the ground fight, field artillery personnel who only think about surface fires, air liaison officers and joint terminal attack controllers who only think about fixed wing aircraft, and air defense officers and brigade aviation officers who only think about their pieces of the puzzle. We have gotten better at collaborating over the years, but we still have a tendency to conduct stove-piped planning in our area of expertise. Additionally, staff officers still have a hard time understanding their own digital mission command systems let alone how those systems integrate with others on the network.

Proposed Solutions

I propose two solutions to help expedite safe and responsive surface fires, both of which could complement current procedures. The first solution is to adopt the aforementioned airspace collision zones and unit firing statuses into doctrine and train personnel on their use. The methodology is still in a conceptual stage and must be discussed among fires and airspace professionals and proofed and tested in real-world scenarios. Additionally, we must do a better job at training personnel on current joint fires and airspace doctrine. Our 13A field artillery officers and 13F fire supporters must be trained on airspace planning and management early on in their careers. The buzzwords are integrate and synchronize "multi-domain" fires, but in order to do this we must have well-rounded officers and noncommissioned officers who understand airspace planning and management. It must be learned early in the training pipeline and practiced often to create true experts. We must also start looking at artillery as an airspace user and plan appropriate airspace measures (i.e., SUA/SSMS ROZs) for surface-to-surface fires. These blocks of airspace can work concurrently with other coordination and control measures.

The second solution involves mission command systems. The Army must subscribe to the Link 16 architecture employed by the Air Force and distribute these tools and/or systems to the lowest echelon possible. Additionally, BCTs need organic radar systems like the Sentinel Radar, or another comparable system, to provide a real-time air picture. We have counter-fire radar systems at all BCTs and radar systems to facilitate airspace are just as important today. This is an uphill battle due to equipment procurement, cost, and personnel training, but it would be worth the effort in the long run. Our airspace is only getting more congested. We can no longer rely on antiquated technology and procedures from a time when there was no such thing as an unmanned aircraft system or remotely piloted aircraft. Getting Link 16, radars, and other mission command systems down to the brigade combat team to facilitate airspace control may be a pipe dream at this point but it is something that needs serious consideration. In the interim, we need to fully leverage the capabilities of the systems that are sitting in all of our command posts. The latest versions of the Advanced Field Artillery Tactical Data System, the Tactical Airspace Integration System, and the Air and Missile Defense Workstation provide powerful tools, but we often fall short of leveraging their true capability due to lack of training and understanding of how they complement each other. Additionally, our operators and leaders need comprehensive training on these systems to include detailed instruction on interoperability.

It is time to get out of the old airspace mindset and generate new ideas. The concepts and methodologies discussed in this article may not be the right solution, but the hope is that it generates discussion that eventually turns into action to make clearance of fires and airspace planning and management that much better in the future. ■

Notes

1. Joint Publication (JP) 3-52, *Joint Airspace Control* (Washington, DC: U.S. Government Publishing Office [GPO], 13 November 2014) C-6.
2. Ibid.
3. Ibid., C-7.
4. Ibid., C-4.
5. Ibid., C-2.
6. Ibid., C-5.
7. JP 3-01, *Countering Air and Missile Threats* (Washington, DC: U.S. GPO, 21 April 2017), V-24—V-25.

US ISSN 0026-4148