

The Fragility of Air Dominance

by

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USAWC STRATEGY RESEARCH PROJECT

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ABSTRACT

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THE FRAGILITY OF AIR DOMINANCE

Today the United States (US) military is facing what is described as a budget “catastrophe” despite continued threats from asymmetric, conventional, and non-conventional forces. At the same time, the world is experiencing a shift to a “multi-nodal” world that challenges regional stability.¹ The US military is required to operate across the full spectrum of operations to meet the National Military Strategy (NMS) objectives in an environment that is experiencing a revolution in technology. While the US has enjoyed a technological advantage for decades, adversary transformation efforts are chipping away at our comparative advantages. The shrinking margins within *air dominance* may continue to decrease to the point US forces will be faced with a new and unacceptable level of risk in future operations.

The dominance of US air assets to hold any target at risk and allow freedom of movement and access for friendly ground forces is unmatched. Not since the Korean War have US ground forces feared attack from enemy air assets. This unprecedented condition is threatened by decisions made in a resource-constrained environment that are political, emotional, and potentially parochial. The purpose of this paper is to examine whether these decisions are undermining US air dominance and to question whether future joint forces will be able to operate across a full spectrum of possible conflict. To do this we will first examine the background to the current situation and what national actors are doing to prevent access to the air domain. Building on this subject will be a survey of the research and development underway in nations of interest, including threat systems such as aircraft and integrated air defenses. Finally,

this paper will analyze, if a credibility gap exists, what might mitigate the risk through feasible courses of action.

Background

In many ways, US airpower is a victim of its own success. Operation DESERT STORM in 1991 was a showcase of joint American airpower with systems that were mature, well led, and expertly employed. US airpower from the Air Force, Navy and Marines made short work of one of the world's largest armies, enabling allied ground maneuvers that required just 100 hours to meet their operational objectives of removing Iraqi forces from Kuwait.

Not long after the success against Saddam Hussein's air and ground forces, Secretary of the Air Force Donald Rice announced the selection of Lockheed Martin's YF-22 as the winner of a fly-off competition to provide the US Air Force an Advanced Tactical Fighter.² The USAF had planned to acquire 750 aircraft, which, because of their technology, would replace twice that number of F-15Cs and F-15Es and allow aging platforms to retire and sustain capabilities and credibility for future conflict and deterrence.³

A key commitment Air Force leaders made after the Gulf War was to incorporate stealth in new weapons systems. The F-117 made tremendous contributions to the air war over Iraq and while every other platform faced significant surface-to-air missile threats ingressing and egressing target areas, the F-117 made their runs relatively unscathed. This combat demonstration of stealth attributes solidified the notion that low-observable technology could revolutionize air warfare. The YF-22 would be the first acquisition in this new paradigm of much greater capability, with less than half the aircraft it was replacing.

The Air Force plan to bring stealth to the fleet was threefold; shrink but update, develop the F-22, and add a multirole stealth fighter to replace aging F-16s and A-10s.⁴ Immediately after the formation of this plan, the world environment saw glacial changes taking place as the realization of the end of the Cold War began to take shape. In a pattern that is all too familiar to military planners, calls for a reduction in standing forces went out across the military in an effort to realize a sort of “peace dividend.”

This environment of contraction was bolstered further by the Air Force’s own statements. In 1994, Chief of Staff of the Air Force, General Merrill McPeak, made the comment in a speech that “our nation has too much tacair,...the United States has nearly twice as many fighter aircraft as any other nation.”⁵ Certainly this was an extraordinary statement in an environment that is looking for budget “pork.” The results were equally astonishing. The Air Force and Pentagon reduced the fighter force from 36 fighter wing equivalents to 26 fighter wings, and later settled at 20.⁶ The first casualty was the venerable F-111. The F-111 had an exemplary record of performance in the Gulf War and was one of the few platforms that could employ precision targeting, reducing the number of sorties and ordinance necessary to destroy intended targets. The entire F-111 fleet was retired.⁷

Comments made about tactical aircraft (tacair) do not just affect Air Force plans. The feeling of an overabundance of a certain capability affects all services that possess those capabilities. The Navy’s aircraft inventory was also being scrutinized and looked upon as yet, more overlap and redundancy in the US arsenal. In the late 1990’s the Navy attempted to consolidate their tacair assets to defensible and unique capabilities that would complement the air dominance mission. The Navy retired its A-7 and A-6

aircraft and funded a modernization to the F/A-18 into the F/A-18E/F Super Hornet.⁸

The Navy cuts went even deeper, retiring its S-3 anti-submarine aircraft as well as the venerable F-14 Tomcat. With these savings the Navy was able to keep the F/A-18 production line open and fund a multi-year purchase. The move toward the F/A-18 gave carrier aviation tremendous flexibility with more range and better performance,⁹ but was inexorably tied to carrier strike groups.

The Air Force plan to downsize but upgrade, buy the F-22, and develop a replacement for aging F-16s and A-10s has produced mixed results to date. The revolution in precision, namely with laser-guided weapons, and the advent of Global Positioning System (GPS) guided weapons, allowed the Air Force to upgrade and gain capability in its fleet. By 2010, all F-16s, F-15Es and A-10s were capable of delivering precision weapons and enjoyed significant upgrades to avionics systems.

The F-22 portion of the plan received the most scrutiny and to date the greatest reduction. In the late 1990s, as the F-22 program was experiencing technical challenges and delays in delivery,¹⁰ the system fell prey to the “too much tacair” comment discussed earlier. To the outside observer the military had F-16s, A-10s, F-15s, F-15Es, and F/A-18s and were now asking for two new platforms leading to claims of overlap and redundancies.¹¹ Because the Air Force did not make an effective case for the expected threat conditions and resulting air dominance requirements, the F-22 program saw constant programmatic revisions throughout the 1990’s. The first Bush administration requirement was revised downward from 750 fighters to 680. The Clinton administration’s “Bottom-up Review” reduced the total buy to 442 aircraft. The 1997 Quadrennial Defense Review brought the bottom line down even further to 339.¹²

The second Bush administration and Secretary Rumsfeld's "transformation initiatives" were the final blow to the F-22 procurement and barely resembled the force structure envisioned in the initial program requirements. In December 2004, Secretary Rumsfeld used a program budget directive to reallocate funds across the Department of Defense. Program Budget Directive 753 removed \$10 billion from F-22 procurement, allowing for a total of just 183 F-22s.¹³ The Air Force was now facing facts that it would not have the force structure available, as it had originally planned, to meet its obligations under the NMS.

The third leg of the Air Force roadmap to fighter capabilities lay in the development and fielding of a lower-cost stealth replacement for the F-16 and A-10 that has been touted as the mitigation for reduced F-22 procurement. Seeing the value in shared development costs, the Navy and Marines joined with the Air Force to develop what would be called the Joint Advanced Strike Technology (JAST) program.¹⁴ This program wasn't dictating an airframe initially, but was developing the technology that would eventually support a future fighter aircraft.

This fighter aircraft was later renamed the Joint Strike Fighter and had multiple stakeholders within the Department of Defense and was also offered up to certain coalition partners. Although a complicated and technology-intensive undertaking, the selection of an airframe proceeded apace after a competitive fly-off from several defense industry entrants. Since the fly off, progress has been slow and marked by technical challenges and cost overruns. The current program chief, Navy Vice Admiral David Venlet has recently stated that it would be wise to "temper production" until we get more testing accomplished.¹⁵ The need to temper production comes from the

results of concurrent airframe and fatigue testing. This testing is revealing premature failures of key structural components that will reduce the aircraft's service life and require extensive repairs to meet the programmed requirement.¹⁶ Admiral Venlet's comments mean increased cost and delayed delivery of a major weapons program, coincident with today's continued discussion of the US tacair inventory.

While this has not played out in any fiscal terms at this point, it is sure to bolster reductionist agendas and further cripple the Air Force modernization plan. With two of the three components of the Air Force plan in question, where does that leave the future US air dominance? It would first be helpful to discuss what is meant by air dominance.

Air Dominance

Air dominance is a challenging concept to define. It would be easy to take a parochial view and say the Air Force is responsible for "air superiority" or "air supremacy" but other services would rightly challenge that is not all-inclusive when discussing air dominance. There is no joint definition of air dominance but maybe best characterized by Dr. Rebecca Grant as "that state in which an airpower force is assured of being effective in all its offensive tasks or missions-in the air, on the ground, and in space."¹⁷ It is more than defeating an enemy in the air, it is also meant to degrade disrupt and deny an enemy's ability to attack from the ground-to-air, attack airbases, and provide freedom of movement to friendly forces.

As stated earlier, not since the Korean War have US ground forces faced a threat from the skies. This condition has come from systemic efforts to provide an integrated air defense system that ensures the destruction of air-breathing platforms capable of delivering payloads. Recent history is replete with examples of "air superiority" and establishment of "no-fly" zones enabling an operational or tactical objective. In order to

maintain this dominance, joint forces will need physical access to the airspace above areas of conflict. While many nations cannot afford an air force replete with technologically superior platforms, some nations are finding other methods to create anti-access and area denial (A2/AD) capabilities at much lower costs. The ability to operate in the benign environments of recent conflicts does not imply future conflict will follow the same pattern. In an attempt to balance the strategic superiority of the US and reduce the asymmetric US advantage of airpower, A2/AD technologies are developing apace and are becoming doctrine in nations wishing to field their own portfolios of deterrence.

Anti-Access and Area Denial

A2/AD is becoming a particular concern for the Air Force and Navy as strategic instruments of national power projection. Countries such as China and Iran have dedicated development efforts to challenge power-projection by non-friendly states.¹⁸ In addition to limiting US military advantages, these developments also threaten US access to the global commons and potentially affect the movement goods in and around the key areas of the western Pacific and Arabian Gulf.¹⁹

A2/AD can be broken down into the different domains and affects each service uniquely. Anti-satellite, cyber weapons, threats to forward bases, and threats to maritime surface combatants constitute capabilities that would deny access to a battlespace or cause operations in a region to be much less effective or much more costly. For the sake of this paper we will define A2/AD in terms of those capabilities that will deny air assets from accomplishing a prescribed mission or to effectively engage a given target.

New efforts to prevent US access to airspace include an impressive investment in land-based interceptor aircraft and surface-to-air missile (SAM) defenses.²⁰ These systems combined with a new interest in A2/AD doctrine form overlapping engagement zones that will do much to keep US airpower from gaining immediate access and control over key contested regions.

Threats to Air Dominance

Choosing the threats to air dominance is a difficult task, primarily because estimating the threat to be countered is akin to consulting a crystal ball. But, by looking at the F-22 we can get an idea of procurement timelines that represent the modern day processes.

The Air Force began the development of the Advanced Tactical Fighter (ATF) in the early 1980's with the fly off and eventual aircraft selection taking place in 1991 as discussed earlier.²¹ The engineering and manufacturing development began in 1991 and the first flight of the test aircraft occurred in September 1997.²² The test program progressed and the acquisition process moved into initial and then full rate production. The F-22 achieved initial operation capability on December 15, 2005, and the process of fielding operational squadrons followed.²³ From concept, to the first F-22 squadrons, the current acquisition paradigm spanned 24 years. Did we anticipate the threat correctly back in the late 1970s or early 1980s? Arguments abound that the US built a behemoth that is out of place in the current threat environment. What it did for certain was to develop breakthrough capabilities that have adversaries scrambling to counter.

Adversaries' development of systems to counter US strength is nothing new. The Cold War period between the US and the Soviet Union is replete with examples of aircraft development and counter-developments. Since the end of the Cold War there

has not been a peer challenger to US dominance of the skies with examples that include the Gulf Wars, Allied Force, and most recently Operation New Dawn in Libya. Aircraft losses in these engagements from direct enemy action number in the single digits in contrast to the thousands of sorties flown.

Throughout these combat engagements, potential competitors have taken note and are in the process of building the overlapping weapons engagement zones mentioned above. As a review of future threats to air dominance, this paper will examine platforms and systems from countries that have reinvigorated military spending. Countries such as India, Russia, and China have either acquired top of the line fighters or are developing counters to the US's stealth advantage. We will also examine the combining of land-based aircraft with new developments in SAM system technology and employment.

India

The Indian Air Force (IAF) is included in this discussion because they are increasingly a part of the Asian arms race. The country's position in South Asia, sandwiched between historic belligerents and resource competitors, make their plans for a modern airpower force a good example of the increased military intent that is fuelling progress in the air arms market. Additionally, there have been recent exercises between the IAF and US Air Force (USAF), the first in forty years, which underscores the progress made in effective aircrew training which makes the IAF an increasingly formidable force. We will first examine what was learned in these exercises and then discuss the modernization of IAF equipment.

In February 2004, the USAF and IAF met in Gwalior, India for Exercise Cope India. The USAF contingent was from the 3^d Fighter Wing at Elmendorf AFB, Alaska

employing the stalwart F-15C, the primary US air superiority aircraft. The IAF flew a number of different fighters to include the Mirage 2000, MiG-27s, MiG-29s, an upgraded MiG-21, and the SU-30K Flanker.²⁴

The result of the inaugural exercise was eye opening and much has been made of the lessons learned. IAF pilots defeated USAF fighters in 90% of the engagements.²⁵ There are those that say this is the warning that the Pentagon needed to reexamine the assumptions concerning the future of air threats and that they have woefully underestimated future threats in order to justify the cuts to air dominance assets. As one might expect, there is also another camp that observes the “chicken little” rhetoric as carefully timed to coincide with procurement discussions surrounding the F-22.

The truth probably lies somewhere in the middle. The scenarios agreed to by the US often had our F-15s outnumbered 12 to 4 and had the American pilots executing “red air” tactics, which are usually not in line with up-to-date Air Force tactics, techniques, and procedures. Nonetheless, the real takeaway should be that there is a capable air force in a key region that has invested heavily in its development of pilots and tactics. While eschewing Russian doctrine, IAF pilots have been trained to think autonomously and creatively while employing capable Russian produced equipment.

It is the Russian built and exported Su-30MKI that is the next generation of Indian airpower. With current orders of the Su-MKI numbering 180,²⁶ the MKI (M=Improved, K=Export, I=India)²⁷ is poised to be the backbone of IAF forces for the next few decades. The aircraft is from the Su-27 family of Russian fighters and designed to directly challenge the F-15.

The aircraft is a twin tailed, twin engine, dual seat fighter that employs beyond-visual-range capabilities that include active radar and infrared detection to engage target aircraft. The Su-30MKI is a fusion of fighter aircraft systems²⁸ incorporating Indian designed components and marrying them with European Union (EU) and Israeli hardware to make a unique variant that capitalizes on proven systems.

Of note, the Su-30MKI uses thrust vectoring to improve handling performance and is outfitted with a phased-array radar.²⁹ Key to the long-range game of detection and weapons employment, a phased-array radar delivers superior performance at range and this particular model, with a greater aperture, will make it highly competitive against newer systems such as the F-35.³⁰ In combination with the Russian air-to-air missile offerings such as the AA-12 Adder, IAF pilots can prosecute successful engagements at greater distances than ever before. The Su-30MKI airframe is still developing, but has already shown excellent kinematics that give it an advantage in the region with reason to expect the Asian arms market to provide further improvements over time.

Russia

From the discussion of the IAF developments, the systems available on the export market should be an area of heightened concern and observation. The Russian Federation has used the weapons export market for decades as a source of income and has seen their products bought and employed around the world. During the Cold War the Soviets happily sold military hardware to those countries around the globe that the US could or would not reach, often as a counter balance to US interests in various regions.

Russian MiG and Sukhoi companies have a history of producing the only credible challenges to US airpower, but have not had much success in the export business as of late due funding difficulties. In an attempt to offer a credible adversary to the F-22, the Sukhoi company has recently surprised the aviation world with its first flight of the PAK-FA, also known as the T-50, on January 29, 2010. The PAK-FA is a joint venture with India who expects to field two hundred and fifty of the stealthy aircraft.³¹

Information and analysis of the PAK-FA prototype has been accomplished through high-resolution video and company disclosures to allow some initial technical evaluations take place.³² It should be noted that this is a new weapon system and is likely to experience a range of developmental obstacles that could affect final performance and initial operating capability timelines.

Australian airpower analysts have used this information to come to an initial evaluation of this new aircraft. It is apparent that the PAK-FA incorporates airframe shaping designed to place it in the Very Low Observable (VLO) category of aircraft with probable thrust vectoring to increase maneuverability.

The avionics suite that will outfit the airframe will be a follow on from the Su-35S family of advanced aircraft with the addition of a high power aperture multimode Active Electronically Scanned Array (AESA) radar. There will also likely be some form of sensor fusion and networking capability for which the F-22 is known.³³

These analysts believe “that a mature production PAK-FA design has the potential to compete with the F-22A Raptor in VLO performance from key aspects, and will outperform the F-22A Raptor aerodynamically and kinematically. Therefore, from a technological strategy perspective, the PAK-FA renders all legacy US fighter aircraft,

and the F-35 Lightning II Joint Strike Fighter, strategically irrelevant and non-viable after the PAK-FA achieves IOC in 2015.”³⁴

China

The Information Office of the State Council of the People’s Republic of China produce “white papers” that serve as the equivalent to the US *National Security Strategy*. On China’s national defense, written in 2010:

To satisfy the strategic requirements of conducting both offensive and defensive operations, the modernization and transformation of the PLA Air Force (PLAAF) follows a carefully-structured plan.The PLAAF is working to ensure the development of a combat force structure that focuses on air strikes, air and missile defense, and strategic projection, to improve its leadership and command system and build up an informationized, networked base support system.³⁵

The majority of the white paper uses “defensive” terms to describe how the Chinese government will interact with its neighbors and regional interests. In the section quoted above, offensive operations are distinctly enumerated and would appear to be a key component to the underpinning of A2/AD operations, a significant shift for PLAAF doctrine.

In a recent RAND Corporation monograph, experts see this distinct development of a mature air doctrine to be focused on four campaign areas.³⁶ These four types of campaigns include air offensive campaigns, air defensive campaigns, air blockade campaigns, and airborne campaigns. The monograph goes on to say that by 2015, China will have the weapons systems and or platforms to enable effective implementation of these air campaigns.³⁷ One of these enabling platforms was recently unveiled and constitutes a great leap in capability.

On January 11, 2011, while Defense Secretary Gates was in Beijing meeting with Chinese President Hu Jintao, the Chengdu Aircraft Company's J-20 prototype took off on its maiden test flight.³⁸ It was an obvious display of Chinese muscle and a significant discrepancy of previous thinking by Secretary Gates who in 2009 predicted that China would not have an operational stealth aircraft before 2020.³⁹ While the prototype only flew for 15 minutes, the impact and strategic implications will need to be debated and assessed in depth.

What is known about the J-20 is derived from the online posts and images that, curiously enough, have not been removed by the state government. In images from initial taxi testing and videos posted online of its purported first flight, it is easy to see stealth shaping and a size slightly larger than the F-22. Dr. Carlo Kopp and Peter Goon, the Australian analysts mentioned earlier have made additional technical observations mostly in regards to the shaping, which they consider better than the T-50 PAK-FA, and resembles a mature stealth design very similar to the F-22.⁴⁰ Further similarities include an undercarriage that will support an internal weapons bay and an engine configuration, to include thrust vectoring, that would support supercruise performance. Supercruise is an important addition to platform performance as it shrinks the weapons employment envelope of adversaries and provides energy to own-ship weapons, furthering their potential energy and range.

Dr. Kopp and Mr. Goon's general conclusions contend that the J-20 demonstrates the Chinese intention to field a long-range interceptor that will complement anti-access operations.⁴¹ These operations push the A2/AD line to what is considered the "Second Island Chain," some 1500 miles from the Chinese mainland

and includes most of Japan, Okinawa, Guam and all of the Philippines. This area is the geographic center of travel and commerce in the Pacific and includes multiple US bases. This proximity would provide a persistent threat that severely threatens US strategic interests in the region.

The additional challenge to overcoming these anti-access efforts are the next layer of defenses embodied by Integrated Air Defense Systems (IADS) which are enjoying a resurgence in development due to improved digital technology.

Integrated Air Defense Systems

Nations and companies known to develop anti-western technology have continued to field systems that capitalize on digital technology and provide a counter to US stealth. This increased capability, in an effort to foil stealth, is of even greater concern to legacy fighters who have radar cross sections (RCS) many times greater than stealth platforms.

For the last 20 years, the success US airpower has enjoyed has been largely due to its ability to overwhelm and target IADS in methodical and precise attacks. The resultant ability to physically penetrate adversary airspace and provide freedom of maneuver then enables other operations of joint and coalition forces. Today's reality is that modern air defenses will mean longer, more complex operations, that will potentially attrit more friendly aircraft and aircrew. Russia's resurgent military industrial machine is leading the way in the evolution of advanced defenses. The US's shift to stealth and precision has created a market demand for products to deter US military action that Russian industry is eager to export.⁴²

Past Soviet-era air defense systems have relied on fixed sites that provide both point and area defense. These sites designs are written into doctrine and include

“puppy paw” and star configurations that are readily identifiable to all combat aircrew since the Vietnam era. This fixed site paradigm is easily targetable through the US’s ability to efficiently find and fix locations through various technologies to include signals intelligence (SIGINT) and remote imaging. This allows preplanned strikes on known sites and provides a starting point for mission planners developing campaign plans and attempting to gain access to a target area.

Russian industry is shifting this paradigm to one of mobility. Previous stationary systems such as the benchmark SA-20 and SA-22 are now capable of 5-minute “shoot and scoot” employment using wheeled chassis, digital phased array radars, and advanced data links that quickly connect supporting systems.⁴³ This uncertainty factor in IADS component location greatly complicates US targeting.

The Suppression of Enemy Air Defenses (SEAD) mission and its corollary, Destruction of Enemy Air Defense (DEAD), rely on the ability to real-time detect, identify, fix the location and pass required information to a kinetic platform capable and close enough to affect the targeted system. These efforts can be focused on a variety of key nodes such as the command and control components, the system’s radar, or missile launchers, to name a few. The US arsenal accomplishes this through a combination of electronic attack assets and “aluminum” fighters equipped with signals detection equipment. While extremely capable in what they do, they do not enjoy the benefit of stealth, which, in light of the increasing capabilities of systems to counter stealth, push these 4th generation fighters to further and further engagement distances.

These engagement distances are not only a challenge to those trying to deliver kinetic effects, they also affect US surveillance and enabling assets that are key to filling

out the operational and tactical “picture” for an area of operations (AO). These assets include Air Force E-3 AWACS, airborne jammers, and air-refueling aircraft.

Greater engagement distances can come from the upgrades to legacy air defense products or from the new class of highly mobile, networked digital air defense weapons.⁴⁴ It is important to remember that these legacy systems were exported world wide for decades with Soviet-bloc and non-aligned states constituting the primary customers, increasing the likelihood that they would be arrayed against the US or coalition partners.

Much of this improvement in range and capability of Russian systems stem from a shift to new guidance laws that more resemble ballistic missile technology than the traditional ascent of surface to air missiles.⁴⁵ This shift improves endgame maneuvering, lethality, and pushes engagement distances out to as far as 215 nautical miles for the updated SA-21. Airborne assets that are required to stay outside that distance are on the edge of their tactical capabilities and don’t provide any penetrating support to the majority of the AO. This shift in doctrine neuters current US entry techniques and forces a strategic dependency on stealth.⁴⁶

The margin that stealth provides is not static or permanent. The impetus to counter stealth technology is only reinforced by the US and partner nations’ development of the F-35. The key attributes of stealth revolve around the exploitation of the principles inherent in the electro magnetic spectrum.

Stealth relies on shaping and material coatings to defeat a wide band of the electro magnetic spectrum that can be used to detect it. This includes a diverse range of frequencies that that acquire, track, and ultimately target air platforms. Each of these

components have wavelengths that can affect the return signals as they bounce, or not, off angles or edges of target aircraft. The energy returned to the originating system from the target will be in proportion to the aircraft's RCS.

Russian counter-stealth technology revives Very-High Frequency (VHF) band radars. By focusing their research and developments on the VHF portion of the electromagnetic spectrum, Russian designers are capitalizing on improvements in solid-state and advanced off-the-shelf technology and have produced ground based active electronically scanned array (AESA) radars.⁴⁷ The development of AESA components and improved processing is producing monopulse systems that are capable of countering hostile jamming techniques and can be included in the self-propelled family of systems.

This research in counter stealth technology is reason for concern, especially if you are an air power with a preponderance of "aluminum" assets, but more importantly the resultant technology starts to detect stealthy assets at more tactically useful ranges. The survivability of stealth is then dependent on a platform's ability to employ through its speed, altitude, and maneuverability in the terminal phase of a SAM intercept.⁴⁸ To date, and maybe for the foreseeable future, the F-22 is the only aircraft that will enjoy these attributes. Without aircraft of sufficient numbers in the F-22 class, the US faces a significant operational and strategic challenge where one has not existed in recent memory.

Key Issues and Concerns

Our national leaders propose, "we must preserve our unparalleled airpower capabilities to deter and defeat any conventional competitors, swiftly respond to crises across the globe, and support our ground forces."⁴⁹ The theme of this quote is clear, but

the reality is US air dominance and the freedom of maneuver it provides is threatened. The commitment of US planners to the strategic advantage that stealth provides has produced a not too surprising response in the world's arms market. The developments of A2/AD capabilities, new 5th generation aircraft that are proceeding faster than anticipated, and IADS that shrink stealth advantages while prohibiting legacy platforms, are all reasons the risk to US air dominance must be reexamined.

While many of these developments are taking place in China, that country is not necessarily the site for future conflict, but is a case study that could define what it means to be capable across a full range of military operations. Military planners would need to deal with the requirement to move US forces into the region in sufficient numbers while denying Chinese efforts to disrupt this force projection. The “tyranny of distance” challenges US operations that would have to operate across great distances to gain and hold access to the AO and then hit key targets. The ability to do this is a key to a credible US deterrence capability in the Pacific theater.⁵⁰

Also of interest is the willingness of both China and Russia to export counter-US technology that is observed in the inventories of forces all over the world, making the prospect of proxy conflict possible in places such as Iran, North Korea, or any other actor with reasonable resources.

Today's US air dominance is rooted in the broad and robust inventory of platforms and systems in the joint “bucket” of air capabilities. These platforms and systems have seen upgrades through the last two decades, but other than the F-22, there have not been any upgrades capable of deterring the future threat laydown. This

includes the limitations in the quantity of the US stealth fleet and is not satisfactorily addressed with significant numbers of the less capable F-35s.

The Air Force plan to update its fleet was formulated with three components. First was to field the F-22, then upgrade the legacy fleet, and finally replace that fleet with the aircraft later designated the F-35. The F-22 and F-35 were eventually meant to be the modern airpower fleet operated across the joint community. The reason both are needed is that they would have complementary capabilities. The F-35 is not a replacement for the F-22.

The F-35 does not have the operational altitude, supercruise ability, and end game maneuverability to defeat the engagement envelopes of the upgraded SAM systems mentioned earlier.⁵¹ This places its stealth capabilities as the primary method of defense. As a mitigating component, the F-35 proponents tout its APG-81 AESA radar as a capable jammer against X and S band radars, negating the threat from a large number of SAM systems.⁵² What these proponents don't include in their argument is that the new generation of air defense systems will increasingly field passive detection systems and emitter location technology in order to guide future SAM engagements.

This means stealth is still the prime attribute required to gain access and defeat area denial attempts. The F-35 all-aspect signature is not in the same class as the F-22 when looking at key bands of the electromagnetic spectrum and is not as survivable.⁵³

The changes in F-22 program numbers have been driven largely out of budget considerations and not the military requirements to get to the current inventory of 187 aircraft. An illustration of this disparity can be seen in a theoretical example based on a

2004 RAND study titled “Shaking the Heavens and Splitting the Earth, Chinese Air Force Employment in the 21st Century.”⁵⁴ This study analyzed Chinese publications in an effort to model how the PLAAF might employ its future capabilities, more specifically in a context of offensive operations targeting Taiwan.

The study theorizes a three lane operational approach over the island of Taiwan in an offensive campaign plan. For the sake of this example, the defense of the island will generate the mission type, namely Defensive Counter Air (DCA) operations. This would be an initial mission type for protection of any forward based air or ground assets. Lane requirements will vary based on the width of the air lane to be defended.

For the sake of discussion we will assume an eight-ship of F-22s will defend each lane, optimized to have at least four on station at all times, allowing periodic air-refueling of the other four and extending the coverage for a period of four hours. The aircraft would therefore have 48 missiles to defend their lane. At the end of four hours aircraft would rotate back to their base to refuel and allow for pilot recovery. Therefore for three lanes, in a 24-hour coverage, 144 sorties would be required. Assuming an aircraft would fly at a minimum of two sorties per day, the total deployment requirement would be 72 F-22s. Considering there will only be three squadrons stationed in the PACOM AO, one 18 aircraft squadron in Hawaii and two 18 aircraft squadrons in Alaska, for a total 54 aircraft it is easy to see the challenge to planners. That is not say that aircraft won’t come from other locations but that represents a significant addition to the work and timeline of campaign planners.

Total Aircraft Inventory (TAI) is normally the result of a planning factor times the Primary Mission Aircraft Inventory (PMAI) required. Traditionally, $TAI = 1.67 \times PMAI$, to

account for aircraft that are not mission-ready due to maintenance, recurring inspections, depot-level maintenance, and to account for the non-combat coded trainers and test platforms. To say that 187 aircraft is enough to face any contingency, doesn't give the operational challenge of *available* aircraft due consideration. By the math above that would mean roughly 112 F-22s are included in the mission ready category across the entire fleet. This does not take into account the mission readiness rate for each platform. The rate is generally around 80% fully mission capable, allowing for regular and preventive maintenance. When taken into account and spread across the force, it is easy to see how quickly available numbers dwindle in light of potential requirements.

Recommendations

The US Air Force is our primary national strategic force. Yet it is too small, has inadequate numbers of aging aircraft, has been marginalized in the current strategic debate, and has mortgaged its modernization program to allow the diversion of funds to prosecute an inadequately Congressionally supported war in Iraq and Afghanistan.⁵⁵

General Barry R. McCaffrey, USA (Ret)

General McCaffrey understands and eloquently expresses the strategic ramifications of decisions that have been made in recent administrations and is someone who intimately understands the freedom of maneuver that air dominance provides to the joint and coalition force. That air dominance, as this paper has attempted to illustrate, is threatened by systems and potential national intentions. What course corrections might mitigate the procurement decisions made to date and provide adequate capabilities to close the credibility gap and provide continued deterrence?

The first option is to analyze this gap. It may be determined that the resources are not available to effectively adapt and counter the developments in both aircraft and IADS that will potentially end up on the world arms market. This will be an important revelation requiring introspection and adaptation of US strategic statements. In the operational near-term it will mean significantly increased risk to US assets both in terms of platforms and personnel. This risk may not be mitigated with the equipment, tactics, and techniques available to US forces and operations may need to take that into account. Other options may help to bring the strategic calculus back in balance.

This balance would be needed for future large-scale operations especially in the context of a large regional dispute or conflict. To use China as a continuing example, the US would certainly attempt to partner with allies in the region who share our interests. Partners such as Japan and Australia are prime examples of traditional allies with military air arms that typically “buy American” and have western-style training programs with frequent US military exchanges. Each of these countries has expressed interest in acquiring the F-22 for their defense needs, but have been largely dismissed for fear of disclosing military technology.⁵⁶ The second option is to develop an export version of the F-22 for the Australian and Japanese arsenals and create an increased friendly air capability in the region. This would also help show US intent to continue long-standing defensive engagement and partnerships within a region that many must view, due to recent decisions, with skepticism.

A third option, acquire more F-22s. This option obviously has many challenges on several fronts. The first is that the F-22 program was intentionally truncated and the political ramifications could be a cost higher than civilian leaders are willing to pay. The

second is that a resource-constrained environment is loath to discuss or consider any program that will add requirements.

But if we were to examine the costs of additional F-22s in comparison with the current estimates for the F-35, there may be an argument to field the more mature system.

As more F-22s are purchased, the per-unit cost is reduced. In 2006, Maj Gen Richard Lewis, the Air Force executive officer for the F-22 program stated, “if I am allowed to buy another 100 aircraft...the average fly-away cost would be \$116 million per airplane.”⁵⁷ Compare that with current F-35 cost projections, continually fluctuating due to cost overruns and delays, when adjusted for inflation estimates put the cost per plane at between \$95 and \$113 million.⁵⁸

This is a very superficial comparison of the costs of two weapons systems and a true comparison would require a standard methodology that itself would probably be controversial. But the fact that the disparity between the costs of these two programs has closed to within a politically viable range is worthy of a more detailed analysis. The increase in strategic options and capabilities would be worth it.

In *Why Air Forces Fail*, authors describe historic examples of why national air forces failed to accomplish what their national command authorities asked them to do.⁵⁹ One of the most appropriate case studies to this the situation we face today is the examination of the British Royal Air Force (RAF) emerging from World War I.

The interwar years in Great Britain produced political, economic, and psychological pressures that resulted in a lethargic and pacific view of potential national threats. Call it the British version of what the US has termed a “peace dividend.” This

disarmament lasted until the early 1930s when German rearmament was finally noted and the alarm was sounded.⁶⁰ But, the damage had been done. The inability of the British to arm with sufficiently developed technology rooted in an appropriate doctrine was highlighted through four very stunning defeats in Norway, France, Greece, and Malaya. The Battle of Britain was the only bright spot, mainly because the RAF tended to reserve the most capable platforms for homeland defense and used them in a fight for their national survival.⁶¹

Unlike the British perception of the interwar years, this world still has threats to security and national interests. Like the British pondering the strategic environment as a legitimate world power in the 1930's, it is a familiar trap to think that air dominance will not be required or that it is a throwback to Cold War thinking. Former Defense Secretary Robert Gates' accusation of "next-war-itis" planning is a charge that minimizes the importance of strategic planning and the time needed to modernize across the range of airpower capabilities.

The men and women of the joint and coalition force need and deserve the freedom to maneuver while the nation should demand the strategic flexibility inherent in airpower. It is not too late.

Endnotes

¹ Ibid., 2.

² Rebecca Grant, *Losing Air Dominance* (Arlington, VA: Mitchell Institute Press, September 2008), 7.

³ Ibid.

⁴ Ibid., 9.

⁵ Ibid.

⁶ Ibid.

⁷ Ibid.

⁸ Ibid.

⁹ Ibid.

¹⁰ Louis J. Rodrigues, "F-22 Aircraft: Progress of the Engineering and Manufacturing Development Program," GAO Report (March 25, 1998), 4.

¹¹ Ibid., 10.

¹² Ibid., 11.

¹³ Ibid., 13.

¹⁴ Ibid., 11.

¹⁵ Jim Wolf, "Lockheed F-35 Output Should Slow: Program Chief," *Reuters (Washington)*, December 2, 2011.

¹⁶ Ibid.

¹⁷ Rebecca Grant, *Losing Air Dominance*, 4.

¹⁸ Andrew F. Krepinevich, *Why AirSea Battle?*, (Washington, DC: Center for Strategic and Budgetary Assessments, 2010), 1.

¹⁹ Ibid., 7.

²⁰ Ibid., 23.

²¹ U.S. Government Accountability Office, *Aircraft Development: Navy's Participation in Air Force's Advanced Tactical Fighter Program* (Washington, DC: U.S. Government Accountability Office, March 1990), 8.

²² Rodrigues, "F-22 Aircraft: Progress of the Engineering and Manufacturing Development Program," 1.

²³ "F-22 Raptor," November 25, 2009, US Air Force Factsheet.
<http://www.af.mil/information/factsheets/factsheet.asp?id=199> (accessed January 18, 2012).

²⁴ "India 1, USAF 0," June 24, 2004, Defense Tech website.
<http://defensetech.org/2004/06/24/india-1-usaf-0/> (accessed December 6, 2011).

²⁵ Ibid.

²⁶ Carlo Kopp, *Indian Air Force / Naval Air Arm Orbat*, November 16, 2011. <http://ausairpower.net/IAF-Orbat.html> (accessed December 6, 2011).

²⁷ Ibid., 27.

²⁸ Ibid.

²⁹ Ibid., 28.

³⁰ Ibid., 29.

³¹ Carlo Kopp and Peter Goon, *Assessing the Sukhoi PAK-FA*, February 15, 2010. <http://ausairpower.net/APA-2010-01.html> (accessed December 6, 2011).

³² Ibid.

³³ Ibid.

³⁴ Ibid., Abstract.

³⁵ Information Office of the State Council of the People's Republic of China, "China's National Defense in 2010," downloaded from http://www.china.org.cn/government/whitepaper/node_7114675.htm on March 31, 2011. http://news.xinuanet.com/english2010/china/2011-03/31/c_13806851.htm (accessed December 10, 2011).

³⁶ Roger Cliff, John Fei, Jeff Hagan, Elizabeth Hague, Eric Heginbotham, John Stillion, *Shaking the Heavens and Splitting the Earth, Chinese Air Force Employment Concepts in the 21st Century*, (Arlington, VA: RAND Corporation for Project Air Force, 2011), xix.

³⁷ Ibid., xxii.

³⁸ Austin Ramzy, "China Flexes Its Muscles with Stealth Fighter Test," January 11, 2011. Time Magazine, <http://www.time.com/time/world/article/0,8599,2041755,00.html> (accessed December 6, 2011).

³⁹ Bill Sweetman, "Chinese J-20 Stealth Fighter in Taxi Tests," January 3, 2011. Aviation Week, http://www.aviationweek.com/aw/generic/story.jsp?id=news/awst/2011/01/03/AW_01_03_2011_p18-279564.xml&channel=defense (accessed December 6, 2011).

⁴⁰ Carlo Kopp and Peter Goon, Chengdu J-XX [J-20] Stealth Fighter Prototype, January 3, 2011. <http://www.ausairpower.net/APA-J-XX-Prototype.html> (accessed December 6, 2011).

⁴¹ Ibid.

⁴² Carlo Kopp, "Evolving Technological Strategy in Advanced Air Defense Systems," *Joint Forces Quarterly*, 2nd Quarter 2010, 87.

⁴³ Ibid., 88.

⁴⁴ Ibid., 90.

⁴⁵ Ibid., 89.

⁴⁶ Ibid., 90.

⁴⁷ Ibid.

⁴⁸ Ibid., 92.

⁴⁹ The White House, "Defense: Guiding Principles," <https://www.whitehouse.gov/issues/defense> (accessed December 14, 2011).

⁵⁰ Dr. Rebecca Grant, "Testimony to the US China Commission," May 20, 2010.

⁵¹ Carlo Kopp, *Evolving Technological Strategy in Advanced Air Defense Systems*, 92.

⁵² Ibid., 93.

⁵³ Rebecca Grant, *Losing Air Dominance*, 22.

⁵⁴ Roger Cliff, et al., *Shaking the Heavens and Splitting the Earth, Chinese Air Force Employment Concepts in the 21st Century*.

⁵⁵ General Barry R. McCaffrey USA (Ret), "After Action Report-Visit Nellis and Scott AFB 14-17 August 2007," memorandum for Colonel Mike Meese, United States Military Academy, West Point, NY, October 15, 2007.

⁵⁶ Dr. Rebecca Grant, "Testimony to the US China Commission," 5.

⁵⁷ Staff Sgt. C. Todd Lopez, "F-22 excels at establishing air dominance," June 23, 2006. Air Force Print News. <http://www.af.mil/news/story.asp?storyID=123022371> (accessed December 19, 2011).

⁵⁸ Matt Loffman, "F-35 Fighters Now Double the Cost," March 11, 2010. ABC News. <http://abcnews.fo.com/blogs/politics/2010/03/f35-fighters-now-double-the-cost/> (accessed December 19, 2011).

⁵⁹ Robin Higham and Stephen Harris, *Why Air Forces Fail*, (Lexington, KY: The University Press of Kentucky), 1.

⁶⁰ Ibid., 316.

⁶¹ Ibid., 336.