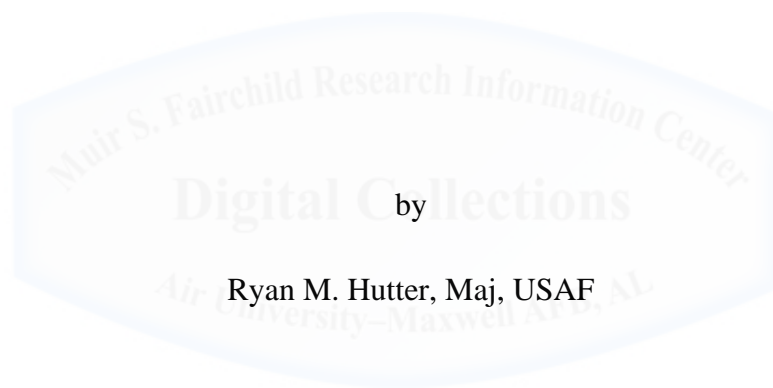


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AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

CUTTING THE CORD: SUSTAINING UNTETHERED AIR SUPERIORITY OPERATIONS IN THE PACIFIC



by

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Abstract

Since the end of the Cold War, the USAF has based airpower safely without a persistent threat from long range. This has allowed the USAF to base aircraft closer to conflicts with recent adversaries in the Middle East. As the US pivots to the Pacific, this freedom of access and maneuver is being challenged. China and North Korea possess long-range weapons that are expanding the safe operating distance further east past the second island chain. As a result, the USAF is beginning to employ untethered operations (UTO) to disperse airpower independent of main operating bases. Although UTOs enhance survivability, they have only been demonstrated on a small scale and supported exclusively from the air. During a major conflict, multiple UTOs will need to be conducted simultaneously to deliver decisive airpower. This paper argues the current USAF airlift capability is not sufficient to sustain large-scale UTOs in the Western Pacific Theater of Operations (WPTO).

A scenario methodology is used to evaluate future sustainment options for UTOs in the WPTO. Four scenarios are presented to determine the effectiveness of the scenarios to integrate land and sea-based sustainment while increasing logistics survivability and sustainment capacity.

While the USAF is demonstrating the advantages of UTOs, the Navy is fielding a new class of ship designed to provide logistics support in an A2/AD environment. In the past the USAF has used sea-based sustainment effectively and could very well apply those concepts to today's sustainment challenges. To meet the demand of future conflict in the WPTO, the USAF should expand current UTOs beyond the baseline package and sustain them by using sea-based prepositioned materiel.

Introduction

Logistics has proven to be a critical center of gravity throughout the history of warfare. Commanders are unable to sustain battle without fuel, munitions, or spare parts no matter how advanced their weapons systems may be. Since the end of the Cold War, the USAF has generated sorties from main operating bases (MOB) in support of Operations Desert Storm, Allied Force, Enduring Freedom, and Iraqi Freedom. MOBs in rear sanctuaries allow aircraft to operate safely from enemy attack. The Soviet Union was the last peer capable of attacking US air bases from long distances, either by aircraft or conventional or nuclear missiles.

As the US pivots from the Middle East to the WPTO, new threats to USAF airpower are emerging. China and North Korea possess anti-access and area-denial (A2/AD) capabilities such as conventional and nuclear weapons able to reach US forces and prevent access to the region. Such threats require the USAF to re-evaluate how air superiority operations can project survivable airpower. Not only are aircraft based in Guam, Japan, and Korea vulnerable to attack, but the USAF logistics centers of gravity located in the region are as well.

As air systems become more advanced, their logistics infrastructure becomes more complex. This complexity makes attacks on this center of gravity easier and more decisive.¹ As a result, the 2014 *Quadrennial Defense Review* stated the Department of Defense will:

enhance capabilities to disperse land-based and naval expeditionary forces to other bases and operating sites, providing the ability to operate and maintain front-line combat aircraft from austere bases while using only a small complement of logistical and support personnel and equipment.²

The USAF is beginning to employ a dispersal strategy to enhance aircraft and logistics survivability in the WPTO. Referred to as untethered operations (UTO), aircraft and their associated maintenance personnel, support equipment, spare parts, fuel, and munitions will

deploy together in a lean strike package, able to operate from nearly any austere airfield.³

Austere airfields consist of a suitable runway, in this case 6,000 to 8,000 feet to accommodate C-17 and F-22 operations, and minimal support infrastructure.

The current concept of operations (CONOPS) to support dispersed operations is to use only one line of communication – the air. The obvious choice to enable this CONOPS is the C-17 due to its cargo capacity and ability to operate from short runways. However, dispersed operations in a full-scale conflict will heavily burden the C-17 fleet and require a new way of sustainment in the WPTO. The USAF should explore the suitability of another line of communication – the sea. By prepositioning materiel at sea, the USAF can make the right materiel available at the right time while freeing more C-17s for other inter and intra-theater airlift missions.

Literature Review

Much of the research on untethered operations focuses on Europe. A strong NATO alliance and access to hundreds of air bases throughout the region make rapid, forward operations an attractive counter to Russian anti-access strategy. Rapid Raptor is beginning to show promise in the WPTO on a small scale. However, large-scale sustainment by air is particularly challenging and requires more research.

In 2010, Jan van Tol described the increasing risk to US forces in the Western Pacific Theater of Operations (WPTO) as China seeks to limit access to the region. He suggested dispersing logistics capability to increase survivability, however he did not discuss specific ways to disperse and sustain USAF air superiority operations.⁴

In his 2014 article titled “Forward Arming and Refueling Points for Fighter Aircraft: Power Projection in an Antiaccess Environment,” Lt Col Robert Davis described one of the primary challenges to sustaining UTOs in the WPTO. He wrote, “sustaining a steady supply of fuel,

munitions, personnel, and equipment on these platforms (C-17s) presents a logistical problem that demands creative solutions."⁵ Although Lt Col Davis recognized the problem, he did not present creative solutions such as prepositioned sea-based materiel to reduce demand on the C-17 fleet.

In 2015, Maj Gen Charles Brown described the UTO concept as an effective tactic to disperse aircraft and their logistics support to increase survivability in a Russian A2/AD environment. Rapid mobility in Europe is facilitated by transporting personnel and materiel by road in a relatively small geographic area compared to the WPTO.⁶ The USAF will need to seek alternative methods of sustainment without access to road transportation in the region. Another advantage Europe provides is a network of NATO and partner bases to operate from. More than 100 site surveys were completed of the more than 400 bases capable of supporting UTOs in Europe.⁷ The same needs to be done to determine the suitability of airfields in the WPTO, especially since no organization like NATO exists there.

Research Question

How can the USAF provide survivable and sustainable logistical support for air superiority operations in the Western Pacific Theater of Operations?

Research Argument

The USAF should expand the scope of the Rapid Raptor concept to conduct UTOs in the WPTO because concentrating logistics support at a limited number of bases decreases survivability in an anti-access area denial region. Chinese A2/AD strategy calls for targeting of key logistics nodes to disrupt operations in the region. Furthermore, Chinese and North Korean ballistic missiles are capable of reaching USAF logistics centers of gravity in Guam, Japan, and Korea. Some argue UTOs will be unsustainable during a high operations tempo in an A2/AD. In

support of the *Joint Concept for Access and Maneuver in the Global Commons* (JAM-GC), the USAF should leverage emerging US Navy sea-based sustainment capabilities to augment existing land and air sustainment capabilities in the Western Pacific.

Research Framework and Methodology

This paper will use a scenario planning framework to evaluate future sustainment options for UTOs in the WPTO. The four scenarios are: “Abandon the Pivot,” “Sitting Ducks,” “Land Grab,” and “Always on the Run.” The scenarios will be developed using two axes of uncertainty: survivability of logistics and the mix of land and sea-based sustainment.⁸ The key factors that will be used to evaluate the scenarios are those that determine the effectiveness of the scenarios to integrate land-based and sea-based sustainment while increasing logistics survivability. The two key factors are: the level of dispersed logistics and the amount of joint USAF and Navy materiel prepositioning. As logistics functions are dispersed throughout the region, air superiority operations become more survivable. For example, by dispersing all logistics functions away from MOBs, the amount of targets are increased, thereby lessening the impact of a single attack. The amount of joint USAF and Navy logistics integration affects where materiel can be prepositioned. For example, a high level of integration would provide the USAF sea-basing opportunities to preposition materiel instead of relying solely on airlift to sustain air superiority operations.

Each scenario will be analyzed through the lens of three guiding principles: the Long View, Outside-In thinking, and Multiple Perspectives.⁹ The long view looks beyond short term needs and is focused on a scenario’s long term impact to the area of study.¹⁰ The Outside-In view considers external influences that may affect the outcome of a scenario.¹¹ Multiple Perspectives considers alternate points of view that may differ from the original perspective of the scenario.¹²

Problem Significance

Although the Pacific global commons is far vaster than Europe, there are only six USAF bases in the WPTO. Given their limited range, USAF fighter aircraft would need to be positioned closer to mainland China to conduct air superiority operations, which would require the use of austere bases and agile, rapid logistical efforts. The USAF should explore emerging US Navy sea-basing capabilities as an enabler of UTOs in the WPTO.

Much of the UTO research has focused on Europe. With the pivot to the WPTO, it is necessary to begin researching UTO feasibility in this region. There are 258 airfields with runways that meet the minimum distances to operate the F-22 and C-17.¹³ However, site surveys must be accomplished to assess the suitability of the runways. Other considerations, besides length of runway, include the pavement classification number that represents how much weight the runway can support.¹⁴

Once suitable airfields are identified, they will need to be sustained. UTOs have been demonstrated using a minimal number of aircraft, usually four fighters plus one C-17. The scope of UTOs will need to be expanded to be effective in a full-scale conflict. The logistics footprint should be small enough to allow for rapid and agile maneuver without building up such a presence to tempt attack.

Currently, the UTO concept relies solely on C-17 support. While this enhances agility independent of a MOB, the C-17 fleet will be limited to the amount of support it can provide. Prepositioning materiel at sea will put spare parts and equipment closer to where they are needed. Maneuverability and the ability to supply just enough parts, fuel, and equipment to support agile operations without establishing permanent forward operating bases enhances logistics survivability.

Problem Background

Since the end of the Cold War, the USAF has operated and maintained aircraft relatively close to the fight with very little threat of attack. With the benefit of rear sanctuary protection in the Philippines, Saudi Arabia, and Italy, USAF aircraft were able to return to their logistics infrastructure to prepare for the next sortie over Vietnam, Iraq, or Kosovo. The same was true for air operations in the Middle East since Operation Desert Storm. The USAF must consider changing this mindset as the US pivots to the Pacific. Chinese and North Korean anti-access strategy calls for specific targeting and destruction of key logistics nodes in the WPTO. Besides Guam, other USAF logistics hubs include: Osan and Kunsan Air Bases in South Korea, and Kadena, Misawa, and Yakota Air Bases in Japan.

Guam is home to Apra Naval Base and Andersen AFB and over 6,000 military personnel. Three Global Hawks are stationed there along with a continuous rotation of B-1, B-2, and B-52 bombers.¹⁵ The island also stores 66 million gallons of jet fuel and 100,000 bombs.¹⁶ Despite its strategic importance, Guam is not currently protected against large salvos of Chinese and North Korean conventional and nuclear ballistic missiles, although it does have minimal protection against small-scale attacks from North Korea.¹⁷ There has been one Terminal High Altitude Area Defense (THAAD) battery stationed on the island since 2013.¹⁸ A salvo of a dozen or more Chinese DF-26 intermediate-range ballistic missiles (IRBM) combined with a dozen or more of the air-launched versions of the DF-26 could quickly overwhelm THAAD's eight interceptors. Guam will continue to be vulnerable until it can be properly defended. The THAAD system is limited in capacity and in quantity. With only five batteries in the inventory, the Army cannot afford to base them all on Guam. A permanent missile defense system, such as the ashore Aegis system, is the best solution.¹⁹ Until one is established, USAF aircraft and their

accompanying logistics infrastructure based at Andersen AFB will continue to be at risk. To mitigate this risk, the USAF should disperse operations to increase the survivability of aircraft and their accompanying logistics infrastructure.

This paper will characterize the A2/AD threat to sustaining USAF air superiority operations in the WPTO. Next, a brief history of dispersed USAF operations will provide historical context for current and future dispersed operations. Sustainment of dispersed operations will then be discussed, followed by scenarios for exploring four different sustainment options moving forward. The paper will conclude with analysis of the scenarios and recommendations.

Anti-Access and Area Denial (A2/AD)

Anti-access capabilities are designed to prevent an adversary from accessing specific target areas such as large land bases.²⁰ Area-denial capabilities are designed to limit an adversary's freedom of movement in an area of operations, such as the sea and the air.²¹ Contemporary discussion of A2/AD often centers on stealth aircraft, sea mines, cyberwarfare, and smart weapons designed to allow access to non-permissive environments, but the concept is not unique to modern warfare. Although it has been present throughout the history of war, A2/AD has also been countered and defeated by new tactics and new technology. An understanding of how A2/AD has been defeated in the past can help solve A2/AD challenges of today, especially in the Pacific.

A2/AD is not limited to the type of weapons used to deny access. Nor does it need to occur simultaneously in multiple domains to be effective. For example, a blockade, either on land or at sea, can be an effective anti-access tactic. The Berlin Airlift is an example of US logistics overcoming Russian anti-access operations in the early days of the Cold War. The Russians did not create a multi-domain A2/AD environment but successfully prevented access by road and

rail, the most common mode of transportation for food and supplies. The Soviet Union closed all ground transportation routes from western occupied Germany into West Berlin in an attempt to drive the Allies out of Berlin. The Soviets believed West Berlin would not be able to receive food and supplies so the US, British, and French would have to leave Berlin once the people began to starve. The American position in Europe would be threatened if West Berlin were to fall, strengthening Communist influence in the region. The Allies could take West Berlin by force and risk possible nuclear war, or they could solve the problem with a creative, peaceful solution. The Americans and Allies chose to avoid war and used existing technology in a creative way and supplied West Berlin from the air. The Berlin Airlift lasted for over one year and supplied 2.3 million tons of cargo into West Berlin.²²

Another historical example of anti-access demonstrates how new technology in the battlefield can affect access and maneuver. The machine gun in World War I contributed to trench warfare that limited the ability to advance the front lines of battle and, therefore, access to enemy territory. It was not until the introduction of airpower when forces used speed and maneuver in the air to access the enemy deep into its own territory. Just as the machine gun denied access by extending the effective range of gunfire, Chinese military advances in conventional ballistic and surface to air missiles are pushing the safe operating range for US forces further from mainland China.

Chinese Threats

Several Chinese A2/AD threats affect the USAF's ability to forward deploy and sustain operations in the WPTO. Geographic conditions, nuclear weapons, conventional ballistic missiles, and surface to air missiles make it difficult to maintain access in the region.

China benefits greatly from its geographic advantage. The flight distance from Los Angeles to Beijing is 6,265 miles.²³ Unlike the Middle East, there are no significant land masses to host an integrated logistics network. Land bases in Europe and the Middle East allow materiel to be transported across three lines of communication – land, air, and sea. Meanwhile, deployments to the WPTO have access to only two – air and sea. The long distance from CONUS to China, coupled with limited real estate available to US forces, makes it difficult to transport and base large numbers of aircraft and their logistics support. To complicate matters, once forces are deployed to the US Pacific Command's area of responsibility, they must cover over 100 million square miles and over 50 percent of the world's population.²⁴

There are two more geographic considerations that impact US access to the region – the first and second island chains. The first island chain is closest to China and runs from the Kamchatka Peninsula to Japanese, Taiwan, the Philippines, Malaysia, Brunei, and Singapore.²⁵ The second island chain runs from Japan, south to Guam, the Marianas, Micronesia, and northern Papua New Guinea.²⁶ China's A2/AD strategy centers on creating "no-go-zones" out to the second island chain. "Unless Beijing diverts from its current course of action, or Washington undertakes actions to offset or counterbalance the effects of the PLA's military buildup, the cost incurred by the US military to operate in the Western Pacific will likely rise sharply, perhaps to prohibitive levels."²⁷

Territorial claims in the South China Sea have increased tensions between China and other countries in the region such as the Philippines, Vietnam, Taiwan, Malaysia, and Brunei.²⁸ China's recent construction of man-made islands in the South China Sea is an example of its attempts to extend the first island chain. By claiming this land as sovereign, China is also claiming rights to air and sea lines of communication that would otherwise be international waters and airspace. This can restrict the areas the US and others can safely operate in the air and at sea.

Economic factors affect access to the area as well. The South China Sea has a rich fishing industry and large supply of oil and natural gas. Vietnam and the Philippines want access to the area to support their struggling economies. China also wants access to these resources to secure resources for the future.²⁹ Additionally, over \$5 trillion in trade passes through the South China Sea each year.³⁰ For these reasons, it is not surprising that this area is highly contested. China's claim to the Scarborough Shoals, located 150 miles west of the Philippines, is the closest contested area to a US ally in the region. In the spring of 2016, A-10s and HH-60Gs based in the Philippines began flying missions over Scarborough Shoals to ensure the air and sea domains remain open in accordance with international law.³¹ If the US cannot access the Pacific west of Guam, it will be forced to sustain operations from an extreme distance, impacting the USAF's ability to project power in the region.

In addition to geographic challenges, US forces must deal with significant military threats from China. Their emergence as a world economic power and their desire to maintain their strategic and military influence is driving the development of advanced nuclear and conventional military capability.³² However, China claims their "no first use" policy underscores that its nuclear weapons are intended strictly for self-defense.³³ Therefore, this paper will focus on

recent advancement of conventional threats and their impact to sustaining USAF air superiority operations in the WPTO.

The most significant conventional military threats to US bases in the WPTO are ballistic missiles. The DF-26 intermediate-range ballistic missile (IRBM), known as the “Guam Killer,” has a range of 1,800 – 2,500 miles.³⁴ Guam, the closest US territory to China, is 1,800 miles from mainland China.³⁵

The anti-ship ballistic missile (ASBM) variant of the DF-26, along with air-launched land-attack cruise missiles (LACM), air-launched anti-ship cruise missiles (ASCM), sea-launched ASCMs, and sea-launched LACMs are now capable of reaching Guam and the second island chain.³⁶ Basing a squadron of F-22s or B-2s in Guam is not as safe as it was only a few years ago.

North Korean Threats

Much of the A2/AD discussion in the Pacific theater focuses on China due to its rising military and economic power. However, North Korea presents multiple threats to USAF logistics. US air bases in South Korea are vulnerable to special forces attacks, weapons of mass destruction, and conventional missiles.

First, Osan and Kunsan Air Bases are vulnerable to attack due to their close proximity to North Korea. North Korean special forces trained for years to infiltrate and strike US air bases to prevent the USAF from projecting airpower into North Korea.³⁷ Clandestine ground forces pose an asymmetric threat against fixed US ground bases and will continue to be a threat whenever the USAF bases aircraft and logistics close to the enemy. Air Force Doctrine Document 1, *Basic Doctrine*, states: “Aircraft are most vulnerable on the ground. Thus, force protection is an integral part of airpower employment. Fixed bases are especially vulnerable as they not only

should withstand aerial, ground, and cyberspace attacks, but should also sustain concentrated and prolonged air, space, and cyberspace activities against the enemy."³⁸

Low-cost weapons such as anti-personnel grenades can inflict great damage to multi-million dollar aircraft and logistics infrastructure. In 2012 the Taliban executed such an attack on the Camp Bastion, Leatherneck, and Shorabak (BLS) Complex, Helmand Province, Afghanistan. Three teams of five, wearing US uniforms, breached the base perimeter and infiltrated the flightline area where they attacked aircraft, fuel storage, and aircraft maintenance areas. Six AV-8B Harriers were destroyed and two were severely damaged. Six additional aircraft were damaged. Three aircraft fuel bladders were destroyed. Multiple aircraft parking areas were ruined and the aircraft maintenance facilities and hangar were damaged.³⁹

Threats to USAF air bases in South Korea are not limited to North Korea. The Islamic State in Iraq and Syria (ISIS) called for attacks on US air bases all over the world in 2016.⁴⁰ Specifically, Osan and Kunsan Air Bases were singled out as targets. It is possible ISIS could team with North Korea to gain access to these fixed bases and unleash an attack similar to the 2012 attack on the BLS Complex.

Second, North Korean weapons of mass destruction threaten USAF logistics in South Korea and beyond. North Korea has an active nuclear weapons program and is suspected of having chemical and biological weapons. It conducted four nuclear tests since 2006 and continue to develop missile delivery of nuclear, biological, and chemical payloads.⁴¹ It has been reported that North Korea can deliver a nuclear warhead with the Rodong missile with a range of 800 miles.⁴² This would put USAF bases in South Korea and Japan at risk. The majority of North Korea's ballistic missile launchers consist of the short-range Toksa and SCUD-B missiles.⁴³ It is likely these missiles will be used during escalated conflict to deliver biological and chemical

weapons to degrade US and South Korean aircraft sortie generation and aircraft maintenance capabilities at nearby air bases. Personal protective equipment and decontamination procedures make operating and maintaining aircraft increasingly difficult.

Lastly, North Korea's conventional ballistic missile program continues to advance. The KN-08 missile is operational and has a range of approximately 1,500 to 3,500 miles, putting Guam within reach.⁴⁴ USAF aircraft and logistics capabilities at Andersen AFB should be dispersed to increase survivability of a North Korean conventional ballistic missile attack.

To summarize the threat to USAF logistics in the WPTO, fixed operating bases like the ones in South Korea and Guam attract attention from US enemies. Concentrated forces allow the enemy to do the most damage with the least amount of effort. Whether bases are targeted by conventional or nuclear missiles or special forces, rapid deployment and agile logistics increase survivability by keeping adversaries guessing on where the USAF is going to operate from next.

Dispersal

Dispersed operations are not new to the USAF. In the 1950's, Dispersed Operating Bases (DOB) were established in Europe to increase survivability in the event of Soviet nuclear attack. The USAFE DOB plan was to divide each base's fighter wing into squadron-sized units and disperse them 30 miles apart. Each DOB was part of the "squadron operating complex." In addition to the DOB, the complex consisted of a Dispersed Landing Area and a Dispersed Parking Area. The situation in Cold War USAFE and current day PACAF are very similar. In both eras, USAF aircraft and logistics resources were concentrated at a small number of MOBs, making them vulnerable to attack. There were a total of 15 USAFE airbases throughout the United Kingdom and the rest of Western Europe in the 1950's. At that time, it was believed that

15 well-placed nuclear warheads could eliminate USAFE's warfighting capability. Of the nine PACAF bases today, only six are within the first and second island chain.⁴⁵

The USAF is starting to re-visit dispersal operations to increase the survivability of aircraft and logistics capability. Known as untethered operations (UTO), they are designed to leverage existing partner interoperability to increase the number of airfields USAF from which fighter aircraft can operate. In 2015, Gen Frank Gorenc, then commander of USAFE-AFAFRICA, stated "the unmatched flexibility and capacity of alliance and coalition C2, mobility, and logistic strengths can bring together the right aircraft, weapons, fuel, maintenance, and Airmen at the right place and time to create the combat power needed to win."⁴⁶

UTOs are similar to the DOBs employed by USAFE during the Cold War. Both concepts disperse aircraft and logistics from away from a MOB. However, UTOs are more flexible than DOBs. UTOs, by definition, are not tethered to a MOB for sustainment. Nor are they designed with any particular mission-design series in mind. The baseline deployment package consists of four fighter aircraft accompanied by one C-17. The C-17 carries the personnel, fuel, spare parts, support equipment, and munitions required to operate the aircraft from nearly any austere airfield for up to three days.⁴⁷

Rapid Raptor

Of particular promise is the Rapid Raptor concept, a UTO developed by PACAF to project airpower in the Pacific quickly. It consists of four F-22s and one C-17. The concept has been exercised annually at Andersen AFB, Guam since 2009.⁴⁸ There have been real-world deployments as well. Two F-22s and one KC-135 from Tyndall AFB, FL deployed to Romania and Lithuania as part of the European Reassurance Initiative in the spring of 2016.⁴⁹

Despite its early success in concept demonstration, Rapid Raptor needs to mature to become an effective dispersal strategy for the USAF in the WPTO. Multiple formations of four Raptors each, or four-ships, will need to operate from different forward operating locations for Rapid Raptor to achieve its full potential. Current estimates suggest an F-22 squadron and aircraft maintenance unit with 21 primary aircraft authorized could support a maximum of three concurrently deployed four-ship Rapid Raptor packages.⁵⁰ The number of sorties each package can support is dependent on the type of mission with which it is tasked. Missions with high weapons expenditure such as offensive counter air or air-to-ground strike would require an earlier return to a forward operating location to re-arm. In this case, it is estimated each four-ship could fly 3-4 missions (12-16 sorties) per day, assuming two to four hour missions.⁵¹ A four-ship of F-22s can be turned in 60 to 120 minutes.⁵² Assuming two hour missions and a two hour turn time between each mission, the flying hour window would be 14 hours, allowing for an eight hour maintenance shift. If the missions are doubled to four hours, the flying window would extend to 22 hours, with only two hours for maintenance. Therefore, the optimal mission time for a four-ship flying three to four mission per day is two to three hours. If sustained for a 30-day period, one F-22 squadron could fly up to 480 sorties. Assuming the standard F-22 air-to-ground loadout of two GBU-32 Joint Direct Attack Munitions and two AIM-120 air-to-air missiles, the squadron could target a maximum of 960 ground targets during the period.⁵³

Rapid Next

The USAF is beginning to consider expanding Rapid Raptor beyond the F-22, influenced by the success of Rapid Raptor deployments to the Pacific and Europe.⁵⁴ Since UTOs are not tied to a mission-design series, potentially any fighter or attack aircraft could be considered to deploy using the Rapid Raptor concept. In 2015 Commander, Air Combat Command, Gen Herbert

“Hawk” Carlisle stated: “We’re working on ‘Rapid Next’. If we have US airpower show up in places and at times people don’t anticipate, that has a great effect for assuring friends and partners and has a deterring effect on potential adversaries and aggressors.”⁵⁵ Although Rapid Raptor is extremely versatile in projecting airpower on a small scale, expanding the concept will only put more demand on the C-17 fleet, especially as the USAF begins to deploy multiple Rapid Raptor and Rapid Next packages simultaneously. The USAF will need to explore other ways to support the deployments, such as sea-based pre-positioning of spare parts and equipment.

Airlift Limitations

There are limitations to how UTOs can be sustained under the current concept of operations (CONOPS). C-17s are not unlimited, nor are maintainers and aircrew. They will need to travel with adequate number of aircrew members to satisfy crew rest requirements for both the C-17 and F-22 aircraft. This is particularly important since the current PACAF Rapid Raptor plan is to depart Joint Base Elmendorf–Richardson (JBER), Alaska for an eight-hour mission to Andersen AFB, Guam.⁵⁶ Upon arriving in Guam, the F-22s will most likely swap out aircrew before continuing on to their next leg of the mission. Additionally, maintenance personnel will require rest. If personnel for only one maintenance shift are deployed, sortie generation rates will be affected since 24-hour operations will require at least two maintenance shifts.

Furthermore, C-17 rotations can be driven by the amount of munitions expended. Ideally, a new four-ship and C-17 should be at least en route, if not on station, before the current four-ship is relieved to enable a seamless transition of F-22 capability. For a period of time, one four-ship Rapid Raptor deployment can employ eight F-22s and two C-17s. If one F-22 squadron disperses as in the earlier example, up to 24 F-22s and six C-17s can be employed at the same time. If the USAF adopts a sea-based prepositioning strategy, it can relieve most of the C-17

burden by using other airlift and sealift to transport materiel from sea to shore. It is possible the only cargo a C-17 from JBER would carry would be personnel, shuttling them from one austere airfield to another.

The C-17 is a key enabler of Rapid Raptor and Rapid Next. Quick deployment of fighter and attack aircraft virtually anywhere in the world - accompanied by the people, parts, and equipment to maintain them - is what makes Rapid Raptor uniquely effective. The C-17 fleet is capable of supporting occasional single-package Rapid Raptor/Rapid Next deployments to respond to a crisis or to conduct a show of force during peacetime. However, the C-17 fleet is also the backbone of the US military's airlift capability, providing troop and cargo transport as well as aeromedical evacuation. In war, these missions will detract from the number of C-17s available to support Rapid Raptor/Rapid Next, especially on a large scale.

A full-scale conflict in the WPTO will require a certain level of mobilization. Even as the DOD continues to downsize America's military, a significant amount of personnel and materiel will need to be transported several thousands of miles to get from CONUS and other parts of the world to the area of operations. There are currently only 78 C-5s in the USAF inventory, 38-percent less than during Desert Shield.^{57,58} There are 213 C-17s in the USAF inventory.⁵⁹ Unlike the C-5, the C-17 can fill both strategic and tactical missions and will likely lead the air bridge to the Pacific.

The US has struggled with large mobilizations in the past. Military Airlift Command conducted the largest strategic airlift since Berlin during Operation Desert Shield.⁶⁰ Active Duty and Reserve aircraft were not enough to meet Central Command's demand. To help shorten the capability gap, the Civil Reserve Air Fleet was activated for the first time ever.⁶¹

Operation Enduring Freedom did not benefit from a months-long airlift prior to the war as was the case during Operation Desert Shield. Airlift to the region began when the war began. The same could happen today in the WPTO. A small conflict in the South China Sea could quickly escalate, forcing the mobilization of troops to Australia or the Philippines without prior notice. If this happened, C-17s would be in high demand, directly impacting the ability of Rapid Raptor/Rapid Next to be self-sufficient.

The C-17 airlift mission does not end when the war starts. The aircraft's short take-off and landing capability allows it to fulfill inter-theater airlift demands at short, austere airfields. In addition to troop and cargo transport, it will most likely be called upon to perform an aeromedical evacuation mission as casualties are to be expected during a full-scale conflict.

There are not enough C-17s in the USAF inventory to perform all of its intended missions in addition to supporting Rapid Raptor/Rapid next during a full-scale conflict. The USAF must consider alternatives to C-17 support, such as pre-positioned materiel at sea. A mobile, floating warehouse of spare parts and equipment is more survivable than a fixed land base.

Project Ivory Soap

Sea-based sustainment of aircraft is not unprecedented for the USAF. Project Ivory Soap was a classified World War II program that deployed a fleet of Army Air Force ships in the Pacific to provide floating aircraft repair shops.⁶² Although an Army Air Force program, it was supported jointly by 5,000 members of the Army Air Force, Army, Navy, and Merchant Marines.⁶³

The fleet consisted of six Liberty ships and 18 auxiliary ships, all modified to perform heavy maintenance and repair of B-29s, P-38s, and P-51s.⁶⁴ When an aircraft was damaged, it would often divert to an austere airfield on a remote island without the resources necessary to repair the

aircraft. Two R-4B helicopters based on each ship then ferried personnel, parts, and equipment to and from the Pacific islands.⁶⁵ Each ship had two amphibious “ducks” able to travel on land or water to transport equipment too heavy for the helicopters.⁶⁶

Project Ivory Soap demonstrated the impact logistics can make on the warfighting effort, saving hundreds of American aircraft by the end of World War II. As the USAF pivots to the Pacific, it is once again faced with sustaining forward operations in the WPTO. Project Ivory Soap can be modified to meet today’s sustainment challenges using emerging Navy capability.

USAF/Navy Integration

The *Joint Operational Access Concept* calls for new sustainment ideas that might “require new platform designs, more robust information networks, and the ability to more rapidly reach distributed combat forces operating in contested areas.” To prepare the operational area for access, the concept “envisions a sustainment system comprising a combination of basing options, the prepositioning of equipment and supplies, and a flexible, protected distribution process.”⁶⁷ The Navy’s Military Sealift Command (MSC) is already fielding new platform designs that allow prepositioning and rapid distribution at sea. The US Navy’s MSC strategically places military equipment afloat all over the world, ensuring US services have access to equipment and supplies needed to support a major theater war, humanitarian operations, or other contingencies.⁶⁸ It consists of 27 ships and supports the Army, Navy, Air Force, Marine Corps, and Defense Logistics Agency.⁶⁹ Prepositioning allows for quick and efficient movement of military equipment across operating areas, without reliance on other nations’ transportation networks. They also allow movement of equipment in areas without ports, such as underdeveloped islands.

Currently, two ships support the Air Force: MV *MAJ Bernard F Fisher* (T-AK 4396) and MV *CAPT David I Lyon* (T-AK 5362). However, their mission is limited to providing prepositioned weapons and ammunition. Unlike the USMC, USAF expeditionary operations are not supported by MSC. There is currently no USAF prepositioning of aircraft maintenance equipment or spare parts.

The Expeditionary Transfer Dock (ESD)/Expeditionary Mobile Base (ESB) is a new ship class developed to provide logistic support in an A2/AD environment. The ships are capable of carrying 380,000 pounds of jet fuel and stowing 25,000 square feet of vehicle and equipment.⁷⁰ By comparison, one C-17 can carry only 1,584 square feet of cargo.⁷¹ The ESD is a new class of ship designed to be a port at sea, capable of resupplying and sustaining forces without the need for land-based ports.⁷² Their large size and storage capacity offer a tremendous amount of flexibility for a multitude of missions. The ESBs have four core capabilities: aviation facilities, berthing, equipment staging support, and command and control assets. These capabilities can directly contribute to the sustainment of Rapid Raptor and Rapid Raptor Next by acting as logistics hub for USAF fighters and shuttling parts to remote islands via Landing Craft Air Cushions (LCAC) and the Spearhead-class Expeditionary Fast Transport (EPF), formerly known as the Joint High Speed Vessels (JHSV).

The Navy recently added two ESD ships to its fleet, the USNS *Montford Point* and the USNS *John Glenn* and plans to add three more by 2017.⁷³ In 2013, then commander of MSC, Admiral Buzby said “One could easily envision this ship serving as a repair ship, a hospital ship, an aviation depot/support ship, or a dedicated LCS mothership in the future...it’s 800 feet of ‘use your imagination’.”⁷⁴ ESD/ESB cargo can be transferred from ship to ship or from ship to shore

by HH-60s or V-22s. New platforms such as the ESD/ESB can free some C-17s for missions other than UTO support.

For Rapid Raptor to be effective in the WPTO, the USAF should leverage the Navy's prepositioning and resupply capabilities to sustain distributed operations in a full-scale war. The USAF should not rely on C-17s alone to sustain distributed operations.

The Marines are not new to sea-based sustainment of air operations and much can be learned from their experience. Maritime Prepositioning Force (MPF) ships provide prepositioned supplies for Marine Air to Ground Task Forces (MAGTF). MPF ships are organized into two Maritime Prepositioning Ship (MPS) squadrons with each squadron assigned four to six MPF ships. Each MPS squadron is capable of supporting one MAGTF for 30 days. The USMC is also supported by two Aviation Logistics Support ships, SS *Curtiss* and SS *Wright*, both capable of providing at-sea maintenance for USMC fixed and rotary wing aircraft.⁷⁵ The USAF could establish a squadron of ESB/ESDs and EPFs to preposition aircraft parts and support equipment. The ESB/ESDs would be floating warehouses and repair shops, acting as the hub. Cargo would be transferred from the ESB/ESD to EPFs for fast, long distance transport. If the ESB/ESDs are within range, LCACS could transfer cargo ashore.

The USAF should work jointly with the Navy to procure and configure one or more MLP ships to directly support USAF distributed logistics in the WPTO. The ships can provide more than just prepositioned weapons storage.⁷⁶ ESD ships can store mobility readiness spares packages, aerospace ground equipment, spare engines, consumables, wheel and tire assemblies, tow vehicles, and tool boxes. They can even be configured for sea-based aviation repair facilities such as an engine repair shop. Because of the F-35's commonality amongst its three variants, an ESD dedicated solely to the F-35 could be shared among the USAF, Navy, and

USMC to resupply forward operating bases, aircraft carriers, and amphibious assault ships.⁷⁷ This would enhance forward sustainment of F-35s while minimizing the logistics footprint at forward operating bases and aboard aircraft carriers and amphibious assault ships. Another configuration might combine similar logistics support for F-22, F-16, F-15, and A-10 aircraft.

The *JOAC* states “self-contained joint elements, supported by joint fires, will move independently on multiple lines of operations from multiple ports of embarkation, rerouting as necessary en route, concentrating quickly against key objectives, and dispersing again as the situation requires.”⁷⁸ To enable self-contained sortie generation in support of dispersed operations, the USAF requires sea-based logistics capabilities to eliminate the need for main operating base logistics support.

Basing Options

Sea-based sustainment should not replace current or future USAF bases in the region. There should be a mix of fixed land bases and mobile, sea-based platforms. The US is working with the Philippines, Australia, Singapore, and Tinian Island to augment existing bases.

The US recently reached a significant basing agreement with the Philippines, giving the USAF access to four air bases in the country. The agreement also allows the US to pre-position logistics supplies to be used by forces on a rotational basis.⁷⁹ The Philippines is a key location due to its close proximity to the South China Sea and the Spratly Islands. Having access to the Philippines gives the USAF flexibility to operate there without the investment a permanent base requires. The Philippines could very well host a Rapid Raptor or Rapid Next deployment in the near future.

The DOD has been working with Australia to base Marines in Darwin since 2011.⁸⁰ Australia provides protection from Chinese and North Korean missiles due to its distance and

could be a favorable area to base USAF aircraft, especially long range bombers. However, plans to base Marines there have been delayed until 2020, primarily because of funding disagreements between the two countries.

When US forces moved out of the Philippines in the early 1990's, Singapore quickly replaced the Philippines as the new logistics hub in the region.⁸¹ There is a considerable Navy presence there and could host USAF aircraft during conflict.

The USAF recently selected Tinian island, north of Guam, as a divert location to be used in the event access to Guam is limited or denied.⁸² The bases in the Philippines give the USAF access to the first island chain and the South China Sea while Tinian Island secures another operating location in the second island chain. These bases could host a Rapid Raptor deployment, providing pre-positioned logistic support. Additionally, they could be re-supplied by the Navy's ESD/ESB ships.

Scenarios

Scenario 1. "Abandon the Pivot"

The Pacific pivot was supposed to "rebalance" military strategic focus to the Asia-Pacific region. As the wars in Afghanistan and Iraq came to an end, resources were to be re-purposed to project US power and protect its allies in the region. However, events in the Middle East and Europe persisted and required continued USAF airstrikes and humanitarian assistance in Syria and Iraq as well as strategic deployments in Eastern Europe.

The year is 2018 and the federal government has instituted a second round of budget sequestration. Still suffering from the first round of budget cuts in 2012, the USAF is struggling to meet worldwide commitments. Training and combat readiness are suffering due to grounded fighter squadrons at home. Operation Inherent Resolve continues to strain aircrew and

maintenance personnel. Ukraine is now a member of NATO which has severely strained US – Russian relations, demanding more USAF presence in Eastern Europe in support of NATO allies.

China's growing military strength must be kept in check, especially its development of man-made islands. Disputed claims of sovereignty directly impact the ability of the USAF and US Navy to maneuver in international airspace and waters. North Korea's unpredictable regime continues to openly threaten the US with nuclear war as a way to coerce the US and its allies.

Although the reasons for the Pacific pivot are sound, the US cannot afford it. The US and Australia have still yet to reach a long-term agreement to fund Marines stationed at Darwin, Australia. Protests in Japan forced the USAF and Marines off the island. To protect US territory and allies, billions must be spent on missile defense systems for Guam, Japan, and South Korea.

As a result of multiple conflicts world-wide and significant resources required, especially during a period of sequestration, the US abandons the pivot. USAF basing in South Korea and Japan will continue since those countries spend billions of dollars to keep US forces stationed there.

Analysis

Fiscal realities require the US to prioritize its world-wide security commitments. When the Pacific pivot was first announced in 2011, it was envisioned the US would expand military involvement in the region. However, ongoing operations in the Middle East, as well as tensions in Eastern Europe and Russia have demanded USAF attention.

When evaluated along the axes of uncertainty described in the Research Framework and Methodology section, this scenario increases survivability of the USAF by eliminating the

forward presence required by the pivot. At the same time, sustainment of USAF assets in this scenario is limited to land bases since forward presence is eliminated.

In the long view, the ability for the USAF to project power is severely limited if budget constraints continue, especially sequestration. UTOs like Rapid Raptor may not be funded, impacting agile, dispersed operations. As a result, stability in the region will be affected. Logistics functions would continue to be concentrated to bases in Guam, Japan, and South Korea, making attractive targets for China and North Korea.

Looking at this scenario from an outside-in perspective, the USAF could use money saved from shifting resources to the Pacific to increase funding for CONUS training to recover the combat capability lost since the first round of sequestration. Instead of focusing on rapid, tactical air superiority operations, the USAF could opt for the more strategic approach of long-range strike. The B-2, and eventually the B-21, can reach targets in North Korea and China from the safety of CONUS bases.

When looking at this scenario from multiple perspectives, the perception of US allies such as Japan, South Korea, Australia, Singapore, and Taiwan must be considered. It is assumed certain defense capabilities in the region, such as missile defense, would be negatively impacted if the US were to abandon the pivot. In this case, allies would need to assume more responsibility for the security of the Pacific region. While the long-range strike approach would increase survivability and eliminate the requirement for forward sustainment, it could be viewed by allies as too reactive.

Scenario 2. “Sitting Ducks”

The year is 2020 and the USAF is operating and maintaining airpower in the Pacific exclusively from six MOBs in the Pacific. Years ago the US decided not to invest political and

economic capital to gain access to airfields throughout the region and is now limited in its ability to disperse USAF operations. USAF aircraft and logistics capabilities are dependent on the security of these bases; however budget constraints and political disagreements with host countries limited the amount of missile defense.

Despite limited air defenses on Guam, F-22s from Joint Base Elmendorf-Richardson and Joint Base Pearl Harbor-Hickam maintained a permanent presence at Andersen AFB for the past four years. Each base continues to share responsibility on a rotational basis, sending one squadron to Guam every six months. Andersen AFB also hosts frequent deployments of B-2s and B-52s. The aircraft are well supported by Andersen's logistics and sustainment capabilities. However, as previously mentioned, Guam is far from mainland China. Aircraft flying missions into the first island chain will require frequent air refueling to have sufficient range to be effective. If they air abort in the first island chain, options for a divert airfield are limited.

For the past two years China focused its expansion effort on the Scarborough Shoal, just 150 miles west of the Philippines, and transformed the land mass from a shoal to an island with a 10,000 foot airstrip. Chinese militarization of the island threatens the Philippine's 200-mile Exclusive Economic Zone (EEZ). The EEZ is the area in which a country has jurisdiction over the water and natural resources off its coast.⁸³ China infringed on the Philippine's EEZ by claiming the man-made island as sovereign Chinese territory.

Since the completion of Scarborough Island, the USAF conducted air patrols off the west coast of the Philippines to ensure free access to the waters between the mainland and the island. Last month during a routine air patrol of the Philippines' EEZ, a Navy F-18 was intercepted by a Chinese J-11. Before the J-11 could fire on the Navy jet, an F-22 from Guam shot it down. China swiftly retaliated and launched a salvo of hundreds air and ground launched DF-26

intermediate-range missiles at Guam. The missiles quickly overwhelmed the lone THAAD battery on the island, resulting in catastrophic damage to the airfield, aircraft, and jet fuel stores.

Analysis

This fictional scenario illustrates the vulnerability of concentrated logistics. The axes of uncertainty described in the Research Framework and Methodology section show this scenario is very dependent on land-based sustainment provided by the six MOBs. Concentrated logistics at these bases negatively impacts the survivability of aircraft and sustainment resources.

The long view indicates operating from MOBs will make it difficult for the USAF to access and operate within the first island chain. Guam's strategic importance as the only US territory in the region gives the US access to Andersen AFB without political and diplomatic agreements. This makes it an attractive location to stage and project airpower. It also makes the island a valuable target for China or North Korea. Not long ago, the island was considered safe from Chinese or North Korean attack. This is not the case today. Without access to airfields near the first island chain, USAF aircraft require significant air refueling capability to get them close to the fight and back home again. Dispersed logistics at remote airfields would allow attacking aircraft the ability to "hop" to their target, or provide a place to divert to in case of an in-flight emergency.

Viewing this scenario from the outside-in, China attacked Guam because of the value it placed on the target. If Guam was a small, austere island between the first and second island chains with no significant military infrastructure, China may think twice about launching valuable intermediate-range missiles at a somewhat inconsequential target. If the USAF dispersed aircraft from Guam to multiple austere airfields in this scenario, the value of Guam as a target diminishes while China's ability to track, target, and destroy critical USAF assets is

complicated. Eliminating the need for reach back to a MOB allows the USAF to deploy aircraft and maintenance together, enhancing survivability.

This scenario is based on the inability of the US to protect key bases from missile attacks. If permanent missile defense systems can be delivered to Guam and Japan, it is possible the USAF could operate from the MOBs protected from attack.

Scenario 3. “Land Grab”

In this scenario the USAF begins to disperse aircraft and logistics together by seeking political and diplomatic cooperation with other Pacific nations to expand its permanent bases throughout the region. Additionally, the USAF recognizes the effectiveness of UTOs and begins to incorporate them into its overall Pacific security strategy.

The year is 2020 and the PACAF landscape looks much different than it did in 2016. The USAF now bases aircraft in Singapore, Taiwan, and the Philippines. The USAF previously maintained a training presence in Singapore, primarily for joint exercises like Commando Sling. This has been replaced by a permanent F-16 combat-ready squadron. Winston Churchill referred to Singapore as “the Gibraltar of the East” because of its strategic location connecting the Indian Ocean with the South China Sea.⁸⁴ Taiwan is also strategically positioned to give the USAF access to the first island chain within approximately 111 miles of mainland China.⁸⁵ Taiwan now hosts a permanent squadron of F-16s. In 2016, the Philippines agreed to reopen Clark Air Force Base. The base is now a joint USAF-Navy base hosting one squadron of EA-18Gs and one squadron of F-35s.

To augment the three new forward operating bases, the USAF incorporates UTOs like Rapid Raptor and Rapid Next. The MV *MAJ Bernard F Fisher* and the MV *CAPT David I Lyon* continue to provide sea-based prepositioned munitions; however the full potential of

prepositioned materiel at sea has not been realized yet. Therefore, instead of hopping from one austere airfield to another, the UTOs are limited to permanent land bases to promote interoperability with international partners as well as benefit from the land-based logistics infrastructure. For example, a squadron of F-22s temporarily based in Guam fly to the Philippines to patrol the South China Sea. The next day they fly to Singapore to conduct training with the Republic of Singapore Air Force. Next, they fly to Guam before heading home to Joint Base Elmendorf-Richardson.

Analysis

Additional bases disperse logistics among a greater number of bases as well as over a greater geographic area; however survivability of the logistics infrastructure is low due to the fixed nature of land bases. UTOs, as used in this scenario, provide a minimal level of unpredictability. UTOs expanded out to austere islands can increase survivability by operating and maintaining from potentially hundreds of airfields. Sea-based prepositioning and aircraft repair capability is needed to use UTOs on a large scale.

Looking at this scenario from the long view, establishing new forward operating locations in foreign countries requires a significant amount of diplomacy. Our allies today may not be our friends tomorrow. Subic Bay Naval Base was critical for the US during World War II, Vietnam, and throughout the Cold War, but it was closed in 1991 when the US lease ran out and the two governments failed to reach an agreement on a new lease.⁸⁶ Today, the US and Australia are still working out the details on how to station 2,500-person MAGTF in Darwin. The plan has been in place for years is now delayed until 2020.⁸⁷ UTOs are attractive because they do not require the same amount of diplomacy as permanent basing. Gaining temporary access to an airfield during

a crisis or escalating conflict is easier than negotiating long-term basing agreements that may deteriorate over time.

Viewing this scenario from the outside-in, our allies may have concerns about allowing the USAF to permanently base aircraft in their countries. An alliance with the US, backed by permanently based aircraft, may increase attention from China or North Korea. Additionally, regular rotations of F-22s in Taiwan may be seen as overly aggressive by China because of Taiwan's close proximity to China and the history between them. Both situations could cause existing tensions to escalate.

The US must consider how to protect the new forward operating bases from the same attacks that make Guam vulnerable. Singapore, Taiwan, and the Philippines most likely would not be capable of providing missile defense for US forces operating there. The financial burden of expanding the number of bases in the WPTO may very well make the expansion cost-prohibitive.

Scenario 4. "Always on the Run"

The year is 2020. Twelve combat armed F-22s from JBER deployed to the WPTO in response to escalating tensions in the South China Sea. Four went to Royal Brunei Air Force Base Rimba, four landed at Royal Malaysian Air Force Base Butterworth, and four landed in Palau. Each four-ship was accompanied by one C-17 with aircraft maintenance personnel, support equipment and munitions on board. One additional C-17 departed JBER with backup maintenance and aircrew arrived at Clark AFB in the Philippines and rested in preparation to relieve current maintenance crews and aircrew. When maintenance crews and aircrews needed to be rotated, the C-17s transported them to Clark AFB where the back-up crews were resting. The C-17s then transported the relief crews to the next operating location while the original

crews rested at Clark AFB. This cycle was repeated throughout the Raptors' deployment. Upon arriving at their destinations, the 12 Raptors were quickly refueled and were flying their first missions within two hours of arriving.

Meanwhile, in the southern part of the South China Sea, USAF Sea Logistics Squadron-1 (SLS-1) was positioned midway between Brunei and Singapore. SLS-1 consisted of one Expeditionary Sea Base (ESB) ship, one Expeditionary Fast Transport (EPF), and four V-22s. While the Raptors were en route to their first operating location, the squadron delivered resupply parts and munitions in advance to Tinian Island, Clark AFB, and Korat Royal Thai Air Force Base. These were the second operating locations scheduled for the Raptors. Jets from Palau continued on to Tinian Island, jets from Brunei went to the Philippines, and the jets at RMAF Butterworth continued on to Korat Royal Thai Air Force Base.

SLS-1 contributed in others ways besides forward positioning parts and munitions. One of the Raptors from Brunei diverted to Puerto Princessa International Airport in Palawan after completing its mission over the Spratly Islands. Palawan is an island located in the southwest part of the Philippines. The jet's number one engine failed and needed to be replaced but the C-17s had not brought spare engines with them to reduce their logistics footprint. Anticipating this scenario, the USAF prepositioned spare F-22 engines and engine removal and installation trailers aboard SLS-1's ESB. One of the ship's V-22s was loaded with a spare engine and engine trailer and departed for Brunei to pick up maintenance personnel and took them to Palawan. The engine was delivered within hours of notification and the aircraft was returned to service with minimal downtime.

Analysis

This scenario was based on the Rapid Raptor concept. It illustrated the challenges presented by expanding the current concept from four aircraft to twelve and demonstrated the value of sea-based prepositioned logistics. The Raptors were able to operate from six different locations without being tethered to a main operating base. The USAF sea-based logistics squadron dispersed materiel to three different bases and provided mission critical assets to a remote airfield. A personnel hub was established in the Philippines, allowing maintenance personnel and aircrew to maintain 24/7 support.

The axes of uncertainty described in the Research Framework and Methodology section show this scenario results in more survivable logistics by using UTOs to disperse air superiority operations over a wide range of airfields and bases in WPTO. At the same time, joint USAF and Navy logistics incorporate sea-based prepositioning and aircraft repair capabilities on a large scale.

Looking at the long view, embracing UTOs on a large scale will require not only increased partnership with the Navy, but investment in new ways of projecting and sustaining air superiority operations. Using Project Ivory Soap as a blueprint for future sustainment, the USAF will need to invest in a fleet of support ships operated by the Navy's Military Sealift Command to preposition materiel to support UTOs. There are three advantages to this solution. First, the dispersal of logistics assets and mobility at sea makes sustainment more survivable in an A2/AD environment. Second, a sea-based logistics fleet positions materiel forward, reducing the dependence on MOB support. Third, the fleet's mobility allows it to operate freely in international waters, independent from host nations for support. In this scenario, the USAF operated from Tinian Island and the island of Palau. Neither island provided support of any kind

beyond access to the airfields. The same is true for the Palawan divert location. Access to the Thai and Malaysian airfields would require minimal diplomatic coordination because of both country's support of frequent joint international exercises.

Evaluating this scenario from the outside-in, it would be very difficult for China or North Korea to target the F-22 logistics infrastructure. The rapid movement of aircraft and self-contained logistics support make UTOs unpredictable. An adversary would have to be willing to launch several missiles at relatively low-threat operating locations in addition to destroying SLS-1. Attacking Brunei to destroy four F-22s may not have the same strategic impact as attacking all 12 aircraft based in one place, like Guam or the Philippines.

The USAF may not intend for Rapid Raptor or Rapid Next to be employed on a large-scale. As this scenario shows, the complexity of UTOs increases as more aircraft and operating locations are included. Additionally, investment in a fleet of ships increases the commitment to UTOs for the long term. Perhaps UTOs can be more effective and sustainable on a small-scale. The ability to have four F-22s show up unannounced to key hotspots around the globe can reassure allies while achieving strategic goals.

Recommendations

The scenarios presented future outcomes of four possible choices the DOD could make concerning the sustainment of large-scale UTOs in an A2/AD environment. They are not the only choices or solutions. Although there is no "silver bullet" for sustaining UTOs, elements of each scenario influenced the following recommendations.

1. Maintain current PACAF MOBs
2. Conduct site surveys to determine the suitability of runways of potential austere operating locations in the WPTO

3. Continue diplomatic efforts to gain access to remote airfields
4. Expand Rapid Raptor and Rapid Next to include multiple, large-scale, simultaneous deployments
5. Fund the acquisition of at least one Sea-based Logistics Squadron consisting of one ESD, one EPF, and four V-22s

Conclusion

The USAF finds itself moving from a region of great access to one of limited access as the US pivots to the Pacific. Geographic conditions coupled with advancing military capability will make it increasingly difficult for the USAF to operate in the WPTO. Just as the machine gun restricted access to enemy territory in World War I, conventional and nuclear missiles are pushing today's safe zone in the WPTO further east and south. UTOs have shown potential to counter these A2/AD threats by operating independently from MOBs on a small scale. A key contributor to this independence has been the C-17. However, the C-17 is the backbone of the US military's airlift. A full-scale conflict will require the C-17 to transport troops and equipment in addition to performing medical evacuation once conflict begins. These operations will most likely limit the ability of the C-17 fleet to support UTOs. Therefore, the USAF needs to explore other sustainment options for UTOs to be effective on a large scale.

History has shown sea-based sustainment can be effective for the USAF. Project Ivory Soap was very successful during World War II and saved hundreds of aircraft. The same blueprint can be applied to today's operations in the WPTO. The scenario titled "Always on the Run" demonstrated how prepositioned logistics assets at sea can support multiple, simultaneous UTOs operating from several locations. However, the affect large-scale UTOs will have on USAF and

Navy manpower and force protection is unknown. Additionally, joint USAF and Navy integration will need to be enhanced for the acquisition and operation of USAF MSC ships.

More research is required to determine how UTOs impact manpower requirements for the USAF and Navy. Additional aircrew and maintenance personnel may be needed to support operating and maintaining aircraft from multiple remote locations in addition to MOBs. The MSC will likely require more manpower to operate additional USAF ships. Force protection capabilities should also be studied to determine if additional resources or capabilities are needed to protect a larger MSC fleet. Finally, collaboration between the USAF and Navy acquisition and operational communities will be critical in fielding ships to sustain USAF UTOs. Although more research is needed, the timeline to achieving sea-based sustainment of UTOs will be much shorter than ongoing USAF acquisitions such as the F-35 and KC-46.

The Berlin Airlift proved an adversary's attempt to deny access to a geographic area could be defeated by using existing technology in a creative way. Similarly, the technology required to enable large-scale UTOs in the WPTO is already fielded by the USAF and Navy. Through the acquisition of additional MSC ships, the USAF can be better positioned to provide survivable sustainment for UTOs in the future.

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