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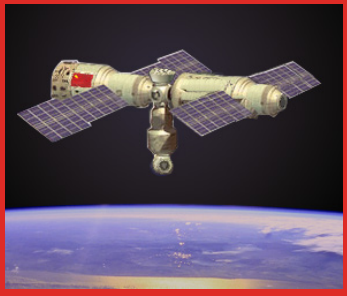

A Primer on Trends in China's Military Air, Space, and Missile Forces

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Forward

The Chinese People's Liberation Army (PLA) continues to develop rapidly across all aspects- hardware, technology, personnel, organization, etc. The PLA's aerospace forces are, in many ways, leading that change. These include the PLA Air Force (PLAAF), PLA Rocket Force (PLARF), Naval Aviation, and space and cyber assets affiliated with the PLA Strategic Support Force (PLASSF). This inaugural volume from the China Aerospace Studies Institute (CASI), seeks to provide a brief primer on the trends affecting these forces and provide basic information about their composition and role today.

This publication outlines the roles and missions of China's aerospace forces, the PLA Air Force and its five branches, the PLA Rocket Force, and the PLA Strategic Support Force. It also identifies trends in PLA aerospace training and operational proficiency for these forces, and discusses the near-term outlook. There is a plethora of information, which evolves on an almost constant basis, available to leaders and policymakers on the hardware and technical aspects of these forces. As such, that is not the focus of this publication. Rather, this work is intended to serve as foundational work, capturing a snapshot of capabilities, and an outline of organizations, while identifying trends underway at the time of its writing, late 2016 to summer 2017.

CASI supports the U.S. Defense Department and the China research community writ-large by providing high quality, unclassified research on Chinese aerospace developments in the context of U.S. strategic imperatives in the Asia-Pacific region. Primarily focused on China's Military Air, Space, and Missile Forces, CASI capitalizes on publicly available native language resources to gain insights as to how the Chinese speak to and among one another on these topics.

With this first volume, CASI begins to describe the fundamentals in the field. Further research projects will expand on the framework laid out in this

primer, and will both expand and deepen public knowledge of developments in Chinese aerospace. While primarily focused on developments related to the services and branches of the People's Liberation Army's aerospace assets and forces, CASI will also explore topics and areas related to the support infrastructure, industrial base, and civil-military integration, that combines together to form the overall China aerospace field.

CASI would like to acknowledge the work and effort of its Research Director, Ken Allen, for the writing, editing, and countless revisions to this publication to make sure it was relevant and up to date. CASI would like to thank the CASI Associates and all those that contributed to the compilation of data, research, and writing, of this volume, particularly Mike, Derek, and Lyle.

We hope you will find this volume useful and timely, and welcome any feedback on its contents, or suggestions for further or future research in this field.

Dr. Brendan S. Mulvaney
Director, China Aerospace Studies Institute

1. Introduction

Over the last two and a half decades, the People's Republic of China (PRC) has invested heavily in the modernization of its military forces. These efforts have yielded dramatic improvements in the personnel, organizational structure, equipment, training, doctrine, and overall proficiency of the People's Liberation Army (PLA). China's air, space, and missile forces in particular—collectively referred to here as the PLA's "aerospace forces"—have transformed rapidly from a comparatively low base of capabilities in the 1990s into forces that today could pose significant challenges to any opponent. China's military leaders have observed the evolution of other nations' forces and have taken lessons from recent conflicts. They have sought to rebuild their own aerospace capabilities with these changes in mind. China seeks to modernize its aerospace forces—including weapons, equipment, personnel, and organizational structure—to support an increasingly ambitious regional security strategy that involves deterring any adversary, and, should deterrence fail, prevailing in combat.

At the start of 2016, Chinese President Xi Jinping, in his role as Chairman of the Chinese Communist Party (CCP) Central Committee's Military Commission (CMC), announced major structural reforms to the PLA. Notably, Xi elevated the PLA's Second Artillery Force (PLASAF)—once an independent branch of the PLA—to service-level stature on par with the three other services (Army, Navy, and Air Force) and renamed it the "PLA Rocket Force" (PLARF).[1] The PLARF has historically been charged with developing nuclear strike and counterstrike options, but its mission and capabilities have grown since the early 1990s to include carrying out conventional ballistic and cruise missile strikes.

Xi also established the PLA's Strategic Support Force (PLASSF) to support joint combat operations in space and to conduct operations in the electromagnetic spectrum. Although the full details are unclear at the time of this writing,

the PLASSF appears to be responsible for providing space-based reconnaissance, communication, and positioning capabilities and for maintaining situational awareness of objects in earth orbit, as well as for cyber and electronic warfare capabilities.[2] The PLASSF may also be charged with developing counter-space capabilities.

President Xi has also stressed the importance of continuing to modernize the PLA Air Force (PLAAF). Xi seeks to "accelerate the construction of a powerful people's air force that integrates air and space and is simultaneously prepared for offensive and defensive operations."[3] The PLAAF, accordingly, is now expected to undertake an expanded set of missions beyond defending Chinese territorial airspace to include launching offensive operations against enemy assets at distances beyond the first island. The PLAAF also fields a robust surface-to-air missile (SAM) capability to defend Chinese airspace. In addition, the PLAAF is expected to improve its capabilities to participate in military operations other than war (MOOTW), such as humanitarian assistance and disaster relief (HA/DR) and non-combatant evacuation operations (NEOs).

[4]
China's President Xi Jinping reviews an honor guard during a welcoming ceremony for Nigerian President Muhammadu Buhari (not pictured) in Beijing, April 12, 2016

In short, as China's interest and capabilities in power projection grow, PLA aerospace power will play an increasingly important role in fulfilling PLA efforts to protect increasingly expansive Chinese interests abroad.

This report provides an overview of China's military aerospace forces today. Chapter 2 describes how we believe the PLA envisions a potential future large-scale conflict and what roles its air, space, and missile forces would play in such a conflict.

Chapters 3, 4, and 5 examine China's aerospace forces in detail, including the PLAAF, PLARF, and PLASSF respectively. In each chapter, we summarize recent developments, describe the major weapon systems within each component, and offer analysis of the types of operational capabilities provided by these systems.

Chapter 6 analyzes recent trends in training across all components within

the PLA aerospace forces, and what such training might mean for operational proficiency.

Chapter 7 concludes with some thoughts about the possible future evolution of China's aerospace forces and potential implications for U.S. defense planning.

2. Roles and Missions of China's Aerospace Forces

This chapter describes the roles that China's military leaders envisage their air, space, and missile forces playing in a potential future large-scale conflict. The chapter highlights the challenges that China's rapidly evolving military capabilities could pose to U.S. and allied security objectives in the Asia-Pacific region. Finally, the chapter provides the operational and doctrinal context for the air, space, and missile systems and capabilities described in subsequent chapters.

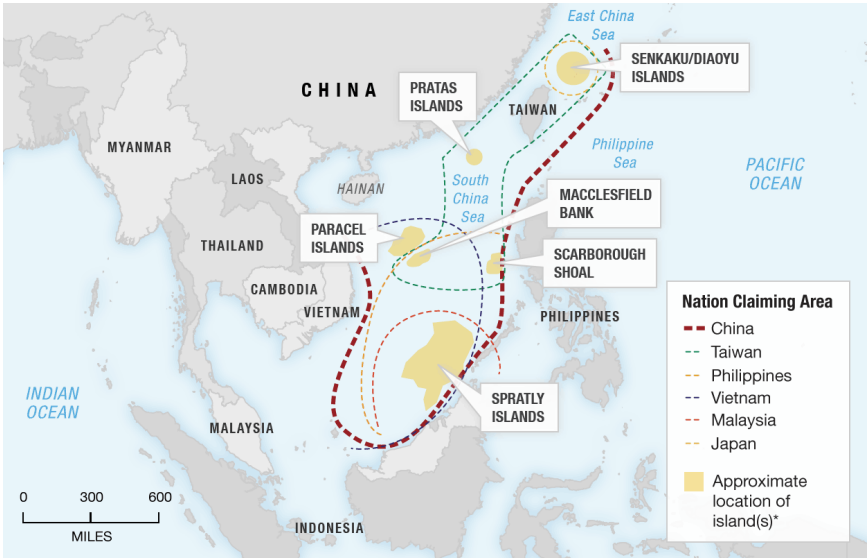
China's Security Objectives

Like all governments, the PRC charges its armed forces with responsibility for protecting China's sovereignty and territorial integrity in the face of potential external threats. The collapse of the Soviet Union in 1991 prompted China's military leaders to turn their focus to the United States as the greatest potential military foe facing China in the future. The performance of U.S. forces in Operation Desert Storm (1991), the Taiwan Strait Crisis (1996), Operation Allied Force (1999), and other large-scale operations, convinced Chinese planners that the challenges posed by the United States were serious and that meeting them would require substantial and sustained investments in modern air, space, and missile forces; advanced command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) assets; sophisticated training and doctrine; and an educated and well-trained enlisted force and officer corps.

As a result, China has been rapidly developing military capabilities that are designed to deter, deny, and ultimately defeat U.S. and other military forces in any security dispute that might occur in its region. Chief among these is Taiwan, which has been a key driver of Chinese military modernization generally and aerospace forces in particular for more than two decades, but China also considers

conflicts that might arise out of sovereignty disputes in the East China Sea and South China Sea.[5]

China is increasing its capabilities to operate in the East China Sea or "first island chain" and the South China Sea



China also looks to its growing military capabilities to be agents of influence in East Asia and beyond. China's leaders have vowed to build "powerful armed forces that are commensurate with China's international standing."[6] This entails military forces with strategic and power projection capabilities, stretching well beyond China's immediate neighborhood. China has been employing these expanding capabilities in missions that include protection of China's sea lines of communication (SLOCs) as well as counter-piracy and HA/DR activities around the world.

Chinese Military Strategy and Doctrine

Chinese warfighting doctrine has remained remarkably consistent in some ways since the establishment of the PLA in 1927, even as it has evolved to keep pace with changes in military technology, an evolving security environment, and China's expanding interests. This is because every Chinese leader has been faced with the same basic challenge of defending China militarily against formidable opponents on its periphery. Indeed, China has long had to find ways to overcome its "inferiority in the material means of war" when competing with the likes of U.S., Russian, or Japanese military forces.[7] As a result, Chinese leaders starting

with Mao Zedong have consistently endorsed a defensive approach to conflict prevention. To be sure, China emphasizes that it retains the right to respond with offensive operations if attacked. Mao, in fact, first coined the term "Active Defense" in 1936—a concept that has maintained relevance today, as evidenced by China's defense white paper in 2015, which dedicated an entire section to this approach.[8,9]

Another critical aspect of Chinese warfighting doctrine is China's perception of technology and the role it plays in military capabilities. Beginning in 1979 during the reform and opening up period under Deng Xiaoping's leadership, China moved away from Mao's concept of "People's War," which emphasized manpower over mechanization, toward a greater appreciation of the need to develop modern combat capabilities. The revised concept, "People's War under Modern Conditions," remained the PLA's guiding principle until the early 1990s when China witnessed advanced capabilities on display by the United States military during Operation Desert Storm—in particular, the use of superior information about the battlespace and precision-guided munitions (PGMs) as key components of modern warfare. Concerns over superior U.S. warfighting capabilities prompted China's military leaders to shift Chinese military strategy.

Starting in 1993, Chinese President and CMC Chairman Jiang Zemin advocated that the PLA "prepare for military struggle and winning local wars that might occur under modern, especially high-technology conditions."[10] This was a major change that prioritized advanced weaponry and recognized the importance of "winning" rather than just "fighting" in any conflict that might occur near China's border. Jiang's statement was modified further in 2004, under President and CMC Chairman Hu Jintao's leadership, to read: "we must clearly place the basis of preparations for military struggle on winning local wars under the conditions of informatization."[11] With this statement, China affirmed that network-centric warfare, i.e. "informatization," had become a central feature of modern military operations and asserted that China's military forces must account for informatized war in future conflict scenarios.

The latest revision to Chinese doctrine goes a step further by dropping "…under the conditions of informatization" to emphasize that China must focus on "winning informatized local wars." This change suggests that China now views information dominance as essential to victory in modern warfare. This is particularly true for operations in the air and space domains due to the rapid pace of such operations and their information-intensive nature.[12]

PLA Concepts of Operations

Understanding how China's military leaders intend to fight a future conflict is key to appreciating what motivates the development of China's military forces. This section highlights the manner in which it is believed the PLA would plan to employ its aerospace forces in future military campaigns.[13] These include the Joint Fire Strike, Air Defense, Air Offensive, Air Blockade, Airborne, and Nuclear Counterstrike Campaigns. Notably, although the PLA does not have an officially codified "counter-intervention" campaign, it emphasizes the ability of PLA aerospace forces to quickly seize the initiative and strike at the enemy's forces from a distance in order to ensure the enemy will be unable to prevent the PLA from achieving its objectives.

Joint Fire Strike Campaign

The cornerstone of Chinese military planning for future war centers on a Taiwan scenario. The PLA's concept of a Joint Fire Strike Campaign calls for large-scale air and missile strikes against Taiwan and against U.S. forces and bases in the region. The objective is to weaken defenses, either to create favorable conditions for subsequent campaigns, or in preparation for an amphibious invasion of the island. Chinese military academics have described the Joint Fire Strike Campaign as being comprised of an "integrated fire assault offensive campaign undertaken against key enemy targets…to destroy, sabotage key enemy targets, paralyze enemy's operations system, undermine the enemy's will to resist, and weaken the enemy's capacity for war."[14] It is notable that in recent years, the PLA seems to have reduced its level of public commentary on this campaign, perhaps due to its sensitive nature.

PLA air and missile assets provide the bulk of the long-range precision strike capabilities needed to carry out the Joint Fire Strike Campaign. Chinese military commentators, for example, have noted that conventionally-armed ballistic and cruise missiles would be employed to strike targets that other types of weapons are unable to target. They state that conventional ballistic missile attacks, carried out by the PLARF, would primarily be aimed at "the enemy's surveillance/early warning systems, electronic warfare systems, air defense/anti-missile formations, air troop bases and other targets."[15] PLA commentators have noted that the PLARF "serves as an important force for the PLA's implementation of long-range conventional strikes, possessing special functions for which there are no substitutes."[16] China is developing and fielding systems to hold at risk enemy platforms and bases as far away as Guam, or approximately 3,000 kilometers from China's shores.[17]

PLA writings emphasize the need for "joint strikes by multiple services and aircraft types, long-range air raids, and beyond-defense-area ("standoff") strikes."[18] Missile strikes such as these can have a crippling effect on the ability of an opposing force to deploy to a region of conflict, perhaps creating a "window" of opportunity in which Chinese forces could accomplish their mission relatively free of interference.

Informatization is another essential component of the Joint Fire Strike Campaign. The PLA seeks to use intelligence derived from space-based assets to enhance the effectiveness of joint warfare capabilities at the strategic, campaign, and tactical levels.[19] The PLA's emphasis on informatization is also leading to investments in command and control (C2) systems that enable secure and reliable communications even when under attack.

Air Defense Campaign

The mission most familiar to the PLAAF is the air defense campaign—a primary focus since the service's establishment in 1949. Indeed, because of Chinese perceptions of military inferiority dating back to the Mao era, air defense has taken on an outsized role within PLA military strategy.[20] As mentioned above, Chinese doctrine increasingly advocates an Active Defense-style approach, whereby the PLAAF not only protects Chinese territorial airspace but also targets and destroys enemy aircraft on the ground as well as the facilities and support infrastructure needed for conducting air operations. PLAAF planning appears to give special priority to protecting the Beijing region, as well as coastal areas, from enemy air attacks.[21] As currently conceived, air defense campaigns are typically organized geographically and employ layered defenses of fighter-interceptor aircraft, as well as long- and shorter-range surface-to-air missile systems to provide defense in-depth.[22] The PLAAF also has a robust antiaircraft artillery (AAA) component. It is notable, however, that there is currently no concept for a joint engagement zone (JEZ), whereby SAMs, AAA, and aircraft engage the enemy in the same airspace at the same time.

Air Offensive Campaign

Alternatively known as the "air strike" or "air raid" campaign, the PLAAF's conceptualization of an air offensive campaign mainly entails air-to-ground attacks against military formations, supply and transportation lines, and political, economic, or other military targets.[23] Such a campaign can occur either independently or jointly as part of a larger military operation. China is increasingly pursuing capabilities tailored to a "strategic air force" that would allow it to conduct

offensive operations "over longer distances using intensive firepower against an enemy in strikes deep in its territory."[24]

Air Blockade Campaign

Designed specifically with the goal of coercing Taiwan, an air blockade campaign would seek to attack Taiwan's airfields and interdict air and maritime traffic to and from the island. Air blockades are described as "often carried out simultaneously with ground and maritime blockade missions," making them part of joint island campaigns.[25] These operations may include bombings, strikes, laying mines, and air combat.[26] The PLARF would also have a role in weakening Taiwan's air defenses to create the more permissive air environment needed for sustained PLAAF patrols.

Airborne Campaign

Airborne campaigns seek to parachute troops in behind enemy lines, either in support of joint operations or on independent missions.[27] Once inserted, airborne forces, which are subordinate to the PLAAF, could be directed to sabotage key enemy military and economic infrastructure. PLA doctrine seems to recognize that these campaigns can be extremely difficult to carry out successfully. Airborne campaigns would require the PLAAF, for example, to carry out suppression of enemy air defenses (SEAD) before bringing in large, low-flying transport aircraft. Once on the ground, airborne forces would likely need air cover, tactical mobility, supplies, and perhaps aerial firepower support to accomplish their mission.[28]

Nuclear Counterstrike Campaign

The PLARF is responsible for Nuclear Counterstrike Campaign planning. China has for decades maintained a policy of "No First Use" of nuclear weapons, stating publicly that China would only use nuclear weapons if attacked first with nuclear weapons, though this policy could change as China's assessment of its security environment continues to evolve.[29] If China were attacked with nuclear weapons, the objective would be "to conduct a nuclear counter-attack, striking the enemy's strategic targets and weakening its war potential and strategic attack forces."[30] Overall, China's leaders appear to regard China's nuclear forces as a primary means of deterring an adversary from attacking it first and reducing the potential for conflict escalation.

3. PLA Air Force

Established as a separate service within the PLA in 1949, the PLA Air Force (PLAAF) has struggled for most of its history to carve out a role and mission distinct from that of China's ground forces. In recent years, the PLAAF has embarked on a major modernization program—which includes not only weapons, but also personnel and organizational structure—due in part to China's growing ambitions and capabilities to extend China's influence abroad. Chinese leaders since the early 2000s have directed the PLAAF to transform itself into a "strategic air force" capable of undertaking operations beyond territorial point and area air defense to encompass all-weather, day/night offensive operations, including air-to-air combat, surface attack, transport, intelligence, C4ISR, and electronic warfare (EW). By honing these capabilities, China seeks to train and equip a modern air force that can deter, coerce, delay, and defeat any adversary within the first island chain.

Size and Force Structure

The PLAAF boasts the "largest air force in Asia and the third largest in the world."[31] The PLAAF's inventory of operational aircraft currently includes air defense fighters, multi-role fighters, ground attack aircraft, fighter-bombers, bombers, and helicopters.[32] Though numerically impressive, only approximately one-third of the PLAAF's total aircraft (and 20 percent of its fighter aircraft) today are considered fully modern by Western standards.[33] The PLAAF, however, has embarked on an ambitious effort to systematically replace obsolescent second- and third-generation[34] fighter-interceptors that lack beyond-visual-range (BVR) capability, advanced radars, and EW with fourth- and 4.5-generation multi-role fighters and fighter-bombers.[35]

In addition to its fighter force, the PLAAF fields transport aircraft, most of which are medium-sized turboprop models.[36] The PLAAF also possesses special mission aircraft capable of reconnaissance, EW, and electronic intelligence (ELINT) operations, as well as slowly transforming at least some of its airborne early warning (AEW) aircraft so that they can conduct airborne early warning and control (AEW&C) operations.[37]

Separate from fixed-wing aircraft, the PLAAF maintains and operates its own integrated air defense system (IADS). The PLAAF possesses "one of the largest SAM forces in the world" and is upgrading its forces with longer-range, more capable systems.[38] The PLAAF also fields anti-aircraft artillery (AAA) units, an airborne force, and radar units.[39] Each of these five types of forces—aviation, SAMs, AAA, airborne, and radar—is organized into a separate branch.[40] The PLAAF also has several specialized categories of troops that are addressed below.

Aviation Branch

Commonly referred to as its "primary branch," the Aviation Branch dominates PLAAF planning and decision-making.[41] The Aviation Branch is responsible for operating and maintaining the full spectrum of the PLAAF's fixed-wing aircraft, including its unmanned aerial vehicles (UAVs) and helicopters. There are six types of fixed-wing aircraft in its inventory: fighter/ multi-role aircraft (J-class), fighter-bombers (JH-class), bombers (H-class), ground attack aircraft (Q-class), transport aircraft (Y-class), and reconnaissance aircraft (JZ-class).[42] The Aviation Branch has 25 air divisions, which include 14 fighter, three bomber, three ground attack/fighter-bomber, two special aviation, and three transport divisions.[43] Depending on the type of missions, an air division is typically comprised of two or three regiments of 18-24 aircraft, each of which has subordinate battalion-level flight groups and company-level flight squadrons.[44,45] In December 2011, the PLAAF revealed that it had begun creating at least 14 air brigades in the Guangzhou, Lanzhou, Nanjing, and Shenyang Military Region Air Forces (MRAFs) by upgrading existing air regiments.[46] Each brigade, which has more than 24 airframes, has from three to five subordinate flight groups, which, in turn, have two to three subordinate flight squadrons.

Fighter Aircraft

The PLAAF is rapidly modernizing its fleet of fighter aircraft and retiring older, less capable aircraft. Historically, the PLAAF relied on variants of the 1950s era Soviet MiG-17 and MiG-19/J-6 aircraft as the core of its fighter aircraft fleet. In fact, up until 1995, nearly 80 percent of the PLAAF's combat aircraft were variants of these aircraft.[47] Since then, the PLAAF has retired nearly 3,500 obsolete fighter-interceptor aircraft and has reduced the total number of air divisions from 50 to 25.[48]

Today, despite its modernization efforts, the PLAAF remains mostly a second- and third-generation fighter aircraft force. Its J-7 and J-8 variant fighters comprise the majority of its fighter aircraft fleet. Although obsolescent platforms by U.S. standards, the PLAAF has been incrementally updating cockpit avionics and other key components such as on-board radar systems and flight data recording systems. The PLAAF has recently added a particularly lethal capability to the J-8 by arming it with a new radar-guided "fire and forget" medium-range air-to-air missile (MRAAM).[49]

The J-7 and J-8 Fighters

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The PLAAF's newer multi-role fighter aircraft include the J-10, J-11A, J-11B, Su-27, and Su-30MKK. The domestically-produced single-seat J-10 is a single engine, fourth-generation multi-role fighter (e.g., air intercept and ground attack) that entered into service in 2003 and is produced at the Chengdu Aircraft Industry Corporation. The J-10 is equipped with 11 weapon stations and appears to have navigation and targeting pods. In addition, the J-10 has an air-refueling probe which may allow the PLAAF to extend its operations beyond the first island chain. An upgraded version of the J-10—the J-10B—reportedly adds an electro-optical targeting system (EOTS), allowing pilots to detect and target enemy aircraft without using their radars.[52]

The J-10 and J-11 Fighters

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The PLAAF maintains several Russian Su-27SK/UBKs purchased in the early 1990s, though it has prioritized using the aircraft as the basis for its domestically-produced J-11A variant. Considered a fourth-generation air superiority aircraft, the J-11A is also outfitted with EOTS and MRAAMs. A variant of the J-11, the J-11B, appears to have entered service in 2007. It was developed to provide the J-11 with a ground attack capability. Some reports indicate the J-11B boasts a dramatically reduced radar cross-section, compared to the standard J-11.[55]

The two-seat Su-30MMK, purchased from Russia, has the potential to one day comprise the core of the PLAAF's fighter force. The Su-30MMK features advanced radar, aerial refueling, and improved air to ground strike capabilities with PGMs. Based on recent increases in procurement, the PLAAF may have instead decided to make the new J-11B/BS the core of its future fighter force.[56]

The Su-30 Fighter

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Ground Attack Aircraft

The PLAAF operates only one dedicated ground attack aircraft, the Q-5, which has single-seat and two-seat variants. Considered a second-generation platform, the Q-5 is derived from the Russian-designed MiG-19.[58] The PLAAF in recent years has upgraded the Q-5 with the ability to deliver laser-guided bombs.[59] The Q-5 is produced in limited numbers for domestic use and export. With the development of fourth-generation J-10B, J-11B, and Su-30MMK multi-role fighters, the number of aircraft in the PLAAF that are capable of ground attack has risen both in both absolute and relative terms in recent years.[60]

Fighter-Bomber Aircraft

The PLAAF's only known dedicated multi-role fighter-bomber, which has both a ground attack and intercept role, is the JH-7. Originally flown only by PLA Naval Aviation, the JH-7 is produced by Xi'an Aircraft Industry Corporation and was acquired by the PLAAF in 2004. Unlike other multirole aircraft, such as the Su-30MMK, the JH-7 is indigenously designed and produced. The JH-7A may possess electronic countermeasures pods, possibly to assist in escort jamming missions. It is also reportedly armed with the Russian Kh-31P/KR-1 anti-radiation missile (ARM), suggesting a role in SEAD operations.[61] The JH-7 is also equipped with MRAAM and a suite of weaponry enhancing its land- and maritime-strike capabilities. [62]

The JH-7 Fighter-Bomber

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Bomber Aircraft

Since 1985, the PLAAF has steadily reduced the number of true bombers in its force by the hundreds. However, this downward trend has been accompanied by the modernization of both the PLAAF's bomber platforms and the weapons that those aircraft can deliver. The only remaining dedicated bomber in the PLAAF's fleet is the H-6, which is also produced by the Xi'an Aircraft Industry Corporation, and based on the mid-1950s era Soviet Tu-16 design. In 2015, the PLAAF flew H6-Ks over the western Pacific Ocean for the first time, probably to demonstrate their long-range capability.

The PLAAF in the last several years has upgraded the H-6, enabling the aircraft to launch PGMs such as air-launched cruise missiles, allowing for longer-range standoff offensive air capabilities. This upgraded variant, referred to as the H-6K, can carry up to six land-attack cruise missiles (LACMs) and is capable of delivering both laser- and satellite-guided munitions. The H-6K also has at least five multi-function displays in a glass-enclosed cockpit along with thermal-imaging sensors., The PLAAF has converted some H-6s into aerial tankers (H-6Us).

The H-6K Medium Bomber

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Transport Aircraft

Transport is considered an area of relative weakness for the PLAAF, as it possesses only a limited number of large aircraft capable of long-distance operations. The PLAAF operates Russian-made IL-76s capable of strategic airlift. The PLAAF was able to deploy four of these aircraft to Libya in 2011 in order to conduct a NEO there. In 2014, the PLAAF also employed IL-76s out of China and later Australia in the search for the missing Malaysian Airlines flight MH370, as well as in support of HA/DR operations following the Nepal earthquake in 2015. These were all relatively small-scale operations, however, and the PLAAF acknowledges the need to expand its strategic lift capacity.

The PLAAF is in better shape when it comes to medium transport aircraft. The PLAAF has built the core of its transport force around the Y-8, which is a domestically-built copy of the Russian-designed An-12 turboprop. It also has several Y-9 medium transports, which has a maximum payload of 20 tons.[70]

The Il-76 and Y-8 Transport Aircraft,

71 72

Reconnaissance Aircraft

The PLAAF has few dedicated manned reconnaissance platforms and their numbers have been dwindling,[73] perhaps due to growing reliance on unmanned platforms for this role. The PLAAF has fielded modified versions of the J-8, such as the J-8FR and JZ-8F, for use in reconnaissance operations. It is also possible that the PLAAF will eventually field a converted JH-7 for reconnaissance purposes.[74] Regarding UAVs, the PLAAF is seeking a High Altitude and Long Endurance (HALE) capability similar to the U.S. RQ-4B Global Hawk. To date, the PLAAF has yet to develop such a capability, however. It does field the high-altitude WZ-5 Chang Hong and Chang Kong 1 as well as the long-range BZK-005.[75]

Two PLA UAVs

76 77

The PLAAF also employs several platforms with AEW&C capability. The most important of these is the KJ-2000, which is a converted Il-76 airframe that provides enhanced aerial battlespace information in support of both offensive and defensive missions.[78,79]

Rotary-Wing Aircraft

The PLAAF also employs various rotary-wing helicopters, including the Z-8, Z-9, and Russian Mi-171.[80] Prior to 1986, the majority of the PLA's helicopters belonged to the PLAAF and Naval Aviation. In 1986, the General Staff Department (GSD) created the Army Aviation Bureau and a separate Army Aviation Branch and transferred almost all of the PLAAF's helicopters to the Army.[81] In 2005, however, the PLAAF began creating an independent helicopter flight group subordinate to the 15th Airborne Corps, which was expanded to a regiment in 2012. It also has other helicopters assigned to various units.

SAM Branch

The SAM Branch of the PLAAF is charged with defending military bases and critical civilian infrastructure during a conflict. The SAM branch fields a range of systems, some of which have been designed indigenously and some purchased from Russia. On the indigenous side, the Chinese HQ-9 features mid- to long-range missiles with active radar-homing capability. The PLAAF is also introducing the more advanced HQ-12, which will be able to target large- high-value airborne assets, such as airborne warning and control system (AWACS) aircraft and surveillance platforms at long range.[82] Also, currently in development, China may seek to use its HQ-19 to provide the basis for a missile defense capability.[83]

The HQ-9 Mobile SAM System

[84]

China also benefits from having the Russian SA-20/S-300 in its inventory, with a range of up to 200 kilometers.[85] These systems are highly mobile and therefore offer improved survivability over earlier model long-range SAM systems.[86]

AAA Branch

Representing the other side of China's ground-based air defense system, the AAA Branch was originally established in 1949 as part of the PLA Air Defense Force, which was a full service, until it was merged with the PLAAF in 1957. According to some reports several AAA units in the PLAAF are integrated with SAM units and various radar systems in combined-arms air defense units. Other than the Central Theater Command, which created a composite air defense division (综合额防空师) composed of subordinate SAM regiment(s) and AAA regiment(s) in the late 1980s, the only other reference to a composite air defense organization is an Eastern Theater Command Composite Air Defense Regiment. Based on one article, it appears this composite regiment was created in 2010 and is composed of composite SAM & AAA battalions with subordinate SAM company(s) and AAA company(s). Other AAA units are standalone regiments or brigades.[87]

It appears that the PLAAF's AAA may be disappearing across the spectrum, as separate units or as a branch. The Northern Theater Command has at least one AAA brigade, while the only other AAA regiments found were in the Western or Central Theater Commands.

Of note, the Army and the Navy's Coastal Defense Branch and North Sea Fleet Naval Aviation have been creating combined-arms SAM, AAA, and radar air defense brigades.

Airborne Branch

Unlike in the United States, the PLAAF is responsible not only for "delivering" troops from its subordinate Airborne Branch to their landing zones, but also for the creation and training of the units.[88] Doctrinally, China has emphasized use of the airborne branch to deploy troops behind enemy lines to seize airfields and conduct sabotage operations alongside PLA Special Operations Forces units.[89] In early 2017, the 15th Airborne Corps abolished its three division headquarters and upgraded its six airborne regiments to brigades. It also upgraded its transport regiment to a brigade, which is complemented by a helicopter regiment, as well as creating a special operations force brigade and combat support brigade.

Radar Branch

When first integrated into the PLAAF in 1950, radar troops were charged with providing early warning capabilities to air defense. Today, depending on the type of radar systems, radar troops are an official branch of the PLAAF, and can be a specialized unit. As such, they provide the technical information for

personnel in aviation branch airfield control towers and command posts, as well as in command posts in higher level headquarters and in command vehicles, for SAM and AAA units to be able to vector intercept aircraft or SAMs/AAA toward targets. Radar stations are typically located close to borders, on mountains, or on islands.[90] In addition, radar units conduct air traffic control operations at airfields.[91] As of late 2007, it was reported that China had an "air intelligence radar network" capable of covering the entire country.[92]

Specialized Units

In addition to the five combat branches described above, the PLAAF also maintains specialized units of troops for a variety of support missions. These are: communications, electronic countermeasures, chemical defense, and technical reconnaissance (as well as certain types of radar units discussed above). **Communications troops** perform functions related to communications, navigation, and automated command support to the PLAAF.[93] Little information is available on **electronic countermeasures troops** in the public domain. However, it can be assumed that they lead the effort to install and maintain electronic countermeasures upgrades to PLAAF aircraft. **Chemical defense troops**, which actually include nuclear, biological, and chemical defense, are charged with decontaminating PLAAF locations or assets affected by not only chemical but radiological weapons as well.[94] Chemical units are fielded in battalion-, company-, and platoon-sized units.[95]

Technical reconnaissance troops conduct work similar to electronic countermeasures troops in that they are responsible for intercepting, decoding, processing, and analyzing different varieties of signals intelligence including both communications intelligence and ELINT.[96] They also conduct measures and signature intelligence (MASINT).[97] Technical reconnaissance troops support PLAAF units at the regiment level and below and are distributed throughout other types of units including aviation, airborne, and radar units.[98]

Modernization Trends

Several important modernization efforts within the PLAAF will influence its ability to support the ambitious military concepts being espoused by the PLA today. These include the PLAAF's pursuit of stealth technology in its fifth-generation fighters, advances in air-launched missiles, development of heavy lift transports, development of UAVs with HALE capability, enhancement AEW&C platforms, and acquisition of increasingly longer-range SAM systems.

Fifth-Generation Stealth Fighters

The PLA's leaders believe that developing advanced, fifth-generation aircraft will be essential to success in future conflicts and they are pursuing such aircraft energetically. Stealth can allow the PLAAF to more effectively engage enemy aircraft in offensive and defensive counter-air operations and can also enable its aircraft to penetrate enemy defenses and attack both land- and sea-based targets.[99,100]

In pursuit of these objectives, China is developing two stealth fighters: the J-20 and J-31. The J-20, which is under development at Chengdu Aircraft Industry Corporation, is billed as a heavy strike fighter similar to the U.S. F-22. The PLAAF seeks to incorporate many characteristics of the F-22 into the J-20 to include "high maneuverability, supercruise, helmet-mounted sights, thrust vectoring, low observability, and sensor fusion characteristics."[101] The J-20 made its maiden flight in 2011 and the PLAAF reportedly now has seven prototypes.[102] It is expected to enter into service as early as 2017.[103] The J-31, which is under development at the Shenyang Aircraft Corporation, is a competing stealth strike fighter. The second prototype of the J-31 took flight in December 2016. Billed as a medium-strike fighter perhaps geared toward air dominance missions, the J-31 may be able to take off and land on Chinese aircraft carriers in the future.[104] China also may be considering offering the J-31 for sale to foreign customers in order to compete with the U.S.-designed F-35.

The J-20 and J-31 Fifth-Generation Fighters

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Air-Launched Missiles

The PLAAF is not only modernizing its combat aircraft, it is also increasing the lethality of its air-delivered weapons. Until the mid-1980s, the most common air-to-air missile (AAM) in the PLAAF's inventory was the PL-2, which was a copy of the U.S. AIM-9B Sidewinder.[107] Today the PLAAF's AAM arsenal features radar-guided AAMs, both at medium- and short-ranges, along with

"fire and forget" and capability to perform in high off-bore sight engagements.[108] In the near future, the PLAAF plans to integrate AAMs, such as the PL-10, which will possess both imaging infrared-guided as well as thrust-vector control capability.[109] Another AAM in development, the PL-15, may feature active-radar capability.[110] Once entered into service, these AAMs will be able to engage targets more than 90 degrees off the nose of the firing aircraft, greatly increasing the tactical utility of the aircraft that employ them.[111]

The PLAAF is also making advances in air-to-surface missile (ASM) technology. ASMs already in the PLAAF arsenal include the Hellfire-class AR-1, and the HN-1, a long-range cruise missile (LRCM) similar to the U.S. Tomahawk.[112] The H-6K bomber is armed with six Tomahawk-like LACMs. In addition, a new Chinese ASM called the CM-400AKG is billed as a hypersonic anti-ship missile.[113] These capabilities are likely to complicate U.S. and allied efforts to protect land- and sea-based assets in the Western Pacific region.

Heavy Lift Transports

To expand its strategic airlift capacity, China for the last several years has been attempting to develop an indigenous heavy lift aircraft referred to as the Y-20. The Y-20 made its maiden flight in 2013 and entered production in 2016.[114] Several Chinese commentators have noted that the successful development of the Y-20 is vital to China's aspirations for building a power projection capability to complement the J-20 and China's first aircraft carrier, the Liaoning. If successful as an airlift platform, the Y-20 could also provide the basis for a range of other functions, including aerial refueling, reconnaissance, and AEW&C.[115]

The Y-20 Developmental Transport Aircraft

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UAVs

The PLAAF is investing heavily in UAV technologies that will support an assortment of ISR and combat-related missions. Unveiled in 2014, the GJ-1, for example, is equipped with PGMs.[117] First presented at China's military parade in September, another platform, the CH-5, appears to resemble the U.S. MQ-9. It is said to be capable of flying for up to 30 hours and carrying a substantial weapons package.[118] In addition to arming its UAVs and increasing their ranges, the PLAAF will likely seek to develop new models with stealth characteristics in order to help penetrate enemy air defenses. The AVIC 601-S (*Lijian*, or "Sharp Sword"), for example, combines these capabilities and might have capabilities similar to those of the U.S. X-47B and the European nEUROn.[119]

China encounters a more complex engineering problem in developing a HALE capability. To date, the PLAAF lacks HALE-capable drones but is working on systems such as *Shendiao* ("Divine Eagle") which will, at least in theory, possess such capabilities. The PLAAF's progress on previous UAV projects will serve as important stepping stones toward attaining further advances in this area.

Enhanced AEW&C Systems

The PLAAF seeks to enhance the sophistication of manned ISR air platforms as well. For example the KJ-500—a Y-9 four-turboprop transport plane produced at the Shaanxi Aircraft Corporation—has been outfitted for AEW&C missions. The Y-9, which made its formal debut at China's military parade on September 3, 2015, reportedly features a phased-array radar capable of "tracking 60 to 100 targets simultaneously out to 470 kilometers."[120] Further advances in this area are to be expected, given the PLAAF's emphasis on informatized warfare.

Longer-Range SAMs

China recently concluded negotiations with Moscow to purchase six batteries of the S-400. This SAM system has a range of 400 kilometers and is said to "combine both track-via-missile (TVM) and active guidance systems, plus new hemispheric phased array guidance radar."[121]

4. PLA Rocket Force

As part of major military reforms, Chinese President and CMC Chairman Xi Jinping re-designated the Second Artillery Force as the PLA Rocket Force (PLARF) on December 31, 2015 and elevated it to service-level stature. The elevation in stature, accompanied by the remarkable growth in its capabilities and force structure, strongly suggests that the PLARF will continue to play critical roles in Chinese strategic deterrence and conventional precision strike capabilities in the coming years. Founded in 1966, China's rocket force was originally charged with maintaining and operating China's ground-launched nuclear ballistic missiles.[122] However, since the early 1990s, the PLARF has taken on a conventional mission and significantly expanded its arsenal to include precision strike capabilities at medium ranges using ground-launched conventionally-armed ballistic and cruise missiles.

The PLARF's transformation is in direct response to the CMC's call to build a service for "dual deterrence and dual operations," meaning a force capable of nuclear and conventional deterrence and strikes. A dual capability not only provides China with nuclear deterrence options, but it also confers conventional "counter-intervention" capabilities to deter, delay, or deny an adversary from deploying to or operating effectively in theaters near China.[123] Approximately 80 percent of the PLARF's weapon systems are intended to carry out conventional strike missions—by far the largest conventional missile arsenal in the Asia-Pacific region.[124] The PLARF's DF-21D, for example —dubbed China's "carrier killer" because of its ability to threaten U.S. aircraft carriers—is the world's first dedicated medium-range anti-ship ballistic missile (ASBM). The PLARF also possesses many hundreds of ground-launched LACMs that are capable of reaching targets in South Korea and Japan. The PLARF is looking to the future by developing hypersonic weapons designed to evade and penetrate missile defenses.

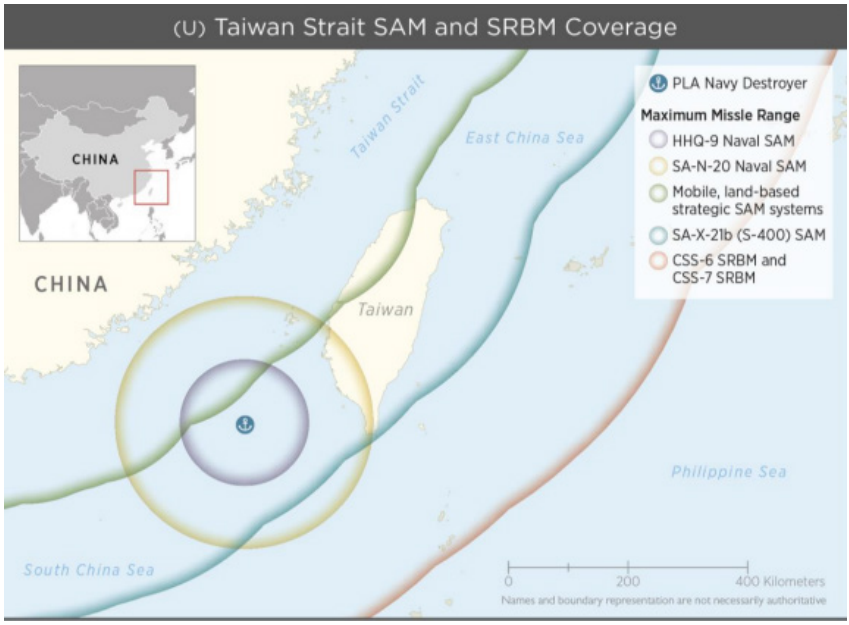
The PLARF has also been modernizing its strategic nuclear forces. In particular, the PLARF has increasingly upgraded what was once a rudimentary nuclear force centered on liquid-fueled and silo-based ballistic missiles toward a more modern and diverse nuclear arsenal featuring solid-fueled and road-mobile systems. Solid-fueled missiles can be launched more quickly than liquid-fueled and road-mobility makes missiles more difficult for an enemy to locate, increasing the survivability of nuclear forces in the face of counter-force attacks. The PLARF is also working to enhance the penetrativity of its nuclear warheads and equipping some of its missiles with multiple independent reentry vehicles (MIRVs). China has already equipped some of its silo-based ICBMs with MIRVs. It is also developing the DF-41, a mobile intercontinental ballistic missile (ICBM) that is capable of carrying MIRVs.[125] Overall, the PLARF continues to increase the quantity and quality of ICBMs in its arsenal for a more capable and effective nuclear deterrent.

Size and Force Structure

The operational command authority of the PLARF is highly centralized. The chain of command runs from the CMC down through the Joint Staff Department to the PLARF Headquarters to missile bases to missile brigades and missile launch battalions; however, higher echelon units can bypass subordinate units and give orders directly to the lowest level units if required. The PLARF is mainly composed of the nuclear missile force, the conventional missile force [ballistic missiles and ground-launched cruise missiles], the support force, educational institutions, a research academy, and headquarters organizations. The missile force is organized into six operational missile bases, each of which has multiple missile brigades, launch battalions, and, depending on the type of missile, launch companies, as well as support units.

The PLARF fields an impressively diverse array of thousands of missiles supporting a range of operational objectives. These systems include short-range ballistic missiles (SRBMs), medium-range ballistic missiles (MRBMs), intermediate-range ballistic missiles (IRBMs), ICBMs, and ground-launched LACMs. This force gives the PLARF the capability to strike hundreds of targets throughout Taiwan and to conduct selective precision strikes on targets up to 3,000 to 5,500 kilometers away (in the case of the recently unveiled DF-26, with further details below).[126]

Coverage provided by PLARF and PLAAF missiles[127]



Missile Capabilities

In wartime, the PLARF would be called upon to play key roles in China's military strategy, including its counter-intervention component, holding at risk a growing array of targets in the first island chain and beyond. This is reflected in the evolution of PLARF capabilities. Overall, the emphasis of development has been on missiles designed for accurate conventional strikes on targets that would be relevant in a potential Taiwan contingency. The PLARF, for example, recently displayed a new IRBM, the DF-26, which can reportedly strike U.S. bases in Guam. Separately, the PLARF continues to modernize its ICBM force to maintain strategic nuclear deterrence.[128]

SRBMs

With more than one thousand conventional missiles in its arsenal, the PLARF currently maintains the world's largest arsenal of SRBMs.[129] These missiles—such as the DF-11 and DF-15—are primarily solid-fueled and road-mobile with ranges of up to 1,000 kilometers.[130] Upgrades to the DF-15 in particular have significantly improved accuracy. The latest variants boast circular error probables (CEPs) of less than ten meters.[131] Such accuracy would be particularly useful in cratering Taiwan's runways and attacking other fixed, hardened military targets. The newer DF-16 may be even more challenging to counter as it is not only

highly accurate, but also reportedly has a higher reentry velocity. Moreover, the DF-16 reportedly offers greater range—800 to 1,000 kilometers—which could make it easier to target wider swaths of the western Pacific Ocean within the first island chain, such as the East China Sea.[132, 133, 134]

DF-15 SRBM and Transporter-Erector-Launcher[135]

MRBMs and IRBMs

Over the last decade, China has significantly improved its conventionally-armed MRBM force designed to hold at risk enemy land and naval assets within the first island chain. With ranges exceeding 1,000 kilometers, the PLARF's main MRBMs include the DF-21 and its variants—all solid-fueled and mobile systems. As noted above, the most commonly discussed of the DF-21 variants is the "carrier killer" DF-21D, which represents China's first dedicated ASBM. Revealed in 2008, the DF-21D has an assessed range of 1,550 kilometers and reportedly relies on space-based ISR and ground-based over-the-horizon (OTH) radar to provide cues regarding the location of potential targets.[136] In addition, the DF-21D reportedly incorporates both inertial guidance and terminal radar guidance yielding a CEP of less than 20 meters. It also features a maneuverable reentry vehicles (MaRV) capability, allowing it to more effectively penetrate enemy defenses.[137, 138] The DF-21C is another variant with a slightly longer range of 1,750 kilometers, bringing both South Korea and Japan into range. China also maintains nuclear MRBMs for regional nuclear deterrence missions.

First revealed during China's military parade in September 2015, the DF-26 is a road mobile IRBM with a range of 3,000 to 5,500 kilometers.[139] Such a range would enable attacks on targets out to the second island chain, including on Guam, or in the South China Sea. China states that the DF-26 is available in conventional, ASBM, and nuclear versions.[140]

Overview of PLARF Conventionally-Armed Missiles[141]

ICBMs

With ranges of more than 5,500 kilometers in most cases, China's ICBM force is used for nuclear deterrence and is capable of hitting most targets in the continental United States and Russia. The PLARF's ICBM inventory consists primarily of DF-5 silo-based ICBMs; and DF-31 and DF-31A ICBMs, which are both solid-fueled and road-mobile. Because of their mobility and survivability, road mobile missiles will likely constitute a growing portion of China's ICBM force.[142]

LACMs

The PLARF fields hundreds of ground-launched LACMs.[143] These LACMs are road-mobile, stealthy, and follow variable flight paths. China's first ground-launched LACM, the CJ-10, was fielded in 2007 and has a range of at least 1,500 kilometers.[144] The CJ-10 is also produced in an air-launched version for delivery by the PLAAF's H-6K bomber.[145]

Modernization Trends

This section highlights specific areas of missile technology in which the PLARF is investing to offset U.S. military advantages in the region as well as complicate U.S. ballistic missile defense efforts. In general, the PLARF will continue to pursue improvements in the mobility, range, speed, and penetrativity of its missile systems for the foreseeable future.

Mobility

The PLARF recognizes that road-mobility in its missile force is increasingly important to ensure survivability—especially in the case of potential counter-force attacks against China's nuclear forces. Therefore, the PLARF has concentrated efforts on transforming its once primarily silo-based nuclear ICBM force into an increasingly road-mobile force. In addition, the PLARF's conventional missile force is road-mobile, enhancing its survivability and enabling it to more effectively perform its conventional deterrence and precision-strike missions.

Range

Although the PLARF already maintains the capability to target virtually any land or naval asset within the first island chain with conventional precision strike, the PLARF continues to seek ways to hold at risk targets beyond this range. Development of the DF-26, for example, extends PLARF conventional strike ranges to targets as far as Guam. Such advancements in range would enhance the PLARF's ability to conduct counter-intervention operations at extended ranges.

Speed

The PLARF is working on a number of programs that aim to increase the speed of its missiles to reduce the adversary's ability to defend against incoming attacks, such as hypersonic weapons. These systems typically can cruise at velocities of Mach 5 to Mach 10 for sustained periods. The PLARF is working on at least two types of hypersonic weapons: boost-glide (also known as hypersonic

glide vehicle (HGV)) and scramjet ("supersonic combustion ramjet") engine.[146] HGV technology uses a ballistic missile to launch and release a projectile that glides unpowered to its target.[147] Scramjet technology may also be launched from a ballistic missile, but also possibly an aircraft, and it would feature an engine-powered delivery to the target, allowing for multi-directional evasion of enemy air defenses.[148]

Speed is not exclusive to the hypersonic weapon category, however. For instance, the PLARF has reportedly increased reentry velocity for the reentry vehicle attached to its DF-16, in part to neutralize Taiwan's ballistic missile defenses.[149]

Penetrativity

The PLARF has invested more heavily in enhancing the penetrativity of its missile systems to counterbalance improvements to ballistic missile defense technology. The PLARF is attempting to accomplish this by increasingly MIRVing and MaRVing some of the missiles in its arsenal. As mentioned earlier, the PLARF, for example, fields the DF-21D, which reportedly uses MaRV technology to target aircraft carriers.

5. PLA Strategic Support Force

Although espousing a policy of the peaceful use of outer space, China nevertheless is actively developing a diverse set of military capabilities in this domain. Through the establishment of the PLA Strategic Support Force (PLASSF), China aims to enable more effective military operations by leveraging space-based assets to disrupt or cripple the ability of adversary forces to use assets in space. Chinese military theorists are fond of saying that "whoever controls space will control the Earth"—a view that is almost certainly driven by their observations of heavy U.S. reliance on space-based assets for enabling high-intensity joint combat operations.[150] In recognition of the importance of outer space, China's 2015 defense white paper specifically referred to space as "a commanding height in international and strategic competition" and stated that "threats from…outer space…will be dealt with."[151] China has focused not only on achieving space supremacy through enhancements to its space-based C4ISR architecture, but also by developing counter-space capabilities to deny an adversary's ability to use outer space against Chinese forces in a conflict.

Recent PLA organizational reforms further underscore the importance that China places on the space domain. On December 31, 2015, President Xi announced the establishment of the PLASSF to command China's military space forces, which may indicate a decision to consolidate China's space operations.

Size and Force Structure

As noted above, President Xi recently announced the establishment of the PLASSF to command China's military space forces.[152] Based on available information, it is difficult to accurately assess the size of the PLASSF. It is clear, however, that the PLASSF is not a military service, but an independent branch, making it similar in stature to the PLASAF before it became the PLARF. This

change means that the PLASSF is more of a functional support element that will provide information derived from space-based assets to all PLA services and five new "theater commands" (which have replaced former seven military regions) to support joint operations. The PLA's new organizational structure shows the PLASSF reporting directly to the CMC.[153] This structure suggests that the PLASSF will take on the space-related roles once performed by the General Supply Department (GSD) and the General Armament Department (GAD). The GSD and GAD, along with the PLA's two other general departments, were recently reorganized and renamed as part of Xi's structural military reforms. GSD responsibilities had included levying operational tasks against Chinese space-based assets and analyzing space-derived information, while the GAD managed research and development for Chinese military satellites and launch vehicles and operated China's launch and satellite control centers.[154] More information about the extent and nature of the PLA's reorganization will be needed before we fully understand the PLASSF's roles and missions.

Xi's establishment of the PLASSF suggests that lobbying efforts by the PLAAF to command China's military space forces have failed, at least for now. For years, the PLAAF had argued its case based on three factors. First, starting in 2004, the PLAAF expanded its domain of operations from just "air" to "air and space," implying that it should have a role in the space domain as well. In particular, PLAAF analysts argued that because manned platforms are more responsive than unmanned platforms, the PLAAF could play a leading role in space operations once manned fighter spacecraft or perhaps hypersonic intercontinental bombers became commonplace.[155] Second, PLAAF analysts contended that it was the most technically-inclined of all the services, and since space is a technical domain, it should naturally command China's space forces.[156] Finally, PLAAF analysts highlighted that out of all other major countries, China is the only one in which the air force does not play the leading role in commanding space forces.[157]

The PLARF, by contrast, did not seem to argue as strenuously that it should be in charge of space, perhaps in part because PLARF control over ballistic missiles makes it nearly impossible to exclude the service from the space domain. Indeed, Chinese military academics wrote in 2013 that the "Second Artillery missile vehicles, with some simple modifications, can be used to launch spacecraft" and that "with more than 40 years of development, [the PLARF] already possesses the basic infrastructure and hardware, as well as personnel, and knowledge to rapidly develop space capabilities."[158] As a result, the PLARF will

almost certainly remain involved in the space domain while prospects for the PLAAF's future role appear to be diminished.

From an organizational perspective, the PLASSF most likely now commands China's four space launch centers: Jiuquan Satellite Launch Center, Taiyuan Satellite Launch Center, Xichang Satellite Launch Center, and Wenchang Satellite Launch Center. Jiuquan is the longest-serving launch facility in China and it features the most extensive launch infrastructure of the four sites. Jiuquan has launched China's Long March (LM) rockets, including the LM-2C, LM-2D, LM-2E, and LM-2F. Jiuquan is also China's only launch center to specialize in human space flight.[159] Taiyuan launches meteorological, remote sensing, and communications satellites into sun and geosynchronous orbits.[160] Xichang focuses on meteorological, broadcast, and communications satellites into geosynchronous orbit.[161] Wenchang's location on Hainan Island will help China to limit the extent to which debris from rocket boosters falls on land. In addition, Wenchang's proximity to the equator allows it to increase satellite payloads by 10 to 15 percent and satellite life by 2-3 years.[162]

Space-Based Capabilities to Support PLA Operations

Space-Based C4ISR

China's defense white paper in 2015 called for the PLA to become capable of "winning 'informatized' local war."[163] In the past, Chinese military thinkers have commonly used some version of the word "informatized," such as "informatization," to express the need for the PLA to become proficient in real-time collection, processing, and dissemination of battlefield information. The space domain plays a key role in informatization efforts because of the enormous quantity of data to be derived from and passed through C4ISR space-based platforms. These satellites provide capabilities for remote sensing, communications, and navigation and positioning.

Remote Sensing Satellites

Over the last fifteen years, China has made significant progress in remote sensing satellite technology.[164] These satellites provide China with an impressive range of capabilities including electro-optical (EO) sensing, synthetic aperture (SAR) sensing, and ELINT collection.[165] China's newest satellites—Yaogan, Gaofen, and Jilin—provide high-resolution imagery with resolutions within one to two meters, and, in the case of Jilin, below one meter.[166]

Communications and Data Relay Satellites

China maintains a combination of commercial, government, and military satellites in a communications system known as Tianlian (Sky Link). These satellites serve as the critical data relay mechanism between remote sensing satellites and the ground station receivers. Without Tianlian, China would be forced to rely on line of sight, which would severely constrain its ability to maintain global remote sensing coverage.[167]

Navigation and Positioning Satellites

China seeks to increase the accuracy of its PGMs. Like the United States, China relies heavily on navigation and positioning satellites to do so. This will be particularly relevant when attempting to conduct OTH targeting of enemy assets. China's Beidou-2 satellite constellation currently allows Beijing to cover all of the Chinese mainland and much of Asia with geo-location signals that provide five-meter accuracy.[168]

Counter-space Capabilities

The other side of China's space strategy is to deny an adversary the ability to use informatized warfare against it. In an outer space context, this capability, broadly known as counter-space, spans a vast range of both kinetic and non-kinetic capabilities. Kinetic operations typically destroy adversary satellites creating debris, while non-kinetic operations are generally intended to temporarily disable, or "dazzle," space-based assets.

Kinetic Capabilities

Arguably the most visible display of China's kinetic counter-space capabilities occurred in January 2007 when China employed a converted MRBM to conduct a live test of its direct ascent kinetic kill vehicle (KKV)—otherwise known as an anti-satellite (ASAT) weapon—against a retired Chinese weather satellite. The Chinese test created the largest man-made space debris field in history, with more than 3,400 pieces of debris.[169] Other key tests took place in 2013 and included a likely ASAT launch into nearly geosynchronous (GEO) orbit—thereby demonstrating the ability to threaten U.S. global position system (GPS) and other types of satellites.[170]

A second area of focus for China's kinetic counter-space program is co-orbital technologies. Co-orbital attacks involve positioning spacecraft within close proximity of an adversary's satellites and conducting a range of kinetic operations. For example, a Chinese spacecraft could ram into an enemy satellite

or detonate near it.[171] China is also interested in operationalizing robotic arm technology, possibly to "grapple" opposing platforms in order to disable them without creating debris—a capability the PLA apparently tested in August 2013.[172] Yet another form of co-orbital attack might entail employment of lasers or other directed-energy weapons.[173]

Non-Kinetic Capabilities

China is also interested in non-kinetic counter-space capabilities. Such capabilities make it possible to disrupt or disable enemy satellites in a less provocative way and without causing space debris that might pose a threat to other satellites or manned space missions. The damage caused by these non-kinetic capabilities is typically reversible, depending on the power levels used.

One example of a non-kinetic capability involves using directed-energy weapons such as lasers, high-powered microwaves, and particle beams.[174] Specially configured lasers, for example, can be aimed at satellites with EO sensors and "dazzle" those sensors, temporarily blinding them while they are within the line of sight of the laser source. Co-orbital spacecraft can also engage in non-kinetic "blinding" operations. For example, these spacecraft could employ "umbrellas" or "spray paint" to block the view of an adversary's sensors.[175] The PLA can also rely on jamming of enemy space assets. China, for example, can already jam the GPS signal.[176] Another example of non-kinetic capabilities in space involves cyber attacks, which could be directed at targets such as satellite ground control stations.

Future Directions

While Chinese military publications and other openly available sources provide only limited insight into China's future plans for space warfare, there are specific technological areas in which China will almost certainly seek to advance its capabilities. First, it is clear that Beijing will continue to develop and launch satellites with increasingly sophisticated sensor payloads to help it acquire global information and intelligence to support decision-makers and planners. China almost certainly hopes to end its reliance on the U.S.-operated GPS system by expanding the coverage of its own Beidou-2. Moreover, China is attempting to secure its satellite communications by investing in so-called "quantum communications"—currently considered unbreakable encryption by modern standards.

China also certainly sees space-based early warning as an essential component to any effective ballistic missile defense (BMD) system. At present,

the PLARF has minimal capability to target and eliminate incoming enemy missiles.[177] However, space-based C4ISR systems, such as the Shijian-11 satellite constellation, reportedly can monitor heat signatures emitted from ballistic missiles that would in theory provide Beijing with some warning.[178]

Finally, China's counter-space capabilities will undoubtedly become increasingly advanced as well, particularly in the area of direct ascent KKV. It also remains an open question whether China will pursue other types of military space capabilities. One possibility raised by some Chinese military publications is manned combat spacecraft, an option other space powers have not favored due to cost and personnel safety concerns. Another is space-based weapons capable of striking targets in the air, at sea, or on the ground.

6. Trends in PLA Aerospace Training and Operational Proficiency

The PLA aerospace forces—the PLAAF and PLARF—have embarked on a set of major institutional reforms aimed at creating a modern, professional fighting force. At the heart of the reform is an effort to train officers and enlisted personnel under what the PLA refers to as "actual-combat conditions." The emphasis on "actual combat conditions" is manifested in training scenarios meant to mimic or simulate real-world battle conditions by adopting within daily training routines elements of nighttime battle training, complex electromagnetic environment (CEME), special geographical environments, and extreme weather conditions. Such an emphasis reflects an acknowledgment by senior leaders that the PLA must reorient itself to be able to fight and win wars against highly capable military competitors.

Historical Context

The PLA as a whole has been rapidly upgrading its weapons and equipment as well as revising its doctrine and strategy over the past two decades in an effort to develop a modern fighting force. In early 2016, it also implemented its eleventh force reduction, which includes one of the most significant organizational changes since the PRC was formed in 1949 and the former Red Army became the PLA. These changes are geared toward honing a leaner and more capable fighting force.

The PLA has not experienced large-scale combat since 1979, when China's ground forces fought a brief border conflict with Vietnam. The last time the PLAAF fought an air battle was in 1958, during a brief engagement with the Republic of China (ROC) Air Force during the second Taiwan Strait crisis. The largest air battle the PLAAF has fought was during the Korean War—more

than sixty years ago. The PLARF has never been involved in any major wars beyond shows of force or posturing during crises.

This lack of recent wartime experience magnifies the importance of constructing a training regime grounded in scenarios that approximate to the greatest extent possible technologically sophisticated battlefield conditions.

Annual Training Cycle

The PLAAF's annual training cycle typically features five partially overlapping segments during the course of a year: 1) new year flight training; 2) training in "subjects" and "topics"; 3) peak drills and exercises; 4) a second round of training in "subjects" and "topics"; and 5) year-end evaluations. Although variations exist in other services within the PLA, most follow this general pattern of training.

Several factors explain the existence of an annual training cycle for PLA aerospace forces. The first is institutional. PLAAF training, for example, must accommodate the annual enlistment cycle of PLAAF conscripts and recruits who all arrive at the same time, serve for two years before they can leave the military or become a non-commissioned officer, and make up a large proportion of PLAAF aviation branch personnel in maintenance and other ground-support positions, as well as within the SAM, AAA, airborne, and radar branches. These individuals typically arrive at their operational unit or a specialty training unit in the fall, where they receive about two months of basic training followed by limited specialty training.

Though conscripts and recruits currently account for a small and decreasing percentage of total personnel in the aviation branch (approximately 30 percent today), running large, integrated combined-arms exercises with other branches that have a higher percentage of conscripts may be difficult until their proficiency is raised to a certain standard. In addition to the new enlisted personnel arriving in the fall, all new officers who have just graduated from pilot training or any other PLAAF academic institution arrive during the peak exercise season in the summer and must start from scratch.

Another driver is the need to accommodate different types of coordinated evaluations and major exercises conducted throughout the year to test the ability of officers and enlisted personnel to perform under standardized criteria. Due to the size and scale of these exercises and evaluations, they can be carried out only during certain times of the year. The peak drill and exercise season for the entire PLA typically occurs during the spring and summer.

Combined-Arms and Joint Exercises

The PLA has recently emphasized "opposition-force training." PLAAF pilots, for example, spend most of the summer months of the annual training cycle participating in multi-day exercises. These are major training events that involve a simulated opposition force and combined-arms elements under competitive scenarios among either different branches within the PLAAF itself (aviation, SAMs, AAA, and radar) or different services within the Chinese military as a whole (army, navy, and rocket force). Exercises seek to integrate and apply the routine training subjects and skills practiced by aviators during the year.

Based on open source PLAAF reporting, most combined-arms drills and exercises take the form of either "confrontational air battle assessments" or "system-of-systems (SoS) confrontational drills." For the former, only fighter aircraft and pilots participate in the test, but for the latter, multiple branches are involved, including SAMs, radar, and AAA. Both evaluate pilots' ability to perform "free-air combat" and are meant to test pilot combat skills and tactics.

Around 2011, the PLAAF began using the term "free-air combat," which basically means that pilots engage in aerial intercepts (1v1, 2v2, 1v2, etc.) that are not completely pre-scripted, but they must still follow the training guidance that is set forth in their various regulations. Furthermore, it means that a flight controller in the control tower, command post, or AEW&C aircraft is not telling them what to do step-by-step once the engagement begins; however, the flight controllers can provide initial guidance and vectoring in order to get the pilots into the engagement zone. If pilots step away from what they have already learned and try a new engagement tactic or combat method during free air combat, then the PLAAF must go through a multi-step process to validate it, write regulations, and then have all units implement them accordingly.

Reflecting this trend, in recent years, flight training for PLAAF combat aircrews has become less scripted and more realistic. For example, mandatory altitude gaps between aircraft, which had been in place as a safety measure, have been reduced; and "Blue" opposition force aircraft have been introduced. However, information about engagement patterns, airspace, and altitude is prearranged and communicated to pilots ahead of time.

"SoS confrontational drills," by contrast, involve a higher degree of uncertainty and complexity. They feature two confrontational parties that do not know about each other's conditions, and both parties have to rely on integrated information support, real-time communication, and their own judgment to achieve success. A typical summer combined-arms training

"season" for a PLAAF combat aviator may feature between six and twelve drills and exercises involving both "confrontational air battle assessments" and "SoS confrontational drills."

"Golden Helmet" Competition

To improve and assess pilot skills and capabilities in combat conditions, the PLAAF in 2011 established an annual 10 to 14 day "Golden Helmet" air-to-air combat competition. The competition takes place at the end of the year at the Dingxin Test and Training Base in the Gobi Desert. The competition is widely regarded as the most important contest to showcase Chinese fighter pilot tactical skills. Individual winners of the annual competition are identified as the PLAAF's "elite pilots" and have the right to wear a gold-colored helmet at their fighter unit. To date, the number of pilots involved in the competition has increased from 100 to 170 and the number of regiments and brigades participating in the competition has increased from 10 to 20. Altogether, 33 different pilots have won "golden helmets," including three pilots who have won the award twice. There is also a unit award, which is given to the team with the highest total score.

Recent articles in PLA media provide a good overview of how the competitions have advanced over the five-year period, to include using different generations of aircraft, dissimilar aircraft, "two-on-two" as well as "one-on-one" confrontations using similar and dissimilar aircraft, and a mix of younger and older entrants. The emphasis on younger participants in the competition, many in their late 20s or early 30s, reflects a desire on the part of the PLAAF to develop fighter pilots who are less hidebound and more willing to implement a "free air combat" approach. In order to avoid issues related to "training for the test," the PLAAF Headquarters began randomly selecting the competitors from each unit in 2014, which resulted in the smallest number of winners to date. Selection of some participants at random also allows PLAAF leaders a means to assess the quality of average pilots relative to their elite counterparts. Additionally, to more closely approximate realistic combat conditions, the PLAAF is relaxing safety restrictions, such as closing the gap between aircraft in formation to 50 meters and adjusting the altitude for engagement, even though these changes entail higher risk of an accident.

A recent winner of the Golden Helmet

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Although Naval Aviation pilots have not participated, in August 2014, two pilots from the East Sea Fleet's "Blue Force" unit equipped with Su-30MK2s conducted the first-ever joint free air combat opposition-force training over water with the Air Force. The PLAAF pilots were Golden Helmet winners flying J-11s. After training for five months, the Naval Aviation pilots won the competition, which involved 1 vs. 1 and 2 vs. 2 engagements.

International Training with Foreign Militaries

In 2002, the PLA began conducting combined exercises with foreign militaries, which the PLA sometimes refers to as "joint exercises." To date, it has participated in more than 70 such exercises and drills with militaries from over 30 countries. There are no indications that the PLARF or its predecessor has ever participated in training with the forces of any foreign country. It also does not appear that China's space forces, previously under the former GAD and now the PLASSF, have conducted any training events with foreign militaries.

As part of this effort, the PLAAF has increasingly become involved in exercises with foreign air forces. Units involved have included those with multirole combat aircraft, bombers, and airborne troops. These exercises have allowed the PLAAF to demonstrate its improving capabilities to the international community. They also provide opportunities to observe and learn from foreign militaries in an operational environment, and serve as a vehicle for building trust and cooperation with select countries.

Exercises with foreign countries can be divided into two categories: those with members of the Shanghai Cooperation Organization (SCO) and those with individual, non-SCO countries.[180] Exercises to date included participation

with Russia, Kazakhstan, Turkey, Pakistan, Venezuela, Belarus, Thailand, and Indonesia. PLAAF Il-76 transport aircraft have supported all of the PLAAF deployments abroad, some of which have involved aerial or ground refueling en route. It should be noted that all of these exercises are highly scripted and the PLAAF trains for the individual components of each exercise for months in advance.

In July 2014, the Russian Air Force hosted "Aviadarts-2014" at Voronezh, Russia, which included the PLAAF and Belarus Air Force. Three PLAAF Su-30s and six pilots competed in six separate events aimed at showing pilot skills in visual reconnaissance, navigation, single-plane or two-plane aerobatics, and air-to-ground attacks. Each crew launched 24 rockets and fired 60 cannon rounds. Based on the total scores, Russia took first place, China took second, and Belarus third. In August 2015, three PLAAF JH-7s competed in the "Aviadarts-2015" competition, which was held within the framework of the "International Army Games 2015."[181] More than 100 pilots in over 50 flight crews from Russia, Belarus, Kazakhstan, and China flew 12 different types of fixed-wing warplanes and helicopters, including Chinese-made JH-7 fighter-bombers. Although China took second out of ten teams overall in the International Army Games that year, the PLAAF came in third behind Russia and Kazakhstan but beat Belarus in the Aviadarts competitions. Unlike 2014, when the PLAAF Su-30s used Russian munitions, in 2015 the JH-7s brought their own munitions.

PLAAF pilot at the 2014 Aviadarts Competition [182]

The PLAAF's 15th Airborne Corps has also participated in combined bilateral and multilateral exercises abroad since 2007, including exercises in Russia, Belarus, Venezuela, and Indonesia.

Finally, the PLAAF's Bayi Aerobatics Team has participated in both domestic and international air shows. They have performed more than 500 times in China, including at the annual Zhuhai Air Show beginning in 1998. They participated in two international air shows outside of China in recent years. The first performance was at the 2013 Moscow Air Show. Its second was in March 2015, at the Langkawi International Maritime and Aerospace Exhibition in Malaysia.

International training events and competitions allow the PLAAF to not only learn training techniques from foreign militaries, they also raise the international profile of China's aviation forces and hone skills in supporting long-distance deployments.

PLA Rocket Force Training

Like other elements of the PLA, the PLARF has emphasized training for actual combat conditions, increasing the force's "informatized" capabilities, and improving "Blue Force" and "opposition-force training." Furthermore, rocket force units focused on improving survivability and the ability to sustain combat operations during war, by conducting training under a variety of conditions, such as training at night, in cold weather and underground, as well as improving their ability to overcome enemy attacks, including air raids, electromagnetic jamming, and reconnaissance activity. It is unclear how often such field training involves real missiles. Nevertheless, training has been geared toward simulating actual combat conditions in different weather and terrain situations and moving missiles between different launch sites more rapidly during all times of the day.

China's rocket forces apparently continue to encounter problems, such as a lack of qualified personnel, physical and psychological issues associated with training in underground facilities, "training for the test," a lack of standardized equipment among units, and equipment breakdowns. Overall, open source reporting tends to highlight success in the five areas below:

- Launching live missiles
- Deploying to a field training or launch site
- Establishing communications along the way and at the final location
- Training all personnel to meet requirements
- Providing support for personnel and equipment during training at distances or in underground facilities.

For example, in 2014, one Chinese report mentioned how an unidentified missile base satisfactorily completed more than ten major exercises and drills and successfully launched nearly 100 missiles of various types over several years.[184] During another deployment, a large convoy of vehicles crossed through mountains and forests during bad weather while successfully handling simulated "enemy situations," such as bridges having been bombed and harassment by enemy operatives, to arrive on time at a pre-designated launch site.[185] Concerning establishing communications, another article mentioned that within 30 minutes of entering a drill site, one unit made use of field combat operations command support components that it had researched and built on its own, and succeeded in installing and debugging military-civilian telephone, videoconferencing, and a dedicated command network, thereby achieving a peacetime-wartime combined, field combat operations interconnected network.[186]

Realistic Training on the Rise

Elements simulating conditions expected in actual combat have become a centerpiece of training exercises within the PLAAF and PLARF. Based on the types of training tasks being reported in Chinese open source reporting, PLA aerospace forces have clearly increased the degree of difficulty of training subjects to include operating under challenging environmental conditions such as during the night and under extreme weather conditions, flying at low and very low altitudes under CEME, cultivating "free-air combat" skills among aviators with decreased altitude restrictions, and conducting sophisticated multi-branch and service exercises against challenging air defense scenarios to mimic actual battle conditions.

In a significant shift from prior practice, PLAAF pilots in some air units are now given the responsibility to create their own flight plans and have full autonomy over their sorties with little guidance from commanders in the tower or an airborne command post. Such elements are part of a broader effort to improve realism and more effectively evaluate unit performance. These measures are consistent with the PLA's objective of being able to fight and win wars under conditions of informatization against formidable opponents.

7. Outlook

As the U.S. Department of Defense has observed, "The PLAAF is pursuing modernization on a scale unprecedented in its history and is rapidly closing the gap with Western air forces across a broad spectrum of capabilities including aircraft, C2, jammers, EW, and data links."[187] The pace and scope of modernization in China's rocket and space forces has been comparable. Assuming that China's leaders continue to define their nation's interests expansively, they will surely look to the PLA, including the PLAAF, the PLARF, and the PLASSF, to sustain their efforts to field ever more capable forces. Areas of emphasis likely will include strengthening the already-formidable air defenses of the Chinese mainland, increasing the reach and lethality of ISR and strike systems out to and beyond the second island chain, improving capabilities to disrupt adversary information systems while better protecting China's, and increasing the scope and complexity of the PLA's security assistance, search and rescue, disaster relief, and other "non-traditional," peacetime activities. All of these areas of policy emphasis will have direct implications for the development of the PLA's air, missile, and space forces.

The ability of the PLAAF, PLARF, and PLASSF to meet the needs of China's increasingly ambitious security strategy will depend, in part, on the future trajectory of military spending in China. Every year between 2000 and 2014, China's military spending grew by more than ten percent, yielding a total increase of more than 480 percent in real terms over that period.[188] China's economy is showing signs of slower growth and this may affect the rate of increase in its military spending in the coming years, potentially reducing the pace of modernization. Additionally, if the PLA is to continue its rapid evolution toward a modern, professional force its leaders will have to sustain

efforts to weed out corruption, overcome certain cultural impediments to rigorous training and exercises, and seek new opportunities for forces to gain real-world operational experience beyond China's borders.

The future evolution of China's air, missile, and space power will depend on developments in at least five areas: Strategy and doctrine, equipment, recruitment and training, infrastructure, and organization.

Strategy and Doctrine

Statements by the leaders of all elements of the PLA reflect their understanding that the leadership of the CCP expects them to make continued strides in fielding forces capable of contending with those of any adversary. Of all of the PLA's components, the leaders of the PLAAF may have adopted the most ambitious goals, as reflected in their oft-repeated intention of becoming a "strategic air force." By this, they appear to mean a force that has the following characteristics:

> [A] clearly defined strategy and an accompanying set of missions that enable it to directly achieve important national security objectives and play a decisive role in protecting Chinese national interests; requirements for modern platforms and systems that are commensurate with China's standing as a major power, including advanced offensive and defensive capabilities; and finally, the institutional status befitting its role as a 'strategic service,' an important consideration given that historically the PLAAF has been relegated to a subordinate role in China's traditionally ground force-dominated military. [189]

Building an air force capable of undertaking a broader set of missions over larger areas and executing powerful strikes against adversaries are seen as requirements for supporting China's growing role on the world stage.

Equipment

As we have seen in the preceding chapters, China's air, missile, and space forces have made great strides in developing, acquiring, fielding, and, increasingly, mastering the integrated employment of new generations of aircraft, rocket and space systems, and their associated weapons and support systems. Barring a major reversal in the performance of China's economy, continued progress along these lines should be expected. Certainly, 4th- and even 5th-generation aircraft will continue to fill out PLAAF fighter units as

older models are retired, and the PLARF will continue to field modern short-, medium-, and intermediate-range missiles, some with specialized warheads and guidance packages for specific missions. But the most significant future developments may come from programs that bring major boosts in capability to areas generally considered to be support functions:

- If the Y-20 program proves successful, it could provide the basis for the PLAAF to undertake more regularized, long-range airlift operations, greatly increasing opportunities for expanded security cooperation, deployments, humanitarian missions, and support to other PLA and national missions.
- The PLAAF has developed a number of UAVs in recent years but these seem not to have been fully integrated into joint PLA operations. As the PLAAF and other elements of the PLA gain increasing experience with UAVs, these platforms and their associated sensors have the potential to significantly improve the PLA's ability to locate, identify, track, and target high-priority assets. PLAAF theorists are calling for the development of new combat platforms that are "unmanned, stealthy, and informatized."[190]
- China already possesses one of the largest and most modern forces of SAM systems in the world. According to the U.S. Defense Department, China may be the first country to import Russia's newest long-range SAM, the S-400/Triumf. The Chinese are also developing their own HQ-19 SAM, which appears to have capabilities similar to those of the S-400.[191] If deployed in significant numbers, these systems will further extend the range of China's integrated air defenses and create new challenges for adversary air forces.
- The PLAAF has lagged, relative to its investment in modern fighter and bomber aircraft, in developing modern airborne warning and control capabilities. Aircraft with powerful on-board radars, controllers, and communication systems can play important roles in orchestrating large-scale, complex air operations. China appears to be taking steps to fill this gap in its capabilities by introducing a new platform, the KJ-500.[192]

Recruitment and Training

As they have fielded more sophisticated and modern equipment and sought to adopt more complex tactics, the PLAAF, PLARF, and PLASSF have found that human capital is also an essential element of operational proficiency. Accordingly, all three arms of the PLA have taken steps to recruit more highly

educated personnel and to retain top performers. The degree to which they succeed at this will go a long way toward determining the extent to which each service will be able to accomplish the ambitious range of missions they have defined for themselves.

This volume has reviewed efforts within China's aerospace forces to make training more valuable and realistic. By all accounts, these efforts have begun to bear fruit, though PLA open sources document continued shortfalls in numerous areas. We should expect to see continued investments by the PLAAF and PLARF in such assets as opposition forces and systems that can replicate the electromagnetic conditions of actual combat. Additionally, the scale, complexity, and "jointness" of PLA exercises likely will continue to increase, reflecting the intent of PLA leaders to prepare their forces to confront any adversary.

Military Infrastructure

As with its combat forces, the past twenty years have seen significant and sustained investments in key infrastructure to support PLA operations. The proliferation of redundant, hardened command and control facilities has perhaps been the most dramatic development in this area, though air bases, missile garrisons, and other facilities have been upgraded as well. We should expect to see future investments in training infrastructure, such as instrumented bombing ranges and airspace, as the PLAAF continues its emphasis on more realistic and rigorous training.

Organization

As noted earlier in this volume, the PLA is in the midst of implementing the most far-reaching reorganization in its history. By elevating the Second Artillery Force to the status of a military service, now called the PLA Rocket Force, and by establishing the PLA Strategic Support Force to consolidate China's military space activities into an independent branch, China's leaders have made clear the importance they place on missile forces and space capabilities. While it will take several years for the reorganization to be fully implemented, and thus for its implications to become totally clear to outside observers, but what has been announced so far suggests that as the PLA implements the reorganization, air and space power will play increasingly prominent roles in Chinese military strategy.

Appendix 1: PLA Air Force Leadership

PLAAF Headquarters

GEN Ma Xiaotian (马晓天)[193] (b. 1949, Henan Province) became the 11th PLAAF Commander, a CMC Member, and Deputy Secretary of the PLAAF Party Committee's Standing Committee at the 18th Party Congress in 2012. In August 2017, Lietenant General Ding Laihang replaced Ma and became the 12th commander, but Ma remained on the CMC, likely until he retires at the time of the 19th Party Congress in October 2017. He is currently a CMC member-grade officer. He joined the PLAAF in 1965 and worked his way up the career ladder as a pilot and unit Deputy Commander and Commander to the air division level. He then served as an Air Corps Chief of Staff, a PLAAF Headquarters Deputy Chief of Staff, Guangzhou MRAF Chief of Staff, Lanzhou MRAF Commander and concurrent Lanzhou MR Deputy Commander, Nanjing MRAF Commander and concurrent Nanjing MR Deputy Commander, a PLAAF Headquarters Deputy Commander, Commandant of the National Defense University, and a Deputy Chief of the General Staff with responsibilities for foreign relations. He received rank promotions in December 1995 (Major General), July 2000 (Lieutenant General), and July 2009 (General).

LT GEN Ding Laihang (丁来杭) (b. 1957, Zhejiang Province) became the 12th Commander of PLA Air Force in August 2017 with the grade of Theater Command leader. He previously served in the Beijing MRAF as a Deputy Commander and Commander of the 24th Air Division's 71st Air Regiment and Deputy Commander of the 24th Air Division, Commander of the Beijing MRAF Transition Training Base. He then transferred to the Nanjing MRAF where he served as Chief of Staff of the 8th Air Corps and Commander of the Air Force Fuzhou Command Post, which was the 8th Air Corps successor, and then became the Commandant of the Air Force Command College in Beijing. In 2009, he became the Chief of Staff of the Chengdu MRAF. In 2012, he became the Commander of the Shenyang MRAF and concurrent Deputy Commander of the Shenyang MR. In February 2016, when the Shenyang MR and MRAF became the Northern Theater Command and Theater Command Air Force, respectively, he continued as the Theater Air Force Commander and concurrent Theater Command Deputy Commander. He received rank promotions in July 2003 (Major General) and July 2013 (Lieutenant General).

LT GEN Yi Xiaoguang (乙晓光) (b. 1958, Jiangsu Province) Preliminary eports indicate Yi became the Commander of the Central Theater Command in August 2017 with the grade of Theater Command Leader. He is the first PLAAF officer to ever serve in this type of billet but it follows the appointment of Vice Admiral Yuan Yubai as the commander of the Southern Theater Command in January 2017. Previously, all former Military Region commanders were Army officers. He joined the PLAAF in 1974 as a flight cadet and worked his way up the career ladder as a pilot, flight squadron Commander, flight group Commander, Gunnery Director in the Chengdu MRAF Headquarters Department's Training Division, air regiment Commander, air division Chief of Staff, Director of the Political Department of the Chengdu MRAF Flight Transition Training Base, air division Commander, Director of the PLAAF Headquarters' Military Training Department, Deputy Chief of Staff of the Chengdu MRAF, Commander of the Wuhan Base (Guangzhou MRAF), a Deputy Chief of Staff of the Guangzhou MRAF, Commandant of the Air Force Command College (Beijing), a Deputy Chief of Staff in PLAAF Headquarters, a Deputy Commander in the Nanjing MR and

concurrently Commander of the Nanjing MRAF, and an Assistant to the Chief of the General Staff. From August 2014 to January 2017, he was a Deputy Chief of the General Staff Department, which became the Joint Staff Department in 2016. He has a Master's Degree in Military Science from the National Defense University. Over the years, he has flown the MiG-15, J-5, J-6, J-7, Su-27, and Su-30. In 1997, he flew in an F-15 while part of a delegation visiting Hawaii. In 2000, he flew in a Mirage 2000 and F1 simulator while visiting Greece. While visiting Turkey, he flew an F-16 simulator. Between 1992 and 1995, he wrote a 100,000-word Pilot's English Dictionary. When he was promoted to corps leader grade in 2004, he was the second youngest officer in that grade in PLAAF Headquarters. When he was promoted to lieutenant general in July 2012, he was the youngest 2-star general.

GEN Yu Zhongfu (于忠福) (b. 1956, Shandong Province) became the 13th PLAAF Political Commissar and Secretary of the PLAAF Party Committee's Standing Committee in July 2015. He is currently a Theater Command leader-grade officer. He joined the PLAAF in 1974 as an enlisted member before becoming an officer and worked his way up the career ladder as a political officer with various leadership positions in subordinate administrative and functional organizations within the Political Department starting at the regiment level. He then became a Political Commissar in various units, including the 19th Fighter Division (Jinan MRAF) and 24th Fighter Division (Beijing MRAF), before becoming a Deputy Director of the Nanjing MRAF's Political Department. He then became the Political Commissar of the Air Force Shanghai Command Post (Nanjing MRAF), Political Commissar of the Jinan MRAF, and Political Commissar of the Nanjing MRAF. He received rank promotions in March 1994 (Senior Colonel), July 2007 (Major General), July 2014 (Lieutenant General), and July 2017 (General).

LT GEN Zhang Jianping (张建平) (b. 1956, Jiangsu Province) became one of the PLAAF Deputy Commanders in April 2013. He is currently a Theater Command deputy leader-grade officer. He joined the PLAAF in 1974. At an unknown year, he received an undergraduate degree from Northwest University in Xi'an, Shaanxi Province. He served in the 3rd Air Division (Nanjing MRAF) as a regiment Commander, division Deputy Commander, and division Commander, as well as a Deputy Chief of Staff in the Nanjing MRAF Headquarters, Chief of Staff and Commander of the 9th Air Corps (Lanzhou MRAF), Chief of Staff of the Shenyang MRAF Headquarters, a Deputy Chief of Staff in PLAAF Headquarters, and the Commander of the Jinan MRAF and concurrent Deputy Commander of the Jinan MR. He received rank promotions in 2003 (Major General) and 2012 (Lieutenant General).

LT GEN Zhang Honghe (张洪贺) (b. unknown) became one of the PLAAF Deputy Commanders in December 2012. He is currently a Theater Command deputy leader-grade officer. He previously served as the Director of the PLAAF Equipment Department's Comprehensive Planning Department, a Deputy Director of the PLAAF Equipment Department, and Commandant of the PLAAF Engineering University (Xi'an, Shaanxi Province). He received rank promotions in 2009 (Major General) and July 2014 (Lieutenant General).

LT GEN Chen Dong (陈东) (b. 1956, Guangxi Zhuang Autonomous Region), became one of the PLAAF Deputy Commanders in December 2012. He is currently a Theater Command deputy leader-grade officer. He previously served as an Army officer in various positions, including as a Deputy Commander of the 42nd Group Army (Guangzhou MR) and Director of the General Staff Department's Informatization Department (former Communications Department). He received rank promotions in July 2005 (Major General) and July 2014 (Lieutenant General). Upon assuming his PLAAF billet, he switched uniforms from Army to Air Force.

LT GEN Zheng Qunliang (郑群良) (b. 1951, Liaoning Province) became one of the PLAAF Deputy Commanders in July 2013. He is currently a Military Region deputy leader grade-officer. He joined the PLAAF in 1970 as an enlisted Army soldier. From 1974-1977, he was a cadet at the PLAAF's 5th Flight School (Jinan, Shandong Province). Upon graduation until 2003, he served in the 1st Fighter Division (Nanjing MRAF) as a pilot, flight squadron Commander, flight group Deputy Commander and Commander, regiment Deputy Commander and Commander, Chief Inspector in the Shenyang MRAF Headquarters' Training Division, and air division Deputy Commander and Commander. He then became the Commander of the Air Force Wuhan Command Post (Guangzhou MRAF), Chief of Staff of the Shenyang MRAF, and a Deputy Commander of the Jinan MRAF, and then Commander of the Jinan MRAF and concurrent Deputy Commander of the Jinan MR. He has flown six different models and 13 variants of aircraft for 2,110 hours. He received rank promotions in July 2005 (Major General) and July 2012 (Lieutenant General).

LT GEN Song Kun (宋琨) (b. 1953, Beijing) became one of the PLAAF Deputy Political Commissars in July 2014 and became a concurrent Secretary of the PLAAF Discipline Inspection Committee in February 2016. He joined the PLAAF in 1970. He is currently a Theater Command deputy leader-grade officer. He began his career as a Political Staff Officer in the Propaganda Office of the 17th Air Division (Beijing MRAF) and 6th Air Corps (Jinan MRAF) before getting an undergraduate degree from Shanghai's Fudan University. He then served as a Deputy Director in the Nanjing MRAF's Political Department, Political Commissar of the Shanghai Base (Nanjing MRAF), a Deputy Director in the PLAAF Headquarters' Political Department, and Political Commissar of the Nanjing MRAF and concurrent Deputy Political Commissar of the Nanjing MR. He received a rank promotion in August 2013 (Lieutenant General).

LT GEN Zhao Yiliang (赵以良) (b. 1954, Guangxi Autonomous Region) became one of the PLAAF Deputy Political Commissars in July 2015 and became a concurrent Secretary of the PLAAF Discipline Inspection Committee at the same time. He joined the PLAAF in December 1969. He is currently a Theater Command deputy leader-grade officer. He began as an ordnance technician in an aircraft maintenance group in the 25th Air Division (Guangzhou MRAF) before shifting to the political officer career track in the same division, where he eventually became the Political Commissar. He then became the Director of the PLAAF Headquarters' Political Department's Organization Department until December 1993, when he became a Deputy Political Commissar in the 8th Air Corps (Fuzhou, Guangzhou MRAF). From 2003 to 2015, he moved around among the various MRAFs and served as a Deputy Director of the Nanjing MRAF Political Department, Director of the Lanzhou MRAF Political Department, Political Commissar of the 15th Airborne Corps, and as the Political Commissar of the Shenyang MRAF and a concurrent Deputy Political Commissar of the Shenyang MR. He received rank promotions in July 1996 (Major General) and July 2010 (Lieutenant General).

LT GEN Ma Zhenjun (麻振军) (b. 1962, Henan Province) became the 13th PLAAF Chief of Staff (e.g., Director of the Headquarters Department) in August 2013. He is currently a Theater Command deputy leader-grade officer. He worked his way up the career ladder as a pilot and unit Deputy Commander and Commander to the air division level in the Guangzhou MRAF, including serving as one of the first Su-27 Fighter Regiment Commanders. After serving as Commander of the 2nd Fighter Division (Guangzhou MRAF), he became a Deputy Chief of Staff in the Guangzhou MRAF Headquarters, a Deputy Commander in the Jinan MRAF, Chief of Staff for the Beijing MRAF, and a Deputy Chief of Staff in the PLAAF Headquarters. Prior to becoming the PLAAF Chief of Staff, he served as the Commander of the Beijing MRAF for one year. He received a rank promotion in 2008 (Major General) and 2013 (Lieutenant General).

MAJ GEN Du Yuanfang (堵远放)[194]
Current Position: Director, Political Work Department, PLA

Background: (b. unknown; location unknown) became the Director of the PLAAF Headquarters' Political Work Department in January 2017. He currently is a TC deputy leader-grade officer. Since the mid-2000s, he has served as a Deputy Director and then Director of the PLAAF Headquarters' Political Department's Cadre Department, Political Commissar of the Air Force Fuzhou Command Post, Director of the Guangzhou MRAF Headquarters' Political Department, and a Deputy Director of the PLAAF Headquarters' Political Department in 2015, which became the Political Work Department in 2016. He received a rank promotion in July 2012 (Major General).

MAJ GEN Zheng Xuexiang (郑学祥) (b. unknown, Shandong Province) became the Director of the PLAAF's Logistics Department in December 2014. He is currently a corps leader-grade officer. He previously served as a Deputy Director of the Beijing MRAF Logistics Department, Director of the PLAAF Logistics Directly Subordinate Supply Department, and Director of the Chengdu MRAF Logistics Department. He received a rank promotion in July 2010 (Major General).

MAJ GEN Li Fan (李凡) (b. unknown) became the Director of the PLAAF Equipment Department in November 2015. He is currently a corps leader-grade officer. He previously served as a Deputy Director and Director in the Equipment Department's Scientific Research and Procurement Department, Director of the Equipment Department's Major Type/Model Department (created in 2010), Chief Engineer in the Equipment Department, and as a Deputy Director of the Equipment Department. He changed from being a Senior Colonel to a Civilian Cadre when he became the Chief Engineer, and then moved back to a Senior Colonel as a Deputy Director of the Equipment Department. He received a rank promotion in August 2014 (Major General).

Eastern Theater Command Air Force

LT GEN Huang Guoxian (黄国显) (b. 1962, location unknown) became the Commander of the Eastern TC Air Force and a concurrent Deputy Commander of the Eastern Theater in February 2016.[195] He is currently a Theater Command deputy leader-grade officer. He previously served in the Chengdu MRAF as a flight group Commander in a flight training base, as an air regiment Commander, and as an air division Chief of Staff and Commander. He then served as the Commander of the Air Force Fuzhou Command Post (Nanjing MRAF). While serving as one of the PLAAF Headquarters' Deputy Chiefs of Staff in 2011, he was selected to become the Nanjing MRAF Chief of Staff. In 2013, he became the Nanjing MRAF Commander. He received a rank promotion in July 2014 (Lieutenant General).

LT GEN Sun Herong (孙和荣) (b. 1957, Shandong Province) became a Deputy Commander of the Eastern TC in February 2016. He is currently a Theater Command deputy leader-grade officer. He previously served as the Commander of the Jinan MRAF.[196] He graduated from the Air Force Engineering University in Xi'an, Shaanxi Province, with a specialty in management science and engineering. He also received a Master's in Engineering. He previously served in several units, as well as serving as one of the Deputy Chiefs of Staff in the Shenyang MRAF Headquarters Department, one of the Deputy Chiefs of Staff in the Nanjing MRAF, and Chief of Staff in the Jinan MRAF. In 2011, he became one of the Deputy Commanders of the Jinan MRAF, and, in 2012, he became the Commander of the Jinan MRAF.

MAJ GEN Liu Dewei (刘德伟) (b. unknown) became the Political Commissar of the Eastern TC Air Force and concurrent Deputy Political Commissar of the Eastern TC in February 2016.[197] He is currently a Theater Command deputy leader-grade officer. He previously served as the Political Commissar of the Air Force Aviation University (Changchun, Jilin Province) before becoming one of the Deputy Directors in the

PLAAF Headquarters' Political Department and as the Political Commissar of the Nanjing MRAF.

Southern Theater Command Air Force

LT GEN Xu Anxiang (徐安祥) (b. 1956, Jiangsu Province) became the Commander of the Southern TC Air Force and a concurrent Deputy Commander of the Southern TC in February 2016.[198] He is currently a Theater Command deputy leader-grade officer. He previously served as the Commander of the 14th Air Division (Nanjing MRAF) and as one of the Deputy Chiefs of Staff then the Chief of Staff in the Nanjing MRAF Headquarters. In July 2011, he moved to PLAAF Headquarters to become one of the Deputy Chiefs of Staff. In December 2012, he became the Commander of the Guangzhou MRAF. He received a rank promotion in 2007 (Major General) and 2014 (Lieutenant General).

MAJ GEN An Zhaoqing (安兆庆) (b. unknown) became the Political Commissar of the Southern TC Air Force and a concurrent Deputy Political Commissar of the Southern TC in February 2016.[199] He is currently a Theater Command deputy leader-grade officer. He served as the Political Commissar of an independent flight group (e.g., regiment grade) subordinate to the 17th Air Division, Political Commissar for the 1st Air Division (Shenyang MRAF), and Political Commissar for the Air Force 1st Flight College (Harbin, Heilongjiang Province). In 2009, he became one of the Deputy Directors of the Shenyang MRAF Headquarters' Political Department. In 2013, he became the Director of the Nanjing MRAF Political Department. In 2014, he became the Political Commissar of the Guangzhou MRAF. He received a rank promotion in 2009 (Major General).

MAJ GEN Chang Dingqiu (常丁求) (b. 1967, Hunan Province) became a Deputy Commander of the Southern TC in February 2016.[200] He is currently a Theater Command deputy leader-grade officer. He joined the PLAAF in 1984 as a pilot cadet. He moved his way up the career ladder as a pilot, flight group Commander, air regiment Commander, and Deputy Commander and Commander of the 3rd Fighter Division (Nanjing MRAF). In 2003, he studied abroad at a Russian Military Academic Institution. He then served as an Assistant to the PLAAF Chief of Staff and then became the Chief of Staff in the Shenyang MRAF. He received a rank promotion in July 2012 (Major General).

Western Theater Command Air Force

LT GEN Zhan Houshun (战厚顺) (b. Heilongjiang Province) became the Commander of the Western TC Air Force and as a concurrent Deputy Commander of the Western TC in February 2016.[201] He is currently a Theater Command deputy leader-grade officer. He previously served as the Commander of Air Force Changchun Command Post (Shenyang MRAF), Chief of Staff of the Chengdu MRAF, and became the Commander of the Chengdu MRAF in 2013. He received a rank promotion in 2002 (Major General) and 2014 (Lieutenant General).

LT GEN Shu Qingyou (舒清友) (b. 1955, Hunan Province) became the Political Commissar of the Western TC Air Force and a concurrent Deputy Political Commissar of the Western TC in February 2016.[202] He is currently a Theater Command deputy leader-grade officer. He received his undergraduate degree from the Air Force Command College in Beijing and has conducted some graduate studies. He previously served as one of the Deputy Directors of the PLAAF Headquarters' Political Department and then Political Commissar of the Chengdu MRAF. He received a rank promotion in 2014 (Lieutenant General).

MAJ GEN Han Shengyan (韩胜延) (b. unknown, Hebei Province) became one of the Deputy Commanders of the Western TC in February 2016. He is currently a Theater Command deputy leader-grade officer. In the early 1990s, he studied abroad. Starting around 2000, he served as a Deputy Commander of the 3rd Air Division (Nanjing MRAF), Commander of the 1st Air Division (Shenyang MRAF), Commander of the 3rd Air Division, a Deputy Chief of Staff in the Chengdu MRAF, Chief of Staff of the Lanzhou MRAF, a Deputy Commander of the Chengdu MRAF, and Commander of the Dingxin Test and Training Base (Jiuquan, Gansu Province), where he oversaw the annual Golden Helmet competition in 2014 and 2015. He received a rank promotion in July 2009 (Major General).

Northern Theater Command Air Force

No information was found concerning who the new commander of the Northern Theater Command Air Force since the former commander, Ding Laihang, became the PLAAF commander in August 2017.

LT GEN Bai Wenqi (白文奇) (b. 1955) became the Political Commissar of the Northern TC Air Force and a concurrent Deputy Political Commissar of the Northern TC in February 2016.[203] He is currently a Theater Command deputy leader-grade officer. He spent most of his career in the PLA Navy. He began his career as a political officer at various times in Naval Aviation units in the North Sea Fleet (NSF), as well as the East Sea Fleet and South Sea Fleet. Until July 2012, he served as the Political Commissar for the NSF Naval Aviation Headquarters. In July 2012, he became the Political Commissar for the NSF. In 2015, he transferred in grade to the PLAAF to become the Political Commissar of the Jinan MRAF. In August 2013, he received a promotion in rank from Rear Admiral to Vice Admiral. Upon assuming his PLAAF billet, he traded his Navy uniform for an Air Force uniform and assumed the rank of Air Force Lieutenant General.

No Photo Available

MAJ GEN Wang Wei (王伟) (b. 1957, Zhejiang Province) became one of the Deputy Commanders of the Northern TC in February 2016.[204] He is currently a Theater Command deputy leader-grade officer. He previously served as the Commander of the Air Force Fuzhou Command Post (Nanjing MRAF), Chief of Staff of the Shenyang MRAF, and a Deputy Commander of the Shenyang MRAF.

MAJ GEN Liu Jian (刘建) (b. 1958, Hebei Province) became a Deputy Political Commissar and concurrent Director of the Political Work Department of the Northern TC in February 2016.[205] He is currently a Theater Command deputy leader-grade officer. He previously served in the Army as the Director of the Political Department in the Beijing Military Region's 27th Group Army and the Political Commissar in the Beijing Military Regions 65th Group Army before putting on an Air Force uniform and serving as the Political Commissar in the Shenyang MRAF and concurrent Deputy Political Commissar in the Shenyang Military Region.

Central Theater Command Air Force

LT GEN Zhuang Kezhu (庄可柱) (b. 1955, Jilin Province) became the Commander of the Central Theater Air Force and a concurrent Deputy Commander of the Central TC in February 2016.[206] He is currently a Theater Command deputy leader-grade officer. He has a graduate degree from Yunnan Normal University in computer software and theory. He joined the PLAAF at age 19 (1974) and served as a pilot, flight squadron Commander, flight group Commander, air regiment Deputy Commander and Commander, air division Deputy Commander and Commander, and Chief of Staff and Commander of the Air Force Kunming Base. In July 2004, he became an assistant to the Chief of Staff at PLAAF Headquarters. He later became the Chief of Staff of the Lanzhou MRAF and Chief of Staff of the Guangzhou MRAF. In December 2011, he became the Commander of the Lanzhou MRAF. In July 2013, he took a lateral transfer to become the Commander of the Beijing

MRAF. He received rank promotions in 2002 (Major General) and 2013 (Lieutenant General).

LT GEN Zhang Yihu (张义瑚) (b. 1962, Jiangsu Province) became one of the Deputy Commanders of the Central TC in February 2016.[207] He is currently a Theater Command deputy leader-grade officer. He joined the PLAAF in the 1980s and served as a flight squadron Commander and flight group Commander. He was also a regiment Commander for a regiment under 3rd Air Division (Nanjing MRAF), when the regiment received the first Russian Su-27s. In 1999, he was the overall Commander of the flight demonstration over Tiananmen for the PRC's 50th anniversary. In 2002, he became the Commander of the 33rd Air Division (Chengdu MRAF). He then served as one of the Deputy Chiefs of Staff in the Chengdu MRAF, an assistant to the Chief of Staff in PLAAF Headquarters, the Chief of Staff for the Lanzhou MRAF, the Chief of Staff of the Beijing MRAF, and finally a concurrent Commander of the Lanzhou MRAF and Deputy Commander of the Lanzhou MR. He received a rank promotion in July 2009 (Major General) and July 2014 (Lieutenant General).

MAJ GEN Li Fengbiao (李凤彪) (b. 1959, Beijing), who is now apparently a PLAAF officer, became one of the Deputy Commanders and the concurrent Chief of Staff of the Central TC in February 2016.[208] He is currently a Theater Command deputy leader-grade officer. He joined the PLA in 1978 as an enlisted member and then worked his way up the officer career ladder as a platoon Commander, company Commander, and a Staff Officer in a regiment headquarters. He then became the Commander of the 44th Division in the PLAAF's 15th Airborne Corps and the Chief of Staff and Commander of the 15th Airborne Corps. In 2014, he moved to the Army as a Deputy Commander in the Chengdu Military Region.

LT GEN Liu Shaoliang (刘绍亮) (b. unknown) became the Political Commissar of the Central TC Air Force and a concurrent Deputy Political Commissar of the Central TC in February 2016.[209] He is currently a Theater Command deputy leader-grade officer. He previously served as the Director of the Beijing MRAF Headquarters Department's second-level Political Department, a Deputy Director and Director of the PLAAF Headquarters' Political Department's second-level Cadre Department, a Deputy Director of the Beijing MRAF Political Department, a Deputy Director of the Nanjing MRAF Political Department, and Political Commissar of the Air Force Shanghai Command Post (Nanjing MRAF). In 2006, he returned to the PLAAF Headquarters, where he served as the Political Commissar for the Equipment Department. In 2010, he became the Political Commissar of the Jinan MRAF and then the Political Commissar of the Beijing MRAF. He received a promotion in rank in 2011 (Lieutenant General).

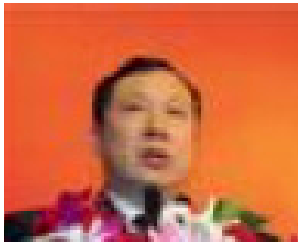
Appendix 2: PLA Rocket Force Leadership

GEN Wei Fenghe (魏凤和) (b. 1954, Shandong Province) became the Commander of the Second Artillery Force in October 2011 and a concurrent CMC Member in November 2011. He continued as the Commander of the PLA Rocket Force, when it was created on 31 December 2015, as well as a concurrent CMC Member. He is a CMC member-grade officer. When Lieutenant General Zhou Yaning became the commander in September 2017, Wei remained on the CMC. He joined the PLA in 1970 as an enlisted member. After attending the Second Artillery Command College as a cadet (1982-1984) and received an associate's degree, he moved his way up the career ladder in Second Artillery as a platoon commander, Staff Officer and Director in a regiment Headquarters Department's Operations and Training Branch, Director of a brigade Headquarters Department's Operations Office, Chief of Staff and Commander of a brigade, Chief of Staff of the 54th Base (Henan Province), Commander of the 53rd Base (Yunnan Province), a Deputy Chief of Staff and Chief of Staff in Second Artillery Headquarters, and a Deputy Chief of the General Staff. He received rank promotions in 1994 (Senior Colonel), July 2004 (Major General), July 2008 (Lieutenant General), and November 2012 (General).

LT GEN Zhou Yaning (周亚宁) (b. 1957, Hebei Province) became the PLA Rocket Force (PLARF) commander in September 2017 at age 60 with the grade of Theater Command leader. The previous commander, General Wei Fenghe, remained on the Central Military Commission. He joined the PLA in 1975 or 1976, most likely as an enlisted member and then received a direct promotion as an officer. He has spent his entire career in the PLA Second Artillery Force (now Rocket Force), which was created in 1966. No information is available about his early career, but he apparently moved his way up the career ladder in launch units, including serving as a missile launch brigade commander. He then served as the Director of the Logistics Department then as the Chief of Staff (director of the Headquarters Department) in Base 52 (Huangshan, Anhui Province). He then served three years as the commander of Base 53 (Kunming, Yunnan Province) before returning to Base 52 for another three years as the commander. In December 2014, he became a PLASAF deputy commander and remained in that position when the PLARF was created. He received rank promotions in July 2009 (Major General) and August 2016 (Lieutenant General). As such, he will most likely not receive his third star until July 2019. No information was found concerning his education background.

LT GEN Wang Jiasheng (王家胜) (b. 1955, Liaoning Province) became the Political Commissar of Second Artillery in December 2014 and continued in the position when the Rocket Force was created on 31 December 2015.[210] In 1984, he received an Associate's Degree in Electronic Specialties from the PLA's National University of Defense Technology. He served as a Deputy Director of the GAD's Political Department, Political Commissar of the GAD's 27th Test and Training Base (Xichang Satellite Launch Center, Sichuan Province), the Director of GAD's Political Department, and a Deputy Political Commissar of Second Artillery and concurrent Secretary of the Discipline Inspection Committee. He received rank promotions in July 2004 (Major General) and July 2013 (Lieutenant General).

Appendix 3: PLA Strategic Support Force Leadership



MAJ GEN Shang Hong (尚宏) (b. 1960, Shandong Province) became the Commander (司令员) of the PLA's Military Space Force (军事航天部队), which is under the PLASSF that was created in December 2015.[211] It is not clear what his grade is, but he is most likely a Theater Command deputy leader-grade officer. He joined the PLA in 1982 and, at some point, graduated from Taiyuan Institute of Mechanical Engineering (now North University of China), Shanxi Province, with a specialty in Automatic Control Systems. He previously served in the Taiyuan Satellite Launch Base for several years before transferring to GAD Headquarters as the Director of the subordinate Logistics Department's Test Equipment Materials Bureau and then a Deputy Chief of Staff and Chief of Staff in GAD before becoming the Commander of the 20th Test and Training Base (Jiuquan Satellite Launch Center, Gansu Province). It is not clear when he received his rank promotion to Major General.

MAJ GEN Kang Chunyuan (康春元) (b. 1958, Beijing) became the Political Commissar of the PLA's Military Space Force (军事航天部队), which is under the PLASSF that was created in December 2015.[212] It is not clear what his grade is, but he is most likely a Theater Command deputy leader-grade officer. He served most of his career in the Beijing Military Region Headquarters, including the Director of the Political Department's Propaganda Department before becoming the Director of the 65th Group Army's Political Department in Hebei Province. He then returned as a Deputy Director of the Beijing Military Region Headquarters' Political Department before becoming a Deputy Political Commissar in the Lanzhou Military Region Headquarters. He received a rank promotion in July 2006 (Major General).

ENDNOTES

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[2] Yao Jianing, "Expert: PLA Strategic Support Force a Key Force to Win Wars," *China Military Online*, 6 January 6th, 2016, http://english.chinamil.com.cn/news-channels/2016-01/06/content_6846515.htm.

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[4] http://www.rand.org/blog/2016/04/xis-purge-of-the-military-prepares-the-chinese-army.html, photo by Jason Lee/Reuters.

[5] In Ronald O'Rourke (Congressional Research Service), Maritime Territorial and Exclusive Economic Zone (EEZ) Disputes Involving China: Issues for Congress. 6 June 2014. p. 17.

[6] Hu Jintao, "Report to the Eighteenth National Congress of the Communist Party of China," November 8, 2012.

[7] Paul H.B. Godwin, "Change and Continuity in Chinese Military Doctrine, 1949-1999," in eds. Ryan, Mark A., Finkelstein, David M., and McDevitt, Michael A., *Chinese Warfighting: The PLA Experience Since 1949*, Armonk, NY: M.E. Sharpe, 2003, p. 23.

[8] The State Council Information Office of the People's Republic of China, "China's Military Strategy," May 2015, accessed on 21 March 2016 at: http://www.chinadaily.com.cn/china/2015-05/26/content_20820628.htm.

[9] In today's paradigm, "Active Defense" may be interpreted as the guiding approach toward China's development of an "Anti-Access and Area Denial" (A2/AD) strategy. Although the PRC does not use the term A2/AD, China nevertheless emphasizes taking offensive measures to defend the homeland. These operations are tantamount to counter-intervention operations though the PRC does not refer to them as such either.

[10] Jiang Zemin, *Jiang Zemin's Selected Works*, Vol. 1, Beijing: Renmin chubanshe, 2006, p. 285.

[11] Jiang Zemin, *Jiang Zemin's Selected Works*, Vol. 3, Beijing: Renmin chubanshe, 2006, p. 608.

[12] M. Taylor Fravel, "China's New Military Strategy: 'Winning Informatized Local Wars,'" China Brief, Vol. 15, No. 13, 23 June, 2015.

[13] These descriptions are drawn from several sources of Chinese military writings to include *Science of Campaigns 2006, PLA Military Terms, 2011,* and *Science of Military Strategy (SMS) 2013* as produced by the PLA's Academy of Military Science (AMS).

[14] *PLA Military Terms*, 2011, pp. 109-110.

[15] PLA AMS, *SMS*, 2013, p. 236.

[16] *SMS*, 2013, p. 229 cited in draft Michael S. Chase, "PLA Rocket Forces: Executors of China's Nuclear Strategy and Policy," p. 13.

[17] Mark A. Stokes, "China's Quest for Joint Aerospace Power: Concepts and Future Aspirations," in eds. Hallion, Richard P., Cliff, Roger, Saunders, Phillip C., *The Chinese Air Force: Evolving Concepts, Roles, and Capabilities*, Washington, DC: National Defense University Press, 2012, p. 39.

[18] *Science of Campaigns 2006*, ed. Zhang Yuliang, Beijing: National Defense Uni-

versity, 2006. Accessed on 27 May 2016 at: https://michalthim.files.wordpress.com/2015/12/the-science-of-campaigns-e68898e5bdb9e5ada6-2006.pdf.

[19] Draft paper, Cristina L. Garafola, "The Evolution of the PLAAF Mission, Roles and Requirements," p. 12.

[20] Cliff, Roger, et al, *Shaking the Heavens and Splitting the Earth: Chinese Air Force Employment Concepts in the 21st Century*, Santa Monica, CA: The RAND Corporation, MG-915-AF, 2011, p. 117.

[21] *SMS*, 2013, p. 221, cited by Garafola, p. 8.

[22] Cliff et al, p. 117

[23] Ibid., pp. 85-6.

[24] Ibid., p. 86.

[25] Cited in Ibid., p. 145.

[26] *PLA Military Terms*, 2011, p. 969.

[27] Ibid., p. 964.

[28] Cliff et al., p. 166.

[29] Chinese authors of the PLA's *The Science of Second Artillery Campaigns*, for example, suggest that China could drop or place conditions on its longstanding No First Use policy in response to particularly threatening conventional attacks by a powerful enemy. Specifically, they state that this method could be used when a powerful nuclear-armed enemy that enjoys conventional military superiority conducts continuous medium- or high-intensity air raids against major strategic targets in China.
See *Science of Second Artillery Campaigns*, cited in Michael S. Chase and Arthur Chan, *China's Evolving Approach to "Integrated Strategic Deterrence,"* Santa Monica: The RAND Corporation, 2016, p. 43.

[30] *The Science of Strategy*, 1987, p. 115 cited in Chase, p. 12.

[31] Office of the Secretary of Defense (OSD), *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2016*, Washington, DC: U.S. Department of Defense, 2016, p. 30.

[32] OSD, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, Washington, DC: U.S. Department of Defense, 2015, p. 80.

[33] Anthony H. Cordesman and Steven Colley, "Chinese Strategy and Military Modernization in 2015: A Comparative Analysis," Center for Strategic and International Studies (CSIS), December 30th, 2015, p. 268.

[34] We are using the term "generation" here as understood in the U.S. system. The Chinese use a different definition of generation for aircraft and recognize only three generations (first-generation (deployed in 1950s and 1960s), second-generation (deployed in 1970s and 1980s), and third-generation (deployed in 1990s and 2000s). Thus, for instance, U.S. third generation aircraft equals the PRC's second generation. U.S. second generation equals the PRC's first generation, etc.

[35] OSD, *Annual Report to Congress*, 2015, p. 11.

[36] Ibid., p. 80.

[37] Cordesman and Colley, p. 268.

[38] OSD, *Annual Report to Congress*, 2016, p. 31.

[39] National Air & Space Intelligence Center (NASIC), *People's Liberation Army Air Force 2010*, 1 August 2010, p. iii.

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[41] Kenneth W. Allen, "PLA Air Force Organization," in James C. Mulvenon and Andrew N.D. Yang, eds., *The People's Liberation Army as Organization: Reference Volume v1.0*, Santa Monica, CA: RAND Corporation, CF-182-NSRD, 2002, pp. 373-4.

[42] Cliff et al., p. 20.

[43] OSD, *Annual Report to Congress*, 2016, p. 32.

[44] Kenneth W. Allen, "Reforms in the PLA Air Force," *China Brief*, Vol. 5, No. 15, July 5, 2005a.

[45] "China: Air Force," *Jane's World Air Forces*, February 23, 2007.

[46] Kenneth W. Allen, "PLA Air Force Organizational Reforms: 2000-2012," in Kevin Pollpeter and Kenneth W. Allen, eds., *The PLA as Organization Reference Volume v2.0*, Vienna, VA: Defense Group Inc., 2015, p. 317.

[47] David Shlapak, "Equipping the PLAAF: The Long March to Modernity," in eds. Hallion, Richard P., Cliff, Roger, Saunders, Phillip C., *The Chinese Air Force: Evolving Concepts, Roles, and Capabilities*, Washington, DC: National Defense University Press, 2012, p. 39. p. 191.

[48] Ibid., p. 192.

[49] Ibid., p. 195.

[50] This file is licensed under the Creative Commons Attribution-Share Alike 2.0 Generic (https://creativecommons.org/licenses/by-sa/2.0/deed.en) license. Photograph by Rob Schleiffert (http://www.flickr.com/people/109661044@N07). Downloaded from https://commons.wikimedia.org/wiki/File:Two_F7s_(Chinese_version_of_the_MiG-21F-13_%27Fishbed%27)_at_Tirana_Airport_(11278465865).jpg.

[51] U.S. Department of Defense. This Image was released by the United States Department of Defense with the ID 010124-D-0000X-001. Downloaded from https://commons.wikimedia.org/wiki/Category:Shenyang_J-8.

[52] Shlapak, p. 195.

[53] Defense Dept. photograph by U.S. Air Force Staff Sgt. D. Myles Cullen, Downloaded from https://commons.wikimedia.org/wiki/File:Chinese_Su-27.JPG.

[54] This file is licensed under the Creative Commons Attribution 2.0 Generic (https://creativecommons.org/licenses/by/2.0/deed.en) license.Photograph by Flickr user mxiong (http://www.flickr.com/people/73385013@N00) was uploaded to Wikimedia Commons using Flickr upload bot on 17:53, 19 January 2011 (UTC) by Dura-Ace (talk). Downloaded from https://commons.wikimedia.org/wiki/File:Chengdu_10.jpg.

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[56] Ibid., p. 196.

[57] According to Wikimedia Commons, this file comes from the Dmitriy Pichugin collection http://www.airliners.net/search/photo.search?photographer-search=Dmitriy%20Pichugin%20&distinct_entry=true) and is copyrighted. Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 only as published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. Downloaded from https://commons.wikimedia.org/w/index.php?title=File:PLAAF_Sukhoi_Su-30MKK_at_Lipetsk-2.jpg&oldid=161396517

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[59] Ibid., pp. 193-4.

[60] Cordesman and Colley, p. 274.

[61] IHS Jane's "China Air Force Summary," pp. 35-6.

[62] Shlapak, p. 195.

[63] According to Wikimedia Commons, this file comes from the Dmitriy Pichugin collection http://www.airliners.net/search/photo.search?photographer-search=Dmitriy%20Pichugin%20&distinct_entry=true) and is copyrighted. Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 only as published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts,and no Back-Cover Texts. Downloaded from https://commons.wikimedia.org/w/index.php?title=File:Xian_JH-7A_at_Shagol.jpg&oldid=197744428.

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[65] IHS Jane's "China Air Force Summary," January 2016, pp. 37-8, accessed on 23 February 2016.

[66] Ibid., p. 38.

[67] Shlapak, p. 197.

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[69] Photograph by 日本防衛省 統合幕僚監部. This file is licensed under the Government of Japan Standard Terms of Use (Ver.2.0) (http://www.kantei.go.jp/jp/singi/it2/densi/kettei/gl2_betten_1_en.pdf). The Terms of Use are compatible with the Creative Commons Attribution License 4.0 International (https://creativecommons.org/licenses/by/4.0/). For terms of use, see this license page (http://www.mod.go.jp/js/e_notice.htm). Downloaded from ttps://commons.wikimedia.org/wiki/File:H-6K_20119_20151127.jpg.

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[75] Michael S. Chase, Jeffrey Engstrom, Tai Ming Cheung, Kristen A. Gunness, Scott Warren Harold, Susan Puska, and Samuel K. Berkowitz, *China's Incomplete Military Transformation*, Santa Monica: The RAND Corporation, RR-893-USCC, 2015, p. 105.

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[78] IHS Jane's "China Air Force Summary," p. 39.

[79] Shlapak, p. 198.

[80] Andreas Rupprecht and Tom Cooper, *Modern Chinese Warplanes: Combat Aircraft and Units of the Chinese Air Force and Naval Aviation*, Houston, TX: Harpia Publishing, 2012.

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[86] IHS Jane's "China Air Force Summary," p. 42.

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[89] Ibid., p. 165.

[90] NASIC, p. 101.

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[101] Ibid., p. 286.

[102] IISS, *Military Balance*, 2016, p. 223.

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[109] IISS, *Military Balance*, 2016, p. 223.

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[118] Franz-Stefan Gady, "China Unveils Its Largest Killer Drone to Date," *The Diplomat*, September 2nd, 2015, accessed on June 6th 2016 at: http://thediplomat.com/2015/09/china-unveils-its-largest-killer-drone-to-date/. Also see Adam Rawnsley, "Meet China's Killer Drones," *Foreign Policy*, January 14th, 2016, accessed on June 6th 2016 at: http://foreignpolicy.com/2016/01/14/meet-chinas-killer-drones/.

[119] Cordesman and Colley, p. 287.

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[121] Ibid., pp. 42-3.

[122] Some observers believe the reforms suggest that the PLARF will be responsible not only for ground-launched nuclear missile systems, but also sea- and air-launched nuclear missiles. However, we have yet to observe any expansion in PLARF nuclear command and control to these domains. In addition, the PLA does not yet possess a fully functioning nuclear triad. For example, PLAAF bombers can drop nuclear bombs but do not currently have nuclear tipped air-launched cruise missiles (ALCMs). Reports suggest, however, that the PLARF is developing this capability. The PLA Navy (PLAN) has yet to conduct its first nuclear patrol using one of its new *Jin*-class submarines, but this may occur soon.

[123] "Counter-intervention" is commonly known in the West as A2/AD capabilities. Beijing, however, does not use the term A2/AD or counter-intervention. Instead, it typically refers to deploying capabilities consistent with countering a powerful adversary's military intervention in a conflict involving China.

[124] Cordesman and Colley, p. 301.

[125] OSD, *Annual Report to Congress*, 2016, p. 25.

[126] Cordesman and Colley, p. 293.

[127] In US Department of Defense "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015," p. 27.

[128] Cordesman and Colley, pp. 302-303.

[129] U.S.-China Economic and Security Review Commission, *2014 Report to Congress*, November 2014, p. 315.

[130] Review Commission, November 2014, p. 315.

[131] The National Institute for Defense Studies, *NIDS China Security Report 2016: The Expanding Scope of PLA Activities and the PLA Strategy*, March 2016, p. 48.

[132] Review Commission, November 2014, p. 315.

[133] NIDS, p. 48.

[134] Richard D. Fisher, Jr., "PLA Flaunts Strategic Missiles of its Rocket Force," *IHS Jane's Defence Weekly*, 16 February 2016, access on 27 May 2016 at: http://www.janes.com/article/58028/pla-flaunts-strategic-missiles-of-its-rocket-force.

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[136] NIDS, p. 50.

[137] Ibid., p. 50.

[138] Review Commission, November 2014, p. 317.

[139] Review Commission, *2015 Report to Congress*, p. 352.

[140] Ibid., p. 352.

[141] In US Department of Defense "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015," p. 29.

[142] Cordesman and Colley, p. 326.

[143] Review Commission, *2014 Report to Congress*, p. 317. It should also be noted that other PLA services are responsible for other types of cruise missiles. For example, the PLAN controls use of anti-ship cruise missiles (ASCMs), which are launched from PLAN surface platforms.

[144] Review Commission, *2015 Report to Congress*, p. 354.

[145] NIDS, p. 51.

[146] Review Commission, *2015 Report to Congress*, p. 362.

[147] Ibid., p. 362.

[148] Ibid., p. 362.

[149] Review Commission, *2014 Report to Congress*, p. 315.

[150] Cited in Kevin Pollpeter, "Space, the New Domain: Space Operations and Chinese Military Reforms," Forthcoming Paper, p. 3.

[151] The State Council Information Office of the People's Republic of China, "China's Military Strategy," May 2015, accessed on 21 March 2016 at: http://www.chinadaily.com.cn/china/2015-05/26/content_20820628.htm.

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[153] Kevin Pollpeter, "Strategic Support Force: Formation of Strategic Support Force Answers Some Questions But Raises More," Presentation to CASI members, February 2016, slide 28.

[154] Kevin Pollpeter, Eric Anderson, Jordan Wilson, Fan Yang, "China Dream, Space Dream: China's Progress in Space Technologies and Implications for the United States," *U.S.-China Economic and Security Review Commission*, no date, p. 96, accessed on 21 March 2016 at: http://origin.www.uscc.gov/sites/default/files/Research/China%20Dream%20Space%20Dream_Report.pdf.

[155] Pollpeter et al, p. 95.

[156] Ibid., p. 95.

[157] Ibid., p. 95.

[158] Kevin Pollpeter and Jonathan Ray, "The Conceptual Evolution of Space Operations as Seen in the Science of Military Strategy," no date, provided by Kevin Pollpeter, p. 16.

[159] Pollpeter et al, p. 97.

[160] Ibid., p. 97.

[161] Ibid., p. 98.

[162] Ibid., p. 98.

[163] "China's Military Strategy"

[164] Pollpeter, "Space, the New Domain," p. 6.

[165] Ibid., p. 6.

[166] Cited in Ibid., pp. 6-7.

[167] Ibid., p 7.

[168] Ibid., p. 7.

[169] Pollpeter, "Space, the New Domain," p. 8. Historical point from Pollpeter's CASI presentation in February 2016.

[170] Cited in Pollpeter, "Space, the New Domain," p. 8.

[171] Pollpeter et al, p. 18.

[172] Pollpeter, "Space, the New Domain," p. 9.

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[175] Pollpeter et al, p. 18.

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[177] OSD, *Annual Report to Congress*, 2016, p. 60.

[178] Pollpeter, "Space, The New Domain," pp. 77-8.

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