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CHINA AEROSPACE
STUDIES INSTITUTE

PLA Aerospace Power:

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

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Introduction

PLA Modernization

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). The Communist Party of China's (CCP) 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 end of 2015, Chinese President Xi Jinping, in his role as Chairman of the Chinese Communist Party (CCP) Central Military Commission (CMC), announced the 11th major structural reform to the PLA since 1949. 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] Historically, the PLA charged the PLARF with developing nuclear deterrence and counterstrike options, but its mission and capabilities have grown since the early 1990s to include carrying out conventional firepower strikes.

In December 2015, Xi also established the PLA's Strategic Support Force (PLASSF), which is a theater command-level organization rather than its own service, to centralize the PLA's with strategic space, cyber, electronic, and psychological warfare missions and capabilities.[2] The PLASSF forms the core of China's information warfare force, supports the entire PLA, and

reports directly to the CMC. According to a Ministry of National Defense[i] spokesman, "The PLASSF will integrate reconnaissance, early warning, communications, command, control, [and] navigation … and will provide strong support for joint operations for each military service and branch."[3] The PLASSF may also be responsible for research, development, testing, and fielding of certain "new concept" weapons, such as directed energy and kinetic energy weapons. The PLASSF's space function is primarily focused on satellite launch and operation to support PLA reconnaissance, navigation, and communication requirements. 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."[4] 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 chain. 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). As a result, according to the PLAAF's spokesperson, "In recent years, advanced fighters, large transport aircraft, airborne early warning aircraft, tankers, advanced SAMs and other high-tech weapons and equipment with world-class advanced levels have been installed, and the capabilities of expeditionary operations and information systems-based systems have been significantly enhanced."[5]

i Note that the PLA often uses "defence" instead of "defense" for multiple terms; however, for purposes of this report, only defense is used.

Figure 1: CMC Chairman Xi Jinping chairs ceremony creating the 5 Theater Commands in Beijing in February 2016[6]

In 2018, Xi declared that "the task of building a strong navy has never been as urgent as it is today." China has extensively modernized the PLA Navy (PLAN) in recent years, transforming it into a much more modern and capable force.[7] This includes improved and new PLAN aerospace forces, such as aircraft carriers, helicopter landing ships, carrier-based aircraft, and surface-based air defenses. With this modernization, the PLAN is increasingly capable of defending China's coast and near seas while also projecting power at increasingly long distances. These improvements are consistent with China's 2019 Defense White Paper, which emphasizes building a modernized naval force capable of carrying out missions on the far seas.[8]

The PLA Army (PLAA) has also modernized its aerospace forces in terms of both equipment and organization. It is developing and fielding modernized helicopters for various roles and is equipped with a variety of mobile, modern air defense weapons. Following the 2016 PLA reorganization, the PLAA integrated its anti-aircraft artillery (AAA), air defense, and electronic warfare (EW) elements into single units rather than each functioning independently. With these equipment and organizational improvements, the PLAA's aerospace forces are better able to support and protect the PLAA's ground-based forces.

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.

China's Security Objectives

According to the PRC's 2002 Defense White Paper, China defines "armed forces" as including the PLA (which is the armed wing of the Chinese Communist Party (CCP)), the People's Armed Police (PAP) (which is subordinate to the CCP's CMC), and the militia. The PLA's primary responsibility is ensuring the leading role of the Communist Party of China. In addition, like most armed forces, those of the CCP and PRC are charged with the responsibility for protecting China's sovereignty and territorial integrity, in the face of potential external threats. A gradual series of events starting with the U.S. response to the Tiananmen Square protests and massacre in 1989 prompted the CCP'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 United States (U.S.) forces in Operation Desert Storm (1991), the Third Taiwan Strait Crisis (1996), Operation Allied Force (1999), and other large-scale operations, convinced Chinese planners that the challenges posed by the U.S. were serious and that meeting them would require substantial and sustained investments. The CMC has focused its efforts on modern air, space, and missile forces; advanced command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) assets with a heavy emphasis on coordination at the same level among the services and branches; 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 since 1949, but China also considers that conflicts might arise out of other regional tensions such as sovereignty disputes in the East China Sea and South China Sea.[9]

Figure 2: In recent years, China has increased its ability to operate within and beyond the first island chain.

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."[10] 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 1949, 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 against formidable opponents on its periphery. Indeed, China has long had to find ways to overcome its "inferiority in the material means of war"[11] when competing with the likes of U.S., Russian, or Japanese military forces. 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 (积极防御)" 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.[12]

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 (人民战争)," 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 (现代条件下的人民战争)," remained the PLA's guiding principle until the early 1990s when China witnessed advanced capabilities on display by the U.S. 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. These concerns over superior U.S. warfighting capabilities prompted China's military leaders to shift Chinese military strategy again.

Starting in 1993, 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."[13] 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 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."[14] 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.[15]

PLA Air Force Overview

Overview

Over the course of its 72 years of history, the PLA Air Force (PLAAF) has evolved from a limited force focused on homeland air defense to a "strategic air force" fielding advanced aircraft and missile systems. The PLAAF is now capable of conducting limited operations beyond the first island chain and deterring, coercing, delaying, or defeating most adversaries within the first island chain. Despite its lengthy history, the PLAAF has struggled to carve out a role and mission distinct from that of China's ground forces and navy. While the PLA Army is largely responsible for handling ground related territorial disputes and the PLA Navy (PLAN) is responsible for handling maritime disputes, the PLAAF is left without a similar mission set that is closely tied to political priorities of the Chinese Communist Party (CCP). Additionally, the establishment of the Strategic Support Force (SSF) in 2016 further restricted the PLAAF's mission set. This chapter will provide an overview of the history of the PLAAF, the PLAAF's current mission set, PLAAF modernization priorities, an outline of PLAAF forces and equipment, PLAAF force employment, PLAAF Command and Control (C2) and organizational structure, and trends in PLAAF leadership and personnel development.

History

Figure 3: PLAAF Mig-15s Circa 1950

Starting Period 1949-1955

At the time of the founding of the People's Republic of China (PRC) and the transition of the Red Army to the People's Liberation Army, the PLAAF was established and placed under command of PLA Army officers. It would take decades until officers who began their career in the PLAAF worked their way up the ranks and filled leadership billets across the board and achieve further autonomy from the PLA Army. During this period of time, the PLAAF established its own command structure, numerous flight schools, and purchased a large number of modern Soviet aircraft. At the time of the founding of the PLAAF, it had less than 3,000 trained aviation personnel including pilots, mechanics, and navigators, around 150 foreign made aircraft, and 542 airfields. In the PLAAF's first development plan, which outlined force expansion from 1950 to 1953, the PLAAF sought to establish more aviation units, expand the size of the force in terms of both facilities and manpower, and construct more military factories to produce aircraft. While the PLAAF did not reach all of these goals, it did get involved

in the PRC's military intervention in support of the Democratic People's Republic of Korea (DPRK) during the Korean War. PLAAF activities consisted primarily of combat operations and pilot training, providing the organization with valuable experience. Despite this, it is likely that the political environment of the time prevented the PLAAF, at least outwardly, from implementing many changes learned from this experience. During this period, the PLAAF was also defeated by nationalist forces during the first Taiwan Straits Crisis. By the end of this period the PLAAF had an inventory of 4,400 soviet aircraft organized into 70 air regiments, and pilots and maintainers to fly and service them. After the end of the war, the PLAAF absorbed the PLA Air Defense Force and integrated it into its organizational structure, conducting a reorganization resulting in six Military Region Air Force Headquarters (HQs).

Homeland Defense 1956-1980s

Figure 4: PLAAF Airfield Circa1965

This period started with a PLAAF that was still of limited capability continuing to struggle against the USAF and U.S. supplied forces. Beginning with the Second Taiwan Straits Crisis, the PLAAF began building more airfield infrastructure in eastern and southern China with confrontation with the Nationalists on Taiwan in mind. During the crisis, the PLAAF largely

failed to overcome its technical disadvantage against the U.S. supported Nationalist Chinese Air Force. During the time period, the Nationalists and the USAF would continually probe and intrude into PRC airspace, demonstrating the inability of the PLAAF to prevent these intrusions. These intrusions served as an impetus for the PLAAF to invest further in supersonic aircraft and increasingly capable surface-to-air missile (SAM) systems. With the launch of the Great Leap Forward and the eventual cessation of Soviet aid after the Sino-Soviet Split, PLAAF modernization was placed on shaky ground. Despite the fraying of PRC-USSR relations, the PLAAF did set up increasing numbers of anti-aircraft artillery (AAA), SAM, and radar units across the PRC in an attempt to further develop its ability to defend homeland airspace. Beginning in 1965, the PLAAF began deploying ground based anti-air units to North Vietnam.

The Cultural Revolution was disastrous for the PLAAF. At the beginning of the Cultural Revolution, PLAAF commander Wu Faxian's close ties to Lin Biao resulted in Wu's arrest and imprisonment in 1971. The PLA did not appoint a new commander until 1973. Prior to the beginning of the Cultural Revolution, the PLAAF educational system was stagnating, despite overall growth in the force. During the Cultural Revolution, almost half of the PLAAF's schools were shut down, and in terms of manpower the size of the PLAAF was reduced by 20 percent. Additionally, training flight hours during this period of time were drastically reduced. Towards the end of this period, the PLAAF was attempting to overcome serious organizational and supply issues that prevented the PLAAF from conducting air operations during the 1979 PRC-Vietnam war. Through the eighties, the PLAAF continued to be severely fuel restricted and was unable to field a fourth-generation aircraft like the USSR or United States. During the period between normalization of relations in 1979 and the Tiananmen crackdown and cessation of military cooperation, the U.S. developed substantial military relations with the PRC, including a program know as Peace Pearl which involved modernization of J-8s with integration of U.S. fire control systems and radar, but this deal was eventually cancelled as a result of the crackdown.

Figure 5: First Production J-10A Landing After First Flight

Border Defense 1990s-2003

The 1990s signaled the beginning of a long period of modernization and reorganization for the PLAAF, which enabled the PLAAF to broaden its mission set to preventing intrusions into mainland PRC airspace. After the Tiananmen Massacre of 1989, all military cooperation between the PRC and United States ceased and resulted in the need to further rely upon imported Russian aircraft as well as an at the time incredibly nascent domestic aircraft industry largely reliant on imported designs and components. It was during this time that the PLAAF began its initial efforts towards becoming a cross-domain "Strategic Airforce" capable of operating across the air, space, and cyber domains. During this time the PLAAF began to expand its sensor network to include airborne early warning and control platforms, airborne command posts, large phased-array radars, and aircraft mounted synthetic aperture radar. During this period, the PLAAF also finally became capable of preventing intrusions into its airspace via a burgeoning Integrated Air Defense System (IADS) network and air defense fighter fleet. The PLAAF's increase in flight activity around Taiwan began during this period. The PLA closely monitored USAF activities over Iraq and Kosovo, coming to prioritize the ability to conduct accurate strikes against enemy

systems, recognizing an air force's capability of independently being able to achieve strategic objectives as a vital component of a joint force.

Integrated Aerospace 2004-Present

Figure 6: J-20s taxi and takeoff

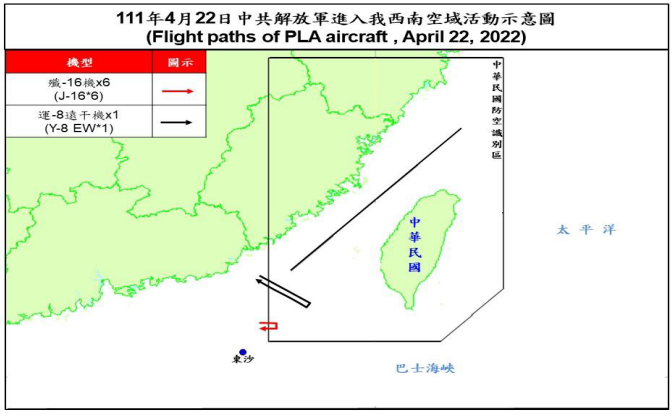
This last period sees the PLAAF further develop its ground-based SAM and radar network, AEW&C aircraft, bomber and ground attack aircraft, and multirole fighter capabilities, while later facing a sort of identity crisis by having large portions of its multidomain capabilities and responsibilities stripped from it. In 2004, the PLAAF adopted a strategy of "Integrated Air and Space and Simultaneously Prepare for Offensive and Defensive Operations," which would later evolve into the "Strategic Air Force" concept. The component of this strategy referred to as Kongtian Yiti (空天一体), was the product of earlier PLA observations of USAF combat operations as well as the acknowledgment of the increasing importance of multidomain operations to modern air force capabilities. The importance of this integration was outlined in the 2013 edition of the Science of Military Strategy: "in line with the strategic requirement of building air-space capabilities and conducting offensive and defensive operations, the PLAAF will endeavor to shift its focus from territorial air defense to both defense and offense, and build an air-space defense force structure that can meet the requirements of informatized operations. The PLAAF will boost its capabilities for strategic early warning, air strike, air and missile defense, information countermeasures, airborne operations, strategic projection and comprehensive support." The founding of the Strategic Support Force

in 2016 stripped the PLAAF of these space and information domain responsibilities, restricting it to conducting air operations, related electronic warfare (EW) and early warning tasks, as well as surface strike operations.

Missions

The following four missions are the primary tasks of the PLAAF. They are presented in order of importance, though they are clearly closely related, especially counter intervention and the Taiwan Mission set, as the PLAAF will be involved in operations preventing other militaries from intervening or providing materiel support to Taiwan. It is important to reiterate that the current role of the PLAAF in the PRC's nuclear triad is nascent at best due to technical limitations and the relatively small size of its nuclear capable bomber fleet.

Figure 7: PLA Taiwan Flights[ii]



Taiwan

The PLAAF's primary mission is a Taiwan invasion. The PLAAF trains to conduct offensive counter air (OCA) and defensive counter air (DCA)

ii Taiwan's Ministry of National Defense publishes reports of PLA incursions regularly at https://www.mnd.gov.tw/PublishTable.aspx?Types=即時軍事動態&title=國防消息

operations to maintain air superiority over and around Taiwan, augment joint firepower strikes with air launched cruise missiles and dumb bombs, conduct suppression of enemy air defenses (SEAD) and destruction of enemy air defenses (DEAD), support joint operations with aerial reconnaissance, and conduct airborne landings to seize key points. During peacetime, the PLAAFs flight activity around the Taiwan ADIZ has the function of both familiarizing PLAAF EW operators with signatures and signals of ROC air and missile defense systems as well as interceptor aircraft. These flights also serve as a potential deterrent targeted at maintaining the status quo of cross strait relations via a demonstration of modern PLAAF capabilities' superiority over the ROC Air Force.

Figure 8: Blue Shield Air Defense Exercise

Air Defense

As outlined previously, the PLAAF is largely responsible for maintaining the IADS system tasked with defending the PRC. While the PLA Navy (PLAN) is responsible for air defense coverage on Hainan Island, Zhejiang Province, and parts of the Shandong Peninsula, the PLAAF is responsible for managing the radar and SAM network that is a cornerstone of PRC air defense in every other part of the PRC. In addition to traditional air defense,

the PLAAF is also introducing the more advanced systems with nascent ballistic missile defense capabilities such as the HQ-19 and S-400.

Counter Intervention

Figure 9: H-6 Bomber Armed with Cruise Missiles

The PLAAF's counter intervention mission is married to its modernization of its longer-range strike capabilities, prioritization of developing capabilities to conduct operations beyond the first island chain, and the Taiwan invasion mission set. The PLAAF is expected to be a key component of joint counter intervention strikes with PLARF conventional missile units, creating a robust and effective capability to sink U.S. Navy surface assets and to strike U.S. bases in the region. The PLAAF will also perform a counter intervention function targeted at preventing the USAF from conducting operations in the region by striking the USAF tanker fleet and AWACs, as well as conducting DCA and OCA as far out as can be sustained by the PLAAF tanker fleet, which while limited today, will not be as few in number in the future.

Nuclear Deterrence

Figure 10: H-6N During the 2019 PRC 70th Year Parade

When the PRC first developed deliverable nuclear weapons, they were initially air dropped bombs delivered by PLAAF bombers. With the development of the then Second Artillery Force's longer range ballistic missiles, the PLAAF's nuclear bomber capability slowly eroded. More recently, the PLAAF has created a brigade of midair refuellable H-6 variants, the H-6N, to serve as a platform for an air launched, nuclear armed ballistic missile. While this platform's limited range restricts its utility to nuclear deterrence messaging and potential long range conventional strike, the unit equipped with these bombers is thought to be crucial for developing TTPs for eventual more capable and survivable platforms that will become a more credible air-based component of a true nuclear triad.

Modernization Priorities and Current Forces

Modernization Priorities

As the PLAAF's mission set and strategic concepts developed through the late 1990s and early 2000s, its modernization efforts evolved from relatively un-coordinated purchases of a variety of foreign capabilities to a more concerted effort designed to supplement a developing domestic

industry with foreign purchases. The PLAAF has been prioritizing the development and acquisition of long-range offensive strike capabilities, be that continued modernization of H-6 platforms to fly further and deliver longer range cruise missiles, or fielding more multirole, cruise missile capable 4.5 generation aircraft like the J-16.[iii]

With an effort to push more commanders into the air, the PLAAF has both put commanders in combat aircraft as well as AWE&C aircraft. The PLAAF traditionally has been reliant on ground-based radar for both early warning and directing aircraft to targets, but has been undergoing a campaign intended on further developing the capabilities and increasing the number of its airborne command platforms, most notably the KJ-500.

The PLAAF is continually seeking to procure more capable, longer-range SAMs to both provide a robust IADS system for homeland air defense, as well as providing a further bubble of shore-based air defense coverage, enabling fighters capable of operating at longer ranges to push farther out from the PRC coastline. Beyond increasing the range of these systems, the PLA is seeking to procure more advanced radar systems to better find, fix, track, and target adversary air threats. Similarly, the PLAAF is also pursuing air defense systems that can employ missiles capable of intercepting incoming ballistic and cruise missiles.

Lastly, the PLAAF is procuring increasing numbers of its new large transport aircraft, the Y-20. The PLAAF transport fleet is currently capable of transporting two light airborne brigades or one light mechanized airborne brigade if it uses its entire inventory of transportation aircraft, leaving limited extra capacity for emergency transport of materiel or other tasks. Given this relative weakness, the PLAAF is seeking to expand this fleet to provide it with more options for rapid logistics support for aviation units or to provide other cargo transportation services without putting the lift it needs for a Taiwan invasion scenario at risk.

iii There are several designations for fixed-wing aircraft in the PLAAF inventory: fighter/multi-role aircraft (J-class), fighter-bombers (JH-class), bombers (H-class), transport aircraft (Y-class), and reconnaissance aircraft (JZ-class). Special Mission Aircraft include airborne early warning and control, the KJ-class, and tankers, denoted by a U suffix (Ex: Y-20U).

Current Forces-Aircraft

The PLAAF is currently fielding a combat aircraft fleet composed of more modern aircraft as well as broadening its ground attack and bomber inventories. As of early 2022, the PLAAF fighter fleet is thought to have three aviation brigades equipped with 5th gen aircraft[iv], 14 aviation brigades equipped with 4.5 gen aircraft, 16 aviation brigades equipped with 4th gen aircraft, and 11 aviation brigades equipped with legacy 3rd gen aircraft. In terms of dedicated strike aircraft, the PLAAF maintains five aviation brigades of JH-7/JH-7A fighter-bombers and nine conventional bomber regiments equipped with a mix of H-6 variants. The PLAAF's primary lift is composed of six aviation regiments equipped with a variety of heavy and medium lift platforms. The PLAAF currently maintains nine special mission aircraft regiments and two VIP transportation units. Regiments and aviation brigades are typically composed of between 20 and 40 aircraft.

Aviation brigades equipped with fighter aircraft are largely composed of one type of aircraft. The PLAAF is continuing to phase out its legacy 3rd generation aircraft, while also beginning to gradually replace its fourth-generation fighter units in coastal China, namely J-11 and J-10A units, with 4.5 gen aircraft. Central Theater Command units are predominantly equipped with 3rd generation or older 4th generation aircraft such as J-7 variants, J-11As, or J-10As. The Eastern, Southern, Western, and Northern Theater Commands all have received newer 4.5 and 5th generation aircraft.

Figure 11: PLAAF 3rd Generation Aircraft

iv The PLA uses different designations for aircraft generations. In this publication we use the standard U.S. numbering convention.

Currently, the PLAAF inventory of active third generation aircraft is largely composed of newer J-7 and J-8 variants, which are a modernized PRC produced mig-21 variant and variants of the indigenously developed J-8 interceptor respectively. These aircraft primarily employ older PL series of air-to-air missiles, namely the PL-5 and PL-8. Upgraded variants of the J-8 are potentially capable of employing the relatively modern PL-12.

Figure 12: Left to Right J-10, J-11, Su-30MKK

PLAAF fourth generation aircraft include the J-10A, J-10B, J-11A, and J-11B. These aircraft consist of primarily domestically produced sub systems and are powered by a mix of Russian and PRC produced engines. These aircraft are primarily equipped with PL-9 and PL-12 AAMs. Additionally, the PRC imported several Su-30MKKs from Russia and are equipped with a mix of Russian engines and munitions.

Figure 13: Left to Right: Su-35, J-16, J-10C

PLAAF 4.5 generation aircraft include the domestically produced and powered J-10C and J-16. Additionally, the PRC has imported several Su-35s, which were also imported with Russian munitions. The J-10C and J-16 employ PRC manufactured weapons such as the PL-10 and PL-15, which outrange their American counterparts the AIM-9X and the AIM-120 AAMRAM, and are equipped with a mix PRC developed engines and imported AL-31s. The J-10B may also be considered a 4.5 generation aircraft, but is only able to field less capable PL-9s and PL-12s and is equipped with imported Russian engines. In addition to the PL-15, PLAAF 4.5 gen fighters, most notably the J-16 and imported Russian Su-30MKK and Su-35, can also employ the PL-17, an even longer-range radar guided AAM intended to shoot down tankers and AWACs to limit the USAF's ability to project power.

Figure 14: J-20

The PLAAF currently fields two active versions of its J-20 fifth generation stealth fighter, the J-20 and the J-20A. The J-20 is equipped with imported Russian engines while the J-20A is equipped with PRC manufactured engines. Both are equipped with PL-10 and PL-15 AAMs.

Additionally, the PLAAF appears to be intent on procuring the J-20S, a two-seat variant of the J-20 which incorporate more modern technologies.

Figure 15: JH-7A

The JH-7 and JH-7A are PRC produced dedicated attack aircraft, powered by licensed produced Rolls Royce Spey Mk 202 engines, and can employ anti-ship cruise missiles, land attack cruise missiles, anti-radiation missiles, as well as laser guided bombs and other PGMs. With the adoption of 4.5 generation aircraft that are strike capable, the PLAAF now has additional multirole aircraft that are capable of supplementing its aging attack aircraft's strike function.

Figure 16: H-6K

The PLAAF currently fields a variety of H-6 variants, ranging from the older M variants, which have mostly been converted to trainers, to newer K variants. Older variants of the H-6 more closely resemble the Tu-16 design on which it is based, while the newer variants have redesigned wing roots, modern sensors and avionics, removed bomb bays, and can carry up to six cruise missiles as opposed to the four of the older variants such as the H-6M.

Figure 17: Top: (left to right) KJ-2000, KJ-200, KJ-500; Bottom: Y-20

PLAAF special mission aircraft are primarily airborne early warning and control platforms, tanker aircraft, and electronic intelligence gathering aircraft. AWA&C aircraft include the KJ-2000, KJ-200, and the KJ-500. Additionally, the PLAAF fields ELINT variants such as the Y-8CB. The

PLAAF also fields dedicated standoff jammer aircraft, the older GX-3 and the newer GX-11, which are based on the Y-8 and Y-9 airframes. In addition to these larger platforms the PLAAF has begun procurement of the J-16D, a dedicated escort jammer. As of early 2022, the PLAAF fields around 30 tankers, a mix of Y-6Us and Y-20Us.

Current Forces-SAM Systems

Figure 18: HQ-9 Mobile SAM System

Having transitioned its legacy AAA to its reserves, the PLAAF ground air defense branch is composed of a variety of modern SAM systems. On the indigenous side, the Chinese HQ-9B features mid- to long-range missiles with active radar-homing capability with ranges of around 250km. China also maintains a smaller inventory of imported Russian systems, including the S-300PMU2 and S-400. It is believed that these Russian systems are primarily based in the Eastern Theater Command.

Force Employment

Layered air defense and offense

PLA military thought increasingly advocates a proactive approach to air defense, 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. 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 SAM systems to provide defense in-depth. 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. Such a campaign can occur either independently or jointly as part of a larger military operation.

Combined offensive strike

PLAAF standoff strike capabilities have matured to a point where they would be an integral part of a joint firepower strike against an enemy surface formation or ground targets. By combining PLAAF air launched cruise missiles with PLARF ballistic missiles, a joint strike becomes much harder for missile defenses to successfully intercept. An attack on surface combatants could also potentially involve PLA Navy assets employing anti-ship weapons, placing further stress on shipborne missile defense capabilities.

Airborne Campaign

PLAAF airborne campaigns seek to parachute troops behind enemy lines, either in support of joint operations or on independent missions. Once inserted, airborne forces could be directed to sabotage key enemy military and economic infrastructure, cut off enemy front lines from support or reserve forces, or seize other key infrastructure. PLA doctrine seems to recognize that these campaigns can be extremely difficult to carry out successfully. Airborne campaigns would require the PLAAF to carry out 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.

Examples of Force Employment

A notional example of a PLAAF assault on targets on Taiwan would involve a mix of supporting ISR and standoff jammers, air cover formations,

and an assault force. Prior to this notional operation, PLARF fires would likely be used to degrade enemy integrated air defenses and C4ISR to prepare the battle space for a PLAAF follow on operation. The first line of an assault formation would be assault and cover formations of multirole aircraft covering northern, central, and southern portions of the assault formation. Standoff jammers and potentially unmanned ISR platforms will be meshed into this frontline cover formation to provide ISR and EW support to the formation. Behind this cover force are Airborne ISR and EW platforms that are more critical to managing awareness of the battle space and coordinating operations within the AO such as AEW&C platforms. In the rear of the formation will be separate bomber assault groups which will launch standoff munitions, or if enemy air defense has been sufficiently destroyed, drop dumb bombs. Prior to this notional assault, the PLAAF will seek to secure information superiority by coordinating its own efforts with that of the Strategic Support Force (SSF). Additionally, the PLAAF may choose to operate after preparatory fires are complete.

Training Priorities

Overall Priorities

The PLAAF's training regime has increased in tempo and adjusted to incorporate more training to employ the capabilities it has been seeking to acquire through its modernization campaign. In its routine training, the PLAAF has begun to prioritize training for long range offensive strike, maritime strike missions, joint air defense, electronic warfare, and the sustainment of combat operations. Joint air defense training typically consists of SAM units from the different services working with radar units from different services to pass target information or track targets between different areas covered by the PLAAF and the PLAN.

Since 2015, the PLAAF has been conducting longer range bomber flights and maritime strike training into the Western Pacific and has begun conducting this training with fighter escorts. Given the PLAAF's counter intervention mission, this training is increasing in frequency. Similar to its efforts at improving maritime strike, PLAAF units have also been increasingly training to conduct long range strikes. This can take the form of H-6 formations practicing simulated strikes on Guam or strike capable

multi role fighters or fighter bombers flying trans-regional flights within the PRC to conduct simulated or live munitions strikes on training ranges.

The PLAAF has also begun training more frequently to employ EW assets in escort jamming and SEAD/DEAD capacities as well as training under contested electromagnetic conditions, especially during national training exercises. However, the ease with which the PLA can close off airspace and the electromagnetic spectrum for routine training allows the PLAAF to more frequently train to operate in a contested electromagnetic environment.

While the PLAAF has long been training out of garrison operations, more recently it has also begun experimenting with various methods of sustaining operations out of garrison for longer periods of time. This has taken the form of testing the mobility and performance of smaller emergency support detachments from aviation brigade maintenance squadrons or slightly larger support units composed of both maintenance squadron and airfield station personnel. These groups have conducted limited training in attempts to generate estimates of minimum sustainment needs of distributed operations and maximize the speed at which aviation support can be provided to disbursed units.

National Training Exercises

The PLAAF has continually improved its training exercises to better integrate its modern capabilities into its capacity to conduct operations. The PLAAF has five major annual training events and competitions that best represent what the PLAAF's contemporary training focuses upon.

The exercises are Red Sword, Blue Shield, Golden Helmet, Golden Dart, and Qingdian. Red Sword is the PLAAF's largest exercise in terms of participating units and is a force-wide exercise roughly similar to the U.S. Air Force's Red Flag. Blue Shield is an exercise designed to test the capabilities of the PLAAF's ground-based air defense forces, specifically SAMs and supporting radar and information systems. The Golden Helmet competition is an air-to-air combat competition designed to improve and assess pilots' skills and capabilities in combat conditions. The Golden Dart competition focuses on air-to-ground attack by attack and bomber aircraft. The newest annual exercise, Qingdian, focuses on electronic warfare.

These exercises and competitions have grown increasingly complex, and now integrate a wide range of PLAAF assets. For example, Red Sword has begun integrating airborne forces, along with 5th generation aircraft, standoff and escort jamming, as well as airborne early warning capabilities. Additionally, joint and integrated air defense exercises are becoming more prevalent. This is exemplified by air defense units and radar units from different services passing target data to each other.

Organization and C2

Overview

The PLAAF is organized into five theater air forces with radar, SAM, and fighter aviation brigades falling under Theater Command Air Force (TCAF) subordinate Air Defense Bases. Other aircraft and units such as transport, bombers, and special mission aviation units, due to their operational nature and small numbers, are directly aligned under TCAFs. While air defense bases are primarily responsible for air defense in their area of responsibility, major offensive strike and joint fires capabilities are subordinate to TCAFs. From a command perspective, the PLAAF while historically reliant on ground-based commanders, is pushing primary command authorities into airborne command posts, be that command posts aboard AEW&C aircraft, or individual flight commanders in combat aircraft. Despite this, secondary command posts still remain on the ground.

Air Defense Bases[v]

In late 2011, the PLAAF abolished at least four air-division headquarters and created four Bases, namely the Dalian, Nanning, Shanghai and Urumqi Bases. These Bases became Air Defense Bases in 2017. The PLAAF upgraded about 15 regiments to brigades and subordinated them under the four Bases. Each Base is responsible for C2 of the aviation brigades, SAM, and radar units in their AOR. They also coordinate with PLAA and PLAN units in their AOR for joint training. This situation did not change until early 2017 when the PLAAF migrated the rest of its tactical air fleet into a brigade

v In the PLA, a Base (with a capital B) is a standing organizational structure, which may include one or more physical locations, also known as a base (with a small b) This publication uses "Base" to denote the organizational structures and "base", or garrison, to denote a specific military geographic location.

structure by converting its remaining fighter and fighter-bomber units into brigades. The PLAAF also abolished the relevant air division headquarters, and created at least seven Bases from existing Command Posts and two former MRAF HQs. Specifically, the former Lanzhou and Jinan MRAF HQ were downgraded and renamed Bases, and the former Wuhan, Lhasa, Kunming, Datong, and Fuzhou command posts were renamed Bases. Each Base is now subordinate to their respective TCAF HQ. Beginning, in late 2017, at least two of the bases – Lhasa and Fuzhou—were renamed Air Defense Bases (空防基地). The new Air Defense Bases have also been given the responsibility for conducting direct C2 for each subordinate unit, which implies that previously the C2 went directly from the TCAF/MRAF HQ to the relevant units.

Aviation Unit Organization

As mentioned earlier, the largest fighter unit formation in the PLAAF is called a "brigade." This formation has a similar number of aircraft as a U.S. Air Force fighter squadron, 24 to 36, but it also owns its own support units that in the USAF would be subordinate to a U.S. Air Force fighter group. A PLAAF aviation brigade consists into three USAF flight-equivalents, a maintenance flight equivalent, a repair shop, and a unit that manages the physical airfield infrastructure called an "airfield station." The previously mentioned "flight equivalents" are battalion-level organizations and are called "flight groups" in the PLAAF and each group has roughly eight to ten airframes divided into two company-level "flight detachments," which they call 'squadrons' so the nomenclature gets messy. A similar structure exists for transport and special mission aircraft, however the largest formation for these units is a division. PLAAF divisions are slightly larger than a PLAAF brigade in terms of both personal and aircraft and maintains a similar structure of subordinate units. PLAAF divisions have subordinate flight regiments, maintenance elements, and airfield stations. PLAAF Divisions are analogous to USAF groups. On average, each aviation unit, be that an aviation brigade or regiment, maintains a pilot-to-aircraft ratio of somewhere between 1.2 for fighter units and 1.5 for bomber and special mission aircraft units.

Airborne Branch

Figure 19: PLAAF Paratroopers

Unlike in the U.S., 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 airborne units themselves. 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. The Airborne Corps is a two-star equivalent command and it oversees a force of six combined arms airborne brigades, an airborne special operations brigade, and a fixed wing transport brigade. This one transport brigade is predominantly to provide an organic lift capability for training purposes and some limited operations, with other PLAAF transport divisions providing the bulk of airlift for the Airborne Corps.

Radar Branch

Figure 20: PLAAF Fixed Radar

When first integrated into the PLAAF in 1950, radar troops were charged with providing early warning capabilities to air defense. Today, the PLAAF has three basic types of radar sites. The first type is located at airfields and is used primarily for air traffic control and for senior officers in the control tower to vector pilots towards their targets. The second type consists of radars located in key areas for long-and medium-range detection along China's borders. Most of these radars are located on mountain tops. The third type consists of over-the-horizon radars near China's coastline that are used for early warning. Besides over-the-horizon, the PLAAF's aviation and SAM units have radars that are indigenous to those units and are considered specialized units.

Surface to Air Missile (SAM) Branch

The PLAAF maintains a SAM Branch that operates SAM brigades throughout the PRC. SAM Brigades maintain subordinate battalions. SAM units have radar and technical support units. SAM units train to operate from both fixed sites as well as from dispersed locations. A battalion of HQ-9s typically consists of eight launchers and associated support vehicles, but the size of the unit largely depends on the type of system it employs. SAM brigades are garrisoned mainly in urban areas, with fixed sites near key

instillations such as airfields.

Specialized Units

In addition to the five combat branches described above, the PLAAF also maintains specialized units of troops for communications and chemical defense (as well as certain types of radar units discussed above). Communications troops (通信兵) perform functions related to communications, navigation, and automated command support to the PLAAF. Chemical defense troops (防化兵), which include nuclear, biological, and chemical defense, are charged with decontaminating PLAAF locations or assets affected by not only chemical but radiological weapons as well. The PLAAF also has its own subordinate engineering units that are responsible for constructing and repairing airfields.

Leadership and Personnel

Leadership

Figure 21: Chang Dingqiu

The PLAAF leadership structure is dominated by fighter pilots. Beginning at the TCAF Deputy Commander level, command staff will be dominated by fighter pilots. Other pilots such as transport and bomber pilots traditionally top out as division leader grade officers, while other officers such as radar branch officer can only top out as brigade leader grade officers.

The current commander of the PLAAF, General Chang Dingqiu, is the youngest general to assume command of the PLAAF and his career experience heralds a change in the force. Not only is Chang the first 4th generation aircraft pilot to command the PLAAF, but he also has the most joint command experience. This joint experience includes serving

in the CMC Joint Staff Department and serving as a deputy commander of the Southern Theater Command. In addition to his more modern career experience, Chang is also a proponent of modernizing the PLAAF's pilot training regime as well as providing more comprehensive care to pilots, such as mental health services, to improve pilot performance.

NCO Corps and Education

The PLAAF recruits non-commissioned officers, or NCOs, either from candidate pools of highly skilled civilians or promoted out of the ranks of two-year conscripts.[vi] While it has always been reliant on a core of NCOs, the NCO corps began to expand in 2009 as part of an intentional program to shift the enlisted force to be predominantly composted of NCOs instead of conscripts. Not every NCO can attend an NCO school. Depending on their specialty, NCOs can receive formal training at one of the PLAAF's universities or academies that have a specific NCO program. For example, the PLAAF Engineering University has an NCO program. However, there is only one PLAAF institution dedicated to educating NCOs- the PLAAF Communications NCO Academy. Ultimately, many of these NCOs will already have or will earn a college-level degree, although frequently this degree will be equivalent to a three-year degree similar to an associates degree in the in the United States.

Officer Education

Officer education is primarily conducted by the five undergraduate academic institutions that provide the bulk of the PLAAF's officers. Those institutions are the PLAAF Engineering University, Aviation University, Early Warning Academy, Medical University, and Service College. Most of these officers will receive degrees in a STEM-related field, with a growing emphasis in fields relevant to information technologies.

Once an officer commissions into the PLAAF, they will periodically return to one of these institutions to receive a graduate degree in their

vi In the PLA, all junior enlisted members are referred to as "conscripts", but many have volunteered to be conscripted, while others are ordered into the PLA.

specialty. However, if they are what is called a "commanding officer," which means anyone who has any leadership position, they return to the PLAAF's Command College in Beijing for mid-level professional military education and receive only a certificate. At the more senior levels, PLAAF officers will attend the PLA's National Defense University for additional joint professional military education, where they also receive only a certificate.

PLA Navy Aerospace Forces

Overview

The PLA Navy (PLAN) has used a variety of aircraft and other aerospace-related forces to support coastal defense and gradually venture further from shore to pursue strategies of "Offshore Defense" and "Far Seas Protection" of China's interests. As PLAN vessels have traveled further from China's shore-based defenses, they have become increasingly reliant on aviation forces for situational awareness and defense.[16]

This chapter will focus on PLAN aerospace-related forces, such as fixed and rotary wing aircraft, aircraft carriers, and air defenses. Most PLAN forces fall under one of the three Theater Command Navies (TCN) in the PLA's main coastal TCs (Eastern, Southern, and Northern).

History

From the PRC's founding in 1949 until the mid-1980s, China's strategic concept for PLAN operations was limited to "coastal defense", which emphasized defending China's coast from amphibious invasion, presumably by Taiwan and U.S. forces.[17] The PLAN created a Naval Aviation Branch in 1952 to incorporate aviation forces into this strategy.[18] During the Vietnam War, PLAN aviation forces were tasked with defending PRC airspace and engaged U.S. aircraft when they intruded on that airspace.[19] PLAN bombers and fighters also reportedly participated in air assault and escort missions during the 1955 Battle of Yijiangshan Islands in the first Taiwan Strait Crisis. PLAN officers consider these successful island seizures an early example of joint operations.[20]

Beginning in the late-1980s, the PLAN established a strategy of "Offshore Defense", which focused on regional goals and deterring a modern adversary from intervening in a regional conflict.[21] Offshore Defense is often associated with operations in the Yellow Sea, East China Sea, and South China Sea.

As this strategy developed, PLAN aviation forces gradually improved their ability to operate over water in some of these areas to offer limited support to surface vessels. By the late 1990s, PLAN aircraft began to fly sorties over the Taiwan Strait.[22] PLAN aviation forces, along with the PLAAF, began flying frequent sorties across the Taiwan centerline and into Taiwan's ADIZ between Taiwan and Pratas (Dongsha) Islands in the South China Sea in February 2020.[23]

In the 2010s, the PLAN also began to focus on developing "far seas" naval capabilities, and as its surface vessels reached further from China's shores, so did its aviation forces. In 2013 and 2014, PLAN bombers and ASW aircraft conducted their first flights into the Western Pacific through the Miyako Strait and Bashi Channel. China's first aircraft carrier, commissioned in 2012, signaled a new age for PLAN aviation, heralding the transition from an almost exclusively land-based force to one with a sea-based component.[24] The PLAN has actively expanded this component with a second carrier commissioned in 2019 and a third launched in 2022, rapidly expanding its ability to project air power into the far seas.[25]

Missions

Figure 22: PLAN Yushen LHA

The PLA has broadly described PLAN aviation missions as maritime airspace protection and support of surface ship operations in coastal and maritime areas[26], but it would likely be expected to play a role in several of the strategic missions associated with the PLAN as a whole, such as various Taiwan-related scenarios, coastal defense, and protecting maritime sovereignty, including in disputed areas in the East and South China Seas.[27] The PLAN is expected to be prepared for a variety of Taiwan-related scenarios, from simply deterring Taiwanese moves toward independence to large-scale invasion. In an invasion and occupation contingency, both land- and carrier-based PLAN aviation forces could be involved in firepower strikes, blockade

establishment and enforcement, and countering intervention from third parties such as the U.S. The PLAN has continued to develop its maritime strike and anti-submarine warfare (ASW) capabilities, which would be expected to play a role in the coastal defense and potentially the maritime sovereignty mission. As PLAN aircraft carriers reach further from shore and the PLAN becomes increasingly comfortable operating from airfields it operates in the South China Sea, PLAN aviation could conceivably expand involvement in other PLAN missions, such as protecting sea lanes of communication (SLOCs) and perhaps even the PRC's overseas interests.

Modernization Priorities

As part of recent initiatives for broader PLAN modernization[28], PLAN aviation has benefited from many developments, with much priority given to carriers, carrier-based aircraft, and air defense.

China launched its third aircraft carrier, the *Fujian*, in 2022, putting it on track to enter service in 2024.[29] This carrier features an electromagnetic aircraft launch system (EMALS) which should allow it to operate with a variety of special mission aircraft, an improvement from China's first two carriers, whose ski-jump configuration limits them to operating with only J-15 fighters.[30] A fourth carrier is reportedly also under construction and may be nuclear powered, unlike the first three.[31]

The PLAN is also working to improve and expand its contingent of carrier-based aircraft. This includes upgraded versions of its carrier-based J-15 fighter, including modifications for catapult takeoff and a version designed for electronic warfare (EW).[32] While China's current carriers operate with only the J-15, future catapult-enabled carriers should be able to support KJ-600 AEW[33] aircraft and a future carrier-based fighter (likely a carrier-based version of the FC-31[vii] stealth fighter).[34]

The PLAN has also focused in recent years on improving air defense for its surface fleet. Newer ships, such as the LUYANG-III class destroyer and RENHAI class cruiser "feature modern combat management systems

vii Many outlets use the unconfirmed designator "J-35" to refer to the carrier-based variant developed from FC-31 demonstrators, mostly to distinguish it from those FC-31 demonstrators and a land-based variant potentially under development.

and air surveillance systems such as the Sea Eagle and Dragon Eye phased-array radars".[35]

These systems allow one or two vessels to provide air defense for an entire task group, allowing surface forces to more safely operate outside of shore-based air defenses.

Forces

Fixed-Wing Aircraft

Prior to the 2010s, the PLAN relied very heavily on older 3rd generation aircraft, but in recent years it has benefited from a mix of domestic combat aircraft production and Russian imports to create a mostly 4th generation fighter force.[36] These platforms continue to enable extended fighter patrols beyond China's coastal areas and appear to continue receiving upgrades[37,38]. Most of the PLAN's fourth generation fighters employ PL-10 and PL-12 AAMs and although rarely observed, can also be equipped with land and maritime attack weapons.[39]

Figure 23: PLA Navy H-6J

For maritime strike, the PLAN relies on heavily modernized variants of the H-6 bomber, which it continues to update with electronics and payload upgrades, to deliver advanced ASCMs against surface targets.[40] The most recent maritime strike variant, the H-6J, includes six weapons pylons for ASCMs such as the long-range YJ-12, and can attack warships out to the Second Island Chain.[41] The H-6J also has two additional pylons fitted with EW pods that did not appear on previous variants.[42] These newer variants supplement previous H-6Gs, which are capable of carrying up to four YJ-12s. H-6s are also capable of flexible delivery of sea mines.[43]

The PLAN has also modified approximately five H-6s to serve as

tankers (HY-6DU or H-6DU) to increase the range of its fighter aircraft.[44] Although these tankers have participated in PLAN exercises, not all PLAN combat aircraft are capable of air-to-air refueling, meaning this capability pushes out the combat radius of only a small (but growing) percentage of the PLAN's total air fleet. The PLAN has demonstrated its ability to use its own tankers as well as PLAAF H-6U tankers.[45]

The PLAN's bomber fleet is augmented by domestically-produced, tandem-seat JH-7 fighter-bombers, which were developed to replace obsolete Q-5 and H-5 aircraft.[46] Updated JH-7A versions feature more capable radar and additional weapons capacity to enhance maritime strike capability. JH-7s are capable of fielding ASCMs, air-delivered mines, bombs, electronic warfare pods, and more rarely anti-radiation missiles and laser guided munitions with associated targeting pods. The JH-7 can carry up to four ASCMs and two AAMs, or it can sacrifice two ASCMs for underwing fuel tanks to increase range. However, the operational radius of these aircraft remains limited by a lack of aerial refueling capability.

Figure 24: KJ-500 AEW&C Aircraft

In addition to combat aircraft, the PLAN operates a variety of special mission aircraft for activities such as maritime patrol (MP), AEW&C, surveillance, and ASW. Many of these have been modifications of the Y-8, a Chinese license-produced version of the ex-Soviet An-12 Cub.[47] In recent years, they have been joined by various modifications to the newer Y-9. Notable examples of these special mission aircraft are the KQ-200 and the KJ-500. The KQ-200 is a maritime patrol/ASW variant that has been consistently observed monitoring maritime chokepoints in the South China Sea.[48] The KJ-500 is based on the Y-9 airframe and is the PRC's most advanced AEW&C aircraft. At least one prototype seen at a PLAN operational unit has been fitted with an aerial refueling probe, which would allow it to provide more persistent coverage.[49]

These and other special mission variants provide PLAN combatants an increasingly clear and persistent picture of the surface and air environment at progressively greater ranges.

Aircraft Carrier Program

The PLAN is committed to developing a fleet of aircraft carriers, with two currently commissioned, a third launched and undergoing testing, and at least one more rumored to be in development. The first carrier is a Soviet Kuznetzov class purchased from Ukraine and then rebuilt and commissioned into the PLAN as the *Liaoning* (CV-16) in 2012. A second carrier, the *Shandong* (CV-17), is a domestically produced variant similar to the *Liaoning* that was commissioned in 2019. These carriers utilize a ski-jump configuration for aircraft takeoff, which restricts takeoff weight, limiting ordnance loads and keeping them from operating with larger specialized support aircraft.[50]

The PLAN launched its third carrier, the *Fujian,* in 2022.[51] This carrier features a catapult launch system that will allow it to operate with various types of fixed-wing special mission aircraft for missions such as AEW, EW, and ASW.[52] A fourth carrier is reportedly also under construction and may be nuclear powered, unlike the first three.[53]

The Shenyang J-15 fighter is currently the only fixed-wing aircraft operating with China's carriers. The J-15 is externally similar to the Russian Su-33 Flanker D but has many of the domestic avionics and armament capabilities of the Chinese J-11B. The J-15 has folding wings, a strengthened landing gear, a tailhook under a shortened tail stinger, a two-piece slotted flaps, canards, and a retractable in-flight refueling probe on the

Figure 25: J-15 Ski-Jump Takeoff from Liaoning

left side of the nose.[54] Ski-jump takeoff likely limits ordnance or fuel loads on these fighters, but the PLAN also appears to be developing a catapult-capable variant known as the J-15T for use on its future carriers.[55,56] Another variant, the J-15D, is a dedicated EW version equipped with wingtip electronic support measures/electronic intelligence gathering pods and several conformal antennas.[57] However, only one J-15D has been confirmed to exist and it is not in production.[58]

The PLAN is also pursuing development of a carrier-capable fifth-generation stealth fighter and may have committed to a variant developed from earlier FC-31 demonstrators, although previous reporting indicated a carrier-capable version of the J-20 would instead be developed.[59, 60] Prototypes of this FC-31-based carrier-capable variant feature modifications for catapult-assisted takeoff, indicating they were designed with the PLAN's future carriers in mind, but it is not yet clear whether they would also be compatible with carriers featuring only ski-jump takeoff.[61] The PLAN is also developing a carrier-based AEW&C aircraft, the KJ-600, which is reportedly similar to the U.S. E-2 Hawkeye. The KJ-600 will likely be limited to only newer catapult-enabled carriers[62], but will be a significant improvement over the current carriers' reliance on shorter-range rotary-wing AEW platforms.[63]

Helicopters[64]

The PLAN operates three main helicopter variants: the domestically produced Z-9 and Z-8/Z-18 as well as the Russian-built Helix (both Ka-28 and Ka-31). The primary helicopter operated by the PLAN is the Z-9C. In the early 1980s, China obtained a license from France's Aerospatiale (now Airbus Helicopter) to produce the AS 365N Dauphin II helicopter and its engine. The AS 365s produced in China were labeled as the Z-9, with the naval variant designated Z-9C. The Z-9C is capable of operating from any helicopter-capable PLAN combatant.

The Z-8 is also a Chinese-produced helicopter based on a French design. In the late 1970s, the PLAN took delivery of the SA 321 Super Frelon. A reverse-engineered version was designated the Z-8, which reached initial operational capability by 1989. Low-rate production continued through the 1990s and into the early 2000s. The Z-8's size provides a

greater cargo capacity compared with other PLAN helicopters but limits its ability to deploy from most PLAN combatants.

A newer PLAN helicopter labeled the Z-18 has operated with the *Liaoning*. The Z-18 comes in three variants: transport, antisubmarine (Z-18F), and AEW (Z-18J). As with the Z-8, the Z-18's size limits its deployment options, although in recent years the PLAN has expanded those options by introducing YUSHEN LHAs (landing helicopter assault) and RENHAI CGs.[65]

Variants of the Helix were the first imported helicopters operated by the PLAN. In 1999, the PLAN took delivery of an initial batch of eight Russian-built Helix helicopters. Five were Ka-28 Helix-As, and three were Ka-27PS Helix-Ds. An additional nine Helix-As have been delivered, and all 17 are operational. As with the Russian Ka-27s, the exported Ka-28s can perform several mission sets but are usually used for ASW, and the Ka-27PSs are optimized for SAR and logistic support missions. The Ka-28 is fitted with search radar and dipping sonar and can employ sonobuoys, torpedoes, depth charges, or mines.

Figure 26: Ka-28 ASW Variant

In 2010, China purchased nine Ka-31 AEW helicopters and its E-801 radar system. The Z-18J and Ka-31have provided the PLAN a serviceable sea-based AEW capability to help fill that critical gap until newer catapult-equipped aircraft carriers and catapult-capable fixed-wing AEW aircraft like the KJ-600 enter service.

The PLAN is also developing naval variants of the multi-role Harbin Z-20, which have been observed armed with air-to-ground/surface missiles and ASW equipment.[66] These variants are expected to be operable across the PLAN's growing fleet of helicopter-capable combatants, significantly improving force protection for these vessels.[67] This includes the PLAN's new

fleet of YUSHEN class LHAs, all three of which were launched astonishing 16-month timeframe between 2019 and 2021.[68] These amphibious assault ships can each reportedly carry an aviation component of up to 30 helicopters, 900 troops with heavy equipment, and landing craft.[69]

As of late 2021, the PLAN is reportedly considering purchasing three dozen Ka-52K naval attack helicopters from Russia, likely for use on its fleet of YUSHEN LHAs.[70] If completed, this purchase could quickly provide the new LHAs with much more capable attack options.

Air Defenses and Electronic Warfare

While the PLAAF is responsible for air defense over most of China, the PLAN is responsible for regional coverage in three areas surrounding Qingdao, Ningbo (extending into the East China Sea), and Zhanjiang (extending throughout Hainan's claimed territory). To support this mission, the PLAN operates a ground-based radar brigade in each of the three TCNs and at least two SAM brigades operating HQ-9 and HQ-9B SAMs.[71, 72] These mobile SAMs have a range of roughly 120 nautical miles (160 for HQ-9B) and operate with the HT-233 engagement radar.[73] The PLAN has also deployed these SAMs to disputed features in the South China Sea.[74]

A naval variant of the HQ-9 known as the HHQ-9 is fielded by the PLAN's larger and more advanced surface vessels such as the LUYANG-III class destroyer and RENHAI class cruiser. These combatants feature modern combat management systems and air surveillance systems such as the Sea Eagle and Dragon Eye phased-array radars.[75] These systems allow one or two vessels to provide air defense for an entire task group, allowing surface forces to more safely operate outside of shore-based air defenses.

In addition to airborne and shipborne self-protection jammers, the PLAN also operates Electronic Countermeasures (ECM) brigades in each of its three TCNs. PLA reporting has highlighted these brigades training with various ground-based mobile equipment to track and jam simulated "enemy" aircraft and counter missiles.[76] Although public information on ECM and EW equipment is limited, these are presumed to be modern EW systems capable of targeting large portions of the electromagnetic spectrum.

Force Employment

General Warfighting Concepts

PLAN aerospace forces play a role in both aspects of the PLAN's "Offshore Defense and Far Seas Protection" strategy. PLAN ground-based radar, air-defenses, and aircraft integrate into overall efforts for anti-access and area denial (A2/AD) in China's near seas, including combat aircraft for conducting combat air patrols and maritime strike as well special mission aircraft for AEW&C and ASW. PLAN ASW variants have been consistently observed monitoring key maritime chokepoints as the PLAN pursues undersea superiority within the first island chain.[77] PLAN bombers and fighter/bombers also provide the PLAN with flexible mine-laying capabilities, which could be useful in blockading ports and key SLOCs.[78, 79]

As the PLAN further develops its aircraft carrier force and operating concepts, carrier formations and their aviation forces will be central to the PLAN's ability to project power into far seas. The carrier *Liaoning* has begun to lead formations outside the first island chain,[80] and while the *Shandong* has remained closer to PRC shores, it is reportedly also preparing for high seas testing.[81] As noted above, future catapult-equipped carriers will provide carrier formations with better options for AEW&C, ASW, and potentially more advanced fighters. During wartime, well-equipped and coordinated carrier formations could help the PLAN counter adversary interdiction of its key sea lines of communication (SLOC) and potentially be a component of strikes on high-value targets inside the adversary's "strategic depth".[82]

Training Priorities

Figure 27: Liaoning Aircraft Carrier Replenishment

PLAN aviation training priorities have generally aligned with the warfighting concepts described above. Much focus is given to carrier training, and the two current carriers have frequently conducted simultaneous but separate drills–potentially a precursor to more coordinated maneuvers.[83] In late 2021, the Liaoning conducted a replenishment exercise in the Western Pacific with one of the PLAN's new FUYU fast combat support ships (AOEs), which were built specifically to support extended aircraft carrier operations.[84,85]

Although the PLAN continues to emphasize joint operations and PLA media has highlighted examples of coordinated training between PLAAF and PLAN aircraft, such training still appears to be rare. Even independently however, ground-based PLAN fighters and bombers form a key part of China's near seas regional defense strategy, and these platforms routinely conduct air intercept and maritime strike training.[86]

Organization and C2

Operational and administrative control of PLAN aviation forces is given to the three TCNs (Eastern, Southern, and Northern), each of which maintains its own corps leader-grade naval aviation headquarters. Within each TCN aviation headquarters are subordinate aviation divisions, brigades, and regiments. TCN aviation headquarters also operate a radar brigade and air defense brigade to support the PLA's overall integrated air defense network.

Most fixed-wing combat aircraft are assigned to aviation brigades, which in turn have subordinate flight groups. Helicopters, bombers, and unmanned aerial vehicles are assigned to independent air regiments that

appear to report directly to the TCN aviation HQ. Special mission aircraft are organized into regiments subordinate to naval aviation divisions within each TCN.[87] At each level, support organizations subordinate to the divisions, brigades, and regiments exist to provide aircraft maintenance and support. Within each theater navy, several regiment-grade airfield stations provide basic airfield services to home-based and visiting aircraft.

PLAN aircraft carriers are division leader-grade organizations subordinate to corps-level aircraft carrier task groups, which in turn are directly subordinate to their respective TCN HQs. As of early 2022, the carrier *Liaoning* falls under the Northern TCN and the *Shandong* under the Southern TCN. Shipboard aircraft are assigned to an element subordinate to the task group to which their ship is assigned. For carriers, this is probably a regiment-sized element consisting of both fighters and helicopters subordinate to the carrier task group. For other formations operating with helicopters, the aviation element would be subordinate to the task group command post.

Operational control of PLAN surface forces and associated aviation elements can be adapted as needed. Most large combatants aside from carriers are administratively assigned to division-level flotillas, but the TCN may assign operational control of individual vessels (and their aviation elements) to task groups as required by mission needs.

PLAN Marine Corps Aviation[88]

The PLAN also maintains a subordinate Marine Corps (PLANMC) with an aviation component. While previously the PLANMC had to rely on other parts of the PLAN for the use of helicopter assets, it now boasts its own 7th Aviation Brigade, which the PLAN established in 2017.[89] The PLAN expects these aviation forces to support vertical landing operations into the adversary's depth. Its pilots appear to be a mix of previously PLAA helicopter pilots transferred to shipborne operations and PLANMC cadets who graduated from the Army Aviation College. The PLANMC has been equipped with a limited number of Z-8 and Z-9 helicopters, likely transferred from the PLAN, and begun training with PLANMC air assault capable units. Other helicopter types could join the force in the future. The brigade currently contains at least two flight squadrons (飞行大队) and

an aircraft maintenance group (机务大队), but will gradually grow in size as more helicopters and pilots are delivered. These may include the Z-20 medium lift helicopter to provide a flexible multi-mission platform and the Z-10 for close air support. PLANMC pilots have been observed training with a PLAN YUZHAO LPD (landing amphibious dock) in day and night operations, including nighttime hot refueling. The PLAN's new YUSHEN LHAs are also expected to be essential platforms for PLANMC air assault and vertical landing operations.

Initial and Professional Military Training

Initial Training of Naval Aviators

Most PLAN aviators attend the PLAN Naval Aviation University (NAU/海军航空大学) for undergraduate education and training, and all receive NAU flight training. The pipeline for naval aviators has changed several times, but generally consists of three years of academic theory with the subsequent three years being mostly dedicated to flight training.[90]

A major source of NAU cadets is the Naval Teenagers Aviation School (NTAS/海军青少年航空学校) program, which provides early aeronautical classes to students in 14 high schools nationwide.[91] In 2021, 38.6% of NAU-admitted pilot candidates came from the NTAS program.[92] A select few NAU cadets participate in a dual-enrollment program (DEP) and receive three years of academic training at civilian universities followed by two years of aviation theory and flight training at NAU.[93]

Training for Carrier-borne Fighter Pilots

The PLAN especially emphasizes training for its carrier-borne fighter pilots. Prior to 2020, carrier-borne fighter pilots were mainly sourced from seasoned pilots in PLAN units, but the PLAN is now also recruiting high school students as cadets bound for these aircraft.[94]

After completing their bachelor's degree, these cadets will complete land-based flight instruction and then transition to carrier-based training.[95] During flight instruction, the student to instructor ratio is usually between three and four to one, but may reach as high as six to one.[96] Occasionally, PLAAF pilots will also transfer from PLAAF aviation brigades to one of the PLAN's carrier-based fighter units.

Training for Shipborne Helicopter Pilots

In 2020, the PLAN reported it had begun to include shipborne operations training to its pipeline for helicopter pilots, including ship landings within their first year of flight training.[97] Prior to this, NAU only provided basic skills training for helicopter pilots, and training for shipborne operations was conducted after pilots arrived at operational units. This caused a burden on operational units, impacted combat readiness, and led to different standards of training depending on units. Shifting these items to the curriculum at NAU reportedly alleviated these issues.

Professional Military Education

As for the overall PLAN, aviation officers receive professional military education (PME) at the battalion, regiment, division, and potentially corps levels. PLAN aviation officers complete tactical-level education below the division level and thereafter attend PME back at NAU. At about the corps level, officers may attend command college or joint PME at the PLA's National Defense University (NDU). In recent years, PLAN PME has begun to focus more on science, technology, engineering, and math (STEM) fields as opposed to a previous system of majoring only in the warfare discipline to which an officer was assigned.

People's Liberation Army Rocket Force

Overview

History

The People's Republic of China (PRC) formed the PLA 2nd Artillery Force in 1966. The 2nd Artillery Force (renamed the PLA Rocket Force (PLARF) in 2016) commanded China's humble inventory of land-based missiles. China's strategic nuclear weapons were developed because of the belief that hegemonic power would continue to use nuclear threats and nuclear blackmail. As early as 1956, Mao Zedong pointed out, "We also need the atom bomb. If our nation does not want to be intimidated, we have to have this thing." China perceived the need for a powerful national defense and its own strategic nuclear weapons. Chinese Communist Party senior leadership made a decision to make China's strategic nuclear weapons independently. This decisive and timely step paved the way for developing strategic nuclear weapons.

These first-generation missiles were largely categorized as unsophisticated and of limited range and capability. The story of the PLARF however, has been one of steady and progressive growth in both size and capability. In the 1960s and 1970s the 2nd Artillery Force developed longer range systems. In the 1980s, 2nd Artillery Force introduced the DF-5, the first intercontinental ballistic missile capable of striking the United States. The 1980s were a seminal decade for the 2nd Artillery in two other ways: first, through its development of the DF-21, the PLA's first road-mobile ballistic missile system, and second, through its decision to field conventional as well as nuclear missiles, leading to the introduction of the DF-11 and DF-15 short range ballistic missiles in the early 1990s enhancing active containment and effective counterattack against enemy forces.

The steady diversification of platforms and improvement in capabilities assigned to the 2nd Artillery was matched by its equally steady growth in size. Four new brigades were stood up between 1980 and 2000, three of

which were equipped with these latest weapons systems. This expansion accelerated in the 2000s: between 2000 and 2010, the 2nd Artillery stood up as many as eleven new brigades equipped with its growing array of weapons, including its first ground-launched cruise missile, the CJ-10, and its first self-contained road-mobile ICBM, the DF-31, as well as the DF-21D anti-ship ballistic missile. The pace of growth intensified between 2010 and 2020, as the 2nd Artillery (and, following its name change in 2016, the PLA Rocket Force) added 13 new brigades, as well as the longer range and more capable DF-41 road-mobile ICBM, the dual nuclear-conventional DF-26 IRBM, and the DF-17 hypersonic glide vehicle.

Incredibly, between 2017 and late 2019 the PLARF added at least ten new missile brigades. This unprecedented expansion from 29 to 39 brigades represents a more than 33% increase in size in only three years. The PLARF has also emerged as the major winner of the PLA's 2015 reforms, being upgraded to a full service at the same time that the other services were either being reduced in size or losing direct control of their forces to the new joint theater commands. Thus, the PLARF has evolved from a small, unsophisticated force of short-ranged and vulnerable ballistic missiles to an increasingly large, modern, and formidable force with a wide array of both nuclear and conventional weapons platforms.

Missions

The PLA Rocket Force is responsible for the PLA's land-based nuclear and most of the PLA's surface to surface conventional missiles. The PLARF has a dual mission set of both nuclear deterrence and counterattack and conventional strike and deterrence in support of PLA military operations.

Nuclear deterrence and counterattack are intrinsically connected. The ability to conduct effective nuclear counterattack is the foundation for effective nuclear deterrence. Without a credible counterattack capability, that is survivable in the event of a conflict, deterrence will fail. Some analysts have characterized this idea as "assured retaliation". For decades, CCP leadership did not seek parity with other nuclear powers, as they believed if they could sufficiently absorb a first strike and retaliate, even with only a few warheads, an adversary would be unlikely to decide that the risk of attacking China was worth the benefit.

Officially, PLA military thought dictates that the PLA has a nuclear "no first use" policy. Only after China suffers an enemy's nuclear attack can it conduct nuclear retaliation and nuclear counterattack operations. However, a recent annual threat assessment conducted by the U.S. Intelligence Community described the PLA as pursuing "the most rapid expansion and platform diversification of its nuclear arsenal in its history". There has been some speculation that the nuclear mission is evolving, or perhaps simply upgrading to maintain a credible nuclear deterrent.

Conventional capabilities in peace time can work well with other strategic forces in the PLA to play a deterrent role and contain the outbreak of war. In wartime, it can ensure the implementation of key strikes against the enemy to disable their warfighting capability. Just as with a nuclear deterrent, having a capable and survivable force is crucial to maintaining a credible deterrent. Conventional missile forces would no doubt play a critical role in any potential conflict between China and its neighbors, with capabilities aimed at Taiwan, the South China Sea, the Korean Peninsula, Japan, India, and the United States.

Modernization Priorities

Modernization priorities can be broken down into five main categories: rapid response, system penetration, long range strike, comprehensive damage and survival. Rapid response refers to the speed the strategic missile force can implement combat operations. Many factors go into being able to respond quickly including reconnaissance, commanders' rapid judgment of enemy actions, command and control communication capabilities, troop training level and comprehensive support capabilities. Constant alertness to potential attack is critical to ensure effective operating time to deploy weapons and equipment. For example, if the PLARF wants to target a ship, such as an aircraft carrier, they need to be able to react quickly, have the correct coordinates and launch a missile to ensure they hit the target. To improve communication response time the PLARF has made significant improvements to its C4ISR[viii] infrastructure in recent years, laying thousands of miles of fiber optic cables.

viii Command, Control, Communications, Computers (C4) Intelligence, Surveillance, and Reconnaissance (ISR)

System penetration is the ability to comprehensively use various technical and tactical measures to break through the enemy's missile defense system. Technical measures include warhead maneuvering, stealth, decoy deception, electronic jamming, and multiple warhead penetration. Tactical measures include timing of nuclear counterattacks, the destruction of the enemy's defense system, and the coordination of multiple forces, which mainly depend on the use of forces during combat. Effective system penetration capability is critical for counterattacks and particularly strategic deterrence. If the adversary knows their missile defense system could be penetrated, they are less likely to attack. This is why there has been a growing shift from ballistic to hypersonic missile development.

Long range strike refers to the ability to guide a missile deep into an enemy's territory in order to hit important strategic targets. Generally speaking, many of the most critical nodes of an adversary are well protected and deep within their territory. An effective long range strike must have both sufficient number of missiles and the requisite range to hit its target. Because of the need for long range capabilities the PLARF continues to develop more capable missiles with ever increasing accuracy such as the intercontinental ballistic missiles (ICBMS) like the DF-31 and DF-41 that can strike most of the continental United States.

Comprehensive damage capability requires the missile warhead to meet the damage requirements of different targets. For example, an aircraft carrier and a runway require different capabilities. The end goal for both targets is loss of function. Warheads with different performances and mechanisms are needed to achieve loss of function for different types of targets.

Survival is critical to success because it means being able to function even after an enemy attack and the ability to counter attack. Important factors include defensive capabilities of the position, the degree of concealment and the maneuverability of the troops. In the event a launch unit takes casualties, PLARF soldiers train to take on multiple roles. Reports indicate a battalion can lose upwards of 40% of its personnel and still be able to maintain a minimal launch capability. Moreover, the PLARF are particular about their choice of underground facilities, ensuring the rock they are built under is sufficient to survive counterattacks.

Forces (Missile Capabilities)

The PLARF fields a diverse and growing array of ballistic and cruise missiles supporting a range of strategic and operational objectives. The PLARF's missile inventory can be broken up into five broad categories: short-range, medium-range, intermediate-range, and intercontinental ballistic missiles, as well as ground launched cruise missiles.

Short-range ballistic missiles (SRBMs) generally have a range of under 1,000 kilometers. The PLARF currently has three SRBMs in its inventory: the older DF-11 and DF-15, which entered service in the early 1990s and have since been periodically upgraded with new variants, and the newer and more capable DF-16, which may have entered service around 2011. All of these missiles are road mobile and are deployed with conventional warheads. According to the Department of Defense's "China Military Power Report" (CMPR) , the PLARF has approximately 200 SRBM launchers and over 600 SRBMs. Currently, it is estimated that there are four SRBM Brigades.

Medium-range ballistic missiles (MRBMs) generally have a range of 1,000 to 3,000 kilometers. The PLARF is currently equipped with two road-mobile MRBMs, the DF-21 and DF-17. The DF-21 is utilized in both the regional nuclear strike role as the DF-21A, the conventional strike role as the DF-21C, and in the anti-ship role as the DF-21D. The DF-21 dates back to the 1980s, and is being slowly replaced by newer missile types such as the DF-26. The PLARF may have one to two nuclear DF-21A brigades still in service although the PLARF appears to be phasing the DF-21A out of frontline service. As of 2019, all DF-21C brigades have likely converted to new missiles, and there is recent evidence that the PLARF's two DF-21D brigades may have already converted to new missiles as well. The newer DF-17 is the PLARF's first hypersonic missile, with the attached DF-ZF hypersonic glide vehicle.

Intermediate range ballistic missiles (IRBMs) generally have a range of 3,000 to 5,000 kilometers. The PLARF is currently equipped with a single road-mobile IRBM, the DF-26, which may have entered service around 2015. According to DoD estimates, the PLARF has at least 200 IRBM launchers and at least 200 missiles in service. The DF-26 is capable of firing nuclear, conventional, or anti-ship warheads. Additionally, in 2021 the DF-

27 with a range up to 7,000 KM was first reported. Some analysts believe it was developed to strike the U.S. mainland. The PLARF currently operates approximately 12 MRBM and IRBM brigades.

Intercontinental ballistic missiles (ICBMs) generally have a minimum range of 5,500 kilometers. The PLARF is currently equipped with one silo-based ICBM, the DF-5, and two road-mobile ICBMs, the DF-31 and DF-41, all of which are capable of striking most of the continental United States. The silo-based DF-5 first entered service in the 1980s, but has been upgraded with A, B, and C variants. The B variant is capable of carrying up to five warheads. The DF-31 and newest DF-41 are notable for being road mobile and solid-fueled. The DF-41 is also Multiple Independent Reentry Vehicle (MIRV) capable, possibly carrying three to five warheads, although this is still a matter of debate. Notably, the PLARF has begun a dramatic expansion of its ICBM silos, with construction on as many as 260 new silos in three new locations. The PLARF currently operates approximately 19 ICBM brigades.

Finally, the PLARF is equipped with two types of conventional ground launched cruise missiles (GLCMs). The CJ-10 entered service around 2006 and has a range of around 1,500 kilometers. It is likely deployed to two brigades. The newer supersonic CJ-100 may have been deployed to its first brigade around 2020. There are no known official statistics for the range of the CJ-100, and given that it maintains supersonic speeds that require greater fuel consumption, it is unclear whether it has a greater range than the CJ-10.

In addition to its new missile systems, the PLARF has also worked to improve the infrastructure needed to support these missiles, including over the horizon radars, satellites, and other sensors to enable long-range precision strikes. Development of these systems will be especially critical to realizing the full potential of the PLARF's anti-ship missile systems, which will be unable to successfully locate and strike far-off ships without these sensor networks. The PLARF also employs limited organic Intelligence, Surveillance, Reconnaissance (ISR).

Force Employment

General Warfighting Concepts

With the PLARF's long range and strategic strike capabilities they are able to disrupt and destroy vital targets in contested environments that other types of weaponry would not be able to penetrate. With this capability to exert force over long distances there has been a growing push to target key nodes in multiple domains including land, air, sea and space. Rarely does the PLARF act as a single service, but part of a larger joint firepower system. An example during a joint fire strike is the use of conventional missile units for preliminary strikes against the enemy's reconnaissance and early warning systems, EW systems, air-defense/antimissile positions, and aviation force Bases, to paralyze the enemy's operational "system of systems" and suppress the enemy's operational strength. With an adversary in a weakened state the necessary conditions for the PLA's other services to conduct follow-up operational activities are met. Moreover, the PLARF is also heavily reliant on other services for support infrastructure such as over the horizon radars, satellites, and other sensors to enable long range precision strikes.

Training

The PLARF, unlike the U.S. military, lacks a centralized institution for training enlisted personnel such as Lackland Air Force Base or Parris Island. Rather, new enlisted personnel are typically assigned to one of the nine PLARF Bases, and then are trained by that base's training regiment for three months before being assigned to an operational unit under that Base, where they will receive further on-site training in their specialty.

The PLARF, as with the rest of the PLA, has in recent years placed great emphasis on more realistic training scenarios, including more frequent use of force-on-force exercises. Traditionally, PLA confrontation exercises have suffered from being highly formulaic and always ensuring a friendly force victory. However, the PLA has worked in recent years to remedy this situation and make these exercises more realistic and difficult. The PLARF has at least one dedicated Opposing Force (OPFOR) regiment, which was at least partially modeled on the equivalent American unit at Fort Irwin. It

also maintains four test and training districts through which launch units regularly rotate for realistic training. These districts allow for training in a range of difficult weather and terrain conditions, including cold weather and desert conditions. PLARF Bases also seem to have their own indigenous OPFOR units, of perhaps company or battalion strength, to allow for additional confrontation training.

The PLARF has also increased training in joint operations with the other services. One major training event is the annual Tianjian, or "Sky Sword" exercises, which feature joint cooperation with the other services, as well as extensive use of OPFOR.

In recent years, the Rocket Force Command College has also held a new annual training exercise called Jianfeng, or Sword Edge. Brigade Commanders are tested on problem solving, strategic thinking capabilities, and deepening operational designs and tactical innovations. Emphasis is placed on real world combat scenarios.

A close reading of PLA and PLARF media suggests that the PLARF has singled out several training areas for particular emphasis. These include nighttime training, as well as defense against enemy satellite surveillance, electronic warfare, Nuclear-Biological-Chemical attacks, and special operations raids, ad-hoc launch sites, multi-role personnel, as well as the ability to remain highly mobile through rapid "shoot and scoot" tactics to avoid being targeted by an enemy. Units assigned to silo-based missiles frequently conduct sealed off underground silo training which can last up to 30 days.

Organization and C2

The PLARF is directly subordinate to the Chinese Communist Party's Central Military Commission, the PRC's supreme national defense authority. Conventional and nuclear forces have semi-unified C2. Like all other PLA services, PLARF Headquarters consists of four major departments. These are the staff, political work, logistics, and equipment departments. There is also a Party oversight entity in the form of the discipline inspection committee.

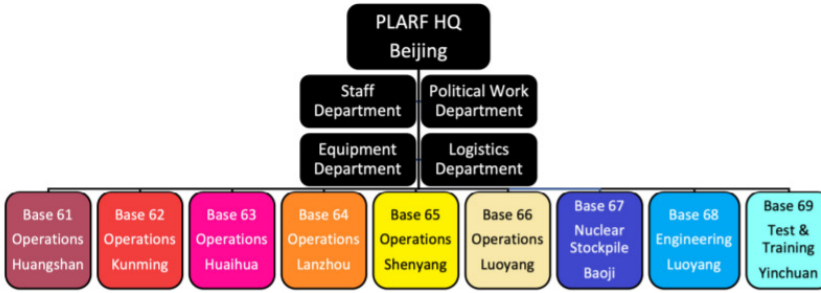


Figure 28: PLARF Organization

The PLARF commander and political commissar, both four-star equivalents, are co-equals in leading PLARF Headquarters. However, formal decision-making authority regarding force-wide manpower, training, and equipment issues resides with the PLARF's Standing Party Committee. This party committee typically consists of the PLARF political commissar as the secretary, the PLARF commander as deputy secretary, along with their deputies, the heads of the four major departments, and the secretary of the PLARF discipline inspection committee. Collectively, these individuals must reach a consensus for all major decisions related to the PLARF.[ix] PLARF leaders usually have experience commanding units with both nuclear and conventional missions with time leading warhead handling units not unusual. In general, PLARF HQ has a diverse mix of backgrounds to include officers with careers in space launch and intelligence.

ix This organization and Party committee structure is fairly standard throughout the PLA in general

PLARF Force Structure

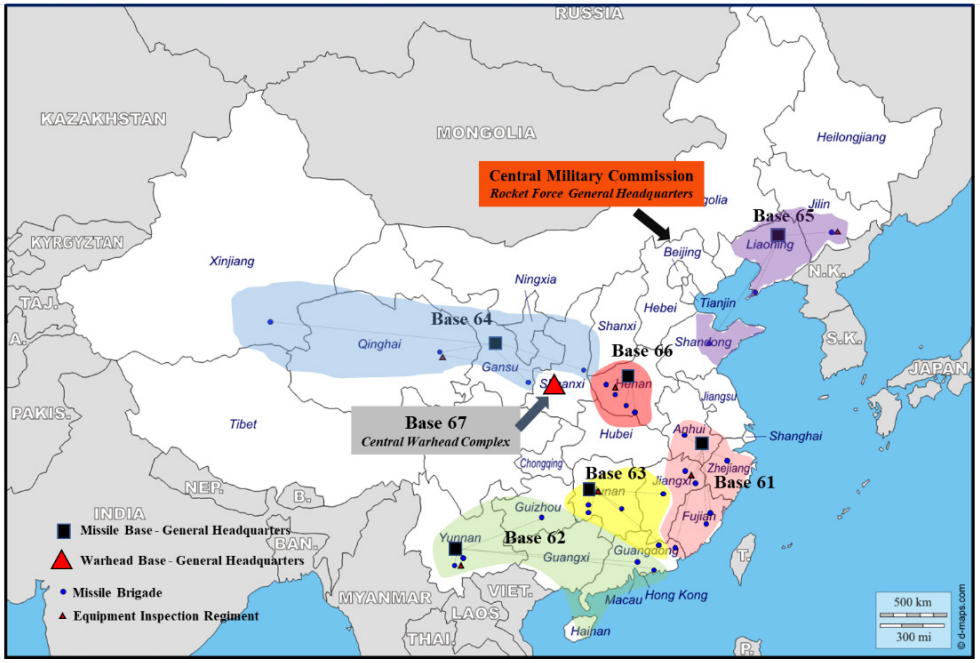


Figure 29: PLARF Bases

The PLARF oversees nine Bases. A Base is usually equivalent to a corps or corps deputy grade unit, one level above a division and is relatively self-sufficient with a highly unified command structure.

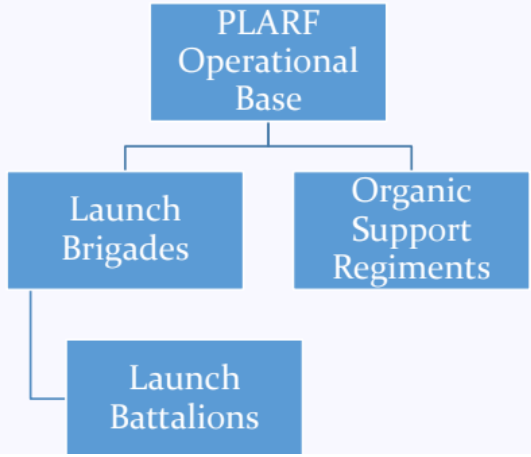
Six of the PLARF's nine Bases, numbered sequentially 61 to 66, are responsible for missile operations, while the other three, Bases 67 to 69, conduct support missions. Each of the six operations Bases cover discrete geographical areas. The missile brigades of Base 61 cover eastern and some of southeastern China, and would be the primary forces tasked with operations against Taiwan. Base 62 covers the rest of southeastern China, Base 63 covers inland southern China, Base 64 covers northwest and north-central China, Base 65 covers eastern and northeastern China, and Base 66 covers central China. Each Base oversees both nuclear and conventional forces, and features a unique makeup of nuclear and conventional capabilities depending on individual mission and strategic

need.

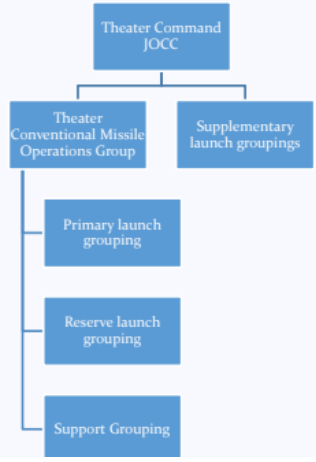
Unlike its PLA Army, Navy, and Air Force counterparts, the PLARF does not have theater Rocket Force commands within each theater command, likely due to the relatively small size of the service and the split between conventional and nuclear assets. The six operations Bases serve a similar role as a theater rocket force, but, given their smaller size, are a tier lower than the other services. Further, the Bases do not map perfectly with each theater command. For example, there are six Bases and only five theater commands, and some bases cover multiple theater commands.

Command authority of the Base's nuclear and conventional missile forces can be somewhat difficult to grasp. In peacetime, nuclear forces are administratively subordinate to their individual Bases, in wartime Bases likely still stay in the loop for nuclear operations, but theater commands are not part of the decision-making process. As seen in the wartime organization chart conventional missile forces are being integrated into the joint operations theater command as Bases shift to conventional missile operations groups. During peacetime, units are stationed at a garrison, which would be a likely target of enemy attack in the event of a crisis. On strategic warning of an adversary attack, the unit will rapidly deploy to hardened shelters, a holding area, or proceed directly to a launch site. Ad-hoc sites can also be used in the event of a conflict.

Peacetime Organization



Wartime Organization



Moving down a level, each Base controls six to seven missile brigades, along with several support regiments responsible for training, communications, operations support, maintenance & logistics, and nuclear warhead management. Each missile brigade typically oversees six launch battalions, as well as four to five support battalions. Each launch battalion in turn oversees two launch companies. Battalions can be widely dispersed and appear to be capable of independent launch. Official and comprehensive estimates of missiles and launchers per brigade are lacking, but knowledgeable observers have given estimates ranging from 6-12 launchers per brigade for certain ICBMs, 12-24 for Medium Range Ballistic Missiles, 18-36 for Intermediate Range Ballistic Missiles, and up to 36-48 launchers per brigade for Short Range Ballistic Missiles and cruise missiles.

Along with the six Operations Bases, there are three Support Bases. Base 67 is responsible for oversight of the PRC's central nuclear warhead storage depots. It ensures safe and secure storage, maintenance, and transport via specialized road, rail, and air assets, of nuclear warheads. It also oversees assets dedicated to ECM, air defense, and nuclear disaster response.

Base 68 is the PLARF's engineering support Base responsible for construction of physical infrastructure. It likely consists of six engineering brigades, at least two of which specialize in installation of key infrastructure such as electricity, ventilation, and blast and radiation shielding, a Communications Engineering Regiment responsible for constructing the PLARF's communications infrastructure, a Communications Repair and Maintenance Regiment, and at least four other support regiments. A critical task of the Base is the construction of underground facilities (UGFS). It is unknown how many miles of underground tunnels the PLARF possesses, and stories of a contiguous 3,000 mile "underground great wall" are likely overblown, but the number is certainly significant.

Finally, Base 69 acts as a testing and training facility for the Rocket Force. This Base provides high-end testing facilities for the research and development of new systems and training facilities for operational forces. Although much remains unknown about this Base, it comprises four Test and Training Districts (created from three former PLARF training Bases), as well as several regiments supporting testing and training missions.

In addition to these nine Bases, the PLARF also oversees two independent

commands. The first is the PLARF's Research Academy. Like all other PLA service research academies, this organization is responsible for conducting and integrating early-stage applied research on both technology useful to the PLARF as well as operational concepts. The second independent command is known as the Golden Wheel Engineering Project in which the PLA sold Saudi Arabia DF-3s in the 1980s and in the 2010s, the DF 21A. In recent news, according to CNN, the U.S. IC has concluded that Saudi Arabia is manufacturing ballistic missiles, with Chinese assistance.

Leadership and Personnel

PLARF's officers graduate from the Rocket Force Engineering University, in Xi'an. As part of its drive toward a more educated force, the PLARF has also begun recruiting officers from civilian academic institutions.

The year before an officer cadet graduates, or immediately upon graduation, at least some PLARF officers spend several months at an operational unit in a student capacity. This is most likely to provide the individual with some operational familiarization. They will then officially commission as an officer and serve for four years at the company level, first as a company deputy commander and then as a company commander. In this capacity, they will oversee a team of enlisted personnel who operate anywhere between one to four launcher units. The number of launchers per company is dependent on the type of weapon system. In addition to ensuring that the launch systems for which they are responsible execute orders as required, PLARF company commanders regularly train to take on battalion command responsibilities. This is almost certainly due to PLARF's desire to cross-train personnel to fulfill multiple functions, such that a launch unit can maintain minimal operational capability despite heavy personnel losses.

It is at the battalion that PLARF launch officers begin to gain a degree of authority and independence. Unlike launch companies that will typically be deployed alongside a battalion headquarters, PLARF launch battalions will often operate far from the brigade headquarters. In essence, the PLARF launch battalion is typically the lowest-level maneuver and fire unit for the PLARF.

After serving as a company commander, PLARF officers will frequently

spend a year or two in a brigade or higher-level staff assignment before landing in a battalion deputy commander position. They will then spend roughly four years as a deputy battalion commander and then battalion commander. In this capacity, a PLARF launch officer is expected to interpret brigade commands and execute them in the field. This frequently involves taking initiative and making decisions without verification from upper echelon command elements. This authority and independence is likely tied to the PLARF's expectation that its launch battalions will be under constant threats from adversary fires, and thus, may need to be able to act without having communications with the brigade headquarters.

PLARF officers will sometimes spend a second tour after the battalion level serving in a staff assignment. Typically, this assignment will be at a level higher than the brigade- usually at the base or service headquarters level.

At the brigade level, PLARF officers will finally exercise leadership over both launch and support units. Launch officers will first serve in a deputy commander or brigade chief of staff position for roughly three years prior to becoming a full brigade commander. In this capacity, they will become familiar with the wider range of responsibilities associated with brigade command.

Once an officer becomes a full brigade commander, they will be responsible for overall unit management and operations. They will also act as the interface for higher echelon commands, typically at the joint level. In a wartime environment, this translates to the brigade commander ensuring that his unit's standing plans and procedures remain valid and that his unit's subordinate battalions are prepared to support a larger firepower strike.

NCO leadership focuses on survivability of their force as a critical goal. To aid NCO leadership, two year enlisted members support missions and security. Among the NCO and enlisted ranks the PLARF (much like the rest of the PLA) has traditionally suffered from a relative dearth of "quality" well-educated personnel. While this situation was acceptable when the PLA relied primarily on overwhelming manpower, it has become increasingly untenable as the PLA attempts to transform itself into a force relying on cutting edge technologies and complex joint operations. Despite oftentimes being placed into technically demanding roles, including roles

which involve handling delicate explosive or nuclear materials, a significant proportion of the PLARF's enlisted and NCO force have only a middle school education and oftentimes struggle to meet the technical requirements of these roles. The PLARF, and PLA as a whole, are well aware of this issue and have taken steps to improve the recruitment of personnel with high school and college education in its enlisted and NCO ranks, with some apparent success.

In addition to slowly improving the quality of its recruitment, the PLARF has begun a variety of pilot programs to improve the education and technical skills of its existing personnel at all levels. These programs include short-term education at PLARF academic institutions, as well as partnerships with local civilian colleges, state owned companies, and factories where personnel can take classes or learn new skills.

As with the rest of the PLA, the PLARF views the creation of a professionalized NCO corps as an essential component for building a modernized force. The Rocket Force NCO School is the primary institution tasked with training this force, and annually trains approximately 20,000 NCOs. This includes training both new and existing personnel to become NCOs, as well as a newer training program to turn recent college graduates into NCOs, as part of the PLARF's drive toward a more educated force.

PLA Strategic Support Force

Overview

The PLA Strategic Support Force (PLASSF) was established on 31 December 2015 as the most decisive and forward-looking high-end force, a "hidden card that will deliver the ultimate victory."[98] PLA military writings have called for merging of cyber, space and electromagnetic spectrum (EMS) capabilities, which were embedded within different organs of the PLA and the CMC. The new command integrates elements of former General Staff Department (GSD) Third (3PLA) and Forth Department's (4PLA) responsibilities for the space, cyber, and EMS domains, and it likely includes technical collection functions of the former GSD Second Department and tactical/operational psychological warfare from the former General Political Department (now the Political Work Department). The PLASSF reports directly to the CMC, and the PLASSF Commander and Political Commissar are both theater command (TC) grade leaders, equivalent to other PLA service leaders. Military services and theater commands continue to operate their own electronic countermeasure (ECM) brigades and retain operational control over electronic warfare platforms in air, maritime, and ground operations, even though PLASSF units have been forward postured across each of the theater command areas of responsibility.

China drew two lessons from observing how the U.S. achieved military success through dominating the information battlefield. First, the integration of information technology could grant military superiority over the adversaries. Second, the United States' use of these technologies created dependencies, which could be exploited during wartime. Practically for China, network (cyber) and information technology were the only domains to counter the asymmetry against the U.S. using critical nodes. The Chinese spent the late 1990s and early 2000s enhancing their space and cyber capabilities. The big boost came in the late 2000s when China successfully tested its anti-satellite (ASAT) system and fielded the BeiDou navigation satellite system (BNS). By the end of the first decade of the 2000s, China had developed its command, control, communication, computer, intelligence, surveillance, and reconnaissance (C4ISR) capabilities in its

own neighborhood. This changing perspective was codified in PLA's 2013 version of the *Science of Military Strategy* and China's 2015 *National Defense White Paper* that called for the strategic expansion in space and information domains.

Missions

The PLASSF collects, processes, integrates, and provides information derived from space, cyber, and electromagnetic spectrum (EMS) assets to all PLA services and the five TCs to facilitate joint operations. It creates synergies between various information warfare capabilities in order to carry out specific strategic missions that Chairman Xi Jinping and other senior CCP leaders believe will be decisive in future wars. Echoing the 2019 *National Defense White Paper*, the PLASSF was described as serving the functions ranging from "battlefield environment support (战场环境保障), information communications support (信息通信保障), information security protection (信息安全防护), and new technology testing (新技术试验)." Beyond information support, the establishment of the PLASSF parallels the Chinese recognition of space, cyberspace, and the EMS as warfighting domains in their own right to carry out China's information warfare missions. In this capacity, the PLASSF carries out information operations such as network espionage and attack as well as defending against adversary space-cyber-electromagnetic missions. In short, the PLASSF's role within the PLA cannot be overstated, since it provides critical means to paralyze the enemy's joint operational capabilities—blinding the enemy's command and control systems in the initial stages of the conflict and disrupting, degrading, and destructing enemy communications throughout a conflict. The PLASSF also synthesizes and feeds information for strategic deterrence in space and nuclear domains and enables information to the military services for force development.

Force Employment

Citing American and Russian experiences, PLA researchers advocated the integration of "constant, controllable, and high-impact" network and electronic warfare with "high-intensity and fast-paced" precision strikes. Together, they may cause "irreversible damage and powerful destruction."

According to these Chinese writers, this is the only way to simultaneously "decapitate and blind (断首致盲)" the adversary while "crushing their bones and damaging their body (毁骨伤身)" to sustain PLA's advantage and accelerate the operational tempo. The "flexibility, controllability, and pervasiveness of such attacks'' enable warfighters to consolidate their exquisite capabilities to attack the enemy's center of gravity and destroy key nodes of enemy operation systems to paralyze their combat capabilities. Such key nodes often include command hubs, critical information nodes, communications hubs, and critical networks. Creating advantages early in an assault is also important, and this needs to be achieved through the exploitation of vulnerabilities within the adversary's operational system of systems. Speed appears to be another key focus in PLA discussions about future electronic warfare capabilities. The advancement of AI and machine learning can significantly accelerate the processing of thousands of unknown, new, and unusual emitters that exist in a complex and constantly changing EMS battlefield. In addition to connecting network and electronic warfare to orbiting systems in space, the PLASSF includes the terrestrial segment (mission control facilities, telemetry, tracking, and control (TT&C) sites, and launch centers, as well as the datalinks that bind them together).

Since its creation, the PLASSF was said to have "actively integrated the joint operations system and carried out multiple force-on-force drills and contingency training." However, detailed reports about training and exercises conducted by or involving the PLASSF remain extremely scarce. Here is a list of selected drills and exercises that have reportedly involved the PLASSF:

February 2019 – An unidentified unit participated in a long-range Southern TC Navy joint exercise along with PLA Air Force and Rocket Force units.

Early January 2019 – The 5th Research Office subordinate to PLASSF Base 25 Taiyuan Satellite Launch Center (TSLC) focused on "S&T drills." This unit previously participated in dozens of launch missions in 2018.

February 2019 – A PLASSF engineering regiment under deputy regiment leader Yuan Xiaojin deployed its 1st and 2nd Battalion to support a major engineering program supporting an unidentified national defense science and research mission.

March 2019 – An unidentified unit conducted a drill likely related to searching and tracking "enemy" targets. According to Engineer Hou Yikun and Party Secretary Ma Hongchao, the main purpose of the drill was to strengthen the command capability of the unit.

Mid-July 2019 – An unidentified unit carried out a simulated drill allowing a 32-year-old technical cadre named Bao Chenming to assume the billet of the "No.1 commanding officer/personnel（一号指挥员)," which is normally reserved for the unit commander. The billet of "No.1 commanding officer/personnel" indicated that this unit is highly likely stationed inside an PLASSF satellite/rocket launch facility where the "commanding officer/personnel No.01," also referred to as "commanding officer No. 0 (0号指挥员)," is usually the one who gives the launch order.

February 2018 – A report described aspects of an exercise in which a PLA Rocket Force targeting officer selected a tracking satellite to provide targeting data for a launch brigade and subsequently sent data requirements to the relevant PLASSF unit managing the satellite.

5 January 2018 – An unidentified PLASSF unit, likely under its Information Communications Base (信通基地), conducted a drill of communications cable repair under complex conditions. Satcom on-the-move was deployed to provide contingency communications support while UAVs were deployed to survey and assess the damages of the cables.

Jan/Feb, 2018 – PLASSF Taiyuan Satellite Launch Center (TSLC/SSF Base 25) successfully carried out three major testing missions within a week. It was established in the 1960s as China's first self-designed and constructed key national defense testing site.

Chinese New Year/16 Feb, 2018 – PLASSF Base 35 deployed its mobility supporting fendui (应急机动保障分队) or crisis response fendui (应急处突分队) to carry out battlefield environment support mission. It is assessed to be Base 35 because 1) it was established sometime in 2017 covering multiple locations all over China and 2) key personnel mentioned in this report Ma Zaixuan, formerly chief of staff of Gansu-based Unit 61243.

March 2018 – Three *fendui* from different PLASSF units participated in an actual-combat exercise (实战演习) that took place in the Gobi desert. A total of 138 personnel participated in this 3-day, 2-night exercise in desert region under adverse weather conditions. 12 training subjects (课目) and seven impromptu subjects including emergency evacuation and grouping, rapid relocation of command post, and emergency response to a sandstorm. Representatives from five different organizations participated in the evaluation process. The unit's Chief of Staff was named Liu Hao.

May 2018 – A unit participated in joint training with an 83rd Group Army brigade drilling force-on-force EW.

Organization and C2

The PLASSF is composed of two Theater Command deputy leader-grade departments: the Space Systems Department (SSD/航天系统部) and the Network Systems Department (NSD/网络系统部). In wartime, the two departments will likely be converted to operational forces known as, possibly, the aerospace force and the cyber and electromagnetic force, which will be directly commanded by the Joint Operational Command Center (JOCC) under the CMC. The Space Systems Department is mainly involved in the PLA's space launch, satellite measurement and control, navigation, space surveillance and early warning, space-based ISR, and counterspace operations. The Network Systems Department likely commands corps or corps deputy grade cyber and EMS bases, an information and communications base, and SIGINT elements and units that support national and theater level

joint operations, as well as a number of key military research institutes (possibly sharing intimate ties with a test and training Base) that carry out research and development agendas on high-end weapon platforms that can deliver strategic effects both in peacetime and in wartime. The PLASSF Network Systems Department headquarters is probably situated in the former 3PLA headquarters compound in northwestern Beijing. Much like its predecessor organizations within the former General Staff Department, the PLASSF can augment its operational strength by tapping into civilian assets through the use of authorized forces.

The creation of the PLASSF and its Space Systems Department in particular underscores the importance that China places on the space domain, and it enables the PLA to carry out more effective military operations by leveraging space-based assets to disrupt or cripple the ability of adversary forces to use assets in space. Preliminary evidence suggests that unlike other PLA services, the PLASSF may have created separate equipment departments for each subordinate Department (SSD and NSD) rather than operating a single Equipment Department for the force as a whole. The Space Systems Department Equipment Department may serve as a focal point for the military space system-related research, development, and acquisition (RD&A) enterprise.

The Space Systems Department took on the space-related roles previously performed by the former GSD and the former General Armament Department (GAD). GSD responsibilities included tasking 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. The PLASSF has effectively integrated such responsibilities into its Space Systems Department as a first-level department. From an organizational perspective, the PLASSF 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 or LM rockets, including the LM-2C, LM-2D, LM-2E, LM-2F, and LM-11. Jiuquan is also China's only launch center to specialize

in human space flight. Taiyuan launches meteorological, remote sensing, and communications satellites into sun and geosynchronous orbits. Xichang focuses on meteorological, broadcast, and communications satellites in geosynchronous orbit. Wenchang's location on China's Hainan Island limits 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 10-15 percent and satellite life by 2-3 years. In April 2022, Xi Jinping, accompanied by PLASSF senior leadership, paid a high-profile visit to Wenchang launch site, symbolizing priority from the highest level of the CCP given to military space as well as the PLASSF as a whole.[99]

The PLASSF also has integrated both land-based and sea-based TT&C centers, including the Xi'an Satellite Control Center (XSCC) and China Maritime Satellite Measurement and Control Department (中国海上卫星测控部) in Jiangyin, Jiangsu. XSCC is tasked with routine telemetry, orbit control, and breakdown diagnosis and maintenance of satellites. It is able to support simultaneous launch of satellites from multiple Chinese aerospace launch sites and manages multiple stations spreading across a dozen provinces including: Kashgar, Xinjiang; Sanya, Hainan; Jiamusi, Heilongjiang; Changchun, Jilin; Weinan, Shaanxi; Nanning, Guangxi; Qingdao, Shandong; and Xiamen, Fujian. China Satellite Maritime Measurement and Control Department manages China's Yuanwang space-tracking ships. As of 2021, there are four operational Yuanwang ships under this department and two cargo ships --Yuanwang-21 and Yuanwang-22 commissioned in 2012 and 2013, respectively. They have been used for transportation of rockets such as China's Long March-5 and Long March-7. Yuanwang-7, the most advanced Yuanwang ship that entered service in 2016 has made more than 20 voyages and performed multiple tasks in the Pacific Ocean and the Indian Ocean, including maritime tracking of China's second space lab Tiangong-2, the Chang'e-4 lunar probe, and BeiDou satellites. In 2021 alone, Yuanwang-7 reportedly was at sea for more than 200 days and completed seven maritime tracking missions.[100]

The establishment of the PLASSF, backed with consistent long-term advocacy of concepts such as "integrated network and electronic warfare" and "networked EMS warfare" suggests the potential creation of strategic and operational synergies between the PLA technical reconnaissance, ECM, cyberspace, information and communications systems, and spectrum management communities. Today, the PLASSF/NSD is composed of former GSD Third and Fourth Department requirement development, as well as operational elements.

Figure 30: General Ju Qiansheng seen standing alongside Chairman Xi Jinping during his promotion in July 2021 (Credit: Xinhua Net)

The PLASSF/NSD Equipment Department is responsible for PLASSF network and electromagnetic spectrum force planning, program validation, and acquisition management. It is housed in facilities previously occupied by the former GSD Third Department Equipment Department and former GSD Fourth Department Equipment Department. PLASSF Network Systems Department Network Bureau and Informatization Bureau may also play a role in PLA's EW/ECM operation planning, but details remain scarce.

Headquartered in Luoyang, the Electronic Equipment Test Center is a significant addition to the PLASSF. It is a division leader grade test and training complex. The center oversees radar, communications, and infrared countermeasure test ranges scattered throughout the city's northern suburbs. Together with National University of Defense Technology (NUDT), the

center co-hosts a national-level lab on measuring complex electromagnetic effects. Since 2009, the center has managed an electronic countermeasures training group to support opposing force training. A separate PLASSF complex is dedicated to directed energy test and evaluation. Before 2016, the GAD Base 21 was headquartered in Malan, Xinjiang and traditionally responsible for nuclear weapons testing. In 2004, Base 21 established an independent unit responsible for directed energy research, development, test, and evaluation, specifically high-powered microwave (HPM) and high energy laser (HEL) weapon systems. Today, this department likely oversees elements in Bayingol, Beijing, and Kaifeng.

Former GAD Base 21 also oversaw the PLASSF Northwest Institute of Nuclear Technology (NWINT). As of 2021, NWINT, transitioned from an institute to academy-level in 2019, is likely a division-grade organization directly subordinate to the PLASSF. It is also sometimes referred to as Xi'an Institute of Nuclear Technology. Directed by Hei Dongwei, NWINT is highly likely a key PLA institute for R&D of directed energy weapons. Huang Wenhua, a former deputy director of the institute and senior researcher, led a team of approximately 100 researchers and made progress in developing China's DEW program during the past decade.

Education and Training

There are currently two key reorganized educational institutions tasked to educate and cultivate future PLASSF personnel, namely, the Space Engineering University (航天工程大学) in Beijing and the Information Engineering University (信息工程大学) in Zhengzhou, Henan. The Space Engineering University, which will be the focus of this section, also has an NCO school attached to it. A reorganized PLASSF Space Engineering University also adds to this equation as a platform for foundational research in strategic areas, and as a hub to implement more military-civil fusion (MCF)-related activities to support the PLA's military operations in the space domain. It is a corps deputy leader-grade organization subordinated to the SSD. It is currently composed of three main campuses in Beijing utilizing more than 3,000 acres in land and has been actively recruiting additional civilian instructors and researchers. The State Key Lab for Laser Propulsion and Application is housed at the Space Engineering University,

most likely inherited from the former Equipment Academy (装备学院). The focus of this lab is the intersection of laser and aerospace, and it is equipped with advanced launch validation system (发射验证系统) and China's only state-of-the-art, unified, whole-system, full-process research platform for laser propulsion. Furthermore, military space-related research and doctrinal development most likely remains to be a key component of the university's missions. Furthermore, a space test and training center and a space monitoring and control station is reportedly part of the university.

Leadership and Personnel

Due to the technical nature of the various tasks assigned to the PLASSF, it is generally manned by troops and civilian personnel who have acquired relatively high-level STEM education. It likely has achieved a high-level of military-civil integration in the domain of talent management. Its PME programs remain unclear at this point, but most likely involve graduate-level study or training at one of the key PLASSF educational institutions. Almost all the current PLASSF senior leaders are graduates or received some form of education from the PLA National Defense University.

Since 2019, Network Systems Department Equipment Department has been recruiting civilian personnel to fill positions of information maintenance, IT and communications, equipment information support, construction management (electronics engineering). All of its civilian billets require CCP membership. It also seeks to recruit multiple military representatives specialized in network/cyberspace security and electronic engineering in Shenzhen, Wuhan, Chengdu, Tianjin, Beijing, Shanghai, and Nanjing.

General Gao Jin was the first PLASSF Commander, following more than 20 years with the 2nd Artillery Base at Huangshan (now PLARF Base 61) that supports operations against Taiwan. Today, he serves as the Director of the CMC Logistics Support Department. Initial PLASSF top leadership came from outside of the space, cyber, and electronic warfare missions, even though there has always been a supporting cadre of second tier of leaders who have spent their careers in the enterprise. For example, Lieutenant General Li Shangfu served as PLASSF Deputy Commander and Chief of Staff beginning in 2016 after a career at the Xichang Satellite

Launch Center and senior leadership positions in the GAD. He has been promoted to lead CMC's Equipment Development Department. The inaugural Political Commissar for the organization, General Liu Fulian, was fired for corruption in 2017.

General Li Fengbiao was the second PLASSF Commander, coming from the PLAAF Airborne Corps and a position as the Central Theater Commander Chief of Staff. He later took over as the Political Commissar for the Western Theater Command. His Chief of Staff from 2017-2019, Lieutenant General Rao Kaixun, was removed from his position for suspected corruption.

Beginning in 2021, General Ju Qiansheng became the first internally promoted PLASSF commander, after leading the PLASSF Network Systems Department. He previously served with the former GSD Technical Reconnaissance Department 12th Bureau and has been affiliated with the former GSD Second Department Remote Sensing Institute.

PLAA Aviation Branch

Overview

The aviation branch of the PLA Army (PLAA) is relatively new. The PLAA began planning to establish an army aviation branch in 1986, and it was not until 1988 that it established its first helicopter unit within a group army in Northern China.[101] However, by the end of the first decade of the 21st century, the branch had grown to include an army aviation regiment in each military region except the Nanjing Military Region, which had two. The PLAA's aviation branch has grown at an even faster pace in the past decade.

The mission of the PLAA's aviation branch is to provide close air support and reconnaissance as well as airlift for air assault operations and the infiltration and exfiltration of special operations forces. Of course, the aviation branch also conducts noncombat missions, such as medevacking injured personnel and transporting men and materiel for deployments or disaster relief operations.

The development of the PLAA's aviation branch is key to the modernization of the PLAA. The PLAA's modernization program initially focused on rationalizing and modularizing the structure of the force; now its focus is on improving its capability to conduct combined-arms operations in multiple domains and environments, for which the aviation branch is essential. The PLAA's aviation branch is still in the process of modernizing its fleet of helicopters. Perhaps attesting to the difficulty of developing aircraft, almost all the PLAA's helicopters are either of foreign design or are based on foreign designs. For the first two decades of the aviation branch's existence, the branch did not even have a proper attack helicopter, relying instead on a modified French civilian helicopter to fulfill that role. However, this was just a stopgap; throughout the past three decades the PLA has worked to develop more appropriate designs, which have rapidly been operationalized in the last decade and are being fielded at a steady pace.

Types of Helicopters Operated by the PLAA Aviation Branch

Transport

Variants of the Mi-8

The PLAA has acquired perhaps as many as 400 of the export variants of the venerable, medium-lift Mi-8: the Mi-17; the Mi-17-1V, Mi-17V-5, and Mi-17V-7, which are all optimized for high-altitude flight and can also be armed; and the Mi-171Sh and the Mi-171E, which is the most numerous variant in the aviation branch.[102] The PLAA's airborne EW and airborne early warning and control platforms are based on these variants. Because of these helicopters' versatility and reliability, it is likely that the PLAA will operate most of them until the end of their service lives.

Z-8A/B

The Z-8A and Z-8B are variants of the PLAN's Z-8, a reverse-engineered version of the medium-lift Aérospatiale's SA 321 Super Frelon.[103] The Z-8B is recognizable by its faired engine cowlings (above). The Z-8A/B has appeared as a hand-me-down from units receiving newer designs, likely indicating that the PLAA seeks to eventually replace these types.

Z-8G

The Z-8G is a derivative of the Z-18, which is itself an improved variant of the Z-8. The Z-8G is optimized for flight at high altitudes, which is necessary in Western China.

Z-8L

The Z8L is a derivative of the Z-8G. It is the PLAA's first heavy-lift helicopter. It is wider than the Z-8G, so it can possibly accommodate small all-terrain vehicles.

Z-20

The Z-20 appears to be a reverse-engineered version of the medium-lift Sikorsky UH-60. It is likely to eventually become a mainstay of transport in the PLAA's aviation branch along with the Z-8G and Z-8L.

Attack

Z-9

The Z-9 is an armed variant of the license-built Aérospatiale SA 365, a medium-lift transport helicopter. It was the PLAA's primary attack helicopter until the Z-10 began to supplant it in the last decade. It is still in use in about half of the PLAA's aviation units, but its inappropriateness for the attack and even the reconnaissance roles will likely drive the PLAA to replace it as soon as possible.

Z-10

The Z-10 is an entirely original design, though it was initially designed by Kamov. It is the PLAA's first proper attack helicopter and is quickly supplanting the Z-9 in the service's aviation units.

Reconnaissance

Z-19

The Z-19 appears to be a redesigned derivative of the Z-9. It is designated as an attack helicopter, but it lacks a cannon, and it is sometimes seen with a mast-mounted radar. It has been observed to cue targets for the Z-10 in training exercises, raising the possibility that it is intended to function primarily as a reconnaissance helicopter.

Force Employment

The PLAA's aviation branch routinely trains to execute its range of missions. Aviation brigades rotate to training grounds in different regions of the PRC in order to practice operating in different climates and altitudes; they provide airlift in the PLAA's special operations forces' training; they regularly train with elements from other combat arms, such as infantry and armor. However, the variety and tempo of all this training is a recent phenomenon, only beginning within the latter half of the past decade. Therefore, the aviation branch's proficiency in these subjects is not likely to be very high at present, but the branch's efforts are serious, and its proficiency will almost certainly improve over the next several years.

Overwater flight training has become more frequent in the past two years. Not only are pilots practicing individual skills in these training events, including nighttime flight and attacking targets at sea, but their units are practicing operating from improvised airfields, and the participation of air defense units in these training events has helped the aviation branch refine its tactics for avoiding detection while flying above the sea.[104] This will be essential if the aviation branch is to support the PLA's invasion of Taiwan. In such a scenario, the aviation branch is expected to support the infiltration of special operations forces, conduct air assaults to seize key terrain or facilities, and provide close air support to the invading forces—perhaps even against maritime targets—all of which will require its pilots and aircraft to crisscross the featureless Taiwan Strait.

Organization and C2

The PLAA's largest operational formation is the group army, which is roughly equivalent to a corps of the U.S. Army. Each of the PLAA's group armies has an aviation brigade. The Xinjiang and Tibet Military Regions, regional commands in the Western Theater Command, are organized much like group armies themselves, and each has its own aviation brigade. Therefore, the PLAA has a total of 15 aviation brigades. Two of the PLAA's aviation brigades are air assault brigades. Except for these two air assault brigades and the Xinjiang and Tibet Military Regions' units, the designation of each unit follows its parent unit's designation.[105]

The PLAA's Aviation Brigades

Theater	Group Army	Aviation Brigade
Eastern	71st Group Army	71st Army Aviation Brigade
	72nd Group Army	72nd Army Aviation Brigade
	73rd Group Army	73rd Army Aviation Brigade
Southern	74th Group Army	74th Army Aviation Brigade
	75th Group Army	121st Air Assault Brigade
Western	76th Group Army	76th Army Aviation Brigade
	77th Group Army	77th Army Aviation Brigade
	Xinjiang Military Region	84th Army Aviation Brigade
	Tibet Military Region	85th Army Aviation Brigade
Northern	78th Group Army	78th Army Aviation Brigade
	79th Group Army	79th Army Aviation Brigade
	80th Group Army	80th Army Aviation Brigade
Central	81st Group Army	81st Army Aviation Brigade
	82nd Group Army	82nd Army Aviation Brigade
	83rd Group Army	161st Air Assault Brigade

The PLAA's aviation brigades are administratively and, usually, operationally subordinate to their parent group armies. Group armies are administratively subordinate to the theater armies and are operationally subordinate to the theater commands. However, group armies seem to be primarily, but not exclusively, administrative formations themselves, and they may not always exercise operational control over their subordinate units in wartime. Therefore, if a theater command gives a group army responsibility for operations in a certain sector during a campaign, then the group army is likely to retain operational control over its aviation units. But it is also conceivable that it would attach an aviation unit to a task force or place an aviation unit under the direct command of the theater's land component commander for more limited operations.

The exact composition of the PLAA's aviation and air defense brigades varies depending on modernization priorities and local requirements. The aviation brigades generally comprise four transport battalions, two attack

battalions, and one reconnaissance battalion, and they have indeed been observed to have at least two attack battalions and four battalions of another type as well as a maintenance battalion. Air assault brigades may have as many as six transport battalions and as many as three infantry battalions. Each battalion is estimated to have, or eventually have, 8 to 12 helicopters. Aviation brigades have also been observed to have unmanned aerial vehicle (UAV) companies that operate reconnaissance drones—primarily the WZ-6 tactical reconnaissance UAV—and that are likely subordinate to a combat support battalion or a combined combat and combat service support battalion. (Aviation brigades are not the only units in the PLAA that operate UAVs, so they are not solely responsible for providing UAV-based support. Artillery brigades operate UAVs for spotting, and it is very likely that other types of units, such as special operations forces, have organic UAV assets.)

The following table lists the types of helicopters that have been confirmed to exist in each of the PLAA's aviation brigades within the past two years. It has been observed that older types of helicopters are distributed to other brigades operating even older types as newer types are introduced, so it is likely that brigades in the following table possessing a mix of older and newer types have shed or will soon shed their older types. The lack of confirmation that a brigade operates the Z-19 should not be interpreted to mean that it does not operate the Z-19 or that it does not have a reconnaissance battalion. The PLAA refers to the Z-19 as an attack helicopter, so it is also possible that the Z-9, for example, fulfills the role of reconnaissance in those brigades operating the Z-10 but not the Z-19.

Types of Helicopters Operated by Each PLAA Aviation Brigade

Theater	Aviation Brigade	Helicopter Types		
		Transport	*Attack*	*Reconnaissance*
Eastern	71st Army Aviation Brigade	Z-8A, Z-8B, Z-20	Z-9	Z-19
	72nd Army Aviation Brigade	Mi-17, Z-20	Z-9, Z-10	
	73rd Army Aviation Brigade	Mi-17	Z-10	
Southern	74th Army Aviation Brigade	Mi-17	Z-9, Z-10	
	121st Air Assault Brigade	Z-8B, Z-8G, Z-8L, Z-20	Z-10	
Western	76th Army Aviation Brigade	Mi-17, Z-8G	Z-10	
	77th Army Aviation Brigade	Mi-17	Z-9, Z-10	
	84th Army Aviation Brigade	Mi-17, Z-8G	Z-10	
	85th Army Aviation Brigade	Mi-17, Z-8G, Z-20	Z-10	
Northern	78th Army Aviation Brigade	Mi-17	Z-9	Z-19
	79th Army Aviation Brigade	Mi-17	Z-9, Z-10	Z-19
	80th Army Aviation Brigade	Z-8A, Z-8B, Z-8G	Z-9, Z-10	Z-19
Central	81st Army Aviation Brigade	Mi-17	Z-9, Z-10	Z-19
	82nd Army Aviation Brigade	Z-8A, Z-8B	Z-9, Z-10	Z-19
	161st Air Assault Brigade	Mi-17, Z-8G, Z-8L, Z-20	Z-10	Z-19

Leadership and Personnel

The PLAA's pilots are all officers. The PLA does not have warrant officers. The PLA does not separate officer and technical training; officer candidates generally undergo officer training in the same schools where they undergo training in a particular field. However, the PLAA's flight academy does not conduct its pilot candidates' officer training. Instead, there appear to be at least two paths to becoming a pilot in the aviation branch. Apparently, prospective pilots can undergo perhaps as many as four years of officer training and aviation education at the PLAA's Engineering University before undergoing one and a half years of flight training at the PLAA's Aviation Academy.[106] Alternatively, prospective pilots may first enter the PLAAF's Aviation University, where they undergo almost four years of officer training and education in aviation before transferring to the PLAA's Aviation Academy, where they undergo one and a half years of flight training.[107] Pilot candidates fly 180 hours during this period.[108]

Until 2022 all new pilots likely underwent another year of transition and combat training in their assigned units after graduating from the Aviation Academy. In early 2020 it was reported that an unspecified, but limited, number of pilot candidates at the academy were training to operate the Z-10 and the Z-19.[109] This facilitated a new program at the academy, the "two levels with operational aircraft" (实装两级 shizhuang liangji) program. The "two levels with operational aircraft" program certifies pilot candidates to operate the academy's basic trainers[x] as well as "advanced" types such as the Z-9, Z-10, and Z-19.[110] Consequently, new pilots graduating from the program do not need to undergo transition training for these types of helicopters after being assigned to an operational unit, reducing the burden of training in those units.[111] (New pilots of transport helicopters likely still undergo transition training in their units.)

x The academy's basic trainers are the Z-11 and HC120 light utility helicopters. The HC120 is a license-built version of the Eurocopter EC120. A light attack and reconnaissance version of the Z-11, the Z-11WB, exists and is apparently in service with the PLA, perhaps in some special operations forces. 威虎堂 [Weihutang], "直-11WB或将入役 特战队员有了 "黄金搭档"" [The Z-11WB may enter service in the future, members of the special operations forces now have a 'golden partner'], 央视网 [CCTV Online], December 30, 2020, accessed July 7, 2022, https://v.cctv.com/2020/12/30/VIDE9ik9LeCN7PV3HbqrG4JC201230.shtml

The program was implemented from the academic year of 2020, which usually begins in September, and every pilot candidate in every class since then has trained in the program.[112]

Most of the "military" leaders of the PLAA's aviation units are aviators themselves, people who have earned the special-class flight rating. As one would expect, then, the commanders of helicopter battalions, too, are aviators, generally those who have earned the first-class flight rating. Unlike in the PLAAF and the PLAN, it is not unusual for at least political instructors (political officers at the company and battalion levels) in the PLAA's aviation branch to be aviators themselves, judging from the fact that they often wear flight suits and have earned flight ratings. Political officers in the PLA are expected to serve as counselors as well as commanders, so these political officers' operational experience should help them better connect with their troops and make better operational decisions when the need arises.

PLAA Air Defense Branch

Overview

In contrast with its aviation branch, the PLAA has had air defense units since the late 1940s, but until the reforms beginning in 2016, the PLAA's air defense branch was not rationally organized for modern warfare, mostly consisting of large and separate antiaircraft artillery (AAA) and air defense formations. The reorganization of the PLAA that began in 2016 resulted in the amalgamation of AAA, air defense, and even electronic warfare (EW) elements into single air defense and combined-arms brigades. The PLA has also had EW units for decades, its first being established in 1958.[113] However, like its air defense units, until the reforms of the last decade, the PLAA's EW units were direct-reporting units of the military regions, so they functioned independently and were therefore not well integrated into the training and operations of the PLAA's other units.

The mission of the PLAA's air defense branch is to provide point defense of PLAA units and facilities from aerial threats. Those air defense elements of the PLAA's combined-arms brigades are more narrowly focused on the defense of the brigade from the same. PLAA air defense units may also support the PLA's overall integrated air defense system. However, the shorter range of the PLAA's air defense systems compared to those found in the PLAAF and the PLAN is a substantial limiting factor.

The PLAA's air defense units are well equipped with a variety of mobile, modern weapons systems. Air defense brigades generally operate a mix of the HQ-7A short-range surface-to-air missile (SAM) system, the HQ-16 medium-range SAM system, and the HQ-17 (tracked) and HQ-17A (wheeled) short-range SAM systems in addition to the PG-99 towed AAA system. The air defense battalions of the PLAA's combined-arms brigades seem to be primarily armed with the HQ-17 or HQ-17A and the PGZ-04 or PGZ-09 self-propelled AAA systems. Both types of units are also equipped with man-portable air defense systems.

HQ-7A

HQ-16

HQ-17A

PGZ-09

Force Employment

In the past, the PLAA's air defense branch was hindered more by its organization than it was by its armament and equipment. The post-2016 reorganization of the PLAA's air defense units has helped them to better integrate with other branches for combined-arms operations. Moreover, of all the branches of the PLAA, the air defense branch seems to most frequently participate in joint training, mostly with the PLAAF's air defense units. The PLAA's air defense units have digitized their maintenance of the air picture and they have established joint datalinks with the PLAAF's air defense units, and they have also fully integrated EW into their training.

Organization and C2

Just as with the aviation branch, each of the PLAA's group armies has an air defense brigade, and the Xinjiang and Tibet Military Regions each have an air defense brigade. Therefore, the PLAA has a total of 15 air defense brigades. In addition, each group army has six combined-arms brigades that each have an air defense battalion. Except for the Xinjiang and Tibet Military Regions' units, the designation of each unit follows its parent unit's designation.

The PLAA's Air Defense Brigades

Theater	Group Army	Air Defense Brigade
Eastern	71st Group Army	71st Air Defense Brigade
	72nd Group Army	72nd Air Defense Brigade
	73rd Group Army	73rd Air Defense Brigade
Southern	74th Group Army	74th Air Defense Brigade
	75th Group Army	121st Air Assault Brigade
Western	76th Group Army	76th Air Defense Brigade
	77th Group Army	77th Air Defense Brigade
	Xinjiang Military Region	84th Air Defense Brigade
	Tibet Military Region	85th Air Defense Brigade
Northern	78th Group Army	78th Air Defense Brigade
	79th Group Army	79th Air Defense Brigade
	80th Group Army	80th Air Defense Brigade
Central	81st Group Army	81st Air Defense Brigade
	82nd Group Army	82nd Air Defense Brigade
	83rd Group Army	161st Air Defense Brigade

The PLAA's air defense brigades are also administratively and, usually, operationally subordinate to their parent group armies, but just as with the aviation branch, whether an air defense brigade is controlled by its parent group army is a situational matter. A group army may control its own air defense brigade as it works to secure a sector over which it has responsibility, or an air defense brigade may be placed under the direct command of the theater's air component commander for more limited operations.

Just as with the aviation branch, the exact composition of the PLAA's air defense brigades varies based on modernization priorities and local requirements. The PLAA's air defense brigades have been observed to have four missile battalions and at least one antiaircraft artillery battalion as well as one electronic warfare battalion, one combat service support battalion, and even one quartermaster battalion.[114]

Industrial Base

While it is necessary to focus on the elements of China's military forces, a complete understanding requires knowledge of the support infrastructure, industrial base, and military-civil fusion that equips, deploys, enables, and sustains China's capability and capacity to employ military force. The following section has two parts: key aspects of China's defense industrial base (DIB) and their support to the PLA's requirements for the research, development, and acquisition of air and space platforms.

The scale and growth of China's economy mean that military production has probably not yet imposed an undue economic burden. In fact, the share of GDP spent on the DIB, along with other costs associated with military modernization, has remained under 2 percent of GDP from 2003-2020 in the official defense budget. While actual defense expenditures are hard to determine, higher estimates still account for only 2.3-2.4% of GDP. In comparison with other stated national goals over the last decade, China's defense expenditures have accounted for an average of 5.66% of the national budget, while education, medical care, and science and technology accounted for a 14.91%, 5.70%, and 3.93% share, respectively. More broadly, from 1980-2019, China's economy grew 9.4% annually in real value terms. By 2019, its gross domestic product (GDP) reached $14.3 trillion, second only to that of the United States, at $21.4 trillion.

A large economy alone does not guarantee innovation nor a strong DIB. An ecosystem for linking and resourcing companies, research organizations, and universities throughout the development pipeline across industrial and service sectors is a complex endeavor for any country. For the DIB in particular, Chinese and Western researchers note that while China could once focus its resources on modernization, it has now reached a level at which it faces difficult choices between investment in modernization and force readiness and sustainment—a choice that peer military powers have faced for some time. The choices China makes on the organization of its DIB will have long-term impacts due to the time necessary to build relationships across sectors and the potential for delays from policy uncertainty.

With an awareness that the DIB can be a driver of economic development

and military strength, Beijing has leveraged the DIB to spur the broader civilian economy through its military-civilian fusion strategy (MCF). MCF has gone through various iterations, starting with Deng Xiaoping's focus on keeping the defense sector alive during peace time and economic reform in the 1970s. Starting in 2017, Chinese leaders and scholars have tried to further articulate how MCF should support national defense and economic strategies. Chinese media have reported on Xi Jinping's speeches at the 19th Party Congress:

> *The ultimate goal of MCF is to build up China's unified military-civil system of strategies and strategic capability, that is, to achieve a balance between national development and national security, to unify building a prosperous nation and a strong military…to form a strategic posture that enables the integrated deployment of politics, economy, military, science and technology, diplomacy, and culture to enhance the country's overall strength and strategic competitiveness...*

Industrial organization in China is characterized by a mix of state-owned enterprises (SOEs), mixed ownership enterprises (MOEs—private and government investment with the government controlling a 51% or higher ownership stake), and privately owned enterprises. The latter continue to be the principal driver of China's growth and efficiency, but the SOEs have retained the most state support. Eight SOEs form the DIB's backbone: AVIC, CASC, CASIC, NORINCO, CSGC, CSSC/CSIC (recently combined), CNNC, and CETC. Over the past ten years, the revenues and assets of these firms increased by over 150 percent—a slower rate than the economy as a whole but sufficient to now rank among the likes of Raytheon, BAE, and Northrop-Grumman as some of world's largest defense companies.

China's leaders understand that the lofty goals of MCF are hard to reach and has set up intermediate milestones to keep the enormous number of players on the same path. According to Chinese documents on MCF strategy, the near-term goal is to improve and deepen cross-sectoral integration between the national defense and economic systems to ensure the optimal use of

resources (in addition to accelerating the development of military capability and capacity. China has prioritized several areas for priority access to resources in the near and medium term (Figure 31).

Central and local government prowcurement is a large contributor to the DIB but alone cannot account for its growth. SOEs have raised private capital by creating publicly traded and privately owned subsidiaries and MOEs.

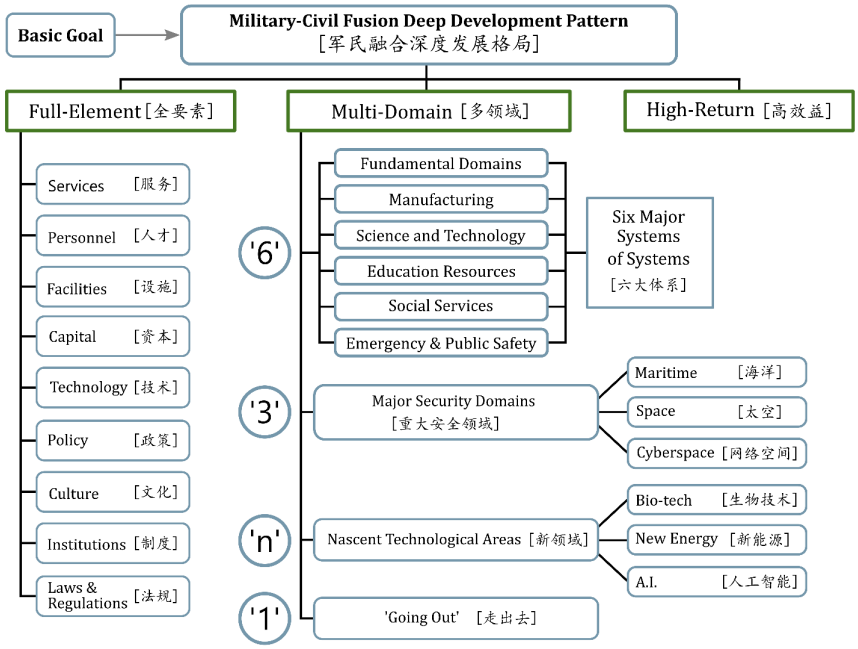


Figure 31: MCF Development Pattern

In 2017, the last year for which official data are available, China exported $4 billion in arms goods and services. This compares with $8.8 billion for Russia and $153.3 billion for the United States in the same year. Chinese DIB firms have also raised capital by issuing asset-backed securities and have benefited from "government guidance funds," set up by central and local governments. Other types of government support include tax breaks,

free land, free utilities, and in some cases even free facilities.

The logic of efficient resource use is wrought with difficult decisions and ongoing debates. In the opinion of key MCF academics, NUDT professors He Kun [贺坤] and Zeng Li [曾立], the core of the "MCF deep fusion" strategy lies in the need to continuously enhance efficient resource allocation, which, they argue, is essentially an economic issue. They make this argument because of concerns about the sustainability of defense spending and China's continuously slowing economic growth. This tension between the competing demands is likely to be even stronger in the near future, given that China's armed forces "are moving towards informatization and shouldering arduous tasks in following the trends of worldwide Revolution in Military affairs."

Central government R&D funding mechanisms have also been reformed to improve information and resource sharing.

China's Aerospace Sector

Shifts in civilian market and military requirements are having a major impact on the Chinese aviation industry. Airport sharing between the PLA and the Civil Aviation Administration of China (CAAC) dates back to 1985. According to the information provided by CAAC, as of 2017, China has a total of 64 military-civilian airports in operation, accounting for over 28% of all transport airports. Among them, there are 59 airports shared by civil aviation and the PLAAF, accounting for more than 92%. The remaining five are believed to be shared with other services. PLA Daily reported in August 2019 that these 59 airports have jointly completed over 1 million flights and transported 92.21 million passengers since 2018, accounting for 7.3 percent of the national total. In addition to sharing spaces, the industries have some natural crosspollination as civilian aircraft manufacturers leverage new advanced techniques and meet demand of the growing middle class for air travel.

The civilian aviation industry, working in tandem with the central government, is attempting to meet domestic demand with indigenously-produced aircraft. Broader manufacturing sector improvements, particularly the use of Computer Integrated Manufacturing Systems (CIMS), which include a full range of processes and tools such as Computer-Aided Design (CAD), Modelling, Quality Control, 3D Printing, and Computer Numerical Control (CNC) milling and lathing, have dramatically improved quality. Manufacturers are using new materials such as composites, carbon fiber, and titanium, which reduce radar cross-sections, save weight, and allow faster speeds in the construction of new airframes.

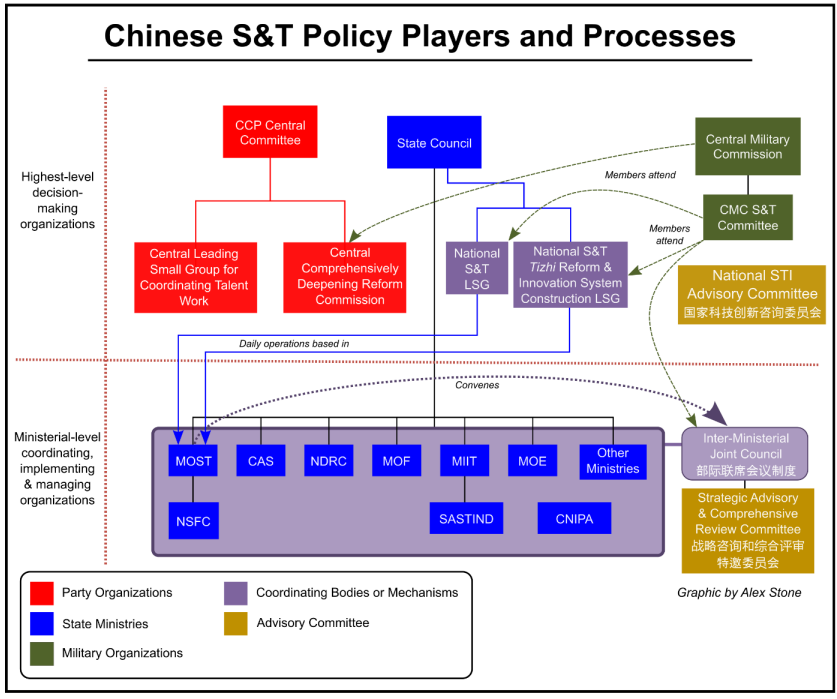


Figure 32: Science and Technology Policy Landscape

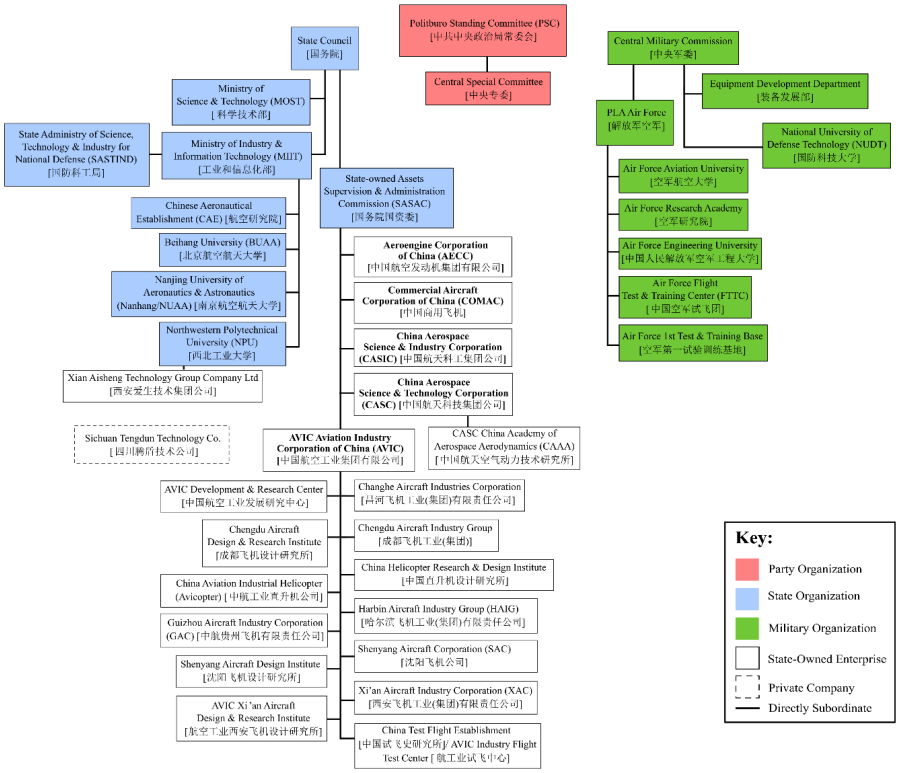
PLA requirements, together with shifts in operational use of aviation by the Naval Aviation and Army Aviation branches, drive the direction of military aviation R&D. One example of these requirements is the transi-

tion to a "Strategic Air Force" in 2014. In an interview with People's Daily, Air Force Command College [空军指挥学院] Professor Wang Mingliang [王明亮] described a "Strategic Air Force" as necessarily possessing three capabilities: Strategic Defense Capability [战略防御能力] across all domains; Strategic Attack Capability, including deep strikes against enemy positions regardless of terrain; and Strategic Power Projection [战略投送能力]. This last capability is particularly important and includes logistical support to be able to gather resources needed for operations, as well as the ability to deliver them over long distances in a short time. Both the PLA Navy's aviation branch and the PLA Air Force (PLAAF) are the recipients of major upgrades over the past decade. Indigenous production of the Y-20 heavy-lift transport aircraft, the introduction of advanced variants of the H-6 bomber, and ongoing development of an "H-20" bomber can all be understood as responses to this strategic guidance. As a result of advances in manufacturing and use of other advanced systems, since 2000, projects appear to be completing their conception-to-test-flight phases more rapidly than before. Hongdu Aviation Industry Group and Hubei Sanjiang Aerospace Honglin Exploration Control Company are among top-ten Chinese military companies based on numbers of patents as of 2019, and, at present, large aviation factories are largely consolidated under the banner of the Aviation Industry Corporation of China (AVIC).

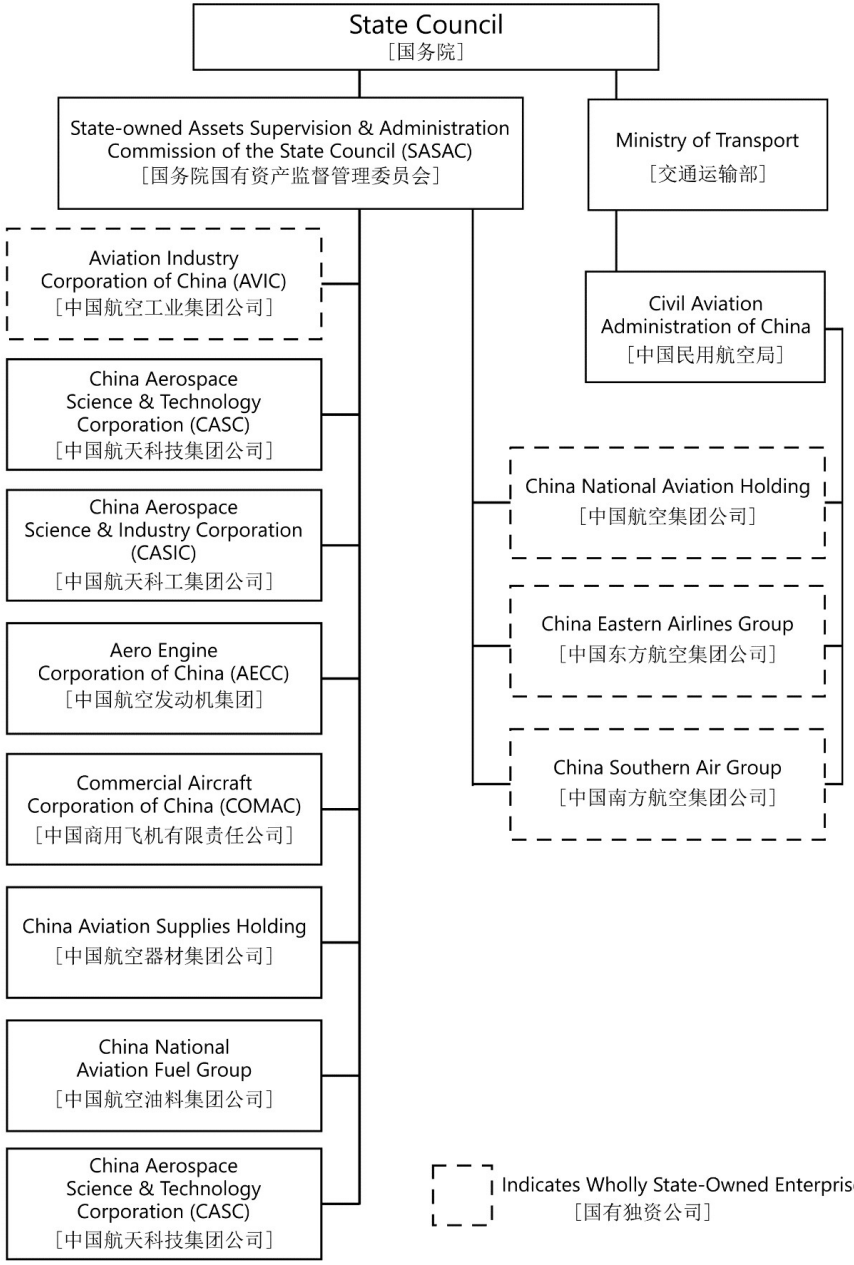
According to official Chinese government assessments and statistics, however, China is overwhelmingly reliant on imports of foreign technologies. For example, Xin Guobin [辛国斌], a Deputy Director of the Ministry of Industry and Information Technology (MIIT), recently noted that 52% of core materials are imported. When certain types of processors and other technology necessary for "intelligentized" [智能化] manufacturing and other industries are considered, this number rises to between 70% and 95%. The most recent official data from 2017 show that China imported $1.1 billion in arms goods and services, an insignificant amount in terms of China's total trade. But the ratio between arms exports and arms imports, 3.6, hints at some lags in China's ability to provide all PLA needs; the same ratio for the United States was 30.6, and for Russia, for which arms exports are a major factor in its trade balance, was 88. China has purchased advanced Russian

fighter jets (Su-35), French aircraft and naval engines, United Kingdom aircraft engines and Switzerland air defense and fire control radar systems.

China's Aviation Industry



State Administration of the Aerospace Industry in China



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