CHAPTER 6

WAITING IN THE WINGS: THE ASIA-PACIFIC AIR-TO-AIR CHALLENGE

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J-20 multi-role fighter aircraft land at the PLAAF's Changchun Air Base during a rehearsal for the 2023 Changchun Air Show, Jilin province, China, 24 July 2023 (Zhou Guoqiang/VCG via Getty Images)

OBJECTIVE:

This chapter examines the continuing development of China's tactical airpower and explores the implications that an increasingly capable People's Liberation Army Air Force (PLAAF) has for the United States as well as other Asia-Pacific air powers.

ARGUMENTS AND FINDINGS:

Over the past decade the PLAAF has benefited from sustained and substantial investment, particularly in tactical-combat aircraft and air-to-air weapons, developments that will make the air force a yet more credible adversary in any peer-on-peer war. Complementing the introduction of new and upgraded combat aircraft, the PLAAF has also been acquiring advanced air-to-air missiles (AAMs) that are equivalent to, if not better than, the weapons currently fielded by the US and its allies in the Asia-Pacific.

REGIONAL SECURITY IMPLICATIONS:

A more capable, and therefore potentially more assertive, PLAAF will make the air domain a strongly contested environment in the eventuality of a peer-on-peer war. It also presents a challenge for other Asia-Pacific air powers that could conceivably be confronted by Chinese airpower.

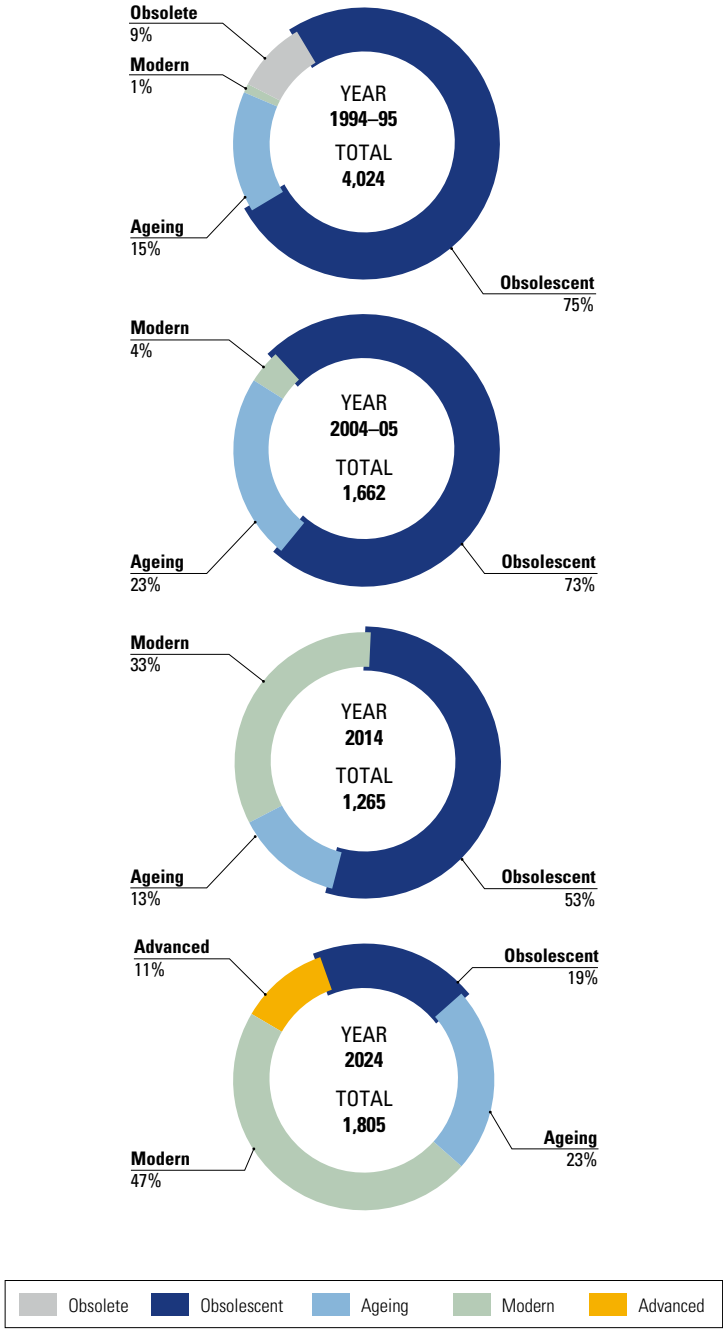
Russia's war of aggression against Ukraine has offered lessons across all domains, but key among these is the importance of gaining air superiority, having the capacity to deny an adversary this, and the impact of its absence. Neither belligerent over the first two years of the war has been able to gain air superiority, even for a relatively short period, with a subsequent limitation on their respective air, ground and maritime operations.

The air domain, alongside the maritime realm, will be fundamental in a peer or near-peer state-on-state war in the Asia-Pacific. For some states, maritime airpower will be an additional yet key component in any air campaign. The US Department of Defense already considered the Asia-Pacific air domain important enough to begin on its Air-Sea Battle concept by 2009. This was to address what it termed the anti-access/area-denial (A2/AD) military problem set.[1] While the A2/AD rubric has received less consideration as of late, developments in the region over the past decade, combined with lessons offered from the war in Ukraine, serve only to further underscore how critical the air realm remains, along with its increasingly contested nature.

A decade on from the IISS's first *Regional Security Assessment* (RSA) in 2014, the challenge of a contested air domain in the Asia-Pacific is all the greater. Deteriorating relations between the US and China continue to be compounded by the latter's ever-growing military capabilities. The PLAAF has received substantial and sustained investment that has transformed its equipment inventory. In 2014 the PLAAF had yet to field its first low-observable fighter aircraft; by the end of 2023, it had an estimated 200 Chengdu J-20 multi-role fighter aircraft.

Since the launch of the RSA, the PLAAF has also introduced the Chengdu J-10C *Firebird* and J-16 *Flanker* N multi-role fighter aircraft in significant numbers. These multi-role planes have been complemented by the introduction of new generations of air-to-air and air-to surface weapons and a growing focus on more realistic training. The PLAAF's inventory of multi-role fighters has more than doubled since 2014, providing the service with greater

Figure 6.1: **PLAAF: percentage of combat fixed-wing aircraft by capability level, 1994–2024**



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Source: *The Military Balance 1994–95, 2004–05, 2014* and *2024*

flexibility as well as more capable aircraft. For the US and other regional air powers, the PLAAF's progress cannot be ignored.

PERILS OF PARITY

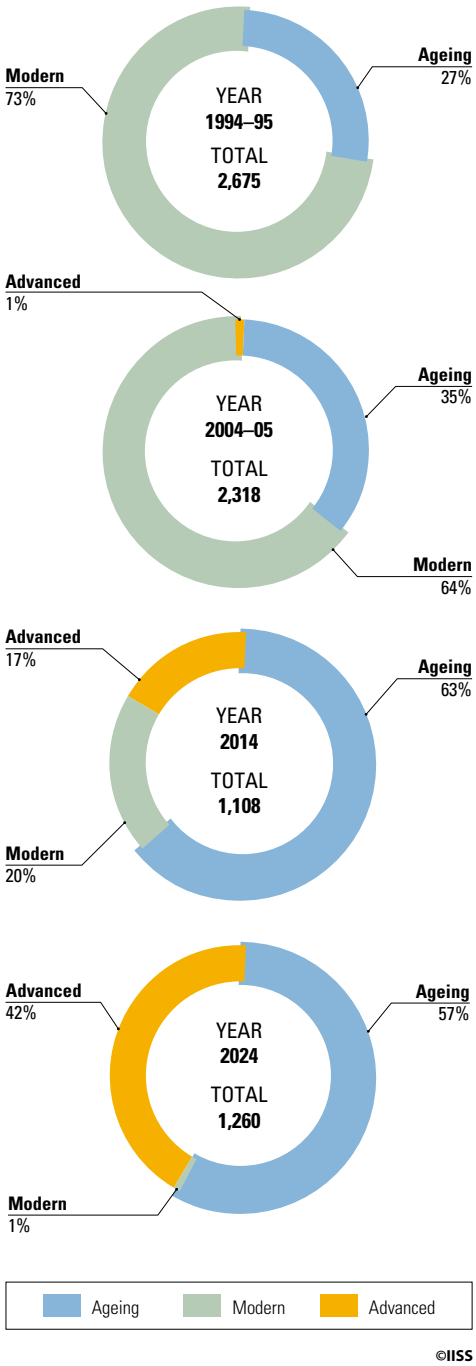
China is now the pacing threat for the US and its regional allies, with the PLAAF near transformed from the service that entered the twenty-first century. Simultaneously, Beijing looks to US capabilities and plans as the metric for its own forces' continuing development. China's tactical-combat aircraft fleets and the associated air-launched weapons now pose a far greater challenge to any adversary than they did 20 years ago.[2]

The PLAAF, additionally, continues to pursue a wide-ranging modernisation, acting to further force the recapitalisation and development plans of the US and regional allies. The key regional powers' acquisition and development programmes, as well as those of Australia, already go beyond combat-aircraft fleet-recapitalisation needs, but are concerned by an increasingly capable PLAAF, along with Chinese naval aviation.

China's air force entered the twenty-first century reliant on mainly obsolescent tactical-combat aircraft designs, supplemented by a small number of considerably more capable aircraft acquired from Russia during the 1990s (see Figure 6.1). Today, more than half of the PLAAF's multi-role fighter aircraft are either modern or advanced. The former consists of the Chengdu J-10C and the Shenyang J-16, alongside the Chengdu J-20A, the most advanced tactical-combat aircraft in the PLAAF inventory. All three of these types are fitted with an active electronically scanned array (AESA) radar, rather than the traditional mechanical antenna. AESA radars perform better and are more reliable than traditional designs and are less vulnerable to jamming countermeasures.

The J-10C, J-16 and J-20A have all been fielded with a missile fitted with an AESA seeker. The J-10C and J-16 are modern combat aircraft, while the J-20 is the PLAAF's first fighter aircraft designed with signature management – or stealth – from the outset. The J-20 is almost certainly not as low-observable as the US equivalent, the Lockheed Martin

Figure 6.2: **US Air Force: percentage of combat fixed-wing aircraft by capability level, 1994–2024**



Source: *The Military Balance 1994–95, 2004–05, 2014* and *2024*

F-22 *Raptor*. As such, in terms of combat-aircraft design and performance, the PLAAF still lags behind the US Air Force (USAF), but the gap is far narrower than it was two decades ago. In the AAM realm – the primary weapon type for a modern or advanced fighter aircraft – the PLAAF is at the very least on par with the USAF, if not arguably ahead.[3]

The airpower that Beijing could now bring to bear in any peer-on-peer conflict would present a more credible challenge and threat than at any other time since the PLAAF's inception in 1949. The PLAAF would be a key element in any Taiwan contingency. In addition to negating Taiwan's capacity for air defence and its ability to mount offensive action, a further role would be to deter the US from intervening or, failing this, limit its ability to do so. With the PLAAF's most capable combat aircraft now on a near-technical par with those of the US, the US faces an evident risk of air parity.

Where the USAF does retain a clear advantage is in the depth of its recent combat experience, operating in joint-force constructs and in the complex training that underpins the development and sustainment of its combat capabilities at all operational levels. The United States' ability to execute coalition campaigns in the Asia-Pacific is underpinned by the growth and quality of its combined military exercises with allies and partners, as chapter 1 of this year's *Asia-Pacific Regional Security Assessment* (APRSA) attests.

Meanwhile, the PLAAF's most recent combat experience, and one that was very limited, was the February 1979 Sino-Vietnamese War. During the three-month conflict, Beijing limited air activities to 'defensive patrols and reconnaissance'.[4] In the ensuing decades Beijing has not just replaced ageing types, but has instead rebuilt and remodelled its airpower to be able to contest the domain and at the very least attempt to deny air superiority to an opponent. It is a challenge that the US and its allies have not had to confront in any military operation since the beginning of the 1990s.

SEEKING SUPERIORITY

The US and its allies have enjoyed freedom of action in the air in almost all combat operations since the collapse of the Soviet Union and the end of the Cold War. Described in 2020 as an 'historically anomalous period' by then-USAF chief of staff General Charles Brown, such freedom of action is no longer a given.[5] The US and its allies are now re-equipping and retraining to be able to fight and prevail in a highly contested air domain against a peer or near-peer rival.

The USAF defines air superiority as 'that degree of control of the air by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats'.[6] While the phrase 'air dominance' continues to be used and, indeed, is enshrined in the eponymous Next-Generation Air Dominance (NGAD) (the USAF's future combat air project), notably it is absent from 'Air Force Joint Doctrine 3-01 Counter-Air Operations'.

The term 'air supremacy' continues to be preferred to 'air dominance' and is widely recognised in doctrinal terms. This is described as 'the highest level of control of the air that air forces can pursue. Air supremacy may be difficult to achieve in a peer or near-peer conflict.'[7] The term 'air dominance' came to prominence in discussions of US airpower post-Cold War, reflecting the extent to which the US lacked a peer rival in the

1990s and early 2000s, with the result that it could operate in the air environment generally uncontested.[8]

How to ensure air superiority, if confronted by a peer rival, has become the USAF's priority. The primary rival for the foreseeable future is, of course, China. The USAF has also been able to respond more quickly to the PLAAF's pace of development than it previously envisaged. When it began what was dubbed F-X in 2015 – the intent to create a fighter-aircraft successor to the Lockheed Martin F-22 *Raptor* – funding constraints and the likely development timeline anticipated a circa 2040 entry into service.[9]

For the USAF, this has raised doubts as to its ability to ensure air superiority in a peer-on-peer war in the 2030s. Studies resulted in the 'Air Superiority 2030 Flight Plan', which included a 'penetrating counterair' capability. The latter was the precursor to what is now known as the NGAD, a programme intended to field a successor to the F-22 *Raptor* fighter aircraft, likely from around the early 2030s.

Twenty-fifteen also marked the year the USAF began to publicly flag a key development in the China Airborne Missile Academy (CAMA)/Luoyang's PL-15 (CH-AA-10 *Abaddon*) extended-range radar-guided AAM. General Herbert 'Hawk' Carlisle, USAF Air Combat Command, pointed to the capabilities a weapon in the class of the PL-15 would bring to the 'high-end flight' in an address to the Center for Strategic and International Studies (CSIS).[10] Elsewhere he raised the spectre of the USAF being out-ranged in the beyond-visual-range (BVR) battle when faced with the PL-15.[11]

Air and space power will be central to any peer-on-peer war in the Asia-Pacific. The ability to gain air superiority remains key to US concepts of operation. For the USAF and the US Navy, this goal underpins the pillars of combat-aircraft procurement, the associated weaponry, and concepts of operation and training. The USAF's NGAD requirement is shaped by the operational demands in the Asia-Pacific theatre, as is the US Navy's equivalent programme (titled F/A-XX) for a next-generation combat aircraft.

For US allies, it will be necessary to ensure inter-operability and having broadly equivalent areas of capability in order to be able to operate alongside the US from 'day one' of a war. This, in turn, will possibly be reflected in the types of regional air exercises the US and its allies conduct, as covered in chapter 1 of this year's APRSA. In turn, the behaviour of the US and its allies continues to inform Chinese defence and aerospace development.

The key tools of an air campaign are the multi-role fighter aircraft and their respective armaments. As previously stated, the PLAAF has considerably narrowed the gap with the USAF in terms of the capabilities of its modern and advanced combat. This is even more the case with the primary air-to-air armaments. The PLAAF's latest BVR AAM, the PL-15, now drives the design of future US and US allies' AAMs.

General Herbert 'Hawk' Carlisle, then-commander of Air Combat Command, speaking at a promotion ceremony at Joint Base Anacostia-Bolling, Washington DC, 28 August 2015

(AB Forces News Collection via Alamy Stock Photo)

(VCG/VCG via Getty Images)

A Chengdu J-10C displayed at the 2023 Changchun Air Show, fitted with PL-10 and PL-15 training rounds

LONGER-RANGE MARCH

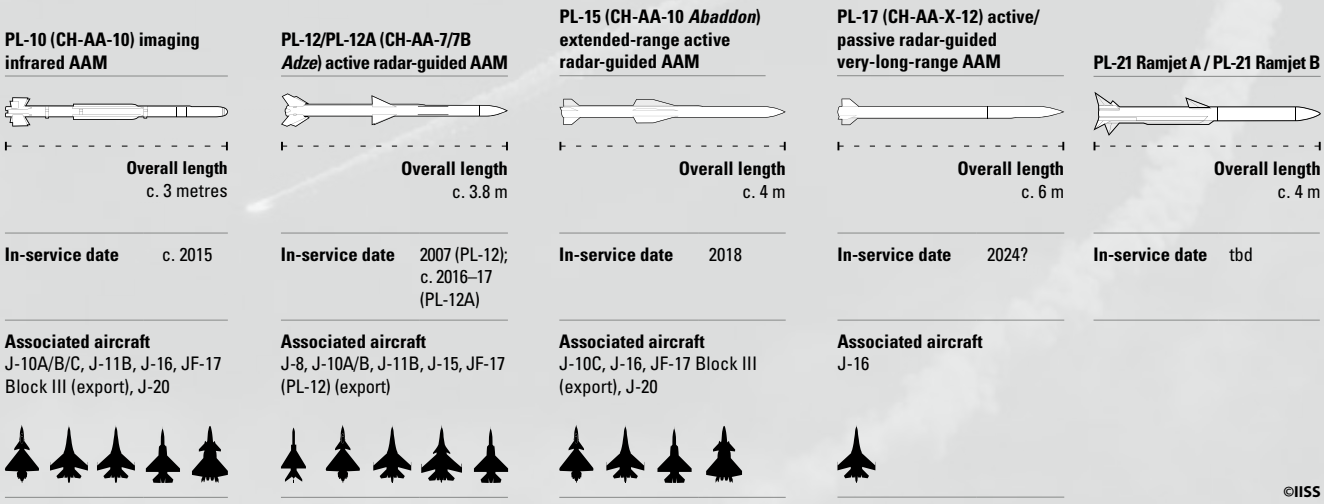
The PL-15 AAM entered service into the PLAAF around 2018 and now has one export customer – the Pakistan Air Force. This active radar-guided missile has a greater maximum-engagement range than even late models of Raytheon's AIM-120 Advanced Medium-Range AAM, while it is also faster than either the AIM-120D or the European *Meteor* rocket-ramjet-powered AAM. The PL-15 is believed to have a peak speed above Mach 5 if the fighter launch occurs at supersonic speed, with the missile sustaining this speed for much of the engagement. Time to target and the missile's remaining energy in the final stage of an engagement are important features of BVR-missile engagement.

The PL-15 is the current apex of Chinese in-service AAM development. Its development has been made feasible by three decades of sustained investment and research, initially with considerable support from Russia. Complementing the acquisition of the Sukhoi Su-27SK *Flanker* B in the early 1990s, China also looked to Russia's AAM-technology manufacturers to help it modernise its domestic capacity more rapidly.[12] By the early 1990s, the PLAAF already had a BVR capability in the shape of the PL-11. This, however, had a semi-active rather than active radar seeker, requiring the launch aircraft to use its air-intercept radar to illuminate the target for the whole of the missile's flight.

Work on an active-radar version of the PL-11 is believed to have been under way by the early 1990s, but development was a challenge. Beijing turned to Moscow for assistance. The key advantage of an active radar seeker is that it does not require the launch aircraft to continually illuminate the target, instead being able to use its own radar to lock on, while receiving target updates from the launch aircraft, if required, via datalink during the engagement.

What was to become the PL-12 (CH-AA-7 *Adze*) was associated with Project 129 and K-93/94 in the mid-1990s.[13] The latter was a Russian identifier, with the 'K' denoting a

Figure 6.3: **PLAAF: selected modern air-to-air missiles (AAMs)**



Source: IISS

developmental programme, with the numerals possibly reflecting when the project began. The active seeker, inertial navigation and datalink technology were all based on Russian designs.[14] The PL-12 and the Russian Vympel R-77 (RS-AA-12A *Adder*) likely had very similar seekers with comparable performance and limitations. The PLAAF began to field the PL-12 around 2006–07, introducing it into service with the J-10A and J-11B.

While the PLAAF was initially reliant on Moscow for its radar-guided AAMs, either directly through the purchase of the R-77 or indirectly through reliance on major sub-systems for the PL-12, this was a period of transition only. Able to provide superior AAM technology in the 1990s, Moscow now lags considerably behind Beijing in this area.

By the time the PL-12 entered service, China was already working on a far more capable active radar-guided AAM – the PL-15 – while also looking to upgrade the basic PL-12. The improved variant of the PL-12, the PL-12A (CH-AA-7B *Adze*), was probably introduced into the inventory by the middle of the 2010s. The focus of the upgrade was on improving seeker performance, specifically its capacity to counter fighter-target escape manoeuvres.

Unlike the PL-12, it appears that the requirement for a longer-range AAM may have been competed between CAMA, Luoyang and at least one other Chinese guided-weapons manufacturer. The PL-15 is notable not only for its considerable range, likely in the order of 200 kilometres (more than double the basic PL-12), but as significant, if not more, is its use of an AESA radar rather than a mechanically scanned antenna.[15]

Senior design specialists from Luoyang had been writing scientific papers exploring the use and advantages of AESA seekers for AAMs since at least the early 2010s. AESA seekers can offer improved performance in terms of range detection, including against low-observable targets, and better resistance against countermeasures. While they are more expensive than mechanically scanned systems, they are also more reliable. The PL-15

A Chengdu J-20 on display during an airshow in Zhuhai, Guangdong, China, 8 November 2022

(CFOTO/Future Publishing via Getty Images)

likely began to enter service around 2018, was first fielded on the J-10C and J-16 and provided the primary AAM armament for the J-20 from its entry into service.[16]

The J-20 can carry four PL-15s in its main weapons bay, with the two shoulder bays each fitting a single PL-10 (CH-AA-9) imaging infrared short-range missile, but appear not be able to house the near four-metre-long PL-15. Imagery of the main internal bay suggests six weapon stations, and China's PL-16 (likely CH-AA-X-13) programme is intended to provide a design in which six weapons can be carried internally by the J-20.[17] Like the PL-15, the PL-16 requirement could also be competitive. The requirement is assumed to provide a similar performance to that of the PL-15. Folding fins and a dual-pulse rocket motor may be elements of any contender.

Alongside the PL-16 programme, Chinese missile manufacturers are believed to have been testing at least two different rocket-ramjet AAM configurations. Two different missile designs – both unofficial – have been shown, but the status of any ongoing ramjet-sustainer AAM programme remains unknown.[18] Whether elements of these programmes were intended to provide an alternative to the PL-15 at the very least is also unclear.

The cumulative upshot of these efforts is that the air domain has become considerably more challenging not just for the US and its regional allies, but for any Asia-Pacific country that could directly or indirectly face such Chinese systems. In a Taiwan contingency, the improvements in the PLAAF's AAMs and its yet-greater capacity to contest the air domain pose capability challenges in the defence of the island.

AIM HIGH

The PL-15, and likely the PL-16, will be the baseline extended-range AAMs for the PLAAF throughout the 2030s and integrated with multiple aircraft. If the PL-15 follows the same path as the PL-12, the missile will then be upgraded over the course of its service life. The air force now also appears to be introducing an additional AAM into its inventory, the PL-17 (CH-AA-X-12). The PL-17 has been in development for over a decade, with imagery of the weapon first appearing in 2016.[19] The missile is almost six metres long, considerably larger and heavier than any other AAM now in service.

The requirement for the PL-17 almost certainly set out a small number but important target list, aircraft referred to by the US as high-value airborne assets (HVAAs). The PL-17 has been designed to be used to engage HVAAs, such as airborne early warning and control system (AEW&C) aircraft, and likely some classes of intelligence, surveillance and reconnaissance aircraft, tankers and signals-intelligence aircraft. Such engagements, furthermore, would be carried out at extreme range: the PL-17 may be able to be used to engage targets at up to 400 km.

A Northrop Grumman E-2 *Hawkeye*, used by the US as an AEW&C aircraft, sits on the deck of US Navy aircraft carrier USS *Nimitz* in Busan Naval Base in Busan, South Korea, 28 March 2023

(Woohae Cho/Getty Images)

The apparent approach to the PL-17 is in part analogous to the US Navy's 'Outer Air Battle' of the 1980s, or to late Soviet-era interest in very-long-range AAMs. In the late 1980s the US was working on the AIM-152, intended to replace the Raytheon AIM-54 *Phoenix*, with the former meant to have a range of over 270 km. The goal was to be able to engage threat systems – Soviet bombers equipped with long-range anti-ship missiles – before these aircraft reached their missile-launch point. In the case of the PLAAF, the intent is to be able to target those types or air platforms – sometimes known as enablers – at very long range in order to disrupt an enemy's ability to mount and sustain a successful air campaign.

The PL-17 missile was first seen on a J-16, and the first image of a training round appeared on social media in December 2023, again on a J-16. As such, it seems reasonable to infer that the PL-17 will be first introduced into service on this Chinese two-seat variant of the *Flanker* family. The missile's range, and the circa-1,300 km unrefuelled combat radius of the J-16, would require any opponent to be aware of this threat at notional ranges of up to 1,700 km from mainland China. Basing the J-16 from island runways, for example, in the disputed South China Sea, would expand the threat footprint yet further.

The designer of the PL-17 remains unknown. As such, it should not be assumed that it is another CAMA programme. The missile most likely uses dual-mode guidance, with an active radar seeker combined with additional sensors. When first observed in public, there was speculation that it might use a secondary-imaging infrared seeker, but given the target set, a passive radar homing capability is a distinct possibility. If a passive radio-frequency mode is indeed part of the guidance, this could be used by the missile to detect target radar emissions first, before switching to active radar guidance for the final stage of the engagement.

US tanker aircraft, such as the Boeing KC-46 *Pegasus*, seen here during the 2023 Dubai Air Show, would be a core element of the PL-17 target set

(Giuseppe Cacace/AFP via Getty Images)

Targeting information and mid-course guidance could be provided by either the launch aircraft or third-party platforms, potentially including from satellites, during the missile fly-out.

The size of the PL-17 precludes the weapon being carried internally on the J-20, while carrying it externally on a wing station would significantly reduce the low observability of the aircraft. As such, the primary carrier for the missile will likely be the J-16.

The ability to target HVAAs at extended range and hold AEW&Cs and tanker aircraft

at threat poses dilemmas for the latter's operator. A more defensive posture could be adopted by simply deploying these aircraft from a greater range from potential threats. This brings with it the penalties of reduced sensor coverage in the case of AEW&C aircraft, or longer transition flights for tactical aircraft to reach tanker aircraft, with an adverse impact on their operational radius. Alternatively, HVAAs could be the focus of greater protection using tactical aircraft, whether crewed or uninhabited, or indeed be the subject of signature-management designs intended to reduce platform detectability, thus improving survivability. A preference for a mix of these options may well emerge.

WITH FRIENDS LIKE THESE

The PLAAF's burgeoning counter-air capability and increasingly advanced AAM arsenal, as already mentioned, has provided impetus to the USAF's next-generation fighter-aircraft programme in the shape of the NGAD. The service's intended replacement for the Raytheon AIM-120 family, the Lockheed Martin AIM-260, is a counter to the PL-15. While the US has released scant information on the AIM-260, having disclosed little technical or performance detail, it is designed to have more range than the AIM-120.[20] The missile, however, does not use a ramjet sustainer, which suggests that it may utilise some form of dual-pulse motor configuration, possibly involving advanced propellants.[21]

The US was hoping to start production of the AIM-260 in 2023. When in service, it will provide the NGAD and the Lockheed Martin F-35 with their primary BVR AAM for carriage in their respective internal weapon bays. Given the sensitivity surrounding the AIM-260, it remains unclear to what extent the weapon, or even its less sophisticated version, will be made available for export.

The AIM-260 will also be integrated with non-crewed platforms. The weapon has already been earmarked for what the USAF now calls collaborative combat aircraft (CCA).[22] As of January 2024, five US companies (Anduril, Boeing, General Atomics, Lockheed Martin and Northrop Grumman) reportedly remained in contention to provide elements of the air force's CCA requirements.[23] CCAs are intended to provide additional combat mass, and, in any war with China, to help offset the United States' numerical disadvantage. Such platforms are intended to operate cooperatively with crewed aircraft in offensive and defensive roles. This could include using CCAs to help provide protection for HVAAs.

China's emergence as an air power continues to have implications for other Asia-Pacific countries, particularly those increasingly aligning with the US. Australia and Japan are at different stages of recapitalising their combat-aircraft fleets and associated weapons, but inter-operability with the USAF is of growing importance to both.

Any large-scale confrontation with China would likely see the Royal Australian

General Atomics was one of five companies bidding for the United States' collaborative combat-aircraft programme

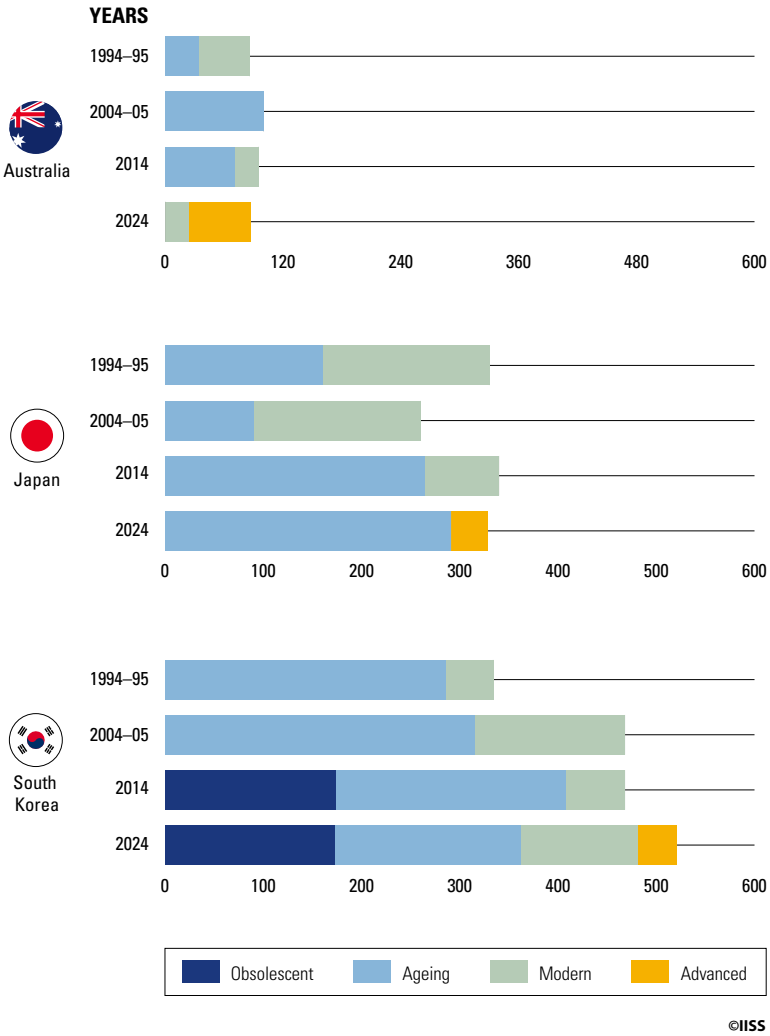
(A rendering of the jet-powered Gambit drone via General Atomics Aeronautical Systems, Inc)

Air Force (RAAF) and the Japan Air Self-Defense Force operate alongside the USAF and US naval aviation. The RAAF continues to modernise its fighter/ground-attack fleet. It introduced the F/A-18F *Super Hornet* into service in December 2010 and placed its first order for the F-35A in 2009, with the last few of the 72 ordered due to be handed over in 2024.

The RAAF is yet to make a decision on a successor to its 24 F/A-18Fs. Further F-35As are an option, but not the only ones. The RAAF's original aim was to acquire 100 of the type, but having to pull the General Dynamics F-111C from service before its planned withdrawal date meant an interim capability was needed, resulting in the F/A-18F purchase. The RAAF now plans for the F/A-18F to remain in the inventory until the mid-2030s. This time frame widens the options for the RAAF.

The multi-role fighter being jointly developed by Italy, Japan and the United Kingdom in the Global Combat Air Programme (GCAP) is planned to enter service from 2035. The New Generation Fighter being designed by France, Germany and Spain is due to enter service from the early 2040s. The GCAP requirement is being shaped partly by the demands of the Asia-Pacific environment.

Figure 6.4: **Australian, Japanese and South Korean air forces: number of combat fixed-wing aircraft by capability level, 1994–2024**



Source: *The Military Balance 1994–95, 2004–05, 2014* and *2024*

The RAAF's AAM arsenal is also mainly procured from the US, although it does also include the British advanced short-range AAM as one of two short-range weapons. The other is the Raytheon AIM-9X *Sidewinder* II. The RAAF's primary BVR missile is the AIM-120, with the B, C-5, C-7 and D variants of the missile already acquired.

Phase 5 of Project Air 6000, the now 20-year-old programme to refresh the overall RAAF combat capability, with the F-35A at its core, covers the purchase of additional AIM-120D missiles, the most capable and longest-range version of the weapon. The AIM-120D provides the RAAF with the aircraft's BVR AAM. The air force is also exploring the utility of CCAs through its Boeing Australia MQ-28 *Ghost Bat* programme. The RAAF is looking at the potential of CCAs to support crewed aircraft and to provide additional combat mass.[24]

Alongside Australia, Japan and the Republic of Korea (RoK) are the two other Asia-Pacific operators of the F-35s. Unlike Australia, both countries also have domestic combat-aircraft projects under way, although at different stages. The Korea Aerospace

Industries' KF-21 *Boramae* is nearing initial production, while, as previously mentioned, Japan is a partner in the tri-national GCAP. Although with the KF-21 the RoK has begun to move away from dependence on the US for its fighter aircraft, its current AAM inventory is made up entirely of US systems. It compromises AIM-9 and AIM-9X *Sidewinder*, AIM-7 *Sparrow* and AIM-120 B, C-5 and C-7s. Both the KF-21 and the GCAP, however, will use missiles other than the AIM-120D as their BVR armament.

The KF-21 will carry the *Meteor* semi-recessed under the fuselage, while Japan's GCAP variant is intended to operate with a new BVR AAM. From 2014, Japan and the UK had worked jointly on what was known as the Joint New AAM (JNAAM). This design married the *Meteor*'s ramjet sustainer with a Japanese AESA seeker and had been anticipated, at least by some participants, to lead to an acquisition programme. The JNAAM was, however, concluded in 2023, with the project used to inform a follow-on project instead.[25]

The need to address the threat of the PL-15 may have contributed to Japan's decision. The mid-1990s British requirement, which the *Meteor* was designed to address, was likely based on the ability to counter projected developments of the Russia R-77, particularly its ramjet-sustainer variant, the R-77-PD. While a ramjet variant of the R-77 was tested in the 1990s, it never went into production.[26] This version of the R-77 likely had a speed between Mach 3 and Mach 4, while the PL-15, under optimised launch conditions, can achieve Mach 5. Ramjet-sustainer missiles have the advantage of still being powered in the final stage of an engagement, while the motor burn of current-generation solid-propellant designs is finished long before any medium- to long-range engagement. The peak speed of the PL-15, and its overall performance, however, is fuelling future requirements. A mid-life upgrade of the *Meteor* is now being considered, driven by the pacing threat of the PL-15.

Most Asia-Pacific nations have traditionally looked to Europe, Russia or the US for their combat aircraft and weapons. As China's capabilities continue to improve, however, this poses a challenge to many of them regarding the kinds of medium-range AAMs they may require in the future. Several of these air forces now use the AIM-120, but the variants available are inferior to the PL-15. The US weapon being developed as the AIM-120 successor, the AIM-260, is unlikely to be available for export to these countries, certainly in the near term. MBDA's *Meteor*, perhaps after a mid-life update, remains an alternative.

CONTESTED SKIES

The PLAAF's progress continues to force the US and its allies to focus on developing operational concepts, tactics and AAM technologies, with the intention of securing air superiority in any war with China. The United States' past qualitative advantage in the BVR realm now appears to be much closer to parity. Developments such as the NGAD, AIM-260 and CCAs are intended to redress this. For Washington's regional allies, using platforms and weapons systems that are inter-operable, and that are complementary and capable of confronting Chinese threat systems, will also be important. This, however, does not always mean buying American, as projects such as GCAP, KF-21 and Japan's new AAM demonstrate.

China's greater combat capability in the air domain, however unproven, only increases its confidence in the outcome of any Taiwan contingency, and in any wider conflict with

the US and its allies. If Beijing perceives the risk of conflict to have lessened, then the possibility of actual hostilities will be greater. Conversely, the more credible the ability of the US and its allies to reinforce deterrence, and to cast in doubt any positive outcome for China, the more regional instability will be reduced. A greater confidence in its capabilities could also lead to yet more assertive behaviour from China, in both air and other domains. This brings with it the concomitant risk of incidents and inadvertent escalation.

A two-seat version of the Republic of Korea's KF-21, now in development, was on show during the Seoul International Aerospace & Defense Exhibition (ADEX) at the Seoul Air Base, Seongnam, South Korea, held on 18 October 2023

(Chris Jung/NurPhoto via Getty Images)

When the APRSA was launched a decade ago, the PLAAF had yet to field the J-20, while the J-16 variant of the *Flanker* was only on the cusp of entering service. The IISS's *Military Balance 2024* records over 200 J-20s and 280 J-16s in service as of the end of 2023. In the same period, the PLAAF has introduced an improved version of the PL-12, fielded the PL-15 and, as of 2024, is on the brink of introducing the PL-17 AAM. Development of the PL-16, meanwhile, appears to continue. By any measure of capability development in the air-combat realm, the improvements are marked. Already a contested domain when the APRSA was first published, China's investment in its tactical airpower has made the Asia-Pacific only more so.

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