



The Balance of Air Power in the Taiwan Strait

US -Taiwan Business Council
May 2010

The Balance of Air Power in the Taiwan Strait

**US-Taiwan Business Council
May 2010**

This report was published in May 2010 by the US-Taiwan Business Council.

The Council is a non-profit, member-based organization dedicated to developing the trade and business relationship between the United States and Taiwan. Members consist of public and private companies with business interests in Taiwan.

This report serves as one way for the Council to offer analysis and information in support of our members' business activities in the Taiwan market. The publication of this report is part of the overall activities and programs of the Council, as endorsed by its Board of Directors. However, the views expressed in this publication do not necessarily reflect the views of individual members of the Board of Directors or Executive Committee.

© 2010 US-Taiwan Business Council

The US-Taiwan Business Council has the sole and exclusive rights to the copyrighted material contained in this report. Use of any material contained in this report for any purpose that is not expressly authorized by the US-Taiwan Business Council, or duplicating any or part of the material for any purpose whatsoever, without the prior written consent of the US-Taiwan Business Council, is strictly prohibited and unlawful.



1700 North Moore Street, Suite 1703
Arlington, Virginia 22209
Phone: (703) 465-2930
Fax: (703) 465-2937
council@us-taiwan.org
www.us-taiwan.org

Edited by Lotta Danielsson-Murphy
Printed in the United States

TABLE OF CONTENTS

Foreword.....i

Executive Summary.....iii

Introduction..... 1

State of Taiwan’s Air Defense Forces..... 3

 Combat Aircraft..... 3

 Ground-Based Air Defense..... 6

 C4ISR..... 7

Comprehensive Threat Environment & Vulnerabilities 9

 China’s Offensive Missile Capability..... 9

 Taiwan’s Air Defense Challenge..... 10

Operational Issues for the Taiwan Air Force 13

 Block Obsolescence.....13

 Material Availability13

Cross-Strait Air Power Balance17

Dynamic Balance Scenarios 19

 Combat Air Patrol 19

 Defensive Counter-Air 19

 Maritime Strike/Anti-Invasion20

 TBM & LACM Defense..... 20

 The Chinese SAM Threat.....21

 Balance Evaluation21

Possible Measures to Strengthen Taiwan’s Air Defense 23

 Bridging the Fighter Gap..... 23

 Mid-Life Upgrade..... 23

 Ground-Based Air Defense..... 25

 ISR 25

 EW & IW..... 26

Innovative and/or Asymmetrical Options 29

 STOVL..... 29

 Passive Defense 29

 Counter-Strike Capability.....30

The Political Dimension 33

Taiwan’s Role in Supporting the U.S. Regional Strategic Presence 35

Conclusions.....37

Appendix..... 39

 Acronyms.....39

 Glossary43

TABLES & FIGURES

Table 1: Taiwan’s Current Combat Aircraft 3

Table 2: Taiwan’s Current Aircraft Deployment..... 4

Table 3: Taiwan’s Current Ground-Based Air Defenses 6

Table 4: Taiwan’s Current Short-Range Air Defenses 6

Table 5: Estimate of Chinese Land-Attack Missiles Deployed Against Taiwan 9

Table 6: Comparison of Approximate Principal Combat Aircraft Strength.....17

Figure 1: Aircraft Deployment and Command & Control Infrastructure..... 5

Figure 2: Timeline Showing Projected Available Air Frames - 2009-202515

FOREWORD

The US-Taiwan Business Council is committed to providing our members and the broader policy-making community with strategic insight into the bilateral relationship between the United States and Taiwan. This report is part of our continuing efforts to offer value-added benefits to all our member companies, as well as to help inform all those individuals who are actively engaged and interested in the Asia Pacific region.

In 2006, Taiwan attempted to submit a Letter of Request (LOR) to the United States for Price and Availability (P&A) data for 66 F-16s to replace its aging fleet of F-5s and Mirage 2000-5s. Over the past four years, two U.S. administrations have taken the unprecedented step of denying a security partner the ability to even submit an LOR, thereby prohibiting a thorough evaluation of the legitimacy of Taiwan's request. In the absence of any movement towards such an evaluation, Congress took it upon itself - in the spirit of cooperation embodied in the Taiwan Relations Act (TRA) - to instruct the Obama Administration to undertake such a review.

On October 28, 2009, President Barack Obama signed into law the *National Defense Authorization Act for Fiscal Year 2010*. Upon enactment of the legislation, the U.S. Department of Defense (DoD) received instruction from Congress directing it to submit a "Report on Taiwan's Air Defense Forces" within 90 days. The directive report language stated:

Report on Taiwan's Air Defense Forces. Not later than 90 days after the date of enactment of this Act, the Secretary of Defense shall submit to Congress a report that contains an assessment of the following: (1) the current state of Taiwan's air defense forces; (2) the ability of Taiwan's air defense forces to defend Taiwan's air space in response to a range of cross-Strait scenarios; and (3) possible measures, if any, that Taiwan could undertake to strengthen its air defense forces. The report shall be submitted in an unclassified form, but may include a classified annex if necessary.¹

The initial report under this directive was submitted to Congress in early 2010 by the U.S. Department of Defense, and contained both classified and unclassified sections. The unclassified report, dated January 21, 2010, contained a brief summary of Taiwan's present inventory, and noted: "Taiwan recognizes that it needs a sustainable replacement for obsolete and problematic aircraft platforms. In addition to pursuing a replacement airframe, Taiwan is also examining an upgrade to its existing F-16 A/B aircraft and its IDF aircraft."² A second DoD airpower assessment is expected to be delivered to Congress in classified form later this year.

Because the bulk of the DoD analysis on this matter is classified, the US-Taiwan Business Council felt it important that the community have a more substantial analysis to consider, leading to the production of this report.

¹ H.R. 2647, National Defense Authorization Act for Fiscal Year 2010 (Washington, D.C.: 111th Congress, 2009)

² DIA-02-1001-028, *Taiwan Air Defense Status Assessment* (Washington, D.C.: Defense Intelligence Agency, January 21, 2010)



The Balance of Air Power in the Taiwan Strait

The Taiwan Relations Act clearly states that “the United States will make available to Taiwan such defense articles and defense services in such quantity as may be necessary to enable Taiwan to maintain a sufficient self-defense capability.”³ But the past two administrations have moved away from the spirit and intent of the TRA with their bundling of arms sales and the commensurate arms freezes (April to October 2008, and January 2009 to January 2010) that have characterized the new arms-sales “process”. This so-called process is not driven by the TRA - which states that “the President and the Congress shall determine the nature and quantity of such defense articles and services based solely upon their judgment of the needs of Taiwan” - but by other considerations in our burgeoning relationship with China.

The United States is currently confronting the most important defense and security challenge related to Taiwan in almost 20 years - if and how to modernize Taiwan’s airpower capabilities. Both China and Taiwan understand the stakes, and China’s recent histrionics on Taiwan arms sales are clearly intended to gauge the extent to which China can redefine America’s security commitment to Taiwan in a manner more favorable to the Chinese position. America’s ongoing global commitments are also placing an acute strain on our forces deployed in North East Asia. While the TRA is quite clear in noting the requirement “to maintain the capacity of the United States to resist any resort to force,” our forces in Alaska, Okinawa, Guam and other locations are already under tremendous pressure to provide adequate security for their present responsibilities.

Thus the Obama Administration must gauge the possible implications of Taiwan’s inability to protect its own airspace, and the U.S. requirement to fill that void in a possible conflict. If the Administration ultimately determines not to provide Taiwan with replacement equipment, then the question becomes what additional U.S. forces will have to be made available in the region to maintain America’s ability to resist any use of force by China.

This report was produced by the Council’s membership and by several outside experts who spent their valuable time reviewing, fact-checking, and otherwise contributing to this report. Their perspectives and sage advice throughout the process proved invaluable. I wish to express my sincere gratitude to my colleague Lotta Danielsson-Murphy, whose dedication to the production of this report made the final product possible. I also wish to thank my Council colleagues Christine Messick and Erik Lundh, who contributed in a meaningful and substantive manner.

The Council believes that we can continue to contribute in a significant way to the health of America’s relationship with Taiwan. However, we can only continue that work with the assistance of our member companies. We are deeply grateful for their ongoing and tremendous support.

A handwritten signature in black ink that reads "Rupert J. Hammond-Chambers". The signature is written in a cursive, flowing style.

Rupert J. Hammond-Chambers
President
US-Taiwan Business Council

³ Public Law 96-8, *Taiwan Relations Act* (Washington, D.C.: 96th Congress, January 1, 1979)

EXECUTIVE SUMMARY

Taiwan's relationship with China continues to improve and expand. Yet the eroding cross-Strait military balance must be redressed so that Taiwan can approach the political dialogue from a position of confidence and strength.

Effective air defense is a crucial component if Taiwan is to mount a viable defense of the island. Taiwan's current air defenses comprise 18 fighter squadrons with a nominal strength of 387 combat aircraft of U.S., French, and indigenous origins: 145 F-16A/Bs, 126 F-CK-1A/Bs, 56 Mirage 2000-5s, and 60 F-5E/Fs. All of these are reasonably modern "Fourth Generation" fighters with BVR AAM capability, with the F-5s - which are mainly used for operational conversion training with only a secondary combat role - as the exception.

The Taiwan Air Force (TAF) also controls ground-based air defense forces in the form of over 25 medium/long-range surface-to-air missile (SAM) batteries, using a mix of U.S. and indigenous missile systems (I-HAWK, Patriot, and Tien Kung-I/II). TAF has three existing PAC-2+ batteries (currently being upgraded) and is in the process of procuring 6 additional operational Patriot systems, for a total of 9 active PAC-3 batteries.⁴ There are also a number of short-range air defense SAM and gun systems, as well as field air defense assets operated by Taiwan's ground forces.

In addition, Taiwan has a sophisticated integrated air defense command & control (C2) system, together with a modern network of ground-based surveillance radars and E-2 AEW&C aircraft. The air defense C2 infrastructure is currently being hardened, further modernized, and integrated with new capabilities such as the Link 16 datalink and the Surveillance Radar Program (SRP).

Taiwan's air defense forces confront a unique threat environment involving long-range SAMs and over 1,300 tactical ballistic missiles (TBMs) and land-attack cruise missiles (LACMs), which could - in concert with manned strike aircraft, UAV, information warfare/electronic warfare and Special Operations Forces (SOF) attacks - threaten their bases and C2 installations. To defend against an integrated Chinese air campaign, Taiwan is investing heavily in active missile defense, BMC3I, and early-warning capabilities. But the runways at TAF air bases are vulnerable, and damaged runways could disable defensive air operations.

Block obsolescence is also a clear and present challenge to the TAF. Its F-5 fleet is nearing the end of its useful structurally-permitted service life, and is slated to retire by 2014. In addition, the actual number of airworthy twin-seat F-5Fs was reduced to just four aircraft in 2009. This shortfall is impacting lead-in fighter training (LIFT) for new pilots, and could erode pilot quality and operational readiness over time. Similarly, Taiwan will also need to address block obsolescence and reliability issues of its I-HAWK SAM systems.

Taiwan does not currently have a cost-effective means to address TAF's fighter capability shortfall caused by F-5 obsolescence. Taiwan's Mirage 2000 fleet suffers from very high Operations & Maintenance (O&M) costs and chronically low availability rates. The TAF poured substantial funding into addressing the Mirage issues over the past two years, leading to recent improvements in material readiness. But a tight O&M budget situation

⁴ Taiwan has also procured an additional training battery as part of this process.

will almost certainly ensure a relapse into low Mirage material readiness over the next few years. Taiwan may resort to mothballing part of the fleet to conserve resources, and the combination of F-5 obsolescence and strained Mirage supportability will create a substantial shortfall of fighter aircraft for the TAF.

Meanwhile, China continues to aggressively introduce large numbers of modern combat aircraft into service. China currently deploys more than 700 combat aircraft within operational range of Taiwan, with hundreds more in ready reserve. These include over 500 very modern aircraft (Su-27, Su-30, J-10, JH-7), which are roughly comparable to TAF's "Fourth Generation" aircraft types (F-16A/Bs, Mirage 2000-5s, F-CK-1A/Bs).

Conversely, TAF fighter strength is projected to decline to only around 300 aircraft by 2014-2015, and thus China will easily be able to array a better than 2:1 numerical superiority. Taiwan will then no longer have the number of combat aircraft necessary to meet the requirements for defending its air space from Chinese military threat.

The significant quantitative decline in air defense capability that Taiwan is expected to experience over the next several years could also have a profound and enduring impact by eroding the already marginal qualitative edge still held by Taiwan. Lessons from past Taiwan Strait crises have demonstrated the importance of Taiwan maintaining a qualitative edge against China, not only to prevail in conflict but also to strengthen deterrence.

The inability to provide timely replacements of obsolete equipment and/or prevent further deterioration in material readiness could result in Taiwan permanently losing its traditional edge in training and experience. Thus the current situation is both widening the quantitative gap in the cross-Strait power balance, and narrowing TAF's qualitative edge in aircraft performance and pilot training/experience.

The principal mission requirements for the TAF are Combat Air Patrol (CAP), Defensive Counter-Air (DCA), Maritime Strike/Anti-Invasion, and Missile Defense (TBM/LACM). To carry out these missions, TAF will need a modern fighter aircraft with sufficient aerodynamic performance, BVR missile capability, and payload/range performance to effectively counter the expected Chinese aerial threats. Taiwan will also need upgraded SAM systems to engage TBMs and LACMs.

A review of the operational scenarios indicates that Taiwan's current air defense forces are only marginally capable of meeting the island's air defense needs. With effective fighter strength weakened by a combination of obsolescence of the F-5E/F fleet, low material availability of the Mirage 2000-5 aircraft, and obsolescence/declining reliability of I-HAWK SAM systems, Taiwan's ability to defend its air space against likely threat scenarios can be expected to significantly deteriorate over the next few years.

TAF urgently needs to procure new combat aircraft to compensate for the significant loss in operational fighter strength projected over the next 5 years. The fighter gap, if not bridged in a timely manner, could solidify cross-Strait military imbalance in favor of China. That would both undermine deterrence and expose Taiwan to Chinese political extortion as the two sides move towards political dialogue.

A suitable candidate aircraft has to possess sufficiently high performance, BVR capability, and payload/range characteristics to conduct the CAP/DCA and maritime-strike/anti-invasion missions. Such aircraft also need to be supportable beyond 2025 and be export-releasable to Taiwan.

Given these criteria, the aircraft best suited to Taiwan's current needs is the F-16C/D. Taiwan has been seeking U.S. approval for the sale of 66 new F-16C/D Block 50/52 fighters since 2006, but has been repeatedly discouraged by the U.S. Government to formally submit the associated Letter of Request (LOR). With the last F-16s under contract slated to be delivered at the end of 2013 - and given the 36-month manufacturing lead time - the production could be forced to close before a decision is made. Thus the window for Taiwan to purchase new-built F-16s is closing rapidly.

Another measure that could help address Taiwan's predicament could include adopting a more rigorous, disciplined, life-cycle cost-based approach to force modernization planning and force management. Taiwan needs to implement a robust mid-life retrofit/modernization (MLU) program for its existing fleet of F-16A/B and F-CK-1A/B fighters, to address DMS/obsolescence issues, improve reliability/maintainability, improve survivability, and update aircraft capabilities.

Taiwan should exercise farsighted MLU investment choices in such systems as radar, electronic warfare systems, power plants, mission avionics, and air-launched weapons. Examples of such capabilities could include an active electronically-scanned array (AESA) radar and an upgraded engine, which could provide force-multiplying capabilities by significantly enhancing engagement capability per platform.

Taiwan should also consider further improving its ground-based air defense capability, through a combination of acquiring additional PAC-3 and other mobile SAM systems, upgrading existing I-HAWK batteries, and introducing mobile, low-altitude air defense systems. Other major force-multipliers for Taiwan would be a modern, integrated intelligence, surveillance and reconnaissance (ISR) capability, and additional investment in electronic warfare and information warfare (EW/IW) capabilities.

In addition to (and in combination with) maintaining a critical mass of air defense fighter capability and ground-based air defenses, Taiwan can also consider more asymmetrical approaches to the problem of integrated air defense, including passive defense measures (e.g. redundancy, dispersal, camouflage/deception, hardening, and rapid repair capabilities) and counter-strike capability (LACM, ARM, standoff-attack weapons).

In summary, Taiwan is facing a pressing fighter requirement that can best be met through acquisition of F-16C/D Block 50/52 aircraft from the United States. Taiwan can further strengthen its air defenses by investing intelligently in MLU programs for its F-16A/B and F-CK-1A/B fighters; by deploying more mobile SAM systems, upgrading existing I-HAWK batteries, and pushing ahead with its new low-altitude air defense system program; by developing advanced, integrated intelligence, surveillance, and reconnaissance (ISR) capabilities; and by adopting a number of asymmetrical measures.

A modernized and capable Taiwan air force could play an important and constructive role supporting U.S. forces in the event of a confrontation with China over Taiwan. In contrast, an absence of credible Taiwan airpower could accentuate U.S. vulnerabilities and negatively influence U.S. power-projection in the Pacific.

In addition, a stronger and more secure Taiwan can be expected to be more confident in its political dialogue with China, which could ultimately lead to a peaceful resolution of the situation in the Taiwan Strait. Such an outcome would certainly serve the national interest of the United States.

The U.S. can and should assist Taiwan in implementing these measures, to help strengthen deterrence and to support peace and stability in the region. Improving Taiwan's defense capability will also help reinforce the positive steps that Taipei has taken in lowering cross-Strait tensions and expanding ties with Beijing.

INTRODUCTION

The relationship between Taiwan and China, and the ongoing broadening and expansion of cross-Strait dialogue, has given further impetus for Taiwan to maintain a strong and viable military posture. Taiwan must approach that dialogue from a position of strength in order to safeguard its own interests.

This is true not only in the traditional sense - where Taiwan's military forces act as a deterrent as well as a potential war-fighting instrument - but it has also become increasingly important as a symbol of Taiwan's commitment to defending its sovereignty.

Taiwan's economy has become ever more integrated with China's over the last several years, and China is now by far the island's largest trading partner. Nevertheless, China's Communist Party leadership still views Taiwan's democratic political system as a threat. China has continued to accelerate its military investments, and the military balance in the Taiwan Strait continues to tip in favor of the People's Republic of China (PRC). Taiwan has become vulnerable militarily, and this trend will continue unless Taiwan takes steps to rebuild the defensive power that has been eroding over the last decade.

To maintain a viable self defense, Taiwan requires the ability to effectively defend the air space over and around the island of Taiwan, while also providing coverage over its offshore island possessions closer to the Chinese mainland.

The first part of this report will examine the current state, structure, and composition of Taiwan's air defense forces. The second part of the report will then focus on the capabilities and limitations of those forces in the context of their ability to meet the requirements of different missions for a range of cross-Strait scenarios. Finally, the last portion of this study will discuss - in the context of the current political environment and Taiwan's potential role in supporting U.S. interests in the region - the measures that Taiwan could undertake to strengthen its air defense forces.

STATE OF TAIWAN’S AIR DEFENSE FORCES

Air defense missions principally fall under the responsibility of the Taiwan Air Force (TAF or ROCAF). Headquartered in Taipei, the TAF currently comprises six fighter wings and a transport and airborne warning/electronic warfare wing, together with a number of surface-to-air (SAM) missile and air defense gun batteries.

Combat Aircraft

The main TAF air combat units consist of 18 tactical fighter groups (squadron-equivalent) stationed at seven major air bases throughout Taiwan, including four on the island’s west coast (Hsinchu AFB, CCK AFB, Chiayi AFB, Tainan AFB) and three on the east coast (Hualien AFB, Chiashan AFB, Taitung AFB).

There is also an advance base at Makung, on the Pescadores islands in the Taiwan Strait, to which TAF forward-deploys a fighter squadron during the fair-weather months. Moreover, the large underground facility at Chiashan (near Hualien in eastern Taiwan) would be used as a major dispersal site in times of war.

TAF’s current air order of battle is comprised of a mix of combat aircraft types of U.S., French, and indigenous Taiwan origins:

Table 1: Taiwan’s Current Combat Aircraft

Number	Aircraft
145	F-16A/B Block 20 fighters
126	F-CK-1A/B (Indigenous Defense Fighter/IDF) fighters
56	Mirage 2000-5Ei/Di fighters
60	F-5E/F fighters

Sixteen of the F-16A/Bs are assigned for training and/or testing & evaluation missions in the United States, and are therefore not physically based in Taiwan. This brings the nominal strength of the TAF air defense fighter force to a total of 371 aircraft. In addition, the 737th Tactical Fighter Wing (TFW), with its fleet of 60 F-5E/Fs, principally operates as an Operational Conversion Unit (OCU) and has only a secondary combat (air defense/close air support) role. See the Table 2 and Figure 1 for aircraft deployment data.

For air defense missions, all TAF fighters, except for the F-5E/Fs, are equipped with radar-guided, beyond-visual range (BVR) air-to-air missiles, as well as with infrared-guided short-range air-to-air missiles. The F-16A/Bs are armed with AIM-7M Sparrow semi-active radar-homing missiles and AIM-9M Sidewinder short-range missiles, supplemented by a steadily growing quantity of AIM-120C-5/C-7 AMRAAM active-radar homing BVR missiles. The Mirage 2000-5s are equipped with French-made MICA active-radar guided BVR missiles and R.550 Magic-2 short-range air-to-air missiles. The F-CK-1A/B (IDF) fighters are armed with an indigenously-produced TC-2 active radar-homing BVR missile, and with TC-1 infrared-guided short-range missiles. The F-5E/Fs use U.S.-supplied AIM-9P4 Sidewinder short-range missiles.

The F-16A/Bs and Mirage 2000-5Ei/Di are also equipped with both active and passive defensive electronic countermeasure (ECM) systems in either onboard or external pod configurations, and the F-16A/Bs are receiving the AN/ALE-50 towed decoy system to improve survivability in high-threat environments. The F-CK-1A/Bs and F-5E/Fs, however, are only provided with threat-warning systems and passive countermeasures dispensing systems.

Table 2: Taiwan's Current Aircraft Deployment

<i>Unit</i>	<i>Base/Wing</i>	<i>Aircraft Type</i>
1 st Fighter Squadron	Tainan (443 rd Tactical Fighter Wing)	F-CK-1A/B (IDF)
3 rd Fighter Squadron	Tainan (443 rd Tactical Fighter Wing)	F-CK-1A/B (IDF)
9 th Fighter Squadron	Tainan (443 rd Tactical Fighter Wing)	F-CK-1A/B (IDF)
41 st Fighter Squadron	Hsinchu (499 th Tactical Fighter Wing)	Mirage 2000-5Ei/Di
42 nd Fighter Squadron	Hsinchu (499 th Tactical Fighter Wing)	Mirage 2000-5Ei/Di
48 th Fighter Squadron	Hsinchu (499 th Tactical Fighter Wing)	Mirage 2000-5Ei/Di
7 th Fighter Squadron	CCK (427 th Tactical Fighter Wing)	F-CK-1A/B (IDF)
28 th Fighter Squadron	CCK (427 th Tactical Fighter Wing)	F-CK-1A/B (IDF)
21 st Fighter Squadron	Chiayi (455 th Tactical Fighter Wing)	F-16A/B
22 nd Fighter Squadron	Chiayi (455 th Tactical Fighter Wing)	F-16A/B
23 rd Fighter Squadron	Chiayi (455 th Tactical Fighter Wing)	F-16A/B
Air Rescue Group	Chiayi (455 th Tactical Fighter Wing)	S-70C
17 th Fighter Squadron	Hualien (401 st Tactical Fighter Wing)	F-16A/B
26 th Fighter Squadron	Hualien (401 st Tactical Fighter Wing)	F-16A/B
27 th Fighter Squadron	Hualien (401 st Tactical Fighter Wing)	F-16A/B
12 th Tactical Reconnaissance Squadron	Hualien (401 st Tactical Fighter Wing)	F-16A/B
44 th Fighter Squadron	Taitung (737 th Tactical Fighter Wing)	F-5E/F
45 th Fighter Squadron	Taitung (737 th Tactical Fighter Wing)	F-5E/F
46 th Fighter Squadron	Taitung (737 th Tactical Fighter Wing)	F-5E/F
101 st Airlift Squadron	Pingtung (439 th Composite Wing)	C-130H
102 nd Airlift Squadron	Pingtung (439 th Composite Wing)	C-130H
2 nd Early-Warning Squadron	Pingtung (439 th Composite Wing)	E-2T/E-2K
6 th Electronic Warfare Squadron	Pingtung (439 th Composite Wing)	C-130HE

Figure 1: Aircraft Deployment and Command & Control Infrastructure



Ground-Based Air Defense

Taiwan’s ground-based air defense is also principally under the control of the TAF, which operates a number of surface-to-air missile (SAM) batteries and air defense gun systems:

Table 3: Taiwan’s Current Ground-Based Air Defenses

<i>Number</i>	<i>Type</i>
20	Improved-HAWK medium-range/medium-altitude SAM batteries
3	Patriot Advanced Capabilities (PAC-2+) SAM batteries
7	Tien Kung-I/II long-range SAM batteries

Taiwan is in the process of upgrading its three existing PAC-2+ batteries to PAC-3 (Configuration 3) standards, an upgrade that is scheduled to be completed by early 2015. The PAC-3 upgrade provides for improved reliability and maintainability, enhanced radar acquisition performance, improved missile performance and firepower against tactical ballistic missiles (TBMs) and cruise missiles (CMs), integration through the Po Sheng network with UHF-band long-range early-warning radar and other sensors, and greatly enhanced command, control, and communications (C3). The TAF has also contracted to purchase four new PAC-3 SAM batteries, with delivery expected by the end of 2015, and is in the process of acquiring 2 more batteries (plus 1 spare training unit) - together resulting in a total of 9 operational Patriot batteries, all of which would be in the latest configuration deployed among the other nations that currently own and operate the Patriot system. Taiwan is also considering a modernization program for the Improved HAWK (I-HAWK) system, to eliminate obsolescence and for improved reliability.

Additionally, Taiwan plans to introduce an advanced version of the indigenous SAM known as Tien Kung-III (TK-3) some time after 2011. This mobile SAM system will have a lower-tier anti-tactical ballistic missile (ATBM) capability, as well as very long-range performance against low-elevation (air-breathing) targets.

Short-range air defense systems, principally deployed for the defense of air bases or other high-value facilities (rather than field air defense units), include:

Table 4: Taiwan’s Current Short-Range Air Defenses

<i>Number</i>	<i>Type</i>
6	Skyguard air defense system (Sparrow SAMs / 35mm AA guns) batteries
2+	TC-1 short-ranged SAM batteries
?	40mm/L60 AA guns (Obsolete, being retired)
74	Avenger (MANPADS and AAA)

The TAF is in the process of upgrading its Skyguard system and its associated 35mm guns. It is also considering introducing a new generation of low-level air defense system, currently known as Crossbow (“*Jing Nu*”), starting sometime after 2012. Systems will be acquired for both point defense (e.g. airbases, critical assets) and mobile field air defense applications.

C4ISR

Taiwan’s principal air defense surveillance sensor network is made up of about a dozen air defense radars, all of which have either been replaced by modern 3-dimensional (3D) radars or been otherwise upgraded during the past decade. These include at least four HADR and GE-592 fixed radars, and seven AN/FPS-117 fixed radars, supplemented by four AN/TPS-75(V) and four AN/TPS-117 transportable tactical air surveillance radars. The transportable radars are paired with mobile tactical air control centers to provide gap-filler coverage, greater radar survivability, and back-up tactical air defense command and control capacity. Ground-based radar surveillance and tactical control are further supplemented by Taiwan’s six E-2T/E-2K airborne warning and control aircraft, which afford long-range detection and tracking of low-altitude targets that are flying below the horizon of ground-based radars. They also serve as more survivable airborne command and control platforms for directing intercepts and other aerial missions. All of Taiwan’s earlier E-2T (E-2C Group II-equivalent) aircraft are being brought up to E-2K (Hawkeye 2000-E) standards.

TAF operational units are controlled by the Combat Air Command (CAC), with its main hardened command and control Joint Air Operations Center (JAOC) and AACC (Automatic Air Control Center) at Chanchushan in southern Taipei. Command and control capabilities are also available at the Combined Operations Center (COC) - another underground facility at Hengshan in northern Taipei. TAF’s automated air defense command and control system, known as System 10-1E, is a reasonably modern system. It has been undergoing constant upgrades, and is also seeing ongoing and/or planned integration with new capabilities such as Po Sheng (Link-16 datalink), Missile Warning Centers (MWCs), and Regional Operations Control Centers (ROCCs).

The C2 functions of the main JAOC at Chanchushan are supplemented and supplanted by four Regional Operations Control Centers (ROCCs) located throughout Taiwan.⁵ The ROCC effort, which is currently being completed, is designed to modernize and enhance System 10-1E, as well as to provide redundancy and increased survivability to the integrated air defense system.

The fighter squadrons and area-defense SAM batteries are all controlled by the JAOC and AACC, and - as they become fully operational - the ROCCs. However, primary control of many SAM systems remains by voice, with limited common situation awareness especially for shorter range SAM systems. Mode T IFF (Taiwan’s equivalent to US Mode 4) has been introduced to aircraft and SAM systems to protect friendly aircraft, though not yet for the new PAC-3 batteries.

The level of integration between the national air defense network (System 10-1E) and point air defense batteries also remains limited, and the field air defense units controlled by the ground forces can not readily

⁵ Known locations at the new Taiwan Air Force General Headquarters in northern Taipei, at Kangshan, and at Chiashan. The fourth ROCC is believed to be at Chanchushan. See Figure 1.

receive early-warning or cueing from the integrated air defense system. Moreover, integration of the MWCs with System 10-1E and the ROCCs remains a significant challenge as the Surveillance Radar Program (SRP, currently under construction at Loshan) approaches completion.

When SRP comes on line in 2011, a new era of situation awareness will be possible. A very accurate source of tracking data on long-range, low cross-section cruise missiles and tactical ballistic missiles will be available over Link 16 to aircraft and SAM shooters. Integrating additional SAM and aircraft shooters into this enhanced Link 16 air and missile network will be a force multiplier.

The Taiwan military acquisition hierarchy has a growing understanding of these issues, and some new and upgrade programs are beginning to address these challenges. For example, the upgraded and new Patriot procurement include a requirement for Link 16 interoperability with Po Sheng, and the addition of Mode T. Many of the air defense systems that Taiwan is procuring, or plans to procure from the U.S., come with already proven Link 16 interfaces. This is not as true for indigenous systems, primarily due to export restrictions on datalinks/proven experience on C2 integration.

All C2 circuits between ground-based facilities are routed through a military information network, with fiber-optic cables, microwave relays, and wireless trunk communication links. E-2T/E-2K airborne warning and control aircraft are linked with ground command centers via the Tau-Ten Ground System/TTGS (Link 11 equivalent) and the new Po Sheng tactical datalink (Link 16). As of the end of 2009, sixty TAF F-16A/B fighters have also been equipped with Link 16/MIDS-LVT datalink terminals under the Po Sheng Phase 1 program, to allow enhanced situational awareness and to provide the building blocks for a common tactical air picture. However, none of the other fighter aircraft types have been integrated with a datalink system, and continue to rely on voice communications for tactical control.

COMPREHENSIVE THREAT ENVIRONMENT & VULNERABILITIES

Taiwan’s air defense forces must operate in a uniquely high-threat environment, including not only threats to platforms from long-range surface-to-air missiles, but also threats to bases and command and control infrastructure from a large number of TBMs and LACMs deployed by the PRC.

China’s Offensive Missile Capability

As of September 2008, China’ had deployed seven brigades with up to 1,150 short-range tactical ballistic missiles (SRBMs) opposite Taiwan, a number increasing at the rate of more than 100 per year. This is further bolstered by a rapidly expanding force of LACMs, which, according to the U.S. Department of Defense, included some 350 DH-10 LACMs as of April of 2008.⁶ The Defense Policy White Paper published by Taiwan’s Ministry of National Defense in October 2009⁷ estimates the total number of Chinese SRBMs and LACMs deployed opposite Taiwan at over 1,300.

Table 5: Estimate of Chinese Land-Attack Missiles Deployed Against Taiwan

<i>Designation</i>	<i>Category</i>	<i>Number</i>
DF-11	Short-range tactical ballistic missile	700-750
DF-15	Short-range tactical ballistic missile	350-400
DH-10	Land-attack cruise missile	150-350

In addition, there are unknown quantities of Chinese-produced C-602 air-launched cruise missiles (ALCM), YJ-62C ground-launched anti-ship cruise missiles, Russian-made Kh-31 air-launched anti-radiation missiles (ARMs), and Harpy anti-radiation unmanned aerial vehicles (UAVs) of Israeli origin in PLA service, all of which could be - and in the event of an armed conflict would likely be - employed against Taiwan. China is also developing a class of shorter-range SRBMs, like the 150km range P-12 which is as effective as the DF-11, and is combining accurate guidance systems with long-range but inexpensive artillery rockets like the WS-2 to give them SRBM capabilities.

Such an impressive offensive missile capability, which China is continuing to aggressively expand, can effectively cover all of Taiwan’s air fields, hardened aircraft shelters (HAS), command and control facilities, radar sites, communication nodes, critical infrastructure, and political targets. An earlier Taiwan Ministry of National Defense (MND) study had concluded that, even with a force of only 800 SRBMs, China would be able to sustain five waves of missile strikes (of 150 launches per wave) against Taiwan, lasting a period of ten hours - using the LACMs, with circular error probable (CEP) of 15-20 meters, to attack high-value point targets.⁸ A

⁶ Office of the Secretary of Defense, *Annual Report to Congress, Military Power of the People’s Republic of China 2009* (Washington, D.C.: Department of Defense, March 25, 2009)

⁷ Ministry of National Defense, *Defense Policy Report 2009* (Taipei, Taiwan: Ministry of National Defense, October 19, 2009)

⁸ Ministry of National Defense, *Briefing Report on the Special Procurement Budget* (Taipei, Taiwan: Ministry of National Defense, July 2, 2004)

2009 RAND Corporation study concluded that China would need less than 240 short-range tactical ballistic missiles to disable every runway at Taiwan's main fighter bases and to destroy all aircraft not protected by hardened shelters.⁹

Another critical aspect of the Chinese land-attack (TBM/CM) missile threat is its flexibility - both politically and militarily. PLA missiles deployed against Taiwan are mobile systems that can not only be moved quickly from one tactical location to another, but can also be easily transported over great distances by rail or flatbed transporters. Even if China should decide to withdraw some, or all, of the missiles presently deployed immediately opposite Taiwan (e.g. in Fujian and Jianxi) into the interior provinces - thereby placing them beyond missile reach of Taiwan - these offensive launching systems could very quickly be returned to their forward-deployed locations. Doing so would take only a couple of days, if not mere hours.

Taiwan's Air Defense Challenge

Taiwan's air defense challenge is an integrated effort against a combined and well-orchestrated air campaign, consisting of ballistic and cruise missile attacks in concert with attacks by manned strike aircraft and unmanned aerial vehicles, in addition to information/electronic warfare and special operations attacks.

In response to this threat environment, Taiwan has committed to making a very large investment in active missile defense; battle management, command, control, communications, intelligence (BMC3I); and early-warning. For example, in 2009 TAF ordered four batteries of Patriot PAC-3 air and missile defense systems, and the U.S. Government notified Congress of the remaining two PAC-3 batteries in 2010 (plus one spare training unit).

Although Patriot possesses an anti-LACM capability, it will not be deployed in sufficient numbers to provide a robust counter to low altitude cruise missiles. Taiwan currently relies heavily on the aging HAWK Phase III system and could accelerate plans for HAWK modernization as a way to counter the growing LACM threat.

Taiwan is working on bringing its locally-developed ATBM-capable Tien Kung-III (TK-3) SAM system into operational service, although its ability to be integrated with Po Sheng and Patriot is questionable. MND is also in the process of planning a low-altitude/field air defense system(s) program that could help address the LACM threat in defense of critical assets, such as TAF airbases. Taiwan's MND and TAF have used a multi-tiered approach for air defense for many years, and have recently reaffirmed this architecture going forward.

The Surveillance Radar Program (SRP), based on a modernized AN/FPS-115 UHF-band missile early-warning phased array radar design, will provide Taiwan with an autonomous, long-range (3,000-km) detection, tracking and cueing capability against ballistic missile and shorter-range (<200-km) low-elevation (air-breathing) threats, including low flying, low cross-section CMs.

⁹ Shlapak, David A., et al., *A Question of Balance: Political Context and Military Aspects of the China-Taiwan Dispute* (Alexandria, Virginia: RAND Corporation, 2009)

The associated Missile Warning Centers (MWCs) will provide the command & control and battle management systems needed to conduct a missile defense battle. Taiwan is also discussing with the U.S. the follow-on integration and capabilities that would be needed to create a single integrated air picture (SIAP), which is necessary for the conduct of coherent extended air defense against a sophisticated Chinese integrated air campaign.

Particularly vulnerable are the runways of Taiwan's major air bases, which, if extensively damaged, could seriously disrupt or even disable TAF air operations. All of Taiwan's current fighters are of conventional take-off and landing design, and require runways of significant lengths for normal flight operations.

OPERATIONAL ISSUES FOR THE TAIWAN AIR FORCE

Taiwan's air defense forces face a number of operational challenges, and are also exposed to several notable vulnerabilities.

Block Obsolescence

The first and foremost challenge is that of block obsolescence. The F-5 fleet is nearing the end of its useful service life, as these remaining aircraft principally represent the last batch of F-5E/Fs ("Peace Tiger 6") the United States sold to Taiwan during the Reagan Administration in 1982. TAF plans call for the type to be phased out by 2014, based on structural analysis and logistics staff studies.

Serious structural issues have begun to surface, and operational safety has become of increasing concern to MND. Problems with the horizontal stabilizers and the vertical tail reduced the number of airworthy twin-seat F-5F fighter trainers from 36 to just four by late 2009. In fact, since 2004 TAF has lost five F-5Fs (12% of the remaining twin-seater inventory) in crashes, resulting in the loss of five pilots. The most recent F-5F incident occurred in July 2009, with both crew members killed.

Because the F-5s are used for operational conversion training, the two-seat F-5Fs are particularly important to the fleet's mission viability. The ongoing problems have forced the TAF to significantly reduce the number of hours of lead-in fighter training (LIFT) for new pilots, down from the 100 hours originally required. This can be expected to result in reduced pilot proficiency, and complicates pilot transition to operational squadrons, thereby contributing to a steady erosion of pilot quality and operational readiness over time.

While short-term measures could be taken to extend the service life of the F-5E/F fleet, such measures would involve significant lead time and would not represent a cost-effective investment. TAF structural assessments suggest that the airframes can not be expected to remain serviceable beyond 2017-2018, short of an extensive and very costly structural and avionics upgrade effort. Yet even an expensive service-life extension upgrade of the F-5E/F fleet would still not provide the type of qualitative capability needed to meet the current PLA air threat, as the 1970s-vintage F-5E/Fs are outclassed technologically in terms of performance, avionics, and air-to-air weapons (e.g. beyond-visual range AAMs).

Material Availability

A second challenge plaguing the TAF is the low level of material availability for some of its combat aircraft types, particularly the Mirage 2000-5Ei/Di. The latter type has suffered from high O&M costs, mainly attributable to the high cost of spare parts and factory repair/refurbishment of critical components and subsystems. Data obtained by a ranking member of the Legislative Yuan's Foreign Affairs and National Defense Committee (FANDC) indicates that the per flight hour cost of a Mirage 2000-5 fighter is more than triple that of an indigenous F-CK-1A/B (IDF), and almost five times that of an F-16A/B. While the Mirage 2000-5s only make up about 17% of TAF's newer-generation fighter strength (F-16s, Mirage 2000s, F-CK-1s), the cost to operate the current Mirage 2000-5Ei/Di fleet would consume nearly 59% of the total Operations & Maintenance (O&M) budget for all three types.

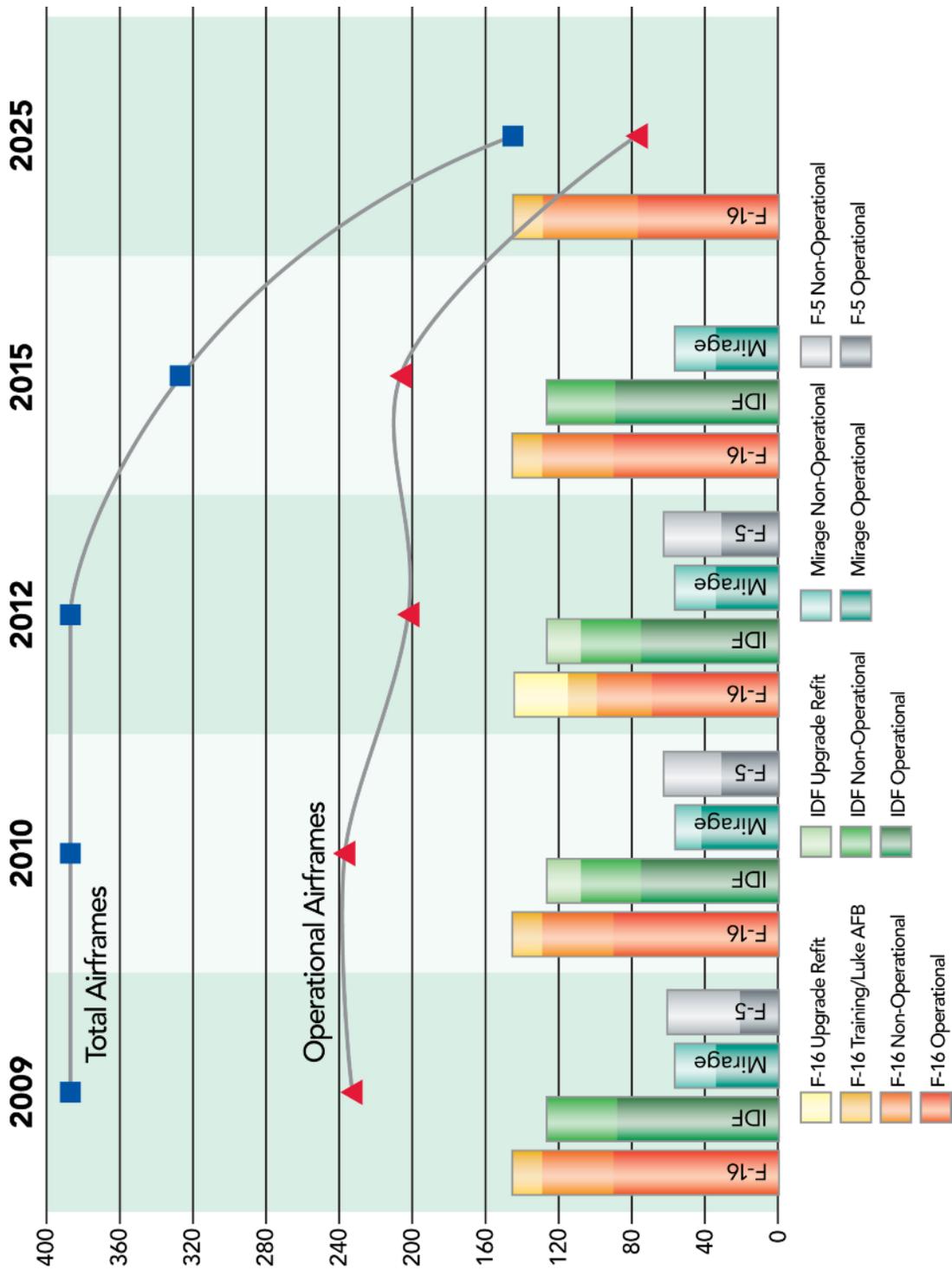
Furthermore, chronically long turn-around times for component/subsystems repair, along with delays in spare parts delivery over the past two years, have seriously undermined the material readiness of the Mirage 2000-5Ei/Di fleet. At one point, the average availability rate fell to only 58% - far below the 75% peace-time standard required by MND - and this has impacted training and operational readiness. TAF's achievement rate for Mirage 2000 training (flight hour) objectives for FY2009 was only 37%, and it is projected to reach only 53% in FY2010. According to a 2009 TAF study, Taiwan's Mirage pilots logged only an average of 8 hours per month in 2009, and they were projected to average no more than 10 hours per month in 2010 - less than the 15 hours per month mandated by the MND.

However, TAF does expect to see some relief after having poured substantial funds into procuring spare parts for the Mirage fleet. Availability should be brought up to around 75% by early 2010. Indeed, due to the remedial actions undertaken with active cooperation from French industry, after January 2010 TAF Mirage pilots reportedly have begun flying up to 15 hours per month. A tight Operations & Maintenance (O&M) budget for FY2010 (US\$677 million, or 22% lower overall from FY2009 levels) will almost certainly ensure that material readiness for the costly Mirage 2000s will again deteriorate over the next few years, and it has become clear that it is an unsustainable situation. Taiwan is now seriously considering mothballing a number of Mirage 2000 aircraft in order to conserve O&M resources. TAF had earlier experimented with placing up to nine Mirage 2000-5s into environmentally-controlled storage, but doing so on a long-term basis would have the effect of reducing the number of available front-line combat aircraft.

With the impending phase-out of the F-5E/Fs (60 aircraft) and the likely mothballing of a number of Mirage 2000-5Ei/Dis (probably no less than a squadron), TAF can be expected to experience at least a 20% reduction in air defense fighter strength within the next five years. Operationally, the impact could be even more profound if TAF has to shift aircraft that are presently assigned for combat missions over to the Operational Conversion Unit (OCU). TAF is currently considering transferring part of its F-CK-1A/B fleet over to the OCU in Taitung AFB upon retirement of the F-5E/Fs. This would leave Taiwan with a substantial shortfall, at a time when China continues to rapidly introduce modern combat aircraft into service in large numbers. It would widen the quantitative gap in air power balance in the Taiwan Strait, while narrowing the already marginal qualitative edge that Taiwan enjoys.

A replacement aircraft is, therefore, urgently needed to fill the gap that will be created by retiring the F-5E/Fs from TAF service. How and when the fighter gap is to be filled will also have implications for other major efforts that affect Taiwan's air defense. Persistent delays in the fighter acquisition process (e.g. caused by U.S. inaction or indecision) could make coherent, coordinated force modernization planning extremely difficult. For example, TAF has been withholding a decision on the direction of its next-generation advanced trainer/lead-in fighter trainer (LIFT) program, pending a resolution to the fighter situation. Ultimately, this will impact the structure and allocation of Taiwan's fighter force, as well as its training philosophy.

Figure 2: Timeline Showing Projected Available Air Frames - 2009-2025



Taiwan's current HAWK System faces the same obsolescence and reliability issues as the combat aircraft fleet. The TAF's large inventory of HAWK missiles, and the ready availability of additional, relatively inexpensive missiles, makes HAWK the logical initial line of defense to detect and intercept a large fraction of the current and projected air-breathing threats (i.e. fighters, bombers, UAVs, and Land Attack Cruise Missiles/LACMs) facing Taiwan - in particular a preemptive attack of LACMs.

However, to optimize effectiveness the TAF's older HAWK force needs to be modernized, refurbished and integrated - via Po Sheng (Link 16) - with the TAF's Regional Operations Control Centers (ROCCs). The current HAWK system continues to age, and performance will steadily degrade due to reduced availability and reliability. At the same time, the PRC is investing in more cruise missiles - creating increased vulnerability.

CROSS-STRAIT AIR POWER BALANCE

As amply demonstrated in past crises, Taiwan’s ability to stare down Chinese military intimidation or even outright provocation has rested largely on its ability to maintain air superiority in the Taiwan Strait. However, China’s rapid, sustained military modernization over the past two decades has steadily eroded Taiwan’s relative capabilities in maintaining a viable air defense.

Table 6: Comparison of Approximate Principal Combat Aircraft Strength

<i>Taiwan</i>			<i>China</i>		
Aircraft	Type	Qty.	Aircraft	Type	Qty.
F-16A/B	MR Fighter	145	Su-30MKK/MK2	MR Fighter	100+
Mirage 2000-5	AD Fighter	56	Su-27SK/J-11B	MR Fighter	190
F-CK-1A/B	MR Fighter	126	J-10A	MR Fighter	150+
F-5E/F	MR Fighter	60	J-8	AD Fighter	390
			J-7	AD Fighter	580
			Q-5	GA Fighter	235
			JH-7A	GA Fighter	130+
			H-6	Bomber	160+

According to the DoD’s report *Military Power of the People’s Republic of China 2009*, there are currently a total of 2,300 operational combat aircraft in service between PLA-Air Force and PLA-Naval Aviation. These include air defense fighters, multirole fighters, ground-attack aircraft, and bombers. A further 1,450 older fighters, bombers, and trainers are relegated to training and other second-line missions. The PLA-AF and PLA-N also operate some 450 transport, reconnaissance/surveillance, and airborne early-warning aircraft. The report estimates that China deploys approximately 330 fighters and 160 bomber/attack aircraft within unrefueled combat radius of Taiwan.

According to Taiwan’s *Defense Policy Report 2009*, China operates over 3,400 combat aircraft, including more than 500 “Fourth Generation” combat aircraft (e.g. Su-27, Su-30, J-10, JH-7). Of these, it estimated that over 700 combat aircraft are based within 600 nautical miles of Taiwan.

In qualitative terms, Taiwan’s F-16A/Bs and Mirage 2000-5s are roughly comparable to Chinese Su-30s, Su-27/J-11s, and J-10s in performance and combat capability. The F-CK-1A/Bs are generally considered superior to J-8s, but lack the aerodynamic performance of some of the newer PLA aircraft types, while the F-5E/Fs should be a match for the J-7s.

Yet the Chinese combat aircraft deployed within range of Taiwan could easily and quickly be reinforced by several hundred more aircraft based in areas further away from the island but ready for rapid deployment into forward bases - either to bolster first-line strength and/or to replenish combat losses. Furthermore, additional Chinese combat sorties could be flown by aircraft outside of the Taiwan Strait theater through a combination of

aerial refueling, more fuel-efficient mission profiles, and payload/range trade-offs. With Taiwan's air defense fighter force projected to decline to only around 300 front-line combat aircraft by about 2014-2015, China can be expected to easily array a better than 2:1 numerical advantage in the number of first-line combat aircraft over the Taiwan Strait.

China has continued its robust introduction of modern, high-performance, multirole fighters and attack aircraft, advanced air-to-air missiles, and combat support/auxiliary aircraft. In addition, China has committed to begin deployment of its first "Fifth Generation" fighter - which may come from the Chengdu Aircraft Corporation - by the end of this decade. Chinese reports indicate that this fighter will feature advanced stealth, the ability to "supercruise" or fly supersonically for extended periods, the ability to use thrust vectoring for high maneuverability, and that it will feature advanced electronics and weapons. When these fighters enter PLA inventories, they will further stress Taiwan's defenses.

Just as importantly, the quality of new equipment and systems (aircraft, weapons, C4ISR) being brought into service with PLA-Air Force and PLA-Naval Aviation regiments is aggressively closing the qualitative gap that Taiwan's current fighter inventory once enjoyed. New capabilities such as the KJ-2000 and KJ-200 airborne early-warning and control (AEW&C) platforms and datalinks, coupled with improved tactics and doctrines, could enable the PLA to much more effectively conduct joint, integrated, high-tempo operations against Taiwan.

Finally, the inability to provide timely replacements for obsolete equipment and/or prevent any further deterioration in material readiness could cause Taiwan to permanently lose its traditional edge in training and experience.

DYNAMIC BALANCE SCENARIOS

This section will look at the principal mission types for Taiwan's air defense forces and try to assess the types of capability needed to fulfill such mission scenarios.

Combat Air Patrol

The most common type of mission flown by TAF in peace time is combat air patrol (CAP) in the Taiwan Strait, normally east of the so-called Taiwan Strait Meridian, an artificial center line approximately 50 miles from the Taiwan coast. This type of mission is more important than often recognized in analyses of the cross-Strait military balance, since regular patrolling reaffirms sovereignty and control over the airspace in question. Moreover, regular presence deters Chinese probing actions aimed at further compressing Taiwan's strategic depth. The CAP flights also provide on-station aircraft ready to react to unexpected contingencies.

CAP would also be important in wartime, beyond strictly defending Taiwan against aerial attacks. The ability to at least temporarily control certain airspace over Taiwan's littorals would be very meaningful in maritime blockade scenarios, where Taiwan's maritime patrol aircraft would need a secure battle space in order to conduct anti-submarine warfare (ASW) patrols to clear sea lanes, or to hunt submarines that may be on patrol stations off Taiwan to interdict shipping bound for the island. Similarly, maintaining local air superiority would be critical to Taiwan's ability to either clear naval mines deployed by Chinese forces in a blockade of the island, or to prevent the PLA from neutralizing Taiwan's defensive minefields.

The fighter aircraft conducting these patrol missions must be at least comparable in performance and air-to-air combat capability with the likely threats. Therefore, the requirements of the CAP mission constitute one of the key operational drivers for TAF force size and capability.

Defensive Counter-Air

One of the most crucial wartime missions for TAF air defense would be conducting defensive counter-air (DCA) operations. In a major shooting war, Chinese manned air strikes would likely be preceded by initial waves of SRBM/LACM attacks focusing on Taiwan's air bases, command and control centers, radar stations, and SAM sites, so as to reduce - or at least temporarily paralyze - Taiwan's air defense capability. Manned strike packages would then provide a far more efficient (and cost-effective) means of delivering the large amounts of precision ordnance necessary to systematically neutralize Taiwan's military infrastructure. Therefore, TAF's most important DCA objective would be to limit the damage to air bases and C3 centers by the preemptive SRBM/LACM attack, and to work against the main raid of manned strike packages - intercepting the incoming aircraft and greatly reducing their mission effectiveness, either by destroying the raiders or by forcing them to divert from attacking their intended targets.

Since all PLA fighters now entering service are armed with BVR air-to-air missiles, the air defense aircraft Taiwan would scramble in response to an attack must be comparably equipped in order to have any realistic chances of successfully engaging these raids. Furthermore, Taiwan must be able to launch a critical mass of BVR missile-capable, high-performance fighters, in order to achieve the favorable exchange ratios and desired

DCA combat outcomes. The operational objective is to steadily attrite Chinese air assets at favorable exchange ratios, so as to disrupt the momentum for follow-on operations.

Maritime Strike/Anti-Invasion

The other main wartime mission for TAF manned combat aircraft would be attack against Chinese invasion forces, either in the form of naval surface groups underway or amphibious forces attempting to land and establish beachheads on Taiwan. China has upgraded and expanded its Army and Marine amphibious forces since the early 1990s, and this decade China is expected to build both more large amphibious assault ships and new large Russian-designed assault hovercraft.

Sinking, damaging or disabling amphibious transports would be the most effective way of defeating a Chinese invasion attempt. Air power is the most efficient way of accomplishing that objective, and TAF has developed a reasonably effective stand-off anti-ship attack capability, with the world's only Air-Launched Harpoon (anti-ship missile) capability onboard its F-16A/Bs. They also have a limited close-air support and precision, all-weather attack capability.

However, TAF must be able to attain and - at least temporarily - maintain a degree of local air superiority in order to permit the outbound strike package to be launched without interference from enemy activity. Here, in addition to the DCA mission requirements, it is important to have sufficient number of aircraft with the necessary payload/range capability to carry out the strikes.

Even with extensive hardening of air bases and aircraft shelters, along with dispersal to backup airstrips to help ensure the survival of a high enough percentage of the combat aircraft inventory to still constitute a viable force, a minimal force size must be maintained so as to ensure that a sufficient number of aircraft would survive the initial attacks and be effective for the counter-air and counter-invasion strike missions. Given the size of the Chinese combat aircraft fleet deployed opposite Taiwan, the minimum number of operational fighter aircraft Taiwan must field at the start of hostilities should be no less than 360~400 aircraft, or roughly the present nominal force size.

TBM & LACM Defense

The most critical mission for ground-based air defense is the defense of vital assets against tactical ballistic missile (TBM) and land-attack cruise missile (LACM) attacks. The Patriot PAC-3 systems that the TAF is fielding will provide defense for the majority of Taiwan's high-value government, military, industrial and infrastructure assets against the TBM threat. The PAC-3's must be reserved for the 1000+ TBMs aimed at Taiwan, and it is impractical for the TAF to deploy its limited inventory of costly PAC-3 missiles against non-TBM targets. In addition, there are not enough Patriot Fire Units to provide coverage against all potential incoming LACM low altitude ingress routes.

The TAF's existing HAWK Phase III assets have an excellent inherent capability against air-breathing targets, including against low altitude LACMs. Yet HAWK is not currently capable of being integrated, other than by voice, into Taiwan's planned air and missile defense system. Taiwan is pursuing modernization of the system

to allow it to be integrated using both voice and data, and to be cued - with accompanying threat information - by the TAF's SRP and other tactical radars via Link 16. This would significantly improve reaction time and would enable the TAF to look for, acquire, identify and effectively engage all manner of hostile air-breathing targets at wider ranges. Enhanced situation awareness would allow for multiple opportunities to engage the enemy further out, increasing Probability of Kill (Pk). In addition, full coordination of ground-based missile defenses with friendly air operation would significantly increase flexibility and system availability, and would improve the safety of friendly forces.

Further, under the current TAF fighter force structure LACM defense is limited. Preparing TAF to mount an effective LACM defense from the air will require upgrading existing aircraft with advanced sensors - like an active electronically-scanned array (AESA) radar - as well as adding new aircraft with similar capability.

The Chinese SAM Threat

Chinese surface-to-air missile (SAM) systems add an extra threat dimension to Taiwan's combat aircraft operations, and could complicate the conduct of even defensive counter-air missions over Taiwan airspace. China has received at least eight battalions of S300 PMU-2 long-range SAM systems since 2006, and reportedly may purchase another 8 battalions over the next few years. During the same period, the PLA has also introduced significant numbers of indigenous HQ-9 SAM systems (similar to Russian S300PMU, 100+km range) into service. A number of S300 PMU-2 and HQ-9 SAM units are now deployed along the Fujian coast, and with their 200-km range they could reach within a few miles of the entire Taiwan west coast. In principle, the S300 PMU-2 could even threaten aircraft operating from Hsinchu AFB in northern Taiwan immediately upon take-off. Hsinchu is located at the island's nearest point to the Chinese mainland, only some 144km from Pingtan Island off the Fujian coast. This decade, China could also purchase the new Russian 400km range S-400, or develop - perhaps with continued Russian assistance - longer range versions of the HQ-9.

In the meantime, the PLA-Navy has dramatically expanded the area defense capability of its surface fleet over the past decade. With four modern AEGIS-like anti-air warfare (AAW) destroyers equipped with phased-array radars and vertical-launched long-range SAMs, China now possesses a measure of protection against Taiwan aircraft conducting maritime strike missions against an invasion force. Moreover, such PLA-Navy ships operating off the Fujian coast could now attack Taiwan aircraft flying over the island's western coast.

Balance Evaluation

In reviewing the preceding scenarios, it becomes apparent that Taiwan's current air defense forces are only marginally capable of meeting the island's air defense needs. However, with effective fighter strength weakened by a combination of obsolescence of the F-5E/F fleet and low material availability of the Mirage 2000-5 aircraft, Taiwan's ability to defend its air space against these likely threat scenarios can be expected to significantly deteriorate over the next few years. By no later than 2014, Taiwan will no longer have the number of combat aircraft necessary for meeting the operational requirements of defending its air space from the Chinese military threat.

Quality in terms of aircraft performance and pilot training and experience is also being significantly eroded by the quantitative shortfall. Lessons and experience from previous Taiwan Strait crises have demonstrated the importance of Taiwan maintaining a qualitative edge against the PLA - not only to prevail in conflict but also to strengthen deterrence.¹⁰

Further, without the modernization of the 20 HAWK batteries, defense of vital areas - particularly those critical to the generation and coordination of fighter sorties - will be significantly diminished against the potential for a preemptive LACM threat. For adequate defense against the preemptive TBM attack, Taiwan must also complete its contracting of the two remaining Patriot PAC-3 batteries and training unit.

¹⁰ Example: In 1958, many PLA-AF regiments had been recently re-equipped with the MiG-17 (which outperformed Taiwanese F-84Gs by a very considerable margin and was superior to F-86Fs). China likely felt emboldened to exploit this new superiority, and in an air engagement that precipitated the Second Taiwan Strait Crisis, PLA-AF MiG-17s attacked a TAF patrol and downed two obsolete F-84Gs. In this case, allowing China to close the performance gap between PLA fighters and those used by Taiwan contributed to a failure of deterrence.

POSSIBLE MEASURES TO STRENGTHEN TAIWAN'S AIR DEFENSE

In order to address the challenges and shortcomings discussed in this report, Taiwan will need to fill a number of pressing requirements. Perhaps even more importantly, however, Taiwan must adopt a more rigorous, disciplined approach to force modernization planning and force management based on life-cycle cost analysis. With budgets for defense spending likely remaining tight for at least some years to come, the Taiwan defense establishment needs to be much more proactive in managing its air defense assets, by making intelligent (i.e. overall most cost-effective and efficient) systems acquisition decisions, by optimizing its management of the equipment fleet and configurations, and by aggressively retiring obsolete, ineffective weapons and equipment.

Bridging the Fighter Gap

Taiwan urgently needs to procure new combat aircraft in order to make up for the significant loss in operational fighter strength that will take place over the next 5 years. A suitable candidate aircraft has to be of sufficiently high performance to undertake the CAP/DCA missions, and requires BVR capability and the payload/range performance necessary to carry out the defensive counter-air and maritime-strike missions. The aircraft type should be supportable through 2025 and beyond, and has to have reasonably low operations and maintenance costs. Finally, the replacement aircraft has to be eligible for export release to Taiwan, or be of a type that has previously been sold to Taiwan.

Given these requirements, the aircraft best suited for Taiwan's current needs is the F-16C/D. In fact, Taiwan has been seeking U.S. approval for the sale of 66 new F-16C/D Block 50/52 fighters since 2006. Officially, the U.S. Government is still reviewing the requirement, even though Taiwan has been repeatedly discouraged from formally submitting the Letter of Request (LOR) for the F-16C/D fighters. With the last F-16 under contract slated to be delivered at the end of 2013 - and given the 36-month manufacturing lead time - the production could be forced to close before a decision is made to sell new F-16s. The window for Taiwan to purchase new-build F-16s is almost shut, as the U.S. and its allies are shifting attention to the production of the F-35.

Taiwan has also considered other alternatives for making up the shortfall in fighters, including the acquisition of F-16s as they are retired from active U.S. inventory. However, because Taiwan does not have ready access to international markets for advanced combat aircraft, whatever fighter TAF now procures must have enough remaining service life and viable growth/upgrade paths to allow the aircraft to remain operational for many years - probably well beyond 2025. As such, the generally high airframe hours and poor physical condition of the available surplus aircraft clearly militate against such a solution.

It might also be possible to enable Taiwan to design an effective successor to the FC-K-1A/B fighter by providing Taiwan with a new high-thrust turbofan engine, a new AESA radar, and design assistance to enable greater stealth. In cooperation with a U.S. partner, Taiwan also has the capability to design a light-weight supersonic STOL fighter.

Mid-Life Upgrade

In addition, Taiwan needs to implement a robust mid-life retrofit/modernization program for its existing fleet of F-16A/Bs and F-CK-1A/B fighters, to address Diminishing Manufacturing Sources (DMS) and obsolescence

issues, improve reliability and maintainability, improve survivability, and update aircraft capabilities to remain abreast of current mission requirements. A key consideration here must be the prospect that aircraft such as the F-16A/Bs may have to remain in service for close to 30 years or more, as the TAF is generally considered unlikely to be able to introduce its next-generation replacement fighters before 2025. The logistical supportability, life-cycle cost, and technological viability of key systems will ultimately determine the effective service life of these TAF workhorses. New technologies that can both provide force-multiplying capability and reduce operation & maintenance costs need to be given priority consideration.

In short, Taiwan needs to exercise farsighted investment choices as part of the mid-life update programs for the F-16A/Bs and F-CK-1A/Bs, particularly regarding such systems as the radar, electronic warfare system, power plant, mission avionics, and air-launched weapons. In fact, that logic equally applies to the new (F-16C/D) aircraft that Taiwan is now trying to acquire.

For example, Taiwan's AIM-120C AMRAAM missiles can currently shoot considerably further than the fire-control radar on TAF F-16A/Bs can track and engage aerial targets - a serious tactical limitation. In order to counter China's widening numerical superiority and the closing of the qualitative gap in advanced fighters, TAF interceptors need to use the relatively small number of weapons they possess to fullest possible potential, by being able to engage a larger number of airborne targets at longer ranges.

This may be achieved by leveraging such new technologies as the active electronically-scanned array radar (AESA) as a force-multiplier. The AESA could enable Taiwan's F-16A/Bs to engage more hostile threats much farther out, thereby improving exchange rate and enhancing survivability, while increasing operational availability and significantly reducing support costs due to its much longer mean-time between failure (MTBF) performance.¹¹ Finally, since electronically-scanned active arrays represent the future of airborne radars, adopting it within the next few years would ensure that the technology could remain viable for many years to come. This last point is particularly important, as adoption of AESA technology would permit the use of the new generation of network-enabled weapons (NEWs), which could give Taiwan an affordable means for precision engagement of large numbers of mobile surface targets (such as landing craft).

Taiwan could also implement an engine upgrade as part of the F-16A/B mid-life update effort, replacing the existing power plant with a new 29,000-pound thrust-class turbofan engine that would significantly improve speed, climb rate, acceleration, and turn-radius - particularly at heavier load-out weights and at altitudes where TAF aircraft are increasingly likely to find themselves in combat with the latest PLA-AF fighter threats. Up-engined F-16A/Bs will be able to fire AMRAAMs at higher launch speeds, thereby achieving longer kinematic range and shorter flight time to target, for higher probability of first kill. F-16A/Bs with a more powerful engine would also enjoy better payload/range performance, which is needed for the maritime strike/anti-invasion missions. An engine upgrade could also lower life-cycle cost by a combination of the new engine's substantially longer time-between-overhaul rating, along with savings on the overhaul of the existing

¹¹ AESA Fire Control Radars would be a force-multiplier for the entire Taiwan force, assuming data-linking capabilities. More importantly, the addition of AESA would lead to lower sustainment costs, along with higher reliability, availability, and readiness. Additional discussions regarding AESA technologies are outside the scope of this report.

F-100-PW-220 power plant. Again, investing procurement dollars wisely could allow Taiwan's smaller force to fulfill greater mission roles while meaningfully strengthening the island's air and maritime defenses.

Ground-Based Air Defense

Taiwan's layered and reasonably dense SAM network would be able to take a significant toll on Chinese bombers and attack aircraft in the event of a military confrontation. However, a number of the SAM batteries (TK-2 series) and the associated phased-array radars are deployed at fixed sites, which makes them highly vulnerable to missile attacks. In fact, this vulnerability has repeatedly been shown in computer-simulated war games during Taiwan's annual Han Kuang exercises. Therefore, one of the steps that Taiwan could take to critically improve its air defense capabilities is to introduce more modern, mobile versions of long-range SAM systems to supplant the existing order of battle.

Part of Taiwan's requirement for ground-based air defense against tactical ballistic missiles will be met by the acquisition of six new PAC-3 batteries, which TAF plans to deploy in central and southern Taiwan to defend critical military and infrastructure facilities. To counter the significant LACM threat, the TAF's existing HAWK Phase III assets - which can help provide a barrier defense as they are proliferated largely around the periphery of Taiwan - must be updated to eliminate obsolescence and to achieve improved reliability, Link 16 integration with the Po Sheng network, and enhanced C3. Possible upgrade paths include the HAWK XXI solution. Taiwan also plans to deploy a "Land-Based Air Defense Missile System" under a program designated Strong Bow. Among the leading candidates being considered is an advanced indigenous long-range mobile SAM system known as Tien Kung-III (TK-3). This system uses a transporter-erector-launcher (TEL) to house vertical launch cells, has credited maximum range of better than 200km, and has a lower-tier anti-tactical ballistic missile (ATBM) capability. The TK-3's associated phased-array fire control radar is also mobile.

In addition, Taiwan has a requirement for a major new mobile, low-altitude/field air defense system, known by its project name Crossbow ("*Jing Nu*"). This system would be widely deployed throughout the island to defend air bases and other high-value installations, and would serve as the backbone of field air defense for Taiwan ground forces. The Crossbow program would play a significant role in Taiwan's cruise missile defense (CMD) efforts, especially if properly linked with an integrated air defense system that could generate a single, common air picture by fusing high-quality tracking data from widely-distributed sensors and systems. Leading candidates for the Crossbow requirement include a mobile, ground-launched variant of Taiwan's indigenous TC-2 air-to-air missile and the Surface-Launched AMRAAM (SL-AMRAAM).

ISR

Another enabling force-multiplier that could greatly benefit Taiwan is a modern, balanced and integrated intelligence, surveillance and reconnaissance (ISR) capability.

Even though Taiwan embarked on the Po Sheng C4ISR system program several years ago, and has just completed the first phase of the project, the effort predominantly focused on building the digital communications backbone and command & control system architecture, without really adding any new ISR systems or capabilities. To take full advantage of the new C4 infrastructure - and to empower the move towards

greater jointness and self-synchronization in combat operations - Taiwan needs to invest in advanced intelligence, surveillance and reconnaissance systems, together with the integration that would help bring together the net-centric synergies from individual sensors and systems, and that would provide the means of analysis and exploitation.

The scope of a Taiwan ISR effort would involve acquisition of new sensor systems and platforms, unmanned aerial vehicles (UAVs), a high-resolution imaging satellite, synthetic aperture radar (SAR) sensor systems, signals intelligence (SIGINT) aircraft, and further development of the measurements and signatures intelligence (MASINT) discipline. The integration portion of the ISR project would be centered on the development of a common backbone (conceptually similar to the U.S. Distributed Common Ground System/DCGS) through which intelligence data from all sources could be input, and efficiently and securely distributed to all eligible users. This would allow real-time access to actionable intelligence for all Taiwan military and other national agencies. Together with all-source intelligence analysis systems, this would help form a seamless intelligence system that could support simultaneous demands for intelligence and targeting information at multiple echelons and across the range of military operations, from tactical to strategic levels.

Advanced ISR capabilities would allow Taiwan to much more efficiently and effectively locate, evaluate, and target enemy threats. It would also enable Taiwan to more fully exploit the kinematic performance of its many existing weapons, which tend to be capable of more range than Taiwan's current target-acquisition capabilities can take advantage of. Lastly, by significantly compressing the "kill chain", Taiwan's integrated ISR capabilities would greatly improve the ability of its air defense forces to engage time-critical threats, such as mobile missile launchers or other high-value targets.

EW & IW

Another field where Taiwan can focus to enhance its air defense capability is electronic warfare (EW). Improving EW capabilities can significantly improve the combat survivability of Taiwan's own forces, while reducing or completely neutralizing the effectiveness of enemy actions. Among the very wide range of EW initiatives that TAF could consider are the updating of secure voice and digital communication systems; building of sufficient stocks of towed decoy systems (e.g. AN/ALE-50) to ensure that all frontline combat aircraft could be so equipped; procurement of dedicated signals intelligence (SIGINT) aircraft; deployment of anti-radiation missile (ARM) decoy systems to protect radar sites from Chinese ARM attacks; and the introduction of advanced active countermeasures systems, along with incorporating such new technologies as Digital RF Memory (DRFM)-based jamming to deal with increasingly sophisticated PLA radar threats.

To help counter the challenge from long-range Chinese SAMs, Taiwan will also require such capabilities as EW jamming (electronic attack) of aircraft and air-launched anti-radiation missiles. Taiwan has already developed a modest capability in both of these areas, using indigenous technology with some foreign technical input. Even though the aggressive modernization of PLA long-range SAM capability deployed opposite Taiwan has continued unabated, the United States has been unwilling to assist Taiwan by providing the means to deal with this clear and present threat (e.g. AGM-88 High-speed Anti-Radiation Missile/HARM).

Taiwan can also expect to reap considerable benefit from additional investment in information warfare (IW) capabilities. Over the past decade, Taiwan's military and national security agencies have been under widespread, constant, and intensive attacks from hackers based in China. While attribution is difficult, such attacks are likely to be supported in some manner by the PRC government. Information security has become an growing concern for the Taiwan military, and has often resulted in denied or reduced access to information.

The degree to which the U.S. considers cyber warfare a threat to its forces, and the widespread measures it is now taking to help combat this very serious threat, is evident from reports in the open press. Therefore, steps to help strengthen network security and to combat hostile network attack operations should contribute materially to Taiwan's ability to both access critical operational information and to enhance information security. Taiwan can also devote greater resources to developing more robust and diverse information attack capabilities of its own, so as to help degrade and/or disrupt Chinese air and other military operations threatening the island.

INNOVATIVE AND/OR ASYMMETRICAL OPTIONS

In addition to, and in combination with, maintaining a critical mass of air defense fighter capability and ground-based air defense, Taiwan can also consider other, more asymmetrical approaches to the problem of integrated air defense against an adversary with a threat profile like that of China.

STOVL

The most logical TAF requirement for a future combat aircraft would be Short Take-Off and Vertical Landing (STOVL) capability. Such a capability would dramatically reduce the fighter fleet's dependence on long, fixed airstrips for normal flight operations, thereby greatly offsetting the threat posed by China's SRBM and LACM arsenal. A STOVL fighter would also be much better suited to operating from dispersal fields or remote sites (such as highways). TAF does have plans to recover fighters on and possibly operate aircraft from expressways. In addition to regular simulated training at the air bases, TAF actually practiced landing, refueling/re-arming, and launching of two Mirage 2000-5 fighters from an expressway during exercises in July 2005.

An operational STOVL fighter is unlikely to be available to Taiwan within the timeframe of the impending fighter shortage. However, such a capability is already included in TAF's core requirements for its next-generation combat aircraft, and should be considered a legitimate defense need based on the nature and scope of the Chinese missile threat.

Passive Defense

Passive defense measures - such as redundancy, dispersal, camouflage/deception, hardening, and rapid repair capabilities - represent another area in which Taiwan could make greater investments. Indeed, it has already begun doing so. For example, Taiwan has taken steps to improve hardening of select air field facilities, a major hardened aircraft storage facility at Taitung in southeastern Taiwan is being completed, and plans are in the works to upgrade the survivability of runways at several air bases.

TAF has also substantially increased and completely modernized its rapid runway repair (RRR) capabilities. Extensively trained repair crews, with dedicated, specialized machinery and a sufficient stock of RRR kits - including over 300 recently procured - have greatly improved Taiwan's ability to quickly repair damaged runways under combat conditions. Furthermore, over the past few years Taiwan has been steadily investing in upgrading and modernizing nuclear, biological and chemical defense (NBCD) and electro-magnetic pulse (EMP) protection at major command centers and other critical facilities.

Taiwan's vulnerability to missile attack is hardly unique. Indeed, other countries in Northeast Asia (including U.S. forces in the region) face a similar threat from missile attacks, as do other countries - such as Israel - elsewhere in the world. Yet no one would ever suggest that the United States should not deploy fighters at Guam, Kadena, and other forward-deployed bases due to a lack of hardening. The reality is that no country can ever pour enough concrete or deploy enough passive defense/repair capabilities to completely eliminate the threat. However, they can invest in equipment and training to the extent where at least a militarily significant portion of the overall force remains viable while under sustained attack.

These countries have, to varying degrees, hardened their infrastructure and have procured associated equipment and trained their forces to best utilize it. They have also made plans for force dispersal and prepared to use non-conventional airstrips such as highways. Typically, countries threatened by missile attacks have also adopted first-strike strategies to counter the vulnerability to their airfields and other infrastructure (e.g. Britain during World War II, as well as the U.S. and Israel today).

Taiwan cannot openly embrace a pre-emptive strike posture, as it would not sit well with the United States and could unnecessarily provoke China. Nevertheless, it has undertaken every other reasonable step needed to counter the type of broad-spectrum threat presented by China, at least to the extent permissible under a balanced defensive force structure. Indeed, Taiwan's efforts to address the vulnerabilities created by China's missile deployments match up favorably with those undertaken by U.S. bases in the region.

Countries vulnerable to missile threats view a robust modern air force as an essential response to significant missile-based threats. At a recent hearing of the US-China Economic & Security Review Commission, Deputy Assistant Secretary of Defense Michael Schiffer was asked a question on whether Taiwan was being held to a double standard in regards to their hardening efforts, in comparison to the efforts undertaken by the U.S. He noted in response that "we're paying an awful lot of attention to that exact set of questions regarding our bases in the region."¹²

Investment in passive defense measures can be quite cost-effective, by materially contributing to improved force preservation and survivability. To achieve a certain amount of desired battle damage, the enemy may have to expend additional sorties and/or weapons, thereby driving up the direct costs of the attack while raising the opportunity cost for the attacker of having to repeat attacks on the same target (e.g. the inability to attack other targets). Deception and camouflage could even cause the attacker to expend munitions on false or secondary targets, completely defeating the enemy's mission objective. Moreover, passive defenses tend to have low operating and maintenance costs compared to sophisticated systems like an aircraft or a missile, which Taiwan could find appealing.

However, passive measures can not, by themselves, defeat enemy forces, nor do they remain effective over a prolonged period of time. With the right combination of intelligence, technology, tactical initiative, and time, an attacker can always overcome passive defenses. Therefore, such passive measures should only be used in conjunction with a more balanced force capable of active defense.

Counter-Strike Capability

Among the most serious challenges to Taiwan's air defense are Chinese SRBMs/LACMs and long-range SAMs, neither of which could be effectively neutralized given Taiwan's current capabilities. As such, since the 1990s Taiwan has been quietly working on a range of weapon systems that, they hope, could provide at least a limited counter-force attack capability against such threats.

¹² Schiffer, Michael. U.S.-China Economic and Security Review Commission hearing on "*Taiwan-China: Recent Economic, Political, and Military Developments across the Strait, and Implications for the United States.*" (Washington, D.C.: March 18, 2010)

The requirement for a deep-strike capability is driven by the need to neutralize high-value military targets within the Nanjing Military Region in China. Such targets include airfields, radar stations, naval bases, command & control centers, SRBM/LACM storage sites, C2 facilities, fixed and transportable SAM fire units, critical logistics facilities, transportation nodes, and select energy grids. Computer wargame simulations have shown that rapid modernization of PLA land-based air defense (mainly in the form of an integrated air defense system and long-range SAMs) would make manned aircraft strike packages in the Military Region infeasible.

Taiwan is therefore currently working on two major land-attack missile projects: a land-attack cruise missile (LACM) and a tactical ballistic missile (TBM). The LACM is much farther along in development, with a 600+km-range version now ready for initial production. Taiwan is also developing a novel long-range supersonic ramjet-powered anti-ship missile, for launch from ground and ship platforms. But beyond a small number of SAMs modified for surface-to-surface applications, Taiwan is not expected to be able to produce an effective TBM for several years.

Taiwan can be expected to continue to pursue this indigenous development project, since there are no alternative ways to acquire the capability necessary for attacking and neutralizing these critical threats. For example, the U.S. has consistently denied Taiwan's requests for the AGM-88 High-speed Anti-Radiation Missile (HARM). From the preceding analysis, it seems that such a capability should be considered a necessary and legitimate defensive requirement that the U.S. Government is required to provide to Taiwan under the Taiwan Relations Act. But in response to the denial, Taiwan has developed an indigenous anti-radiation missile, the TC-2A. Similarly, Taiwan was forced to develop a stand-off attack munitions dispenser (conceptually resembling the U.S. AGM-154 JSOW), for use against heavily-defended threats on the Chinese mainland. Both are now ready to enter service on TAF F-CK-1A/B fighters.

It is America's increasingly politicized and erratic support that is driving Taiwan to divert its stretched defense resources to locally develop weapon systems and capabilities that, like Taiwan's LACM and TBM programs, could create additional complications for U.S.-China-Taiwan relations. Providing systems that Taiwan requires for its legitimate defense, such as new fighters and HARM, would be a good way for the U.S. to reassert persuasive influence over Taipei's ballistic missile plans.

TAF must also possess a degree of offensive counter-air (OCA)/strike capability, so as to counter Chinese TBM and LACM launch platforms. Counterforce operations constitute one of the four pillars of U.S. missile defense doctrine (the other three pillars being active defense/interception, early-warning, and BMC₃I). In Taiwan's case, such capability provides an essential element of a layered defense to a very real and potentially devastating ballistic/cruise missile threat (with Patriot PAC-3 serving in a terminal defense layer).

Another key reason for this capability is that the TAF must be able to "take the fight" to offensive Chinese assets, which would force China to divert its defense dollars away from purely offensive pursuits and into more defensive capabilities, such as hardening and/or defensive systems for their offensive missile launchers, storage/support facilities, and C2 installations. That would help alleviate pressure not only on Taiwan but also on other countries in the region threatened by the aggressive expansion of Chinese missile forces.

Taiwan's military modernization efforts are designed to maximize the challenge for China, should the PRC attempt to use force in resolving its differences with Taiwan. It is disingenuous to suggest that Taiwan should be denied counter-strike capabilities because they are somehow "offensive" in nature. Such capabilities are inherently defensive, in that Taiwan's ability to strike mainland-based assets being used in an assault on Taiwan would play a crucial role in complicating Chinese calculations.

THE POLITICAL DIMENSION

Taiwan has clear and legitimate military needs to maintain its self defense capabilities, but there are also other compelling reasons to support Taiwan's strengthening of its defense posture.

As Taiwan moves closer to a historic free trade pact with Beijing - officially known as the Economic Cooperation Framework Agreement (ECFA) - the government of Taiwan President Ma Ying-jeou will be under increased domestic political pressure to prove that the ongoing push for détente has not betrayed the island's sovereignty in the process.

Taiwan recognizes the need to balance its ever growing cultural and economic ties to China on the one hand, with strengthened economic and security relations and fortified ties to the United States - its traditional strategic partner - on the other hand. Keeping close and balanced ties with both sides will help promote stability, both in the Taiwan Strait and within Taiwan itself.

Stability of Taiwan's body politic will be crucial to continued improvements in cross-Strait relations over the next few years, as the two sides delicately approach dialogue aimed at addressing their longstanding political differences. Certainly, the ability for Taiwan's people and leadership (irrespective of political persuasion) to feel more secure and confident about greater interdependence with China would benefit the political process towards an eventual, peaceful resolution and a more enduring peace in the region. It is commonly acknowledged, both by Beijing and by Taipei, that a peaceful resolution is an important objective of the ongoing talks.

Nevertheless, the two sides have starkly different goals underlying their present engagement strategies. China continues to approach Taiwan with a dual strategy where economic engagement is "the carrot" and military coercion is "the stick." The Chinese understand well that Taiwan's domestic political situation is fluid, and that future elections may result in a Taiwan government less amenable to engagement with China under terms it views as favorable to its ultimate goal - unification. Therefore, China continues to bolster its military presence in the Taiwan Strait, ensuring that it has a hedge strategy for just such an outcome.

It is also possible that China will attempt to take the initiative through demonstrations of what some might view as "good faith" actions in an effort to delay or defer decisions in support of Taiwan's defense requirements. The missiles that China has stationed in range of Taiwan have a high degree of strategic mobility, rendering them a very useful bargaining chip in China's political negotiations with Taipei. A pull-back of these missiles could be offered by Beijing as a powerful, but deceptive, gesture of goodwill and peace towards Taiwan.

With the missile threat the most visible symbol of China's threat posture towards Taiwan, it is possible that Beijing will use some form of missile withdrawal as leverage to effect a reduction in U.S. security assistance to Taiwan, or to barter for U.S suspension (or even cancellation) of specific arms sales. Despite the optics of such a move, temporary removal of these missiles has no tangible military or strategic significance for Taiwan or for other countries in the region. A Chinese offer to reduce the number of missiles deployed against Taiwan would

be politically welcome, but such a move must not be reciprocated with permanent, irreversible reductions in Taiwan's defense capabilities, or with concessions made in U.S.-Taiwan security cooperation.

In contrast to China, Taiwan seeks economic normalization and liberalization with China and the region. With America sitting on the sidelines, China is currently driving Asian economic engagement. Taiwan views its ECFA with China as the first step towards involving itself in this dynamic process, as failing to engage could result in economic marginalization and increased domestic instability. A weak and unstable Taiwan is not in anyone's interest.

By offering material and meaningful support, the U.S. can provide options and ensure that Taiwan negotiates from a position of confidence. To this end, U.S. government support for such initiatives as availing Taiwan of combat aircraft or re-launching a robust Trade and Investment Framework Agreement (TIFA) could only have a salutary influence on the evolving cross-Strait rapprochement. They would not set back the political dialogue, but would rather contribute to making such dialogue possible. It is for this reason that U.S. security assistance programs, such as the sale of F-16C/D fighters, will not ultimately be deemed "red line" actions by Beijing.

Even though Taiwan could not realistically expect to, by itself, prevail in a protracted, full-scale war with China, it would be a mistake to consider maintaining a reasonable defensive capability a wasteful, futile exercise. Both the current (Ma) administration and any future Taiwan leadership will want to keep China convinced that it is much more attractive and cost-effective to engage Taiwan peacefully and as an equal, rather than to fight Taiwan.

However, to maintain this calculus, China's cost of militarily subjugating Taiwan must be substantially higher than that of peaceful resolution through gradual economic normalization and political engagement. Continued vigilance and appropriate investment in a viable defense posture in response to China's military threat will be essential, as they could provide Taiwan with critical respect and equality in its political dialogue with China.

TAIWAN'S ROLE IN SUPPORTING THE U.S. REGIONAL STRATEGIC PRESENCE

U.S. strategists and military planners have often posited that a crisis or conflict with China would be a short and narrowly concentrated event taking place in the Taiwan Strait, in the South or East China Sea, or in the Sea of Japan. But as the PLA increases its ability to project power into each of these areas, the prospects of multiple confrontations or a wider war grow in tandem. The western Pacific is well on its way to becoming one continuous battle space.

Many American observers believe that in the event of a conflict, the first goal of Chinese military strategy is to restrict or even deny U.S. forces access to the region. Yet even as the PLA modernizes, their ability to operate simultaneously across this vast region is in doubt. Indeed, China's ability to exclude American forces from all the potential points of access is far beyond the PLA's reach. If U.S. forces could gain access *somewhere*, their prospect of turning back a Chinese challenge would improve immeasurably. In addition, if Beijing chose to attempt this course of action, it might also quickly find itself in a wider war against all its neighbors.

Operationally, the tables can also be turned. Currently, it falls to the U.S. and its allies to try to curb PLA power projection. But if Beijing attempts to establish a *cordon sanitaire*, or sphere of exclusive influence, in East Asia, they would have to defend it at every point. The choice of which vulnerability to attack would then fall to the United States. Should such a moment come to pass, the value of U.S. alliances and the military capabilities of U.S. allies and partners become clear, and a seemingly marginal contribution may have a decisive effect. In particular, the ability to gain access to and exploit the airspace, air bases, ports, etc. in Japan, South Korea, Taiwan, or even Southeast Asia will be critical.

This trend towards a growing battle space has unambiguous implications for the TAF, and indeed for all the air forces in the region. It is vital that U.S. allies and partners be able to contribute in the event of a larger crisis or conflict - by providing or easing access, defending its air space, and facilitating coalition air operations (even on an ad hoc coalition basis). If China is attempting to deny access to U.S. forces across a broad arc extending from the Sea of Japan to the South China Sea, its ability to concentrate its forces at any one point will be sharply diluted, particularly since the ability of the PLA to conduct such a large scale operation at all is questionable. Thus the "local" air-to-air balance - be it across the Taiwan Strait or in the skies over Japan or Korea - will be favorable not only for U.S. forces (which can choose their point of concentration), but to allied air forces as well. Even a modest but modern fleet, capable of communication and "de-conflicted" operations with U.S. aircraft, can have a reasonable expectation of local air superiority.

It is clear that improving the reconnaissance, surveillance, command & control, and combat air capabilities of U.S. allies and partners in East Asia - that is, "building partnership capacity" - can make a critical difference in frustrating any Chinese attempts to deny access to U.S. forces operating in the region. Conversely, a failure to modernize regional air capabilities would make China's denial of access operations easier, while increasing the power-projection challenges for the United States.

In light of this Chinese anti-access challenge, current U.S. force levels in the Asia-Pacific are themselves worryingly low. That is true not only for those permanently based in Japan, Korea, Guam and Hawaii, but also those based on the west coast of the continental United States and Alaska. Absent support from modern

regional air partners, in the event of a crisis the U.S. military would have to rely exclusively on longer-range systems such as the F-22 fighter, which are inherently more expensive and fewer in number.

Consider the case of the F-22 - the most advanced aircraft in the American inventory, and the platform best able to penetrate advanced Chinese air defenses. The practical reality is that no more than a maximum of 120 F-22s are likely to be operationally available globally at any one time, and it is further unlikely that all of them would be detailed to any particular potential crisis in Asia. The real value of the F-22, and indeed of the kind of complex air campaign that only the United States can design and execute, is in support of counteroffensive air operations of the sort needed to defeat a Chinese anti-access campaign. F-22s would be wasted assets if frittered away on combat air patrols over the Taiwan Strait.

Traditionally, U.S. campaign planners have assumed that Navy carrier aircraft would be most useful in a Taiwan scenario. However, recent Pentagon studies and war games reveal a strong correlation between air power and the maritime military balance. Absent at least local air superiority, the ability of the U.S. Navy's surface combatants - or carrier-based air power - to operate within effective range will be severely diminished. In addition, not only are the carriers themselves increasingly vulnerable, but the fleet is smaller - there are rarely more than two carriers at sea in the Pacific, and they often patrol as far afield as the Persian Gulf area.

A Navy carrier can only call on somewhere between 32 and 40 F-18 Hornets, maximum. Even if one considers U.S. air power stationed in Japan and Korea, the number of aircraft immediately available in the region is limited. There are two squadrons of F-15s and two of F-16s in Japan - about 70 aircraft total - and three F-16 squadrons in Korea numbering about 50 planes. Consequently, Taiwan's current fleet of 145 F-16s is not that much smaller than the total number of aircraft that the United States could "surge" in the region in a crisis. But if Taiwan's air force is modernized and older equipment is replaced with modern equipment, Taiwan could continue to play a pivotal and positive role in U.S. power-projection calculations.

In short, a division of labor that maximizes allied defensive capabilities with U.S. strike or counteroffensive operations is both the most militarily effective and efficient combination - a coalition whole that is larger than the sum of its parts. Overall success depends upon having complementary and capable allied and partner capabilities that free U.S. aircraft and other military forces to conduct counteroffensive operations.

CONCLUSIONS

Taiwan will be experiencing a significant decline in its air defense capability over the next several years due to the impending retirement of obsolete F-5s, the potential withdrawal of up to a squadron of its F-16A/Bs in an upgrade program, and the mothballing of its high-cost Mirage 2000 fleet. This will result in a serious shortfall of modern fighters. In addition, the ever increasing LACM threat is effectively countered today by the HAWK missile system. But maintenance costs for the aging system, along with significant obsolescence and reliability issues, will ultimately eliminate the contribution of Taiwan's 20 HAWK Batteries in terms of defending against the LACM threat, unless MND accelerates their modernization. These quantitative declines could have a profound and enduring impact on the qualitative edge that Taiwan's air defense forces have traditionally relied on to deter Chinese aggression, and, when necessary, to prevail in armed conflict.

The fighter gap, if not bridged in a timely manner, could permanently solidify the already tilting cross-Strait air power balance in favor of China. Such a state of military imbalance would then undermine deterrence, and could expose Taiwan to political extortion backed by military intimidation, just when improving relations between Taipei and Beijing are expected to bring the two sides closer to a sustainable dialogue and incremental improvements in cross-Strait relations.

Taiwan's pressing combat aircraft requirement can best be met with the acquisition of F-16C/D Block 50/52 fighters from the United States. Yet since 2006, the U.S. Government has repeatedly put off a decision on whether to sell the fighters to Taiwan. It is imperative to deal quickly with the growing cross-Strait fighter imbalance, so that deliveries to Taiwan may begin by 2014. That is when the fighter shortfall is expected to fully materialize, upon the scheduled retirement of Taiwan's current F-5s. In addition, the F-16 production line has been solely sustained by export orders since the late 1990s. With a typical production lead time of 36 months, the F-16 production line faces potential closure without an additional order before 2011.

Taiwan can further strengthen its air defense capabilities by investing intelligently in mid-life update programs for its F-16A/B and F-CK-1A/B fighters, by deploying more mobile SAM systems, and by developing advanced, integrated intelligence, surveillance & reconnaissance (ISR) capabilities. Taiwan can also enhance its air defense by adopting a number of asymmetrical measures, including greater investment in passive defense measures and a limited counter-force attack capability.

In the event of a conflict with China, a modernized and capable Taiwan air force could play a critical and constructive role in supporting the United States. It would appear that a promising approach towards defeating a Chinese anti-access strategy would be to force the PLA to diffuse its forces and capabilities by placing widely dispersed stress on the anti-access "fence" in search of weak links. Modernized and coalition-ready forces - such as the one represented by a Taiwan air force using modern equipment - could add to the cumulative strain on Chinese strategy and PLA concepts of operations, thereby supporting U.S. operations. Conversely, an absence of credible Taiwan airpower would accentuate U.S. vulnerabilities and negatively influence U.S. power-projection in the Pacific.

The U.S. can and should assist Taiwan in implementing measures in support of its air defense, to help strengthen deterrence and thereby to help maintain peace and stability in the Taiwan Strait. At a more

strategic level, helping Taiwan improve its air and overall defense capability will also help reinforce the positive steps that Taipei has taken in lowering cross-Strait tensions and in significantly improving and expanding economic and other ties with Beijing. A stronger and more secure Taiwan can be expected to be more confident in its political dialogue with China, which could ultimately lead to a peaceful resolution to the situation in the Taiwan Strait. Such an outcome would certainly support the goal of peace and stability in the region, and would serve the national interest of the United States.

It would be easy to presume that China's vast resources, and its commitment towards expanding the capabilities of its military, would render the situation hopeless for Taiwan. But as the US-Taiwan Business Council has often noted, the United States sells weapons to Taiwan not as a goal in and of itself; instead it is in response to China's military investments and force deployments. It is China's actions that destabilize the Taiwan Strait, thereby compelling an American response.

This report concludes that Taiwan has both the resources and the wherewithal to mount a sufficient self-defense in response to the evolving threat represented by PRC military modernization. Taiwan clearly recognizes this threat - evidenced by the statements and actions of its government, such as seeking to procure modern fighters for the Taiwan air force.

The challenge lies in Washington, in the willingness on the part of successive administrations to provide Taiwan with needed support in the face of Chinese opposition. An economically and militarily strong Taiwan - able to engage China with confidence - is in the best position to act as a force for stability in the Taiwan Strait. The United States need only follow the Taiwan Relations Act to provide that support.

It is not too late for Taiwan.

APPENDIX

Acronyms

AAA	Anti-Aircraft Artillery
AACC	Automatic Air Control Center
AAM	Air-to-Air Missile
AAW	Anti-Air Warfare
AESA	Active Electronically Scanned Array (Radar)
AEW&C	Airborne Early Warning & Control
AFB	Air Force Base
AGM	Air-to-Ground Missile
AIM	Advance Interceptor Missile
ALCM	Air-Launched Cruise Missile
AMRAAM	Advanced Medium Range Air-to-Air Missile
AN/ALE	Army Navy/Air Launched Expendable
AN/FPS	Army Navy/Fixed, Radar, Search
AN/TPS	Army Navy/Transportable
ARM	Anti-Radiation Missile
ASW	Anti-Submarine Warfare
ATACMS	Army Tactical Missile System
ATBM	Anti-Tactical Ballistic Missile
BMC3I	Battle Management, Command, Control Communications, Intelligence
BVR	Beyond Visual Range
C2	Command & Control
C3	Command, Control & Communications
C4	Command, Control, Communications & Computers
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance & Reconnaissance
CAC	Combat Air Command
CAP	Combat Air Patrol
CEP	Circular Error Probable
CM	Cruise Missile
CMD	Cruise Missile Defense
COC	Combined Operations Center
DCA	Defensive Counter-Air
DCGS	Distributed Common Ground System
DMS	Diminishing Manufacturing Sources
DoD	Department of Defense

DRFM	Digital Radio Frequency Memory
ECM	Electronic Countermeasures
ECFA	Economic Cooperation Framework Agreement
EMP	Electro-Magnetic Pulse
EW	Electronic Warfare
FANDC	Foreign Affairs & National Defense Committee
HADR	Hughes Air Defense Radar
HARM	High-speed Anti-Radiation Missile
HAS	Hardened Aircraft Shelter
IDF	Indigenous Defense Fighter (FC-K-1A/B)
IFF	Identification, Friend or Foe
ISR	Intelligence, Surveillance, Reconnaissance
IW	Information Warfare
JAOC	Joint Air Operations Center
JSOW	Joint Standoff Weapon
LACM	Land Attack Cruise Missile
LIFT	Lead-In Fighter Training
LOR	Letter of Request
MANPADS	Man-Portable Air-Defense System
MASINT	Measurement & Signatures Intelligence
MICA	Missile d'Interception et de Combat Aérien, "Interception & Aerial Combat Missile"
MIDS-LVT	Multifunctional Information Distribution System - Low Volume Terminal
MLU	Mid-Life Upgrade
MND	Ministry of National Defense (Taiwan)
MTBF	Mean Time Between Failure
MWC	Missile Warning Center
NBCD	Nuclear, Biological & Chemical Defense
NEW	Network Enabled Weapon
OCA	Offensive Counter-Air
OCU	Operational Conversion Unit
O&M	Operations & Maintenance
P&A	Price & Availability

PAC	Patriot Advanced Capability
Pk	Probability of Kill
PLA	People's Liberation Army
PLA-AF	People's Liberation Army Air Force
PLA-N	People's Liberation Army Navy
PRC	People's Republic of China
RF	Radio Frequency
ROCAF	Republic of China Air Force
ROCC	Regional Operations Control Center
RRR	Rapid Runway Repair
SAM	Surface to Air Missile
SAR	Synthetic Aperture Radar
SIAP	Single Integrated Air Picture
SIGINT	Signals Intelligence
SL-AMRAAM	Surface-Launched Advanced Medium Range Air-to-Air Missile
SOF	Special Operations Forces
SRBM	Short-Range Ballistic Missile
SRP	Surveillance Radar Program
STOVL	Short Take-Off/Vertical Landing
TAF	Taiwan Air Force
TBM	Tactical Ballistic Missile
TEL	Transporter-Erecter-Launcher
TFW	Tactical Fighter Wing
TIFA	Trade & Investment Framework Agreement
TRA	Taiwan Relations Act
TTGS	Tau-Ten Ground System
UAV	Unmanned Aerial Vehicle

Glossary

10-1E Strong Net “Chiang Wang” System

10-1E Strong Net is Taiwan’s current air-defense command and control system. The system relies on the Joint Air Operations Center (JAOC) in southern Taipei and on a network of primarily 2-dimensional radars. Currently, the system is being upgraded under the ANYU program, which will significantly enhance its capabilities.

Active Electronically-Scanned Array (AESA) Radar

Also known as active phased-array radar, an AESA is a radar system whose transmitter and receiver components spread their broadcasts out across a band of frequencies, making it difficult to detect over background noise. This allows the ships and aircraft that use them to broadcast powerful radar signals while remaining stealthy.

AGM-88C HARM (High-speed Anti Radiation Missile)

The AGM-88 HARM is a supersonic air-to-surface tactical missile designed to seek and destroy enemy radar-equipped air defense systems. The HARM missile has a terminal homing capability that provides a launch and leave capability for the launch aircraft. Additional features include the high speed, low smoke, rocket motor and the seeker sensitivity that enables the missile to easily attack sidelobes and backlobes of an emitter.

AGM-154 Joint Standoff Weapon (JSOW)

A standardized medium-range precision guided air-to-surface glide weapon with standoff capabilities. The weapon is designed to engage targets outside the range of standard anti-aircraft defenses.

AIM-7M “Sparrow”

A radar-guided, air-to-air missile with a high-explosive warhead. The 7M variant entered service in 1982 and featured a new inverse monopulse seeker, active radar fuse, digital controls, enhanced electronic countermeasure resistance, and improved low-altitude performance.

AIM-9M “Sidewinder”

A supersonic, heat-seeking, air-to-air missile whose main components are an active infrared homing guidance system, an optical target detector, a high-explosive warhead, and a rocket motor.

AIM-120 “Slammer” AMRAAM

The AMRAAM (Advanced Medium Range Air-to-Air Missile) is a medium-range air weapon with multi-shot capability. Initially guided by an inertial reference unit and a microcomputer, receiving target coordinate updates from the radar system of the launch aircraft in mid-course, in the terminal phase of flight the missile's active radar seeker guides it independently, without further reliance on the launching aircraft. The C-7 variant features a new guidance section that gives it an improved ability to detect, track and home in on current and emerging air threats, even when operating in an environment of severe electrical interference.

Airborne Early-Warning & Control (AEW&C)

An airborne radar system designed to detect aircraft. Typically, AEW&C enabled aircraft operate at high altitudes and large, external radar dishes enable onboard operators to view and distinguish between friendly and hostile aircraft hundreds of miles away. The system is used offensively to direct fighters to their target

locations, and defensively to counter attacks. Older terms for AEW&C include Airborne Early Warning (AEW) and Airborne Warning and Control System (AWACS).

Air-Breathing Engines

Term used for jet engines that require outside air to operate. In contrast to rocket engines, whose fuel is self-contained, for air-breathing engines outside air is brought in, mixed with fuel, and then ignited to create thrust.

Air-to-Air Missile (AAM)

Guided missiles that are fired from one aircraft to destroy another. They are typically powered by rocket engines that use either solid or liquid fuel. AAMs are categorized as short-range (SRAAM), medium range (MRAAM), or long range (LRAAM) and are typically outfitted with infrared or radar guidance systems.

AN/ALE-50 Towed Decoy System

A towed decoy that acts as a preferential target to lure enemy missiles away from its host aircraft by providing a much larger radar cross-section than the aircraft itself. The system is currently operational on F-16, F/A-18E/F, and B-1B aircraft.

AN/FPS-115 Radar

A long-range, phased array, Land-Based Fixed Defense Radar (LBFDR) designed to detect and characterize ballistic missiles. The radar system is capable of detecting and monitoring a great number of targets consistent with a massive attack. The system must rapidly discriminate between vehicle types, calculating their launch and impact points in addition to the scheduling, data processing and communications requirements. The operation is entirely automatic, requiring operators only for monitoring, maintenance and as a final check on the validity of warnings.

AN/FPS-117 Radar

A long-range, phased array, Land-Based Fixed Defense Radar (LBFDR) designed to provide both air-surveillance and en-route air traffic control. The radar is considered dual-use, making it the most popular radar of its kind.

AN/TPS-75 Radar

A mobile, tactical radar system capable of providing radar azimuth, range, height, and Identification Friend or Foe (IFF) information. The deployable/transportable radar system is capable of providing long-range radar data to support operations and control of tactical aircraft.

Anti-Air Warfare (AAW)

Term used to describe the actions required to destroy, or reduce to an acceptable level, enemy air and missile threats. AAW includes the use of interceptors, bombers, antiaircraft guns, surface-to-air and air-to-air missiles, electronic attack, and destruction of the air or missile threat both before and after it is launched.

Anti-Submarine Warfare (ASW)

Anti-submarine warfare involves the use of submarines, aircraft, and surface ships (commonly destroyers), to locate, track, and then either damage or destroy submarines and submarine port facilities, production facilities, and supply routes. Anti-submarine warfare also involves communication interception, decryption, and disinformation.

Anti-Tactical Ballistic Missile (ATBM)

A system or part of a system for defending against tactical ballistic missile strikes. ATBM components can include a number of sub-systems such as satellites, radars, C2, missiles, and warning arrangements.

Automatic Air Control Center (AACC)

The command and control authority for daily execution of detection, identification (ID), interception, and destruction/negation of hostile forces operations within the Taiwan Air Defense Identification Zone (ADIZ). Controls fighters, SAMs, and AAAs, along with Army and Navy air defense assets.

Ballistic Missile, Conventional

A ballistic missile is a missile with a prescribed course governed by the laws of ballistics. A conventional ballistic missile is a ballistic missile with a non-nuclear, conventional warhead.

Ballistic Missile, Tactical

A ballistic missile is a missile with a prescribed course governed by the laws of ballistics. A tactical ballistic missile is designed for short-range battlefield use of typically less than 300 km, filling the gap between conventional artillery and long-range missiles. Usually mobile to ensure survivability and quick deployment, tactical ballistic missiles can carry a variety of warheads to target enemy facilities, assembly areas, artillery, and other targets behind the front lines.

Ballistic Missile Defense (BMD)

All active and passive measures designed to detect, identify, track, and defeat attacking ballistic missiles, in both strategic and theater tactical roles, during any portion of their flight trajectory (boost, post-boost, mid-course, or terminal phase) or to nullify or reduce the effectiveness of such an attack.

Beyond Visual Range (BVR)

Refers to the use of missiles to kill an airborne foe at distances outside the range of the human eye, generally outside about 15 miles. Radars and missiles are necessary in BVR combat, and command, control and positive identification are crucial to avoid hitting the wrong target.

BMC3I

BMC3I stands for Battle Management, Command, Control, Communications and Intelligence, and represents a system through which the U.S. military manages Theater Missile Defense (TMD). BMC3I is built upon the existing command and control (C2) structure for Theater Air Defense (TAD) and adds communications linking TMD C2 nodes, weapons, and sensors, as well as TMD interfaces to intelligence systems and other supporting capabilities.

C4ISR

C4ISR refers to systems that are part of the Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance domain. The C4ISR domain is one of four domains for which the Joint Technical Architecture specifies a domain annex. C4ISR is defined in the Joint Technical Architecture (JTA, Defense Information Systems Agency, 1999) as those systems that:

- Support properly designated commanders in the exercise of authority and direction over assigned and attached forces across the range of military operations.
- Collect, process, integrate, analyze, evaluate, or interpret available information concerning foreign countries or areas.

- Systematically observe aerospace, surface or subsurface areas, places, persons, or things by visual, aural, electronic, photographic, or other means.
- Obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy, or secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area.

C-602 Air-Launched Cruise Missile (ALCM)

The C-602, also known as YJ-62, is a Chinese subsonic anti-ship missile that can also be used as a land attack cruise missile. The missile has a maximum range in excess of 400 km and a top speed of over Mach 0.9. It is propelled by a turbojet engine with a solid fuel rocket booster.

Chanchushan

Chanchushan, or “Toad Mountain”, is a small mountain in the south of Taipei, home to the Taiwan Air Force’s main hardened command and control Joint Air Operations Center (JAOC).

Chiashan Air Force Base (AFB)

The Chiashan Air Force Base is a tightly guarded base in Hualien County's Hsincheng township, in eastern Taiwan. Part of the base is located in a hollowed-out mountain for hardened storage that is rumored to accommodate over 200 fighter aircraft.

Chiayi Air Force Base (AFB)

The Chiayi Air Force Base is located in Chiayi County’s Shuishang township, in southwestern Taiwan. It houses the 455th Tactical Fighter Wing.

Ching Chuan Kang Air Force Base (CCK AFB)

Ching Chuan Kang Air Force Base is the home of Taiwan’s 3rd Tactical Fighter Wing, with three squadrons of Ching-kou (IDF) air-defense /attack fighters. The base is located along Taiwan’s west coast, near the city of Taichung.

Circular Error Probable (CEP)

In the military science of ballistics, circular error probable (CEP) is an intuitive measure of a weapon system's accuracy. It is defined as a circle, centered about the mean, whose boundary is expected to include 50% of the population within it.

Combat Air Command

The Command is in charge of commanding and controlling the operations, exercises and training missions of all flying troops, and integrating all air defense artillery/missiles to conduct joint air defense operations.

Combat Air Patrol (CAP)

An aircraft patrol provided over an objective area, over the force protected, over the critical area of a combat zone, or over an air defense area for the purpose of intercepting and destroying hostile aircraft before they reach their target(s).

Combined Operations Center (COC)

The Combined Operations Center for the Taiwan armed forces is located at Hengshan in northern Taiwan. The COC offers centralized control of elements of the Army, Navy, and Air Force.

Command and Control System (C2)

Command and control (C2) is the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission.

Crossbow “Jing Nu”

The project name for a new mobile, low-altitude/field air defense system currently under preliminary consideration. If implemented, it would be widely deployed throughout the island to defend air bases and other high-value installations, serving as the backbone of field air defense for Taiwan ground forces.

Cruise Missile

A guided missile using a lifting wing and most often a jet propulsion system to allow sustained flight, making them, in essence, unmanned aircraft. Cruise missiles are generally designed to carry a large conventional or nuclear warhead many hundreds of miles with excellent accuracy.

Cruise Missile Defense (CMD)

An integrated and joint architecture to protect against the threat of a cruise missile attack. Components include the capability to detect and track missiles after launch, interceptors to destroy missiles in-flight, and an effective battle management and communications network.

Defensive Counter-Air (DCA)

The term for all defensive measures, both active and passive, designed to detect, identify, intercept, and destroy or negate enemy forces attempting to penetrate or attack through friendly airspace.

DF-11

The DF-11 (M-11/CSS-7), or Dongfeng-11, is a road-mobile short-range ballistic missile (SRBM) designed by Wang Zhenhua at the Sanjiang Missile Corporation in the late 1970s. The DF-11 has range of 300 km and 500 kg payload. An improved DF-11A version has increased range of >825 km. Unlike previous Chinese ballistic missiles, the DF-11 uses solid fuel, which greatly reduces launch preparation time to 15-30 minutes. The DF-11 is the Chinese equivalent of the Scud-series of missiles.

DF-15

The DF-15 (M-9/CSS-6), or Dongfeng-15, is a single-stage, solid-fuel short-range ballistic missile (SRBM) with 600 km range and 500 kg payload. During the 1995-1996 Taiwan Strait crisis, the PLA launched 6 DF-15's in an "exercise" to demonstrate the missile's capability. Although the DF-15 is marketed for export, its range would violate the Missile Technology Control Regime (MTCR) agreement, and thus no DF-15 has been exported to date. Approximately 300-350 DF-15's are estimated to be in service with the PLA Second Artillery Corps.

Digital Radio Frequency Memory (DRFM)

An electronic method for digitally capturing and retransmitting an RF signal. DRFM technology is typically used in radar jamming, although applications in cellular communications are becoming more common.

Diminishing Manufacturing Sources & Material Shortages (DMSMS)

DMSMS is a condition brought about when the last known manufacturer announces the intention to discontinue production of an item or group of items still required for defense activities or for systems support.

The problem can thus directly affect readiness and sustainability of the armed forces. Weapon systems can be impacted by DMSMS at any point in their life cycles.

Distributed Common Ground System (DCGS)

An integrated architecture for all ground/surface systems. DCGS is designed to integrate into the Imagery Intelligence (IMINT) ground/surface systems in the Common Imagery Ground/Surface System (CIGSS) architecture. Signals Intelligence (SIGINT) ground/surface systems are integrated in the Joint Airborne SIGINT Architecture (JASA), and the CIGSS and JASA architectures are combined into DCGS. DCGS will be completed by the addition of IMINT, SIGINT, and MASINT specific functions and components to the common infrastructure.

DH-10 “East China Sea-10” Dong Hai LACM

The DH-10 is a Chinese-developed ground-launched Land Attack Cruise Missile (LACM) with a range of more than 1,500km. It is likely to be equipped with an integrated inertial navigation system/Global Positioning System, supplemented by a terrain contour mapping system and digital scene-matching terminal-homing system able to provide a circular error probable (CEP) of 10m.

Economic Cooperation Framework Agreement (ECFA)

The ECFA is a proposed partial free trade agreement between Taiwan and China, and has become a top goal of the Ma Administration. The proposed agreement, originally called a Comprehensive Economic Cooperation Agreement (CECA), is intended to maintain Taiwan's economic competitiveness in the world market and allow Taiwan to avoid marginalization. The agreement would permit the free flow of many goods, services and capital between the island and China, but key items such as agricultural produce would be exempt, largely as a concession to Taiwan farmers. Discussions on the ECFA formally started in early 2010.

Electronic Countermeasures (ECM)

A subsection of electronic warfare that includes any sort of electrical or electronic device designed to trick or deceive radar, sonar, or other detection systems like infrared and laser. It may be used both offensively and defensively in any method to deny targeting information to an enemy. The system may make many separate targets appear to the enemy, or make the real target appear to disappear or move about randomly.

Electromagnetic Pulse (EMP)

A burst of electromagnetic radiation that results from an explosion (especially a nuclear explosion) or a suddenly fluctuating magnetic field. The resulting electric and magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges.

F-5 “Tiger II/Freedom Fighter/Peace Tiger 6”

The F-5 is a small, light supersonic fighter that is easy-to-fly and simple to maintain. Never a part of the USAF tactical forces, it has been used to represent a hostile fighter in simulated combat, as some of the characteristics of the F-5 resemble those of the Soviet-built MIG-21. In the 1970's, AIDC cooperated with the U.S. designers to manufacture F-5E for the Taiwan Air Force, and AIDC imitated the F5-E to produce F-5F. “Peace Tiger” was the name for the license production program.

F-16 “Fighting Falcon”

The Fighting Falcon is a highly maneuverable, lightweight fighter aircraft flown in large numbers by the U.S. Air Force and by many other countries. More than 4,000 F-16s have been produced, in over 110 different

versions (designated by “block” numbers and letters). Highly versatile and maneuverable, the F-16 is a very popular multi-role fighter.

F-16 Block 20 is an Operational Capability Upgrade for Taiwan. The Block 20s feature an improved AN/APG-66(V)3 radar, a carriage of AGM-45 Shrike, AGM-84 Harpoon, AGM-88 HARM, and Low Altitude Navigation and Targeting Infrared for Night (LANTIRN). The computers onboard Block 20 are significantly improved in comparison to that of the earlier versions, with the overall processing speed increased 740 times and the overall memory storage increased 180 times in comparison to that of Block 15 OCU.

The F-16 C/D variants requested by Taiwan are single/two-place fighters, incorporating built-in structural and wiring provisions and systems architecture that permit expansion of the multirole flexibility to perform precision strike, night attack and beyond-visual-range interception missions.

F-22 “Raptor”

A single-seat, twin-engine fighter aircraft built for air superiority and air space dominance. This advanced aircraft is characterized by a low-observable, highly maneuverable airframe; advanced integrated avionics; and aerodynamic performance allowing supersonic cruise without afterburner.

F-35 JSF (Joint Strike Fighter)

The F-35 is the result of the Defense Department's Joint Strike Fighter (JSF) program, seeking to build a multi-role fighter optimized for air-to-ground combat but with secondary air-to-air capability. The JSF is designed to meet the needs of the Air Force, Navy, Marine Corps and U.S. allies, with improved survivability, precision engagement capability, and reduced life cycle costs. Using many technologies developed for the F-22, the F-35 capitalizes on commonality and modularity to maximize affordability. The F-35B variant - produced for the United States Marine Corps - will feature a Short Take Off/Vertical Landing capability (STOVL).

F-84 Thunderjet

An American turbojet fighter-bomber aircraft produced by Republic Aviation in the late 1940's. The aircraft was not considered fully operational until the F-84D model was released in 1949 and was further improved in 1951 when the F-84G was introduced.

F-86 Sabre

A transonic jet fighter aircraft designed by North American Aviation. Although developed in the late 1940s and outdated by the end of the 1950s, the Sabre proved adaptable and continued as a front line fighter in air forces around the world until 1994. It was by far the most-produced Western jet fighter, with total production of all variants at 9,860 units.

F-100-PW-220

Pratt & Whitney's family of F100 engines is the mainstay of air forces worldwide, powering the F-15 and F-16 fighter aircrafts. Developed especially for the F-15, these high-pressure-ratio engines have much improved efficiency over earlier engines for fighter aircraft. The PW-220 model, introduced in 1986, included digital electronics allowing for precision control, advanced maintenance features, and added extended durability and reliability of metallurgical and heat-transfer advances.

F-CK-1A/B “Ching-kuo” Indigenous Defense Fighter (IDF)

The Ching-kuo, also known as the Indigenous Defense Fighter (IDF), is a fighter aircraft produced by the Aerospace Industrial Development Corporation (AIDC) for the Taiwan Air Force along the same general lines as the F-16 Fighting Falcon. It was named in honor of late Taiwan President Chiang Ching-kuo.

Foreign Affairs & National Defense Committee (FANDC)

An LY committee that is the result of the merging of the National Defense and Foreign Affairs Committees after the 2008 Legislative Yuan elections. The committee is responsible for foreign relations, overseas Chinese affairs, national defense, intelligence/national security, and veterans' affairs.

GE-592 Radar

A transportable, ground-based, three-dimensional phased array air-surveillance radar. It is very similar to the AN/TPS-59 radar.

H-6

A version of the Soviet Tupolev Tu-16 twin-engine jet bomber that was built for the People's Liberation Army Air Force (PLAAF). Xi'an Aircraft Industrial Corporation signed a license production agreement with the USSR to build the aircraft in the late 1950s. Delivery began in 1958, and the first Chinese H-6 in service began flying in 1959. At least 150 of the aircraft were built into the 1990s, and China is believed to currently operate around 120 of the aircraft. The latest H-6K is modified with current radar and sensors to deliver a version of the DH-10 LACM and new precision-guided munitions.

Han Kuang “Han Glory” Military Exercises

The "Han Kuang" series is the largest combined services military exercises in Taiwan, and takes place annually. The exercises includes computer war-games as well as live-fire military maneuvers that aim to evaluate Taiwan's defense capabilities. Beginning in 2008, the live-fire and computer war-game sections are conducted during alternate years. The 2010 series of exercises are known as “HK-26”.

Hardened Aircraft Shelter (HAS)

Also known as Protective Aircraft Shelters (PAS), HAS are reinforced structures that house and protect military aircraft from enemy attack. Cost considerations and building practicalities generally limit their use to fighter size aircraft.

Harpy

The Harpy is an unmanned aerial vehicle (UAV) produced by Israel Aerospace Industries. It is designed to attack radar systems and carries a high explosive warhead. The PLA acquired an unknown number of Harpy UAV's in 1994. Yet the deal was not revealed until late 2004, when Washington was reported to have pressured the Israeli government to 'roll back' its defense relations with China. According to reports, the U.S. intelligence spotted the PLA deploying Harpy UAV in an exercise held near the Taiwan Strait in 2004.

HAWK Missile System

The HAWK surface to air missile system provides medium-range, low to medium altitude air defense against a variety of targets, including jet and rotary wing aircraft, unmanned aerial vehicles, and cruise missiles.

Hengshan

A hardened military command center located in the heart of Dazhi Ya Nan Mountain in northern Taipei.

HQ-9

The HQ-9 is a Chinese medium to long-range, active radar homing Surface-to-Air Missile (SAM). Initially an indigenous design, the HQ-9 is believed to have undergone a redesign to incorporate Russian rocket technology after the acquisition of S-300 5V55-series missiles from Russia. There are unconfirmed rumors that the HQ-9 uses a sophisticated guidance system not dissimilar from that used in the U.S. Patriot missile system.

Hsinchu Air Force Base (AFB)

An airbase located along Taiwan's western coast near the city of Hsinchu.

Hualien Air Force Base (AFB)

An airbase located along Taiwan's eastern coast near the city of Hualien. The station is an airport for civil and military uses, with 11.5 hectares of land borrowed from the air force for commercial use.

Hughes Air Defense Radar (HADR)

The HADR, or Hughes Air Defense Radar, is a three-dimensional planar array air defense radar manufactured by Hughes. Computer controls enable radar coverage up to 30,000 meters and a 24° elevation.

Identification Friend or Foe (IFF) Code

IFF codes are the primary method towards positive identification of another aircraft. Proper use of such codes facilitates rapid engagement of enemy aircraft, conserves air defense assets, and reduces risk to friendly aircraft.

Information Warfare (IW)

Information warfare is the use and management of information in pursuit of a competitive advantage over an opponent. Information warfare may involve collection of tactical information, assurance that one's own information is valid, spreading of propaganda or disinformation to demoralize the enemy and the public, undermining the quality of opposing force information and denial of information-collection opportunities to opposing forces. Information warfare is closely linked to psychological warfare.

ISR

Acronym for Intelligence, Surveillance and Reconnaissance, a term used for units and systems that collect and process information into intelligence that can be used to initiate operations.

J-7

The Chengdu Jian-7 is a People's Republic of China-built version of the Soviet Mikoyan-Gurevich MiG-21. Though production ceased in 2008, it continues to serve - mostly as an interceptor - in several air forces, including in the People's Liberation Army Air Force (PLAAF).

J-8

The Shenyang Jian-8 is a high-speed, high-altitude Chinese-built interceptor fighter aircraft. A PLA effort to develop an all-weather interceptor to combat high altitude threats began in 1964 and resulted in China's first domestically designed and built jet fighter. Following their deployment in the People's Liberation Army Air Force and Naval Air Force (PLAAF/PLANAF) in 1980, the J-8 has been improved and upgraded numerous times using Soviet technology. Currently, an estimated 300 J-8's are in service in China, although the J-10 and J-11 variants are expected to replace them over the coming years.

J-10A

This “Fourth Generation” aircraft is a new addition to China’s Peoples Liberation Army Air Force. Improvements from older models include a short-take-off ability and improved maneuvering capabilities.

J-11A/B

In 1998 the Shenyang Aircraft Corporation entered into an agreement with Russia’s Sukhoi to build 200 “Fourth Generation” Su-27SKs as the J-11A. China built a little over 100 such aircraft before appropriating the design and adding an indigenous radar and indigenous weapons like the PL-12 AAM. The resulting aircraft is called the J-11B, which will reportedly shortly feature a new indigenous turbofan.

JH-7

The Xian Jianjiji Hongzhaji-7 is a twin-engine fighter-bomber in service with the People’s Liberation Army Air Force and Naval Air Force (PLAAF/PLANAF). The main contractors are Xian Aircraft Industry Corporation and the 603rd Aircraft Design Institute. The first batch of JH-7 aircraft were delivered to the PLANAF in the mid-1990s for evaluation, and the improved JH-7A variant entered service in 2004. There are also reports of a stealthy JH-7B in development.

Joint Air Operations Center (JAOC)

The principal operations installation from which aircraft and air warning functions of combat air operations are directed, controlled, and executed by more than one military service. It is the senior agency from which command and control of air operations are coordinated, issuing daily Air Tasking Orders (ATOs) to all air defense units for the coordination and execution of DCA & OCA operations.

KH-31

The KH-31 is a Russian air-to-surface missile carried by aircraft such as the MiG-29 Fulcrum or Su-27 Flanker. It is a sea-skimming cruise missile with a range of 110 kilometers or more, capable of speeds of up to Mach 3.5. There are several variants of the KH-31, although it is best known as an anti-radiation missile (ARM).

KJ-200

Based on a new version of the four-turboprop powered Y-8 transport, the KJ-200 features a new “beam” active phased array radar. It costs less than the KJ-2000, and is also expected to enter PLA Navy Air Force service.

KJ-2000

KJ-2000 is a Chinese Airborne Early Warning and Control system (AWACS) that uses domestically designed electronics and radars installed on a modified Russian Ilyushin IL-76 airframe. The current KJ-2000 AWACS in Chinese service is equipped with a domestically developed AESA (active electronically scanned array) radar.

40mm/L60 AA Guns

The 40mm Bofors Light Anti-Aircraft Gun, based on a Swedish design and built in Canada, served in a number of different theatres during the Second World War. A derivative design, with a shortened barrel and a bell-shaped blast deflector, is mounted on the AC-130 gunship.

Land Attack Cruise Missile (LACM)

One of the two primary types of cruise missiles (the other being Anti-Ship Cruise Missiles, or ASCM), a LACM is an unmanned, armed aircraft designed to attack a fixed or mobile ground-based target. It spends the

majority of its mission in level flight, as it flies a preprogrammed path to a predetermined target. Propulsion is usually provided by a small jet engine.

Land-Based Air Defense Missile System

A land-based architecture for protecting against the threat of missile attacks.

Lead-In Fighter Trainer (LIFT)

An aircraft used to develop war-fighting skills and providing on the job training to military pilots.

Letter of Request (LOR)

The document that starts the Foreign Military Sales (FMS) government-to-government sales process. The LOR can be a formal letter, E-mail or message requesting articles, military construction, or other services, as well as Price & Availability data. In the U.S., each LOR is reviewed and validated by the Military Department affected, by the DSCA, and by the U.S. Department of State.

Link-16 (TADIL J)

Link-16 is a relatively new tactical data link employed by the United States Navy, the Joint Services, Japan, and some nations of the North Atlantic Treaty Organization (NATO). Link-16 has certain technical and operational improvements over existing tactical data link (Link-11/Link-4A) capabilities, with some data exchange elements. It provides significant improvements, including improved security, increased data rate (throughput), increased amounts/granularity of information exchange, and reduced data terminal size (allowing installation in fighter and attack aircraft). It also offers digitized, jam-resistant, and secure voice capability; relative navigation; precise participant location and identification; and an increased number of participants.

Makung

Makung is the county seat of Penghu, a small island chain also called the Pescadores, located off Taiwan's western coast in the Taiwan Strait.

MASINT

Measurement and Signature Intelligence, or MASINT, is scientific and technical intelligence information obtained by quantitative and qualitative analysis of data derived from sensors. The purpose is identifying any distinctive features associated with the source, emitter, or sender of the data, and to facilitate subsequent identification and/or measurement of the same.

Mean-Time Between Failure (MTBF)

The predicted elapsed time between inherent failures of a system during operation.

MICA Missile

The MBDA MICA (Missile d'Interception et de Combat Aérien, or "Interception and Aerial Combat Missile") is an anti-air multi-target, all weather, fire-and-forget short and medium-range missile system. It is intended for use by air platforms as well as by ground units and ships, which can be equipped with the rapid fire MICA Vertical Launch System. The first trials occurred in 1991, and the missile was commissioned in 1996 to equip the Rafale and Mirage 2000 aircraft. It is a replacement for both Super 530 (interception) and Magic II (dogfight).

Mid-Life Upgrade (MLU)

The term refers to the process of upgrading a system to enhance survivability and to extend its service life. Upgrades can include additional hardware and/or software upgrades, retrofitting of new technology, updating communications and navigation systems, or other modifications to keep pace with high tech advances in sensors, weaponry, and communications.

MIDS-LVT/MIDS

The Multifunctional Information Distribution System-Low Volume Terminal (MIDS-LVT) is an advanced Link-16 command, control, communications, and intelligence system incorporating high-capacity, jam-resistant, digital communication links for exchange of near real-time tactical information - including both data and voice, among air, ground, and sea elements. MIDS-LVT is intended to support key theater functions such as surveillance, identification, air control, weapons engagement coordination, and direction. The MIDS ON-Ship (MOS) variant supports key theater functions from naval platforms.

MiG-17

The Mikoyan-Gurevich 17 is a high-subsonic performance jet fighter aircraft produced in the USSR from 1952 onward, operated by numerous air forces in many variants. It is an advanced version of the MiG-15 used in the Korean War, and was used as an effective threat against supersonic fighters. The Chinese version is known as the Shenyang J-5.

Ministry of National Defense (MND)

The MND is responsible for formulating military strategy, setting military personnel policies, formulating draft and mobilization plans, delineating supply distribution policies, arranging the research on and development of military technology, compiling the national defense budget, setting military regulations, conducting court martial proceedings, and administering military law. Within the Ministry of National Defense is the General Staff Headquarters (GSH), under which are the various services, including the Army, Navy, Air Force, Combined Services Forces, Armed Forces Reserve Command/Coast Guard Command, Military Police Command. The MND also has other subordinate agencies such as military academies, military courts, prosecutorial bureaus, and jails, as well as R&D institutions like CSIST.

Mirage 2000-5 [Ei/Di]

The Mirage 2000-5 by Dassault Aviation is a multi-role fighter, its multiple-target air-to-ground and air-to-air firing procedures linked to the use of RDY radar and a visualization and control system. As a combat aircraft with versatile air-to-air mission capabilities, the Mirage 2000-5 is designed for the most-advanced armaments. Taiwan currently fields both the Ei & Di variants.

Missile Defense

An overarching term for the systems, weapons programs, and technology that is used in the defense against an offensive missile strike.

Missile Warning Center (MWC)

An MWC manages a set of ballistic missile sensors and its reporting systems to provide timely, accurate, and unambiguous warnings of a missile attack.

Mode T

The Taiwan military's aviation transponder interrogation mode for Identification Friend or Foe (IFF) systems. The term refers to the specific format of a sequence of pulses sent from an interrogating radar to an aircraft or other vessel to determine its IFF status. Taiwan's Mode T is the equivalent of the U.S. Mode 4.

Nanjing Military Region

One of seven military command regions for the Chinese People's Liberation Army. Its jurisdiction covers all military and armed police located in Anhui, Jiangsu, Zhejiang, Jiangxi, Fujian, and Shanghai. The International Institute for Strategic Studies lists the formation with an estimated 250,000 personnel, three group armies, two armored, one mechanized infantry, three motorized infantry, and one artillery division. There are also one armored, four motorized infantry, two artillery, three anti-aircraft brigades, plus an anti-tank regiment. The headquarters for the East Sea Fleet are located within the region, at Ningbo.

Network Enabled Weapons (NEWs)

Weapon platforms that are designed to be integrated into Network Centric Warfare systems.

Nuclear, Biological, Chemical Defense (NBCD)

A form of defensive warfare focusing on the combination of nuclear, biological, and chemical threats to humans and their environment.

Operational Conversion Unit (OCU)

A unit within an air force whose role is to support preparation for the operational missions of a specific aircraft type by providing trained personnel. OCUs teach pilots how to fly an aircraft and which tactics best exploit the performance of their aircraft and its weapons.

PAC-2+ "Patriot" (Patriot Advanced Capability 2+)

Acquired by Taiwan in 1994, the Modified Air Defense Systems (MADS) is an upgraded version of the Patriot missile system, with improved intercept capability and incorporating lessons learned by the U.S. in the Persian Gulf War. The Patriot PAC-2+ systems, comprising missiles, wheeled vehicles, and a multifunctional radar, provides medium and high altitude air defense and protection against short and medium-range ballistic missiles.

PAC-3 "Patriot" (Patriot Advanced Capability 3)

The Patriot Advanced Capability 3 is an advanced surface-to-air guided missile defense system effective against low-to-high-altitude air threats in defense of ground combat forces and critical assets. Its key features are the multifunction phased array radar, missiles with semi-active and active guidance, and automated operations with capabilities for human override. The PAC-3 missile is a highly agile hit-to-kill interceptor for defense against tactical ballistic missiles, cruise missiles, and air-breathing threats, and destroys its targets by direct, body-to-body impact. The PAC-3/Configuration 3 introduces an upgraded AN/MPQ-65 radar to increase detection in high-clutter environments, and to improve discrimination of closely spaced objects (better decoy recognition).

People's Liberation Army (PLA)

The PLA serves as the military of the Peoples Republic of China (PRC) and is comprised of Ground Forces, Navy (PLAN), Air Force (PLAAF), two Artillery Corps (strategist missile forces) and the Peoples Armed Police Force. Estimated at 2.3 million personnel, the PLA is the largest standing military in the world. The PLA was

established in 1927 as the military arm of the Communist Party of China and was originally designated the 'Red Army'. The semi-autonomous organization reports to two Central Military Commissions, one belonging to the state and one belonging to the party.

Peoples Republic of China (PRC)

The official name of the Mainland China-based government.

Pescadores Islands

The Pescadores islands, also known as the Penghu islands, are an archipelago off the western coast of Taiwan in the Taiwan Strait. It consists of 90 small islands and islets covering an area of 141 square kilometers. The whole archipelago forms Taiwan's Penghu County.

PL-12

This active-guided air-to-air missile benefits from Russian technology and has an estimated 70 to 100km range, making it competitive with the Russian R-77 and the U.S. AMRAAM.

Po Sheng "Broad Victory" Project

The C4ISR project codenamed "Po Sheng" is aimed at integrating different weapons systems of the three services in Taiwan by building data links (see Link-16) between them. The goal is to share information in real time. The main Po Sheng project for the Taiwan military was completed in 2009.

Price & Availability Data (P&A)

One of the first steps in an FMS case. A foreign government will request "price and availability data" (P&A data) on the U.S.-produced items it is interested in purchasing.

Q-5

The Nanchang Q-5, also known as the A-5 in its export versions, is a Chinese-built ground-attack aircraft based on the Soviet MiG-19. It was introduced to the People's Liberation Army Air Force (PLAAF) in 1970. Numerous variants of the original Q-5 were subsequently developed, although the aircraft is best known for its close air-support capabilities.

R.550 Magic 2

The Magic 2 is a short-range, air-to-air missile designed for close-in engagements. The missile features an IR seeker, and is the French counterpart to the U.S. Sidewinder missile. It is used on Mirage fighter jets, among other platforms.

RAND Corporation

The RAND Corporation (Research ANd Development) is a nonprofit global policy think-tank initially formed to offer research and analysis to the United States armed forces. It is financed by the U.S. government and from a private endowment, as well as by contributions from corporations, universities and private individuals. RAND aims for interdisciplinary and quantitative problem solving via translating theoretical concepts from formal economics and the hard sciences into novel applications in other areas.

Regional Operations Control Center (ROCC)

A facility serving as the nerve center for air defense operations. Taiwan's three ROCCs are designed to help modernize and enhance Taiwan's automated air defense command and control system, as well as to provide redundancy and increase the system's survivability.

S-300 PMU-2

A Russian long-range surface-to-air missile system, developed to defend against aircraft and cruise missiles for the Soviet Air Defense Forces. Subsequent variations were developed to intercept ballistic missiles, and in 1997, the S-300PMU-2 was introduced as an upgrade. This system is reportedly capable not just against short-range ballistic missiles but also against medium-range tactical ballistic missiles. China was the first foreign government to purchase the system from Russia.

Short-Range Tactical Ballistic Missile (SRBM)

A short-range tactical ballistic missile (SRBM) is a ballistic missile with a range of about 1,000 km or less that is usually mobile. Warheads can include conventional high explosive, chemical/biological and nuclear warheads. In potential regional conflicts, these missiles would be used because of the short distances between some countries and their relative low cost and ease of configuration.

Short Take-Off and Vertical Landing (STOVL)

STOVL refers to the ability of some aircraft to take off from a short runway and land vertically (i.e. with no runway). Both the Harrier Jump Jet (although technically a Vertical Take-Off and Landing/VTOL aircraft) and the F-35 Joint Strike Fighter - with demonstrated VTOL capability in test flights - are operationally STOVL.

SIGINT (Signals Intelligence)

SIGINT is a form of intelligence gathering, which involves the interception of signals through radio or other electronic means.

Single Integrated Air Picture (SIAP)

The "Air" component of the Common Tactical Picture that allows military personnel and allies to share a single graphical representation of the battle space. This is accomplished using data generated by multiple land, surface and air sensors, broadcast via a sophisticated logistical information distribution system. Once implemented, the SIAP will help users make better, more informed decisions by linking military forces and their tactical situations.

Skyguard Air Defense System

An air defense system that combines two Oerlikon 35-mm twin cannons with a fire control radar. It is housed on a towed trailer, mounted on the roof of which is a pulse doppler search radar, a pulse doppler tracking radar, and a co-axial television camera. The trailer also houses the crew of two and a small petrol generator.

SL-AMRAAM (Surface Launched Advanced Medium Range Air-to-Air Missile)

The SLAMRAAM is a short-range air weapon, giving the capability to engage targets (including missiles and helicopters) to beyond line-of-sight. SLAMRAAM is also intended to defend against the evolving air threat from unmanned aerial vehicles (UAVs) and cruise missiles.

Strong Bow

Designation for a new Taiwan land-based air defense missile system.

SU-27

The Sukhoi Su-27 is a one-seat Mach-2 class jet fighter with a 3,530 km range, heavy armament, sophisticated avionics and high agility. Originally manufactured by the Soviet Union, China acquired 76 Su-27 fighters from Russia before signing an agreement in 1998 to redesign China's own versions of the plane as the Shenyang J-11

SU-30

The Sukhoi Su-30 is a twin-engine, two-seat, multi-role military aircraft developed by Russia and introduced into operational service in 1996 as a dual-role fighter for all-weather, air-to-air and air-to-surface deep interdiction missions. The PLAAF operates 76 Su-30MKKs and the PLANAF operates 24 Su-30MK2.

Surface-to-Air Missile (SAM)

A radar or infrared guided missile, fired from a position on the ground to intercept and destroy enemy aircraft or missiles. SAMs are generally classified by their guidance, mobility, altitude, and range, and vary from man portable versions (MANPADS) to large fixed installations.

Surveillance Radar Program (SRP)

A foreign military sales (FMS) acquisition to provide an integrated early warning radar system for Taiwan. Planned missions for the system include missile warning, air-breathing threats, and maritime ship tracking. This system, consisting of a UHF phased array radar and 2 Missile Warning Centers (MWCs), will be installed and tested at locations in Taiwan and integrated into Taiwan's Military Information Communication System (MICS).

Tactical Ballistic Missile (TBM)

A ballistic missile designed for short-range - typically less than 300 km - and for bridging the gap between conventional rocket artillery and longer-range theatre ballistic missiles. TBMs are generally mobile, ensuring survivability and giving the ability to deploy quickly, and can carry a variety of warheads, including conventional high explosive, chemical/biological, and nuclear.

Tainan Air Force Base (AFB)

The Tainan Air Force Base is located on Taiwan's southwest coast, in the South District of the City of Tainan. Its runways serve both military and civil functions, and the commercial Tainan Airport is the third busiest domestic airport in Taiwan.

Taitung Air Force Base (AFB)

The Taitung Air Force Base (previously known as the Chih-hang AFB) is located on Taiwan's southeastern coast, in the city of Taitung. A major hardened aircraft storage facility, rumored to have a capacity for between 60-80 aircraft, is in the process of being completed here.

Taiwan Relations Act

Following termination of official relations between the U.S. and Taiwan on January 1, 1979, Congress signed into law the Taiwan Relations Act to authorize "the continuation of commercial, cultural, and other relations" between the U.S. and Taiwan. The Act also established the American Institute in Taiwan as the organization through which such relations would be handled, stipulated that the U.S. would "provide Taiwan with arms of a defensive character", and set the legal framework for the current relationship.

Taiwan Strait

The Taiwan Strait is a 180 km-wide section of ocean between Fujian Province on mainland China and the island of Taiwan. The strait is part of the South China Sea and connects to East China Sea to the northeast. The narrowest part is 131 km wide. Beijing and Taipei respect a "middle line" in the Taiwan Strait, sometimes called the Taiwan Strait Meridian, and have generally kept their warplanes and ships from crossing this line. The

"middle line" or Taiwan Strait Meridian was drawn by the United States when it signed the - since obsolete - Mutual Defense Treaty with Taiwan in 1954.

Tau-Ten Ground System (TTGS)

A Taiwan equivalent to TADIL-A/Link 11, it is a secure half-duplex radio UHF/HF link used to exchange digital information among airborne, land-based, and ship-board tactical data systems.

TC Tien-Chien "Sky Sword" Missile System

TC-1 is a short-range IR guided air combat missile, with ECCM (electronic counter-countermeasures) and "fire and forget" capability. TC-2 is an air-to-air medium-range intercept missile, with mid-course inertial guidance and terminal homing guidance. TC-2 has the capabilities of multiple target engagement and ECCM. The TC-2A is an indigenously developed anti-radiation variant of the Sky Sword missile.

TC-2A "Sky Sword" Anti-Radiation Missile

The TC-2A air-to-surface Anti-Radiation Missile (ARM) is being developed by CSIST. The missile uses both active and passive radar guidance and has a range of between 74km and 90km, enabling its carrier plane to fire at targets along China's southeastern coast from a safe distance in the Taiwan Strait. The missile is expected to considerably enhance Taiwan's retaliatory strike capability.

TK Tien-Kung "Sky Bow" Missile System

A surface-to-air missile system, derivative of the Patriot system, designed for air defense against intensive aircraft attack. The TK-1 missile is designed for mid-range interception against aerial saturation attack, and is equipped with a semi-active radar homing seeker. TK-2 missiles further extend the range and fire power by adopting the active radar homing seeker. An indigenous anti-tactical ballistic missile system is called TK-3.

TK-3 "Sky Bow" Anti-Tactical Ballistic Missile

The TK-3 is an indigenous Anti-Tactical Ballistic Missile (ATBM)-capable surface-to-air missile system, upgraded with a longer range and improved anti-missile capability over its predecessor TK-2. Under research and development at CSIST for a number of years, the TK-3 system began operational testing and evaluation in 2006.

Trade and Investment Framework Agreement (TIFA)

A bilateral framework between the United States and a foreign economy, through which trade and investment issues are discussed. A TIFA is often seen as a precursor to a Free Trade Agreement.

Transporter-Erector-Launcher (TEL)

The term for a vehicle that can carry, elevate to firing position, and launch one or more missiles.

Unmanned Aerial Vehicle (UAV)

UAV refers to aircraft that navigate by remote control or by internal guidance systems. Originally designed for reconnaissance and intelligence-gathering, UAVs have come into the public eye through their recent use in combat and search & destroy missions. The Predator UAV is perhaps the most famous incarnation of this type of aircraft.



The Balance of Air Power in the Taiwan Strait



The Balance of Air Power in the Taiwan Strait

© 2010 US-Taiwan Business Council

The US-Taiwan Business Council has the sole and exclusive rights to the copyrighted material contained in this report. Use of any material contained in this report for any purpose that is not expressly authorized by the US-Taiwan Business Council, or duplicating any or part of the material for any purpose whatsoever, without the prior written consent of the US-Taiwan Business Council, is strictly prohibited and unlawful.



1700 North Moore Street, Suite 1703
Arlington, Virginia 22209
Phone: (703) 465-2930
Fax: (703) 465-2937
council@us-taiwan.org
www.us-taiwan.org