

Pivot point:

Re-shaping US maritime strategy to the Pacific



A multinational armada seen underway during the RIMPAC 2012 exercise. RIMPAC and similar regional exercises will take on an increasing importance as the US seeks to improve interoperability and strengthen engagement with partners across the Pacific region.

The strategic pivot toward the Asia-Pacific region is intended to rebalance the projection and focus of US military power in the years ahead. However, it will not be without its challenges. **Robbin Laird** and **Ed Timperlake** offer this analysis

During the past 18 months President Barack Obama's administration has put in motion a set of policy changes that will re-shape US strategy in the Pacific. The challenge in successfully implementing this is that, after more than a decade of war in Iraq and Afghanistan, the US military is confronting a depleted set of key capabilities.

New defence guidance, maritime strategy and shaping capabilities are essential to ensuring a successful transition in the Pacific. However, in the presence of looming resource constraints, how will this happen and what kind of innovative thinking might drive a shift in Pacific strategy? If 'hollow thinking' goes along with hollowing out the force, no 'Pivot to the Pacific' will actually succeed.

Furthermore, there will not be a set of briefing charts that can express what a successful Pacific strategy might look like.

The strategy will be remade by responses to events, and leveraging new technologies in the Pacific as US forces work with allies and other partners to deal with various threats and challenges as they emerge across the region. A new Pacific strategy will only be successful if based on partnership.

Strategic challenges

The challenges currently confronting the US armed services in the Pacific are far different than those of 2001. Not only have conflicts in Afghanistan and Iraq consumed US defence investment and taken critical thinking away from air-sea maritime theatres such as the Pacific, but new threats and challenges have substantially re-shaped the theatre.

The most obvious change has been the rise of China and its emergence not only as the key economic partner of the major trading nations

in the Pacific, but also their major strategic challenge. The issue facing the United States and its allies is how to shape a strategy that allows robust economic collaboration with China, while simultaneously developing a capacity to constrain Chinese ambitions and influence in the Pacific and beyond. To retain the upper, the United States has postulated a new and inherently scalable concept that combines forward presence with high levels of interoperability with regional allies.

Another significant strategic challenge is the rapid emergence of the Arctic Ocean areas as key drivers of global economic and energy development, as well as opening up new, shorter transit routes to European markets from Pacific ports. This will additionally enable Russia, should it require to do so, to coalesce its European and Pacific maritime forces. China will also be able to use transit

routes in the Arctic and be a key player in the economic development of Arctic areas where it can exert strategic influence. Meanwhile, the five-nation “Arctic 5” group – Canada, Denmark, Norway, Russia and the United States – will seek to shape a strategic agenda at the top of the world.

In addition to the new strategic dynamic is the role of nuclear weapons in what defence strategist Paul Bracken calls the ‘second nuclear age’. Any realistic US strategy for the Pacific has to be built around nuclear deterrence as a bedrock element, but increasingly some strategists in the US wish to rule nuclear weapons ‘out of the equation’.

The strategic reality is quite different. Deterrence in a region like the Pacific will be significantly shaped by the presence of nuclear weapons. China is strengthening and diversifying its nuclear force, while North Korea is building and expanding.

Another dynamic is the growing military capability of key allies in the Pacific such as Australia, Japan, and South Korea. Each of these is building specific capabilities to secure their national interests, and the challenge for the United States will be to work more effectively with those allies in constraining China’s rise.

In effect, the United States will need to shape a new strategy in the Pacific. Any US-China rivalry in the region will revolve around who has the most effective allied strategy, and whether or not the United States delivers what the allies are looking for. In short, presence, engagement and effective capabilities to deflect Chinese efforts to dominate in the region.

Integrated approach

Accordingly, the US Navy (USN) and US Marine Corps (USMC) – complemented by the US Air Force (USAF) and the US Coast Guard (USGC) – are having to think afresh to shape a different approach in the Pacific. One expression of such ‘integrationist’ thinking has been the Air-Sea Battle construct.

The Air-Sea Battle is ultimately about the future of power projection in the region, and overcoming the challenges posed by China’s growing anti-access/area denial (A2/AD) capabilities. The objective of the Air-Sea Battle is clear: to enhance conventional deterrence in the Pacific to offset the rise of Chinese political, military and economic influence.

For the authors of the Pentagon’s Joint Operational Access Concept (JOAC), the Air-Sea Battle is a subset of the broader

strategic problem of presence and access. Nonetheless, the document contains a very clear statement regarding what it believes is the focal point of the Air-Sea Battle concept: “The intent of Air-Sea Battle is to improve the integration of air, land, naval, space, and cyberspace forces to provide combatant commanders with the capabilities needed to deter and, if necessary, defeat an adversary employing sophisticated [A2/AD] capabilities. It focuses on ensuring that joint forces will possess the ability to project force as required to preserve and defend US interests well into the future.

“However, it is important to note that Air-Sea Battle is a limited operational concept that focuses on the development of integrated air and naval forces in the context of [A2/AD] threats. The concept identifies the actions needed to defeat those threats and the materiel and non-materiel investments required to execute those actions.”

The capacity to work more effectively across the US military services in delivering capabilities to the combatant commanders to support operations is central to the Air-Sea Battle concept. As then Chief of Staff of the USAF General Norton Schwartz commented in the JOAC document: “Our testing last year of an [Lockheed Martin] F-22 [fighter] in-flight, re-targeting a Tomahawk cruise missile that was launched from a [USN] submarine, is an example of how we are moving closer to this joint pre-integration under our Air-Sea Battle concept.”

Admiral Jonathan Greenert, Chief of Naval Operations, provided another characterisation during the same presentation, observing: “Air-Sea Battle uses integrated forces for what we like to think as three main lines of effort. It’s integrated operations across domains to complete, as I said, our kill chain,

but it’s also Air-Sea Battle lines of effort to break the adversary’s kill or effects chain. We want to disrupt the C4ISR piece of it; decision superiority.

“How do we get into that information superiority area? Defeat of weapons launch, get to the archer, or defeat the weapon kinetically to defeat the arrow?”

“Looking at those three lines of effort, kind of summarises how we approach that? Air-Sea Battle is a subset of a broader presence and engagement challenge.”

If China and North Korea are the foci, then re-enforcing the entire US precision strike enterprise is the priority. The objective is to have as many forces as possible that can be deployed forward to strike Chinese or North Korean assets in time of war.

Precision strike coming by air, ground, and sea forces would be the means to target as many aim points as possible to create escalation dominance and to win the Air-Sea Battle. In a more traditional mindset sense, the onus falls on carrier strike groups, air/expeditionary strike groups, and systems like long-range bombers that can deliver large strike packages.

However, what if the Air-Sea Battle really is more about shaping a presence with reach back to other capabilities to support a different kind of force architecture and a different set of objectives? If so, deploying precision strike on as many platforms as possible is not the means to the end. Rather, a different set of ends could well drive a new approach.

Maximising presence forces able to operate across the entire spectrum of security and military operations then becomes the focus. These forces need to be effective, agile, and scalable with both significant interoperability in the region and reach-back to surge forces operating on the fringes of the Pacific.



US Secretary of the Navy Ray Mabus meets with Chinese officials in Beijing in November 2012. Mabus visited China as the United States is rebalancing its maritime force towards the Pacific.

Assuming the approach is not primarily about striking Chinese and North Korean assets, but to constrain adversary operations in the Pacific and beyond, the tools needed are presence, partnership building and operations – and an ability to put in place distributed, forward-deployed capabilities that can be rapidly augmented.

Indeed, USN and USMC leaders are discussing presence in terms of the Single Naval Battle. Rather than a monolithic strategy, it is a mindset about how to shape templates for more effective integration of naval forces in the epoch ahead.

The USN and USMC might not use the term 'single naval battle', because in today's media world, one would spend endless time debating what the concept means. The point is less about the concept and more about how to shape a mindset, which will lead to tighter integration of the key elements of naval power projection.

Commanders' perspectives

During recent interviews conducted by IHS Jane's with US commanders involved in Pacific operations, a common thread was simply the size of the Pacific Area of Responsibility (AOR), and the challenge of operating limited forces over such a large region.

There is also concern with the limitations on available resources to operate throughout the depth and scope of the Pacific. For example, the USGC is concerned about the absence of major vessels and how many of the improved

National Security Cutters will be procured. This concern was matched by worries about the numbers of amphibious ships.

In all discussions, the demand on resources was highlighted. For example, Marine Forces Pacific conducted more than 100 exercises and events during 2012, spread across 48 countries, both inside and outside the AOR. This included deploying the first marines to start a more permanent presence in Australia.

Through the training efforts, the USMC established an operational presence throughout the entire region. Training kept deployed marines as the ready force to respond when crises occurred, and through forward training in the region, the USN and USMC teams were able to respond when a crisis such as the flooding in Thailand and the Philippines with forces that were already in theatre.

Furthermore, it was clear from the interviews that ongoing operational demands made it difficult to move forward on a new strategy without additional investment in platforms and systems. Implicitly, if the US does not invest in new platforms and systems, there will inevitably be a shortfall in future US capabilities in the Pacific.

For General Mike Hostage Commander, Air Combat Command, there is no alternative but to build out air capability with Lockheed Martin F-35 Lightning II Joint Strike Fighter aircraft. He is clearly concerned with numbers and the need to procure a serious fleet of F-35s to provide the kind of "combat cloud" crucial to cover an area as vast as the Pacific. The fleet

implications are also about innovative new ways to work with allies. Gen Hostage said: "The F-35s are central to the transition. We are operating in contested air space and need to shape a distributed air operations capability."

"The F-22s aggregated in appropriate numbers can do some amazing and essential tasks, and with a significant number of F-35s, we can reshape the operational space."

"The ability of the planes to work with each other over a secure distributed battlespace is the essential foundation from which the air combat cloud can be built. And the advantage of the F-35 is the nature of the global fleet."

"Allied and American F-35s, whether USAF, USN, or USMC, can talk with one another and set up the distributed operational system. Such a development can allow for significant innovation in shaping the air combat cloud for distributed operations in support of the Joint Force Commander."

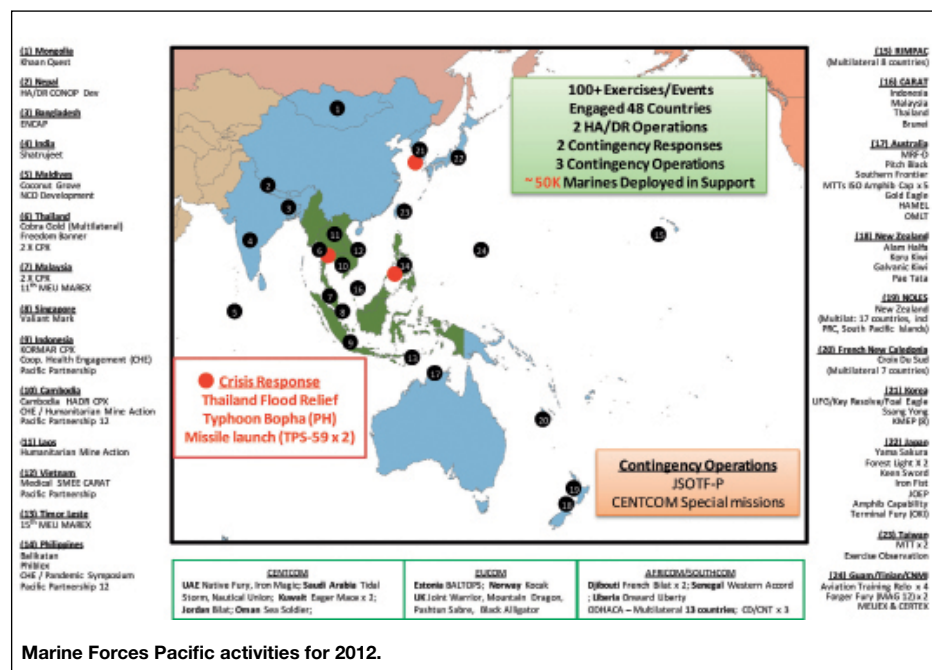
In addition to diminishing platform numbers, many leaders expressed concerns about new challenges and emerging threats. For General Charles Jacoby, US Northern Command and North American Aerospace Defense Command chief the addition of the Arctic as an operating environment meant new challenges and new demands for resources:

"We need to make advances over time that [will] allow us to stay ahead of evolving problems, with a solid strategic direction defined and in place. There is a school of thought that says we can have competitive commercial and economic interests in the Arctic, but not have any associated security challenges. That is simply not the way the world works."

"Economic opportunities and challenges shape or imply security interests. We need to not only be prepared to take advantage of and exploit the economic opportunities in the Arctic, but also to be prepared to address security challenges."

For Lieutenant General Jan-Marc Jouas, deputy commander of United Nations Command Korea and US Forces Korea, the evolving North Korean missile capabilities ramps up the challenges to providing for the kind of air superiority crucial to deterrence in the future: "Air power is an essential element in Korea. This is a 'come as you are' fight over here. No one is going to let us reinforce for six months; when people take on the United States, they know they don't want to give us the time to build up our forces."

By air power, Gen Jouas was discussing the full range of integrated assets whether on land or at sea. He emphasised the central role



of support from the sea to the evolving threat environment on the Korean peninsula.

A common emphasis throughout was the need for what Lieutenant General Terry Robling, Commander, US Marine Corps Forces Pacific, called “persistent presence.” If you are not there, you are not a player: “The United States has been a significant presence in the region throughout the post-war period. That presence has been significant glue in the region facilitating both security and economic growth. Our allies and partners certainly recognise this and are looking at new ways to work with us to get that persistent presence.

“A key driver of demand is from partner nations, as well as the more obvious allies. South Korea, Japan, Australia and Thailand are certainly core allies, but we have growing demand from and opportunities with Cambodia, Vietnam, India, Malaysia and Indonesia for expanded working relationships.”

Coupled with “persistent presence” was a significant emphasis upon partnering and alliances and innovations in ways of working with other forces.

As Vice Admiral Manson Brown, then head



The guided-missile destroyers USS Fitzgerald (DDG 62) and USS McCampbell (DDG 85) manoeuvre with the Chinese People's Liberation Army Navy Type 052B destroyer Guangzhou off the coast of North Sulawesi, Indonesia, in 2009. The rise of China represents the biggest challenge to US influence in the Pacific.

US Navy - 1405130

of the USCG in the Pacific, emphasised: “It’s presence in a competitive sense, because if we are not there, someone else will be there, whether it’s the illegal fishers or whether it’s Chinese influence in the region. We need to be very concerned about the balance of power in the neighbourhood.

“If you take a look at some of the other players that are operating in the neighbour-

hood there is clearly an active power game going on.”

A key theme for the commanders was shaping an effective logistic and sustainment approach to supporting a widely deployed fleet of aircraft and ships. The head of the Military Sealift Command, Rear Admiral Mark H Buzby, provided an important “reality” check to the challenge of supporting deployed assets

Main Specifications:

- Two axis stabilized turret
- Automatic target tracking
- Day/night operation under all weather conditions
- Automatic ballistic calculation and correction
- Remote control
- Automatic slew to targets assigned from radar, target designator or C3
- Manual back-up mode

Stabilized Weapon Platforms

STAMP System:

- 7.62 mm / 12.7 mm MG
- 40 mm Grenade Launcher
- 12.7 mm GAU-19/A Gatling Gun

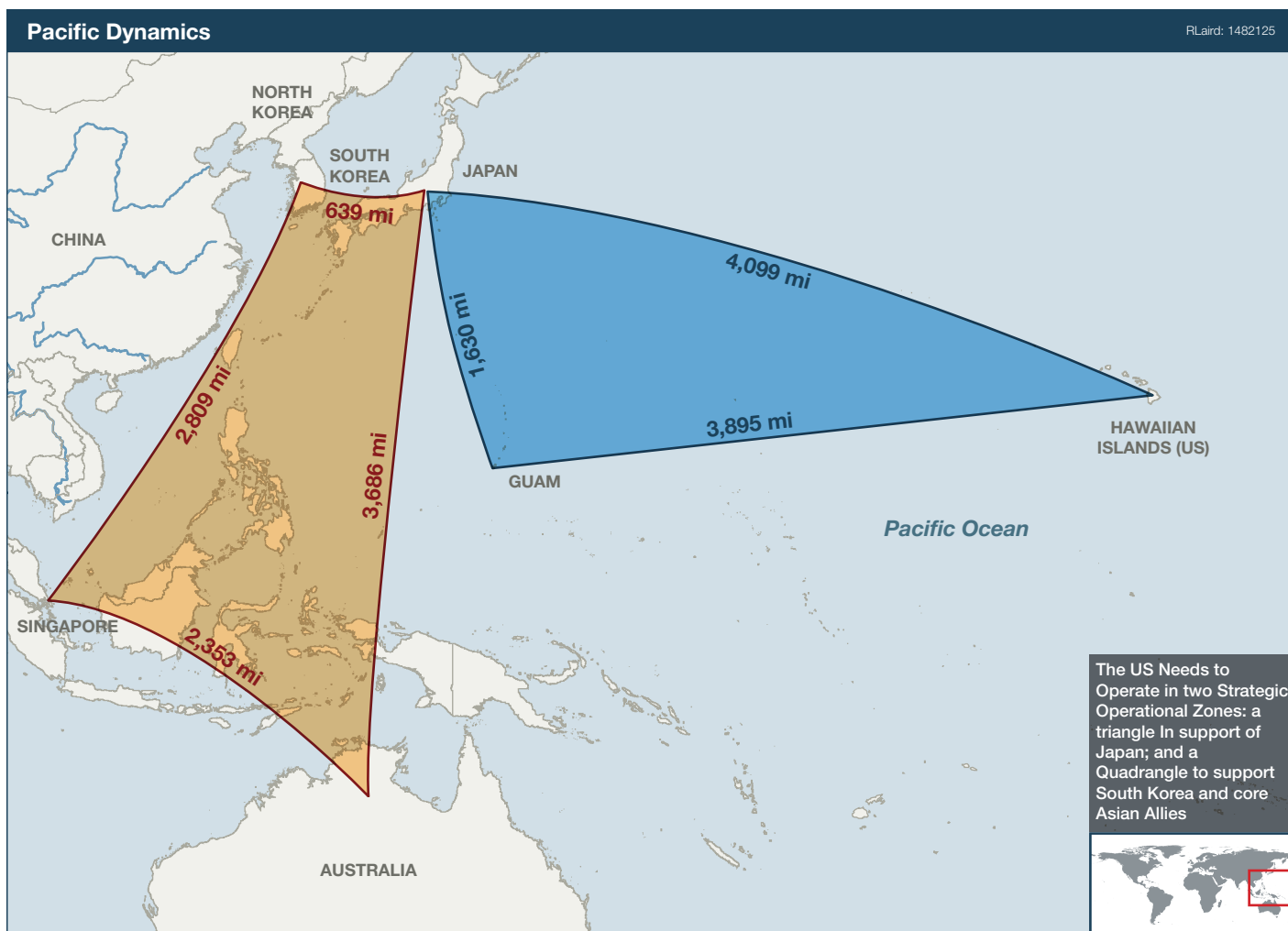
STOP System:

- 25 mm / 30 mm Dual Feeding Automatic Cannon

www.aselsan.com

aselsan

marketing@aselsan.com.tr



over a wide swath of ocean, pointing out that the kind of distributed fleet operations central to the future would place significant logistical demands on the fleet as well.

Several of the commanders cited operational innovations they were making to try to cope with the gap between demand and supply for security and defence forces.

For example, Major General Christopher Owens, Commanding General, 1st Marine Aircraft Wing, discussed how the Bell-Boeing MV-22 Osprey tilt-rotor aircraft was being leveraged to allow USMC forces to operate over a wider area and on a wider variety of platforms and locations to shape presence capabilities. “When I was a young lieutenant and captain, I think we had somewhere in the neighbourhood of 65 amphibious warships in the navy inventory. Now, we have 28 and they’re spread about as thin as they possibly can be. We’re running through their lifecycle faster than anticipated, and yet they’re never enough.

“Going back to the whole challenge in this

AOR is getting to where you need to be with some capability. Being able to stretch the legs of the aircraft and operate from austere sites is critical.”

An important modernisation effort involves command and control (C2) and information warfare systems to be developed, deployed, and integrated with US and allied forces in the Pacific. There are clear flashpoints or decision points, which can be leveraged to highlight modernisation opportunities.

A final theme, which was discussed but not highlighted in the interviews, was the A2/AD challenge posed by China, among others. Because these were commanders, they were not treating the problem as fixed in concrete, but very much in terms of dealing with a reactive opponent. A2/AD is an operational problem, not a final statement of an inability to deal with the challenge.

One commander who spoke to *IHS Jane’s* about the A2/AD challenge argued that thinking among many strategists is too narrowly focused: “The Chinese have an

advantage if they can use their resources on the mainland to support operations fairly close to their territory, he said”. That is not the strategic direction in which they are headed. They are coming out into the Pacific. And if we build the appropriate distributed force able to work closely with allies, then they have a different kind of anti-access, anti-denial problem of their own.”

Strategy will emerge in response to crises and when leveraging new technologies and allied relationships in the decades ahead, leadership will be imperative. Between the two world wars, the United States faced significant challenges to redefine naval strategy. As such, leadership emerged and guided the transformation of maritime forces and capabilities that paid dividends during the Second World War.

What was demonstrated by key leaders at that time was a profound grasp of the harsh reality that all military technology is evolving, and thus in a constant relative action/reaction cycle against a reactive enemy.

So how might US forces be shaped and work with allies to execute a 21st-century maritime strategy, one which draws on the diversity of air, ground and sea assets necessary for success?

There are two ways to think of the strategic objectives of force structuring in the period ahead. The first can be called shaping an attack and defence enterprise. The second can be labeled as the 21st century equivalent of the "big blue" blanket that the USN crafted to succeed in the Pacific in the Second World War.

The evolution of 21st-century weapon technology is breaking down barriers between offensive and defensive systems. Is missile defence about providing defence or is it about enabling global reach, for offence or defence? Likewise, the new fifth-generation aircraft have been largely misunderstood because they are inherently multi-mission systems, designed for both forward defence and forward offensive operations.

Indeed, an inherent characteristic of many new weapons systems is that they are really about presence, and laying a 'grid' over an

operational area so as to enable both strike and/or defence within an integrated context. In the 20th century, surge was built upon the notion of signaling: one would put in a particular combat capability – a carrier battle group, amphibious ready group, or air expeditionary wing – to put down a marker and to warn a potential adversary that you were there and ready to be taken seriously. If one

needed to, additional forces would be sent in to escalate and build up the force.

With today's new multi-mission systems – fifth-generation aircraft and the Aegis battle management system for example – the key is presence and integration with those same assets able to support strike or defence missions in a single operational presence capability. Now the adversary cannot be certain that



A2/AD challenges are spurring new programmes, such as DARPA's Long Range Anti-Ship Missile prototype demonstration programme.

Lockheed Martin 1460730

Client customised sea technology

Global solutions: Design, Construction, Systems Integration and through life support

Visit us at

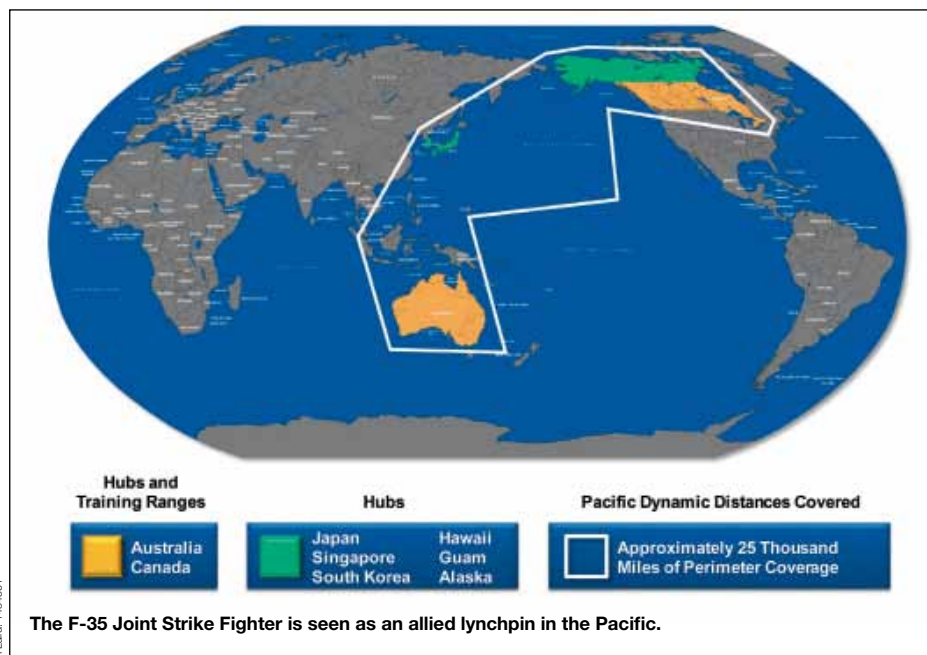
IDEF
Istanbul
May 7th - 10th, 2013

INDEX
Singapore
May 14th - 16th, 2013

CANSEC
Ottawa
May 20th - 30th, 2013

Navantia
www.savantia.es

The wake of the future



one is simply putting down a marker. This is what then USAF Secretary Michael Wynne called the “attack and defence enterprise”.

The strategic thrust of integrating modern systems is to create a grid that can operate in an area as a seamless whole, able to strike or defend simultaneously. This is enabled by the evolution of C5ISR (Command, Control, Communications, Computers, Combat Systems, Intelligence, Surveillance, and Reconnaissance), and it is why Wynne has underscored for more than a decade that fifth-generation aircraft are not merely replacements for existing tactical systems, but a whole new approach to integrating defence and offence.

By shaping a C5ISR system inextricably intertwined with platforms and assets that can ‘honeycomb’ an area of operation, an attack and defence enterprise can operate to deter aggressors and adversaries or to conduct successful military operations.

Inherent in such an enterprise is scalability and reach-back. By deploying the C5ISR ‘honeycomb’, the shooters in the enterprise can reach back to each other to enable the entire grid of operation, for either defence or offence.

In effect, what could be established from the US perspective is a ‘plug-in’ approach rather than a ‘push’ approach to projecting power. Allies are always forward deployed; the US does not attempt to replicate what those partners need to do in their own defence.

But what the US can offer is strategic depth to those allies. At the same time if interoperability and interactive sustainabil-

ity are recognised as a strategic objective of the first order, then the US can shape a more realistic approach than one which now rests on trying to proliferate power projection platforms, when neither the money nor the numbers are there.

Geo-political realities

As things stand, the core for the US effort from Hawaii outward is to enable a central strategic triangle, one that reaches from Hawaii to Guam and to Japan. This triangle is at the heart of the US’ ability to project power into the Western Pacific. With a 20th-century approach, one which is platform centric and rooted in step by step augmentation of force, each point of the triangle needs to be garrisoned with significant numbers of platforms which can be pushed forward.

To be clear, having capability in this triangle is a key element of what the United States can bring to the party for Pacific operations, and it remains fundamental. However, with a new approach to an attack and defence enterprise, one would use this capability differently from simply providing for push forward and sequential escalation dominance.

Rather than focusing simply on projecting power forward, what is crucial to a successful Pacific strategy is enabling a strategic quadrangle in the Western Pacific, anchored on Australia, Japan, Singapore, and South Korea. This will not be simple. Competition, even mutual suspicion, among US allies in the Western Pacific is historically deep-rooted; as

a former US 7th Air Force commander underscored, “history still matters in impeding allied co-operation.” But in spite of these challenges and impediments, enabling the quadrangle to do a better job of defending itself and shaping interoperability across separate nations has to become a central strategic US goal.

This will require significant cultural change for the United States. Rather than thinking of allies after its own strategy, it will need to reverse its logic. Without enabled allies in the Western Pacific, the United States will not be able to execute an effective Pacific strategy. It is not about to have a 600-ship navy; and putting Littoral Combat Ships into Singapore is a metaphor for the problem, not the solution.

The quadrangle can be populated by systems that form a C5ISR grid, in turn supporting a network of deployed forces. The population of the area with various sensors – aboard new tankers, fighter aircraft, air battle managers, unmanned aerial vehicles, ships, and submarines – creates the pre-conditions for shaping a powerful grid of intersecting capabilities. Indeed, the US can shape an attack-and-defence enterprise in the Western Pacific that it can easily plug into, if indeed it prioritises interoperability and the mutual leveraging of capabilities.

At the heart of re-crafting a 21st century US maritime strategy will be the grasp of new technologies and partnerships that will allow a credible evolution of a war winning and scalable presence force for Pacific deterrence. Among the core principles for building such a force is the recognition that not only is all weapon technology relative against a reactive enemy, but it is also relative amongst allied fighting forces.

In Max Hastings’ book ‘Inferno: The World at War 1939-1945’, he characterises the USN as showing itself to be “...the most impressive of its nation’s fighting services.”

Hastings goes on to stress that it took the relief of some early commanders, who did not understand the lessons of Carrier Operations (provided by the visionary insight of Admiral William S Sims at the Naval War College in 1924) that “carriers presented a 360-degree range of firepower via their aircraft that far outdistanced the radius of a battleships’ guns.” The navy wanted a “big blue blanket” to cover the distances of Pacific combat that required a lot of ships.

Now, everything has evolved to the 21st-century version of a “Big Blue ‘Tron’ Blanket” of US and allied forces. True, the number of submarines, ships and aircraft still matter



Deploying the first-of-class Littoral Combat Ship USS Freedom to work alongside regional partners in southeast Asia is totemic of the new US engagement in the Pacific region.

R. Lardet 1478631

greatly. At the same time the technology soon arriving in the F-35 will allow each aircraft to network and direct engagements in 360-degrees of 3-D space by handing off tracks to other air/land/sea platforms, including UAVs and robots. F-35 pilots will not only have situational awareness, they will have situational decision-making that is truly revolutionary. They will all have the best real-time battle information database.

It is not enough to have just "things." Elemental accounting of quantitative differences can often overlook qualitative differences such as the intangibles of C2, training and tactics and logistic support. The "modernisation" of aircrew proficiency along with all other human components in the military is essential.

Again, if the past is prologue, UAV battlefield evolution in the stain of Afghanistan and Iraq has an invaluable dimension. Recognising

that UAVs are not the future of aviation but a component of the future of aviation has been discussed largely in technology terms.

However, the real force multiplier is the actual battlefield skill-set learned by a cadre of junior officers who are RPA operators. A new generation is being born that understand how datalinks work half a world away to fight and win combat engagements. Marrying up this new fighting force with the F-35 situational decision-making pilot linked to all air/land/sea combat systems is a formula for 21st century warfighting that embraces the future.

The United States' and allies' innovation in understanding the evolving 21st-century "information revolution" and making that technology combat effective is a path to out-maneuvering and out-fighting the People's Liberation Army (PLA), should conflict ever come to pass. A battle-ready force of distributed weapons platforms and precision weapons all networked vertically and horizontally from submarines to satellites empowering combat situational decision making at all levels at the speed of light is something PLA forces have not yet demonstrated.

INTRODUCING THE FIRST USE OF THE NEW "LOW-SPEED STABILIZATION" TECHNOLOGY FOR AN OPV* - QUANTUM'S ROTARY MAGLIFT™

Quantum has been awarded many contracts over the years, from a diverse range of military customers and builders to supply the roll stabilization systems for coastal patrol vessels, offshore patrol vessels, frigates and a number of specialized projects. Their proprietary technology has once again been selected for a NEW class of OPV's* requiring ride control called the AMP.

The AMP (Advanced Multi-Mission Platform) by RiverHawk Fast Sea Frames is the first OPV of its class to use the latest in Low-Speed Stabilization technology from Quantum called the MAGLIFT™, a rotary stabilizer utilizing the "Magnus-Effect" to generate a powerful lifting force to stabilize the roll of a ship.

The MAGLIFT™ improves the performance envelope of a vessel for RIB, UAV and Helo deployment and adds to the crews safety and comfort at speeds of 3 - 15 knots, especially in higher sea states where reduction in ship roll is important. RiverHawk were quick to recognize the benefits of Quantum's Low-Speed Stabilization for the mission profile of their advanced OPV* design.

For a free brochure and DVD about The MAGLIFT™ Low Speed Stabilization, please contact:

Mark Armstrong at +1 954-330-8081 or
Email: marmstrong@quantumhydraulics.com



Your Stability Is Our Mission



The 45m OPV* AMP built by RiverHawk Fast Sea Frames.

Close-up of the MAGLIFT™ Rotary Stabilizer.

3700 SW 30th Ave., Ft. Lauderdale, FL USA 33312 • Office: +1 954-587-4205 • Fax: +1 954-587-4259
www.quantumhydraulics.com

* Offshore Patrol Vessel