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Contested Commons:
*The Future of American Power
in a Multipolar World*

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Acknowledgments

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Executive Summary

The United States has been the primary guarantor of the global commons since the end of World War II. The U.S. Navy and Coast Guard have dissuaded naval aggression and fought piracy around the world, ensuring unprecedented freedom of the seas. The United States led the creation of international agreements on air transportation, enabling the creation of a global air industry. America also forged an international consensus on the openness of space, ensuring all countries with the means to do so can utilize orbital space for scientific, commercial and military purposes. Lastly, research funded by the U.S. government led to the creation of a decentralized network of connections now called the Internet, which connects physically dispersed markets, capital and people.

The United States derives great benefit from open access to these global commons, but so too does the world at large. Indeed, dependable access to the commons is the backbone of the international economy and political order, benefiting the global community in ways that few appreciate or realize. Today, over 90 percent of global trade, worth over 14 trillion dollars in 2008, travels by sea.[1] Civil air transportation carries 2.2 billion passengers annually and 35 percent of all international trade, by value.[2] Governments, militaries and corporations around the world rely on space for communications, imagery, and accurate positioning services, making space a 257 billion dollars industry in 2008.[3] Financial traders in New York City use the Internet to transfer 4 trillion dollars, greater than 25 percent of America's annual GDP, every day.[4]

For the past 60 years, and especially since the end of the Cold War, America's nearly unchallenged military advantage in the global commons has guaranteed their openness and stability. Yet, this dominance is increasingly challenged. New powers are rising, with some adopting potentially hostile strategies and doctrine. Meanwhile, globalization and technological innovation are lowering

the threshold for states and non-state actors to acquire asymmetric anti-access capabilities, such as advanced anti-ship cruise missiles, anti-satellite weapons, and cyber warfare capabilities. The decentralization of military power and expanded access to technologies once reserved for superpowers will necessarily contest America's 60-year-old dominance over the global commons and its ability to maintain their openness.

While disturbing on their own, these trends are developing concurrently with America's growing reliance on the commons. Militarily, the United States increasingly relies on the commons to enable many aspects of its operations, from logistics, to command and control, to extended power projection. Economically, the United States depends on the global commons to provide essential services to its citizens, connect its markets to suppliers and customers overseas, and manage billions of dollars of financial transactions.

As threats mount, it is in the interest of the international community to reaffirm its commitment to preserving the openness of the global commons. American military primacy will not dissuade rising powers from acquiring capabilities designed to contest U.S. power on the sea, in the air, in space and in cyberspace. Thus, while the United States should continue to develop military capabilities to ensure it can counter anti-access threats posed by state and non-state actors in the global commons, it must recognize that it cannot and should not protect the commons alone.

This report advocates a new strategy that is firmly grounded in the American traditions of maintaining openness, building institutions and empowering friends and allies. As part of this strategy, the United States should use all elements of national power, and work with its friends and allies, to ensure that responsible states continue to enjoy the ability to operate within the global commons. This renewed commitment to defending

the global commons will require not only changes in American policy and posture, but also a coordinated set of international agreements, foreign military and civilian capacity building initiatives, and a network of subnational norms and agreements that support openness and stability while confronting disruption and exclusivity.

Specifically, as part of this strategy, the United States should renew its commitment to the global commons by pursuing three mutually supporting objectives:

- **Build global regimes:** America should work with the international community, including allies, friends, and potential adversaries, to develop international agreements and regimes that preserve the openness of the global commons.

- **Engage pivotal actors:** The United States should identify and build capacities of states and non-state actors that have the will and ability to responsibly protect and sustain the openness of the global commons.

- **Re-shape American hard power to defend the contested commons:** The Pentagon should develop capabilities to defend and sustain the global commons, preserve its military freedom of action in commons that are contested, and cultivate capabilities that will enable effective military operations when a commons is unusable or inaccessible.

Introduction

Dependable access to the commons is the backbone of the international economy and political order, benefiting the global community in ways that few appreciate or realize. Over 90 percent of global trade, worth over 14 trillion dollars in 2008, travels by sea.[5] Every year, 2.2 billion passengers and 35 percent of the world's manufactured exports by value travel through the air.[6] Governments, militaries, and corporations around the world rely on space for communications, imagery, and accurate positioning services, making space a 257 billion dollars industry in 2008 alone.[7] Financial traders in New York City use the Internet to transfer 4 trillion dollars, greater than 25 percent of America's annual GDP, every day.[8] Moreover, any computer in the world with access to the Internet can access and transmit information to any place in the world within seconds, allowing unprecedented connectivity for global social networks, commercial enterprises and militaries.

While the liberalization of global trade laws is a major cause of today's active and robust global market, a fundamental physical openness is also essential. Goods manufactured overseas have to be shipped in large containers on huge cargo ships over vast oceans. The orders for the goods and requisite parts assembled in a factory must be transmitted over networks that constitute the Internet. The container ships carrying goods use satellites to navigate and communicate. These capabilities do not happen by accident — they are the result of decades of effort by governments and private corporations to build a "system of systems" that allows for global commerce. These systems exist within and between the global commons: the high seas, air, space and cyberspace.

The interconnectedness and interdependence brought by the globalized economy contributes significantly to stability and prosperity, allowing people, ideas and capital to freely crisscross the world with little regard for international borders. Globalization has lifted millions out of poverty and given emerging regional powers new influence over their own destinies. Indeed, the 2008 *U.S. National Defense Strategy* claimed that "global prosperity is contingent on the free flow of ideas, goods, and services."[9] Clearly, if the United States and the international community want to sustain this level of globalization, the openness of the global commons must be maintained.

Contemporary American strategists recognize the commons, individually and as a group, as central to American national security interests. The United States regularly updates naval, air and space strategies to detail how the U.S. military should think about each commons. Moreover, President Barack Obama has identified cyberspace as a national security priority, bringing it into the fold as a recognized strategic commons. Taken together, the global commons form "the connective tissue of the international system and of our global society."[10] Secretary of Defense Robert Gates described the American approach toward the global commons as:

> Opening doors, protecting and preserving common spaces on the high seas, in space, and more and more in the cyber world. This presence has offered other nations the crucial element of choice and enabled their entry into a globalized international society. ... We stand for openness, and against exclusivity, and in favor of common use of common spaces in responsible ways that sustain and drive forward our mutual prosperity.[11]

Since the end of World War II, the openness and stability of the global commons have been protected by U.S. military dominance and sustained by U.S. political and economic leadership. The U.S. Navy and Coast Guard have dissuaded naval aggression and fought piracy around the world, ensuring unprecedented freedom of the seas. America also forged an international consensus

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on the openness of space, ensuring that all countries with the means to do so can utilize space for scientific, commercial and military purposes. The United States drove the creation of international agreements on air transportation, enabling the creation of a global air industry. Lastly, research funded by the U.S. government created a decentralized network of connections now called the Internet, which facilitates the free flow of ideas and connects physically dispersed markets, capital and people. In all these domains, the United States supported political and economic leadership with uncontested military dominance.

The prevailing American approach to the global commons was described and eloquently advocated in Barry Posen's influential 2003 article, "Command of the Commons." Posen argues that command of sea, air and space "provides the United States with more useful military potential for a hegemonic foreign policy than any other offshore power ever had."[12] He paints a picture of American military dominance that was sweeping and uncontested:

> Command of the commons is the military foundation of U.S. political preeminence. It is the key enabler of the hegemonic foreign policy that the United States has pursued since the end of the

Cold War. The military capabilities required to secure command of the commons are the U.S. strong suit. They leverage science, technology, and economic resources. They rely on highly trained, highly skilled, and increasingly highly paid military personnel. On the whole, the U.S. military advantage at sea, in the air, and in space will be very difficult to challenge — let alone overcome. Command is further secured by the worldwide U.S. base structure and the ability of U.S. diplomacy to leverage other sources of U.S. power to secure additional bases and over-flight rights as needed."[13]

As a result of this unfettered access to the commons, the U.S. military has dominated all dimensions of conflict. Geography made the United States a natural sea power, and successful exploitation of air, space and U.S. technological prowess made the United States a power in the cyber commons as well. The commons, in turn, serve as a key enabler of the U.S. military and its ability to project power globally. The American military demonstrated its conventional military dominance in the 1991 Persian Gulf War, the 1994 air war over Yugoslavia, the 2001 invasion of Afghanistan, and the 2003 invasion of Iraq. The utilization of satellites and advanced communications technologies empowered the U.S. military to operate with overwhelming speed, coordination, efficiency and destructiveness. For example, as former Secretary of the Air Force Michael Wynne explained, "In World War II, it took 1,500 B-17s dropping 9,000 bombs to destroy a given target. Today, one B-2 can strike and destroy 80 different targets on a single mission using weapons guided by space-based USAF global positioning system signals."[14]

Yet, this dominance is becoming increasingly contested, with significant consequences for the world's access to the commons and the power of the American military. While Posen was correct to argue that American primacy is rooted in its

continued access to the commons, some emerging trends suggest that cracks may be appearing in the U.S. military's capacity to maintain command of the commons.

The free flow of capital has facilitated the emergence of a multipolar world, giving rise to new centers of power. While the consequent reduction in poverty has generally been a positive development and a long-sought American objective, some of these new powers have used their newfound wealth to acquire and develop high-end anti-access capabilities that could undermine the openness and stability of the global commons. Globalization and technological advancements have also lowered the threshold for poor states and non-state actors to acquire disruptive military technologies. Some developing nations and non-state actors have acquired and developed advanced military technologies, such as anti-ship cruise missiles and cyber warfare units.

These threats to America's role in the commons coincide with the rise of other challenges that will tax the U.S. military. In fact, some states are developing anti-access military capabilities and exclusionary policies that threaten the very international system that has made them stable and prosperous. Pentagon assessments suggest the United States in the coming decades will confront a greater number of threats, across a broader spectrum of warfare, in a more geographically diverse and challenging number of hotspots, than it has in the past.[15] In addition, the United States will need to maintain existing military commitments to deter and defend attacks on U.S. interests and allies.

At the same time, America's allies are showing less willingness to employ military force. While some states have joined in operations to preserve the maritime commons, many others free ride on American power.

These troubling trends are occurring within the context of an ongoing reduction in the size of America's forward-stationed military forces in Europe, Asia and the Middle East. In 2004, the Department of Defense's Global Posture Review recommended a 35 percent reduction in forward-stationed military personnel, and a 30 percent cut of U.S. military facilities abroad. There are several reasons for these shifts (e.g., changing threats, ongoing operations, technological improvements), not the least of which is a degree of reluctance to permanently station U.S. forces in other nations, particularly in the Middle East and East Asia. While the United States is attempting to revise many of its alliances into broader agreements focused on multilateral and global missions, the declining presence of U.S. military bases abroad will force American military power to become more reliant on an expeditionary, rather than a forward-stationed, posture. In other words, just as the global commons are becoming more contested, the U.S. military will rely increasingly on the global commons for extended power projection.

Taken as a whole, the future security environment will test American leadership.

Taken as a whole, the future security environment will test American leadership. Protecting open access to the global commons will be in high demand, but the capacity of the U.S. military to protect the commons will be challenged by new commitments and an increasingly diverse set of military threats. The status quo, in which the United States is the sole guarantor of the openness of the global commons and other states free ride, is unsustainable.

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If states and non-state actors are able to disrupt the commons, the existing international political and economic order will be fundamentally undermined. However, the United States has a unique opportunity to shape the world's approach to the commons. If a larger number of existing and emerging powers can be persuaded to promote the openness and stability of the commons, the international political and economic order will be strengthened.

Despite the emergence of an increasingly complex set of military threats, it is important to remember that it is not America's *absolute* level of power and influence that is falling, but its *relative* power compared to other emerging states.[16] While its dominance may be contested in the coming decades, America's ability to lead remains. The key for the United States will be to recognize both its capabilities and its limitations, and to act now to shape the future security environment in ways that will protect key U.S. interests, as well as interests shared with the international community.

PROTECTING THE CONTESTED GLOBAL COMMONS

Going forward, the United States should develop political and military strategies that take these new realities into account and preserve the openness and stability of the global commons in an age of multipolarity. This report advocates a broad and multi-pronged strategy to preserve the openness of the four global commons: maritime, air,

space and cyberspace. This strategy should employ all elements of national power, including diplomacy, strategic public engagement, and economic incentives and disincentives. Military power will continue to play an essential role because militaries worldwide can sustain the commons by promoting access, or they can destroy them by enforcing exclusivity or rendering a commons unusable. The U.S. military, for its part, should be prepared to sustain and defend the global commons.

This strategy should be firmly founded in the best traditions of American institution-building and with the recognition that the United States can no longer protect the commons alone. Specifically, the United States should develop and enable an international order which, in turn, nurtures a loose set of international agreements and regimes among responsible and like-minded states that effectively preserves the openness and stability of the global commons. Although America's "unipolar moment" may be fading and its military dominance becoming increasingly contested, the need for American leadership is as strong as ever.

To support this strategy, the United States should re-commit to three traditional pillars of American foreign policy: preserving American leadership, projecting American power as necessary, and promoting alliances and partnerships.

Preserving American Leadership: American leadership in the coming decades will depend on Washington's ability to adapt to an era in which American military primacy throughout the global commons will be contested. Rising and revanchist powers are investing heavily in naval, air, space and cyber power; non-state actors are also gaining access to advanced anti-access military capabilities. The United States must be prepared to lead in a world in which its dominance is also contested politically in a world where other powers demand influence on and within the world's common spaces.

Projecting American Power: American power faces a critical paradox: the United States requires the ability to project military power anywhere, but the use of forward bases in the key regions in the world come at considerable strategic cost.[17] Thus, throughout the world—from the Middle East to Africa to East and South Asia—the United States needs to retain the ability to persistently project power without provoking resentment. It is therefore vital that America develop flexible basing and access options that do not require large and politically costly forward bases, but can support sea-based power projection. As Robert Kaplan notes, "Carrier strike groups, floating in international waters only a few miles offshore, require no visas or exit strategies."[18] Further, as cyber power emerges as a form of warfare, options to project power from cyberspace with a minimal overseas footprint could develop.

Promoting Alliances and Partnerships: Working with and through allies and partners will be key to America's ability to develop an effective international community that can share the responsibility of maintaining the global commons with the United States. These partnerships reinforce America's position as a global leader.[19] The 2007 maritime strategy recognizes this fact, and identifies the imperative for the Navy, Marine Corps and Coast Guard to "foster and sustain cooperative relationships with more international partners."[20] Such an approach can and should be pursued in all commons.

D. Kaplan contributed a case study on the future maritime security environment in the Indian Ocean to illustrate how one area of the global commons could become contested. These papers directly informed this chapter, which presents a comprehensive assessment of the global commons, the threats to American interests in those commons, and strategies to address them.

Overview of the Global Commons

There are four major global commons: maritime, air, space and cyberspace. Each commons is fundamentally different from the others. However, this report examines them together as a global commons because they share four broad characteristics:

1. They are not owned or controlled by any single entity.

2. Their utility as a whole is greater than if broken down into smaller parts.

3. States and non-state actors with the requisite technological capabilities are able to access and use them for economic, political, scientific and cultural purposes.

4. States and non-state actors with the requisite technological capabilities are able to use them as a medium for military movement and as a theater for military conflict.

Academics have long studied "the commons," though primarily as shared properties or resources that pose challenges for societal resource management. While that examination can be traced back to commentary by the likes of Thucydides and Aristotle,[21] contemporary academic investigation of the commons was catalyzed by a seminal 1968 article, "The Tragedy of the Commons," by the ecologist Garrett Hardin.[22] Hardin described a hypothetical common pasture in which local herdsmen graze their cattle. Although each herdsman relies on the pasture to sustain his cattle,

Hardin argues that each herdsman is individually motivated by self-interest to increase the size of his herd. This action, repeated by every herdsman with the means, quickly leads to overgrazing and the destruction of the pasture. Thus, to quote Hardin's bleak conclusion, "Freedom in a commons brings ruin to all."[23]

To overcome the tragedy of the commons, theorists point to several potential means of governance:

- Hardin proposed the establishment of control by a central authority and/or commercialization of common property, either of which could overrule the self-interest of individuals.

- American economist Mancur Olson proposed that smaller groups are more capable of cooperation than larger groups, as it is easier to share values and responsibilities with a smaller set of actors.[24]

- International relations theorist Robert Keohane argued that a "hegemonic" power can establish international regimes that facilitate international cooperation, but these regimes can remain effective after periods of hegemony have ended.[25]

- Elinor Ostrom, who received the 2009 Nobel Prize for Economics for her work on the commons, argues that self-governing institutions, properly constructed, can play a lead role in maintaining resources.[26] For Ostrom, a key to lasting governance of the commons is the ability to deny benefits of the commons to states that violate its rules and norms.

These perspectives suggest that the United States, as the "hegemonic power," has an opportunity to develop international institutions that last beyond its "hegemonic period." By engaging a set of like-minded states and non-state actors with the ability or potential to substantially contribute to the health and success of the global commons (referred to in this study as "pivotal actors"), the United States could build and lead an international effort to protect the global commons. Moreover, by firmly opposing efforts by those who would undermine the openness and stability of the global commons, the United States and its partners will give challengers new incentives to contribute to the health and openness of the global commons.

THE STRATEGIC GLOBAL COMMONS

Parallel to this academic focus on the commons, strategists have pointed to the commons as the primary channels through which commerce, militaries, people and ideas travel. The concept was probably first coined in 1890 by the famed naval strategist Alfred Thayer Mahan, in his influential work *The Influence of Sea Power Upon History, 1660–1783*:

> The first and most obvious light in which the sea presents itself from the political and social point of view is that of **a great highway; or better, perhaps, of a wide common,** over which men may pass in all directions, but on which some well-worn paths show that controlling reasons have led them to choose certain lines of travel rather than others. These lines of travel are called trade routes; and the reasons which have determined them are to be sought in the history of the world [emphasis added].[27]

As technologies advanced, new commons have become accessible. The birth of the airplane made it possible for people and goods to travel across continents and over oceans in a matter of hours, with the effect of bringing the most far-flung parts of the world closer together in terms of time, if not space. The advent of high-thrust rocketry during and after World War II allowed for the use of space for several applications, including international communications at the speed of light and ever-present satellite observation. Most recently, the digital revolution spurred the development of the Internet, enabling the transfer of vast amounts of information across the Earth in a matter of seconds.

Table 1

MILITARY COMPARISONS OF THE GLOBAL COMMONS[28]				
	MARITIME	**AIR**	**SPACE**	**CYBER**
Strategic Advantages	Enables global power projection	Allows direct strikes against enemy forces and centers of gravity	Creates a new high ground; enables global imaging and communications	Enables fast transfer of information; finely coordinated military operations; force multiplier, especially for non-state actors
Speed and Scope of Operations	Slow transit over long distances; enables global strikes	Fast, global transit. Scope dependent on sortie rates close to targets	Allows for continuous global operations; detailed C3ISR; precision strike	Extremely fast global operations; automation of command and control
Examples of Key Features	Sea lanes, straits, canals, sea ports	Airports, air ceilings, English language commercial standard, basing and over-flight access	Orbit slots, Lagrangian points, space ports	**Physical:** submarine cables and their landing stations, Internet exchange points, corporate data centers, infrastructure nodes; **Logical:** TCP/IP standard, highly-connected web nodes

The global commons all have distinct military applications and implications, in addition to their importance to the global economy (Table 1).

The maritime, air, and space commons are based (to varying degrees) on a conceptual foundation that facilitates international cooperation by defense and commercial establishments, as well as a set of global regimes that regulate behavior within, and open access to, the commons. The maritime and air commons are the most mature, with robust intellectual and institutional frameworks. The space commons is less mature, with governance that is limited and dated. The cyber commons is largely anarchic, with an amalgamation of multilateral, national, and non-state agreements that have all had limited success in governance and regulation.

The characteristics of each of the commons should not obscure their fundamental similarities. Indeed, their fundamental interdependence is what binds them. In many ways, the global commons only functions effectively because each aspect is utilized simultaneously. To provide just one example, American aircraft carriers — the most potent symbol of American military power — sail on the high seas, use satellites for communications and positioning, use the air for combat and patrol, and

The characteristics of each of the commons should not obscure their fundamental similarities.

leverage cyberspace to transfer data quickly inside the ship and to ground stations around the world. Just one ship, therefore, uses all of the commons in one voyage.

The following sections summarize key characteristics of each of the global commons, with particular attention to the strategic importance of each.

THE MARITIME COMMONS[i]

The maritime commons includes 139 million square miles of ocean, ports and the littoral corridors that connect widely dispersed markets and manufacturers around the globe. Goods produced in Asian or American factories, or oil extracted from Middle Eastern oil fields, require the openness of this commons in order to deliver their goods to customers around the world. With 90 percent of global commerce traveling by sea, and many countries (for example, China and Japan) relying on maritime shipping for critical energy supplies, the openness of the maritime commons is essential to a healthy international economic system and is vital to the national security interests of the United States and its allies. As articulated in the United States' 2005 *National Strategy for Maritime Security,* "The right of vessels to travel freely in international waters, engage in innocent and transit passage, and have access to ports is an essential element of national security. The free, continuing, unthreatened intercourse of nations is an essential global freedom and helps ensure the smooth operation of the world's economy."[29]

The maritime commons has been central to trade and military power since antiquity. Mahan emphasized the close link between maritime power and economic development, and the application of sea power to sustain geopolitical influence. He recognized that whoever controlled the commons had great leverage and could exploit it to preserve the peace and exert influence. Another leading naval theorist, Julian S. Corbett, focused on the importance of sea lines of communication, and described a strategy now known as *sea control.*[30] The openness of the maritime commons today depends to some degree on the security of key ports of entry and vulnerable straits. About 75 percent of the world's maritime commerce passes through a handful of international straits and canals, which function as choke points.[31]

The importance of the openness of the maritime commons has been enshrined in a series of international agreements, most notably, the UN Convention on the Law of the Sea (UNCLOS). This agreement defines acceptable claims of sovereignty in the oceans, identifies the rights and responsibilities of coastal states, and preserves the rights of states to operate peacefully within international waters. Other agreements detail accepted rules of behavior and standardize forms of communication at sea. To date, UNCLOS has been a tremendous success of international institution building — 158 countries, and the European Union, have joined the Convention. Although the United States signed UNCLOS in 1994, the agreement has not yet been ratified by the Senate. Nevertheless, the United States operates according to its main provisions and regards it as customary international law.

THE AIR COMMONS[ii]

Open access to the air is a foundation of the global economy. The air commons see more than 2.2 billion passengers annually.[32] In 2006, air transport facilitated the movement of 35 percent by value

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i   The views expressed in this section are derived from Frank Hoffman, "The Maritime Commons in the neo-Mahanian Era," *Contested Commons: The Future of American Power in a Multipolar World* (January 2010) 49 – 75.

ii   The views expressed in this section are derived from Lt Col Kelly Martin and Oliver Fritz, "Sustaining the Air Commons," *Contested Commons: The Future of American Power in a Multipolar World* (January 2010) 77 – 103.

(3.5 trillion dollars) of the world's manufactured exports, as well as over 40 percent of the world's international tourists, which accounts for 3.4 percent of global GDP. The air transport industry directly employs 5.5 million people and indirectly brings about 32 million jobs worldwide. [33]

Since World War I, air power has been a fundamental aspect of military power. Air power allows a military to overcome geographic obstacles on the battlefield, at speeds that minimize the distance between the air bases and the battlefield, given sufficient air-refueling capabilities. The scope and speed of air power allows countries to influence a conflict at the strategic and tactical levels from positions around the world. Contemporary American theorists on air power emphasize the importance of it in influencing an enemy's leadership and in striking the enemy's military. [34] While a decades-old debate about the ability of air power to influence events on the ground continues to rage, the U.S. military views air superiority as critical enough to warrant the expenditure of billions of dollars.

The air commons today represents a "mature" commons. Use of the air for commercial purposes is managed effectively by a series of international organizations and bilateral agreements, all of which are largely unseen by the casual traveler. States exercise unquestioned authority over their airspace up to 60,000 feet in their geographic borders, plus 12 miles out from their coastlines. Despite a successful set of international standards and bilateral access agreements, a single international agreement on access and over-flight continues to elude the international community. International air travel agreements today remain almost entirely bilateral, leading to inconsistencies and inefficiencies in the system. That being said, access is generally open, and limitations on access usually result more from internal challenges than external threats.

In many ways, the global commons only functions effectively because each aspect is utilized simultaneously.

The U.S. military has embraced a strategy of preserving the military advantages necessary to maintain air superiority during conflict. Secretary of Defense Gates claimed that by 2020, "The United States is projected to have nearly 2,500 manned combat aircraft of all kinds. Of those, nearly 1,100 will be the most advanced fifth-generation F-35s and F-22s. China, by contrast, is projected to have no fifth-generation aircraft by 2020. And by 2025, the gap only widens." [35]

THE SPACE COMMONS [iii]
Satellite-based positioning information, overhead imagery and communications facilitate global coordination of commercial, scientific and military activities with a degree of speed and precision that would be impossible without the use of outer space. In general, space can be understood as a utility that lies at the heart of other international activities. For example, signals from the Global Positioning Satellite (GPS) system not only help users navigate the surface of the planet, but they also can help to precisely time financial transactions around the world. Militarily, space provides the "strategic high ground" from which global communications and remote sensing can be quickly transmitted to militaries around the world. A military that can effectively use space has a tremendous advantage in terms of speed of communications, breadth of surveillance and intelligence, and accuracy of positioning and timing.

[iii] The views expressed in this section are derived from Eric Sterner, "Beyond the Stalemate in the Space Commons," *Contested Commons: The Future of American Power in a Multipolar World* (January 2010) 105 – 135.

Space's *militarization*—its use as a medium to support military operations—has existed for more than four decades. Since the height of the Cold War, satellites have monitored nuclear tests and other military activities and facilitated global communications, mapping, and other activities with both military and scientific purposes. Yet space has yet to be *weaponized*, in that it is not yet a theater for warfare or for the placement of arms, and it remains a global commons open to any actor with the means to access it.[36]

To a large degree, this openness can be credited to a robust set of international agreements that effectively codify space as a global commons. When space first became accessible to humanity in the 1950s, the United States proposed an agreement establishing orbits as common spaces beyond traditional conceptions of sovereignty. The Soviet Union initially disagreed, arguing that its sovereign claim over its territorial air space extended to orbit and beyond. Once Moscow saw the benefit of sending satellites into orbit to spy on the West, its conceptions of its sovereign interests changed, and the USSR agreed to establish space as, in effect, a global commons. Although several arms-control agreements helped to solidify space as a commons, the most comprehensive existing international agreement on the use of space is the 1967 Outer Space Treaty. It defines space as an area beyond claims of state sovereignty, but it has a limited focus on military matters—beyond banning weapons of mass destruction in orbit or on any celestial body, and prohibiting the use of celestial bodies for military bases or the testing of weapons.

U.S. policy has consistently embraced space as a global commons "by all nations for peaceful purposes and for the benefit of all humanity."[37] Yet the United States has also defended space as a legitimate medium for defense and intelligence activities. The 2006 National Space Policy

reinforced an American commitment to the "exploration and use of outer space by all nations for peaceful purposes, and for the benefit of all humanity," rejected claims of national sovereignty, and reaffirmed the "rights of passage through and operations in space without interference." On the issue of military objectives, it was quite clear, asserting:

> The United States considers space capabilities—including the ground and space segments and supporting links—vital to its national interests. Consistent with this policy, the United States will: preserve its rights, capabilities, and freedom of action in space; dissuade or deter others from either impeding those rights or developing the capabilities intended to do so; take those actions necessary to protect its space capabilities; respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests.[38]

THE CYBER COMMONS[iv]

Cyber space is now an integral part of modern life. People interact, cooperate, and compete through a series of networked linkages that span the world. This unique system has evolved into a global commons. Through a combination of simple web-based communications and more complex infrastructure networks, the cyber commons enables private and public institutions to provide essential services such as energy, food, and water. Banks and asset traders use the Internet to shift billions of dollars within seconds. Modern militaries—especially the U.S. military—employ the cyber commons as a key enabler of military operations, using both commercial and private networks for everything from command and control to logistics support.

As the newest and least-understood global commons, a more robust discussion on the nature of the cyber commons is necessary. Its speed

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[iv] The views expressed in this section are derived from Dr. Greg Rattray, Chris Evans and Jason Healey, "American Security in the Cyber Commons," *Contested Commons: The Future of American Power in a Multipolar World* (January 2010) 137-176.

and scope creates advantages and challenges. Communications across cyberspace can happen near instantaneously, and vast amounts of data can rapidly transit vast distances, often unimpeded by physical barriers and political boundaries. However, dependence on the use of cyberspace creates vulnerabilities and weaknesses that could be exploited by adversaries.

To date, the United States and the international community have had little success in governing the cyber commons. In many respects, governance in cyberspace resembles the American Wild West of the 1870s and 1880s, with limited governmental authority and engagement. Users—whether organizations or individuals—must typically provide for their own security. Much of cyberspace operates outside the strict controls of any hierarchical organizations. No one individual or entity is in charge. Internet traffic is routed through peer arrangements between Internet Service Providers (ISPs), without central authority or control. The resolution of domain names fundamental to web browsing and e-mail is strictly based on an agreed set of protocols, loosely coordinated by a nongovernmental organization referred to as the Internet Corporation for Assigned Names and Numbers (ICANN).

Further challenging any effort to govern or control the cyber commons is the complexity of its ownership—the physical infrastructure of the cyber commons is largely owned and controlled by the private sector. States do not, and cannot, command the cyber commons to the same degree as the sea or air, or even to the extent that they controlled communications technologies in the past. Today, there are myriad providers of devices, connectivity and services in loosely woven networks with open standards. Many governments, especially in the western world, have a limited ability to control cyber activities that originate within their borders. To date, the American approach to

cyberspace has been supportive of a cyber commons that is open and market-based.

This condition of anarchy is not absolute. Economic imperatives and the desire to widen and standardize communication networks have led to the creation of relatively public and transparent nongovernmental operations of the Internet Engineering Task Force (IETF), ICANN, and other organizations for standardization, governance and regulation of cyberspace. States and other organizations can also establish boundaries by making choices in how to employ hardware, software and standards. To date, America has supported a cyber commons that is open and market-based.

The United States has also come to realize the strategic value of the cyber commons. Late in the Bush administration, in 2008, a Comprehensive National Cyber Security Initiative was formulated and launched, codified in NSPD-54/HSPD-23. Early in the Obama administration, a White House-led review of cyberspace policy identified cyberspace as a "national asset" and committed the United States to a concerted effort to secure its infrastructure from attack. A few months later, the U.S. military established Cyber Command, charged with protecting networks and conducting offensive cyber warfare. Beyond the Department of Defense, national cyber security efforts have included the National Security Agency, the Department of Justice and the Department of Homeland Security.

Challenges to the Global Commons
In the coming decades, the United States will face a more diverse set of threats, from a broader array of actors, than ever before. As new powers rise and globalization lowers the threshold for less-advanced nations and non-state actors to acquire cheap yet advanced military technologies, the openness of the global commons, and America's traditional military dominance therein, will become increasingly contested.

THE COMING MULTIPOLARITY

There is an emerging consensus that the dynamics of the international system are gradually but fundamentally evolving.[39] Since the end of the Cold War, globalization has connected previously separated nations and markets, leading to an unprecedented creation of global prosperity and the rise of new economic powers such as China, India, and others. Since 1999, the United States' share of global GDP has declined, while that of Brazil, Russia, India, and China (BRIC) has increased (see Figure 1). By 2014, the International Monetary Fund predicts that BRIC countries will represent more than 27 percent of global GDP, and the United States and the EU will represent less than 20 percent each.[40]

In his book *The Post-American World,* Fareed Zakaria eloquently described the "rise of the rest" as a broad trend of economic growth throughout the developing world:

In 2006 and 2007, 124 countries grew their economies at over 4 percent a year. That includes more than 30 countries in Africa. Over the last two decades, lands outside the industrialized West have been growing at rates that were once unthinkable. While there have been booms and busts, the overall trend has been unambiguously upward. Antoine van Agtmael, the fund manager who coined the term "emerging markets," has identified the 25 companies most likely to be the world's next great multinationals. His

Figure 1: Percentage of World GDP (1992 – 2014).[41] 2007 – 2014 data is projected.
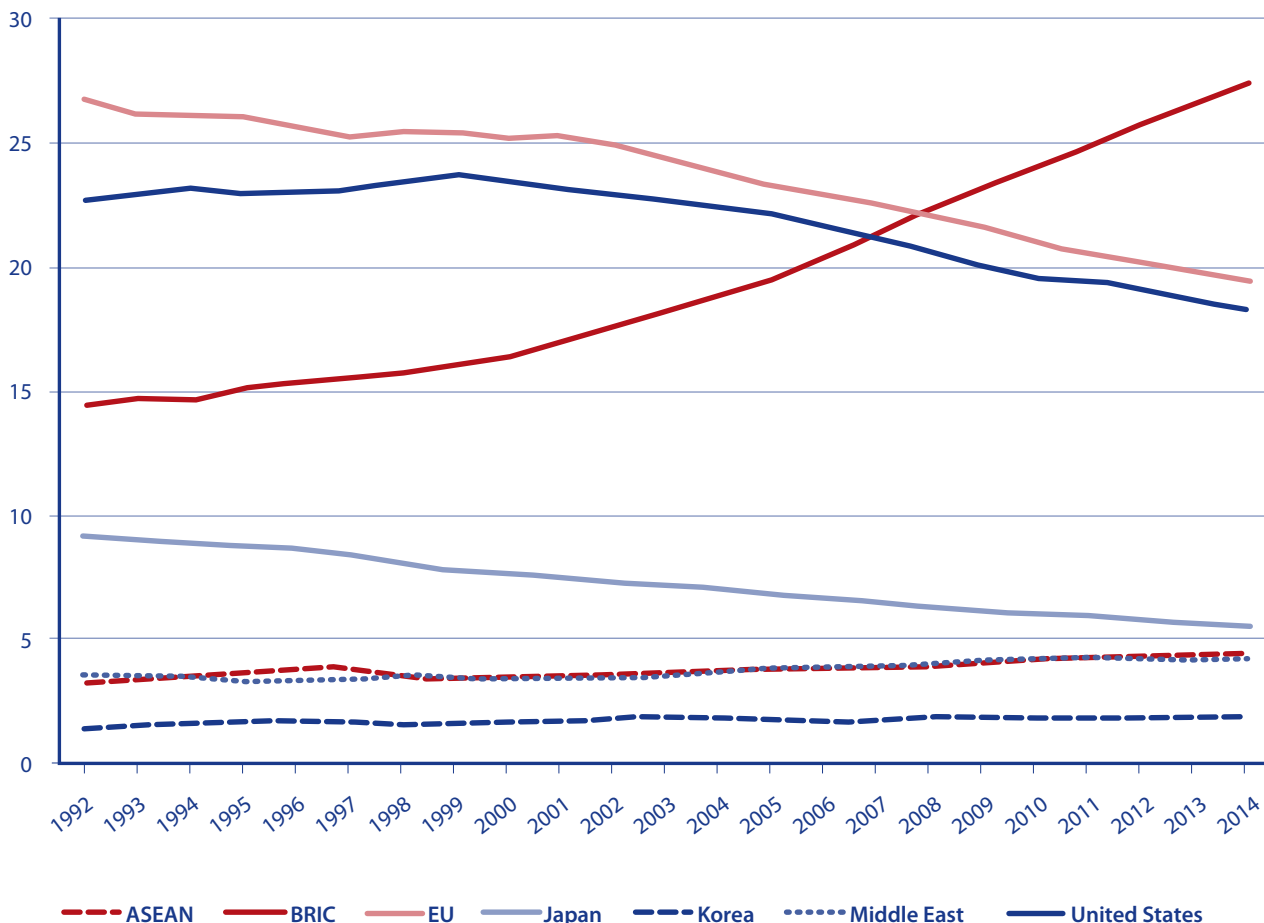
list includes four companies each from Brazil, Mexico, South Korea, and Taiwan; three from India, two from China, and one each from Argentina, Chile, Malaysia, and South Africa. This is something much broader than the much-ballyhooed rise of China or even Asia. It is the rise of the rest—the rest of the world.[42]

Despite an emerging consensus that international power dynamics are changing, there is little agreement as to what the future world will look like. Indeed, America's leading strategic thinkers demonstrate uncertainty about the security environment. Some, like Council on Foreign Relations President Richard Haass, foresee a world in which American power is in relative decline and states themselves are forced to share power with non-state groups and empowered individuals.[43] Princeton University's Dr. G. John Ikenberry argues that Americans continue to live "in an extraordinarily benign security environment."[44] The Carnegie Endowment's Robert Kagan argues that "nationalism in all its forms is back … and so is international competition for power, influence, honor, and status."[45]

Regardless of the specific form one believes the future world will take, it is clear that the international system of the new millennium is evolving toward, or returning to, a more complex environment.[46] As new powers rise, they may develop interests and perspectives on the global commons that differ from those of the United States. Moreover, in a multipolar world, the United States will be increasingly forced to consider the preferences of other powers.

THE GLOBALIZATION OF THREATS
This shift in relative economic and political power is driving a change in the global balance of military power. A combination of economic growth and a relatively stable and benign security environment has allowed state and non-state actors to enhance their military capabilities. While several states are

For the first time since the end of the Cold War, challengers seek to prevent the use of the commons to extend American military dominance.

building traditional complements of blue-water navies, more modern land armies, and advanced air forces, certain actors are focusing their military modernization efforts on capabilities tailored to undermine traditional U.S. military advantages.

For the first time since the end of the Cold War, challengers seek to prevent the use of the commons to extend American military dominance. After careful analysis of American war-fighting practices in the 1991 Persian Gulf War and subsequent wars in Yugoslavia, Afghanistan, and Iraq, potential adversaries recognize that, in all of these wars, the U.S. military depended on its access to, and use of, the global commons. This dependence on the commons is a vulnerability that, if exploited, could render the U.S. military less potent and easier to deter or defeat. Specifically, potential adversaries have identified the U.S. military's reliance on long logistics chains and regional bases, on space-based communications and imagery, and on digitized communications networks as key vulnerabilities whose loss would significantly undermine America's ability to fight.

To take advantage of American vulnerabilities, adversaries are developing two general types of capabilities:

• Low-End Distributed Threats: Capabilities and tactics generally utilized by insurgencies and guerilla movements, in which the

adversary denies the dominant power a direct confrontation.

- High-End Asymmetric Threats: Capabilities and tactics tailored to undercut the traditional military advantages and enabling capabilities of the dominant power.

In each case, America's potential adversaries hope to avoid military confrontation where America is strongest and focus on areas where the United States is vulnerable—often within the global commons.

Another troubling component is what some American strategists have identified as the emergence of "hybrid warfare," in which an adversary combines the structure and tactics of insurgencies with high-end technologies that are employed to target and undercut traditional advantages of a conventional, modern military force. In the summer 2006 war in Lebanon, Hezbollah utilized advanced battlefield tactics and weaponry, including the successful use of an advanced ground-to-ship missile and anti-tank weapons, along with unconventional command and control and suicide bombers.[47] The Israeli experience in Lebanon has become a textbook case of the kind of hybrid warfare that some defense analysts believe will be a defining feature of the future security environment.[48]

THE CONTESTED COMMONS

Rising powers and broader access to potent new technologies give potential adversaries the ability to contest the openness of the global commons, with profound consequences for the maintenance of American military dominance and the persistence of an open international system. This section will detail threats and vulnerabilities in the maritime, air, space and cyber commons and how those vulnerabilities could challenge the U.S. military and the openness of the global commons in the coming decades.
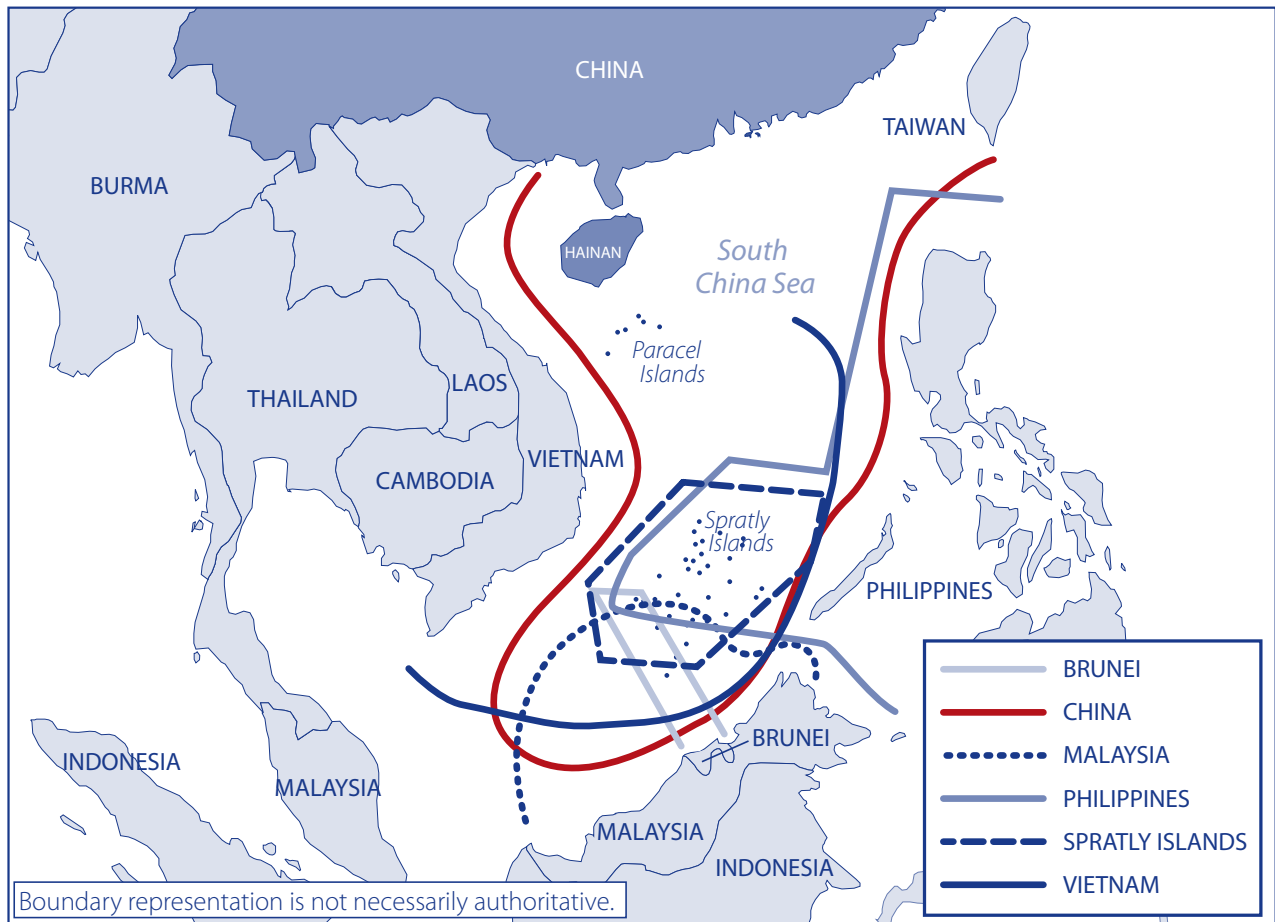
Maritime

As the oldest and best understood commons, the maritime domain possesses elements of all attributes needed to support its openness and stability. There is a well-recognized norm and tradition supporting the freedom of the seas, and international law protecting the openness of the maritime commons is robust and widely recognized. However, diplomatic challenges to the existing legal regime are emerging. Moreover, the rise of new and revanchist naval powers, the development of non-state and hybrid maritime threats, and the effects of global climate change threaten to undermine the mix of international law and American dominance that has preserved the maritime commons since the end of World War II.

Shrinking Diplomatic Space: While international acceptance of UNCLOS is a boon for the openness of the commons, codification does not mean that all states agree on the interpretation of the Convention, as illustrated by several competing claims of sovereignty in the South China Sea. Six countries claim all or part of the South China Sea and have attempted to use UNCLOS to justify their claims. Several of the disputing countries, China being the most egregious example, have attempted to exaggerate UNCLOS's meanings to extended territorial borders (Figure 2). In the case of China, it claims territorial borders more than a thousand miles from the Chinese mainland.

As defined in UNCLOS, a state maintains sovereign control of coastal waters out to 12 miles beyond its beach, and the sole right to extract resources as much as to 200 miles from its shores. The area between 12 and 200 miles is known as the Exclusive Economic Zone (EEZ). As stated in UNCLOS, the EEZ remains an international waterway through which warships may make innocent passage. Yet China claims that states must first obtain permission from Beijing before transiting its EEZ, in direct contradiction to the letter of UNCLOS and the spirit of traditional laws of the

Figure 2: Conflicting Claims in the South China Sea. [49]

Legend:
- BRUNEI
- CHINA
- MALAYSIA
- PHILIPPINES
- SPRATLY ISLANDS
- VIETNAM

Boundary representation is not necessarily authoritative.

sea. Similar reading of international law by Beijing has already contributed to tension with the United States, as the 2001 EP-3E incident and the 2009 USS *Impeccable* encounter demonstrated.

The implications of this interpretation are profound. If states are able to determine who is able to sail in what have traditionally been international waters and exclude whatever maritime traffic at will, the openness of the maritime commons would be challenged. Navies would be forced to request permission before sailing through what would normally be international waters, in effect extending sovereign claims 200 miles beyond the coastline. The openness of the maritime commons demands freedom of navigation within EEZs, and

restrictive interpretations of UNCLOS would fundamentally undermine that openness.

Rising Naval Powers: Advanced naval capabilities, and weapons that could be used to deny access to the maritime commons, are spreading to new state actors. Rising powers such as China, India, Russia, Japan and South Korea continue to invest heavily in naval capabilities, portending a future with many blue-water navies on the high seas. These rising maritime forces have already achieved startling successes, including improvements in submarine capabilities, surface fleets, and, in the case of China, ballistic missiles designed to attack major ships at sea.

The rise of new and revanchist naval powers, some with unclear intentions regarding longstanding norms and regimes, raises serious questions about the future of the maritime commons.

A key variable is how these new capabilities are used. As discussed above, the preservation of a globalized economic system and the openness of the global commons should be in the interest of the international community. Some resurgent naval powers, such as South Korea and India, are clearly developing naval capabilities in order to protect the openness of the commons. They speak of their burgeoning naval powers as important contributors to the international system, and they envision employing them in counter-piracy and other operations. Other states, such as Russia and China, are much more circumspect about the purposes envisioned for their growing navies. China's counter-piracy operations off the coast of Somalia are encouraging, however, China's insistence on an exclusionary definition of its rights over EEZs, its behavior toward foreign vessels in the international waters of the South China Sea, and its development of anti-ship ballistic missiles, suggest a different vision of the maritime commons.

The rise of new and revanchist naval powers, some with unclear intentions regarding longstanding norms and regimes, raises serious questions about the future of the maritime commons. Such powers will test the ability of the United States and its allies to maintain open access to the world's

oceans. In addition, with some projecting a mid-term future of several blue-water navies, America's ability to sustain maritime dominance is open to question.[50]

Threats from Maritime Armed Groups: Other threats to the maritime commons originate from non-state actors, referred to in this study as Maritime Armed Groups (MAG). Increases in the incidence of piracy, and rare but notable acts of maritime terrorism and insurgency from the sea, have garnered more attention in recent years.[51] Although worldwide rates of piracy have actually fallen since the early 2000s, the average annual rate of pirate acts remains about 300 per year.[52] While piracy tends to occur in narrow straits, the Gulf of Aden and the Horn of Africa have recently emerged as a new hotspot for pirates, accounting for 37 percent of pirate attacks in 2008.[53]

In addition to piracy, maritime terrorism — though rare — has succeeded in the past. Al Qaeda's successful attack on the USS *Cole* in Aden in October 2000 is the most well-known example. Others include al Qaeda's somewhat successful October 2002 attack on the oil tanker MV *Limburg*, which was rammed by a small suicide boat in the Arabian Sea off of Yemen. Nigeria's insurgent group, the Movement for the Emancipation of the Niger Delta (MEND) has proven to be effective at mounting riverine and littoral operations, having attacked oil facilities 75 nautical miles from the coast. These attacks slowed energy shipments from West Africa, which is the source of about 15 percent of American oil imports. Before its defeat, the Tamil Tigers, or LTTE, in Sri Lanka possessed a substantial navy, which attacked targets in the brown, green, and even blue waters around the island.

At this time, threats posed by MAGs do not present significant threats to the maritime commons. While these threats will spur some tactical adjustments, they do not yet have the ability to threaten the global commons with any degree of scope

or persistence. Yet, the potential exists for these groups to escalate and coordinate their actions to threaten the maritime commons.

Hybrid Maritime Threats: State and non-state actors have the ability to bring hybrid warfare to the maritime commons. The war between Hezbollah and Israel in summer 2006 saw Hezbollah's successful incorporation of a maritime dimension. Hezbollah fighters used an Iranian-supplied anti-ship cruise missile, probably a Chinese variant of the C-802 *Silkworm*, to strike an Israeli corvette that was not aware of the need to activate its missile defense system. While terrorist groups like Hezbollah have yet to develop the ability to sustain threats against the maritime commons or press them beyond the littoral waters of the Middle East, their ability to acquire and successfully employ advanced anti-access capabilities is an example of a lowering threshold for the acquisition of disruptive technologies, and may be a harbinger of future developments.

With its ability to use a small fleet of frigates and fast patrol craft, along with submarines, mines, and advanced anti-ship cruise missiles, Iran also represents a hybrid threat. Iran's coastline and 17 islands in the Persian Gulf are a strategic choke point in the maritime commons and a potential challenge to the U.S. military. Iranian military doctrine suggests that it will employ asymmetric tactics that exploit the constricted geographic character of the gulf and the advanced systems that it has acquired.[54]

Air

Like the maritime domain, the air commons is fairly mature, with robust international governance and a strong tradition of international cooperation supporting freedom of the skies. However, the persistent threat of terrorism, and the proliferation of advanced surface-to-air and surface-to-surface missiles, could undermine the openness of the air commons in the coming

decades. Moreover, the U.S. military's ability to access the air globally will be challenged by reliance on basing agreements and over-flight rights, dependence on the space and cyber commons, and a lack of a central authority to respond to challenges and threats to the air commons.

Terrorist Threats: If terrorists successfully demonstrate that air travel is unsafe, the free flow of air travel between states could be constrained. Air hijackings have been a problem since the 1930s, but the perceived threat posed by hijackings has grown exponentially in the wake of September 11. Bombings, as conducted by Libyan nationals over Lockerbie and as conceived by the al Qaeda "Bojinka" plot in 1995, also remain a significant threat. Additionally, airports have presented attractive targets to terrorists, as demonstrated in airport attacks in London, Rome and Vienna. Surface-to-air threats from terrorists also exist, as demonstrated by a 2002 attempt to shoot down a chartered Boeing 757 airliner, owned by Israel-based Arkia Airlines, with shoulder-launched Strela-2 (SA-7) surface-to-air missiles as it took off from Moi International Airport in Mombasa, Kenya.

Terrorism is a significant threat to air travel, but it does not yet pose a systemic threat to the air commons. Popular confidence in the safety of air travel has been shaken in the wake of major terrorist attacks, but it has always returned after a period of months. Unless terrorists could demonstrate the ability to persistently threaten commercial aircraft across a broad geographic scope, it is unlikely that terrorism would fundamentally threaten the openness of the air commons.

Advanced Air-to-Air Systems: Advanced combat aircraft have proliferated in recent years, largely because of Russian exports and China's increased role in cooperative research and development. The family of fighters that evolved from the Russian Su-27 represents a potent technical competitor to

Emerging Maritime Commons in the Arctic

As worldwide temperatures increase and the polar ice caps shrink, maritime shipping lanes are emerging, and previously unreachable resources are becoming accessible. In 2005, the Northeast Passage opened along the Eurasian border for the first time in recorded human history. The Northwest Passage along Canada opened up for the first time in 2007. The melting of polar ice has not only opened new shipping routes of potential significance, but it has also made significant resources more accessible. Some estimates suggest that as much as 25 percent of the Earth's untapped energy resources could be found in the Arctic.[55] These new opportunities are challenging the long-held international moratorium on competition in the Arctic Circle. As Frank Hoffman quips, "The only thing in the Arctic melting faster than the northern ice cap is the international comity."[56]

This new competition for the Arctic maritime commons was cast into stark relief by the August 2007 planting of a titanium Russia flag, on the seabed 4,200 meters (14,000 feet) below the North Pole, by Russian mini-subs to further Moscow's claims to the Arctic.[57] Moscow argued before a UN commission as early as 2001 that waters off its northern coast were, an extension of its maritime territory, and Prime Minister Vladimir Putin has already described the urgent need for Russia to secure its "strategic, economic, scientific and defense interests" in the Arctic.[58] Several countries with territories bordering the Arctic—including Russia, the United States, Canada and Denmark—have launched competing claims to the region. The competition has intensified as melting polar ice caps have opened the possibility of new shipping routes in the region.

For its part, the United States is far behind Russia in its capability to operate on the ocean surface in the Arctic. Russia is expanding its fleet of large icebreakers to about 14, including the world's largest, the nuclear *50 Years of Victory*. At the same time, the United States has two heavy icebreakers, with one currently out of service.[59] While the United States today contracts ice breaking services to Russia, this disparity is diminishing U.S. capacity to defend its access to the Arctic just as its strategic significance is on the rise. In September 2008, the Russian national security council began drafting new policy to formalize its claims of sovereignty in areas previously recognized as beyond claims of sovereignty.[60]

the current U.S. F/A-18E/F, F-16, F-15 and F-15E aircraft. The well-publicized "Cope India" exercises in 2004 and 2005 included media reports that U.S. forces were frequently "shot down" during exercises with the Indian Air Force, and that the U.S. Air Force was surprised at the technical improvements made to the Indian MiG-21s and Su-30s as well as the quality of the pilots.[61]

In addition to exporting fighter aircraft, Russia and China are developing "fifth-generation" fighter aircraft and cooperating heavily in research with other countries. Russia has long been developing the PAK-FA program with MiG and Sukhoi design teams. In November 2009, India and Russia announced an expansion of their cooperative work on the PAK-FA, and industry sources believe 2017 to be the target date for an Indian prototype.[62] Currently an importer and license producer of Su-30 aircraft, China is clearly moving toward an indigenously developed next generation of combat aircraft.[63] There have been other indications that China may instead focus expanding the capabilities of the J-10 fighter, with potential sales to Pakistan.[64]

Advanced Surface-to-Air Systems: Russia's development and proliferation of advanced surface-to-air-missiles—coined "double digit" SAMs because of their North Atlantic Treaty Organization (NATO) code names—threatens American air dominance. As a system, these weapons are focused on countering U.S. control of the air through increased lethality, the defeat of stealth, and the targeting of standoff command, control and refueling assets. Russian SA-20 deployments reportedly caused NATO to decide against sending airborne warning and control system (AWACS) craft during the conflict with Georgia in 2008, demonstrating Western concerns about the capabilities of the SA-20.[65]

Double-digit SAMs have become a major proliferation concern. China reportedly possesses 16 SA-20

battalions and an equivalent number of shorter-range, but still lethal, SA-10 systems.[66] Around the globe, other reported customers of the SA-10 and SA-20 include Iran, Libya, Algeria, Venezuela and Vietnam.[67] In addition, China is developing an indigenous variant of the SA-10, the HQ-9, which is now available for export—repeating the trend seen with combat aircraft.[68]

These systems could threaten America's most advanced fighters and bombers as well as American military operations in the air, and they could fall into the hands of terrorists if transferred to state sponsors of terrorism or states with internal security problems. If so, the openness of the air commons could be significantly challenged by states or non-state actors, with profound implications for international commerce and American military operations.

Precision surface-to-surface weapons: A military's ability to use the air as a theater for operations depends on the use of bases, either on land or at sea, where aircraft can land, refuel, rearm, repair and take off. The utility of short-range military aircraft is also directly associated with the ability to launch aircraft rapidly in close proximity to its targets (sortie rates). To address these requirements, the United States since the end of World War II has established a network of bases around the world, bringing much of the world into reach of American air power.

Yet the development and proliferation of long-range precision weapons, primarily short- and medium-range ballistic missiles, are increasingly threatening the security of these bases and thus the reach of short-range American air power. China, Iran, North Korea, India and Pakistan have developed medium-range ballistic missiles (MRBM) and/or intermediate-range ballistic missiles (IRBM), though India and Pakistan target theirs largely at one another. The threat of MRBMs and IRBMs to American bases in East Asia is

similar to the one posed to Taiwan's air bases by short-range ballistic missiles (SRBMs) from China. A 2009 report by RAND Corp. concluded, "The threat to Taiwan from Chinese ballistic missiles is serious and increasing. ... Although literally thousands of missiles might be needed to completely and permanently shut down Taiwan's air bases, about 60–200 submunition-equipped SRBMs aimed at operating surfaces would seem to suffice to temporarily close most of Taiwan's fighter bases."[69]

The development of highly precise ballistic missiles, and an accompanying Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) network, may also threaten sea bases. China's development of an anti-ship ballistic missile (ASBM), based on an MRBM airframe, poses a significant threat to naval operations in the western Pacific. China's ability to bypass America's robust air-defense capability and strike ships at sea with ballistic missiles could severely limit American naval power projection capabilities, and thus its ability to maintain the openness of the maritime and air commons.

The proliferation of highly-accurate ballistic missiles capable of striking American bases at sea or on land could undermine American power projection, and the U.S. military's ability to protect the air and maritime commons. Without the use of land and sea bases, the U.S. military would not be able to sustain large forces at sea for extended periods of time, thus leaving the air and maritime commons open for disruption or domination.

Reliance on Access to Bases and Over-flight Agreements: While aircraft carriers allow the United States military to project air power far from regional bases, extended global power projection cannot be sustained without access to resources stored on land. American forward land bases have become hubs for the protection of the air and

maritime commons. However, the United States made the decision in the years after World War II that bases would be maintained with the consent of the host nation. While most of these bases were originally established to contain the expansion of Communism, they now serve as way stations for humanitarian assistance and disaster relief, for the protection of the commons, and for the projection of American military power.

A host nation's support for these bases is not a given and has, at times, been revoked or revised in reaction to the local government's displeasure with the actions of the United States and/or U.S. military personnel. For example, the Subic Bay Naval Base in the Philippines was the largest U.S. naval base in the Pacific Ocean until it was closed in 1992 over disagreements between the two governments. Moreover, crimes and accidents committed by U.S. military personnel, and the sheer presence of U.S. military personnel in forward bases can create resentment in local populations, as seen occasionally in Japan, South Korea and Germany.

Yet forward bases are not the only element of air power that depend on foreign cooperation. The United States must also seek permission if any plane, be it military or commercial, flies within a country's sovereign air space (up to 60,000 feet). The U.S. military has often been forced to alter its war plans because of an inability to gain over-flight permission.[70] Thus, the U.S. military's ability to access the air and maritime commons is inextricably interwoven with diplomatic and economic influence around the world.

Reliance on Cyber and Space: In the past decade, commercial airlines utilized advanced technologies, such as GPS and wireless computer-to-computer communication, to greatly increase the efficiency of air travel. The greater accuracy of positioning provided by GPS, in turn, allowed air traffic controllers to increase the density of

airplanes in a given area. Use of the cyber commons has given air traffic controllers greater insight into the status of planes in flight, and airline companies rely on access to cyberspace for day-to-day operations, such as scheduling and ticketing. This reliance on the space and cyber commons represents a significant vulnerability, should either of these commons become contested. The American air travel system got a small taste of the effects of lost access in November 2009, when a Federal Aviation Administration computer outage in Salt Lake City forced air traffic controllers to manually direct aircraft, instead of using computers, causing significant delays throughout the country.[71]

Diffuse Authority: America's ability to preserve the openness of the air commons will be challenged by its decentralized system of responsibility, in which dozens of agencies and departments are charged with securing specific aspects of the air commons. For example, airport security is handled by the Department of Homeland Security, while plots and acts of terrorism are investigated by the Federal Bureau of Investigation. Other than direct military threats and combat air patrols over American cities, the U.S. Air Force is largely uninvolved in defending the air commons. This lack of a central organizing authority presents a particular challenge for American policymakers as they develop initiatives to maintain the openness of the commons.

Space
The openness and stability of the space commons are challenged by the inherent fragility of satellites and the space commons itself, as well as the development and proliferation of anti-satellite jamming and strike capabilities.

Fragility of the Space Commons: Satellites are highly vulnerable. They are susceptible to kinetic and directed energy attacks, as well as jamming

from the surface of the Earth. Even modest damage to satellite subsystems, such as its optics or solar arrays, can prove disastrous. Compounding this fragility is the vulnerability of space infrastructure that develops, launches, maintains and operates spacecraft. The United States possesses only two launch sites that are meant to handle large launch vehicles, and four overall. Each has a small number of launch pads, and the two large facilities are on coastlines, increasing their vulnerability to monitoring and attack. Moreover, the United States does not stockpile launch vehicles or significant numbers of spare satellites, limiting America's ability to replenish space assets in times of conflict.

The high speeds and the amount of debris in orbit—hardware and spacecraft fragments that have broken up, exploded or otherwise become abandoned—render the space commons themselves inherently fragile. There are more than 19,000 objects in orbit larger than 10 centimeters, and more than 1.5 million objects less than 10 centimeters.[72] Since 1947, more than 6,000 satellites have been put into space, and about 800 are operational now. These objects in orbit make for a crowded, and dangerous, commons (Figure 3). A tiny speck of paint that had broken off of a satellite once dug a pit in a space shuttle window nearly a quarter-inch wide, causing a near catastrophe. It is estimated that a pea-sized ball moving in orbit would cause as much damage to a satellite or manned spacecraft as a 400-pound safe travelling at 60 mph.[73] Without a more robust governance regime, this situation is likely to worsen.

The destruction of satellites threatens the space commons, as explosions in orbit create millions of small pieces of debris, some of which can remain for decades. About 50 percent of all trackable objects in orbit are due to in-orbit explosions or collisions.[74] A broad kinetic anti-satellite campaign could be analogous to fighting World War II

in an environment where all the stray bullets, mortars and bombs do not simply fall to Earth, but continue to fly around the world for decades, rendering much of the surface of the Earth uninhabitable. Similarly, orbits littered with debris from a kinetic anti-satellite campaign would be useless for the satellites upon which the global economy depends.

This fragility represents an Achilles' heel for the space commons and the U.S. military. The Commission to Assess United States National Security Space Management and Organization succinctly summarized its concerns about American vulnerabilities:

> The relative dependence of the U.S. on space makes its space systems potentially attractive

targets. Many foreign nations and non-state entities are pursuing space-related activities. … An attack on elements of U.S. space systems during a crisis or conflict should not be considered an improbable act. If the U.S. is to avoid a "Space Pearl Harbor" it needs to take seriously the possibility of an attack on U.S. space systems.[76]

Burgeoning ASAT Capabilities: A growing number of states have recognized American reliance on space, have access to space, and are developing capabilities to exploit U.S. vulnerabilities.[77] Recent developments demonstrate that access to, and use of, space is becoming increasingly contested. These developments threaten the American way of war, given the U.S. military's use of space for everything from logistics to Command, Control,

Figure 3: Artist's Impression of Trackable Objects in Orbit Around Earth.

For visibility, size of debris is exaggerated relative to the Earth.[75]

Communications, Intelligence, Surveillance and Reconnaissance (C3ISR). These developments also threaten the space commons in general:

- China successfully tested a direct-ascent anti-satellite missile in January 2007, which created over 35,000 pieces of debris larger than 1 centimeter.[78] China also reportedly used lasers to temporarily blind an American satellite in 2006.

- Russia provided Iraq with GPS jammers in 2003, which were somewhat successful in countering American precision-strike weapons.[80]

- Several states and non-state actors have used radio and cyber capabilities to disrupt or degrade an adversary's space capabilities. Indonesia jammed a Chinese-owned satellite. Iran and Turkey have jammed satellite broadcasts of national dissidents.[81] In 2003, Iran jammed satellite broadcasts of Voice of America, and in March of that year, Iran jammed GPS signals. In 1999, hackers attacked a British satellite via cyberspace. In 2008, Brazilian hackers were arrested for using homemade communications dishes to "hijack" transponders on a U.S. Navy satellite.[82] More recently, the Iranian government reportedly jammed U.S. satellite and radio broadcasts during the protests surrounding its 2009 presidential election.

The threshold to access space is lowering, allowing several countries to develop indigenous abilities to access and operate in space. While these efforts are primarily commercial and civilian in focus, many new space programs have military components. In May 2008, Japan's legislature passed a law ending a ban on the use of its space program for defense. France's new defense white paper calls for doubling investment in space assets, including spy satellites. In late June, India announced that it would "optimize space applications for military purposes," and one of its most senior military officers candidly stated: "With time we will get sucked into a military race to protect our space assets, and inevitably there will be a military contest in space."[83]

Space may, in the coming decades, be more accessible to non-state actors. The high costs associated with developing, putting into orbit, and maintaining assets in space have, to date, kept space a domain for states, but costs are falling. Private companies have been attempting to develop relatively cost-effective space platforms for commercial launch purposes. The companies Scaled Composites and Virgin Galactic have developed a craft, *White Knight Two*, which they hope will carry a manned space capsule into orbit. In future years, it is possible (if not likely) that advanced high-altitude flight capabilities demonstrated by the *White Knight Two* will proliferate, making low orbit accessible for actors that do not have the resources to develop a full-fledged space program.

The implications of new actors operating within the space commons are potentially significant. Long the domain of the United States and the Soviet Union, space in the coming decades will become more crowded, with inexperienced actors who may not have responsible mentorship of the space commons in mind. Indeed, some may use space to strike at the United States and the international system, a kind of terrorism in zero gravity.

CYBER SPACE

The cyber commons today is a complex and anarchic environment lacking effective international agreements. Currently state and non-state actors are able to hack, intrude, corrupt and destroy data with relative impunity. While economic and technological necessity have allowed for the creation of standards and protocols to enable consistent communication, security in the cyber commons is often self-provided by users rather than by a central authority.

At the same time, the increasing use of the Internet and other aspects of the cyber commons by advanced states to manage domestic infrastructure creates new strategic vulnerabilities that adversaries cannot ignore. For example, sustained power outages or catastrophic breakdowns in

Cyberspace has changed the dynamic of political and military competition, as states may be able to compete aggressively in cyberspace while still being deficient in other measurements of national power.

transportation systems could result in significant physical damage and casualties, not to mention severely disrupting crucial economic, military and social activities. More disturbingly, attacks against these systems are technologically feasible.[84]

The distributed and interactive nature of cyberspace, combined with the low cost of computing devices, has lowered the threshold for actors to operate with great effect in cyberspace. Actors do not necessarily have to build complex weapons systems, like the Joint Strike Fighter, in order to leverage the benefits of cyberspace. Instead, accessibility and anonymity have created an environment in which smaller organizations and political actors, especially those who seek to hide from retribution in other environments, can achieve a disproportional increase in capabilities to conduct their operations and disrupt those of adversaries. The ease of achieving anonymity on the Internet also facilitates the rapid orchestration of operations across wide geographic areas with less chance of tipping off adversaries that disruptive attacks are imminent. A 2005 Washington Post article noted that al Qaeda "has become the

first guerrilla movement in history to migrate from physical space to cyberspace."[85]

Cyberspace has changed the dynamic of political and military competition, as states may be able to compete aggressively in cyberspace while still being deficient in other measurements of national power. Weak adversaries can use cyberspace to exploit vulnerabilities of their more powerful adversaries and, for instance, steal intellectual property from advanced states. Just as the expansion of global maritime trade required the development of colonies, naval fleets and their supporting infrastructures, cyberspace will require political and military measures to protect economic and informational interests. The United States will have to learn how to protect its cyberspace presence in a cost-effective fashion.

Indeed, using the cyber commons to achieve rapid strategic impact has become a tool for non-state actors. Organized criminal activity, Internet posting of terrorist videos of beheadings and malicious disruption on a global scale can all spread rapidly.[86] Cyberspace has multiplied opportunities for small groups to achieve large effects by getting their message to a global audience. This increases their geographic base for acquiring resources, whether through voluntary contributions or illicit activity. In the future, these groups will use cyberspace as a place where guerilla campaigns, orchestrated dispersal and surreptitious disruption can occur. The challenge for the United States is to create a recognizable signature in cyberspace that renders such nefarious groups vulnerable to retaliation and future deterrence.

Cyberspace offers opportunities for disrupting and crippling even the largest state opponents through new methods of attack. The disruptive attacks against U.S. and South Korean government and economic sites in early July 2009 illustrate this. While the actors behind the attack remain

unknown, it is known that they utilized a bot-net of tens of thousands of computers based on a long-known vulnerability to network security protocols.[87] In this volume, Dr. Greg Rattray and his co-authors argue that the behavior of viruses and malicious code in the cyber commons is similar to the behavior of biological diseases.[88] They argue that the dynamics of infection and transmission parallel the dynamics of malicious code and viruses in the cyber commons.

Although the major threat to the openness of the global cyber commons stems from its anarchic and decentralized nature, several state and non-state actors are developing the capability to challenge U.S. and international access to the cyberspace.

- **Russia** reportedly has developed a robust ability to deny its adversaries access to cyberspace. In April 2007, during an imbroglio surrounding the removal of a Soviet-era monument, the websites of the Estonian Parliament, ministries, media outlets, and banks were attacked and defaced. While the Estonian government immediately blamed Russia for the attack, they could not definitively link it to Moscow.[89] Georgia faced similar attacks during its war with Russia over South Ossetia in 2008.

- **China** reportedly has developed several types of computer network operations. According to a Pentagon report, China's military has "established information warfare units to develop viruses to attack enemy computer systems and networks, and tactics and measures to protect friendly computer systems and networks."[90] Indeed, according to the Pentagon, China's military has integrated these sorts of strikes into its exercises, using them as first strikes against enemy networks.

- **Al Qaeda** apparently has developed plans to target key businesses, government agencies, financial markets and civil infrastructure using cyberspace.[91]

An American Strategy to Protect the Global Commons

The United States should pursue a range of political and military initiatives, as well as military investments, to sustain the openness of the commons, reduce the burden of leadership from the United States, and improve the ability of the U.S. military to operate in an environment in which access to the commons is contested. In this pursuit, the United States should not limit itself to using only the military. Rather, it should utilize all elements of national power, including diplomacy, economic investment, public diplomacy, and military power.

Since World War II, American power has been derived in part from providing global public goods that also serve vital U.S. interests: stability in key regions, a vibrant global economy and fair access to the global commons. Theorist Joseph Nye has argued that considering the relationship of American power to global public goods helps to unveil "an important strategic principle that could help America reconcile its national interests with a broader global perspective and assert effective leadership."[92] It is time to recommit to this vision and to re-imagine America's stewardship of an international system that benefits both the United States and the world.

Focusing U.S. power on leading the effort to sustain these basic features of the global system is well within America's strategic tradition. Recall that America's Cold War defense and national security policy was predicated on exactly these priorities. The United States used all the elements of its power to *contain* what American diplomat George Kennan called "Russian expansive tendencies," but it also helped construct and then *sustain* an international system, the broad contours of which continue to underpin today's world.[93] Indeed, NSC 68, the famous Cold War planning document written in 1950, embraced these goals: "One is a policy which we would probably pursue even if there

Since the end of the Cold War, the international system has become an effective means for states to peacefully assert their own interests and pursue prosperity through integration into the global economy.

were no Soviet threat. It is a policy of attempting to develop a healthy international community. The other is the policy of "containing" the Soviet system. These two policies are closely interrelated and interact on one another."[94]

Since the end of World War II, the United States has led and sustained an international system that has enabled states to peacefully assert their own interests and pursue prosperity through integration into the global economy. Indeed, before becoming Deputy Secretary of State, James Steinberg argued: "Far from justifying a radical change in policy, the evolution of the international system since the collapse of the Soviet Union actually reinforced the validity of the liberal internationalist approach."[95] In future years, as states that have benefited from global integration come into their own as regional powers, they can use their newfound influence to sustain the system that has enabled their rise. The United States should channel the newfound power of rising states, and lead a global effort to protect and sustain the openness and stability of the global commons.

To achieve this new vision, the United States should pursue three key objectives.

RECOMMENDATION: BUILD STRONGER GLOBAL REGIMES
Washington should work with the international community, including potential adversaries, to develop bilateral and multilateral agreements that preserve the openness of the global commons. As Secretary of Defense Gates declared in May 2009, "Whether on the sea, in the air, in space, or cyberspace, the global commons represent a realm where we must cooperate — where we must adhere to the rule of law and the other mechanisms that have helped maintain regional peace."[96]

Maritime: As the world's oldest commons, the maritime domain has a rich tradition promoting the freedom of the seas. From international agreements to traditions of responsible seamanship, the maritime commons enjoys support from a robust set of global regimes.

The United States could greatly advance the openness of the global commons by ratifying UNCLOS. While the United States has long conformed to UNCLOS in practice, its arguments against exclusivity are undermined by not ratifying the Convention. In the words of several naval officers interviewed by the authors, not ratifying UNCLOS prevents the United States from having a "seat at the table" as continental shelves are identified, sovereign control of coastal waters is assigned, and UNCLOS provisions are interpreted.

Air: Like the maritime domain, the air commons has a robust set of regimes and a long international tradition of supporting the freedom of the skies. Yet, the international agreements that undergird the air commons are almost entirely bilateral — to date, almost 4,000 bilateral air transport agreements are registered with the International Civil Aviation Organization (ICAO).[97] The United States should lead an effort to multilateralize these agreements, which would greatly improve standardization and efficiency in civil air transportation.

Additionally, the United States should continue to strengthen peacetime aviation security. While there is no single means to accomplish this end, the United States should strive for the harmonization and implementation of best practices at airports and aviation facilities. Promulgating standards for security, from baggage inspection to airport surroundings, would greatly enhance the security of the air commons.

Space: Space is in serious need of stronger international regimes. Although fundamentally flawed, the stated goal of the space governance treaty proposed by Russia and China—"keeping outer space from turning into an arena for military confrontation, in assuring security in outer-space and safe functioning of space objects"—is laudable. To accomplish this objective, the international community should adopt two mutually supporting agreements.

1. **Kinetic No-First-Use in Space:** Given the foundational role of space in the international economy and American military operations, the United States and international community have a significant interest in preventing the kinetic destruction of satellites in orbit. An agreement that no state will be the first to kinetically destroy an object in orbit and create debris, except in cases to protect human populations from out-of-control satellites, would protect U.S. and international interests in preserving the openness of the space commons without restricting U.S. military interests in dissuading and hedging against threats in space. As this approach regulates behavior and not capability, it bypasses obstacles such as the need to define "anti-satellite weapons" and verification.

2. **Against Harmful Interference in Peacetime:** An international agreement against harmful interference of space objects would encompass a prohibition against the jamming, blinding, and hacking of satellites. Such disruptions—even

In future years, as states that have benefited from global integration come into their own as regional powers, they can use their newfound influence to sustain the system that has enabled their rise.

if they do no permanent damage to the satellite itself—threaten the openness of the space commons. However, such actions would be acceptable during times of conflict.

With these agreements in place, the United States would be able to research kinetic and non-kinetic military capabilities for use in extremis while developing defenses against a condensed range of threats. The international community would also benefit, as the use of kinetic weapons would be restrained, as would the creation of destructive orbital debris. Moreover, prohibiting harmful interference of space systems in peacetime would offer better protection while labeling such interference more clearly as acts of hostility.

Additionally, the United States should revise its National Space Policy to encourage the development of global regimes designed to promote the openness of the space commons. The current policy, published in 2006, is blatantly hostile to any form of international agreement that limits U.S. activities in space:

> Proposed arms control agreements or restrictions must not impair the rights of the United States to conduct research, development, testing, and operations *or other activities* in space for U.S. national interest [emphasis added].

While the United States should certainly retain some ability to deny an adversary the use of space during a time of conflict, it must recognize that international agreements that limit the behavior of the United States in space will also apply to other states. Properly crafted international agreements can effectively limit threats to U.S. satellites while retaining U.S. freedom of action in space.

Cyberspace: To exercise leadership, the United States must be perceived as acting within a broader global agenda and not merely looking for advantage and dominance in this environment. The Internet was spawned from a Department of Defense-funded experiment, however it grew into a new environment for human interaction. As this experiment developed into a global commons, the United States had the vision to facilitate its global use and to cooperate broadly in the diffusion of the technology. It supported Internet governance structures that include people, groups and governments around the world.

The United States must understand the utility of a cooperative strategy to advance its interests. It should continue to leverage its place on the high ground to mobilize international and global action. Additionally, the United States should collaborate with states and others to develop norms for proper behavior through declaratory statements, and it should promote international efforts, such as the Convention on Cybercrime, to maintain a healthy and clean cyber commons.

The United States should lead global efforts to clean up the cyber environment. A clean, healthy cyber commons serves national security purposes, making it easier to identify the source of attacks and reducing the spread of botnets and other threats by malicious actors. A cleaner cyber commons would also reduce risks to U.S. military systems and operations that require cyberspace to conduct network-centric warfare and to project U.S. power globally.

Any effort to clean up the cyber environment will require international engagement for success. As in other commons, the Internet is too interconnected to make standalone national defenses effective. While there are existing programs to build the capacity of national Computer Emergency Readiness Teams (CERT), the United States should move beyond working with governments to engage and support global multi-stakeholder organizations such as IETF or ICANN. In addition, the United States should encourage network operator groups to play active roles in ensuring the technological systems and operations of the cyber commons are more resistant to abuse by malicious actors and are resilient in the face of attacks. In making the commons a better place for all users, these organizations can reach across political boundaries and remain outside the interplay of day-to-day political struggles.

RECOMMENDATION: ENGAGE RESPONSIBLE PIVOTAL ACTORS
In 1999, the historian and strategist Paul Kennedy and his colleagues called for an American strategy that focuses attention on "pivotal states" whose futures are "poised at critical turning points, and whose fates would significantly affect regional, and even international, stability."[98] With respect to the global commons, the United States should identify pivotal actors who share an interest in maintaining open access to the global commons, build their capacity to promote and protect those interests, and engage their support in efforts to build a lasting set of institutions and norms to protect the commons. Assistance provided to the littoral states surrounding the Strait of Malacca, which enhanced local control of a strategic choke point without increasing U.S. or foreign military commitments, could be an important model for future efforts to engage pivotal actors to secure the global commons.[99]

Maritime: The Malacca Model can most easily be replicated in the maritime domain. Naval power is traditionally distributed and cooperative, and

it lends itself well to the kind of engagement that the United States will have to pursue to maintain the openness of the global commons. The identification and engagement of key littoral states along critical sea lanes of communication, such as Australia, South Korea, Japan, Malaysia, Indonesia, Singapore, India, Egypt, Israel and Spain, should be relatively straightforward. These states already have close relationships with the United States, and America has encouraged their contributions.

For strategically located states that have intentions toward the global commons that are compatible with U.S. interests, the United States and its partners should selectively and carefully provide technical assistance, financial assistance and training to improve their maritime capabilities. With improved capabilities, these states could gradually assume responsibility to maintain the openness of the maritime commons in their regions.

A more difficult task for the United States and its allies will be engaging states with important geographic locations that do not have a clear commitment to maintaining the global commons. China is the most obvious example. While China's development of a blue-water navy could be utilized to promote openness and stability in the commons, the development of anti-access capabilities (such as an anti-ship ballistic missile) raise significant questions about China's intentions. Similarly, while China's contribution to counter-piracy operations off the coast of Somalia was a positive commitment to openness, China's behavior in the South China Sea suggests a preference toward exclusive access. The United States should encourage China's participation in multilateral operations to preserve the openness of the maritime commons. At the same time, the United States should work to counter, dissuade and deter China's apparent leanings towards developing anti-access capabilities and exclusionary policy practices.

Air: To protect the air commons, a key aspect of engaging responsible pivotal actors will be building their air forces, which will be in the mutual interest of the United States and the partner countries. For the United States, new partnerships mean production contracts and the development of capable air forces that are interoperable with the U.S. military. For the pivotal actor, partnering with the United States means gaining access to advanced technologies and building a relationship with the world's dominant air power.

In addition to building military air capabilities, engaging pivotal actors in the air commons should include assistance in the construction of robust air infrastructure. The United States should encourage private investments and target foreign assistance to build airports and supporting facilities, enhance their security, improve navigation systems networks, and train its operators and managers. Tapping into the air commons is a proven mechanism for bringing jobs and economic growth to a region, especially in developing nations. Additionally, the air commons allows greater social and economic integration across borders. In short, by promoting broader use of the air commons, the United States can not only promote the openness of the air commons, but also bring greater prosperity and stability to states worldwide.

Space: The rise of several new space powers, including Japan, India and South Korea, offers the United States ample opportunities for positive engagement. As an experienced space power and the world's leader in space technologies, the United States can leverage its superior position in space to encourage the responsible behavior of pivotal space actors. This will mean encouraging the use of space for scientific exploration and collaboration, instead of as a theater for nationalistic chest-thumping.

The Malacca Model

The Strait of Malacca, a narrow, 500-mile-long waterway between peninsular Malaysia and the Indonesian island of Sumatra, is one of the most important shipping lanes in the world. Some of the world's largest economies, such as China, Japan and South Korea, depend on access to the Malacca Strait for access to the Indian Ocean and Middle Eastern energy sources beyond. In all, about 40 percent of the world's traded goods travel through the Strait of Malacca, including an estimated 15 million barrels of oil per day.[100]

The Strait of Malacca is also one of the world's most vulnerable strategic choke points—its narrowest point (Phillips Channel near Singapore) is only 1.5 nautical miles wide. Historically, piracy has been a major threat to the openness of the channel. In 2004, the Strait of Malacca saw 38 pirate attacks, the second highest total in the world that year.[101] Yet, piracy has fallen drastically—only two attacks were recorded in 2008. The reason for this sudden drop in pirate attacks should be seen as a model for how American engagement of responsible pivotal actors can help improve the openness and stability of a common without increasing American burdens.

Historically, the littoral states along the strait (Indonesia, Malaysia, and Singapore) were distrustful of one another, precluding any cooperation. When the threat of piracy escalated in 2004, these states decided to collaborate to address the problem and prevent the need for foreign (read: American) military intervention. The three countries began to coordinate sea and air patrols and share intelligence, while Indonesia addressed internal problems that had driven its citizens to piracy as a way to earn a living.

In the background of this newfound cooperation were the United States, Japan and Australia, quietly facilitating increased coordination and providing technical assistance and training. Thus, the United States and its allies were able to help like-minded, pivotal actors to maintain the openness of a commons without violating the regional state's sense of autonomy or taking on additional burdens for the U.S. military.

Cooperation between these actors has not been limited to counter-piracy. In early September 2007, naval forces from the United States, India, Japan, Australia and Singapore participated in the joint exercise MALABAR-07-02, the largest multi-national Asian naval exercise in decades. In the eastern Indian Ocean, these navies exercised a wide range of scenarios, including mock air battles involving Indian and American aircraft carriers, sea strikes near the Strait of Malacca, and anti-piracy drills off the Andaman Islands. This exercise roughly coincided with then-Chief of Naval Operations Adm. Michael Mullen's call for a "thousand-ship navy" consisting of countries with shared interests in counter-piracy, counter-proliferation and other naval issues.

Central to the responsible use of space will be the development and promulgation of space situational awareness (SSA), or the ability of a space power to know what objects are in orbit and identify potential problems before they emerge. SSA is a closely-held secret, but it need not be. The United States could, and should, develop a version of SSA that can be shared with responsible space-faring nations.

Another potential area for the engagement of responsible space actors is the tracking, and eventual mitigation, of space debris. The Inter-Agency Space Debris Coordination Committee (IADC), composed of space agencies from the United States, the European Union, Russia, Japan, Italy, the U.K., France, China, Germany, India and the Ukraine, has already been established to exchange information on space debris research activities and facilitate cooperation. Yet, additional cooperation to limit the creation of additional orbital debris and to mitigate existing debris is needed, and it will be a major challenge in the coming decades.

As in the maritime commons, the United States will be challenged to engage states that have unclear capabilities and intentions. The United States should engage emerging, responsible space powers with technical assistance and cooperative scientific missions while emphasizing the importance of maintaining the openness and stability of the space commons. Moreover, the United States should use cooperation and the potential for technological exchanges to entice these states to behave responsibly and contribute positively.

Cyberspace: The seeds of international cooperation to maintain the openness of the cyber commons are already sprouting. The U.S. CERT Coordination Center (US-CERT/CC), other national CERTs, and international organizations such as the Forum of Incident Response and Security Teams (FIRST) perform some of the same functions for cyber security as do the World Health Organization and the Centers for Disease Control for public health. But they are not nearly as comprehensive. As an example, the US-CERT/CC provides risk management and threat awareness at the system and software levels, assists in vulnerability reporting to vendors, and facilitates information sharing.

The United States should take steps to make international organizations such as FIRST more comprehensive, and it should give them the same level of legitimacy and capability to address shared cybersecurity concerns as the WHO has in the realm of global health. Because of the lack of a global consensus on cybersecurity approaches, the United States would initially have to build a coalition of like-minded actors (including states and corporations) to promote the health and openness of the cyber commons.

Washington should also utilize public-private partnerships and encourage country- and local-level information sharing on cyber defense. National organizations should exchange information with local groups, and help them implement security measures. Sector-specific entities (for example, in banking or energy) should address security for companies in their sector. Collecting and publishing best practices for security and threat management from constituent organizations, sharing and monitoring data, championing research efforts, and assisting with response activities during times of crisis are activities these cyber-defense organizations should undertake. Such an effort would produce a national view of cyber threats, events, and collaborative response that can be linked into the global community just as America's CDC is linked to other nations' public health programs through the WHO.

RECOMMENDATION: RESHAPE AMERICAN HARD POWER TO PROTECT THE GLOBAL COMMONS

Washington should clearly signal America's intentions to stand by its long tradition of supporting the openness and stability of the global commons. While the building of global regimes and the engagement of responsible pivotal actors can go a long way toward promoting this goal, these steps are not sufficient to ensure an open and stable global commons. The United States should develop a robust military capability as well. Such a capability could dissuade efforts to undermine the commons and defeat any actor that attempts to limit access by the United States, and its allies and partners. As a precaution, the Pentagon should also develop capabilities to enable effective U.S. military operations when a commons is unusable or inaccessible.

Maritime: In the coming decades, U.S. naval capabilities will need to operate in a more contested environment in which the use of regional bases will be uncertain. An increased reliance on expeditionary warfare, and threats from advanced cruise missiles, anti-ship ballistic missiles, Maritime Armed Groups, terrorists, and pirates will require the flexibility to respond to a diverse set of challenges, far from home, with varying degrees of regional support.

In an age when the United States will rely more on expeditionary power than on forward basing, aircraft carriers and advanced surface ships will be at the center of America's ability to project power around the world. The Pentagon's proposed budget from Fiscal Year 2010 included slowing the rate of aircraft carrier production by one year, which will ultimately reduce the active U.S. carrier fleet to 10. Secretary of Defense Gates also requested a delay in the development of a next-generation guided missile cruiser, finishing production of the over-budget and delayed DDG-1000 Zumwalt-class destroyer, and restarting the highly-capable

Arleigh Burke-class guided missile destroyer. While the U.S. Navy will still be the dominant naval power with considerable power projection capability, the loss of one aircraft carrier is a significant reduction in available blue-water firepower. Most significant for operating in oceans with anti-access threats will be the revitalization of the Arleigh Burke-class destroyer, which is upgradeable to a missile defense capability that counters ballistic and cruise missile threats.

Additionally, a robust littoral capability will be essential to preserving the openness of strategic maritime commons, such as the Strait of Hormuz and the Persian Gulf, where low-end distributed threats present a particular hazard. The Pentagon's FY 2010 budget request included the accelerated development of the Littoral Combat Ship (LCS) program, which is intended to be smaller, faster and more agile in order to effectively operate in the near-shore environment. A fleet of these relatively inexpensive yet highly capable ships,[v] commanded by the U.S. Navy and its partners, would be a robust defender of the openness and stability of the commons.

Yet the United States must do more to counter anti-access capabilities and reassure allies. As forward bases come under threat of ballistic missile strikes, and their utility becomes increasingly constrained by political sensitivities of the host countries, the United States should continue the pursuit of a robust and flexible force posture and logistics chain, while investing in base-hardening and missile defenses.

The United States must adjust to the increasing reluctance of many host countries to support large military bases. Maintaining the ability to sustain expeditionary power projection is important, but even the most advanced carrier strike groups rely on regional bases for logistics support. Thus, the United States cannot rely on

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[v] The rising costs of the LCS (which has gone from a planned per-ship cost of 223 million dollars to over 700 million dollars for the first ship of its class) are highly concerning.

The Littoral Command Ship-1.

(LT ED EARLY/U.S. Navy)

maritime expeditionary power alone—some form of regional basing support will be required if the United States is going to retain the ability to support extended power projection.

The United States should pursue the creation of a more flexible network of smaller bases and supply stations around the world that support the U.S. military's logistical needs yet require a smaller geographic and political footprint with the host nation. This will require moving away from the Cold War model of large, overtly-military bases to dual-use civil-military facilities based on more implicit bilateral agreements.[103] Supporting this should be a sustained effort to cultivate strong diplomatic and economic ties with strategically-located states. An example is Singapore's Changi Naval Base, which can accommodate the largest of ships, including an aircraft carrier.[104]

Air: The Department of Defense appears confident about the future of its air-to-air advantages in the coming decades.[105] Yet air superiority requires more than a technological or numerical advantage in air-to-air platforms. The ranges of

current and projected surface-to-air and surface-to-surface missile systems possessed by potential adversaries, or on the global market, will reshape dramatically the familiar terms of competition in the air. The United States should bolster the range and survivability of its air power. The utilization of long-range reconnaissance and strike systems, combined with cruise-missile-equipped attack submarines, would enable the United States to operate in some denied environments.[106]

Space: While global regimes and responsible behavior by pivotal actors can go far toward mitigating this problem, the United States should develop capabilities to rapidly replace satellites lost in a conflict, and research ways to harden satellites against kinetic and nonkinetic attack.

However, replenishment and hardening is insufficient, as it does not address the fundamental problem that the United States relies on a commons that is inherently fragile and vulnerable. In the coming decades, the United States should not allow its military to remain dependent on space to fight modern wars. This vulnerability may be

simply too tempting a target for adversaries during a major conflict. Thus, the U.S. military should develop capabilities and doctrine to ensure it can operate at a high level of effectiveness without the use of space for C3ISR. Networks of sub-orbital, stealthy and unmanned planes with extended flight times offer significant promise.

Cyberspace: The cyber warfare environment is decentralized, anarchic, broad in scope and remarkably fast in tempo.[107] The speed with which attacks on a network can be initiated and adjusted will require the United States to develop rapid response capabilities, entailing higher levels of automated decision-making. Writing elsewhere in this volume, Dr. Greg Rattray and his co-authors point out that:

> Rules of engagement often call for high-confidence identification of potential targets, but a commander may not fully trust automated systems to make the call regarding weapons employment. Unfortunately, cyberspace presents myriad opportunities for adversaries to subvert automated systems and turn them against their operators, or against third parties.[108]

Yet adapting to the particulars of cyber warfare obscures the fact that the U.S. military remains highly dependent on commercial networks for rapid C3ISR. Although it will be highly challenging, the Pentagon must begin to develop technologies and concepts that will allow the military to operate effectively without use of the Internet. This will, in part, mean a reversion to reliance on commander's intent and the empowerment of lower levels of command. But it will also mean increased dispersion and robustness of physical infrastructure, so the effects of the destruction or compromise of a particular node is contained.

Conclusion

America's power and the stability of the existing international order depend upon the openness and stability of the global commons. Goods flow, ideas promulgate, militaries operate and people travel through these commons with little thought to how and why they are kept open.

The rise of new economic powers will fundamentally change the dynamics of the international system, and the development and proliferation of disruptive military threats will challenge the openness of the commons. The United States must realize that, as these challenges develop, it will not have the capacity to maintain these commons on its own. Thus, the development of a responsible and effective international effort, supported by global regimes, pivotal actors, and the U.S. military will maintain the stability of the commons and act as a bulwark against the forces of exclusivity and chaos.

In the end, however, protection of the global commons will depend on America's will to lead. Despite the rise of new powers and the enduring capabilities of old allies, no other country has the ability to lead a global effort to protect the commons. No other country can challenge America's legacy of building global institutions to advance shared goals. The United States should summon the will to apply its diplomatic, economic, military and moral power in defense of the global commons. This act of leadership will protect vital American interests and those of the international community for years, and even decades, to come.

That they have power to hurt and will do none,
That do not do the thing they most do show,
Who, moving others, are themselves as stone,
Unmoved, cold, and to temptation slow,
They rightly do inherit heaven's graces
And husband nature's riches from expense;
They are the lords and owners of their faces,
Others but stewards of their excellence.

— William Shakespeare
  Sonnet 94

Summary of Recommendations

MARITIME

- Ratify UNCLOS.

- Selectively and carefully provide technical and financial assistance and training to improve the maritime capabilities of states whose intentions toward the global commons are compatible with U.S. interests and whose geographic locations are strategic.

- Encourage states with unclear intentions toward the global commons to participate in multilateral operations to preserve the openness of the maritime commons while countering, dissuading and deterring efforts to develop anti-access capabilities or pursuing exclusionary policy practices.

- Maintain robust power projection capabilities with aircraft carriers, missile defense-capable destroyers and an adaptable logistical system.

- Continue to pursue a robust and flexible force posture and logistics chain while investing in base hardening and missile defenses.

- Develop the ability to operate in some denied environments with the utilization of long-range reconnaissance and strike systems, combined with cruise-missile equipped attack submarines.

AIR

- Pursue multilateral civilian air transportation agreements.

- Standardize best practices at airports and aviation facilities around the globe.

- Build the air forces of allies and partners whose military air capabilities are under-developed.

- Assist in the construction of a robust air infrastructure in under-developed states with objectives in the global commons that are compatible with U.S. interests.

SPACE

- Pursue an international no-first-use agreement against kinetic strikes against satellites, except in cases to protect human populations from out-of-control satellites.

- Pursue an international agreement against the harmful interference of satellites in peacetime.

- Revise the U.S. National Space Policy to encourage the development of global regimes designed to promote the openness of the space commons.

- Encourage the use of space for scientific exploration and collaboration.

- Encourage the responsible use of orbits and prevent the creation of harmful debris.

- Develop a publicly releasable version of space situational awareness (SSA) that is shareable with other responsible space-faring nations.

- Develop robust international efforts among responsible space powers to track and mitigate orbital debris.
- Engage emerging responsible space powers with technical assistance and cooperative scientific missions, coupled with an emphasis on the importance of maintaining the openness and stability of the space commons.
- Use cooperation and the potential for technological exchanges to entice states with unclear intentions to behave responsibly and contribute to the openness and stability of the space commons.
- Develop capabilities to rapidly replace satellites lost in a conflict.
- Research technologies to harden satellites against kinetic and non-kinetic attack.
- Develop capabilities and doctrine to ensure the U.S. military can operate at a high level of effectiveness without the use of space for C3ISR.

CYBERSPACE

- Establish norms for proper behavior within the cyber commons.
- Promote international efforts to maintain a healthy and open cyber commons, such as the Convention on Cybercrime.
- Move beyond working with governments to engage and support global multi-stakeholder organizations like the Internet Engineering Task Force (IETF) and the Internet Corporation for Assigned Names and Numbers (ICANN).
- Encourage network operator groups to cross political borders to play active roles in improving the health, openness and resilience of the cyber commons.
- Make international organizations, such as the Forum of Incident Response and Security Teams (FIRST) more comprehensive, to bring them to the same level of legitimacy and capability for cybersecurity as the World Health Organization (WHO) does for global health.
- Utilize public-private partnerships and encourage information-sharing on cyber defense among state and local organizations.
- Develop rapid response capabilities, including higher levels of automated decision-making.
- Develop technologies and concepts that will allow the military to operate effectively without use of the Internet.

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