



Warfare by Internet

The Logic of Strategic Deterrence, Defense, and Attack

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“Of what use is a thinker who doesn’t hurt anybody’s feelings?”

—Diogenes the Cynic

ADVERSARIES THREATENING OUR national security in the modern era will be hostile states, violent extremists, and even criminal syndicates. What fundamental principles should guide our security policies in meeting these threats in the cyberelectromagnetic dimension of global conflict? What strategic logic of deterrence, defense, and attack should guide the military doctrines of advanced industrialized nations like the United States and its allies? Would such logic be similar to that of warfare in general, or is it counterintuitive in some important ways? The purpose of this article is to explore possible answers to these kinds of questions by engaging in an excavation of the conditions in which vital information infrastructures of modern industrial states are at stake.

Relevant Factors

The principle issues are these:

- Determining who would want to attack critical information infrastructures and why.
- How such adversaries would attack “by Internet.”
- How a state could deter such attacks.
- How a state should defend against and defeat such attacks.
- Whether offense by Internet is a viable way to change an undesirable status quo.

More questions requiring answers rise from thinking about these concerns. Causing a temporary disruption of a nation’s critical cyber nervous system to provide an advantage in other dimensions of conflict is one thing, to leverage that disruption alone into anything more than a punitive act is quite another. From such dubious aspirations, it follows that creating offensive formations of “cybersquadrons” and “cyberfleets” to control the cyberdomain or the “global commons” of cyberspace will not be the greatest concern. For the wired community of advanced industrial states, enacting the more mundane yet challenging recommendations of the Center for Strategic and International Studies Commission will be more important.¹ Techno-capable

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When asked by Alexander the Great what wish he could fulfill for Diogenes, the philosopher replied, “Move out of the sunshine so that you don’t take what you cannot give.”

ART: Diogenes of Sinope. Painting by Nicolai Abildgaard, c.1790

outcast nations, extremist political movements, and criminal syndicates stand to benefit more from current conditions. Therefore, the way military thinkers approach doctrine relevant to the potential for Internet warfare must change. The Internet is a global commons to which the “cyberspace” metaphor is useful from the standpoint of political and legal approaches to sharing its utility with global allies. From the perspective of denying its benefits to adversaries, the cyberspace metaphor gets in the way of clear thinking.

Cyberspace as a “Domain”

William Gibson, the cyberpunk science fiction author, originally coined the term *cyberspace* (from cybernetics and space) in 1982. This now ubiquitous term has become the conventional way to describe anything associated with computers, information technology, the Internet, and the diverse Internet culture. In the 1980s, the term *cyberspace* started to become a de facto synonym for the Internet. During the 1990s, it was the same for the World Wide Web. Author Bruce Sterling, who popularized this meaning, credits John Perry Barlow as the originator who referred to “the present-day nexus of computer and telecommunications networks.”² The term *cyber* is rooted in a forerunner to current information theory and computer science—the science of cybernetics and Norbert Wiener’s pioneering work in electronic communication and control science.³

Cyber is used metaphorically to refer to objects and identities that exist largely within the communication network itself, so that a website, for example, might be said to “exist in cyberspace.” According to this metaphor, events taking place on the Internet are not therefore happening in the countries where the participants or the servers are physically located, but “in cyberspace.” This is understandable because the Internet and computer and communications systems permits people to be at any location while communicating with other entities or people that are “connected” at another location somewhere else in the world. People can

be made to believe they are having a virtual interactive experience within cyberspace regardless of their real geographic location. They can exchange ideas and otherwise act *within cyberspace*. This metaphor suggests new ways of thinking about computer-mediated communications.

First, it describes the flow of digital data through the network of interconnected computers as not *real* since one cannot spatially locate it or feel it as a tangible object. However, such communication clearly has real effects. The “space” in cyberspace does not have the physical duality of positive and negative volume. Internet users cannot enter the screen and explore the unknown part of the Net as an extension of the space they are in. Metaphorically, the spatial meaning in the term is analogous to the relationship between different pages of books inhabiting the web servers, considering the unturned pages to be somewhere “out there.” The concept of cyberspace, therefore, refers not to the content presented to the web surfer, but rather to the possibility of surfing among different sites, with feedback loops between the user and the rest of the system creating the potential to always encounter something unknown or unexpected.

Second, the cyberspace metaphor posits an alternative virtual world where online relationships and alternative forms of online identity exist. Before cyberspace became a technological possibility, many philosophers suggested the possibility of a virtual reality similar to cyberspace. Common descriptions of cyberspace contrast it with the “real world.” Some people think of cyberspace as a culturally significant social destination in its own right, one in which they can be whoever or whatever they want to be.

Finally, this metaphor also suggests that cyberspace provides new opportunities to reshape society and culture through hidden identities and borderless communication and culture. Although the more radical consequences of the global communication network predicted by some cyberspace proponents (i.e. the diminishing of state influence envisioned by John Perry Barlow) have failed so far to materialize, their possibility remains current.⁴

From the perspective of denying its benefits to adversaries, the cyberspace metaphor gets in the way of clear thinking.

By the mid-1980s, use of computers, the Internet, and popular culture began to inspire a new generation of military strategists around the world to think about cyberspace and cyberwar. By the mid-1990s, thinkers in militaries everywhere were looking through the lens of warfare among advanced states, even after the collapse of the Soviet Union. They saw modern nation-states becoming as dependent on information infrastructures as the most advanced 20th-century states were on industrial and transportation infrastructures. The broadcast media of an enemy state came to be viewed as a worthy target of disruption and manipulation. It was tempting to think of analogies to airpower theories. For example, by 1993, two scientists of the Rand Corporation, John J. Arquilla and David F. Ronfeldt, wrote an influential article titled “Cyber War Is Coming,” published in *Comparative Strategy*. They, and many others, contend that the information revolution has transformed both international relations and warfare.

Since then, the cyberdomain metaphor, first championed by the U.S. Air Force, has not only entered military thought but also has established a firm foothold. For example, the Defense Department’s *“The National Military Strategy for Cyberspace Operations”* defines cyberspace as a “domain characterized by the use of electronics and the electromagnetic spectrum to store, modify, and exchange data via networked systems and associated physical infrastructures.” On 2 November 2006, the secretary of the Air Force announced the establishment of the Air Force Cyber Command (Provisional). In a 28 February 2007 posting on the official web site of the U.S. Air Force, the new commander commented on his understanding of Cyber Command’s mission and approach. He said, “First, we must control the domain,” then he stated that his command would conduct offensive operations in cyberspace in much the same way as its adversaries.

On the one hand, the term *cyberspace* suggests boundlessness. The modern system of



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Information Systems Technician 2nd Class Athena Stovall, assigned to U.S. 3d Fleet in San Diego, scans the network on her computer for intrusions during a cyber war training course at the Space and Naval Warfare Systems Center. 12 July 2007, Pearl City, Hawaii.

communications may seem boundless to the uninitiated, but it is not. The Internet can be mapped and understood. While there may be many pathways for a packet of information to travel a modern network, the number is finite, and bounded by the existing physical structure. Operations in a “space” suggests a space apart and invites reasoning by analogy to air or naval operations in which the chief aim is controlling or dominating a domain. The translucent qualities of the space in such domains lead to certain kinds of tactics and modes of operating that do not translate well to the labyrinthine and opaque world of modern computer-mediated networks. For instance, in the translucent air, naval, and outer space domains, advances in sensors and high-speed missiles enabled mutual deterrence, boosted the power of defenses, and, in relative terms, challenged the power of offenses when adversaries were roughly on par in capabilities. Gaining a physical position of advantage was mostly a matter of maneuvering in a true commons by means of speed, stealth, and power.

While cyberspace can be similarly understood to be a kind of global commons, the things that make it appear so are *owned* by private persons, corporations, institutions, or governments. Much of it is physically located in the sovereign territory of states and actually has very little in common with other traditional domains of war. These and many other unique properties of vital cybernetworks transform some crucial aspects of the logical workings of deterrence, defense, and offense in this dimension.

American cybersecurity experts beyond the military play down the metaphorical sense of a space or domain. Instead, they replace that sense by scientifically sounding descriptive language. The term “cyberelectromagnetic” combines “cybernetics,” the root of modern information and computer science and “electromagnetics,” the root of modern electronic communications and all so-called information technologies. The more recent *Securing Cyberspace for the 44th Presidency* similarly downplays the virtual space or domain metaphor and simply defines cyberspace as “all forms of networked, digital activities.”

War in the Cybernetic Age

There are more useful ways for military experts to think about this modern warfare phenomenon. For instance, in February 1999, two Chinese officers, Qiao Liang and Wang Xiangsui, framed the problem of conflict, or warfare, in the modern world differently:

In terms of beyond-limits warfare, there is no longer any distinction between what is or is not the battlefield. Spaces in nature including the ground, the seas, the air, and outer space are battlefields, but social spaces such as the military, politics, economics, culture, and the psyche are also battlefields. And the technological space linking these two great spaces is even more so the battlefield over which all antagonists spare no effort in contending. Warfare can be military, or it can be quasi-military, or it can be non-military. It can use violence, or it can be nonviolent. It can be a confrontation between professional soldiers, or one between newly emerging forces consisting primarily of ordinary people or experts. These characteristics of beyond-limits war are the watershed between it and traditional warfare, as well as the starting line for new types of warfare.⁵

These Chinese authors see “the technological space as an integrative “space” that is “technological” in nature but linked to actions in other “spaces.” They stress the centrality of conflict and that modern warfare is no longer restricted to “traditional” spaces or dimensions.

The nervous systems of modern nations. Our economy and national security are fully dependent upon information technology and infrastructure, the “nervous system” of the critical functional sectors of the nation. These critical functional sectors are productive today because we lead the world in the adoption of information technologies, just as we led the world in developing the industries and their supporting circulatory system during the late 19th and early 20th centuries. This nervous system is a vital national interest and is comprised of hundreds of thousands of interconnected computers, servers, routers, switches, and fiber optic cables, the software that makes it work, and the data and services stored within and provided by this system. At the core of it is the Internet, that

today connects millions of other computer networks making most of the nation's essential services and infrastructures work.

America's enemies (hostile states, violent extremists, and criminal syndicates) can invade this nervous system anytime to conduct espionage on our government, university research centers, and private companies. They may map it to identify key targets for later attack and lace its computers with back doors and other means of access. In wartime or crisis, adversaries may disrupt key economic functions and critical operations, cause loss of revenue and intellectual property, or loss of life, and even threaten the continuity of government. *Assuring* the speed, efficiency, and integrity of the interconnected cyberelectromagnetic nervous system of modern industrial nations ought to be the aim of military doctrine and the foundation for its logic rather than *controlling* cyberspace.

Both cyberspace and the "cyberelectromagnetic dimension" are merely conceptual formulations rather than physical realities. Neither exists except in our minds. The important question is which is the more useful conception?

Air and naval campaigns can be autonomous from land campaigns, linked only at the level of the overall war. This was a useful way to think about warfare in the 20th century. However, this way of thinking has diminished as the interdependence of the services has increased. Contests within one dimension could affect all other dimensions and are thus inseparable from the operation as a whole.

The macro logic of warfare by Internet. Offense and defense have a reciprocal but asymmetric logic. Offenses have the privilege of specializing, and defenses are often forced to generalize. Offensive operations are uniquely defined by their purposes. The end of an offensive campaign is to somehow change the existing status quo a particular way. For instance, a cybernetic act of terror has to carry a strong message. A regime about to be overthrown by force can attack the cybernetic infrastructures of its aggressors to save itself. Offensive warfare by Internet must adapt offensive warfare theory, in general, to the peculiarities of the Internet and to the nature and aims of the parties in conflict.

The purpose and logic of cyberdeterrence. Military capability-in-being deters others from committing acts of war. The mere existence of such capabilities can guarantee a status quo, freeing the

state from coercion by the violent threats of others. Deterring an act of war is based on understanding certain fundamentals:

- Deterrence is perceptual. An image must count as a judgment of deterrence. In other words, deterrence is wholly psychological.

- The audience must appreciate the deterrent value of the image.

- Implications must exceed the audience's threshold of acceptable cost in light of anticipated gain.

- One must appreciate that some people, in some circumstances, simply cannot be deterred. Some attitudes (e.g., otherworldly teleological aims) confound the usual logic of deterrence.

In every case, a deterrent has to be tailored specifically to those people who are most likely to decide whether to act or not. It is best to err on the side of too much rather than not enough, because there is no scientific way of knowing what deterrence value the audience will assign. Nor can one predict the price an adversary may be willing to pay in this complex and veiled transaction. The art is to know how to project the right image so that it is properly appreciated and sufficiently appropriate.

If this is the general law of deterrence, how does cyberdeterrence work? How does one project the right image of cybercapabilities so that it is properly appreciated by decision makers contemplating acts of war and sufficient to deter such acts?

First, we need to make explicit what is unstated in the general law: the "act of war" we wish to deter. For cyberdeterrence to work, the parties to what is already a "complex and veiled transaction" under the very best circumstances, must at least be clear what acts count as "acts of war." So, what cybernetic acts count as war, and how do we convince potential adversary decision makers that they count? If we have not reacted sharply to certain kinds of acts up to now, how do we now convince them that we will? Where do we draw the line between criminal acts, whether they are committed by private individuals

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Estonian Minister of Defense Jaak Aaviksoo, left, talks about how he views the threat of cyber terrorism during his discussions with Secretary of Defense Robert M. Gates in the Pentagon, 28 November 2007.

(for monetary or political gain) or by agents of a state (for economic or political gain), and true acts of war? The best policy may be to treat most of the cybernetic activities committed by the agents of states as crimes, rather than acts of war. That is, we should treat all hostile cybernetic activity by private persons, whether by criminals or terrorists, that way. For one thing, it is a way to control the escalatory process. It also promotes a law-and-order approach to bad behavior. Expanding the efficiency of apprehending, convicting, and punishing criminals will deter the agents of states as well. Having an agent exposed is bad public diplomacy.

However, if a state cyberattack crippled critical services in another state, which then influenced the attacked leaders to yield to the attacker's will, that would be "using force to advance hostile ends," and it would be widely accepted as an "act of war." There would be little quibbling over whether the force used was physical or cybernetic. Acts that produce widespread damage and suffering are violent acts of force. Hostile state decision makers would then understand what is considered an act of war. This would fulfill the first requirement for a functioning system of deterrence—that the parties understand what effects are likely to trigger a counterstrike.

The second requirement is that those contemplating cybernetic acts of war must fear reprisal. For reprisals to be feared, cybercounterstrikes need to be sufficiently drastic: they need to be acts of war themselves. For a reprisal of that scale to be credible, it is essential to assign unequivocal blame in a relatively short span of time. It is difficult to deter an aggressor who believes he can remain hidden. No rational state decision maker will respond with an act of war without a high degree of certainty about the source of attack.

Any actual attack on American or allied networks can use unsuspecting civilian computer networks, assembled into "botnets," as intermediary surrogates, making it appear they came from an innocent third state. There are now many ways to mask an attack. For example, the 2007 attacks on Estonian networks were widely attributed to Russia, as were the August 2008 attacks on Georgian networks, yet there was no way to "prove" these theories. The attacks on Estonia appeared to come directly from computers in Europe, China, the United States, and elsewhere. A counterstrike against the attacking computers would have damaged innocent networks in many countries without affecting those responsible for the attack.

...cyberforensics must be able to attribute blame quickly.

During the more recent Georgian–Russian conflict, anyone who wanted to participate in these attacks was invited to download certain pages from public web sites that could cause the volunteer cybersoldier’s browser to launch thousands of targeted queries to the most important Georgian sites, overloading them. Mobilizing such proxy swarms masks forensic attempts to identify the real source of attacks.⁶

For reprisal to be feared, not only must its strength and power be feared, but cyberforensics must be able to attribute blame quickly. Without this, fear is not rational.

Another requirement for a system of cyberdeterrence to function properly and reliably is that cybercounterstrikes must not only be effective acts of war but also must be sufficiently precise to do more good than harm. In other words, they must control the collateral damage they may cause. When American political authorities choose to respond in kind to a cyberstrike, they will be concerned about collateral damage. Powerful and feared cybercounterstrikes will need to be precise and controllable to deter reliably, because a counterstrike that inflicts harm to friends and allies is just not credible.

These concerns represent difficult challenges indeed. However, cyberdeterrence need not be based on similar cybercounterstrikes. Assuming blame can be attributed quickly, counterstrikes could be any other feared, effective, and precise act of war. This means that the only real impediment to a credible system of cyberdeterrence against other states is being able to attribute blame quickly and reliably.

Cyberdeterrence may work in an unconventional way as well. As much as both sides in World War II anticipated the use of gas warfare, its use was

mutually deterred in practice. Neither side would unilaterally give it up, but neither side would chance initiating its use because the clouds of gas could drift over their own troops and gas droplets contaminating the ground was a great hazard to subsequent friendly maneuver. In other words, beyond-first-order effects were considered unpredictable. These weapons became more trouble than they were worth.

Suppose nation-states come to realize that controlling the collateral damage from cyberstrikes is so problematic and so feared that even the launching state incurs unacceptable penalties, especially if cyberstrikes are not very effective in achieving political aims as recent attacks on Estonia and Georgia seem to have been. Rather than intimidating Estonians and Georgians, they seem to have stirred them up instead. If anything, these efforts spurred the development of cybersecurity, raising the bar for the next round of cyberattacks. This fundamental logic of deterrence also applies to nonstate actors up to a certain point—potential counteractions must be feared, effective, and precise. However, threatening to commit cybernetic acts of war against nonstate actors is a very tricky business:

- There is the challenge of finding targets to attack that might add up to an “act of war.”
- There is the problem of precision and containing collateral damage.
- The act may violate the sovereign space of another nation-state.
- There is the problem of deterring people who do not fear reprisal.

What would it take to deter Al Qaeda from committing a cybernetic act of war against the Western country of its choice, assuming it could? A sound system to deter cybercriminals and cyberterrorists is possible in theory, but very demanding. It would more likely *not* be based on cyberstrikes. As a foundation for this system of deterrence, the fear of apprehension, conviction, and punishment must be much higher than they now are. Nation-states will need to cooperate with each other far more than they currently do.

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States are at a disadvantage and will have more difficulty using cyberstriking capability to deter other states *and* terrorists than the terrorists themselves, especially when the terrorists have no cybernetic infrastructure at risk and care less about the precision of deterring strikes. This ragged asymmetry should be of great concern.

In summary, cyberdeterrence appears a complex matter, and a reliable system of cyberdeterrence based either on assured retribution or swift and sure legal action is still some distance off. For potential counteractions to be feared, effective, and precise, states first need to make clear what kinds of actions will merit counter actions. Identifying and communicating what are potential acts of war should not be that difficult. However, in the shorter-run, states may avoid substantial attacks against other states for fear of unpredictable second- and third-order effects that could harm their own interests as well. The more that states apply expertise and collective efforts against cybercrime and cyberterrorists, the more such attacks will be deterred. Even when systems of deterrence become credible to most, they will never be credible to all. Violent stateless actors, who become cybercapable, can credibly threaten states and thereby modify the states' behavior. Even the best systems of deterrence need to be underwritten by solid defenses; solid defenses need to be underwritten by solid cybersecurity provisions and practices.

The purpose and logic of cyberdefense. Defenses are tested only when deterrence fails. This permits defenders to concentrate resources and strength against threats least likely to be deterred. In the near term, because of the challenge of forensics, this is not a very discriminating criterion. Any weakness in an outer layer of defense imposes additional burdens on the layers beneath it.

Defense has its own peculiar logic and economy, as aforementioned. As a general proposition in warfare, denying success to an offensive is cheaper than employing offensive aims, all other things being equal. The defender merely has to cause the attack to fail. While deterrence is wholly psychological, defense physically defeats attack or thwarts its aim. The design of cyberdefenses depends on knowing what the aim of an attacker might be and finding ways to confound such aims.

When the potential aims of attackers are many, the design of defenses becomes complicated, and when the aims are obscure, defense becomes difficult indeed. Knowing who the attacker is could help reveal possible aims. Without reconnaissance to find the line of least expectation and least resistance to discover a key vulnerability, attacks will be rare. Counter-reconnaissance coupled with reliable and quick forensics can aid the defense.

Sound practice would be to always begin with a thorough systemic self-assessment. Cyberdefense operates on this same principle. What the cyberdefender chooses to label "essential functions and decisive terrain" depends on who wants to harm the country, the aims of the potential attacker, and the scheme of the offense:

- What would yield the results this adversary would pursue?
- What are the "acts of war" that should top the list?
- What would be attractive to undeterrable adversaries?
- What are the functions most critical to prosperity, stability, and power at the national and international level under crisis conditions?
- Which of these are most enabled and controlled by cyberelectromagnetic networks?

Active defenses are always more potent than passive ones, and there is no reason to believe that it is otherwise for network defenses. Another historic military practice is to arrange defenses in depth to gain early warning, cause delay, reveal the aim, and to adjust, respond, and thwart an attack. Such defenses in depth, incorporating active and passive elements, demand coordination and unity of command.

What does depth mean in a cyberdefense, and how can early warning be obtained when attacks arrive from many directions at the speed of light? The purpose of delay in historic defenses is to provide time to reoptimize the disposition of defensive forces or set conditions for a counterstrike. Sound defensive dispositions and decisions force the attacker to commit the bulk of his forces early and thus reveal the nature and direction of his main effort, revealing the aim of the attack, and a vulnerable flank.

How can cyberdefenses be designed for such defensive maneuver? Challenging as it might be,



SRA Christian Thomas, U.S. Air Force

U.S. Air Force CMGST Thomas Narofsky, U.S. Strategic Command, briefs military personnel about cyber and space threats during a senior enlisted leaders training conference, 24 March 2009.

achieving the design aims of traditional defenses in depth is possible for network defenses. Whereas the elements and functions of the traditional defensive system are dispersed geographically, those of a network defense are dispersed throughout the integrated and cooperating elements of the global network. The difficulty is that the positioning of a dispersed network defense requires access to network nodes that are not owned by the defender.

How do these achieve coordination if not by unity of command? It would also be valuable to adapt the logic of defensive integrated strike networks to cyberdefenses.⁷ “Integrated strike networks” are specifically designed to engage an enemy with an optimized strike for recurring patterns of threats in a number of common mission settings. Strike networks synergistically integrate: various combinations of sensors, distributed digital information processors, human decision makers, and various lethal, destructive, and suppressive weapons, which are all served by robust automation enhanced networks tuned to a specific purpose. Such automated systems of defense operate on the principle that if they can recognize a hostile intrusion rapidly enough, and with adequate reaction time, then they can intercept

and defeat it. Designers should expect attackers to employ swarming tactics designed to overload the capacity of defensive strike networks, and they should design their defenses to learn and adapt in the midst of an assault to thwart their attackers.

The challenge, and the major preoccupation, of the defense during a sustained offensive is to seize the initiative from the attacker and to cause the attack to culminate before it succeeds. However, what does causing “culmination” mean in the cyber dimension? Is there such a thing? The notion of “causing culmination” may still be a useful mental construct, but the mechanics of it will be logically different. The “tooth-to-tail” ratio of a cyberattack is very high compared to attacks in the physical dimension. Not all of the advantages of historical defenses apply to cyberdefense, but there is no doubt that time-tested defensive theory can guide the design of systems of cyberdefense. Whether the cyberdefense is inherently stronger than cyberattack is in doubt for a number of reasons. The attacker can always choose the time and place of concentration, and the cyberattacker can do this at the speed of light. Coordinated defenses in depth will depend on international cooperation throughout global

networks. Sovereign nations, including Russia and China, will eventually see the need to cooperate, as they are now encountering some terrorists bent on cybernetic sabotage.

Cyberdefenders also have several other challenges traditional defenders may not have encountered. Knowing one's own cyber vulnerabilities at the national level can be problematic. Infrastructures that count toward prosperity, stability, and national power are not all in public hands, and those that are, are not centralized at the federal level.

In addition, no defense can guard against all attacks. Desperate and intelligent adversaries will always try to find the line of least expectation and least resistance to the vulnerability most productive for their greater purposes. We will often not know what they intend. The most important attribute of network defenses is that they are designed to learn and adapt, just as attackers are constantly learning and adapting.

The purpose and logic of cyberoffensives. Can offensive warfare by Internet compel an aggressor to submit to a new status quo, one that has greater strategic value than costs? How can states make offensive cyberstrikes undeterable *and* strategically useful at the same time? These are questions properly addressed by imagining a cybernetic offense used in defending against a physical aggressor by employing the traditional logic of military operations. Attacking along the line of least expectation and least resistance to a vulnerability, the attacker has the advantage of deciding when and where initial engagements will be fought. The aggressor—once forced onto the defense—is obliged to react, losing the initiative. The power to set the terms for subsequent action is an advantage that the attacker must fiercely press if he is to keep it. The real enemy of an attacker entails culminating before achieving desired ends.

Cyberattacks can press some offensive advantages much more efficiently because the product of reconnaissance and intelligence can be optimized far more speedily. As complicated as the Internet is, it is a real structure that can be mapped and understood, as aforementioned, and its defenses can be understood and mapped as well. Second, once defenses are understood, attacks can proceed at such speed that the defense has little time to change its nature and configuration before it is overcome, and

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the immediate destructive purposes of the attack can often be achieved in seconds.

One major practical difficulty of cyberoffensives is that precision, stealth, and power are difficult to achieve in combination. Offensive acts must be powerful enough to influence the decisions of aggressors in some way, yet be precise and controllable enough not to inflict harm to friends and allies. Any attempts to punish a hostile regime could easily spill over into affecting society and its economy at large. As previously noted, damaging key economic infrastructures in a foreign country may have costly repercussions for our allies and for American businesses as well. In fact, all members of the Group of Twenty most wealthy industrial countries (G-20) would be concerned about such difficulties.

The actions, words, or images of cyberoffensives may be intended to shape decisions and elicit desired responses, but to compel adversaries to act in the intended way that we want, they must perceive the message, understand it, interpret it, and act predictably. To punish bad behavior and deter a repeat of it is hard enough, but to predictably compel other human beings to act a certain way is a fool's errand, as they are not susceptible to mechanical closed-system causal chains. Since human beings act for reasons having intentions made up of beliefs and desires, the realm of human activity possesses complexity inaccessible to scientific predictability.⁸ Warfare by Internet alone provides no way to force the desired change in the status quo regardless of the decisions or actions the opponent may take.

This logic should not be surprising. Between February 2003 and today, we have learned that physically toppling an undesirable Iraqi regime was easy compared to causing a constructive outcome, one not complete seven years later. The recent cybernetic attacks on Estonia and Georgia caused considerable damage, but they did not cause the effects desired by the cyber aggressor.

Similarly, any efforts to derive strategic advantages from “wars of choice” fought chiefly by Internet would be ill-conceived, regardless of whether they are preventive or preemptive. Consider the practical utility of a future NATO cyberoffensive aimed at halting the invasion of an ally or stopping a genocide in progress. Disrupting the cybernetic nervous system of the offending country could be quite simple to do, but how that destruction could cause the specific behavior changes the alliance desires is ineffably more problematic. Inducing pain is one thing, expecting enemy leaders to make the right choices is another.

This example also fails to address the difficulty of avoiding fratricidal collateral damage if any member of the G-20 nations, which includes all the major advanced industrial democracies as well as Russia and China, were to initiate warfare by Internet against any other member. These economies are so intertwined, and their information infrastructures so interlaced, that it would be difficult to translate the intended destruction into useful influence and favorable decisions by leaders on the opposite side without fratricidal collateral damage.

However, cyberstrikes intended merely to terrorize are excluded from this logic. Terrorists are not out to shape behavior; they merely want to punish and to strike fear. They have no need to conceal the authorship of a strike after the fact and have few concerns about collateral damage. For instance, it is not difficult to imagine a repeat of the 2001 Al-Qaeda strikes, but try to imagine it this time in cyberstrike form. To serve a terrorist’s purpose it must strike fear in the population, signal the helplessness of the government, portray the relative power of the terrorist movement, and communicate a clear message to a number of audiences. The terrorists would want the results of their strike to appear sudden, surprising, dramatic, and spectacular. They would desire vivid media images that could impress and fixate global audiences around the world. No silent, invisible, and slowly but surely crippling financial system meltdown would do.

Under what conditions can offensive warfare by Internet possibly produce greater strategic value than costs? I think there is one fairly certain case. It is also easy to see the utility of a regime-preserving cyberstrike capability to a country threatened by a war of aggression or “regime change.” Would the

Hussein regime have liked to have the capacity to strike with crippling cyberstrikes against the sources of power within the homelands of the coalition approaching Baghdad in the spring of 2003? They would want to have had an immediate effect on the physical war-waging capabilities of their aggressors and also an immediate restraining effect on political decision makers arrayed against them. They would not be satisfied with punitive measures that arrive too late or stimulate even greater efforts against them.

Such conclusions do not mean that investing in a robust capability to conduct warfare by Internet is unwise. The previous paragraphs illustrate the potential defensive value of an offensive cyberstrike capability. It is also easy to appreciate the utility of offensive cyberpower alongside other forms of military power. Just as air, land, sea, and space power are naturally useful complements to one another, so would cyberpower advance advantages from the cyberelectromagnetic dimension into all the others. This would not be warfare by Internet; it would just be combined arms and services warfare.

Thinking Realistically Rather than Metaphorically

This article is not an attempt to promote “warfare by Internet” but rather a genealogy of the logic of deterrence, defense, and attack in the global cyberelectromagnetic dimension of modern conflict. Understanding this logic requires understanding that, unlike “space,” the Internet is finite. How it relates to military operations for national defense requires this realistic view rather than the boundless perspective encouraged by currently dominant metaphors.⁹ We have to think realistically about the Internet to become as serious as we need to be to assure the speed, efficiency, and integrity of our vitally necessary cyberelectromagnetic networks.

The international and national cybernetworks we use to such advantage are only a “commons” in the sense that all can send packets of information across the cooperating elements of it without regard to ownership or territorial borders. The databases, websites, and other services accessible on the Internet can serve customers across borders in far off cities at the speed of light, but the nodes, servers, routers, and communications links of the Internet exist on sovereign territory, and are most

likely the property of private persons, businesses, governments, or educational institutions. One has to try to understand the uniqueness of this phenomenon to make sense of it. Any theory or analogy borrowed from some other context to help make sense of this dimension needs to be rigorously tested not only for valid parallels, but also for invalid and incomparable ones.

Assuring the speed, efficiency, and integrity of modern cyberelectromagnetic networks against attacks by cybercriminals, cyberterrorists, cyber-spies, and hostile state regimes, and thus protecting the host of advantages modern industrial states gain through their functioning, bears a great price. This price is well worth bearing when the cost of protecting these advantages can be far less than the value of benefits derived. Reducing that price to a minimum depends on a comprehensive layered system in which serious attacks first confront a system of deterrence, then those not deterred face a sound defense, and those that penetrate defenses are blunted and confined by effective systems of cybersecurity measures. Finally, we must ensure that damage-limiting design features and practices mitigate those attacks that penetrate security. In exploring how these elements work together, and the unique logical requirements of each, this discussion has aimed to demonstrate the

real and theoretical difficulties and uniqueness of this challenge.

Where in the traditional case the defense is the stronger form of war, in the cyber dimension, because of the uniqueness of the conditions, offense tends to be more effective than defense. This situation is further aggravated by the possibility that the normal attacker may be better educated and more motivated than the normal defender in this environment. It is also aggravated because the layered and active defenses possible in the traditional domains of war are extremely difficult to erect within the Internet. They require negotiation among layers of governments and with private bodies within sovereign states. Effective coordinated defenses of vital global networks require sovereign states to band together.

On top of a robust system of cybersecurity and mitigation, modern democracies like the United States should invest in the capabilities that provide a balanced distribution among cyber deterrence, defense, and offense, guided by a forward looking and logical doctrine that bridges established military theory and the uniqueness of the Internet. Such doctrine should recognize the wisdom that modern military power has many interacting dimensions, and that the cyberelectromagnetic dimension needs more brainpower and attention than it is getting. **MR**

NOTES

1. *Securing Cyberspace for the 44th Presidency*, Center for Strategic and International Studies, Washington DC, December 2008, 20-24.

2. See Bruce Sterling in Wikipedia. <http://en.wikipedia.org/wiki/Bruce_Sterling>.

3. See Norbert Wiener in *Cybernetics: Or Control and Communication in the Animal and the Machine* (Paris, France: Librairie Hermann & Cie, and Cambridge, MA: MIT Press, 1948). The term "cyber" (from the Greek *kybernētēs*) means steersman, governor, pilot, or rudder.

4. The discussion of the origins of the cyberspace metaphor was drawn from Wikipedia. <http://en.wikipedia.org/wiki/Cyberspace3/1/09_8:42_AM>, and other sources.

5. Qiao Liang and Wang Xiangsui, *Unrestricted Warfare*, PLA Literature and Arts

Publishing House, 1999.

6. Clay Shirky, *Here Comes Everybody: The Power of Organizing Without Organizations* (New York: The Penguin Press, 28 February 2008).

7. Huba Wass de Czege, "Net War," *Military Review* (March-April 2010): 20. See the section on "integrated strike networks."

8. Tim Challans, "Tipping Sacred Cows: Moral Potential Through Operational Art," *Military Review* (September-October 2009): 25.

9. The "we" are military professionals; national, state, and local politicians and civil authorities; international civil authorities; corporate executives; and all other educational and nongovernmental leaders.