14 Cyber Warfare: Surviving an Attack

By Devabhaktuni Srikrishna

Cyberspace is a new domain of warfare. Created to minimize the vulnerability of United States communications networks to a crippling nuclear first strike by the Soviet Union, the Internet that was originally envisioned to enhance U.S. security is turning into a battlefield [1] for nations or sub-national groups to launch virally spreading attacks [2] and induce network failures potentially involving critical infrastructure systems.[3]

Cyber warfare and cyberoffense [4] have been a part of U.S. military operations for decades.[5] Treaties and rules of engagement define what is off-limits during a cyberwar.[6] The more vulnerable the system is, the more policy is necessary to deter adversarial nations from launching attacks, and vice-versa.

Some cyberattacks are analogous to air forces probing one another's defenses or perhaps to espionage during the Cold War, which occurred though there was no official war and no physical harm. Cyberespionage operations of China, for example, against the United States and its allies have been going on for years and will never really end.[7]

U.S. Air Force General Kevin Chilton, former Commander-in-Chief of Strategic Command, has stated that every computer system fielded by U.S. servicemen is on the front lines of a virtual battlefield.[8] Perhaps all people should think of their computer systems (PCs, mobile devices, etc) in this manner, not just as a tool for achieving personal goals but also as a conduit for an enemy attack.

This survey of cybersecurity literature explores answers to the question of how to secure the Internet from a cyberwar.

What is Cyberwar and Cyberoffense?

Richard A. Clarke and Robert Knake offer a vivid explanation of some of the largest recent cyberattacks in their book, *Cyber War: The Next Threat to National Security and What to Do About It*. Once a virus or malware is inadvertently downloaded onto a networked personal computer (PC) by a user[9], the PC can be commandeered to perform cyberattacks ranging from electronic banking crimes, politically motivated denial of service attacks[10], email spam[11], and click-fraud[12].

The U.S. Government Accountability Office (GAO) offers a taxonomy of different types of attacks in "Cybersecurity for Critical Infrastructure Protection,"[13] – denial of service, exploits, logic bombs, sniffers, Trojan horses, viruses, and worms. Attackers also employ arbitrary combinations of these attacks as part of an integrated attack plan.

Causes of Cyber Vulnerability

In "Cyberwar and Cyberdeterrence," Martin Libicki points out that system vulnerabilities do not result from immutable physical laws, but due to a gap in theory and practice. Organizations are vulnerable to the extent they want to be and to how much they want to spend to address vulnerabilities. [14] And cyber vulnerabilities can be completely eliminated -- unlike conventional, nuclear, chemical, or biological which are permanent vulnerabilities due to laws of nature.

Aside from keeping individual PCs secure and virus-free through antivirus software [15] or having Internet providers enforce anti-virus policies on their subscribers,[16] several tools with varying degrees of sophistication exist for identifying and policing unusual behavior in real-time – for individual PCs (Bothunter[17]), enterprise networks (Damballa [18]), federal government networks (Einstein [19]), and critical infrastructure (Perfect Citizen [20]). The drawback of such systems is that creative attackers continue to find ways to circumvent them. Software must be constantly updated and will at some point be outdated when the next threat emerges.

Another option is to eliminate anonymity on the Internet through end-to-end authentication in order to prevent anonymous attackers from carrying out distributed attacks with impunity.[21] While end-to-end authentication may prevent cyberattacks and identify the culprits, it would result in the loss of privacy, individual liberties, and split the Internet into multiple Internets.

As an outstanding example of loss of privacy and violation of individual liberties, cyberattacks on hospital networks are of particular concern as they deal with patient-sensitive data. In the case of medical records, system design involves backup and distributed storage – attacks that involve data destruction can be recovered if the data is routinely backed up in multiple independent locations. The lost data can be made accessible quickly and reliably after an attack. But unless stronger data protection measures are in place, the concern remains that a cyber thief can steal sensitive data that could be used to blackmail people with certain medical conditions.

Similarly there ought to be no critical infrastructure connected to the Internet left vulnerable to cyberattack. Curiously, the nuclear power industry, known for its fail-safe engineering in reactor design, is sometimes recognized as better prepared than most other industries to withstand cyber threats. It does this through upfront planning and design for isolated or disconnected operation to avoid the worst-case scenario of a reactor being commandeered by a hacker, "The safety and control systems that operate nuclear power plants are isolated from the Internet and are protected against outside invasion." [22]

Who Are the Cyberattackers?

The same Internet that allows for billions of dollars in electronic commerce can also empower a single mobile device to control millions of personal computers (PC) around the world for electronic crime. Due to its anonymous and highly scalable nature, the Internet can also be used as a weapon to disrupt and commandeer essential services that rely or connect to the Internet.

Cyberattacks can be carried out by anyone with the know-how and interest, and in many cases the cost of attacking is disproportionately small compared to the potential damage that can be inflicted. Groups involved in planning and executing attacks range from nations to individuals. Most nations would probably agree that attribution of a cyberattack is imperfect – whether it means identifying the nations involved, sub-groups, or motives. [23] Mistakes in attribution due to haste or inaccurate information can lead to collateral damage.

While the GAO summarizes potential attackers and motivations, [24] the range of possible groups and motives is much broader: criminal groups, hackers, hacktivists, insiders, intelligence agencies, terrorists, and virus writers.

Martin Libicki explained that attribution is difficult because: [25]

1. Cyberattacks can launch from anywhere, and computers do not leave physical traces behind.
2. A rogue employee or sysadmin presents risks similar to those of an attacker within the periphery of a closed system.
3. Code within the electronics supplied by third parties can bring down a system at a pre-specified time or in response to some system state.
4. When attribution is localized to a country or on government networks, it may be someone operating on behalf of what they perceive to be state interests without clear authorization from the state.
5. Organized criminals posing as governments, or "super-patriots" may be attacking in advance of what they perceive to be government actions.

An example of a cyber attack by a country or nation was revealed when the group WikiLeaks released a cache of confidential American diplomatic cables to the New York Times among several other news organizations. Some of these cables described a computer hacking effort against Google's computer system by the Chinese Politburo.[26]

This cyber intrusion was part of a global campaign to sabotage the multinational corporation and carried out by Chinese operatives and computer hackers hired by the Chinese government, according to news stories about the leaked cables.

The recent Stuxnet PC virus illustrates a cyberattack by an anonymous agent. The Stuxnet virus spread via PCs and was designed by its authors to infect and then destroy or sabotage the operation of a specific type of CPU made by Siemens and used for automated control in electric power plants worldwide including in North America, Iran, Pakistan, India, Indonesia, and Germany. [27]

Articles and weblog posts suggest that the U.S. and/or Israel [28] targeted Iran's nuclear program.[29] Attribution in the Stuxnet case is far from straightforward – unless a link or evidence is found.[30] In spite of international politics on nuclear proliferation, it is difficult to imagine the motive of a country like the U.S. to carry out such a sloppy sabotage attack – especially as the cyberattack affects reactors in many countries including the United States. [Editor's Note: As this article was going to press, the New York Times reported that Iranian President Mahmoud Ahmadinejad said that a cyberattack had damaged an unspecified number of Iranian centrifuges for enriching uranium. [31] Reportedly, Stuxnet caused the frequency of the spinning centrifuges to change so that the devices would spin out of control. Ivanka Barzashka, a research associate at FAS, was one of the first analysts to discover this feature of Stuxnet.[32]]

The attack was facilitated because systems deployed worldwide are (1) standardized on a vendor's product so the virus can replicate and (2) use of proprietary code used in the standardized platform – not benefiting from widespread peer-review (vs. open-sourced software/code).

Conclusions

To secure the Internet from cyberattacks requires a combination of public policy, standardization, and market forces. Intelligent application of simple, proven engineering design principles in different situations such as end-to-end authentication, behavioral analysis, distribution (vs. centralization), backup, redundant routes (vs. single paths), fault-tolerance, diversity of supply (hardware, software, and services), and decoupling from the Internet, might eliminate the worst consequences of most vulnerabilities.

Perhaps the biggest challenge is to create secure practices for individuals and organizations that are easy to understand, adopt, and apply when designing and operating networked computer systems. [Editor's Note: FAS will continue to research this issue and provide practical policy recommendations.] **FAS**

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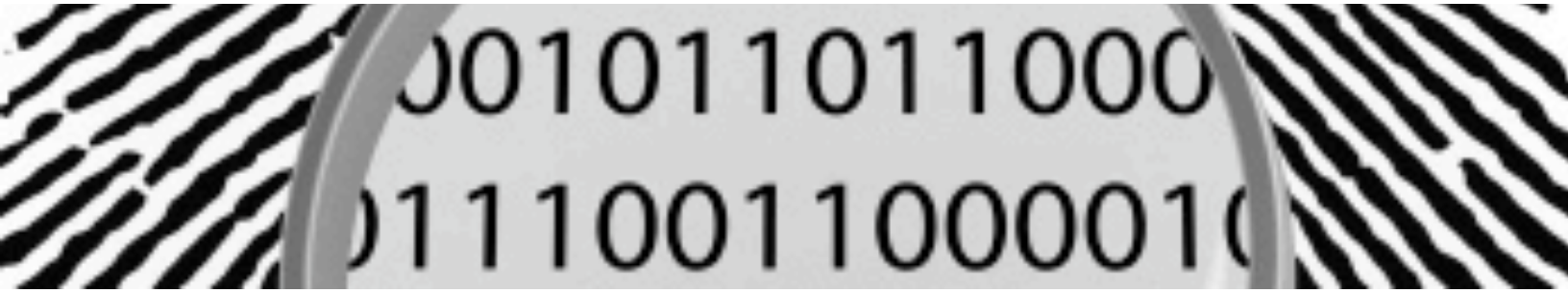

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