

IMPERVA®

Web Attack Survival Guide

PLAYBOOK



What's Inside

Why You Should Read This Guide	3
What Is Your Website Security Nightmare?	3
What Do You Do When Your Worst Nightmare Becomes Reality?	3
The State of Application Security	4
The Application Threat Landscape	4
Rise of Hacktivism	4
Distributed Denial of Service (DDoS) Attacks Go Commercial	5
Fighting Back	5
Web Attack Survival: Step-by-Step Strategy	6
Step 1. Understand the Threat Actor	6
Step 2. Develop a Security Response Plan	6
Step 3. Locate and Assess Applications and Servers	8
Step 4. Strengthen Application, Network, and End-Point Security Controls	9
Step 5. Counter the Attack: Monitoring and Tuning Procedures When Under Attack	12
Step 6. Bring in the Experts: Optional Security Consulting Services	13
Step 7. Conduct a Post Mortem of the Attack	14
Conclusions and Recommendations	14
Web Attack Survival Checklist	15
About Imperva	16

Why You Should Read This Guide

The data your company runs on is its most valuable asset. It's also the coveted target of cybercriminals. We've seen time and again how major brands fall prey to malicious attacks that cost them millions in revenue and customer retention. For example: 1) ransomware that requires you to pay up or lose data forever, 2) DDoS attacks that take your websites and mobile apps offline, 3) hacktivist campaigns that expose your vulnerabilities—these are rampant.

Your company is an eligible target. It's no longer a matter of if you will be attacked, but when and how often.

Securing your data, applications and websites from potential and recurring web attacks requires careful planning and investment.

It may feel daunting, but you can minimize the severity and impact cyber attacks create.

In this guide, we walk you through the basics to get you well-prepared to thwart and mitigate attacks. We'll show you the steps to take before, during and after attacks. You'll also find a handy checklist you can print to use with your teams.

Web attacks are inevitable; the financial and customer losses they cause are not.

With the right preventative measures and attack responses in place, you can protect your data and applications, in the cloud and on premises.

What is Your Website Security Nightmare?

Is it, when you receive a "ransom note" with an ultimatum to pay millions of dollars or to watch your company's website buckle under a deluge of DDoS requests? Or when you open an ominous Google alert that reveals your company is the next target of a hacktivist campaign? Or when you discover the application framework that powers your website is riddled with vulnerabilities—and to learn it will take months to fix them?

What Do You Do When Your Worst Nightmare Becomes Reality?

The Web Attack Survival Guide describes today's application threat landscape, including the attack methods and tools used by hacktivists and cybercriminals. It explains the processes and the technologies you can use to safeguard your website from attack. It also helps you prioritize security efforts and it lists security tips and tricks that you might otherwise have overlooked.

After reading the Web Attack Survival Guide, you will be able to confidently face an impending web attack with a well-thought out strategy.

The State of Application Security

The Application Threat Landscape

Web applications sit at the top of the list for hackers' favorite attack targets. In fact, 75% of all cyber-attacks target web applications. Most websites suffer dozens of attacks per day and some sites sustain, on average, up to 26 attacks per minute.

While web attacks are not new—they have existed since the dawn of the Internet—one attack trend is hacktivism and prolonged attack campaigns.

- 
- > **Web app attacks** were the **#1 cause of data breaches** in 2016¹
 - > Use of **stolen credentials** and **SQLi** are the **top two web app attacks**
 - > **Denial of Service** accounted for the most number of incidents in 2016
 - > **86% of all websites** have at least **one serious vulnerability**²
 - > **75% of all cyber-attacks** target **web applications**³
 - > **93% of breaches** (for web app attacks with botnets) come from **organized crime**

Rise of Hacktivism

Hacktivism vaulted onto the scene and into the collective imagination in late 2010, with the emergence of hacktivist groups like Anonymous, LulzSec, and Anti-Sec. Initially targeting financial institutions, Anonymous and its imitators quickly moved on to dozens of other government and business targets. Within two years, 58% of all data theft⁴ was attributed to hacktivist attacks.

In 2012, players like the Syrian Electronic Army, AnonGhost, and Iranian Cyber Army, joined the party and launched a spree of attacks against U.S. banks and other targets. Many of these attacks combine traditional web attacks, like SQL injection and cross-site scripting, with Distributed Denial of Service (DDoS) assaults. Hacktivist attacks not only pose public relations disasters for the targeted companies, but many also result in costly data breaches and prolonged website outages.

¹ 2017 Verizon Data Breach Investigation Report

² "WhiteHat website Security Statistic Report," WhiteHat Security, 12th Edition

³ Gartner Research

⁴ Security information sharing and analysis organizations include National Council of ISACs, Financial Services ISAC, SANS Internet Storm Center, and National Healthcare ISAC.

Distributed Denial of Service (DDoS) Attacks Go Commercial

Besides the specter of hacktivism, organizations must contend with DDoS attacks launched by competitors or cyber extortionists. These industrialized DDoS attacks can be extraordinarily powerful—hundreds of times greater than typical bandwidth levels, reaching over 500 Gbps or more. DDoS attacks are becoming more advanced in order to outwit conventional security controls. Instead of simply inundating targets with a flood of TCP or UDP packets, many DDoS attacks now exploit application aws.



DDoS Attack Tools Used by Hacktivist and Commercial DDoS Services

Fighting Back

Every day, hackers unleash massive attack campaigns designed to take websites offline, steal confidential data, and deface content. Fortunately, organizations can prepare for and repel these attacks. Based on feedback from application security consultants and from IT security personnel on the front lines of attack, this survival guide lays out a step-by-step plan to fend off web threats.



“If you know your enemies and know yourself, you will not be imperiled in a hundred battles... if you do not know your enemies nor yourself, you will be imperiled in every single battle.”

SUN TZU | THE ART OF WAR⁵

⁵ Although over-quoted, Sun Tzu’s suggestions—from preparation, to the art of deception, to battle tactics—are surprisingly apropos for defending against web attacks.

Web Attack Survival: Step-by-Step Strategy



Step 1. Understand the Threat Actor

To prepare for an attack, the first step is to understand the threat actor. What enemy do you face? Is it a well-known hacktivist group such as Anonymous or the Syrian Electronic Army? A script kiddie? Industrialized cybercriminals? Research their attack techniques and identify the tools.

Monitor Social Media

If hacktivists have threatened your organization, then track social media sites such as Twitter, Facebook, and YouTube for updates about their attack methods and timelines. Hacktivists may discuss vulnerabilities or weak points of your site.

Hacktivist groups will also disclose the types of DDoS attack tools that volunteer recruits can use to attack your site. Armed with this information, you can create application security signatures to easily block these attack tools.

With several recent attacks, hacktivists have published “booster packs” that configure attack tools to exploit web vulnerabilities or URLs in the targeted websites. Be aware of the contents of these booster packs, so you can implement policies to repulse them.

Profiling cybercriminals is more challenging than profiling hacktivists, simply because cybercriminals do not advertise their methods or strategies. Unless you monitor hacker forums, your best option is to talk to peers in your industry about attack sources, techniques, and tools.⁶ Be sure to read hacker intelligence reports and security research that pertain to your industry.



Step 2. Develop a Security Response Plan

If your organization is the target of a specific attack campaign, like a DDoS attack or a hacktivist attack, then you should organize an incident response team that will manage security response efforts. The response team may potentially need to be available around-the-clock. Depending on the severity of the attack, assign 24x7 coverage to assure that someone is available to respond to new threats, immediately.

The security response team will most likely be composed of IT security personnel, but may include members from the networking and application development teams.

Red Team

Create a “red team”—a team of security engineers that will look for vulnerabilities that attackers could exploit. The red team should evaluate all potential risks including, application, network, end-user, social engineering, and even physical threats.

⁶ Security information sharing and analysis organizations include National Council of ISACs, Financial Services ISAC, SANS Internet Storm Center, and National Healthcare ISAC.

Your Little Black Book of Contacts

Prepare a contact list with the names, phone numbers, and email addresses of the following groups:

1. IT security (including members of your security response team), IT operations, networking, application development, database administration, legal, and executive management
2. DNS and Internet Service Providers
3. DDoS Protection Services
4. Relevant security specialists or consultants—for example, record the contact information of field engineers at your web application firewall (WAF), Security Information and Event Management (SIEM), and Intrusion Prevention System (IPS) vendors. You may need to enlist their help when you are under attack.

Document Network and Server Information

Gather network and server information, including:

1. IP addresses of web servers, databases, DNS servers, network firewalls, web application firewalls, database firewalls, and routers and switches
2. Disaster recovery IP addresses, if applicable

Also, prepare network architecture diagrams of all data centers at risk. If architecture diagrams already exist, review them, and confirm they are up-to-date.



SECURITY TIP

DO: Keep your response plan information, network diagrams, and IP address schemes secure.

DON'T: Email your network architecture and contact lists to the entire security department or store them in a public file share titled "Steal me first."

Notify Executive Management and Employees

When you know about an impending attack, inform your executive management team about the threat and provide periodic status updates. In addition, you may need to warn company employees of the attack. For DDoS attacks, notify all relevant users of potential application or network downtime.

If your organization faces a hacktivist attack or a targeted attack, instruct users to update any non-secure passwords and educate them about the risk of phishing attacks. Prepare your IT personnel for social engineering threats. Ask them to verify any IT helpdesk and password change requests.

Hackers may resort to physical attacks when necessary. Secure employee laptops, cables, and network devices.

**SECURITY TIP**

Assign a “general” for the war room. This person will be in charge of all high-level security decisions during the attack.

Establish a War Room

Designate a war room that will be “ground zero” for all planning and communications during the web attack. The war room will be a centralized place to review security updates and to strategize defense schemes. Choose a location to conduct security operations such as an existing Security Operations Center (SOC), Network Operations Center (NOC), or even a private conference room.

**Step 3. Locate and Assess Servers and Applications**

Even if you have documented your servers in network architecture diagrams, it is still important to scan your network for rogue servers and applications. Application developers or QA testers may have spun up new web applications or databases; other departments may have deployed unsanctioned applications. Until you have scanned your network and located all servers and applications, you cannot completely assess your risks.

Classify, Classify, Classify

Once you have located your applications and databases, determine which ones contain sensitive data like Personally Identifiable Information (PII), Personal Healthcare Information (PHI), credit card numbers, or intellectual property. Determine which applications are needed for your business to function properly. Even if your corporate website does not contain sensitive information, it may still be a top target for attack, because it is the most visible to customers and partners.

Once you have identified your servers and applications, and determined which are the highest risk, prioritize your efforts on these assets.

Look at the Cloud

Digital assets today are not just limited to the devices on the physical network. Be sure to locate third-party applications like CRM systems, intranet applications, email applications, and internally developed websites that are hosted in the cloud. These applications may contain confidential information. Hacktivists have targeted externally hosted applications in the past, so it is essential to make sure these applications are secure.

Scan Your Network and Applications for Vulnerabilities

One of the most important steps to fortify your applications is to test them for vulnerabilities. Scan your servers and networking devices for system vulnerabilities and unpatched software. More importantly, scan your web applications using a purpose-built web application scanner. Network scanners are a starting point, but only web application scanners will uncover the application vulnerabilities that hackers are most likely to exploit.

Do not limit your assessments to your corporate website. Scan all of your applications, including partner portals, CRM applications, extranets, and other potential attack targets. All of these sites could be brought down by hackers and, therefore, damage your company's brand.

**SECURITY TIP**

Use a combination of different scanners to test your applications. Each scanner may find unique vulnerabilities.

To prepare for an application DDoS attack, analyze the URLs in your applications that connect to a backend database and could potentially be an attack target, such as the login, registration, password change, or search pages. Submit application forms with characters like wildcards to determine if they are susceptible to business logic exploits.

Once you have scanned your applications, fix identified vulnerabilities and rescan your applications. If time constraints prevent you from fixing all vulnerabilities, then focus your efforts on virtually patching critical vulnerabilities in your high-risk applications.

**SECURITY TIP**

Include the same tools used by hackers—such as the Havij SQL injection tool and free application scanners—in your scanning arsenal.

Assess Databases

Since sensitive data is typically stored in databases, verify these databases are secure by scanning them for vulnerabilities and configuration flaws. Based on the assessment results, determine if you need to apply any operating system or database security patches or any configuration changes.

To strengthen the security of your database servers, delete default database user accounts and disable unnecessary services like vulnerable database listeners. To fortify the underlying server from attack, disable any unneeded services such as Telnet, FTP and rlogin.

**Step 4. Strengthen Application, Network, and End-Point Security**

After you have assessed and patched your applications and servers, you can ratchet up your defenses. To thwart a web attack, you may want to apply stricter web application, network and server level security policies.

Protect Network Devices and Servers

To prevent network and server attacks:

- Enforce stringent network firewall and Intrusion Prevention System (IPS) policies. Restrict inbound traffic to your web application servers to necessary services like HTTP and HTTPS. Configure IPS policies to block high and critical security violations.

- Install anti-virus or anti-malware software on your servers. Make sure virus, malware, and spyware definition files are up-to-date.
- Configure your database firewall to virtually patch unpatched vulnerabilities. The database firewall can also control access and block unauthorized queries to the database.

Lockdown Web Applications

Since the web application is the ultimate target of a web attack, organizations must focus their efforts on tuning and testing their web application firewall to stave off an impending attack. The following reflects a list of best practices to ensure your WAF will block all online threats.



SECURITY TIP

Work closely with application developers when enforcing stricter profile policies. Developers can help analyze the profile for accuracy. They can also review security alerts to ensure that your new, heightened security controls do not block legitimate requests.

Review and tune the web application profile—also called the “white list” security model. To confirm that the profile is accurate, you will want to:

- Check for URLs or directories that have been removed from the website, but still appear in the profile.
 - Review acceptable characters and parameter value lengths in the profile and look for irregularities in the profile.
 - Compare the application profile to vulnerability scan results to make sure that all URLs in assessment reports appear in the application profile and all URLs in the profile have been assessed by the scanner.
 - Tighten profile policies to block on white-list security violations like parameter values with unauthorized characters such as brackets and question marks. Block excessively long form field values to prevent buffer overflows and SQL injection attacks.
- Configure the WAF to enforce HTTP protocol compliance. Review and tune protocol-related security policies like double encoding, extremely long URLs, and malformed Apache URI messages. Enforcing HTTP protocol compliance, at least during the attack, will foil evasion techniques, as well as buffer overflow and DoS exploits.
- Ensure that standard web application firewall policies such as SQL injection and cross-site scripting (XSS) are enabled. All high risk attacks, such as directory traversal, remote file inclusion (RFI), local file inclusion (LFI,) and cross-site request forgery (CSRF), should be blocked.
- Block malicious sources that have attacked other websites. Leverage intelligence from the global community to stop malicious users and malicious attack strings used against your peers.

- Web application firewalls can detect requests from common scanning and hacking tools like Nikto, Paros, and Nessus based on header agent information. They can also block scanning tools by detecting a frequent number of security violations in a short period of time. Prevent attackers from uncovering vulnerabilities in your site and configure your WAF to block scanners and perform website reconnaissance.

If your organization hosts customer-facing, partner, or extranet applications in the cloud, ensure that these applications are protected by a WAF. Various solutions exist to safeguard hosted applications, including Security as a Service (SaaS) and virtual appliance-based web application firewalls.



SECURITY TIP

Always On: Make sure you can manage all of your security products from an out-of-band network. Otherwise, they may be unreachable when you need them most—at the peak of a DDoS attack.

Prevent Application DDoS Attacks

Application-layer DDoS attacks, which account for over half of all DDoS attacks, are designed to overwhelm application resources or exploit application vulnerabilities. To stop application DDoS attacks, we recommend that the following policies are configured:

- Block high rates of requests in a short period of time by user, by IP address, and by session. For this DDoS mitigation rule and many of the subsequent rules, configure extended blocking policies—block the offending user for minutes or even hours after the initial violation.
- Block users that download large amounts of data in a short period of time. In addition, to prevent attackers from overwhelming server resources, block users that request multiple files with extensions like “.pdf”, “.mp3”, “.mpg”, or “.mp4” in a short period of time.
- Block users that initiate multiple requests that cause extremely slow web server response times. Such users may be exploiting business logic flaws in the application. In addition, block users that perform multiple HTTP requests that result in web server errors, like 400, 405, or 503 error codes.
- Limit requests to high-risk URLs such as login pages and search pages. These pages are frequent attack targets. To prevent DDoS attacks targeting login pages, create policies that prevent:
 - A. An excessive number of failed logins
 - B. Multiple successful logins from the same user
- Many application DDoS attacks are launched by botnets. In addition, many attackers attempt to cloak their identity by using anonymizing services. To stop these high-risk sources, block known malicious IP addresses, anonymous proxies, and Tor networks.

- For hacktivist attacks, targeted organizations can monitor social media sites to learn which DDoS tools will be used to conduct the attack. To develop laser-precise DDoS mitigation policies, download the DDoS tool and test it. Look for unusual header or payload strings that can be used to create custom attack signatures. Then define new policies in your web application firewall to block these DDoS tools.

Use Cloud-Based DDoS Mitigation Services to Stop Network DDoS Threats

To combat network-layer, or volumetric, DDoS attacks, your network must be able to handle large volumes of traffic—to the tune of tens of gigabits, or even hundreds of gigabits, of traffic per second. To avoid expensive infrastructure and Internet bandwidth costs, many organizations rely on a cloud-based DDoS service to mitigate DDoS attacks.

Cloud DDoS mitigation services can scale on-demand to prevent massive attacks and ensure that malicious traffic never reaches your network.



SECURITY TIP

Prepare! To reduce the risk of downtime, develop bot mitigation and rate control policies before the attack occurs. Then, enable and adjust the policies when you are under attack.

When evaluating DDoS mitigation services, consider the following capabilities:

- Can the service block both network and application DDoS attacks?
- Can the service accurately detect bots? Can it present various challenges like browser checks to ensure that only malicious bots are blocked?
- Does the service support any cast DNS routing to ensure that its own DDoS filtering data centers aren't targeted for attack?
- Does the service offer around-the-clock monitoring and tuning from security specialists?



Step 5. Counter the Attack: Monitoring and Tuning Procedures When Under Attack

Once the web attack is underway, your security response team should devote all available resources to monitor and manage the attack. For intense attacks, you may need to assign shifts to ensure coverage at night and on weekends.

Your security response team should continuously review security alerts from your web application firewalls.

- When attacks are coming from a specific geographic region, create policies to block requests from that region, if it does not represent an important segment of your customer base.
- Analyze bot activity and determine which URLs bots are targeting. Create bot mitigation rules that block bots from accessing those URLs.

- Look for attack patterns and tune policies to block those attacks. For example, if you determine that hackers are attacking a search page, create a policy to block users if they perform 10 search requests in a minute. Additionally, you will want to create a second policy to block users for 4 hours if they perform 25 requests in 10 minutes. Your goal is to make policies challenging for hackers to recognize the thresholds.

In addition to reviewing application security alerts and adjusting policies, monitor alerts from other networking and security equipment.

- Review log messages from your database firewall; look for unusual activity indicative of a breach.
- Analyze security alerts from network performance monitoring tools to detect bursts of traffic or performance issues.
- Examine aggregated log messages from routers, switches, web servers, and network security tools in your SIEM.



“Prepare for a cyber-attack as you would prepare for a hurricane. Have a strategy, supplies, and batten down the hatches before the storm starts. When it does start, stay calm and focus on protecting your most important assets.”

CYBER SECURITY EXPERT IN FLORIDA

Continue reviewing social media, hacker forums, Internet Relay Chat (IRC) rooms, and sites that catalog website defacements⁷ for attack information or evidence that your site has been penetrated. Hacktivists often use the phrase “#TangoDown” on IRC channels to announce they have brought a website down.

Depending on the impact of the attack, it may be necessary to inform your organization’s public relations and legal teams of any website outages or data breaches.



Step 6. Bring in the Experts: Optional Security Consulting Services

If you face an impending attack and you’re worried your organization might not have the experience or the expertise to counter it efficiently, consider engaging outside consultants to assist you through the process. Security consultants can help you prepare for an attack by evaluating your application infrastructure for weaknesses. They can also review your application defenses and help you fine-tune the policies of your security products, such as your web application firewall.

⁷ Zone-H lists recent of Website defacements at www.zone-h.org/archive.

⁸ Non-alcoholic beer and coffee are suitable alternatives.

Security consultants can act as an extension of your own security response team during the attack by helping you monitor web attack traffic and adjust mitigation rules accordingly. Based on their extensive experience defeating web attacks, they can help ensure that your organization is well defended against any type of attack.



Step 7. Conduct a Post Mortem of the Attack

According to several interview sources, when the web attack is over, the first order of business for your security response team will often be “to get a beer.”⁸ After enduring a stressful and prolonged web attack, your security engineers will need some time to recover. However, once the dust has settled, your organization will want to conduct a post-mortem of the attack.

As part of the post-mortem, your team should review the impact of the attack, analyze security reports from your web application firewall to investigate attack trends, and examine alert logs from your WAF, your SIEM, and your network monitoring tools.

Your post-mortem assessment should address the following questions:

- Did your network suffer any downtime during the attack?
- Did the attack affect application performance or latency?
- Was any sensitive data compromised?
- What security technologies and processes were in place? Were they effective?
- What improvements can be made in the future?

Once you have completed your post-mortem, you will be better prepared to tackle future web attacks.

Conclusions and Recommendations

Web attacks vary drastically. A script kiddie trying to create a small nuisance attack uses starkly different attack methods than hackers trying to take down a Fortune 50 banking site. Attack tools change over time—hackers develop new attack tools to evade signature detection and outwit application developers. As a result, your response will need to be flexible.

Regardless of their motivation, most hackers target websites they deem potentially vulnerable. Once they have exhausted their portfolio of attack techniques, they will move on to the next potential victim. As a result, if organizations can make their websites seemingly impenetrable to attack by implementing ironclad defenses such as real-time attack blocking, anti-automation, multi-gigabit bandwidth elasticity, and session protection, then hackers will move to easier prey.

By following the best practices outlined in the Web Attack Survival Guide, organizations can fortify their websites against threats like hacker attacks, application DDoS, and industrialized cyber-attacks.

Web Attack Survival Checklist

Understand the Threat Actor

- Identify the threats you face.
- Research attacker's techniques and identify attacks they may use.

Develop a Security Response Plan

- Organize an incident response team to manage security response efforts.
- Prepare a little black book of contacts for the incident response team.
- Document network and server information.
- Document plan to notify executive management and employees.
- Establish a war room.

Locate and Assess Applications and Servers

- Identify servers and applications, and prioritize your efforts on these assets.
- Locate all third-party applications that are hosted in the cloud.
- Test your network and applications for vulnerabilities.
- Verify your databases' security by scanning them for vulnerabilities and configuration flaws.

Strengthen Application, Network, and End-Point Security Controls

- Apply strict web application, network and server-level security policies.
- Ensure your WAF will block all online threats by tuning the web app profile.
- Prevent application DDoS attacks by configuring recommended policies.
- Stop network and application DDoS threats by using cloud-based DDoS mitigation services.

Counter the Attack: Monitoring and Tuning Procedures When Under Attack

- Review security alerts from your WAF.
- Monitor alerts from other networking and security equipment.
- Continue reviewing Social Media and IT forums.
- Inform PR and legal teams.

Bring in the Experts: Optional Security Consulting Services

- Consider bringing outside help to prepare for or during an attack.

Conduct a Post Mortem of the Attack

- Analyze security reports from your WAF.

About Imperva

Imperva® (NASDAQ: IMPV) is a leading provider of cyber security solutions that protect business-critical data and applications. The company's SecureSphere, CounterBreach, Incapsula and Camouflage product lines enable organizations to discover assets and risks, protect information wherever it lives—in the cloud and on-premises—and comply with regulations. The Imperva Defense Center, a research team comprised of some of the world's leading experts in data and application security, continually enhances Imperva products with up-to-the-minute threat intelligence, and publishes reports that provide insight and guidance on the latest threats and how to mitigate them. Imperva is headquartered in Redwood Shores, California. Learn more: www.imperva.com, our blog, on Twitter.