Microsoft | Security Intelligence Report

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January through June 2010

An in-depth perspective on software vulnerabilities and exploits, malicious code threats, and potentially unwanted software, focusing on the first half of 2010

Microsoft

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About This Report

Scope

The *Microsoft® Security Intelligence Report (SIR)* focuses on malware data, software vulnerability disclosure data, vulnerability exploit data, and related trends, as observed through data provided by a number of different Microsoft security-related products, services, and technologies. The telemetry used to produce this report was generated by millions of computers in more than 200 countries and regions on every inhabited continent. The ninth volume of the *Security Intelligence Report* also includes a special section, "Battling Botnets for Control of Computers," that provides an in-depth look at the botnet phenomenon, the threat it poses to people and computers worldwide, and steps that IT administrators and computer users can take to fight back. Past reports and related resources are available for download at www.microsoft.com/sir. We hope that readers find the data, insights, and guidance provided in this report useful in helping them protect their networks and users.

Reporting Period

In the current volume of the *Security Intelligence Report*, statistics about malware families and infections are reported on a quarterly basis, while other statistics continue to be reported on a half-yearly basis. In future volumes, Microsoft expects to report all statistics on a quarterly basis.

Throughout the report, half-yearly and quarterly time periods are referenced using the *n*H*yy* or *n*Q*yy* formats, respectively, where *yy* indicates the calendar year and *n* indicates the half or quarter. For example, 1H10 represents the first half of 2010 (January 1 through June 30), whereas 2Q10 represents the second quarter of 2010 (April 1 through June 30). To avoid confusion, always pay attention to the reporting period or periods being referenced when considering the statistics in this report.

Conventions

This report uses the Microsoft Malware Protection Center (MMPC) naming standard for families and variants of malware and potentially unwanted software. For information about this standard, see "Microsoft Malware Protection Center Naming Standard" on the MMPC website.

Foreword

Microsoft Malware Protection Center

Thanks for your interest in Volume 9 of the *Microsoft Security Intelligence Report (SIR v9)*. As you may have noticed, we've made some changes in *SIR v9* based on your feedback. We think these changes are pretty cool, and we hope they help you find information that's important to you. One of the changes is to focus within each new volume on a different issue; *SIR v9* focuses on botnet threats.

At the Microsoft Malware Protection Center (MMPC), one of our goals is to make the Internet a safer place for people to work and play. MMPC technologies now service more than 600 million unique computers around the world, and the amount of data we collect is mind-boggling. The MMPC sifts through this data daily to help minimize computing threats. *SIR v9* relies on this intelligence for its comprehensive analysis, and the knowledge that is gained goes right back into our security products and anti-malware technologies to produce improved protection services for the community. Furthermore, malware data and samples then make their way to Microsoft partners as well as other industry players.

The first half of 2010 saw the world come together for the World Cup (and congratulations to Spain on their well-earned first-ever hoisting of the trophy). While the battle for the World Cup was

Continued on next page...

Microsoft Trustworthy Computing Group

Welcome to Volume 9 of the *Microsoft Security Intelligence Report (SIR v9)*. Volume 9 covers the first half of 2010 (January 1 through June 30) and is based on data that we receive from more than 600 million computers around the world each month and from some of the most widely used services on the Internet.

We've been publishing this report for four years now and are always striving for ways to make it the best possible source of authoritative security data. Our global insight and analysis makes the *SIR* unique in our industry, and although the report has been well-received, you will notice some significant changes for Volume 9. In response to your feedback, we've made an effort to keep the size of the report more manageable and to produce analysis that can be made available in smaller, stand-alone sections.

My teams in the Microsoft Security Response Center (MSRC) and Microsoft Security Engineering Center (MSEC) work with product and service groups across Microsoft to help improve our customers' security experience. The data in *SIR v9* indicates our actions continue to have positive effect on the overall security of the computing ecosystem. The Microsoft share of the software vulnerabilities disclosed each six-month period since the introduction of the Security Development Lifecycle

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(*Microsoft Malware Protection Center* continued)

between teams on a field, my team battles criminals in cyberspace to detect malware and find better ways to protect computers from its effects. This battle is far from over, and will continue well past the next World Cup, but the important message is that the stakes for data and identity protection are much greater than any sports event or trophy.

SIR v9 also introduces a new website that provides easy-to-use, searchable intelligence content. It also provides risk management information as well as information designed to help you understand how best to combat malware in general and, more specifically, botnets. On www.microsoft.com/sir you will find the following five categories of security intelligence information:

A comprehensive story that examines the topic of botnets from all angles.

A Reference Guide that provides guidance and an introduction to the many topic items covered in the *SIR*.

Key findings that consider the most relevant telemetry intelligence from Microsoft on malware.

Comprehensive risk management information to help you protect your people, software, and organization.

Regional telemetry intelligence that examines botnet threats in 15 regions/countries around the world.

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(*Microsoft Trustworthy Computing Group* continued)

(SDL) remains very low (only 6.5% of all vulnerabilities disclosed in the first half of 2010 were in Microsoft software); malicious software infection rates for more recent versions of the Windows operating system (and more recent service packs, where available) were significantly lower than previous versions (Windows 7 had the lowest client infection rate; Windows Server 2008 R2 had the lowest server infection rate).

Microsoft (in conjunction with partners from industry and academia) has also taken legal action this year to combat prominent botnets. I encourage you to read the Featured Intelligence story "Battling Botnets for Control of Computers" which contains a description of the actions taken by Microsoft Digital Crimes Unit to combat the Waledac botnet.

We are committed to sharing the results of our security investment with our industry partners and competitors to help create a more secure ecosystem for all. I encourage developers to visit www.microsoft.com/sdl to take advantage of the free SDL framework, tools, and guidance to help create secure applications. Developers can also subscribe to our Trustworthy Computing blogs to keep up to date on the latest vulnerability and exploit developments and other announcements from my team.

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(*Microsoft Malware Protection Center* continued)

The future of the *SIR* depends on your feedback. We are always seeking ways to improve the report—your experience with it and any feedback you provide will help us tremendously. One such request, for instance, resulted in interpreting data over three-month periods (quarters) instead of six-month periods.

So, please take a few minutes to send us a note at sirfb@microsoft.com. We take all comments seriously, and we want to do all we can to ensure that our next report will help you better protect your computer resources and those of your organization.

Vinny Gullotto

General Manager
Microsoft Malware Protection Center
Microsoft Corporation

(*Microsoft Trustworthy Computing Group* continued)

Just want to reduce your risk profile and protect your PC? Then keep all of the software on your computers up to date (including third-party software); use the Microsoft Update service in preference to Windows Update; move to the latest version of software, if possible; and run an up-to-date antivirus and antispyware product from a trusted vendor.

We hope the changes we've made in *SIR v9* make it an invaluable resource for helping you make well-informed security decisions.

Do drop us a line if you have suggestions—join us at the new *SIR* website or email us at sirfb@microsoft.com.

Matt Thomlinson

General Manager
Microsoft Product Security
Microsoft Trustworthy Computing Group

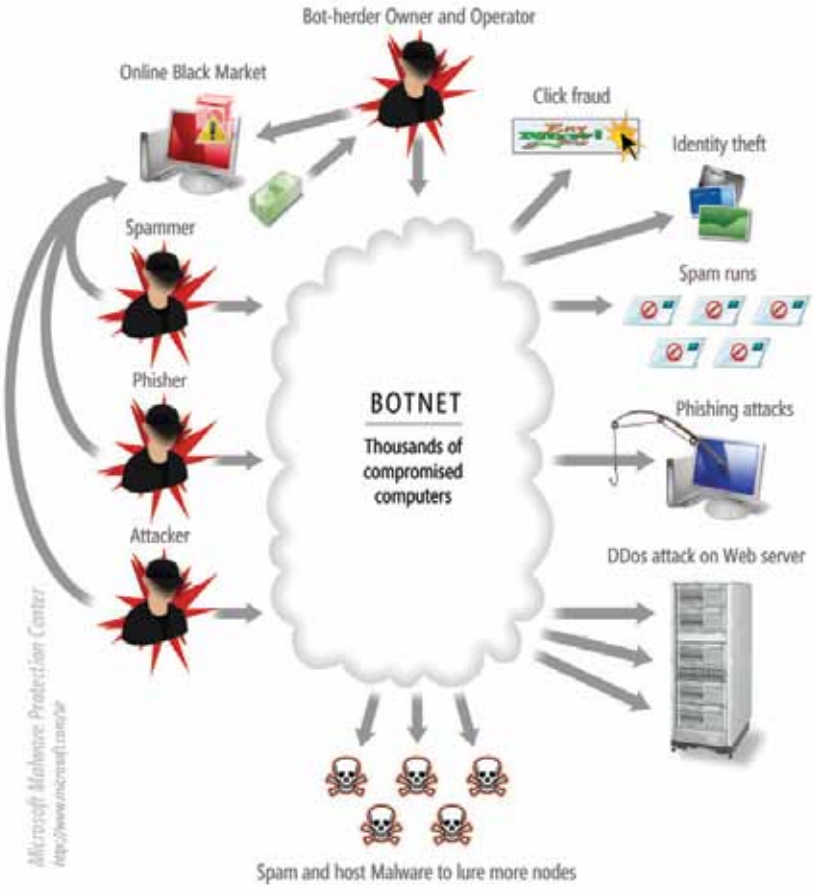
Battling Botnets for Control of Computers

What Is a Botnet?

Since the early days of the public Internet, the word *bot* (from *robot*) has referred to automated software programs that perform tasks on a network with some degree of autonomy. Bots can perform many beneficial and even vital functions. For example, the web crawling software programs used by popular search engines to index webpages are a class of bots, and participants in the well-known SETI@HOME program (http://setiathome.berkeley.edu) voluntarily install bots on their computers that analyze radio telescope data for evidence of intelligent extraterrestrial life. Unfortunately, bots can also be developed for malicious purposes, such as assembling networks of compromised computers—*botnets*—that are controlled remotely and surreptitiously by one or more individuals, called *bot-herders*.

Computers in a botnet, called *nodes* or *zombies*, are often ordinary computers sitting on desktops in homes and offices around the world. Typically, computers become nodes in a botnet when attackers illicitly install malware that secretly connects the computers to the botnet and they perform tasks such as sending spam, hosting or distributing malware or other illegal files, or attacking other computers. Attackers usually install bots by exploiting vulnerabilities in software or by using social engineering tactics to trick users into installing the malware. Users are often unaware that their computers are being used for malicious purposes.

FIGURE 1. Example of a typical botnet in action



In many ways, a botnet is the perfect base of operations for computer criminals. Bots are designed to operate in the background, often without any visible evidence of their existence. Victims who detect suspicious activity on their computers are likely to take steps to find and fix the problem, perhaps by running an on-demand malware scan or by updating the signature files for their existing real-time malware protection. Depending on the nature of the bot, the attacker may have almost as much control over the victim's computer as the victim has, or perhaps more.

By keeping a low profile, bots are sometimes able to remain active and operational for years. The growth of always-on Internet services such as residential broadband has aided bot-herders by ensuring that a large percentage of the computers in the botnet are accessible at any given time. Botnets are also attractive to criminals because they provide an effective mechanism for covering the tracks of the botnet herder—tracing the origin of an attack leads back to the hijacked computer of an innocent user, which makes it difficult for investigators to proceed further.

In practice, many threats include limited command and control capabilities that are tailored to specific tasks, like downloading files, but do not provide the attacker with the kind of full-featured control that bots typically do. Malware authors also often add command and control capabilities to existing families as they develop them, so it is possible for malware families to evolve into botnets over time as new variants are released. For the purposes of this analysis, the *Security Intelligence Report* defines botnet as a network of computers that can be illicitly and secretly controlled at will by an attacker and commanded to take a variety of actions. Under this definition, a trojan downloader that is only designed to download arbitrary files and cannot otherwise be controlled by the attacker would not be considered a bot.

History

Many prevalent botnet families today have their roots in innocuous and beneficial utilities that were developed to manage Internet Relay Chat (IRC) networks. IRC is a real-time Internet chat protocol, designed for group (many-to-many) communication. IRC was designed to provide Internet users around the world with a casual way of communicating with each other in text-based discussion forums called *channels*.[1] A typical IRC network is comprised of a number of servers in various locations that connect users so that they can chat. Channels are administered by channel operators, who can take actions such as muting or ejecting unruly users. To extend the functionality of IRC, some channel operators used automated scripts—the original IRC bots—to perform functions such as logging channel statistics, running games, and coordinating file transfers.

As the popularity of IRC communities grew and the number of servers increased, so did the number of conflicts between users, which led to battles over the control of popular channels. IRC is structured so that when all of the designated channel operators disconnect from a channel, another member of the channel is automatically assigned as the new operator. In an effort to gain control of a channel, some malicious users created scripts

[1] (Oikarnen n.d.)

that could perform denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks against IRC servers. By targeting the server used by a specific channel operator, these scripts could force the operator offline so that the attacker or someone else could gain operator status. Eventually, these same bots were used to target individual users.[2]

One of the earliest malware families to make use of IRC as a means of *command and control* (C&C) was a mass-mailing worm called Win32/PrettyPark, which appeared in 1999. After the PrettyPark bot infects a victim's computer, it secretly connects to a remote IRC server using its built-in client program and waits for instructions. An attacker serving as channel operator can command the bots to collect basic information about victims' computers, such as the operating system version and computer name, and user information such as sign-in names, email addresses, nicknames, and dial-up user names and passwords. This technology was enhanced over the next few years, and a number of more sophisticated bots, such as Win32/AgoBot and Win32/Sdbot, emerged, which extended the basic functionality of the technology and added other attack methods. Much of the IRC-based C&C functionality of the PrettyPark worm is still seen in the current generation of IRC-based bots operating today.

Botnets Today

The botnet world is divided between bot families that are closely controlled by individual groups of attackers and bot families that are produced by *malware kits*. These kits are collections of tools, sold and shared within the malware underground, that enable aspiring bot-herders to assemble their own botnet by creating and spreading customized malware variants. Several malware kits are freely available for downloading and sharing; some have been published as open source code, which enables malware developers to create modified versions of the kits.[3] Other kits are developed by individual groups and sold like legitimate commercial software products, sometimes even including support agreements. For example, variants in the Win32/Zbot family are built from a commercial malware kit called Zeus; Win32/Pushbot bots are built from a kit called Reptile. The existence of botnet malware kits is one of the reasons why it is difficult for security researchers to estimate the number and size of botnets currently in operation. Detections of malware samples from a family like Zbot, for example, do not necessarily represent a single large botnet controlled by one individual or group, but instead may indicate an unknown number of unrelated botnets controlled by different people, some of which might encompass just a handful of controlled computers.[4]

Bot operators use several tactics to attack organizations, companies, and individuals in an effort to achieve their goals. Botnets typically exhibit a variety of behaviors based on the purpose of the attacks and the tools used to establish them. Being aware of and understanding the different attacking mechanisms can help IT and security professionals gain a deeper understanding of the nature of the botnet, the purpose behind it, and sometimes even the origin of the attack.

[2] (Canavan 2005, 5–6)
[3] (Bächer, et al. 2008)
[4] (Ollmann 2009, 3)

Bots, like other kinds of malware, can be spread in a number of different ways. Three common ways that computers are successfully compromised involve the following tactics:

- Exploiting weak or non-existent security policies
- Exploiting security vulnerabilities
- Using social engineering tactics to manipulate people into installing malware

Some bots are designed to spread using these techniques directly, as worms; security researchers analyze the behavior of these self-replicating bots to learn more about how they spread. Other bots don't spread themselves directly and are delivered by other malware families as payloads.

Many attackers and types of malware attempt to exploit weak or non-existent security policies. The most common examples of such exploits are attackers taking advantage of weak passwords and/or unprotected file shares. A threat that gains control of a user's account credentials could perform all of the actions the user is allowed to perform, which could include accessing or modifying resources as a local or domain administrator.

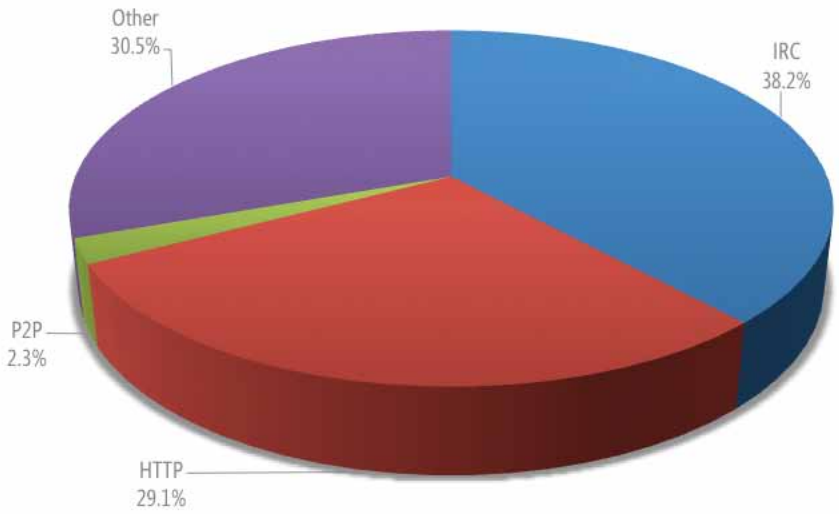
Other types of malware attempt to exploit security vulnerabilities to gain unauthorized access to computer systems. This type of attack is more successful on older operating systems than on newer systems that are designed with security as a core requirement. An analysis of infections reported by the Microsoft Malicious Software Removal Tool (MSRT) during the second quarter of 2010 (2Q10) reveals that infection rates for computers around the world are significantly lower on newer versions of the Windows® operating system than on older versions. (See Figure 13 on page 37 for more information.)

Although these kinds of attacks remain a significant part of the threat landscape, improvements in software development practices and the increased availability and awareness of automatic software update mechanisms have greatly limited the kinds of technical exploit opportunities that are available to attackers. Instead, most attackers today rely heavily on *social engineering* techniques to mislead victims into unwittingly or even knowingly giving them information and access that would be much harder to take by force. Although media attention on social engineering attacks, such as phishing, have raised public awareness of this type of threat in recent years, attackers continue to find success with a variety of techniques for manipulating people. (See "Social Engineering as a Weapon" on page 15 of *Microsoft Security Intelligence Report, Volume 6 [July through December 2008]* for more information.)

IRC Botnets

The IRC protocol is used by many applications to support simple text-based chatting environments. Because the earliest bots were derived from benign IRC bots (and probably also because IRC has many legitimate uses), this protocol is still the most common C&C mechanism used by bots. As shown in the following figure, IRC-based families account for the largest share of the botnet-infected computers cleaned by Microsoft desktop anti-malware products in 2Q10, 38.2 percent.

FIGURE 2. C&C mechanisms used by botnet families in 2Q10, by number of unique computers reporting detections



Upon infection, the IRC clients built into the bot connect to a specified IRC server and channel like a typical chat client, and wait for instructions from the operator in the form of specially formatted text messages. Some of the more sophisticated bot operations have also encoded or encrypted bot commands in the channel topic, which is displayed to each client as it enters the channel. These commands can be complex enough to partition large botnets and give each subset its own task, which can be done based on country, network location, bot uptime, available bandwidth, and other variables. (See "How Botnets Work," beginning on page 21, for more information and examples.)

HTTP Botnets

The use of HTTP as a botnet C&C mechanism has increased in recent years as malware authors have moved beyond the first generation of malicious bots, although HTTP bots are still responsible for fewer infections than IRC bots. HTTP has the advantage of being the primary protocol for web browsing, which means that botnet traffic may be more difficult to detect and block. HTTP may be used to facilitate control either by having

the bot sign in to a site that the bot controller operates or by having the bot connect to a website on which the bot controller has placed information that the bot knows how to interpret as commands. This latter technique has an advantage in that the controller doesn't need to have an affiliation with the website. Some botnets even use blogs or social networking accounts for C&C, such as Win32/Svelta, a family discovered in 2009 that receives instructions from specially coded entries the attacker posts on the Twitter social networking service.

The HTTP protocol is also commonly used by bots to download updates and other malware, regardless of which C&C mechanism the bots use. Many bots include their own HTTP servers for hosting phishing websites or illegal content, such as child pornography, or to provide an HTTP proxy that enables bot-herders to hide the location of their main (and usually illegal) websites.

Other Protocols

Modern botnets sometimes use other protocols and ports for command and control. These less common mechanisms may be implemented as a way to avoid detection by intrusion detection systems (IDS) and intrusion prevention systems (IPS).[5] In many scenarios these "custom protocols" simply involve transmitting binary or text data over a TCP or UDP port of the attacker's choosing, which is sometimes a port assigned to a different protocol or service.

P2P Command and Control

Historically, most large botnets have relied on a centralized control mechanism. In such scenarios, bots contact a preconfigured IRC channel or URL to receive commands directly from the bot-herder. Recently, a number of prevalent botnet families have adopted *peer-to-peer* (P2P) control mechanisms in an effort to evade scrutiny and resist shutdown. Although bot creators attempted to use P2P networking as a C&C mechanism for bots as far back as 2003, it has become more popular in recent years. Some botnet families use mechanisms derived from open source P2P implementations such as Kademlia. Others, including Win32/Waledac, use their own custom P2P implementations. (See "Win32/Waledac and the Law: Fighting Botnets in Court" on page 45 for more information about actions Microsoft has taken to bring the perpetrators of the Waledac botnet to justice.)

In a conventional botnet, the C&C server acts as a single point of failure; if it is taken offline or communications are disrupted, the entire botnet becomes inoperative. Some botnet families include redundancy features such as backup C&C servers, use of dynamic DNS services, and the ability for the bot-herder to redirect bots to a different server on demand, but the centralized control mechanism still introduces a measure of fragility to the system. Passing commands through intermediate peers in a P2P network makes it more difficult for analysts to identify bot controllers and determine the size of a network. This technique also makes the botnet more robust, in that any number of bots might be lost (in theory, at least) without fatally disrupting the botnet.

[5] (Nazario and Linden, Botnet Tracking: Techniques and Tools 2006)

How Botnets Are Used

Getting a botnet up and running is only the first step. A botnet can be used as a platform for a variety of criminal activities, depending on how the bot-herder chooses to configure the individual nodes. In addition to identity theft, botnets have many uses, some of which are described in the following subsections.

Spamming

Most of the spam that is sent today originates from botnets, which use several different techniques to get their unwanted messages past recipients' mail filters. In addition to renting out their botnets to spammers, bot-herders also use the botnets' spamming functionality themselves, sending out disguised copies of the bot malware (or hyperlinks to hosted copies of it) in an effort to increase the size of the network.

To understand how bots have come to play a central role for spam and phishing schemes, consider the typical life cycle of a spam or phishing attack. Attackers must first find a list of email addresses to target, and then they must craft their messages in a way that is likely to bypass email spam filters. They usually also host a landing page on which the product or service that is advertised in the message can be purchased. Bots can assist the attackers in all of these phases.

Attackers have traditionally found new potential victims by crawling the web or buying lists from other spammers. However, the email addresses obtained in this way are often of low quality—they might be old and no longer used, or the lists they buy might include trap accounts that notify the administrators of the receiving email system upon receiving a spam message so that the originating IP address can be quickly blocked.

Bots can be used to harvest high quality email addresses. For example, the HTTP botnet family Win32/Waledac searches through many different kinds of files on fixed and remote drives on compromised computers looking for addresses. In addition to sending spam to the harvested addresses directly, Waledac also transmits the addresses to a list of remote websites, presumably for the attacker to retrieve. The market for lists of email addresses is well-established, and bot owners can easily turn the lists they harvest this way into profit by selling them to spam and phishing attackers. Addresses that include demographic information, such as name and address, or targeting information, such as the name of the bank the person uses, command a premium. Bots can steal very specific information from computers, which makes them especially useful for *spear phishing*, a type of phishing attack that targets the employees or customers of a particular institution.

Spambots, as bots that send spam are sometimes called, also give attackers access to tens of thousands of computers or more that can be used to originate spam. Typically, a prospective spammer contacts a bot-herder to rent the services of a botnet. Several modern botnet families are designed to be partitioned into segments that can be controlled separately. Partitioning allows the bot owner to control how much capacity to rent at a time, prevents valuable parts of the botnet from being used without their permission, and segments the market by collecting higher-quality bots (newly compromised, high-bandwidth, rarely rebooted) together and renting them for a premium.

After the spammer and bot controller negotiate the product and price, the bot controller instructs each of the selected bots to start a proxy server and typically provides the spammer with access to a webpage that lists the IP addresses of the selected bots and the ports on which they are running their proxy servers. These bots go online and offline as the compromised computers' real owners reboot them; IP addresses might change, and the ports on which the proxy servers run might change over time. Every time there is a change, the bot notifies its C&C server, which automatically updates the list of IP addresses the spammer can use.

Phishing

Phishing is a method of credential theft that tricks Internet users into revealing personal or financial information online. Attackers send messages purporting to be from a trusted institution, such as a bank, auction site, online game, or other popular website. These phishing messages—which are often generated and sent by bots, like spam—direct victims to webpages run by the attackers, where they are instructed to submit private information such as login credentials or credit card details. Some malware families, such as Win32/Pushbot, have also been observed to redirect URLs for banking websites in the victim's browser directly.

Stealing Confidential Data

Many bots can be commanded to search a computer's hard disks for personal information, including computer authentication credentials, bank account numbers and passwords, product keys for popular computer games and other software products, and other sensitive data. Some of the earliest malicious bots included the ability to transmit product keys back to the attacker, and such features are common in kit-based bots such as Win32/Rbot and Win32/Zbot.

Perpetrating Distributed Denial-of-Service (DDoS) Attacks

One of the oldest attacker uses of botnets is as a mechanism for launching distributed denial-of-service (DDoS) attacks, as discussed earlier. A denial-of-service (DoS) attack is an attempt to make a computer resource, such as network connectivity and services, unavailable to its intended users. Typically, such attacks flood the resource with network traffic, which saturates its bandwidth and renders it unavailable to perform legitimate services. A DDoS attack involves multiple computers—such as those in a botnet—attacking a target at the same time, making it harder to defend against than an attack from a single computer. Several common bots, including Win32/Hamweq, Win32/Pushbot, and Win32/Waledac, have been observed participating in DDoS attacks.

Bot-herders usually target high-profile websites or companies, but any service available on the Internet can be a victim, including corporate, government, education, and private computer systems. However, as with most malware in the modern era, the motive is usually financial—attackers use the threat of a DDoS attack to extort money from the target. There have been numerous reports of DDoS attacks against public commercial websites

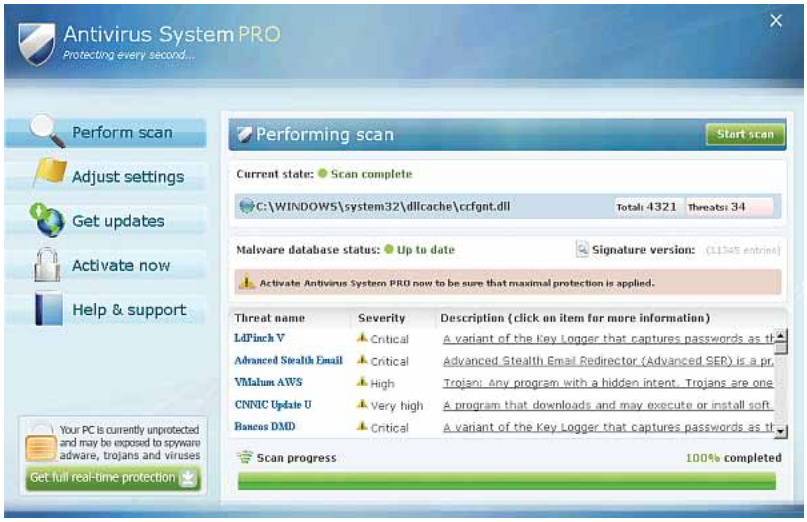
and even Internet infrastructure components such as DNS root servers. The potential impact of DDoS can be very significant. As botnets grow larger, their ability to launch DDoS attacks grows more powerful, with one recent attack involving sustained traffic in excess of 7.3 Gbps over a 10-Gbps link.

Installing Malware and Potentially Unwanted Software

Bot-herders often use their botnets to download additional malware to victims' computers to reap additional profits. Early botnets often focused on installing adware, spyware, and other potentially unwanted software in an effort to earn quick profits. In a typical incident in 2005, a bot-herder in California used the bot family Win32/Rbot to install adware on more than 20,000 computers as part of a pay-per-click advertising scheme that brought in more than U.S. $50,000, according to the U.S. Department of Justice.[6]

Malware installed by botnets often works silently to avoid tipping off the victim that the computer is infected, but not always. Some botnets, including Win32/Waledac, have been observed to download *rogue security software*—programs that masquerade as legitimate anti-malware products, displaying false alerts about nonexistent infections on the victim's computer and offering to remove them if the victim pays for the "full version." Botnets have also been observed downloading packet sniffers and additional downloaders. Some botnets are even instructed to download and install other bots. Variants of Win32/Hamweq have been observed to download Win32/Rimecud, a botnet family with more sophisticated backdoor features.

FIGURE 3. Win32/FakeSpypro, a rogue security software family downloaded by Win32/Waledac

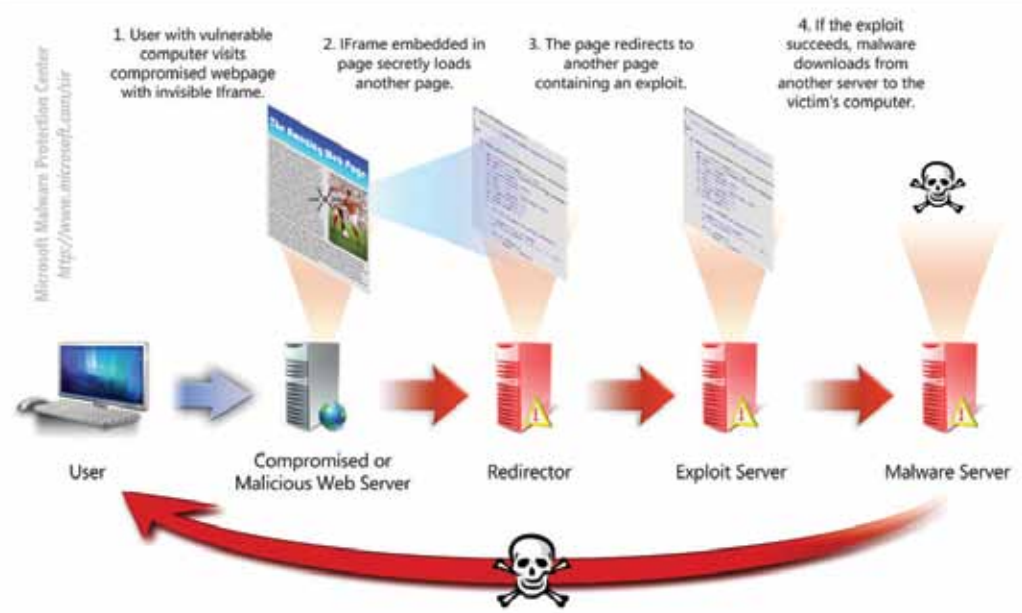


[6] (United States of America v. Jeanson James Ancheta 2005)

Distributing Malware

Botnets often play important roles in malware distribution schemes. In a typical scenario, an attacker uses bots to send spam messages that contain links to malware, which itself is often hosted by the botnet. The messages use social engineering techniques to convince recipients to click the links, such as disguising the message as a news digest with provocative-sounding fake headlines or as a message from a friend purporting to offer a link to an embarrassing photo of the recipient. The malware is either offered for download directly, as a disguised executable file, or is hosted on a webpage that includes exploits that are designed to use specific browser vulnerabilities to secretly install malware on visitors' computers (a tactic sometimes called *drive-by downloading*). (See "Analysis of Drive-By Download Pages" in the Reference Guide section of the *Security Intelligence Report* website for more information.)

FIGURE 4. One example of a drive-by download attack



Occasionally an attacker sends malware directly to recipients as a file attachment, although most popular email programs and services block users from downloading actual or suspected malicious files. (See "Email Threats" in the Reference Guide section of the *Security Intelligence Report* website for more information.)

Click Fraud

Much advertising on the Internet operates on a "pay-per-click" model, in which the operator of a website that contains advertisements receives a fee from the advertiser every time a visitor clicks on the ad. Criminals sometimes use botnets to generate fraudulent "clicks" on pay-per-click advertisements. For example, a bot-herder may set up a website with advertisements and negotiate an arrangement with a web host that pays the bot herder for clicks on their ads. The bot-herder then writes bot code that automates the click-throughs so that the bots in the botnet, which can number in the thousands, instantly click on the ads on that website. The pay-per-click marketer, honoring the advertisement agreement, pays for these illegitimate clicks without gaining the sales or leads that were hoped for.[7] This process can be further enhanced if the bot hijacks the start page of a compromised computer so that the click-throughs are executed each time the owner of the compromised computer opens their browser, victimizing both the owner of the compromised system and the web host.[8]

How Botnets Work

Most botnets are similar in the details of their operation, whether they are created specifically for the benefit of one criminal organization or built from a kit by a single attacker or small group. The details given in this section apply most directly to "traditional" IRC-controlled botnets built from kits, but much of this information is also relevant to other kinds of botnets.

Botnet Creation

The first step for the prospective botnet operator is acquiring the necessary software. Professional criminal organizations with the resources to build the largest botnets may create or commission their own proprietary software, but most prospective bot-herders are likely to seek out software and services from an online black market forum (for more information, see "Botnet Commerce" on page 26). This approach doesn't require a great deal of technical sophistication, and in fact some researchers have observed the programming skills of low-level bot-herders to be quite limited.[9] With the tools and assistance available on the black market, however, prospective bot-herders have access to all the information they need to create, maintain, and profit from a botnet.

Unless the botnet software uses a P2P control mechanism, which is still relatively rare, bot-herders must also find a home for the C&C server. A bot-herder who has access to a compromised computer in advance may install the IRC server software on it for C&C use. Alternatively, the bot-herder might open an account with a "bulletproof" provider that is resistant to efforts to disconnect lawbreakers. Other choices include establishing secret channels on public IRC servers (inexpensive, but risky) or setting up servers on their own computers (which gives them the most control, but can be expensive and also risks termination by their upstream providers).

[7] (United States of America v. Jeanson James Ancheta 2005)
[8] (Bächer, et al. 2008)
[9] (Ibid)

Most bot-herders choose to register domain names for hosting their C&C servers. Although it is technically possible to control a botnet without a domain name by configuring its bots to connect directly to the IP address of the server, this approach has significant disadvantages. If bot-herders find it necessary to quickly move a server to a different provider to avoid detection or in response to a termination of services, they might not have time to reconfigure the bots to connect to a new IP address and will lose control of them entirely. Bot-herders might choose to register domain names directly with one of the many registrars around the world or open accounts with a *dynamic DNS* service, which provides stable host names for resources that change IP addresses frequently. Using a domain name incurs a risk that the domain's DNS provider might terminate service to the server, which is one reason P2P mechanisms have become more popular recently.

The server software for some bots can be quite complex, offering functionality such as geographic segmentation and task maintenance, although most kit-based bot servers are relatively simple and can be controlled through an ordinary IRC client or web browser. Bot-herders often use the same IRC server packages as legitimate IRC operators, with open source programs like UnrealIRCd being among the most popular. IRC server software is often minimized and modified by the botnet owner or the kit developer. Common modifications include removing JOIN, PART, and QUIT messages on channels to avoid unnecessary traffic. In addition, the functionality provided by the WHOIS (information about specific users), WHO (host details about specific users), LUSERS (information about number of connected clients), and RPL_ISUPPORT (information about the features the server supports) commands is removed to hide the identity of the bots that join the channel and to conceal the size of the botnet from unauthorized people who connect to the IRC server.

In an effort to block unauthorized people such as security researchers and rival bot-herders from entering the channel and seizing control of the bots, botnet owners typically secure the channel using standard IRC commands such as the following:

- `/mode #channel +k [password]`. This command password-protects the channel. The bot client must be configured to supply the correct password when attempting to access the channel. (Some herders choose to password-protect the whole server as well.)
- `/mode #channel +q`. This command marks the channel as quiet. System messages such as JOINs, PARTs, and nickname ("nick") changes are not broadcast, which makes it appear to each client as if that client is the only one on the channel.
- `/mode #channel +s`. This command marks the channel as secret, so it will not appear in channel listings. Users who are outside the channel will not be able to discover the names of the channel participants.
- `/mode #channel +t`. This command locks the channel topic so only channel operators can change it. Channel topics are often used to send commands to bots as they enter the channel.

- `/mode #channel +u`. This command puts the channel into auditorium mode, in which channel operators are the only participants who can see the names of all of the clients connected to the channel. Along with `+q`, this mode makes it difficult for investigators and others to measure the size of the botnet.

After the server and channel are set up, bot-herders can build and distribute the bots. Technically sophisticated bot-herders might choose to code their bots themselves; others build bots using malware creation kits or simply hire someone to do it for them on the black market. For IRC botnets, bot-herders configure the bots with the name or IP address of the server to connect to, the channel name, and any passwords they will need to connect.

Controlling the Botnet

After a bot infects a computer, it attempts to contact its C&C server for instructions. A typical communication that can be observed after a successful infection might look like the following excerpt:

```
<- :irc.XXX.XXX NOTICE AUTH :*** Looking up your hostname...

<- :irc.XXX.XXX NOTICE AUTH :*** Found your hostname

-> PASS s3rv3rp455

-> NICK [d1f]-511202

-> USER hlxahl 0 0 :hlxahl

<- :irc.XXX.XXX NOTICE [d1f]-511202 :*** If you are having prob-
lems connecting due to ping timeouts, please type /quote pong
SF125722 or /raw pong SF125722 now.

<- PING :SF125722

-> PONG :SF125722

<- :irc.XXX.XXX 001 [d1f]-511202 :Welcome to the irc.XXX.XXX IRC
Network [d1f]-511202!hlxahl@heh

<- :irc.XXX.XXX 002 [d1f]-511202 :Your host is irc.XXX.XXX, run-
ning version Unreal3.2.7

<- :irc.XXX.XXX 003 [d1f]-511202 :This server was created Mon Sep
10 2007 at 20:30:33 PDT

<- :irc.XXX.XXX 004 [d1f]-511202 irc.XXX.XXX Unreal3.2.7 iowghraA-
sORTVSxNCWqBzvdHtGp lvhopsmntikrRcaqOALQbSeIKVfMCuzNTGj
```

After connecting, the bot tries to join the operator's channel as configured:

```
-> JOIN #[d1f] channelpassword

-> MODE [d1f]-511202 +iwx
```

If the topic does not contain any instructions for the bot it remains idle in the channel, awaiting commands.

To control the bots, bot-herders enter the channel like ordinary IRC users and issue specially formatted commands. With some commands, such as commands to collect and report information about the victim's computer, the bots report their results as chat messages within the IRC channel or save them locally as files that the herder can retrieve later. Depending on the capabilities of the bot malware, bot-herders can execute a wide range of actions, as described in "How Botnets Are Used" on page 17. A brief selection of typical botnet commands, in this case from the Win32/Rbot family, provides an idea of the kinds of operations a herder can execute:

- **.capture**. Generates and saves an image or video file. Depending on the parameters used, this file could be a screen shot of the victim's desktop or a still image or video from the victim's webcam. The operator can recover the saved picture using the **.get** command.
- **.ddos.syn**, **.ddos.ack**, **.ddos.random**. Launches a DDoS attack on a specified IP address for a specified length of time.
- **.download**. Downloads a file from a specified URL to the victim's computer and optionally executes it.
- **.findfile**. Searches for files on the victim's computer by name and returns the paths of any files found.
- **.getcdkeys**. Returns product keys for software installed on the victim's computer.
- **.keylog**. Logs the victim's keystrokes and saves them to a file.
- **.login**, **.logout**. Authenticates the bot-herder with the bots. Before issuing commands to any bots in the channel, the bot-herder must use the **.login** command with a password that is specified in the bots' configuration data so the bots will recognize the bot-herder as an authorized controller.
- **.open**. Opens a program, an image, or a URL in a web browser.
- **.procs**. Lists the processes running on the victim's computer. Other commands can then be used to kill processes by name or ID.

Spreading Bots

Some bots include worm functionality for spreading themselves through exploits, a mechanism that early malicious botnets used widely. Today, however, vulnerabilities that are conducive to worm activities are rare and herders rely heavily on social engineering to distribute malware to victims. One leading method involves distributing infected files on P2P networks, purportedly as pirated copies of software or films. Another way is through drive-by downloads in which the attacker hosts a webpage (or compromises a legitimate one) with malicious code that downloads the bot malware to vulnerable computers that visit.

After the botnet is up and running, it can be used to attack and infect additional computers. Bot-herders can designate a few nodes as malware servers, using various techniques to disguise their locations and to provide protection in case one or more of them are discovered and shut down. Other nodes can be used to send spam with links to exploit-laden pages on the malware servers, using various forms of social engineering to lure recipients to click the link in the message. Committed bot-herders can use these techniques to build networks of thousands of compromised computers over time.

Defending the Botnet

Bot creators use many techniques to prevent bots from being detected or removed. Many bots contain rootkit components, which are designed to be hard to remove. Bots that enter a computer by exploiting a vulnerability also sometimes "fix" the vulnerability after infection to prevent other malware from exploiting the same vulnerability and interfering with the bot.

Many bot creators package their software using *packers*, software utilities that compress and obfuscate binary code. Packers are designed to make software more difficult to reverse-engineer so that malicious programmers, or *crackers*, cannot make unauthorized modifications to it. Malware authors often use packers both to protect their own code and to evade detection by anti-malware software. Bots are often packaged using many of the same packers used by legitimate software publishers, such as the open source program UPX and commercial utilities such as Silicon Realms' Armadillo and Oreans Technologies' Themida.

Scripting languages used to author many common bots are modular enough to support various encoding and obfuscation techniques to hide the original source from other malware authors and the anti-malware industry. There are many documented techniques, ranging from simple string manipulation functions to uuencode or MIME encoding techniques.

Bot creators sometimes use *polymorphism* in an effort to make it more difficult for antivirus software to identify and remove bots. Polymorphism results in malware files that are functionally identical but differ from one another in file size, content, or other respects. There are two general types of polymorphism that malware creators use:

- **Server-side polymorphism**, in which a server is configured to serve a slightly different version of a file every time it is accessed, possibly by changing the file name of a component to a new random value, or by encrypting or compressing it in a slightly different way.
- **Malware polymorphism**, in which the malware itself is designed to change slightly every time it replicates.

Before distributing a new bot or variant, a bot-herder may have it scanned by popular anti-malware products and services to see if any of them successfully detect it as malware. A number of free online services allow users to upload files to be scanned by multiple anti-malware engines. Legitimate services of this nature share the malware samples they receive with security software vendors to help them improve their detection signatures, so a malware author who uses one of these services to test a new family or variant is likely to guarantee a limited active lifespan for it, even if it initially goes undetected. Malware authors can also use private online testing services that do not share samples with vendors, which can prolong the amount of time a variant remains active before being detected by major anti-malware products.

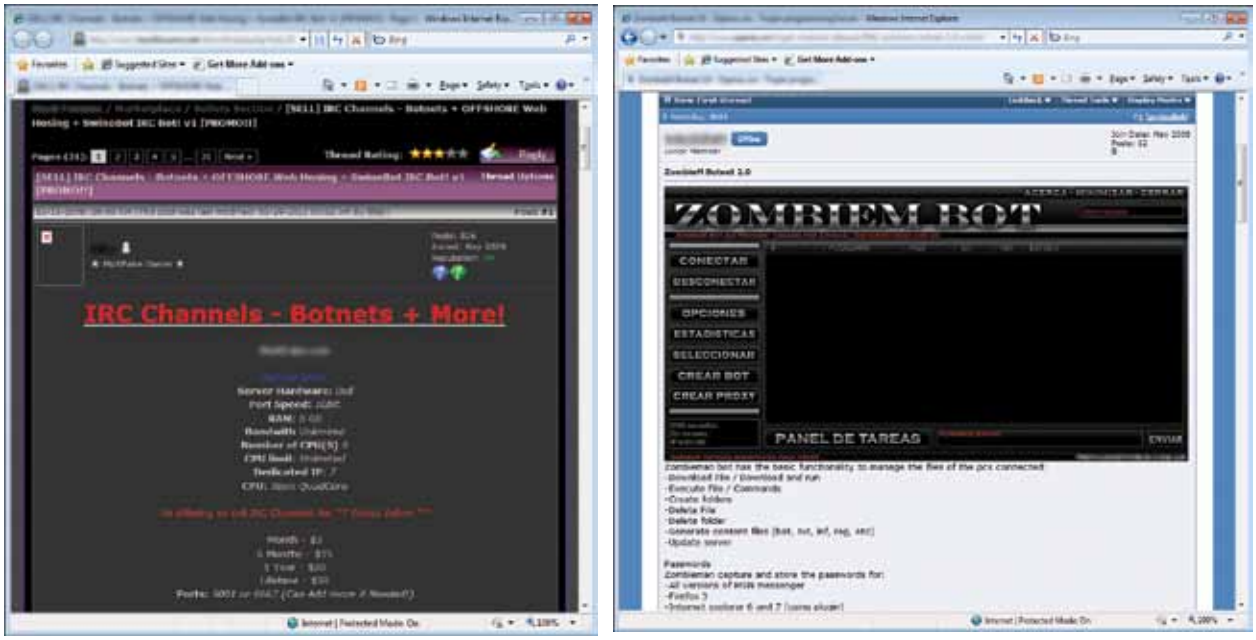
Botnet Commerce

Attackers have developed a number of different ways to make money with botnets, as described in "How Botnets Are Used," beginning on page 17. Bot-herders might choose to attempt these activities individually, or they might return to a black market forum and advertise the services of the new network. These black market forums are online communities that bring sellers of malware and services together with interested buyers. These communities have their roots in the virus exchange (VX) forums that operated in the late 1990s and early 2000s, when the malware scene was dominated by amateur hobbyists who created and distributed malware as a means of raising their status in such communities. The hobbyists were eventually displaced by professional criminals, and today malware on the Internet is almost entirely a profit-oriented enterprise.[10]

Black market sites often offer a comprehensive selection of products and services related to botnets and other malware. Sellers may offer malware kits that enable prospective bot-herders to build their own botnets. Existing botnet owners may rent their networks to spammers and attackers, or sell collections of bots to new owners. Other sellers offer lists of vulnerable IP addresses, "bulletproof" hosting for C&C servers that are supposedly less likely to be taken down by law enforcement and upstream providers, utilities such as packers and encryptors that they claim render malware undetectable by current antivirus signatures, and more. Building a botnet typically involves several different components—the bot itself, the server component, other malware such as downloaders and rootkits to use as payloads, and so on—so black market sites greatly simplify the process of assembling the necessary tools. New sellers with no established reputation might offer potential buyers a free trial in the form of access to the botnet for a very short time, typically less than an hour. As with many mainstream businesses, a few successful transactions give a seller a good reputation in the community, which in turn leads more buyers to bot-herders' virtual doors.

[10] (Fogie 2006)

FIGURE 5. Criminals sell botnet software and services in online black markets.



Black markets often feature many of the trappings of legitimate e-commerce, such as "verified sellers" whom the site operators assert are trustworthy, and even round-the-clock technical support for purchasers. Perhaps owing to the nature of the commerce involved, such marketplaces tend to be rife with swindlers, and buyers frequently complain about "rippers" who took their money but didn't deliver the products or services ordered.

Some of the goods on sale in these markets, especially up-to-date malware creation kits, can be expensive. However, the rates bot-herders and malware authors can charge for access to their wares are usually quite low, at least for renters in wealthy, developed nations. Adam Sweaney, a U.S.-based bot-herder who pled guilty in September 2007 in U.S. District Court to a one-count felony violation for conspiracy, fraud, and related activity in connection with computers, was caught after he offered an undercover federal investigator access to more than 6,000 compromised computers for just U.S.$200 per week.[11]

Black markets are frequently associated with online communities of bot-herders and malware authors, who come together to share techniques and stories, like many groups of people with shared interests. Such forums are often fairly friendly to novices, with experienced malware authors writing tutorials and answering questions posed by newcomers. Such support networks make it relatively easy and convenient for a novice bot controller to get started, although gaining real competence probably still takes a while.[12] This might change if vulnerable computers become more of a scarce resource or if the marginal reward for a new bot increases significantly for some reason, thus increasing the competition for resources.

[11] (United States of America v. Adam Sweaney 2007)
[12] (Nazario and Linden, Botnet Tracking: Techniques and Tools 2006)

The Scope of the Problem: Botnet Data and Metrics

It is difficult to measure with any certainty the numbers of bots and botnets in existence, and estimates from botnet researchers can vary by an order of magnitude or more. Counting the number of bot-infected computers found and cleaned by antivirus software can sometimes yield figures that are very different from estimates produced by researchers who concentrate on the effects of botnets, such as the amounts and origins of spam and the number of known active C&C servers. There is no widespread agreement about which methods are best for estimating the size of botnets. The information presented in this section is intended as a straightforward presentation of telemetry data produced by Microsoft tools and services and should not be taken as making or supporting any particular estimates of botnet size and scope.

For information and guidance about defending computers and networks against botnet infection, see the Managing Risk section of the *Security Intelligence Report* website.

Most Active Botnet Families in 2Q10

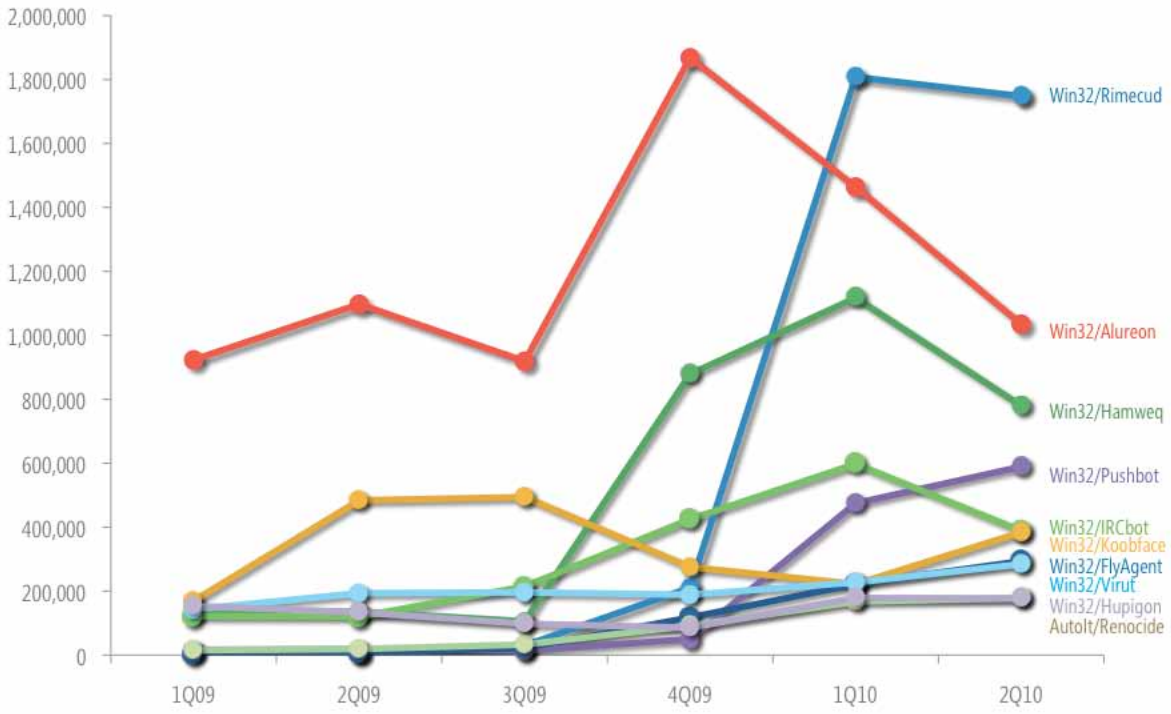
Microsoft anti-malware products and utilities include detection signatures for many individual bot families, and the number continues to grow as malware creators pursue efforts to evade detection and create more effective botnets.

Microsoft desktop anti-malware products removed bots from 6.5 million computers around the world in 2Q10. Figure 6 shows the top 25 bot families.

FIGURE 6. Top 25 bot families detected by Microsoft desktop anti-malware products worldwide, 1Q10–2Q10, by number of computers cleaned

Rank	Family	Primary Control Mechanism	Computers Cleaned (1Q10)	Computers Cleaned (2Q10)	Change
1	Win32/Rimecud	Other	1,807,773	1,748,260	-3.3% ▼
2	Win32/Alureon	HTTP	1,463,885	1,035,079	-29.3% ▼
3	Win32/Hamweq	IRC	1,117,380	779,731	-30.2% ▼
4	Win32/Pushbot	IRC	474,761	589,248	24.1% ▲
5	Win32/IRCbot	IRC	597,654	388,749	-35.0% ▼
6	Win32/Koobface	HTTP	222,041	383,633	72.8% ▲
7	Win32/FlyAgent	HTTP	221,613	293,432	32.4% ▲
8	Win32/Virut	IRC	227,272	284,519	25.2% ▲
9	AutoIt/Renocide	IRC	167,041	178,816	7.0% ▲
10	Win32/Hupigon	Other	178,706	177,280	-0.8% ▼
11	Win32/Sdbot	IRC	125,466	146,922	17.1% ▲
12	Win32/Nuwar	P2P	8,098	133,951	1554.1% ▲
13	Win32/Bubnix	HTTP	91,144	132,771	45.7% ▲
14	Win32/Zbot	HTTP	107,363	131,078	22.1% ▲
15	Win32/Ursap	IRC	121,239	121,302	0.1% ▲
16	Win32/Rbot	IRC	145,107	110,316	-24.0% ▼
17	Win32/Pasur	Other	95,040	91,612	-3.6% ▼
18	Win32/Rustock	HTTP	82,712	52,312	-36.8% ▼
19	Win32/Slenfbot	IRC	56,898	51,228	-10.0% ▼
20	Win32/Bagle	Other	48,326	34,240	-29.1% ▼
21	Win32/Tofsee	HTTP	29,367	32,031	9.1% ▲
22	Win32/Bifrose	Other	28,966	30,466	5.2% ▲
23	Win32/Waledac	P2P	83,580	29,816	-64.3% ▼
24	Win32/Prorat	Other	26,913	25,726	-4.4% ▼
25	Win32/Trenk	Other	24,093	21,749	-9.7% ▼

FIGURE 7. Top 10 bot families detected by Microsoft desktop anti-malware products worldwide in 2Q10, by quarter since 1Q09



Win32/Rimecud

Win32/Rimecud was the most commonly detected bot family in 2Q10, with 68.9 percent more detections than the next most common family. Detections for Rimecud were added to the MSRT in January 2010.

Rimecud is a "kit" family: different people working independently use a malware creation kit to create their own Rimecud botnets. (See "Botnets Today" on page 13 for more information about malware creation kits.) Rimecud is the primary malware family behind the so-called Mariposa botnet, which infected millions of computers around the world in 2009 and 2010. In July 2010, the Slovenian Criminal Police arrested a 23-year-old Slovenian citizen suspected of writing the malware code, following the February 2010 arrests of three suspected Mariposa botnet operators by the Spanish Guardia Civil.[13]

Rimecud is a backdoor worm that spreads via fixed and removable drives and by sending malicious hyperlinks to a victim's contacts via several popular instant messaging programs. Rimecud can be commanded to take a number of typical botnet actions, including spreading itself via removable drives, downloading and executing additional malware, and stealing passwords.

[13] (Federal Bureau of Investigation 2010)

Rimecud is somewhat unusual in that it uses its own UDP-based protocol and dynamically configurable port for command and control functions, rather than a standard IRC- or HTTP-based mechanism like most bots.

Win32/Rimecud uses a variety of obfuscators to hinder detection. These obfuscators typically use virtual environment detection and anti-emulation tricks to make the malware harder to detect.

As bots often install other malware as payloads, or are installed by other malware as payloads themselves, it is not uncommon for anti-malware utilities to detect multiple malware families on a single infected computer. Figure 8 lists the other threats that were most often detected on computers infected with Win32/Rimecud in 2Q10. For example, 36.9 percent of the computers that were infected with Rimecud were also infected with Win32/Autorun, a significant correlation. Like Rimecud itself, four out of the five families on the list are worms, which illustrates how vulnerabilities and unsafe practices can put a computer at risk of infection by multiple families that use similar infection vectors.

FIGURE 8. Other threats found on computers infected with Win32/Rimecud in 2Q10

Other Family	Most Significant Category	Percentage of Win32/Rimecud-Infected Computers
Win32/Autorun	Worms	36.9%
Win32/Conficker	Worms	23.2%
Win32/Taterf	Worms	15.6%
Win32/Sality	Worms	15.3%
Win32/VBInject	Miscellaneous Potentially Unwanted Software	10.1%

For more information about Win32/Rimecud, see the following posts at the MMPC blog (http://blogs.technet.com/mmpc):

- Rimecud and Hamweq—birds of a feather (January 12, 2010)
- Win32/Rimecud: MSRT's success story in January 2010 (January 19, 2010)
- In focus: Mariposa botnet (March 4, 2010)

Win32/Alureon

Win32/Alureon was the second most common bot family detected by Microsoft anti-malware products in 2Q10. Detections for Alureon were first added to the MSRT in March 2007.

Alureon is a large family of data-stealing trojans, some variants of which include bot components that use HTTP for command and control. Alureon variants typically perform such actions as stealing confidential information, downloading and executing arbitrary files, and redirecting URLs for popular search engines.

Some Alureon variants include a rootkit component, which has caused problems for some infected users when they apply security updates. In February 2010, a number of infected computers experienced repeated "blue screen" stop errors caused by the Alureon rootkit after Microsoft Security Bulletin MS10-015 was installed. The Microsoft Security Response Center (MSRC) subsequently addressed the issue with a revised version of the update that notifies Alureon-infected users of the problem and helps them resolve it.

For more information, see the following posts at the MMPC blog (http://blogs.technet.com/mmpc):

- MSRT April Threat Reports & Alureon (April 30, 2010)
- MSRT May Threat Reports and Alureon (May 21, 2010)

For more information about the MS10-015 issue, see the following post at the MSRC blog (http://blogs.technet.com/msrc):

- Update - Restart Issues After Installing MS10-015 and the Alureon Rootkit (February 17, 2010)

Win32/Hamweq

Win32/Hamweq was the third most common bot family detected by Microsoft anti-malware products in 2Q10. Detections for Hamweq were added to the MSRT in December 2009.

Hamweq shares some similarities with Win32/Rimecud, the most prevalent bot family in 2Q10, although Rimecud supports a more diverse and sophisticated set of commands than Hamweq. Both include IRC-controlled backdoors and spread via removable volumes, instant messaging, and P2P networks. Both families also inject code into the explorer.exe process and use the Recycle Bin as the target drop folder for copies of themselves.

Worms that spread via removable drives often spread with relative ease in enterprise environments because of the widespread use of such devices, and Hamweq is no exception. Variants of Hamweq have been observed to download other malware to infected computers, including Rimecud. Some Hamweq variants are also used to perform DDoS attacks.

FIGURE 9. How the Win32/Hamweq bot family works

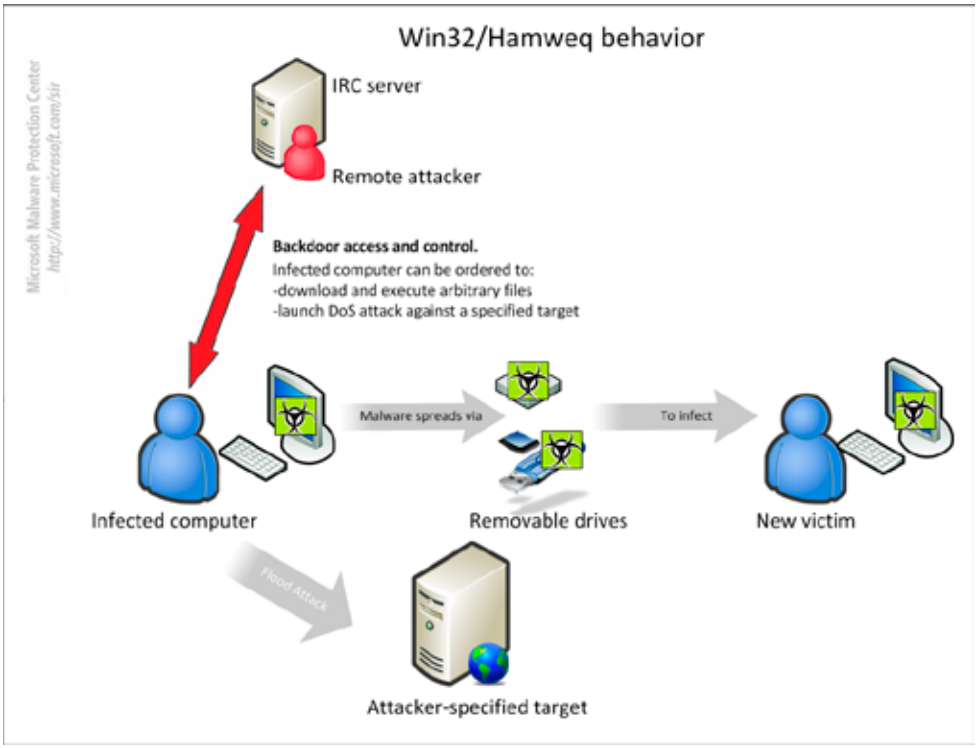


Figure 10 lists the other threats that were most often detected on computers infected with Win32/Hamweq in 2Q10.

FIGURE 10. Other threats found on computers infected with Win32/Hamweq in 2Q10

Other Family	Most Significant Category	Percentage of Win32/Hamweq-Infected Computers
Win32/Autorun	Worms	44.3%
Win32/Rimecud	Worms	34.1%
Win32/Conficker	Worms	28.2%
Win32/Taterf	Worms	23.0%
Win32/Sality	Worms	15.6%

For more information about Win32/Hamweq, see the following posts at the MMPC blog (http://blogs.technet.com/mmpc):

- MSRT slices the Hamweq for Christmas (December 8, 2009)
- Rimecud and Hamweq—birds of a feather (January 12, 2010)

Win32/Pushbot

Win32/Pushbot, the fourth most commonly detected bot family in 2Q10, is an IRC-controlled bot that spreads via removable volumes and popular instant messaging programs, as Win32/Rimecud and Win32/Hamweq do. Detections for Pushbot were added to the MSRT in February 2010.

Pushbot is a kit family, so Pushbot detections represent numerous small networks controlled by independent operators, rather than a single monolithic botnet. Pushbot variants are based on a kit called Reptile, which dates to 2005 and is itself based on the even older Win32/Sdbot family.

Because Pushbot bots are created and released by different people, the functionality can vary from one bot to the next, although they all share a number of basic features. Fundamentally they are all IRC bots, although each may be controlled through a different IRC server. Like Rimecud and Hamweq, some variants spread by copying themselves to the file sharing directories of popular P2P programs or use the Recycle Bin to spread to removable volumes. Some recent variants have the instant messaging feature disabled.

The core bot command set is fairly typical. A remote attacker can order a bot to spread via instant messaging, stop spreading, update itself, remove itself, and download and execute arbitrary files, among other possibilities. Some variants may also be able to perform one or more of the following additional activities:

- Spread via removable drives.
- Spread via P2P networking.
- Attempt to terminate other backdoors running on the system by searching the memory of other running processes for particular strings.
- Participate in DDoS attacks.
- Add extra instant messaging contacts.
- Send other messages to the user's contacts.
- Modify the Hosts file to redirect banking sites to a specified location.
- Retrieve data from Windows Protected Storage, which might include auto-complete data and stored passwords from Windows Internet Explorer®, Microsoft Outlook®, and Windows Live™ Messenger.
- Connect to websites without downloading files.
- Return various spreading and uptime statistics.

Figure 11 lists the other threats most often detected on computers that are infected with Win32/Pushbot.

FIGURE 11. Other threats found on computers infected with Win32/Pushbot in 2Q10

Other Family	Most Significant Category	Percentage of Win32/Pushbot-Infected Computers
Win32/Autorun	Worms	49.7%
Win32/Rimecud	Worms	36.5%
Win32/Conficker	Worms	31.9%
Win32/Taterf	Worms	24.2%
Win32/Renos	Trojan Downloaders & Droppers	22.4%

For more information, see the following post at the MMPC blog (http://blogs.technet.com/mmpc):

- MSRT February—When Push Comes to Shove (February 9, 2010)

Win32/IRCbot

Win32/IRCbot, the fifth most commonly detected bot family in 2Q10, is a large family of IRC-controlled backdoor trojans. Variants of this family, which has been detected for many years, exhibit a wide range of behaviors and use several different mechanisms to spread, but they all share the same basic IRC-based C&C design. Some IRCbot variants download and run other malicious software, including other bot families. Some variants are also designed to report system information from the victim's computer to the attacker. Detections for IRCbot were first added to the MSRT in December 2005.

Figure 12 lists the other threats most often detected on computers infected with Win32/IRCbot.

FIGURE 12. Other threats found on computers infected with Win32/IRCbot in 2Q10

Other Family	Most Significant Category	Percentage of Win32/IRCBot-Infected Computers
Win32/Oficla	Trojan Downloaders & Droppers	61.0%
Win32/Autorun	Worms	51.1%
Win32/Rimecud	Worms	39.7%
Win32/VBInject	Miscellaneous Potentially Unwanted Software	33.9%
Win32/Conficker	Worms	33.9%

Where's Conficker?

Win32/Conficker is a worm that infects computers across a network by spreading via removable hard drives, exploiting weak passwords on file shares, or exploiting a vulnerability in the Server service that was addressed by Microsoft Security Bulletin MS08-067. Infection can result in remote code execution when file sharing is enabled. The worm also disables important system services and some security products and may download arbitrary files. Conficker was the fifth most prevalent malware family in the first half of 2010. For domain-joined computers, Conficker has held the top spot for the past year.

If placed among bot families, Conficker would rank second to Win32/Rimecud. However, the coordinated efforts of the Conficker Working Group effectively limited or eliminated the Conficker bot-herders' ability to issue instructions to infected computers. (See "Case Study: Conficker Working Group" on page 29 of *Microsoft Security Intelligence Report, Volume 7 [January through June 2009]* for more information.) In this report, Win32/Conficker is not tabulated with the other bots and botnet malware so as to more accurately reflect botnets under active control by attackers.

Other Notable Families

Win32/Virut, the eighth most commonly detected bot family in 2Q10, is a family of file-infecting viruses that target and infect .exe, .scr, and (in some recent variants) .html files accessed on infected computers. Win32/Virut also opens a backdoor by connecting to an IRC server, allowing a remote attacker to download and run files on the infected computer. Most variants attempt to connect to IRC servers located at proxima.ircgalaxy.pl and ircd.zief.pl, which suggests that Virut is closely controlled by a single individual or group. Detections for Virut were first added to the MSRT in August 2007.

Win32/Rbot, the sixteenth most commonly detected bot family in 2Q10, is another large IRC family with variants that exhibit a wide range of behaviors. Like Win32/Pushbot, Win32/Rbot is a kit family—variants are typically built from an open source botnet creation kit called RxBot, which in turn is based on the older SDBot family. The RxBot kit is widely available among malware operators, and many different groups have produced their own versions with different functionality. Detections for Rbot were first added to the MSRT in April 2005.

Win32/Rustock, the nineteenth most commonly detected bot family in 2Q10, is a closely controlled family of rootkit-enabled backdoor trojans that were originally developed to help distribute spam. (See "Spam from Botnets" on page 40 for more information about spam sent by Rustock and other botnets.) First discovered sometime in early 2006, Rustock has evolved to become a prevalent and pervasive threat. Recent variants appear to be associated with the incidence of rogue security programs. Detections for Rustock were added to the MSRT in October 2008.

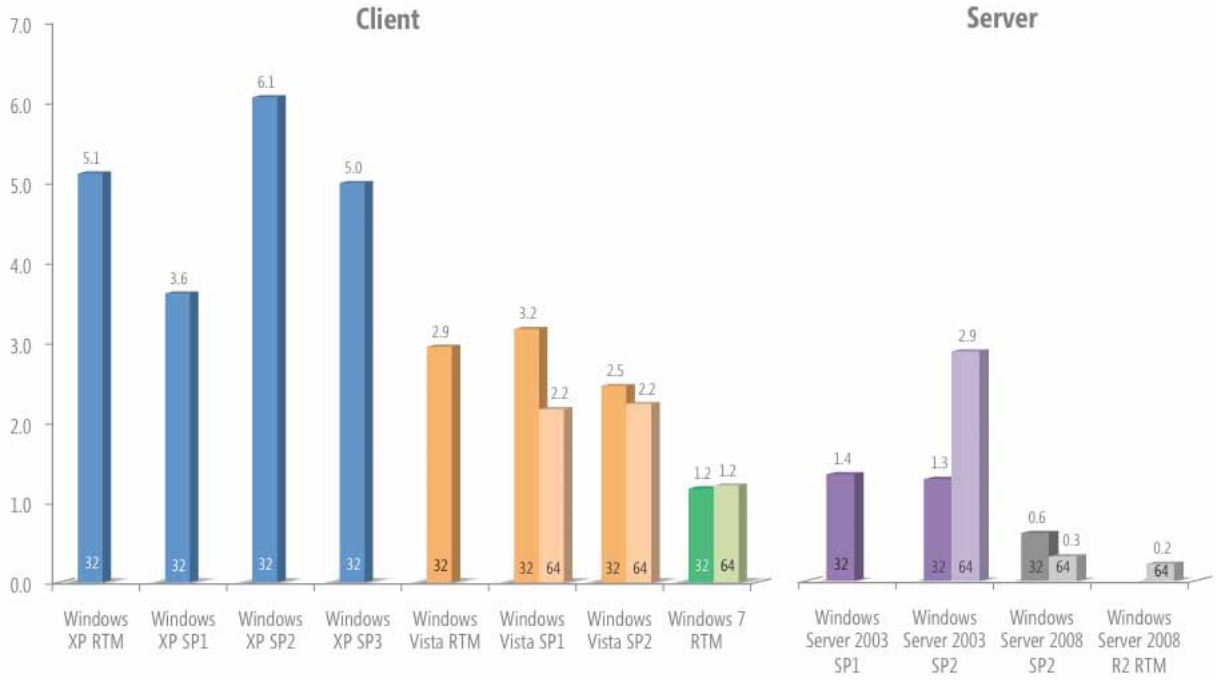
Win32/Waledac, the twenty-third most commonly detected bot family in 2Q10 is a closely controlled bot family that is best known for sending spam, but has also been observed to download other malware families, including Win32/FakeSpypro and Win32/Rugzip. It uses its own P2P network to distribute commands between infected computers. In February 2010, a U.S. federal court judge granted a Microsoft request[14] to cut off 276 Internet domains controlled by the Waledac attackers, thereby preventing them from issuing commands to the botnet. (See "Win32/Waledac and the Law: Fighting Botnets in Court," beginning on page 45, for more information.) Detections for Waledac were added to the MSRT in April 2009.

[14] (Microsoft Corporation v. John Does 1-27, et. al 2010)

Operating System Statistics

The features and updates available with different versions of the Windows operating system, along with the differences in the way people and organizations use each version, affect the infection rates seen with different versions and service packs. The following figure shows the average monthly botnet infection rate for each Windows operating system/service pack (SP) combination that accounted for at least 0.05 percent of total MSRT executions in 2Q10, expressed in *bot CCM*, or the number of computers from which bot-related malware was removed by the MSRT for every 1,000 MSRT executions. (See "Infection Rates" in the Reference Guide section of the *Security Intelligence Report* website for more information about the CCM metric and how bot CCM differs from the CCM figures used elsewhere in this report.)

FIGURE 13. Number of computers cleaned of bot-related malware for every 1,000 executions of the MSRT, 2Q10



("32" = 32-bit; "64" = 64-bit. Systems with at least 0.05 percent of total executions shown.)

The botnet infection rate for Windows 7 and Windows Vista® is significantly lower than that of their desktop predecessor Windows XP with any service pack installed, which reflects the security improvements that have been made to the more recent versions of Windows. Considering only computers that have had the most recent service pack for their operating systems installed, the infection rate for Windows XP SP3 is twice as high as that of Windows Vista SP2 and more than four times as high as that of the release-to-manufacturing (RTM) version of Windows 7.

Infection rates for Windows XP RTM and SP1 are lower than those of more recent versions of Windows XP. MSRT installations on the older versions, which are no longer supported by Microsoft, have decreased significantly over the past several quarters as computers have been decommissioned or upgraded. As IT departments and computer users move to more recent service packs or Windows versions, computers running older operating system versions are often relegated to non-production roles or other specialized environments, which may explain the lower infection rates.

Infection rates for Windows Server® are generally lower than those of the client versions of Windows. Servers tend to have a smaller attack surface than computers that run client operating systems because they are more likely to be used under controlled conditions by trained administrators and to be protected by one or more layers of security. Server versions are hardened against attack in a number of ways, which reflects this difference in usage. For example, Internet Explorer Enhanced Security Configuration is enabled by default, and the Roles Wizard automatically disables features that are not needed for the configured server role.

Geographic Statistics

The telemetry data generated by Microsoft security products includes information about the location of the computer, as determined by the setting of the **Location** tab or menu in **Regional and Language Options** in the Control Panel. (See "Geographic Statistics" in the Reference Guide section of the *Security Intelligence Report* for more information.) This data makes it possible to compare infection rates, patterns, and trends in different locations around the world.

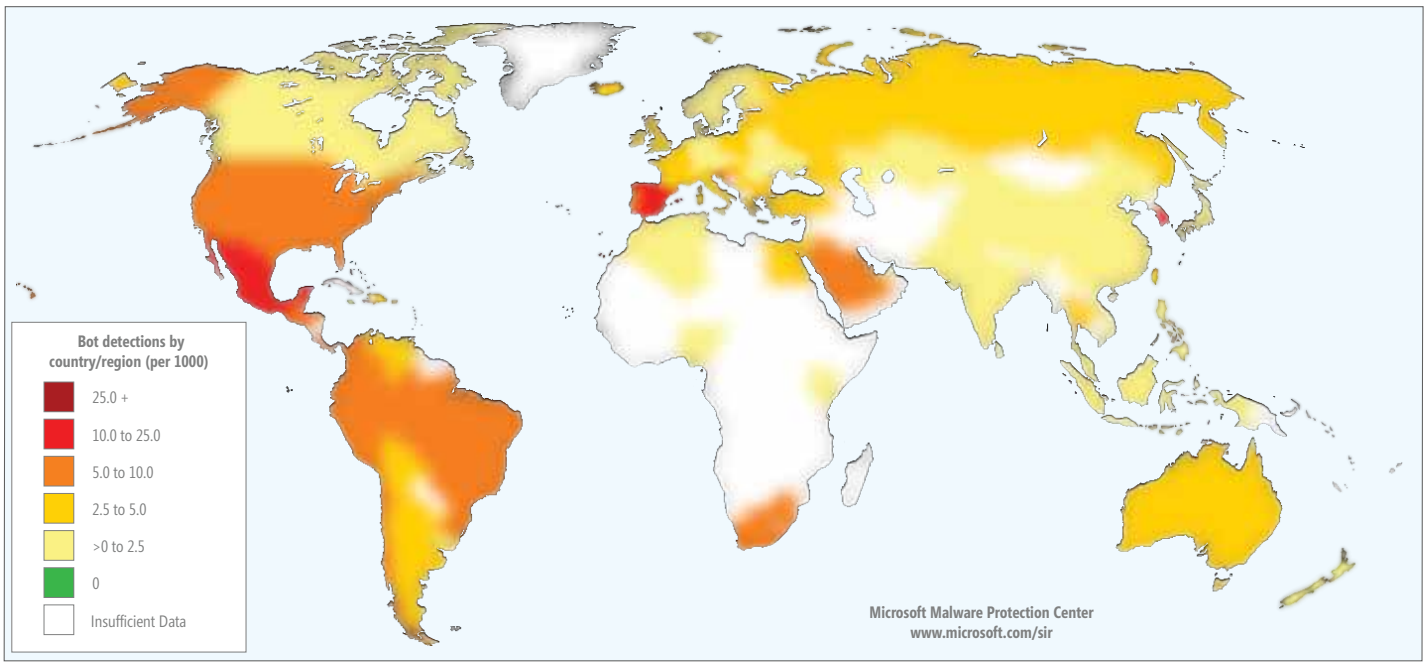
The following table shows the top 25 countries and regions around the world with the most bot infections detected and removed in 2Q10.

FIGURE 14. The 25 locations with the most bot cleanings in 2Q10

Rank	Country/Region	Computers with Bot Cleanings (1Q10)	Computers with Bot Cleanings (2Q10)	Bot Cleanings Per 1,000 MSRT Executions (Bot CCM)
1	United States	2,163,216	2,148,169	5.2
2	Brazil	511,002	550,426	5.2
3	Spain	485,603	381,948	12.4
4	Korea	422,663	354,906	14.6
5	Mexico	364,554	331,434	11.4
6	France	344,743	271,478	4.0
7	United Kingdom	251,406	243,817	2.7
8	China	227,470	230,037	1.0
9	Russia	181,341	199,229	4.3
10	Germany	200,016	156,975	1.4
11	Italy	191,588	130,888	2.6
12	Turkey	91,262	98,411	4.7
13	Canada	96,834	87,379	1.4
14	Netherlands	115,349	77,466	2.5
15	Colombia	76,610	71,493	5.8
16	Portugal	83,379	68,903	5.7
17	Australia	72,903	66,576	2.8
18	Poland	87,926	62,704	3.9
19	Taiwan	52,915	54,347	3.4
20	Japan	63,202	52,827	0.6
21	Argentina	38,229	43,162	3.8
22	Saudi Arabia	33,283	40,793	5.5
23	Belgium	51,689	39,508	3.4
24	Chile	37,705	39,245	5.1
25	India	37,895	38,954	1.0

Unsurprisingly, the list is dominated by populous locations with large numbers of computer users, led by the United States and Brazil. When these differences are accounted for by calculating the number of infections found per 1,000 instances of MSRT being run, Korea, Spain, and Mexico have the highest infection rates among the locations on this list, as shown in Figure 15.

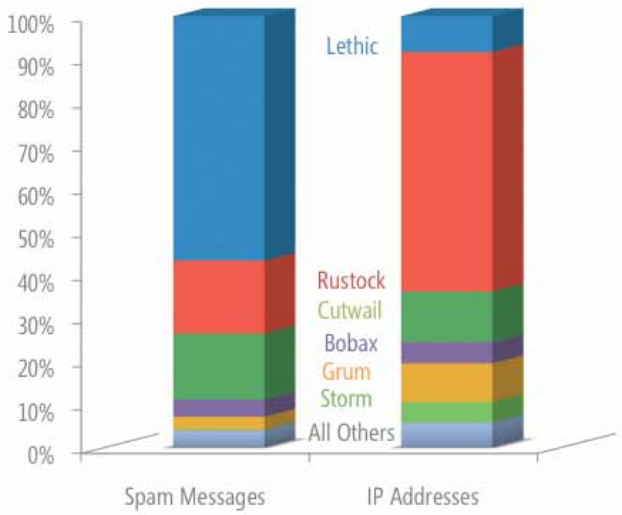
FIGURE 15. Bot infection rates by country/region in 2Q10



Spam from Botnets

Microsoft Forefront® Online Protection for Exchange (FOPE) provides spam, phishing, and malware filtering services for thousands of enterprise customers. To measure the impact that botnets have on the spam landscape, FOPE monitors spam messages sent from IP addresses that have been reported to be associated with known botnets.

FIGURE 16. Botnets sending the most spam from March to June 2010, by percentage of all botnet spam messages and percentage of all botnet IP addresses sending spam



The names used to track botnets usually coincide with the names assigned to the dominant malware families associated with each one, but not always. Some botnets are associated with more than one threat family because of development activity on the part of malware creators and to the existence of generic detections. For example, some Win32/Lethic variants are detected as VirTool:Win32/CeeInject.gen!AS.

The Lethic botnet sent 56.7 percent of the botnet spam received between March and June 2010 from just 8.3 percent of known botnet IP addresses. Lethic is a closely controlled botnet that uses a custom binary protocol for C&C. A takedown of the Lethic C&C servers in January 2010 disrupted the attackers' ability to send spam,[15] although they subsequently regained control of the botnet, as Figure 16 illustrates.

The Rustock botnet controlled 55.6 percent of known botnet IP addresses, but sent only 16.9 percent of the spam. (See "Other Notable Families" on page 36 for more information about Win32/Rustock.)

The Cutwail botnet was responsible for 15.4 percent of spam sent from 11.8 percent of known botnet IP addresses. Win32/Cutwail is a multipurpose threat family that employs a rootkit and other defensive techniques to avoid detection and removal.

[15] (M86 Security Labs 2010)

Fighting Back Against Botnets

Detecting Botnets

Methods for detecting bots can generally be divided into two categories— those that involve *static analysis*, or checking computers' characteristics against a list of known threats, and those that involve *behavioral analysis*, or monitoring communications in a network for behaviors that are known to be exhibited by botnets. Static analysis results in more reliable judgments but requires threat signatures that are current and available. Behavioral analysis potentially allows for much broader detection methods (especially by aggregating information from multiple sources) but is more likely to result in false positives. Effective botnet detection strategies generally involve aspects of both static analysis and behavioral analysis.

Static Analysis

Static analysis methods involve checking items against a known list of malicious or dangerous items, such as executable binaries, URLs, and IP addresses. If the list is accurate and up to date, this process can be a very fast and relatively risk-free way to identify bad items. In practice, however, static analysis alone is not an effective way to keep a network free of botnets, because of the continuing efforts of malware authors to generate fully undetected threats. Malware authors use a variety of techniques to avoid detection by antivirus tools and security researchers. These techniques include the following:

- Polymorphism, which involves the creation of multiple unique but functionally identical malware files. (See "Defending the Botnet" on page 25 for more information.)
- URL obfuscation methods, such as using escape sequences and converting an IP address to its decimal representation.
- Changing IP addresses rapidly and using large numbers of alternate URLs that connect to the same resource (or copies of the same resource).
- Serving different downloads or webpages depending on factors like the time of day or the origin of the request (for example, serving clean webpages to requests coming from security software vendors).

Behavioral Analysis

Behavioral analysis can be a powerful tool for identifying botnets, but processing time, the need for an appropriate environment in which to observe the computer's behavior, and the danger of false positives can make diagnosis difficult. The process is further complicated by the tendency of some malware to refuse to run if it detects that it is being executed in a virtual or isolated environment, or a debugger.

It was once common to see bots that would attempt connections to each port on a target computer in sequence (a *port scan*). This technique allowed the target to recognize an attacker quite easily. Now it appears that most bots use targeted attacks in their efforts to spread. They examine only a small number of ports, which are generally those that are in use by some other service and therefore open to connections.

Researchers from Microsoft and elsewhere have observed that the external behavior of bots tends to have a number of distinctive characteristics:

- Bot activities are often, although not always, closely coordinated with DDoS attacks and time-sensitive spam and phishing attacks, as evidenced by a sharp correlation in the timing of their network activities. For example, the controller instructs all bots to start sending their pump-and-dump spam payload at the same time. For individual bots, network activity tends to be almost silent for much of the time, and then they have a very high number of connections in a short period of time.
- The intervals between a bot's acquisition of new targets (distinct destination IP addresses) are generally much shorter than the intervals between an uninfected computer's communication with other distinct IP addresses. In other words, bots talk to more distinct IP addresses in a shorter period of time than uninfected computers do.[16] In addition, bots tend to evenly distribute their attentions among their targets—they make about the same number of connections to each of a large number of destination IP addresses.
- Bots often have a higher number of failed connections than uninfected computers do.[17]
- Bots that are controlled via IRC often exhibit a significant amount of IRC traffic. IRC is a well-known protocol that is used legitimately in many contexts, including games and technical support web applications, but it is still relatively rare and many computers and even whole networks have no legitimate reason to use it at all.
- Bots are much more likely than uninfected computers to send large volumes of email from locally installed Simple Mail Transfer Protocol (SMTP) servers. Most home and enterprise users connect to email servers that are operated by their ISPs or IT departments and have no need to install SMTP servers on their desktop or laptop computers.
- Some bots use the User Datagram Protocol (UDP) exclusively, which is somewhat unusual for Internet communication.
- HTTP bots often communicate using the IP addresses of web servers rather than server names, which is less common for legitimate traffic. HTTP traffic between bots and C&C servers can include suspicious URI strings or nonstandard HTTP headers (such as the "Entity-Info:" and "Magic-Number:" headers used by Win32/Bredolab C&C servers to transmit data).

However, it is certainly possible for legitimate computer users and programs to exhibit many of the behaviors listed here. In particular, online games often use IRC and UDP extensively and have built-in SMTP servers.[18]

[16] (Jung 2006)
[17] (Ibid)
[18] (Karasaridis, Rexroad, and Hoeflin 2007)

Honeypots

A *honeypot* is a computer that is configured by security analysts to act as a deliberate target for malware infection. The intent is to collect malware infections so that their behavior can be analyzed in detail, and in some cases to collect logs of the bots' activities. The Honeynet Project (http://honeynet.org), one of the best known sources of honeypot data, provides information, tools, and techniques for setting up honeypots and analyzing the data they provide.

Darknets

A *darknet* is a subnet of unused IP addresses that are monitored for incoming traffic. The intent is to detect malware as it scans a subnet while crossing over the darknet. Data can also be used to identify network configuration issues. Darknets can be used to host flow collectors, DDoS backscatter detectors, and intrusion detection systems as well as to redirect traffic to honeypots.

Win32/Waledac and the Law: Fighting Botnets in Court

Microsoft Digital Crimes Unit (DCU)

Digital criminals use a variety of sophisticated tools and techniques to attack unsuspecting computer users. Often these attacks leverage social engineering techniques that trick users into installing botnet malware that is designed to conscript computers into a botnet army, such as the Win32/Waledac family of malware.

Botnet armies consist of thousands, if not millions, of computers that are called upon to execute a wide range of illegal activities on behalf of those who control them. Such large scale botnets have begun to threaten the very fabric of the Internet. Given this threat, for the past two years the Microsoft Digital Crimes Unit (DCU) has been examining how botnets leverage the Internet's Domain Name System (DNS) infrastructure and how they have evolved into criminal infrastructures used to abuse all that use the Internet.

A New Approach

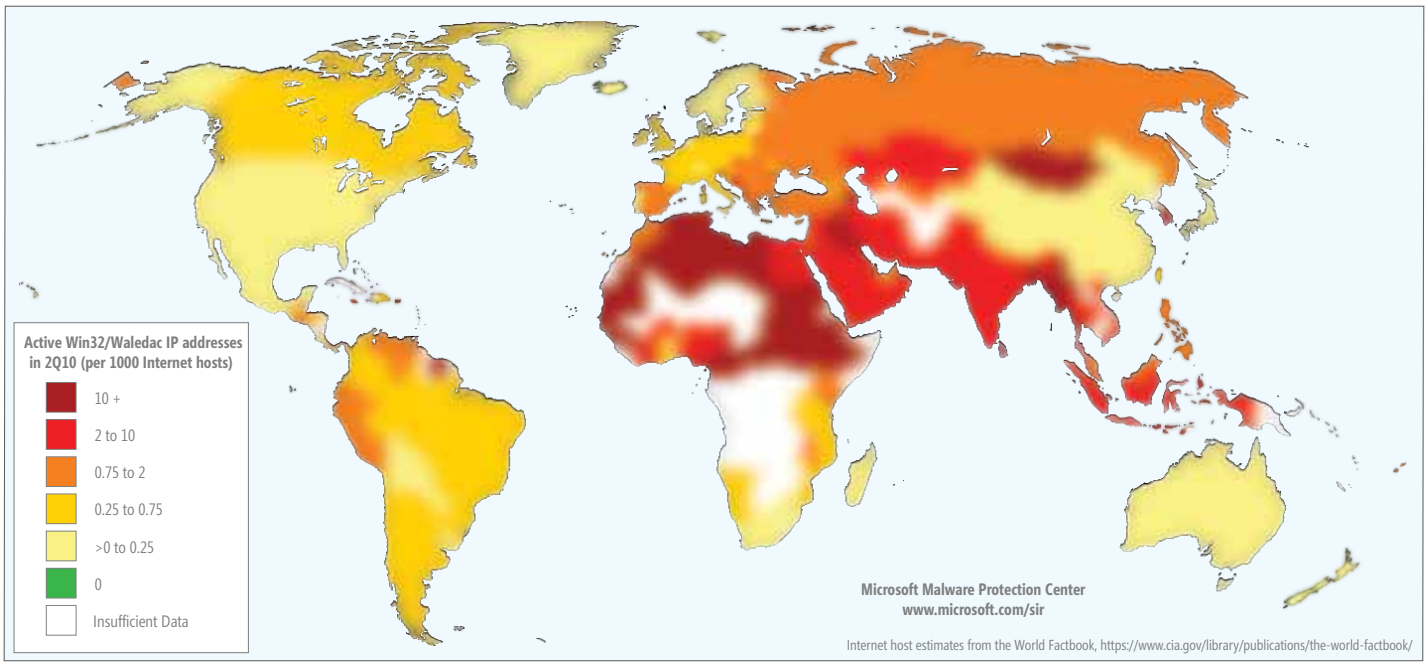
At the Digital Crimes Consortium (DCC) meeting held in Redmond, Washington, in October 2009, the DCU called for industry, law enforcement agencies, government entities, and academics to become more proactive in protecting customers and citizens. Within Microsoft, DCU partnered with Trustworthy Computing (TWC) and sought to develop a new program that would begin to reshape the way Microsoft approached large scale systemic threats that affect users on the Internet. The Microsoft Active Response Strategy (MARS) was created to examine new ways of tackling such threats.

MARS builds on the "Protect Your PC" messaging while adding proactive real world disruptive action and incorporating new ways of working with ISPs, governments, law enforcement, CERTS, and academics to help customers and citizens ensure their computers are clean and secure.

Why Waledac, Why Now?

Waledac was selected because of its technical complexity. The malware utilized a robust communication mechanism, with both a peer-to-peer (P2P) and hypertext transport protocol (HTTP) command and control infrastructure that is able to control thousands of infected computers around the world. A unique feature of this communication mechanism was the way its structure was divided into tiers, with each tier serving to abstract it from all the others. The complexity of Waledac's communication mechanism made it a favorite of numerous researchers within the security community, many of whom had been examining Waledac for a number of years and publishing their findings in various technical and academic journals. Consequently, Microsoft began its analysis by first conducting a detailed examination of the research already conducted by researchers at Trend Micro, iDefense, the Microsoft Malware Protection Center (MMPC), and a host of other organizations.

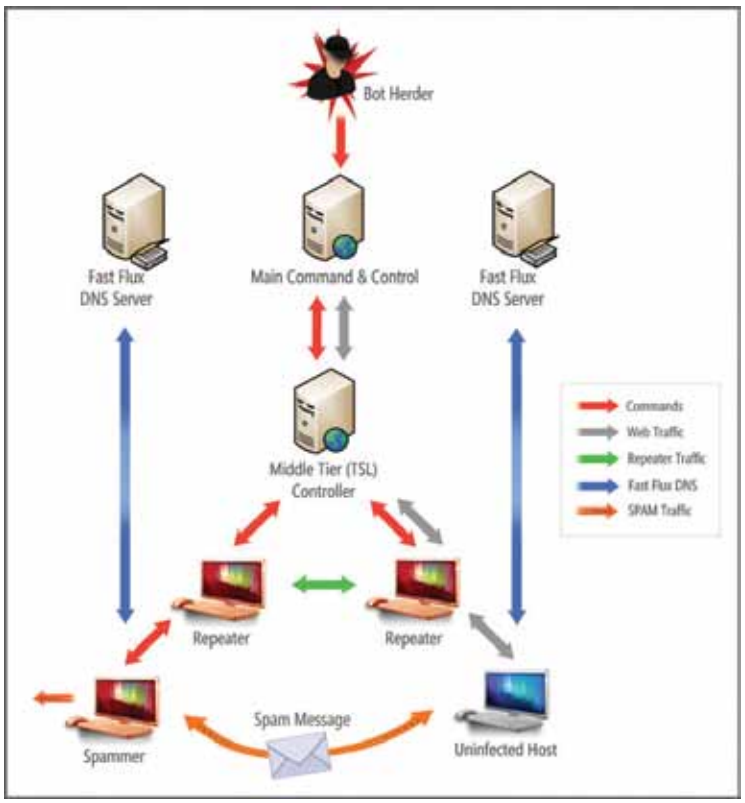
FIGURE 17. Active IP addresses in the Win32/Waledac botnet in 2Q10, per 1,000 Internet hosts



Technical Action Plan

Working with resources from the University of Washington, the Shadowserver Foundation, the Technical Universities of Vienna and Bonn, and the MMPC, Microsoft began to outline a plan of action. Ultimately a plan was developed by Microsoft, the Technical University of Vienna, and iDefense for the technical disruption of the Waledac botnet. The plan called for a three-pronged approach: 1) disruption of the peer-to-peer command and control mechanism; 2) disruption of the DNS/HTTP command and control mechanism; and 3) disruption of the top two tiers of command and control. The timing of the operations had to be coordinated to avoid detection and so that the team could maximize the effect of the countermeasures by leveraging the element of surprise.

FIGURE 18. The Win32/Waledac tier infrastructure



Waledac was a relatively robust and decentralized botnet, which made it difficult to attack. The preceding figure illustrates the overall design of the Waledac botnet infrastructure. To take down such a threat it was important to understand its operation.

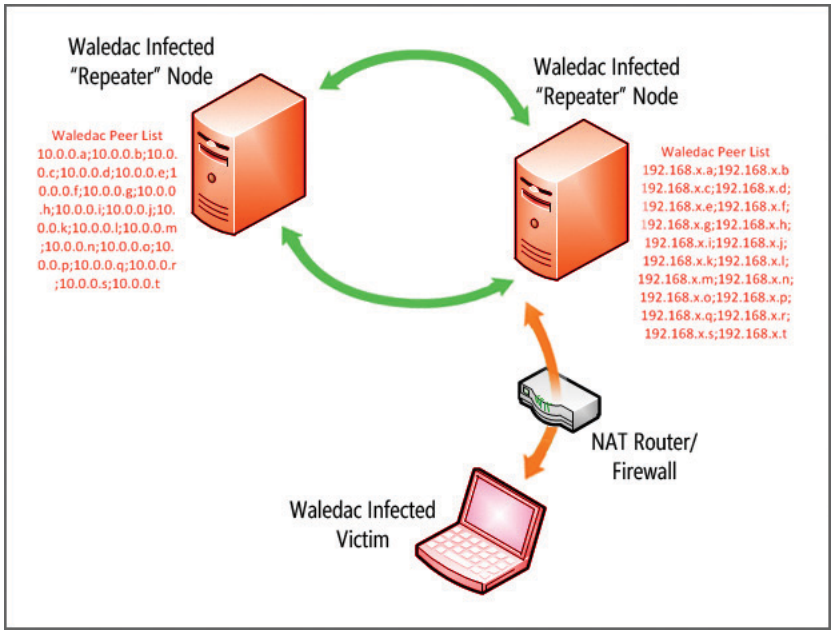
A central aspect of the innovative command and control mechanism is the bot classification routine during infection. When a computer becomes infected with the Waledac malware it is classified as either a spammer node or repeater node. If the infected computer is using an RFC 1918 address, it is assumed to be behind a network address translation (NAT) device and is automatically relegated to a spammer node status. The assumption is that the newly infected computer will not be accessible via TCP port 80, the protocol and port that Waledac uses for command and control. If the infected computer is

configured with a publicly routable IP address, it is then tested to see if it is accessible via TCP port 80. If the computer passes both tests, it becomes part of the repeater node tier and is added to the fast flux DNS infrastructure.

Repeater nodes make up the bulk of the computers in the peer-to-peer infrastructure. The job of the repeater nodes is twofold:

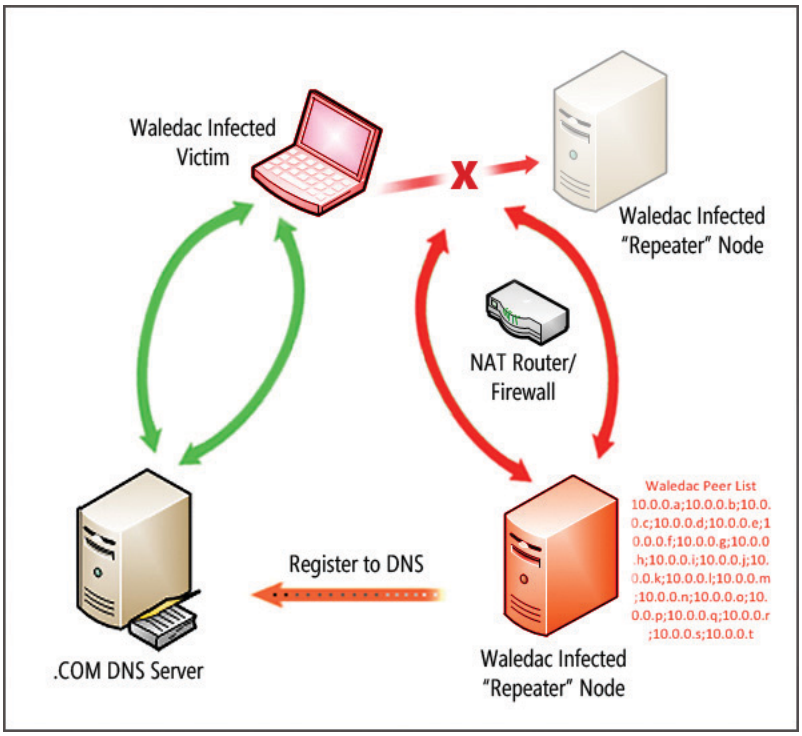
1. Repeater nodes are responsible for maintaining valid peering lists. Because the repeater level of the botnet was large (several thousand at any given time), it was not practical for each repeater to maintain a list of all repeater nodes. Therefore, each repeater node would only maintain a list of approximately 100 other repeater nodes known to it at any given time. This list would be traded or exchanged with other repeater nodes, as well as with spammer nodes, that make contact with the repeater.

FIGURE 19. Win32/Waledac peering list exchange between infected spammer node and repeater node



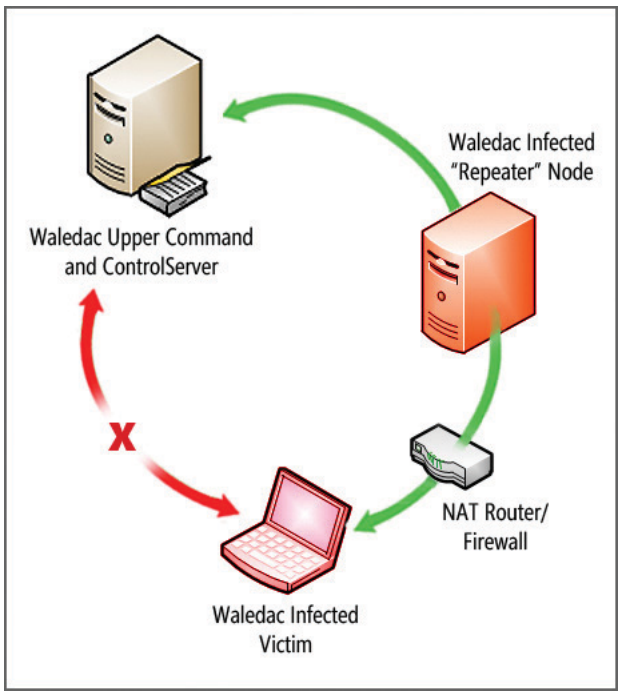
Each repeater node plays a role in the fast flux DNS infrastructure. When a repeater node has been online for a certain amount of time, it is registered in DNS as an authoritative name server for the registered domains and is used for command and control of the Waledac botnet. If a Waledac-infected computer is not able to connect to a repeater node through its seeded repeater list, it will call out to any number of domain names (usually less than 10) as a backup mechanism for bootstrapping into the botnet. These domain names are constantly being updated by the botnet with newly added repeater node computers. This update process serves as a failover mechanism if the seed list becomes stale.

FIGURE 20. Win32/Waledac peering list exchange using fast flux DNS



2. Each repeater node serves as a proxy to the upper tier command and control servers as a way of obfuscating these upper, more traditional command and control mechanisms. The upper tiers of the Waledac botnet are comprised of servers configured by the bot herder and are not Waledac-infected computers. Because these computers are significantly more static, the repeater nodes offer a mechanism to prevent direct access to these upper tiers. In addition, the upper tiers are only accessible through the repeater node proxy functionality, which provides a kind of firewall effect.

FIGURE 21. Win32/Waledac proxy function through the repeater tier

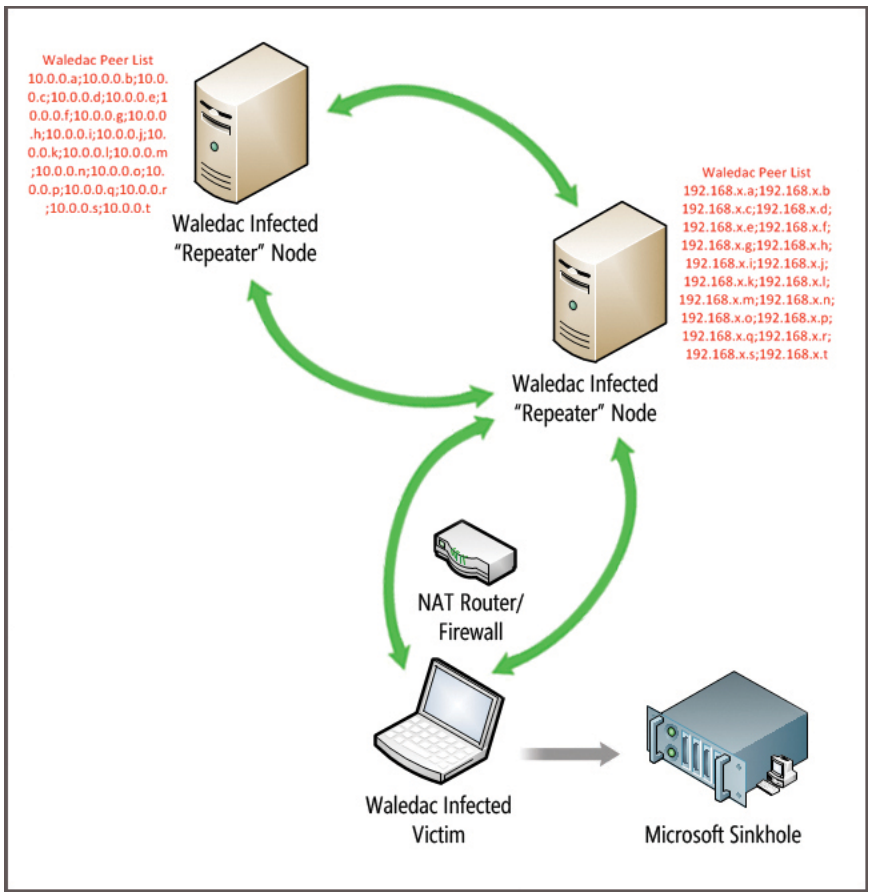


Tackling P2P

Disrupting the P2P network used by Waledac for command and control was the first component in the technical plan. The "repeater" tier of the Waledac botnet was comprised of infected computers that had public IP addresses and were reachable on TCP port 80. When a computer became infected with the Waledac botnet malware it would reach out to any number of preconfigured IP addresses compiled in the malicious binary. After a connection was established to the repeater node, the infected victim would download an updated list of active repeater nodes.

In later versions of the Waledac malware, the P2P bootstrap mechanism was less than reliable; it was not uncommon for an infected honeypot to work through 20 or so IP addresses before reaching a node that was an active repeater, often using the DNS fallback mechanism. Security researcher partners were able to develop a custom repeater that would provide the ability to "poison" the peering tables of all computers that connected to the custom repeater. The thought was not to get a list of available Waledac repeaters but for the security team to poison the network with its own repeater nodes as well as the sinkhole devices they deployed. This part of the operation needed to happen first so that the security team could infiltrate the P2P network and thereby limit the ability of the bad actor(s) from being able to inject themselves back into the command and control infrastructure. However, this approach alone wasn't sufficient. Because of Waledac's heavy reliance on DNS as a backup mechanism for bootstrapping infected computers into the botnet, the domain names had to be dealt with in close coordination with the P2P countermeasures.

FIGURE 22. Poisoning the Win32/Waledac botnet with Microsoft sinkhole IP addresses



After the P2P poisoning was underway, the DNS issue had to be addressed. Although the DNS mechanism that was used to control the Waledac botnet was a very complex mechanism, attorneys at the Microsoft DCU developed a new approach to deal with the command and control mechanism.

The Legal Action Plan

Informal efforts to take down the domains that supported the Waledac botnet posed serious limitations. Cease and desist letters would not force immediate action. Similarly, domain takedown is inexact and somewhat limited under typical ICANN procedures. For example, ICANN's Uniform Domain-Name Dispute-Resolution Policy (UDRP) provides a relatively long window in which bad actors would be able to register new domains, update the botnet code, or take other evasive actions to move the botnet while the ICANN process unfolded.

One effective alternative to such informal efforts was to apply in federal court for a temporary restraining order (TRO) to shut down the malicious domains at the registry level. An *ex parte* TRO is an extraordinary remedy that allows a party to temporarily restrain (between 14 to 28 days) a bad actor's harmful conduct ***without notice*** to the bad actor and ***without giving them an opportunity to be heard***. In particular, federal courts may temporarily restrain a bad actor's conduct without notice in situations where notice would give the bad actor an opportunity to destroy evidence, relocate the instrumentalities of the harmful conduct, or avoid prosecution. A court can issue an *ex parte* TRO to shut down malicious domains with limited delay (within 48 hours of the application for relief). And because bad actors will not receive notice, they are deprived an opportunity to register new domains or take other actions to redirect the botnet.

Federal courts, however, are reluctant to issue *ex parte* TROs because of concerns about their inherent inconsistency with constitutional due process. Microsoft was able to twice obtain *ex parte* relief by providing the court with strong evidence of the merits at the outset of the case and a definitive strategy for effecting legal notice to the bad actors immediately after the domains had been shut down, thereby preserving their due process rights.

Legal basis for *ex parte* relief: Under Rule 65 of the Federal Rules of Civil Procedure, a party can apply for a TRO and preliminary injunction to temporarily stop the harm caused by a bad actor's wrongful conduct. Rule 65 allows a party to proceed without notice if it can show (1) that it will suffer immediate and irreparable harm if the relief is not granted, and (2) the party attempts to provide the other side with notice. Rule 65 typically requires that the moving party attempt to provide the adverse party with notice and, if unsuccessful, explain why it was unable to provide notice. Therefore, Rule 65 is by itself insufficient to overcome the obstacles posed by informal efforts to shut down malicious domains.

However, courts have recognized in some circumstances that providing notice to a bad actor would give them an opportunity to avoid prosecution and continue their wrongful conduct. In those circumstances, courts have issued *ex parte* TROs—***even where a moving party has not attempted notice—***where notice to the bad actor in those circumstances would render fruitless further prosecution of the action. This principle was applied more than 30 years ago in the context of clothing counterfeiters. A federal appellate court concluded that an *ex parte* TRO to seize counterfeit contraband was necessary, because it was apparent from prior experience that notifying one member of the counterfeiting enterprise would allow the bad actors an opportunity to transfer the contraband to other unknown counterfeiters and thereby avoid prosecution. See *In re Louis Vuitton Et Fils S.A.,* 606 F.2d 1 (2d Cir. 1979). Courts have since applied this reasoning to issue *ex parte* TROs for computer-related activity. In 2009, a federal court in California issued an *ex parte* TRO to suspend Internet connectivity of a company that enabled botnet activity on the basis that "Defendant is likely to relocate the harmful and malicious code it hosts and/or warn its criminal clientele of this action if informed of the [plaintiff's] action." See *FTC v. Pricewert LLC et al.,* Case No. 09-2407 (N.D. Cal., Whyte J., June 2, 2009). As such, an order can provide a viable alternative to informal domain takedown processes.

With substantial factual support from its investigation of the Waledac botnet, Microsoft provided a compelling argument that the botnet's fundamental characteristic—namely, the propensity of the botnet controllers to move and conceal the botnet and the ease by which they could do so—warranted the issuance of an *ex parte* TRO.

Obtaining *Ex Parte relief*: Even if the facts warrant *ex parte* relief, a court may still refuse to grant such an order if it is not convinced that the bad actor's due process rights will be preserved. Microsoft obtained *ex parte* relief in this case by, among other things, offering the court a definitive and robust strategy for serving the domain registrants with all papers in the case. Microsoft outlined the steps it would undertake to serve the bad actors under the Federal Rules of Civil Procedure as well as proposed alternative methods for service. In addition, Microsoft explained how its proposed methods of service were reasonably calculated to provide the domain registrants with notice and satisfied due process.

The Microsoft approach in this matter consisted of the following steps:

1. **Filing of the John Doe Lawsuit to Protect Innocent Domain Registrants:** To obtain an *ex parte* TRO, a preliminary injunction, or any other relief, a party must first initiate litigation against the bad actors. The most immediately obvious candidates to be named as defendants were the registrants of the malicious Waledac domains. However, this information raised an obstacle in that there was a possibility that the domains themselves had been hijacked. Therefore, to protect potentially innocent domain registrants, Microsoft filed a John Doe lawsuit that did not name the domain registrants as defendants, but rather named 27 John Does, with each "doing business as" a particular domain registrant. In this way, Microsoft provided the court with an identifiable target for legal service and notice while protecting the registrants' due process rights.
2. **Articulating a Definitive Strategy to Effect Legal Service:** Notwithstanding the concern about innocent domain registrants, a review of the domain registrant information revealed a likelihood that much of the information was false. Most of the domains were registered through registrars in China. Microsoft worked with its attorneys in China to research and confirm the validity of this information, to the extent possible.

The falsified registrant information posed a fundamental question regarding how to quickly and effectively identify, locate, and notify the botnet operators of the lawsuit immediately after the domain takedown was ordered by the court. Anticipating this issue, in its application for an *ex parte* TRO Microsoft articulated a definitive strategy to effect service on the domain registrants that satisfied the Federal Rules of Civil Procedure, and the U.S. Constitution, and was consistent with the laws of China. Under these rules, a plaintiff can serve a non-U.S. defendant pursuant to delivery through official means set forth in various treaties and also by certain alternative means calculated to give notice, as long as not prohibited by treaty.

As part of its strategy, Microsoft proposed serving the international domain registrants through (1) the Hague Convention on Service Abroad by sending the complaint, summons, and all other documents to the Chinese Ministry of Justice; (2) alternative methods,

including service and notice by email, facsimile, and by mail; and (3) publication of all relevant pleadings on a website Microsoft set up solely to provide the domain registrants with notice (www.noticeofpleadings.com). When the court ultimately issued its *ex parte* TRO, it concluded that these methods satisfied due process requirements. In part, this conclusion was made because the registrants had agreed in their registrar-registrant agreements to receive notices through their contact information and because publication is a well-established alternative means of providing notice.

FIGURE 23. Notice posted at www.noticeofpleadings.com

Date of First Publication: February 24, 2010

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
Alexandria Division

MICROSOFT CORPORATION,
a Washington corporation,

Plaintiff,

vs.

JOHN DOES 1-27, CONTROLLING A COMPUTER BOTNET THEREBY INJURING MICROSOFT AND ITS CUSTOMERS,

Defendants.

CIVIL ACTION NO. 1:10 CV 156 (LMB/JFA)

NOTICE AND SERVICE IN ENGLISH

Plaintiff Microsoft has sued defendants John Does 1-27 associated with the Internet domains listed below. Microsoft alleges that Defendants have violated Federal and state law by operating a computer botnet through 276 internet domains, causing unlawful intrusion and dissemination of unsolicited bulk email to the injury of Microsoft. Microsoft seeks a preliminary injunction directing Verisign to take all steps necessary to lock these domains at the registry level and remove them from the zone file to ensure that changes to the domains cannot be made absent a court order and that all such domains be held in escrow by Verisign pending resolution of the dispute. Microsoft seeks a permanent injunction and damages. Full copies of the pleading documents are available at http://www.noticeofpleadings.com.

NOTICE TO DEFENDANT: READ THESE PAPERS

NOTICE AND SERVICE IN CHINESE

原告微软已经对27位每以下列出的因特网域名有关的身份不明的被告1至27（被告John Doe 1-27）提起诉讼。微软指控该等被告通过276个因特网域名操作计算机僵尸网络、导致非法入侵和散布未经请求的的大量邮件而给微软造成伤害，其行为已违反联邦和州法律。微软寻求初步禁令：命令威瑞信（Verisign）采取所有必需的步骤在注册管理机构级别锁定这些域名以确保在没有法院命令的情况下不得对这些域名做出变更，并且在该争议未解决之前，所有这些域名都由威瑞信进行提存监管。微软寻求永久禁令和损害赔偿。诉讼文件的完全副本可从http://www.noticeofpleadings.com获取。

致被告的通知：请仔细阅读这些文件！你必须在本案中□正式出面□，否则另一方将自动胜诉。要□正式出面□，你必须向法院提交称为□动议□或者□答辩□的法律文件。□动议□或者□答辩□必须自在此指定的首次公告日之日起21天内被提交给法庭秘书或者行政管理人员。该□动议□或者□答辩□必须以合适的形式并且有证据证明已送达原告律师Preston Burton，贵睿律师事务所，华盛顿特区第15西北大街1152号哥伦比亚中心

1. **Understanding the venue:** Microsoft knew it would file in the United States District Court for the Eastern District of Virginia. Therefore, it researched the closest possible scenarios under that court's prior decisions and paid careful attention to the concerns expressed in the court's decisions. Understanding the venue allowed Microsoft to craft its arguments in a manner that anticipated questions and obstacles that the court might raise. This approach was especially important, given the absence of the defendants to raise such issues.
2. **Developing credibility with the court:** Microsoft worked very hard to develop and maintain credibility with the court by ensuring that its arguments were supported by substantial evidence and law and also by offering timely submissions, avoiding undue delay, and ensuring that it worked with counsel who was familiar with the court's practices.

3. **Taking down the botnet, effecting legal service, and preparing for the preliminary injunction hearing:** A TRO usually expires 14 days after it is issued. In the Waledac takedown, the court issued the *ex parte* TRO and an Order to Show Cause why it should not issue a preliminary injunction. A preliminary injunction enjoins the wrongful conduct until the case has been concluded. After the court granted the *ex parte* TRO, Microsoft had 14 days to (1) shut off the infected domains, (2) serve the domain registrants, and (3) prepare for the preliminary injunction hearing.

   The Microsoft planning and coordination efforts facilitated an immediate shutdown of the infected domains within 48 hours of receiving the court's temporary order. By having a definitive strategy in place to effect legal service abroad, Microsoft was able to begin serving the domain registrants also within 24 hours of shutting down the infected domains. Microsoft worked with its attorneys in China to coordinate attempted service through China's Ministry of Justice and to continually work with the China domain registrars who could assist in attempting to notify the registrants of the action. Microsoft went to great lengths to provide notice of the action through all of the email addresses of the registrants and by widely publicizing the action and the papers filed in the action on www.noticeofpleadings.com and in the press.

4. **Entry of Default and Entry of Default Judgment:** As part of its overall strategy, Microsoft wanted to obtain long-term control over the infected botnet domains and to enjoin the defendants from any ongoing operation of the Waledac botnet. In July 2010, Microsoft filed a motion requesting the court to enter default against the Doe defendants and a motion requesting that the court transfer the infected domains to Microsoft. Under Rule 55 of the Federal Rules of Civil Procedure, a court can enter default when a party, after being served, has failed to defend the action. After the court enters default, it may enter default judgment against the defendants and award the plaintiff its requested relief.

   Despite the extraordinary efforts of Microsoft to provide notice to defendants over a period of many months, defendants have not responded in any manner whatsoever and have not objected to any of the court's actions. On this basis, in August 2010, the court ordered the clerk to enter default as to each of the defendants. In early September 2010, the court held a hearing on entry of default judgment against the defendants and transferring Microsoft ownership of the domains; a permanent injunction is pending.

5. **Why This Framework Was Successful:** Aside from having a compelling investigation and evidence as well as strong legal arguments in its favor, this framework proved successful because Microsoft carefully coordinated the legal relief with sophisticated technical action, anticipated all of the arguments the absent defendants might raise, strove to answer those arguments in their absence, took steps to understand the venue it was operating in, and developed credibility with the court.

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Malware Key Findings

Trustworthy Computing: Security Engineering at Microsoft

The computer threat landscape is constantly changing. As threats continue to evolve from mischievous hackers who pursue notoriety to organized criminals who steal data for monetary gain, public concern is escalating. Trustworthy Computing (TwC), formed in 2002, is Microsoft's commitment to providing more secure, private, and reliable computing experiences for our customers.

TwC Security includes three technology centers that work together to address security issues by coordinating their efforts to supply the services, information, and response needed to better understand the evolving threat landscape, help protect customers from online threats, and share knowledge with the broader security ecosystem.

Microsoft Security Engineering Center

The Microsoft Security Engineering Center (MSEC) helps protect Microsoft customers by providing security guidance to our product teams, helping them implement the industry-leading Security Development Lifecycle, and deploying applied security science and technology that help improve product security.

Microsoft Security Response Center

The Microsoft Security Response Center (MSRC) is a leading security risk analysis and management center that helps identify, monitor, resolve, and respond to security incidents and Microsoft software security vulnerabilities 24 hours a day, seven days a week. On constant alert for security issues, the MSRC monitors security newsgroups, responds to email messages sent to secure@microsoft.com, and manages a company-wide security update release process.

Microsoft Malware Protection Center

The Microsoft Malware Protection Center (MMPC) is a global team of experienced malware research and response specialists dedicated to protecting customers from new threats, including viruses, worms, spyware, adware, and other malicious and potentially unwanted software. The MMPC provides malware research and response expertise that supports the range of Microsoft security products and services, including the Microsoft Forefront suite of products, Windows Live OneCare™, Windows Defender, Microsoft Security Essentials, and the Malicious Software Removal Tool. The response arm of the MMPC includes a global network of research and response labs located around the world.

The data and analysis in this report are presented from the perspective of these three centers and their partners in the various Microsoft product groups.

Industry-Wide Vulnerability Disclosures

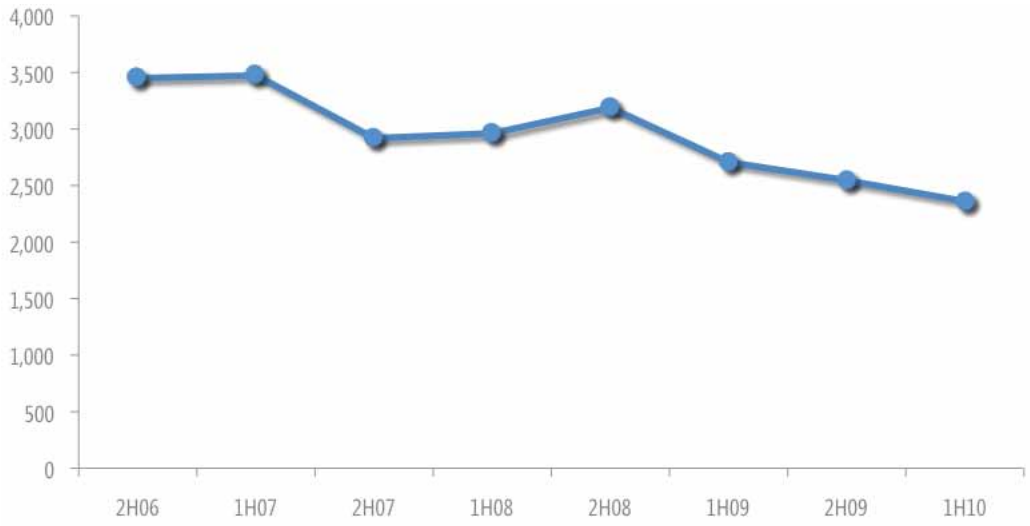
Vulnerabilities are weaknesses in software that allow an attacker to compromise the integrity, availability, or confidentiality of that software. Some of the worst vulnerabilities allow attackers to run arbitrary code on the compromised system. See "Industry-Wide Vulnerability Disclosures" in the Reference Guide section of the *Security Intelligence Report* website for more information about vulnerabilities.

The information in this section is compiled from vulnerability disclosure data that is published in the National Vulnerability Database (http://nvd.nist.gov), the U.S. government repository of standards-based vulnerability management data represented using the Security Content Automation Protocol (SCAP).

Vulnerability Disclosures

Figure 24 illustrates the number of vulnerability disclosures across the software industry for each half-year period since 2H06. (See "About This Report" on page 6 for an explanation of the reporting period nomenclature used in this report.)

FIGURE 24. Industry-wide vulnerability disclosures by half-year, 2H06–1H10

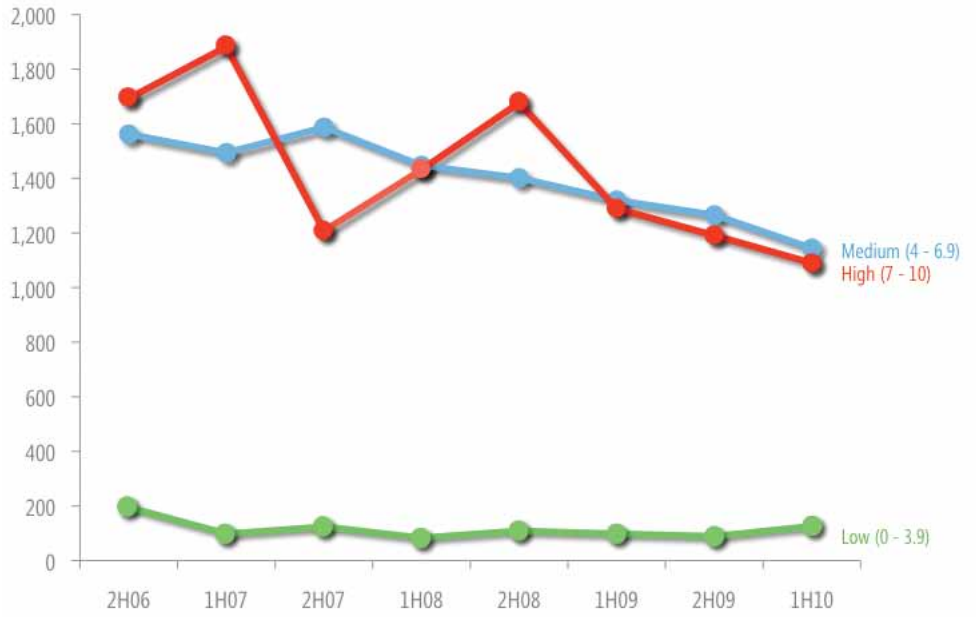


- Vulnerability disclosures in 1H10 were down 7.9 percent from 2H09.
- This decline continues an overall trend of moderate declines since 2H06. This trend is likely because of better development practices and quality control throughout the industry, which result in more secure software and fewer vulnerabilities. (See "Protecting Your Software" in the Managing Risk section of the *Security Intelligence Report* website for additional details and guidance about secure development practices.)

Vulnerability Severity

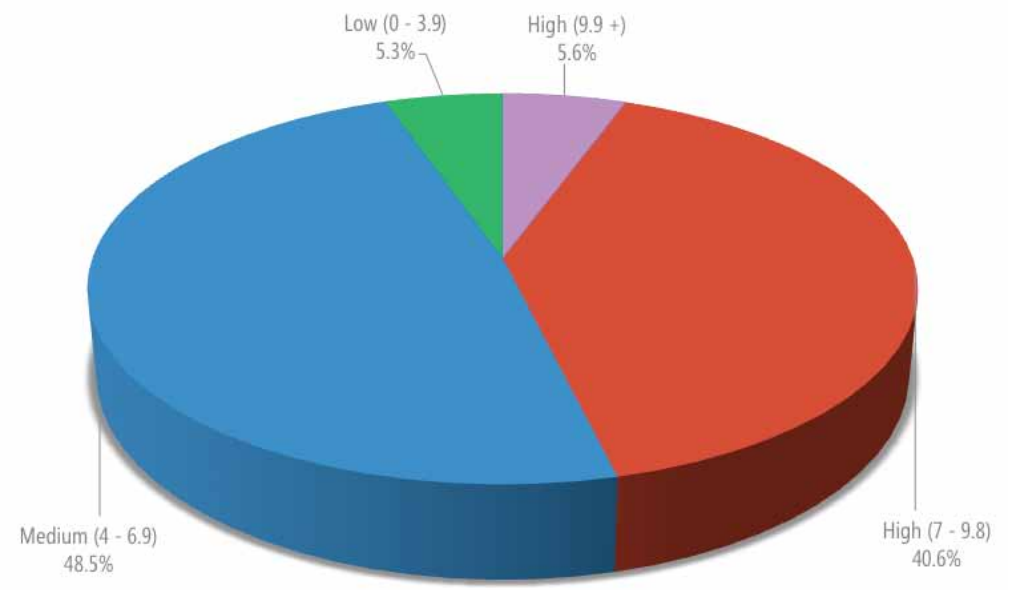
The Common Vulnerability Scoring System (CVSS) is a standardized, platform-independent scoring system for rating IT vulnerabilities. Currently in its second version, the system assigns a numeric value between 0 and 10 to vulnerabilities according to severity, with higher scores representing greater severity. (See "Vulnerability Severity" in the Reference Guide section of the *Security Intelligence Report* website for more information.)

FIGURE 25. Industry-wide vulnerability disclosures by severity, 2H06–1H10



- Although the number of Medium and High severity vulnerabilities disclosed is routinely much greater than the number of Low severity vulnerability disclosures, the trend in 1H10 is a positive one, with Medium and High disclosures declining by 10.7 percent and 9.3 percent from 2H09, respectively.
- Low severity vulnerability disclosures increased 41.6 percent, from 89 in 2H09 to 126 in 1H10.
- Mitigating the most severe vulnerabilities first is a security best practice. High severity vulnerabilities that scored 9.9 or greater represent 5.6 percent of all vulnerabilities disclosed in 1H10, as Figure 26 illustrates. This figure is down from 7.2 percent in 2H09.

FIGURE 26. Industry-wide vulnerability disclosures in 1H10, by severity

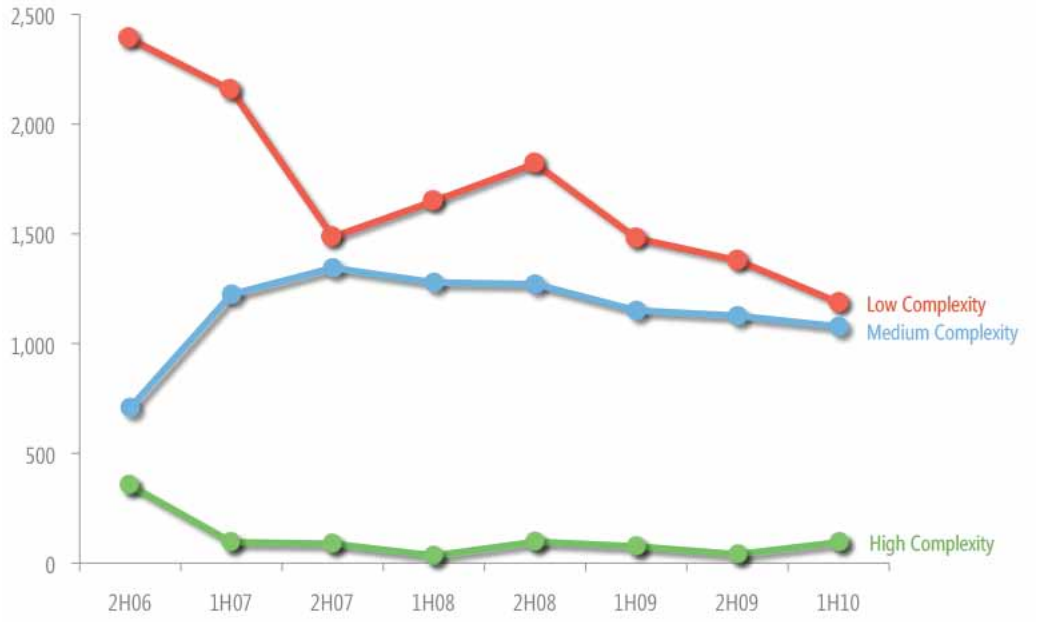


Vulnerability Complexity

Some vulnerabilities are easier to exploit than others, and vulnerability complexity is an important factor to consider in determining the magnitude of the threat a vulnerability poses. A High severity vulnerability that can only be exploited under very specific and rare circumstances might require less immediate attention than a lower severity vulnerability that can be exploited more easily.

The CVSS gives each vulnerability a complexity ranking of Low, Medium, or High. (See "Vulnerability Severity" in the Reference Guide section of the *Security Intelligence Report* website for more information about the CVSS complexity ranking system.) Figure 27 shows the complexity mix for vulnerabilities disclosed in each half-year period since 2H06. Note that Low complexity indicates greater danger, just as High severity indicates greater danger in Figure 25.

FIGURE 27. Industry-wide vulnerabilities by access complexity, 2H06–1H10

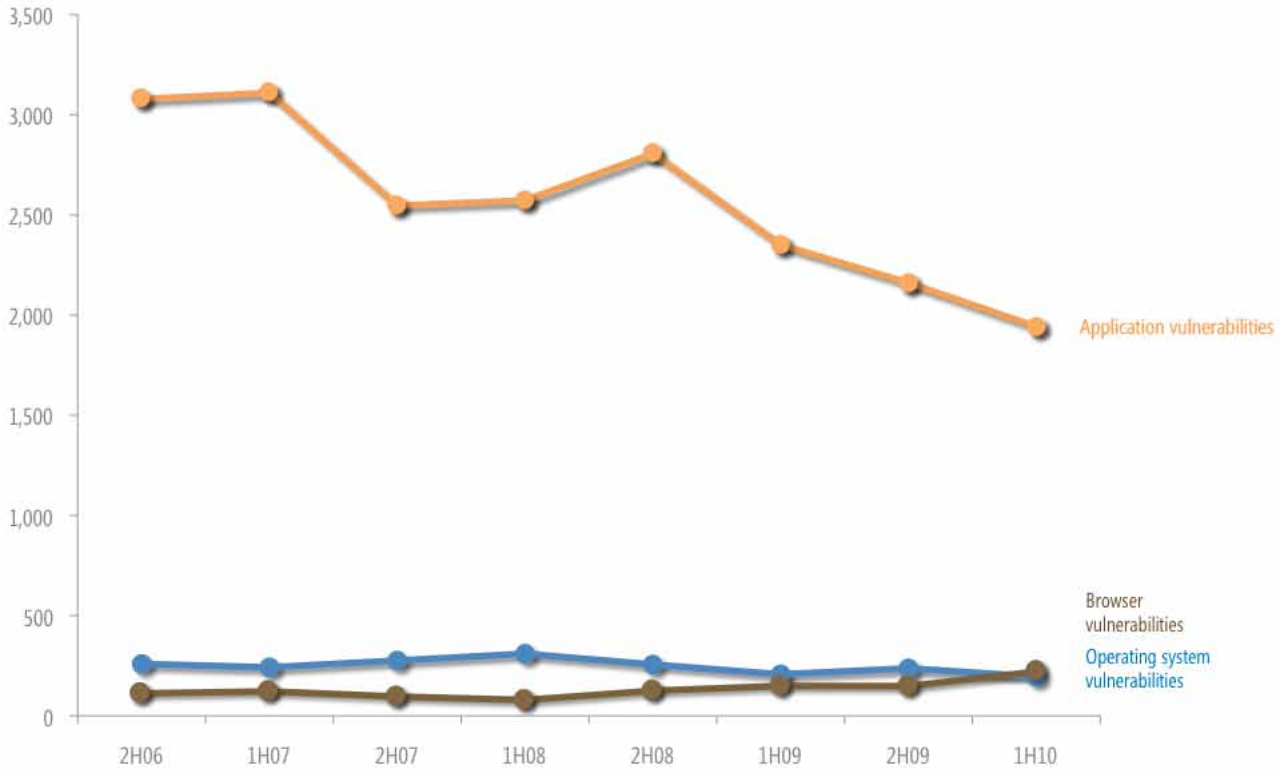


- As with vulnerability severity, the trend here is a positive one, with Low and Medium complexity vulnerability disclosures declining 16.2 percent and 4.5 percent from 2H09, respectively.
- High complexity vulnerability disclosures increased 137.5 percent, from 40 in 2H09 to 95 in 1H10.

Operating System, Browser, and Application Vulnerabilities

Figure 28 shows industry-wide vulnerabilities for operating systems, browsers, and applications since 2H06. (See "Operating System and Browser Vulnerabilities" in the Reference Guide section of the *Security Intelligence Report* website for an explanation of how operating system, browser, and application vulnerabilities are distinguished.)

FIGURE 28. Industry-wide operating system, browser, and application vulnerabilities, 2H06–1H10



- Application vulnerabilities continued to account for a large majority of all vulnerabilities in 1H10, though the total number of application vulnerabilities declined 11.2 percent from the previous period.
- Operating system and browser vulnerabilities remained relatively stable by comparison, with each type accounting for a small fraction of the total.
- For the first time the number of vulnerabilities in browsers exceeded the number of vulnerabilities in operating systems, which continues a gradual trend that began in 1H08.

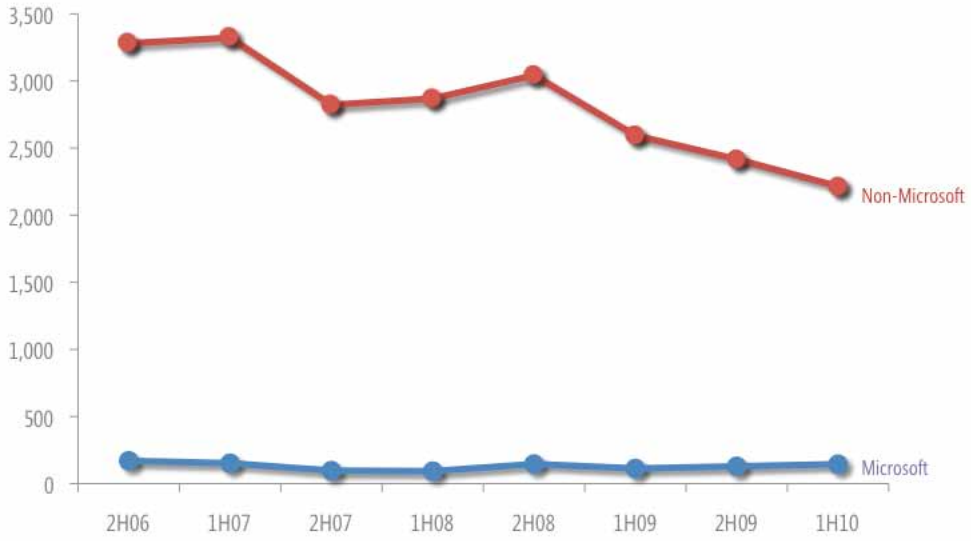
Guidance: Developing Secure Software

The Security Development Lifecycle (www.microsoft.com/sdl) is a software development methodology that embeds security and privacy throughout all phases of the development process with the goal of protecting end users. Using such a methodology can help reduce vulnerabilities in the software and help manage vulnerabilities that might be found after deployment. (For more in-depth information about the SDL and other techniques developers can use to secure their software, see "Protecting Your Software" in the Managing Risk section of the *Security Intelligence Report* website.)

Vulnerability Reports for Microsoft Products

Figure 29 charts vulnerability disclosures for Microsoft and non-Microsoft products since 2H06.

FIGURE 29. Vulnerability disclosures for Microsoft and non-Microsoft products, 2H06–1H10

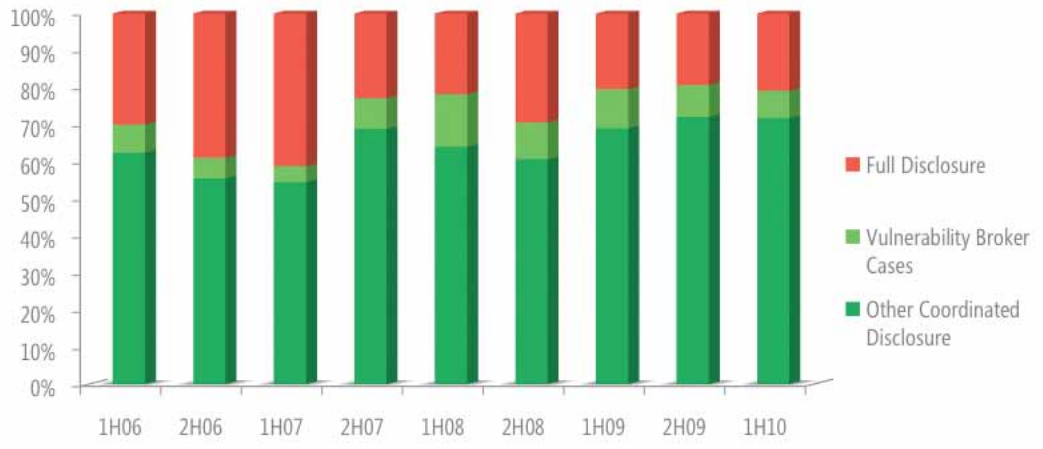


- Vulnerability disclosures for Microsoft products increased slightly in 1H10 but have generally remained stable over the past several periods.
- Vulnerabilities in Microsoft products accounted for 6.5 percent of all vulnerabilities disclosed in 1H10. This percentage is up from 5.3 percent in 2H09, primarily because of the overall decline in vulnerability disclosures across the industry during that time.

Coordinated Vulnerability Disclosure

Coordinated vulnerability disclosure means disclosing vulnerabilities privately to an affected vendor so they can develop a comprehensive security update to address the vulnerability before the details become public knowledge. Ideally, with coordinated disclosure, the release of the security update coincides with vulnerability information becoming publicly available. When vulnerabilities are reported to the affected vendor privately, attackers are less likely to become aware of them before security updates are available.

FIGURE 30. Coordinated disclosures as a percentage of all disclosures involving Microsoft software, 1H06–1H10



- In 1H10, 79.1 percent of vulnerability disclosures involving Microsoft software adhered to coordinated disclosure practices, down slightly from 80.0 percent in 2H09.
- The coordinated disclosure rate has remained mostly steady since 1H09 despite fluctuations in the overall volume of case submissions to Microsoft.
- Coordinated disclosure figures include disclosures brought to the MSRC by vulnerability brokers. In 1H10, disclosures submitted by vulnerability brokers accounted for 7.3 percent of all disclosures, down slightly from 8.6 percent in 2H09.

(See "Coordinated Vulnerability Disclosure" in the Reference Guide section of the *Security Intelligence Report* website for more information about coordinated vulnerability disclosure and vulnerability brokers.)

Microsoft Security Bulletins in 1H10

The MSRC releases security bulletins each month that address vulnerabilities in Microsoft software. Security bulletins are typically released on the second Tuesday of each month, although on rare occasions Microsoft releases a so-called *out-of-band* security update to address an urgent issue. A single security bulletin often addresses multiple vulnerabilities from the Common Vulnerabilities and Exposures (CVE) database (http://cve.mitre.org), each of which is listed in the bulletin, along with any other relevant issues. (See "Microsoft Security Bulletins" in the Reference Guide section of the *Security Intelligence Report* website for more information about the CVSS complexity ranking system.)

FIGURE 31. Security bulletins released and CVEs addressed by Microsoft, 1H06–1H10

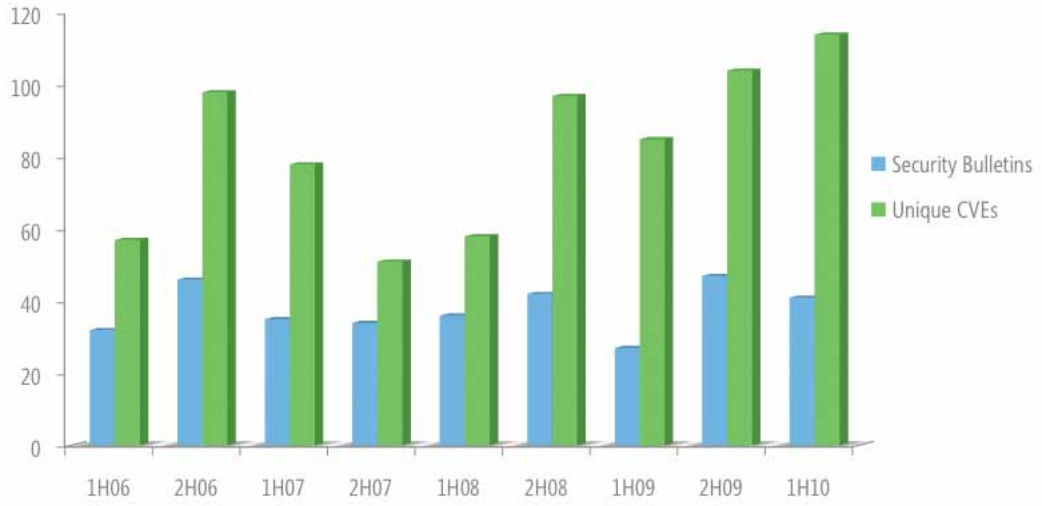
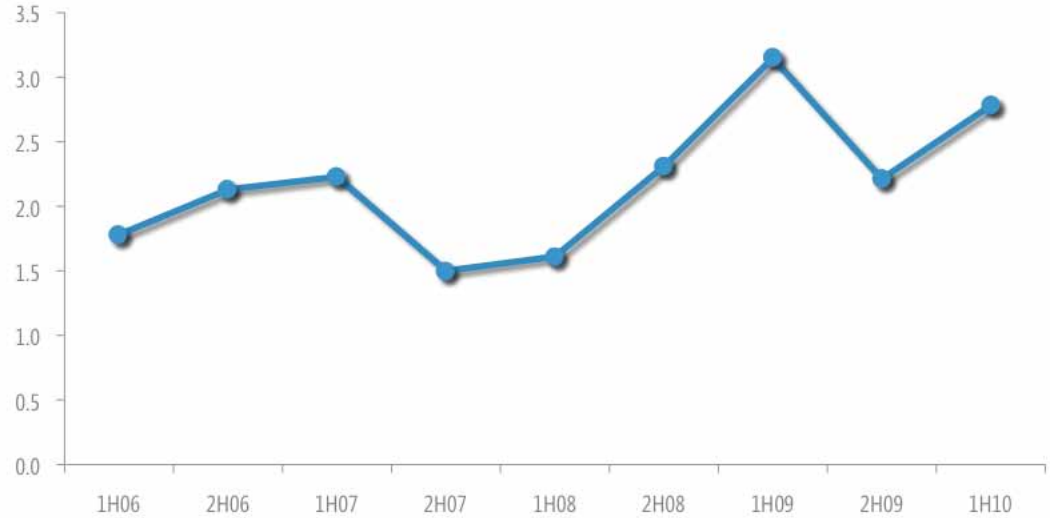


FIGURE 32. Average number of CVEs addressed per security bulletin, 1H06–1H10



- In 1H10, Microsoft released 41 security bulletins that addressed 114 individual vulnerabilities identified on the CVE list.
- The overall number of bulletins published decreased from 47 in 2H09, but the number of vulnerabilities addressed in 1H10 increased from 104 in 2H09. The number of vulnerabilities addressed per bulletin therefore increased from an average of 2.2 in 2H09 to 2.8 in 1H10. Whenever possible, the MSRC consolidates multiple vulnerabilities that affect a single binary or component and addresses them with a single security bulletin. This approach maximizes the effectiveness of each update while minimizing the potential inconvenience that customers face from testing and integrating individual security updates into their computing environments.

Usage Trends for Windows Update and Microsoft Update

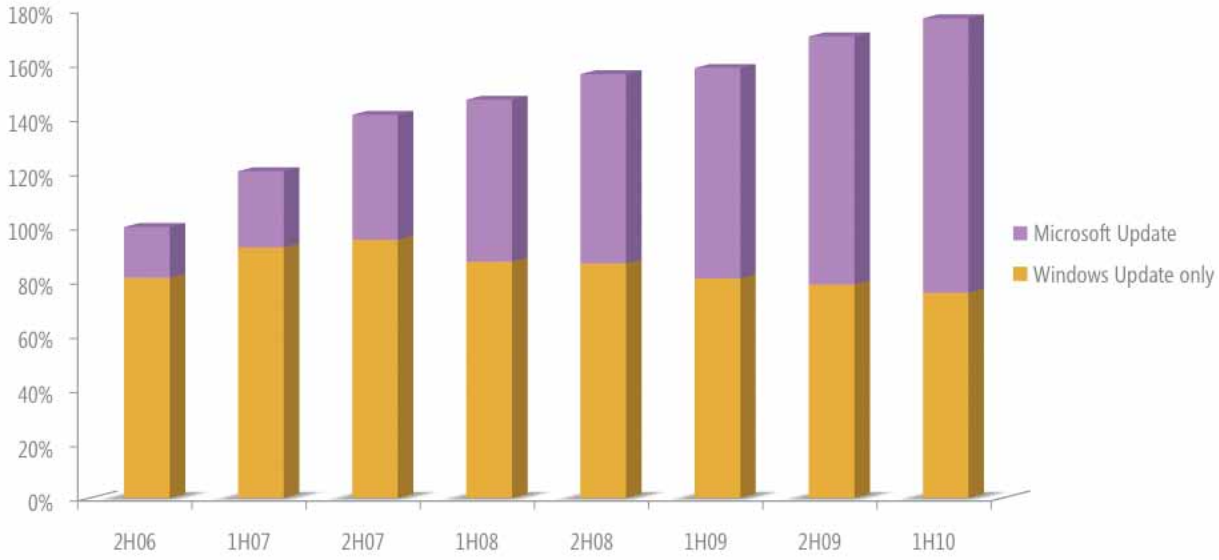
The prompt, widespread adoption of security updates and other software upgrades can significantly mitigate the spread and impact of malware. Over the past decade, many software vendors have developed mechanisms to inform users about the availability of new updates and enable them to obtain and install updates easily and automatically. Security-conscious IT departments have responded by developing practices to quickly test and assess newly issued updates and to deliver them to their users.

Update Clients and Services

Microsoft provides two publicly available update services. **Windows Update** provides updates for Windows® components and device drivers provided by Microsoft and other hardware vendors as well as updates for Microsoft anti-malware products. **Microsoft Update** provides all of the updates offered through Windows Update and provides updates for other Microsoft software, such as the Microsoft Office system, Microsoft SQL Server®, and Microsoft Exchange Server. (See "Usage Trends for Windows Update and Microsoft Update" in the Reference Guide section of the *Security Intelligence Report* website for more information about these services.)

Figure 33 shows the relative usage of these two services since 2H06.

FIGURE 33. Usage of Windows Update and Microsoft Update, 2H06–2H09 (2H06 total usage = 100%)

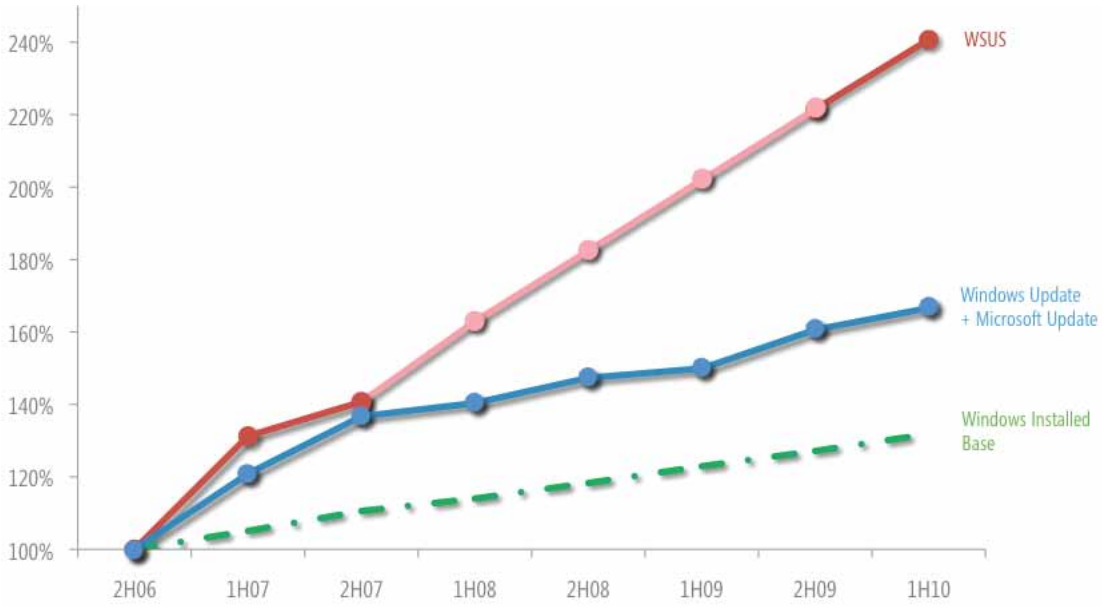


- Microsoft Update adoption has risen significantly over the past several years. The number of computers using the more comprehensive service has increased by more than 10.7 percent since 2H09.

- Overall usage of Windows Update and Microsoft Update has increased by more than 75 percent since 2H06.

Enterprise customers can use Windows Server Update Services (WSUS) or the Microsoft System Center family of management products to provide update services for their managed computers. Figure 34 shows the growth of WSUS usage and Windows Update/ Microsoft Update relative to 2H06.

FIGURE 34. Relative growth in Microsoft WSUS and end-user update services, 2H06–1H10 (2H06 = 100%)



- WSUS usage from 1H08 to 2H09 is estimated due to a reporting error that was resolved in 1H10.
- Public update service usage and the number of WSUS servers managing updates have both grown faster than the Windows installed base since 2H06, which indicates that users are choosing to enable updating on existing Windows installations as well as on new installations.

Guidance: Keeping Your Software Up To Date

Installing the latest security updates from Microsoft and other software vendors as they are released is one of the most important steps organizations and individuals can take to defend against threats that spread through exploits. Using the Microsoft Update service will help ensure that security updates are delivered in a timely manner for all Microsoft software.

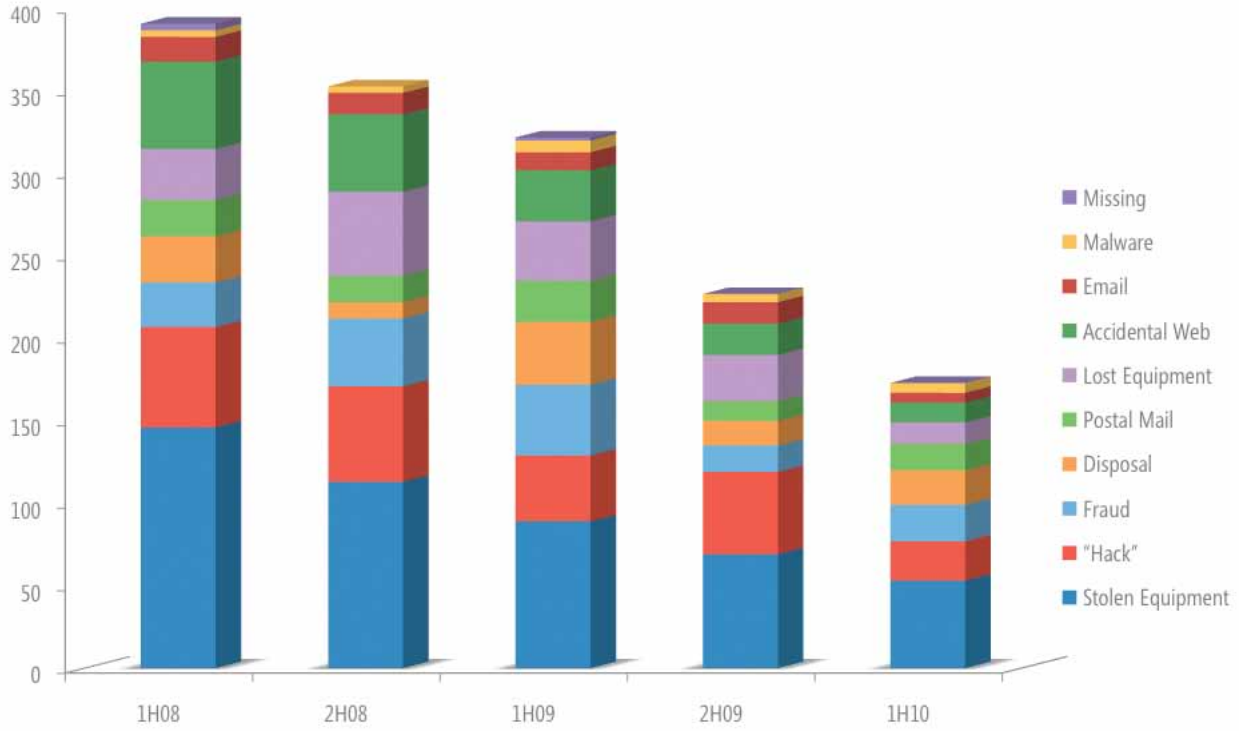
For in-depth guidance, see "Using Update Services" in the Managing Risk section of the *Security Intelligence Report* website.

Security Breach Trends

In recent years, laws have been passed in a number of jurisdictions around the world that require affected individuals to be notified when an organization loses control of personally identifiable information (PII) with which it has been entrusted. These mandatory notifications offer unique insights into how information security efforts need to address issues of negligence as well as technology.

The information in this section was generated from worldwide data security breach reports from news media outlets and other information sources that volunteers have recorded in the Data Loss Database (DataLossDB) at http://datalossdb.org. (See "Security Breach Trends" in the Reference Guide section of the *Security Intelligence Report* website for more information about the DataLossDB and the breach types referenced here.)

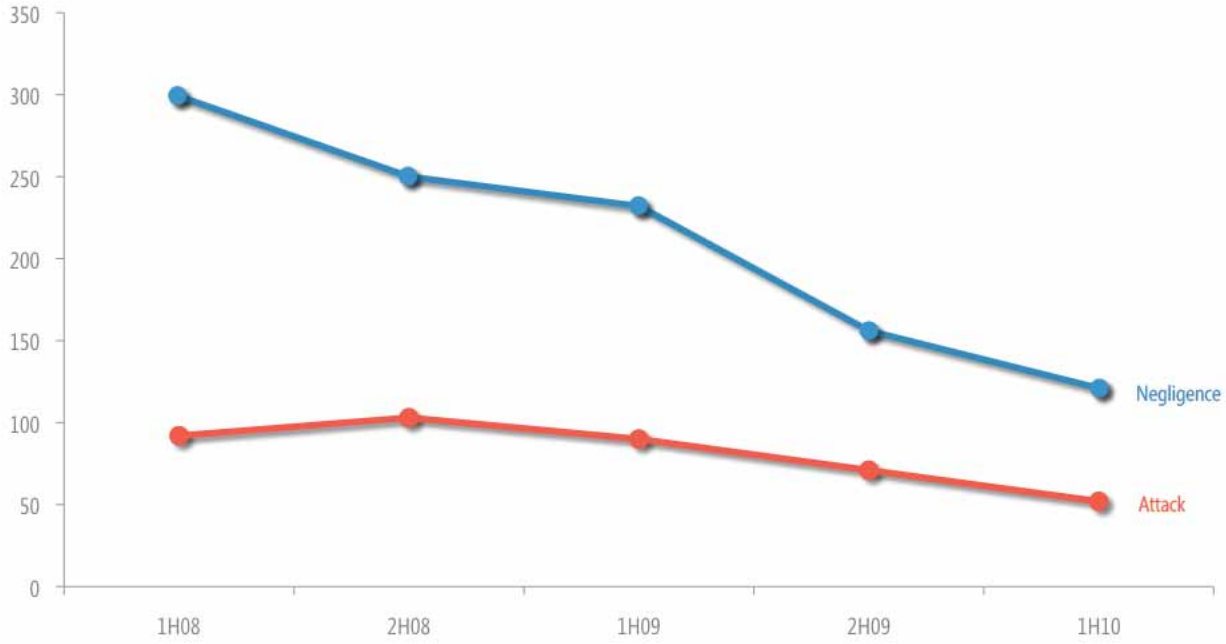
FIGURE 35. Security breach incidents by incident type, 1H08–1H10



- As in recent periods, the first six months of 2010 saw a decline in the total number of incidents reported. This downward trend may be related to the overall decline in worldwide economic activity over the same time period.
- The largest single category of incidents involved stolen equipment, with 30.6 percent of the total.

- Malicious incidents (those involving "hacking" incidents, malware, and fraud) routinely account for less than half as many incidents as negligence (involving lost, stolen, or missing equipment; accidental disclosure; or improper disposal), as Figure 36 illustrates.
- Improper disposal of business records is the second largest source of breach incidents related to negligence, and the third largest source of incidents overall. Improper disposal is relatively easy for organizations to address by developing and enforcing effective policies regarding the destruction of paper and electronic records that contain sensitive information.

FIGURE 36. Breach incidents resulting from attacks and negligence, 1H08–1H10



Guidance: Preventing and Mitigating Security Breaches

Organizations can take steps to reduce the occurrence of security breaches and to reduce the severity and impact of breaches when they do occur. For in-depth guidance, see "Prevent and Mitigate Security Breaches" in the Mitigating Risk section of the *Security Intelligence Report* website.

Malware and Potentially Unwanted Software Trends

Except where specified, the information in this section was compiled from telemetry data generated from more than 600 million computers worldwide by a number of different Microsoft security tools and services, including the MSRT, Microsoft Security Essentials, Windows Defender, Microsoft Forefront Client Security, Windows Live OneCare, and the Windows Live OneCare safety scanner.

Infection Rate Calculation Updated

To improve the detail and accuracy of the information presented in the *Security Intelligence Report*, the CCM (computers cleaned per thousand) metric used to report infection rates is now calculated on a quarterly basis. The CCM figure for a given quarter now represents the number of unique computers cleaned by the MSRT for every 1,000 MSRT executions during that quarter. For this reason, the numeric CCM figures reported in the current volumes tend to be significantly different from the corresponding figures in previous volumes and should not be directly compared with them. (For more information, see "Infection Rates" in the Reference Guide section of the *Security Intelligence Report* website.)

Geographic Statistics

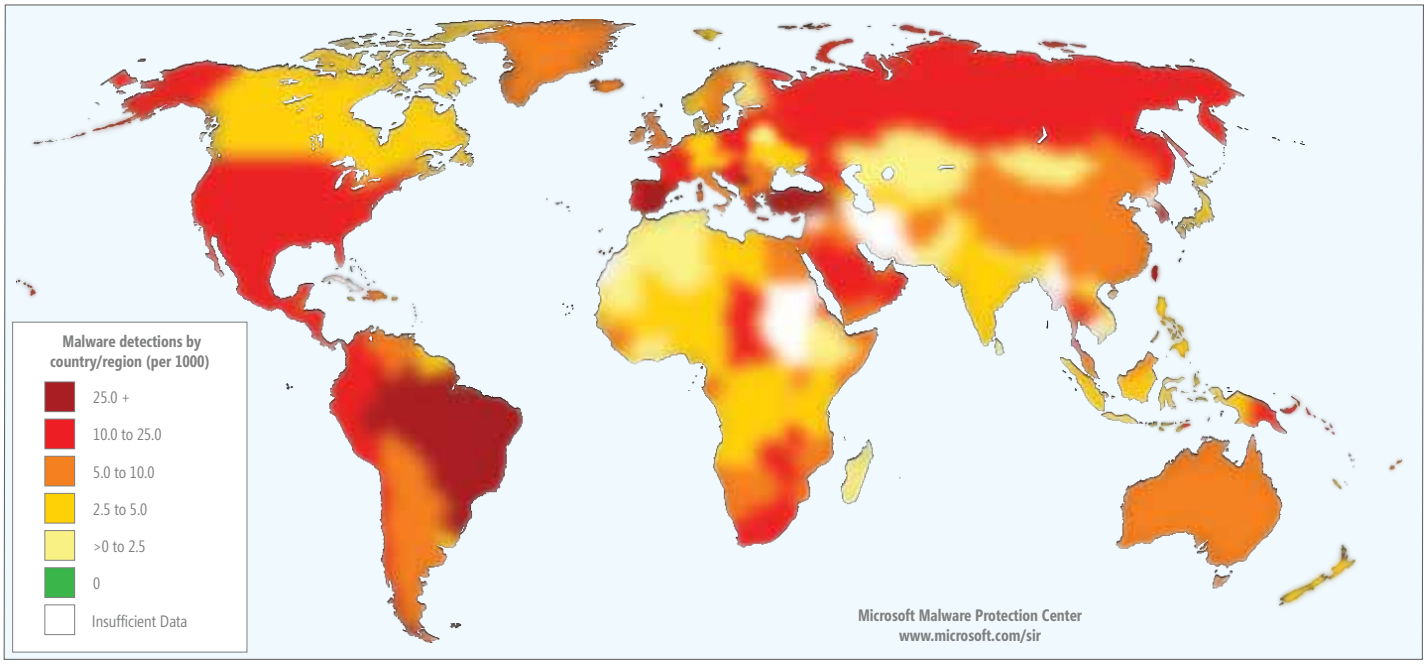
The telemetry data generated by Microsoft security products includes information about the location of the computer, as determined by the setting of the **Location** tab or menu in **Regional and Language Options** in the Control Panel. This data makes it possible to compare infection rates, patterns, and trends in different locations around the world.

FIGURE 37. The locations with the most computers cleaned by Microsoft desktop anti-malware products in 1Q10 and 2Q10

Rank	Country/Region	Computers Cleaned (1Q10)	Computers Cleaned (2Q10)	Change
1	United States	11,025,811	9,609,215	-12.8% ▼
2	Brazil	2,026,578	2,354,709	16.2% ▲
3	China	2,168,810	1,943,154	-10.4% ▼
4	France	1,943,841	1,510,857	-22.3% ▼
5	Spain	1,358,584	1,348,683	-0.7% ▼
6	United Kingdom	1,490,594	1,285,570	-13.8% ▼
7	Korea	962,624	1,015,173	5.5% ▲
8	Germany	949,625	925,332	-2.6% ▼
9	Italy	836,593	794,099	-5.1% ▼
10	Russia	700,685	783,210	11.8% ▲
11	Mexico	768,646	764,060	-0.6% ▼

In absolute terms, the locations with the most computers cleaned tend to be ones with large populations and large numbers of computers. To control for this effect, Figure 38 shows the infection rates in locations around the world using a metric called *computers cleaned per thousand*, or *CCM*, which represents the number of reported computers cleaned for every 1,000 executions of the MSRT. (See the *Security Intelligence Report* website for more information about the CCM metric.)

FIGURE 38. Infection rates by country/region in 2Q10, by CCM



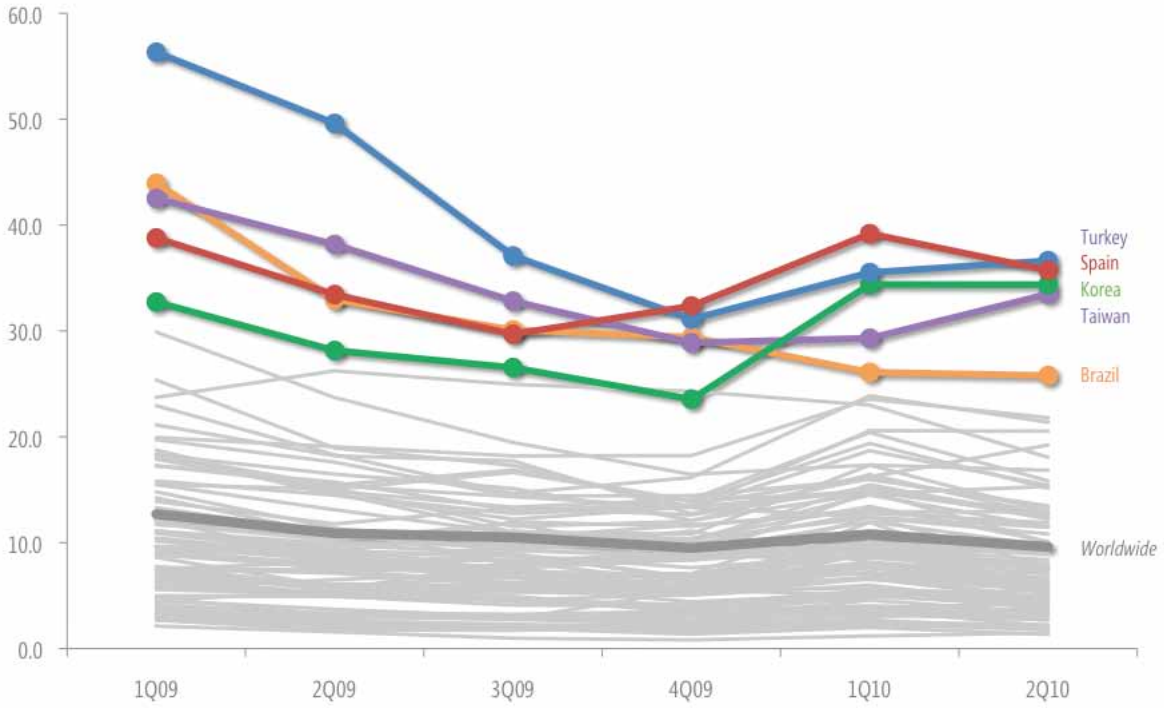
- Among locations with more than 200,000 executions of the MSRT in 2Q10, Turkey had the highest infection rate, with 36.6 computers cleaned for every 1,000 MSRT executions (CCM 36.6). Following Turkey were Spain (35.7), Korea (34.4), Taiwan (33.5), and Brazil (25.8). All have been among the locations with the highest infection rates for several periods.
- Locations with the lowest infection rates include Belarus (1.3), Bangladesh (1.5), Sri Lanka (1.8), Tunisia (1.8), and Morocco (1.9).

Infection Trends Around the World

The number of computers cleaned in individual countries/regions can vary quite a bit from period to period. Increases in the number of cleaned computers can be caused not only by increased prevalence of malware in that country but also by improvements in the ability of Microsoft anti-malware solutions to detect malware. Large numbers of new installations in a location are also likely to increase the number of computers cleaned there.

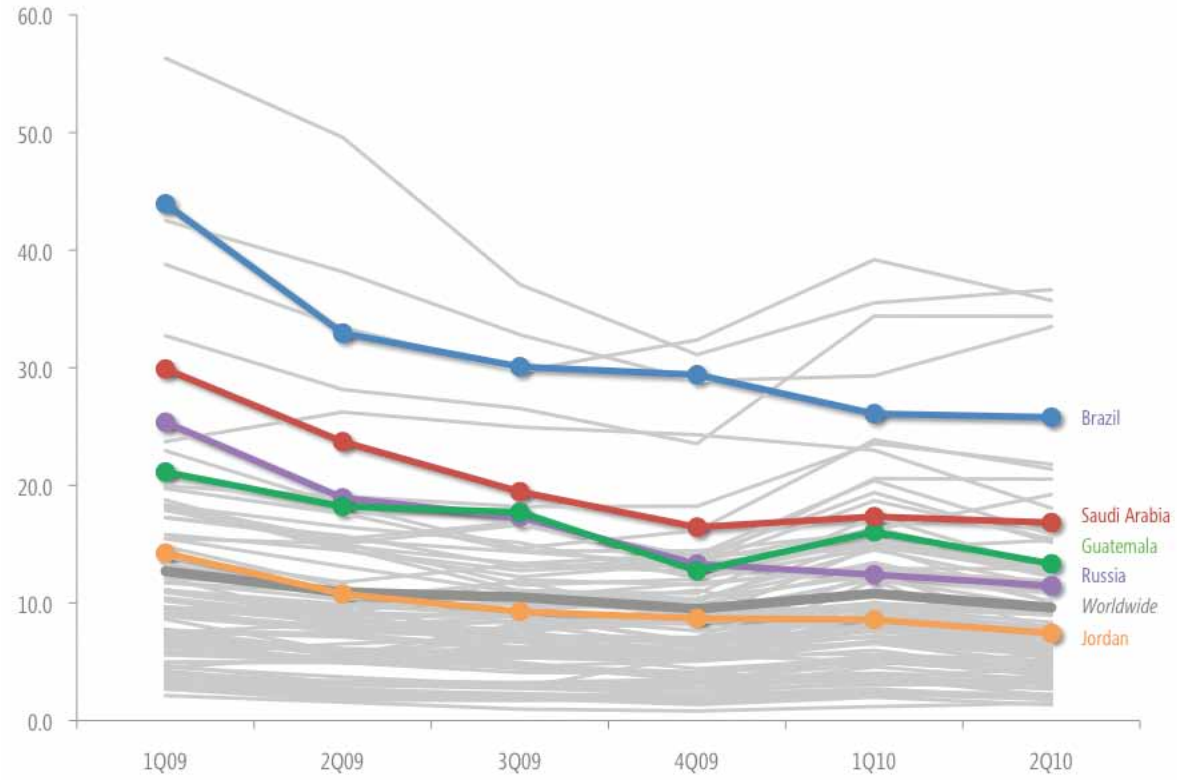
The next two figures illustrate infection rate trends for specific locations around the world, relative to the trends for all locations with at least 100,000 MSRT executions in 2Q10. (See "Infection Trends Worldwide" in the Key Findings section of the *Security Intelligence Report* website for additional details about this information.)

FIGURE 39. Trends for the five locations with the highest infection rates, 1Q09–2Q10, by CCM (100,000 monthly MSRT executions minimum)



- Turkey, Spain, Korea, Taiwan, and Brazil had the highest infection rates among locations with at least 100,000 MSRT executions in 2Q10.
- Of these locations, each one improved between 1Q09 and 2Q10 except Korea, which went from 32.7 to 34.4.

FIGURE 40. Infection rate trends for the five locations that most improved between 1Q09 and 2Q10, by CCM (100,000 monthly MSRT executions minimum)

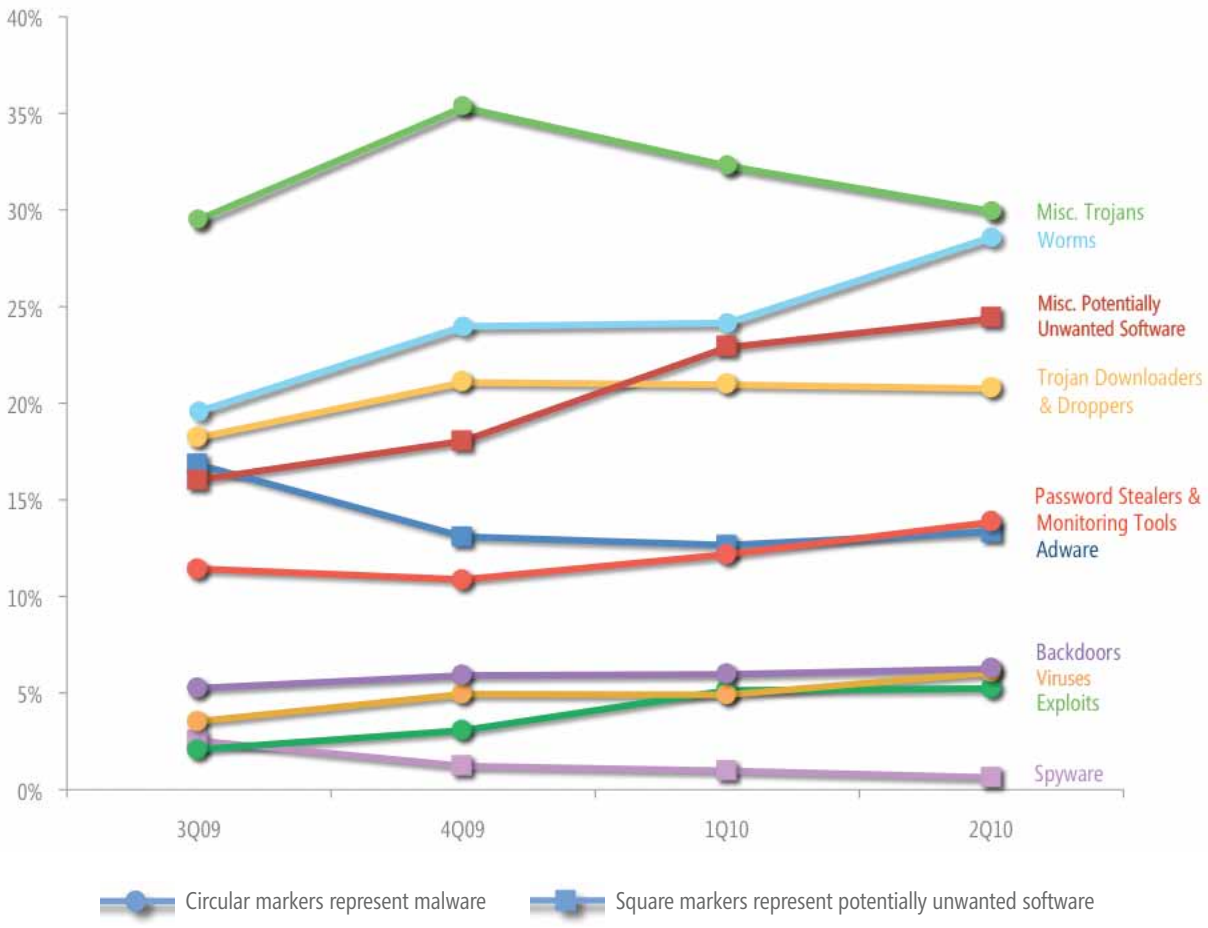


- The most improved locations are those that showed the largest decline in CCM between 1Q09 and 2Q10 and that also showed declines in at least two of the last three quarters.
- Brazil, Saudi Arabia, Guatemala, Russia, and Jordan each improved by at least 4.0 points (CCM) from 1Q09 to 2Q10.
- Brazil showed the most significant CCM drop, from 43.9 in 1Q09 to 25.8 in 2Q10. Much of the drop was caused by a steep decrease in the number of computers infected with Win32/Banker, though detections of the related families Win32/Bancos and Win32/Banload remained relatively high. Saudi Arabia declined from 29.9 in 1Q09 to 16.8 in 2Q10, primarily because of decreased detections of Win32/Taterf, Win32/Frethog, Win32/Alureon, and Win32/RJump.
- For Guatemala and Jordan, most of the decline was because of significantly fewer detections of Taterf. The infection rate in Guatemala decreased from 21.1 to 13.3, and the infection rate in Jordan decreased from 14.2 to 7.4.
- The infection rate in Russia declined from 25.4 to 7.4, primarily because of decreased detections of Taterf, Alureon, and Win32/Cutwail.

Category Trends

The MMPC classifies individual threats into types based on a number of factors, including how the threat spreads and what it is designed to do. To simplify the presentation of this information and make it easier to understand, the *Security Intelligence Report* groups these types into 10 categories based on similarities in function and purpose. (See "Category Trends" in the Reference Guide section of the *Security Intelligence Report* website for more information about the categories used in this report.)

FIGURE 41. Computers cleaned by threat category from 3Q09 to 2Q10, by percentage of all infected computers

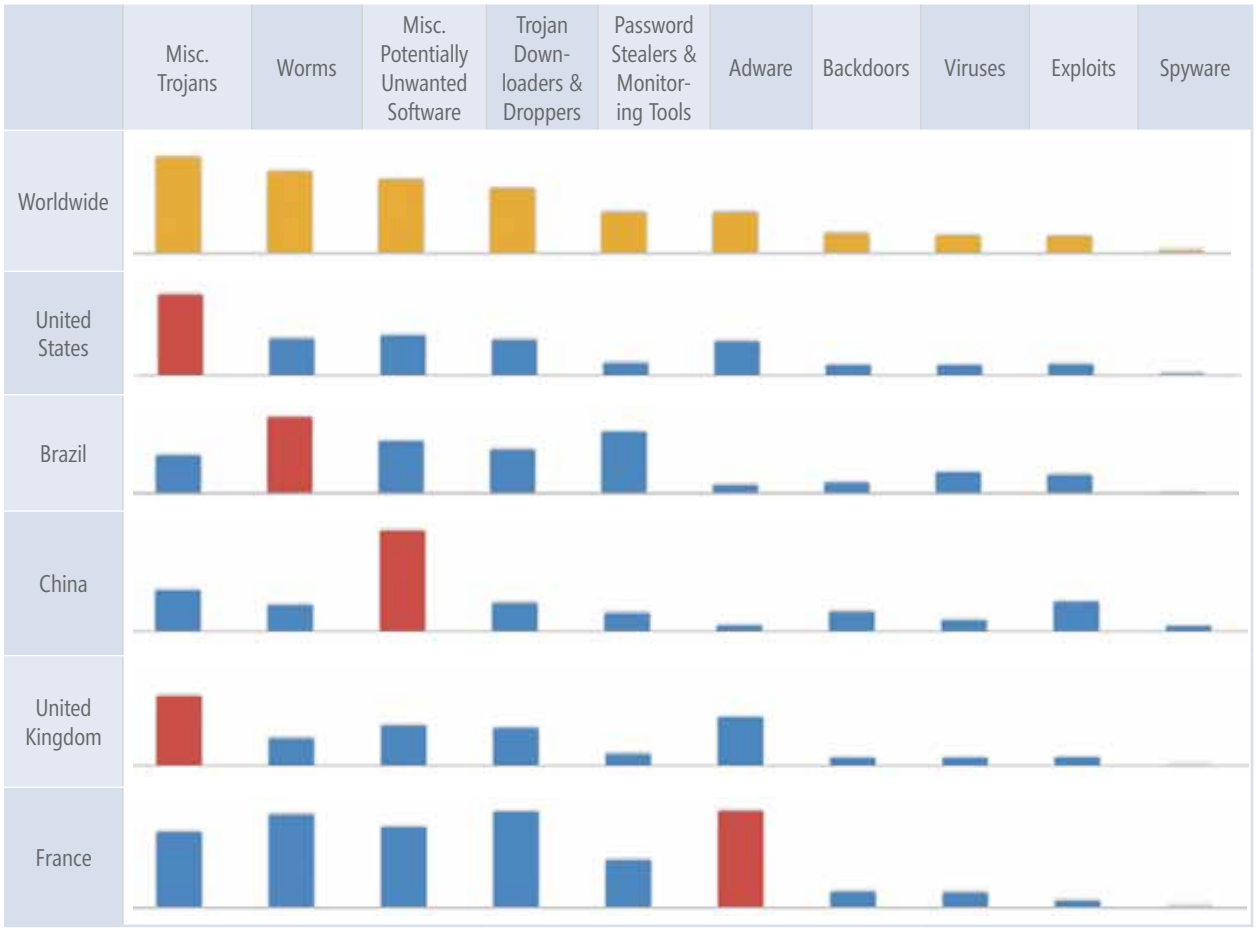


- Totals for each time period may exceed 100 percent because some computers have more than one category of threat detected on them in each time period.
- Worms and Miscellaneous Potentially Unwanted Software were the two categories that increased in prevalence the most over the past four quarters, primarily because of increased detections of the worm families Win32/Taterf and Win32/Autorun and the potentially unwanted software family Win32/Zwangi.
- Notably, Worms went from almost 10 percentage points behind Miscellaneous Trojans in 3Q09 to a virtual tie in 2Q10.
- After peaking in 4Q09, Miscellaneous Trojans has dropped steadily since. Trojan Downloaders & Droppers has exhibited a similar trend, though not nearly to the same degree.
- Spyware, which has never been a very prevalent category, declined by more than two-thirds over the past four quarters.

Threat Categories Around the World

There are significant differences in the types of threats that affect users in different parts of the world. The spread and effectiveness of malware are highly dependent on language and cultural factors, in addition to the methods used for distribution. Some threats are spread using techniques that target people who speak a particular language or who use services that are local to a particular geographic region. Other threats target vulnerabilities or operating system configurations and applications that are unequally distributed around the globe. Figure 42 shows the relative prevalence of different categories of malware and potentially unwanted software in the five locations that had the most computers cleaned in 2Q10.

FIGURE 42. The top five countries/regions and their relative infection rates in 2Q10, by category

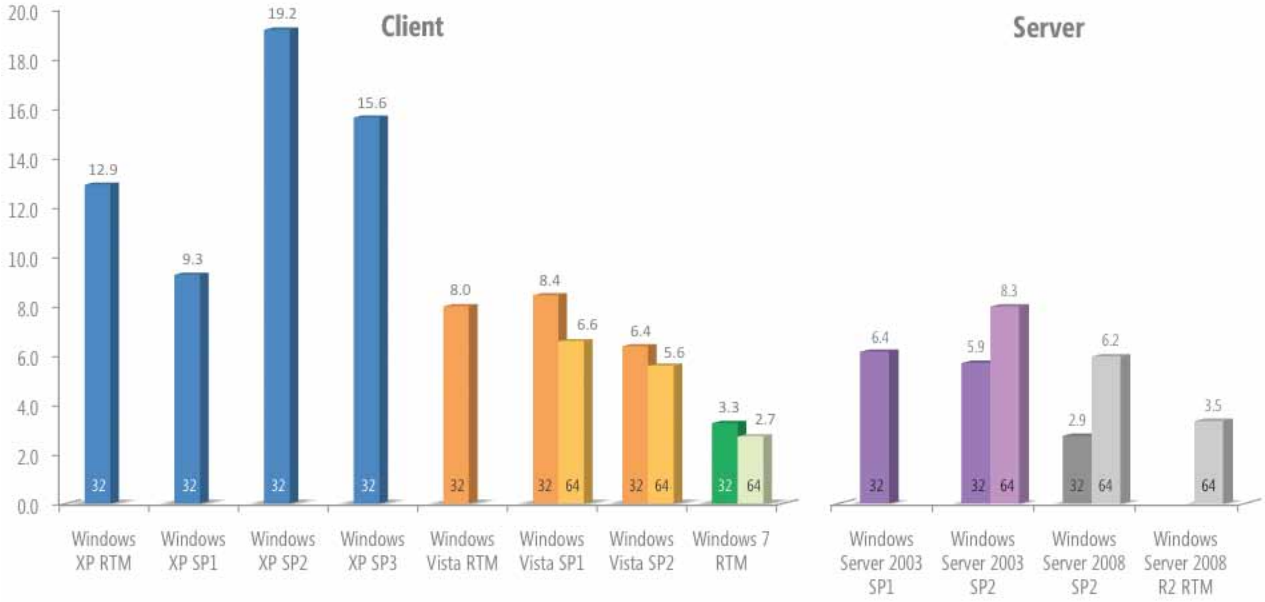


- The United States and the United Kingdom, two predominantly English-speaking locations that also share a number of other cultural similarities, have very similar threat mixes, led by Miscellaneous Trojans.
- In France, Adware was the most common category, led by Win32/Hotbar.
- Brazil has an unusually high concentration of Password Stealers & Monitoring Tools, primarily because of the prevalence of Win32/Bancos and Win32/Banker, which target customers of Brazilian banks.
- Miscellaneous Potentially Unwanted Software is the most common category in China, led by versions of Win32/BaiduSobar, a Chinese language browser toolbar.

Operating System Trends

The features and updates that are available with different versions of the Windows operating system, along with the differences in the way people and organizations use each version, affect the infection rates for the different versions and service packs. Figure 43 shows the infection rate for each Windows operating system/service pack combination that accounted for at least 0.05 percent of total MSRT executions in 2Q10.

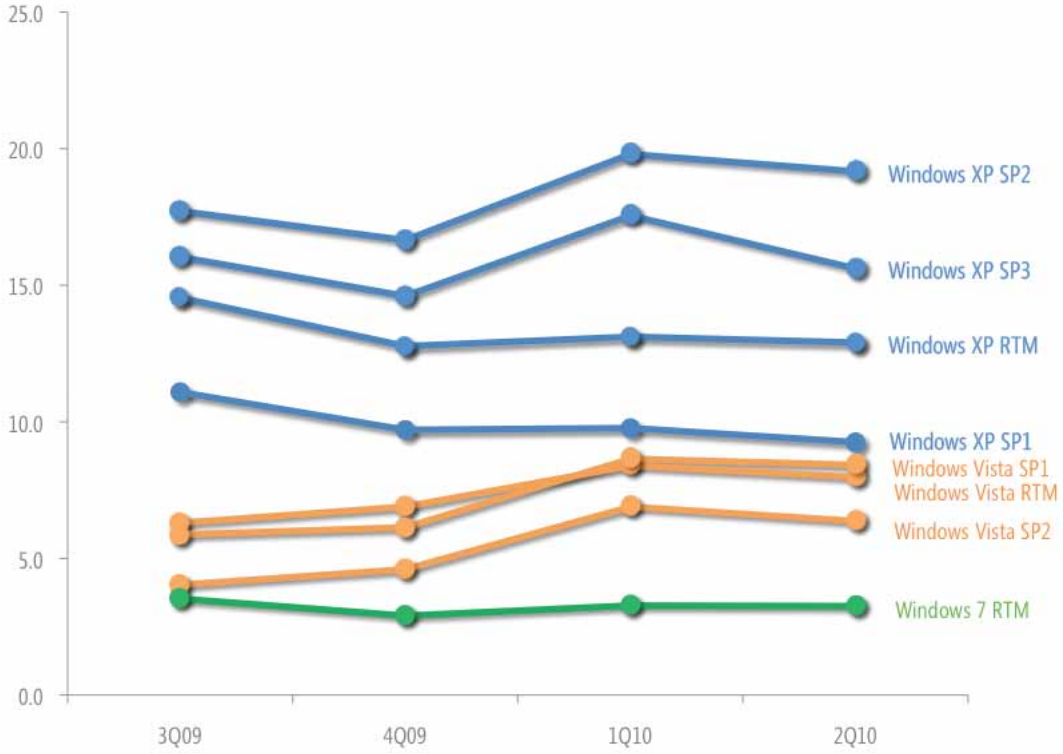
FIGURE 43. Number of computers cleaned for every 1,000 MSRT executions in 2Q10, by operating system



("32" = 32-bit; "64" = 64-bit. Systems with at least 0.05 percent of total executions shown.)

- This data is normalized: The infection rate for each version of Windows is calculated separately, and the infection rate for each version is not affected by the number of computers running it.
- As in previous periods, infection rates for more recently released operating systems and service packs are consistently lower than earlier ones, for both client and server platforms. Windows 7, Windows Server 2008 SP2 (32-bit), and Windows Server 2008 R2 have the lowest infection rates on the chart.
- Infection rates for Windows XP RTM and SP1 are lower than those of more recent versions of Windows XP. MSRT installations on the older versions, which are no longer supported by Microsoft, have decreased significantly over the past several quarters as computers have been decommissioned or upgraded. As IT departments and computer users move to more recent service packs or Windows versions, computers that run older operating system versions are often relegated to non-production roles or other specialized environments, which may explain the lower infection rates.
- Infection rates for the 64-bit versions of Windows XP, Windows Vista, and Windows 7 are lower than for the corresponding 32-bit versions of those platforms; however, the same is not true of the Windows Server versions shown. One reason may be that 64-bit versions of Windows still appeal to a more technically savvy audience than their 32-bit counterparts, despite increasing sales of 64-bit Windows versions among the general computing population.
- Purchasers of Windows Server are likely to decide between 32-bit and 64-bit versions for reasons other than technical savvy, which would explain why the pattern for client versions is not replicated among server versions. The higher infection rates for the 64-bit versions of Windows Server 2003 SP2 and Windows Server 2008 SP2 might be explained by the increasing popularity of 64-bit web and database servers for web applications. These servers benefit from the performance enhancements that 64-bit computing provides but also require exposing the servers more directly to the Internet.

FIGURE 44. CCM trends for 32-bit versions of Windows XP, Windows Vista, and Windows 7, 3Q09–2Q10



- Windows 7 has consistently had a lower infection rate over the past four quarters than versions of Windows Vista, which have consistently had lower infection rates than versions of Windows XP since the original release of Windows Vista in 2006.

Malware and Potentially Unwanted Software Families

Figure 45 lists the top 10 malware and potentially unwanted software families that were detected on computers by Microsoft desktop security products over the past two quarters.

FIGURE 45. Top 10 malware and potentially unwanted software families detected by Microsoft anti-malware desktop products in 1Q10 and 2Q10

Rank	Family	Most Significant Category	1Q10	2Q10	1 Year Trend
1	Win32/Taterf	Worms	1,495,286	2,320,953	
2	Win32/Frethog	Password Stealers & Monitoring Tools	2,010,989	1,997,669	
3	Win32/Renos	Trojan Downloaders & Droppers	2,691,987	1,888,339	
4	Win32/Rimecud	Worms	1,807,773	1,748,260	
5	Win32/Conficker	Worms	1,496,877	1,663,349	
6	Win32/Autorun	Worms	1,256,356	1,645,851	
7	Win32/Hotbar	Adware	1,015,055	1,482,681	
8	Win32/FakeSpypro	Miscellaneous Trojans	1,244,353	1,423,528	
9	Win32/Alureon	Miscellaneous Trojans	1,463,885	1,035,079	
10	Win32/Zwangi	Misc. Potentially Unwanted Software	542,011	859,801	

- Win32/Taterf and Win32/Frethog, the two most commonly detected malware families in 2Q10, belong to a category of threats that are designed to steal passwords for popular online computer games and transmit them to the attackers. (See "Online Gaming-Related Families" on page 62 of *Microsoft Security Intelligence Report, Volume 5 [January through June 2008]* for more information about these threats.)
- Win32/Renos, the most prevalent threat in 1Q10, dropped to third in 2Q10. Renos is a family of trojan downloaders that is often used to install rogue security software. Since 2006, it has consistently been one of the threats most commonly detected by Microsoft anti-malware desktop products and services.
- Win32/Rimecud (ranked fourth overall) and Win32/Alureon (ranked ninth) were the two most commonly detected botnet families in 2Q10. (See "Battling Botnets for Control of Computers" on the *Security Intelligence Report* website for more information about botnets.)

Rogue Security Software

Rogue security software has become one of the most common methods that attackers use to swindle money from victims. Rogue security software, also known as *scareware*, is software that appears to be beneficial from a security perspective but provides limited or no security, generates erroneous or misleading alerts, or attempts to lure users into participating in fraudulent transactions. These programs typically mimic the general look and feel of legitimate security software and claim to detect a large number of nonexistent threats while urging the user to pay for the "full version" of the software to remove the threats. Attackers typically install rogue security software programs through exploits or other malware or use social engineering to trick users into believing the programs are legitimate and useful. Some versions emulate the appearance of the Windows Security Center or unlawfully use trademarks and icons to misrepresent themselves. (See "Rogue Security Software" in the Reference Guide section of the *Security Intelligence Report* website for more information about this kind of threat, and see www.microsoft.com/security/antivirus/rogue.aspx for an informative series of videos about rogue security software aimed at a general audience.)

FIGURE 46. Some of the "brands" used by different variants of Win32/FakeXPA, one of the most prevalent rogue security software families in 2Q10

FIGURE 47. The countries and regions with the most rogue security software infections in 2Q10, with the number of computers cleaned in total and the top five rogue families in each location

Worldwide	*4,391,982*
Win32/FakeSpypro	*1,424,275*
Win32/FakeXPA	*569,049*
Win32/FakeVimes	*559,076*
Win32/FakeRean	*493,443*
Win32/Winwebsec	*439,766*

United States	3,036,867
Win32/FakeSpypro	1,139,157
Win32/FakeXPA	412,018
Win32/FakeVimes	346,553
Win32/FakeRean	344,285
Win32/Winwebsec	301,300

United Kingdom	330,719
Win32/FakeSpypro	71,660
Win32/Winwebsec	55,385
Win32/FakeRean	49,037
Win32/FakeXPA	48,665
Win32/FakeVimes	42,989

Canada	168,993
Win32/FakeSpypro	63,426
Win32/Winwebsec	27,146
Win32/FakeVimes	19,679
Win32/FakeXPA	15,964
Win32/FakeRean	12,914

France	121,401
Win32/FakeSpypro	22,276
Win32/FakeXPA	14,653
Win32/FakeVimes	14,300
Win32/FakeRean	12,469
Win32/Fakeinit	11,547

Germany	92,484
Win32/FakeSpypro	22,979
Win32/FakeVimes	12,141
Win32/FakeXPA	10,929
Win32/FakeCog	8,749
Win32/FakeRean	7,211

Spain	70,596
Win32/FakeSpypro	22,961
Win32/FakeVimes	10,812
Win32/FakeRean	8,067
Win32/FakeXPA	4,949
Win32/FakeCog	4,866

Australia	64,047
Win32/FakeSpypro	21,714
Win32/FakeXPA	9,427
Win32/FakeRean	8,533
Win32/FakeVimes	7,577
Win32/Winwebsec	5,702

Italy	55,349
Win32/FakeSpypro	11,180
Win32/FakeVimes	8,585
Win32/FakeRean	7,428
Win32/FakeXPA	6,106
Win32/FakeCog	5,031

- Most rogue security software is written in English, so the social engineering techniques they use tend to be more effective in English-speaking regions. Four of the top eight locations with the most rogue security software detections in 2Q10 have large English-speaking populations.
- Win32/FakeSpypro was the most commonly detected rogue security software family in 2Q10 worldwide and in each of the top locations, with more than twice as many detections as the next most prevalent family. Names under which FakeSpypro is distributed include AntispywareSoft, Spyware Protect 2009, and Antivirus System PRO. Detections for FakeSpypro were added to the MSRT in July 2009.

- Win32/FakeXPA was the second most commonly detected rogue security software family in 2Q10. FakeXPA is a persistent, frequently updated threat that uses a variety of techniques to evade detection and removal by legitimate security products. It is distributed under a large number of names, some of which are illustrated in Figure 46. Detections for FakeXPA were added to the MSRT in December 2008.
- All of the top rogue security software families have been persistent threats for several quarters. Malware creators do release new families from time to time, such as Win32/FakeYak, the tenth most commonly detected rogue security software family in 2Q10, which first appeared in late 2009 or early 2010. Generally, however, rogue security software creators have found success updating existing families with new branding and anti-detection techniques.

Threats at Home and in the Enterprise

The behavior patterns of home users and enterprise users tend to be very different. Enterprise users typically use computers to perform business functions while connected to an enterprise network and may have limitations placed on their Internet and email usage. Home users are more likely to connect to the Internet directly or through a home router and to use their computers for entertainment purposes, like playing games, watching videos, and communicating with friends. These different behavior patterns mean that home users tend to be exposed to a different mix of computer threats than do enterprise users.

The infection telemetry produced by Microsoft desktop anti-malware products and tools includes information about whether the infected computer belongs to an Active Directory® domain. Domains are used almost exclusively in enterprise environments, whereas computers that do not belong to a domain are more likely to be used at home or in other non-enterprise contexts. Comparing the threats encountered by domain computers and non-domain computers can provide insights into the different ways attackers target enterprise and home users and which threats are more likely to succeed in each environment.

Figure 48 and Figure 49 list the top 10 families detected on domain-joined and non-domain computers in 1Q10 and 2Q10, respectively.

FIGURE 48. Top 10 families detected on domain-joined computers in 2Q10, by percentage of all infected domain-joined computers

Rank	Family	Most Significant Category	1Q10	2Q10
1	Win32/Conficker	Worms	21.3%	22.0%
2	Win32/Rimecud	Worms	9.0%	9.8%
3	Win32/Autorun	Worms	7.3%	8.3%
4	Win32/Taterf	Worms	4.1%	6.9%
5	Win32/Frethog	Password Stealers & Monitoring Tools	6.5%	6.0%
6	Win32/RealVNC	Miscellaneous Potentially Unwanted Software	5.6%	5.4%
7	Win32/Hamweq	Worms	7.0%	5.3%
8	Win32/Renos	Miscellaneous Trojans	5.2%	3.4%
9	Win32/FakeSpypro	Miscellaneous Trojans	2.3%	3.0%
10	Win32/Bredolab	Trojan Downloaders & Droppers	2.4%	2.7%

FIGURE 49. Top 10 families detected on non-domain computers in 2Q10, by percentage of all infected non-domain computers

Rank	Family	Most Significant Category	1Q10	2Q10
1	Win32/Taterf	Worms	4.8%	8.0%
2	Win32/Frethog	Password Stealers & Monitoring Tools	6.4%	6.9%
3	Win32/Renos	Miscellaneous Trojans	8.8%	6.6%
4	Win32/Rimecud	Worms	5.6%	5.7%
5	Win32/Autorun	Worms	3.8%	5.4%
6	Win32/Hotbar	Adware	3.4%	5.3%
7	Win32/FakeSpypro	Miscellaneous Trojans	4.1%	4.9%
8	Win32/Conficker	Worms	3.8%	4.7%
9	Win32/Alureon	Miscellaneous Trojans	4.8%	3.6%
10	Win32/Zwangi	Miscellaneous Potentially Unwanted Software	1.8%	3.1%

- Seven families are common to both lists, though ordered differently and in different proportions. The worm family Win32/Conficker, which employs several methods of propagation that work more effectively within a typical enterprise network environment than they do over the public Internet, leads the domain-joined list by a wide margin, but ranks eighth on the non-domain list.

- Worms accounted for 5 of the top 10 families detected on domain-joined computers. Several of these worms, including Conficker, Win32/Autorun, and Win32/Taterf, are designed to propagate via network shares, which are common in domain environments.
- The trojan family Win32/Alureon and the potentially unwanted software families Win32/Hotbar and Win32/Zwangi are all more common on non-domain computers than on domain-joined computers. Alureon is a large family of data-stealing trojans, some variants of which include bot components. Alureon variants typically perform such actions as stealing confidential information, downloading and executing arbitrary files, and redirecting URLs for popular search engines. (See "Battling Botnets for Control of Computers" on the *Security Intelligence Report* website for more information about Alureon.)
- Taterf and Win32/Frethog are two related families that are designed to steal the passwords of users playing massively multiplayer online role-playing games (MMORPGs). Such games are not common in the workplace, yet both families were detected with similar frequency on both domain-joined and non-domain computers. Taterf and Frethog both rely heavily on removable drives to propagate—a technique that was probably developed to help spread them in Internet cafés and public gaming centers, but one that has had the (perhaps unexpected) effect of spreading them efficiently in enterprise environments as well.

Guidance: Defending Against Malicious and Potentially Unwanted Software

Effectively protecting users from malware requires an active effort on the part of organizations and individuals to maintain up-to-date anti-malware defenses and to stay informed about the latest developments in malware propagation techniques, including social engineering. For in-depth guidance, see "Protecting Against Malicious and Potentially Unwanted Software" in the Mitigating Risk section of the *Security Intelligence Report* website.

Email Threats

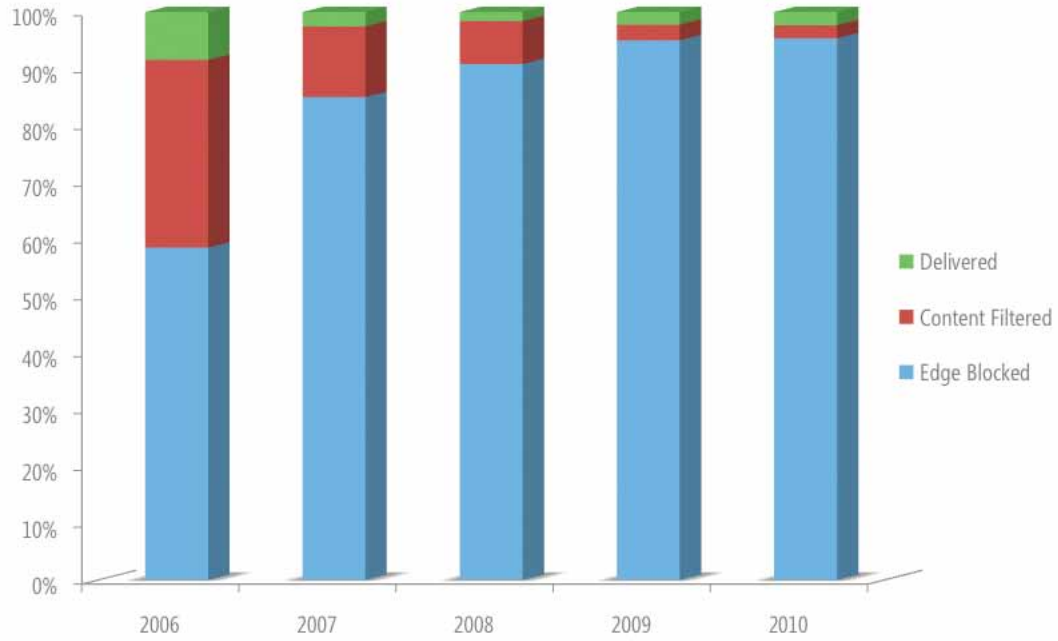
Almost all of the email messages sent over the Internet are unwanted. Not only does all this unwanted email tax the recipients' inboxes and the resources of email providers, but it also creates an environment in which emailed malware attacks and phishing attempts can proliferate. Email providers, social networks, and other online communities have made blocking spam, phishing, and other email threats a top priority.

Spam Trends and Statistics

The information in this section is compiled from telemetry data provided by Microsoft Forefront Online Protection for Exchange (FOPE), which provides spam, phishing, and malware filtering services for thousands of enterprise customers and tens of billions of messages per month. (See "Spam Trends" in the Reference Guide section of the *Security Intelligence Report* website for more information.)

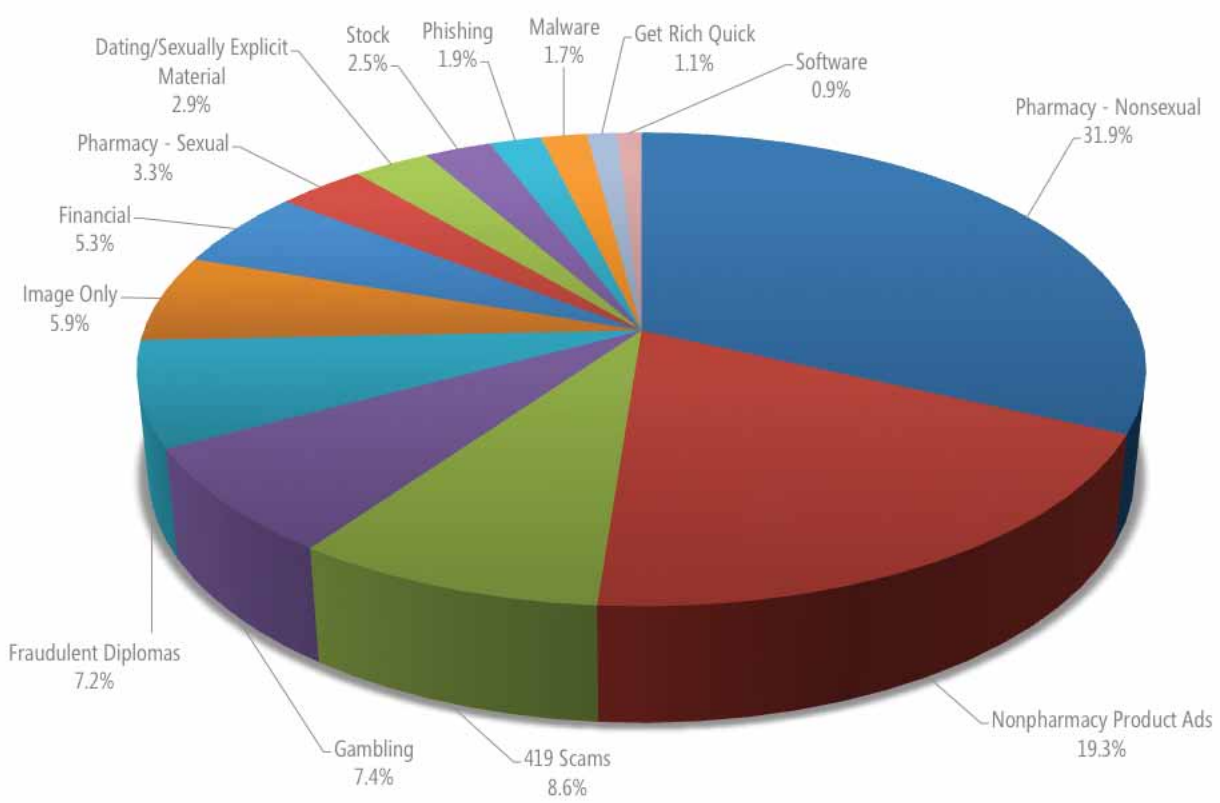
- FOPE performs spam filtering in two stages. Most spam is blocked by servers at the network edge, which use reputation filtering and other non-content-based rules to block spam or other unwanted messages. Messages that are not blocked at the first stage are scanned using content-based rules, which detect and filter many additional email threats, including attachments that contain malware.

FIGURE 50. Percentage of incoming messages blocked by FOPE using edge-blocking and content filtering, 2006–2010



- In 2010 overall, only about 1 out of every 47.6 incoming messages made it to recipients' inboxes. The rest were blocked at the network edge or through content filtering.
- About 95.4 percent of all incoming messages were blocked at the network edge, which means that only 4.6 percent of incoming messages had to be subjected to the more resource-intensive content filtering process.
- As Figure 51 shows, the effectiveness of edge-filtering techniques such as IP address reputation checking, SMTP connection analysis, and recipient validation, have increased dramatically over the past several years, which enables mail-filtering services to provide better protection to end users even as the total amount of unwanted message traffic on the Internet remains as high as ever.

FIGURE 51. Inbound messages blocked by FOPE filters in 2Q10, by category

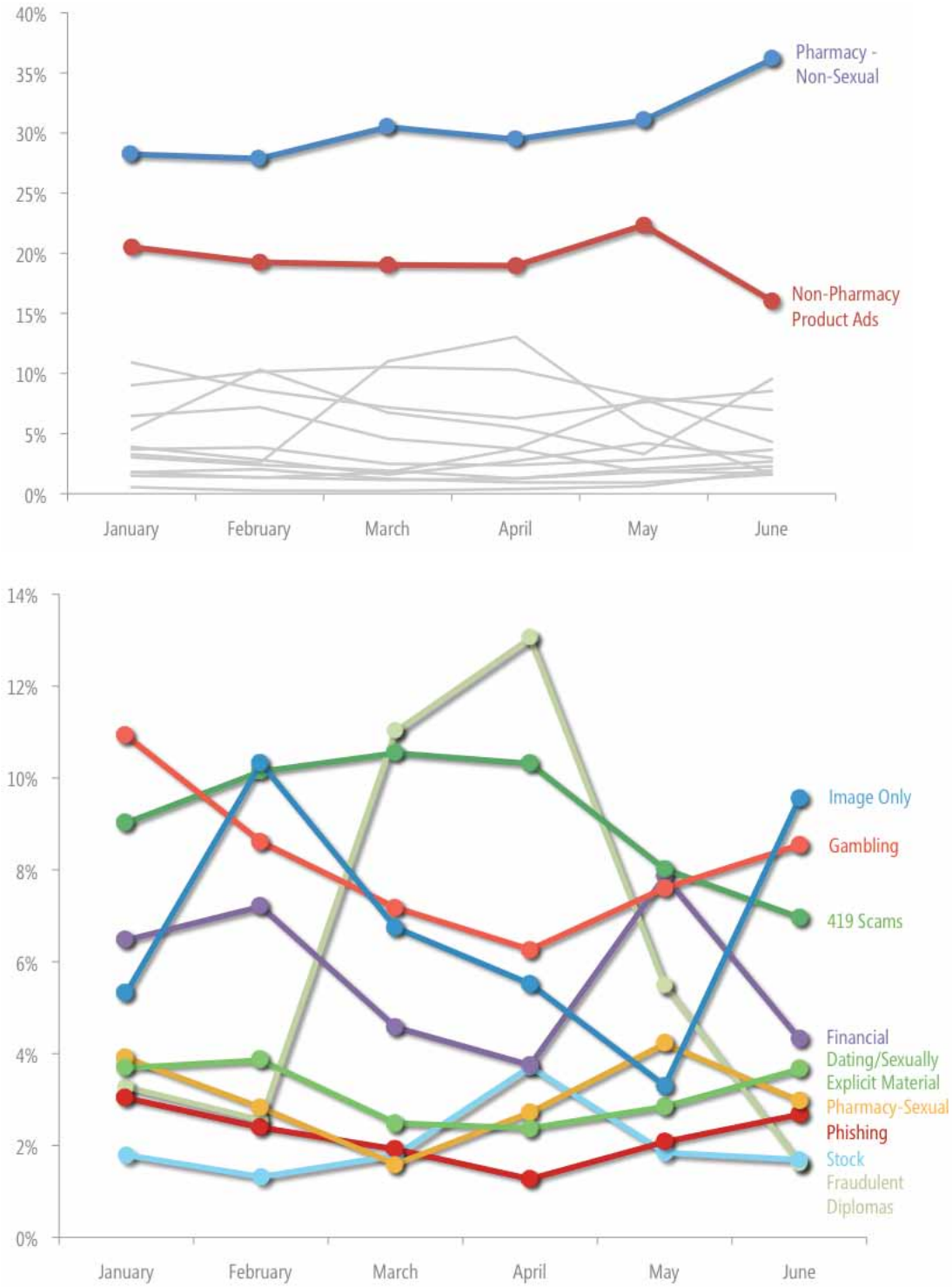


- Advertisements for nonsexual pharmaceutical products accounted for 31.9 percent of the spam messages blocked by FOPE content filters in 2Q10.
- Together with nonpharmaceutical product ads (19.3 percent of the total) and advertisements for sexual performance products (3.3 percent), product advertisements accounted for 53.9 percent of spam in 2Q09, which is down from 69.2 percent a year ago.
- In an effort to evade content filters, spammers often send messages that consist only of one or more images, with no text in the body of the message. Image-only spam messages accounted for 5.9 percent of the total in 2Q10.

FIGURE 52. An example of an image-only spam message

- Image-only spam messages have become less common recently. Messages that include images consume more network bandwidth than text-only messages, which reduces the number of messages a spammer can send in a given timeframe. Accordingly, spammers have begun to shift their evasion efforts to new techniques that use less bandwidth, like using link-shortening services to disguise malicious URLs.

FIGURE 53. Inbound messages blocked by FOPE content filters in 1Q10 and 2Q10, by category



- Nonsexual pharmaceutical ads and nonpharmaceutical product ads are consistently the most highly ranked categories from period to period, and 2010 has been no exception.
- As Figure 53 illustrates, spam categories can vary considerably from month to month as spammers conduct time-based campaigns, much like legitimate advertisers do. Spam that advertises fraudulent university diplomas, normally a low-volume category, increased nearly sixfold between February and March and was actually the third most prevalent category in March and April before declining to last place in June.

Guidance: Defending Against Threats in Email

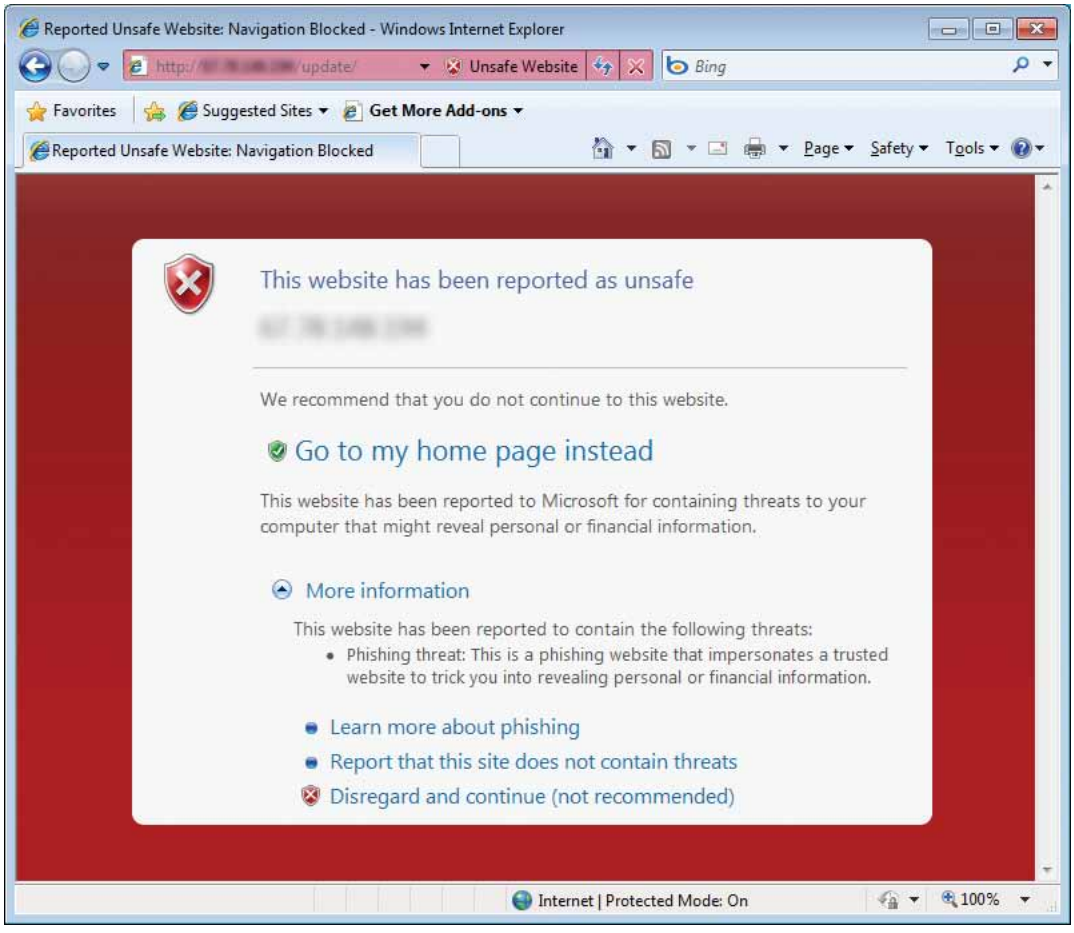
In addition to using a filtering service such as FOPE, organizations can take a number of steps to reduce the risks and inconvenience of unwanted email. Such steps include implementing email authentication techniques and observing best practices for sending and receiving email. For in-depth guidance, see "Guarding Against Email Threats" in the Mitigating Risk section of the *Security Intelligence Report* website.

Malicious and Compromised Websites

Attackers often use websites to conduct phishing attacks or distribute malware. Malicious websites typically appear completely legitimate and often provide no outward indicators of their malicious nature, even to experienced computer users. To help protect users from malicious webpages, Microsoft and other browser vendors have developed filters that keep track of sites that host malware and phishing attacks and display prominent warnings when users try to navigate to them.

The information in this section is compiled from a variety of internal and external sources, including telemetry data produced by the SmartScreen® Filter (in Windows Internet Explorer 8), the Phishing Filter (in Internet Explorer 7), from a database of known active phishing and malware hosting sites reported by users of Internet Explorer and other Microsoft products and services, and from malware data provided by Microsoft anti-malware technologies. (See "Phishing" and "Malware Hosts" in the Reference Guide section of the *Security Intelligence Report* website for more information.)

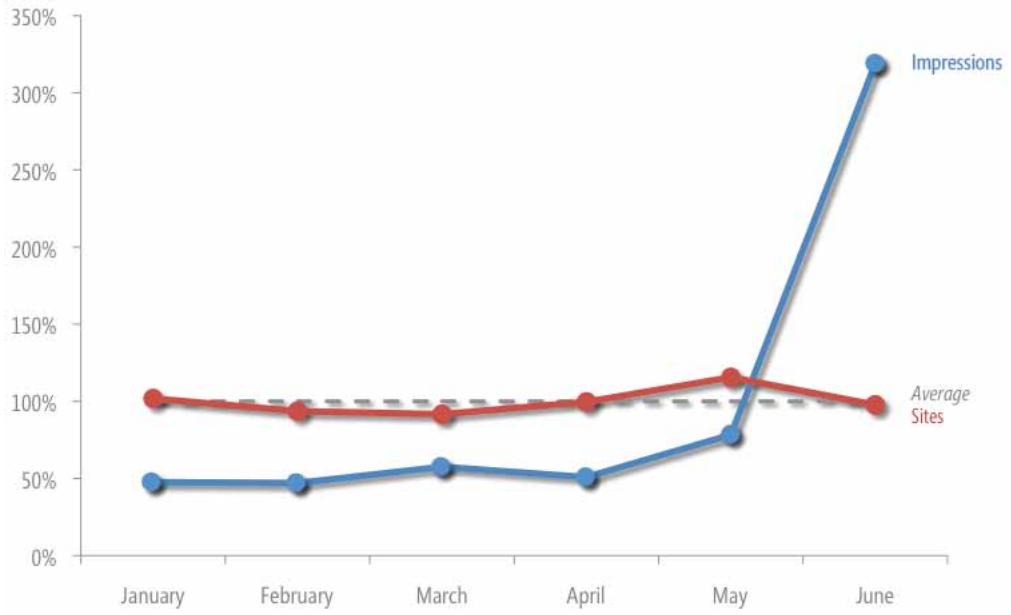
FIGURE 54. The SmartScreen Filter in Internet Explorer 8 blocks reported phishing and malware distribution sites.



Analysis of Phishing Sites

Figure 55 compares the volume of active phishing sites in the SmartScreen database each month with the volume of *phishing impressions* tracked by Internet Explorer. A phishing impression is a single instance of a user attempting to visit a known phishing site with Internet Explorer and being blocked.

FIGURE 55. Phishing sites and impressions tracked each month from January to June 2010, relative to the monthly average for each



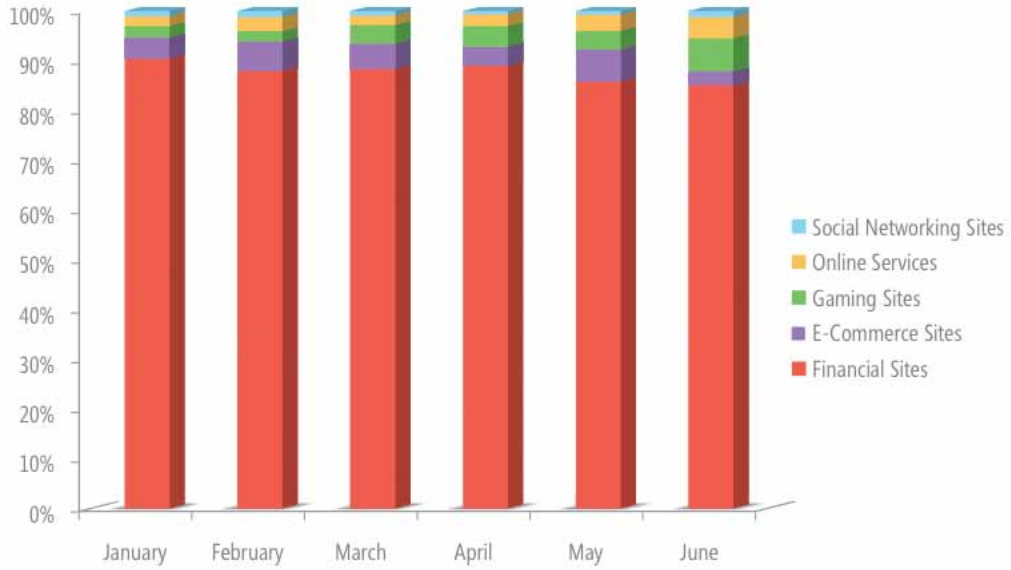
- Sudden sharp spikes in impressions like the one shown in June are not unusual. Phishers often engage in discrete campaigns intended to drive more traffic to each phishing page, without necessarily increasing the total number of active phishing pages they are maintaining at the same time. In this case, the June increase is not strongly correlated with increases in any particular type of target institution.
- Phishing impressions and active phishing pages rarely correlate strongly with each other. The total number of active phishing pages tracked by Microsoft remained very stable from month to month, with no month deviating by more than about 15 percent from the six-month average.

Target Institutions

Figure 56 and Figure 57 show the percentage of phishing impressions and active phishing sites, respectively, recorded by Microsoft during each of the first six months of 2010 for the most frequently targeted types of institutions.

FIGURE 56. Impressions for each type of phishing site each month from January to June 2010

FIGURE 57. Active phishing sites tracked each month from January to June 2010, by type of target



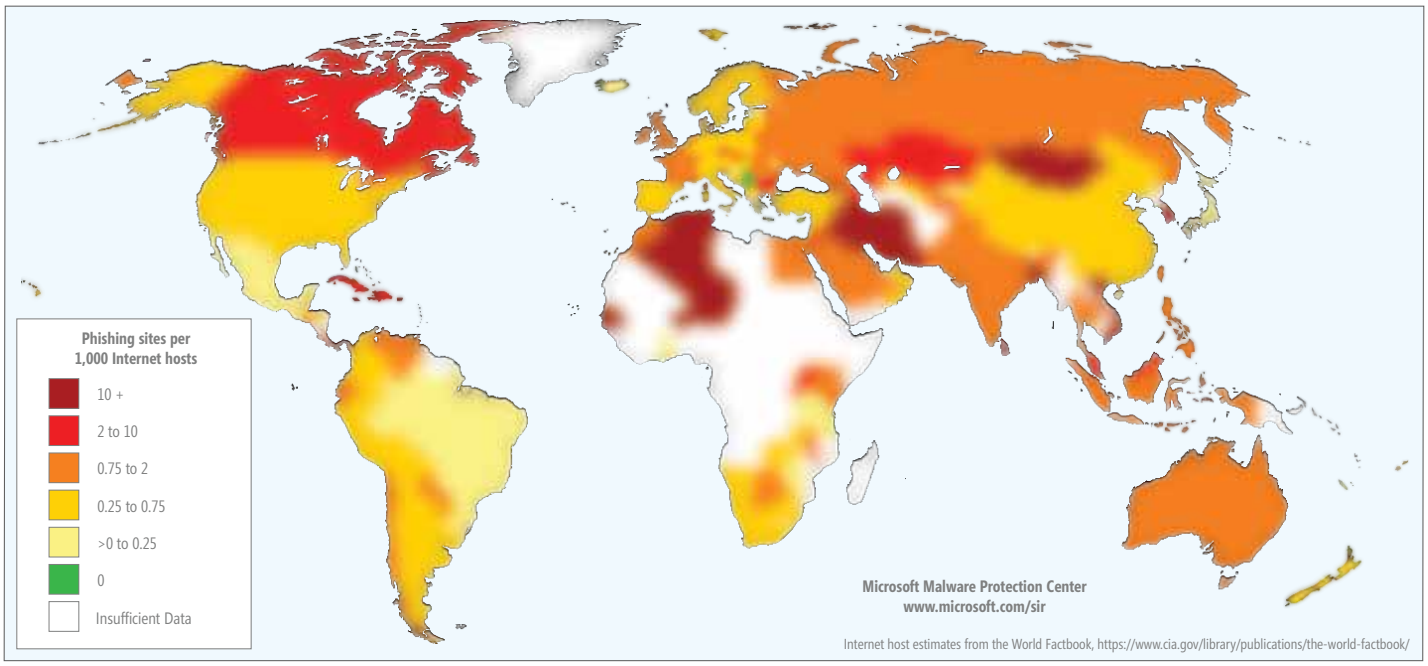
- For the current volume, the *Security Intelligence Report* has begun to track online gaming sites separately from other online services. Phishers have targeted gaming sites with increasing frequency over the past few months. In 2009, gaming sites accounted for about 1 percent of active phishing sites and 2 percent of impressions. By June 2010, gaming sites had increased to 6.7 percent of phishing sites and 16.6 percent of phishing impressions.

- Phishing sites that target social networks routinely receive the highest number of impressions per active phishing site. In May, sites that target social networks received 62.4 percent of all phishing impressions despite accounting for less than 1 percent of active phishing sites.
- As in previous periods, sites that target financial institutions accounted for the majority of active phishing sites, ranging from 85 to 90 percent of sites each month. Financial institutions targeted by phishers can number in the hundreds, and customized phishing approaches are required for each one. By contrast, just a handful of popular sites account for the bulk of the social network and online service usage on the Internet, so phishers can effectively target many more people per site. Still, the potential for direct illicit access to victims' bank accounts means that financial institutions remain perennially popular phishing targets, and they account for the majority of phishing impressions most months.

Geographic Distribution of Phishing Sites

Phishing sites are hosted all over the world on free hosting sites, on compromised web servers, and in numerous other contexts. Performing geographic lookups of IP addresses in the database of reported phishing sites makes it possible to create maps that show the geographic distribution of sites and to analyze patterns.

FIGURE 58. Phishing sites per 1,000 Internet hosts for locations around the world in 2Q10



- Phishing sites are concentrated in a few locations but have been detected on every inhabited continent.
- Locations with smaller populations and fewer Internet hosts tend to have higher concentrations of phishing pages, although in absolute terms most phishing pages are located in large, industrialized countries/regions with large numbers of Internet hosts.

Analysis of Malware Hosts

The SmartScreen Filter in Internet Explorer 8 helps provide protection against sites that are known to host malware, in addition to phishing sites. The SmartScreen anti-malware feature uses URL reputation data and Microsoft anti-malware technologies to determine whether those servers are distributing unsafe content. As with phishing sites, Microsoft keeps track of how many people visit each malware hosting site and uses the information to improve the SmartScreen Filter and to better combat malware distribution. (See "Malware Hosts" in the Reference Guide section of the *Security Intelligence Report* website for more information.)

Types of Malware Distributed Over the Web

Figure 59 and Figure 60 explore the threats hosted at URLs blocked by the SmartScreen Filter in 2Q10.

FIGURE 59. Threats hosted at URLs blocked by the SmartScreen Filter in 2Q10, by category

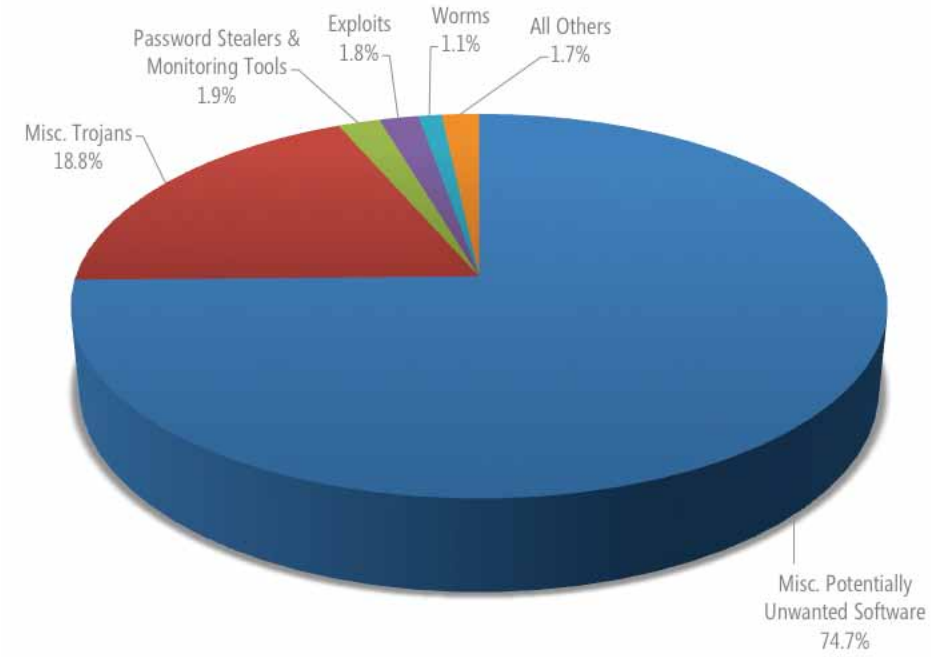


FIGURE 60. The top 10 malware families hosted on sites blocked by the SmartScreen Filter in 2Q10

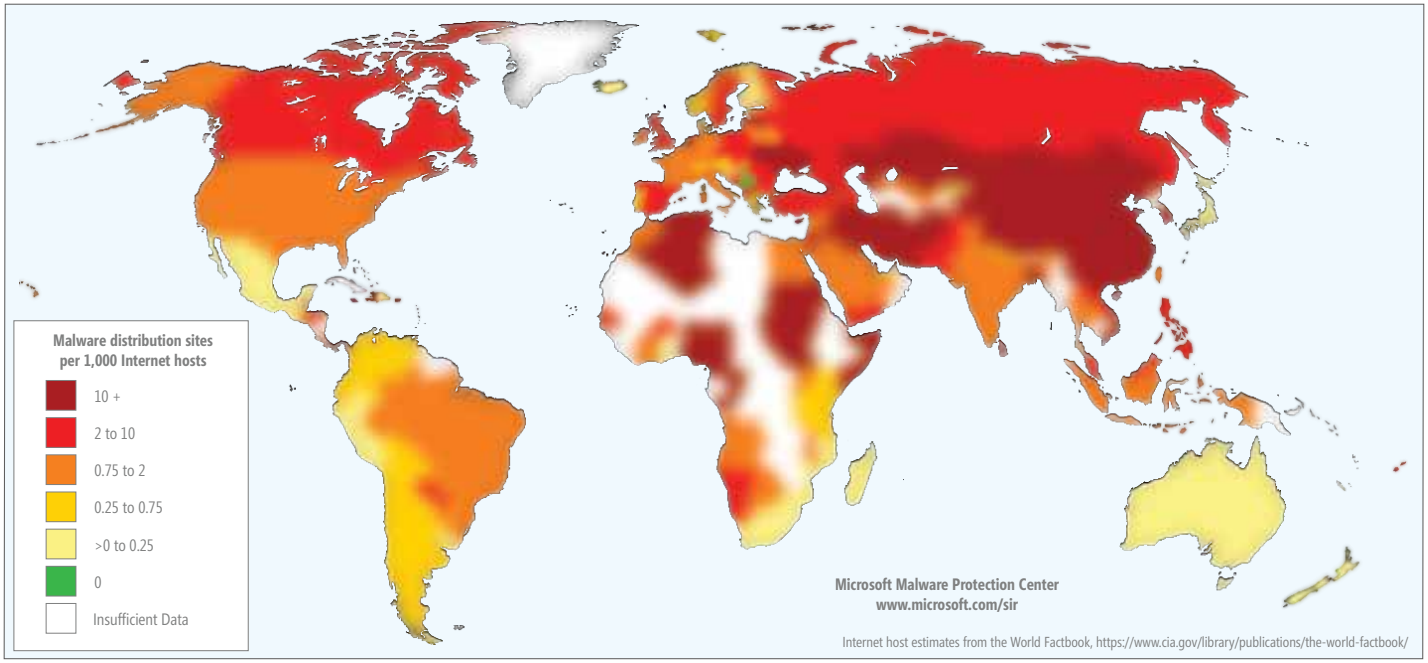
Rank	Threat Name	Most Significant Category	Percent of Malware Impressions
1	Win32/MoneyTree	Misc. Potentially Unwanted Software	61.1
2	Win32/FakeXPA	Miscellaneous Trojans	3.3
3	Win32/VBInject	Misc. Potentially Unwanted Software	2.3
4	Win32/Winwebsec	Miscellaneous Trojans	2.0
5	Win32/Obfuscator	Misc. Potentially Unwanted Software	1.9
6	Win32/Pdfjsc	Exploits	1.4
7	Win32/Small	Trojan Downloaders & Droppers	1.3
8	Win32/Bancos	Password Stealers & Monitoring Tools	1.3
9	Win32/Swif	Miscellaneous Trojans	1.2
10	WinNT/Citeary	Misc. Potentially Unwanted Software	1.1

- Overall, sites hosting the top 10 families constituted 76.9 percent of all malware impressions, up from 71.4 percent last year.
- Miscellaneous Potentially Unwanted Software accounted for nearly three quarters of all malware impressions, primarily because of Win32/MoneyTree. MoneyTree, which accounted for 31.6 percent of malware impressions in the second half of 2009, now accounts for 61.1 percent of malware impressions.
- Win32/VBInject, Win32/Obfuscator, Win32/Pdfjsc, Win32/Small, and Win32/Swif are all generic detections for collections of unrelated threats that share certain identifiable characteristics.

Geographic Distribution of Malware Hosting Sites

Figure 61 shows the geographic distribution of malware hosting sites reported to Microsoft in 2Q10.

FIGURE 61. Malware distribution sites per 1,000 Internet hosts for locations around the world in 2Q10



- Locations with high concentrations of malware hosting sites include China (16.5 malware hosting sites per 1,000 Internet hosts), Ukraine (14.4), the Netherlands (11.1), and Israel (9.4).
- Mexico, Japan, and Finland all had fewer than 0.1 malware hosting sites per 1,000 Internet hosts. Other locations with low concentrations of malware hosting sites include Australia, New Zealand, Croatia, and South Africa.

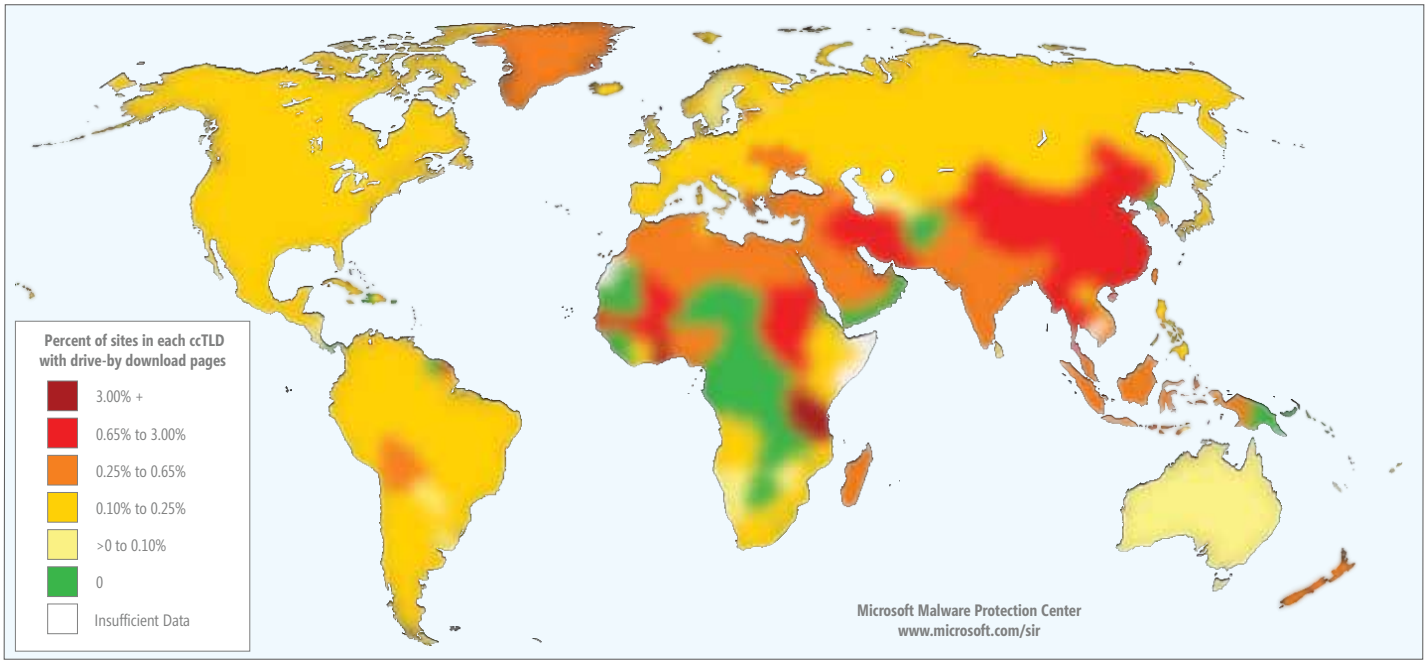
Analysis of Drive-By Download Sites

A *drive-by download* site is a website that hosts one or more exploits that target vulnerabilities in web browsers and browser add-ons. Users with vulnerable computers can be infected with malware simply by visiting such a website, even without attempting to download anything.

Search engines such as Bing™ have taken a number of measures to help protect users from drive-by downloads. Bing analyzes websites for exploits as they are indexed and displays warning messages when listings for drive-by download pages appear in the list of search results. (See "Drive-By Download Sites" in the Reference Guide section of the *Security Intelligence Report* website for more information about how drive-by downloads work and the steps Bing takes to protect users from it.)

The information in this section was generated from an analysis of the country code top-level domains (ccTLDs) of the websites in the Bing index that hosted drive-by download pages in 1H10.

FIGURE 62. Number of websites per 1,000 in each country code top-level domain that hosted drive-by download pages in 1H10



- In 1H10, drive-by download pages accounted for about 0.3 of every 1,000 pages in the Bing index and appeared on about 2 of every 1,000 search results pages displayed to users during that time.
- In absolute terms, the .cn domain (associated with China) hosted more drive-by sites than any other ccTLD, with 5.8 percent of all drive-by download sites found in 1H10. Next on the list were .ru (associated with Russia) with 2.8 percent of all drive-by sites, .de (associated with Germany) with 2.8 percent, and .uk (associated with the United Kingdom) with 1.7 percent.
- Among the largest country-code top-level domains (ccTLDs), .cn had the highest rate of infection, with 6.7 of every 1,000 websites in the .cn TLD found to be hosting drive-by download pages. In second place was .ru (associated with Russia), with 2.3 of every 1,000 .ru domains infected. The .jp (associated with Japan), .uk (associated with the United Kingdom), and .de (associated with Germany) ccTLDs each had a drive-by infection rate of about 1 of every 1,000 websites.
- Among mid-sized ccTLDs, .th (associated with Thailand) and .ae (associated with the United Arab Emirates) each had a drive-by infection rate of about 10.2 of every 1,000 websites. About 5.1 of every 1,000 websites in the .my TLD (associated with Malaysia) were found to be hosting drive-by download pages, along with 4.9 of every 1,000 sites in the .id TLD (associated with Indonesia).

- Overall, the most heavily infected ccTLDs were small ones. Small TLDs are susceptible to large swings in infection rate because of their size. For example, if a major ISP in a small country or region were to become compromised by an attacker, it could affect a large percentage of the domains in the associated ccTLD.
- Figure 62 does not reflect the physical locations of hosted sites; not all ccTLD sites are hosted in the locations to which the ccTLDs themselves are assigned. However, most ccTLD sites are targeted at Internet users in a particular country/region and are typically written in an appropriate language, so Figure 62 can be taken as a reasonable indicator of how users in different parts of the world are more or less at risk of encountering drive-by download pages.

Automated SQL Injection Attacks

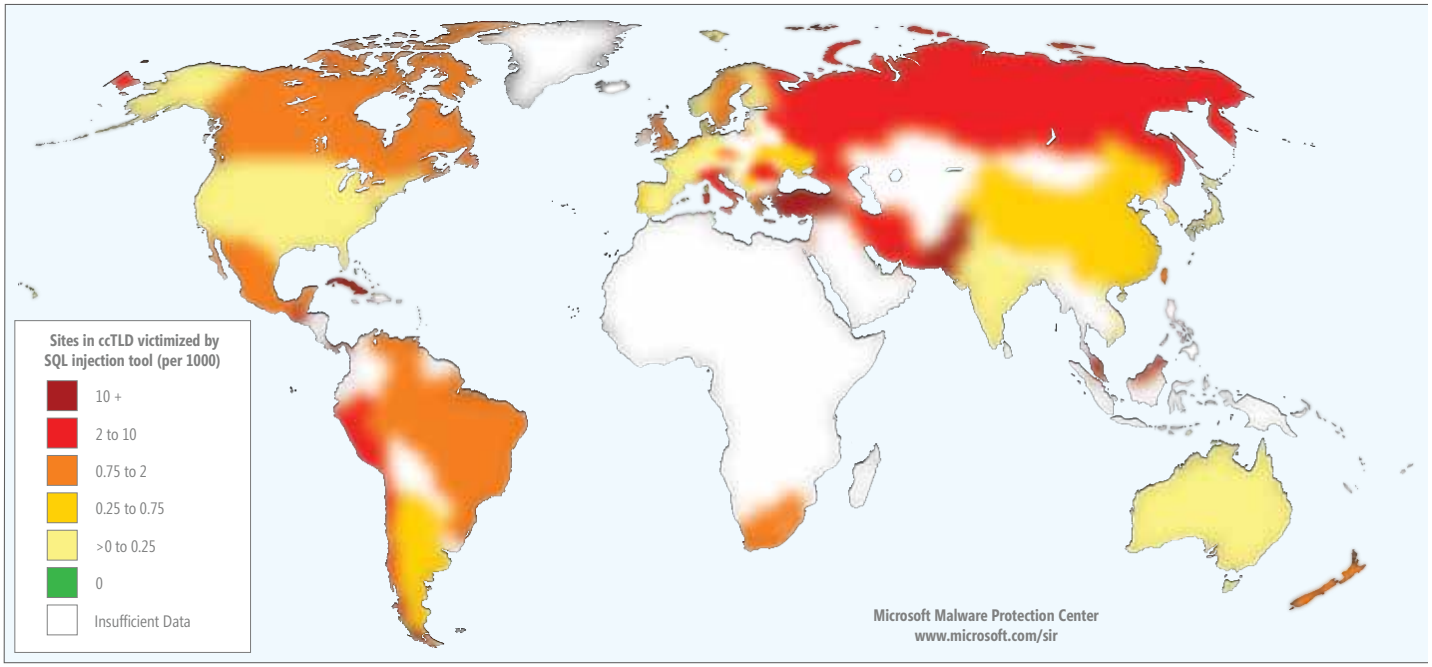
SQL injection is a technique used by attackers to damage or steal data from databases that use Structured Query Language (SQL) syntax to control information storage and retrieval. SQL injection attacks involve entering malicious SQL statements into fields that accept user data, such as text fields on a webpage. If the program or script that processes the input does not properly validate it, an attacker may be able to execute arbitrary database commands. Attackers use SQL injection to delete or alter sensitive records, upload malware to a website, or perform other harmful actions. (See "Automated SQL Injection Attacks" in the Reference Guide section of the *Security Intelligence Report* website for more information about SQL injection and the automated tools attackers use to find and exploit vulnerable websites.)

Microsoft uses a number of methods to detect and track websites that have been victimized by certain classes of automated SQL injection attack. Figure 63 and Figure 64 show how different TLDs were affected in 1H10.

FIGURE 63. Top 10 TLDs affected by SQL injection attacks in 1H10

Rank	TLD	Associated with	Victimized pages
1	.tr	Turkey	88,378
2	.com	Commercial entities	43,144
3	.org	Nonprofit organizations	18,331
4	.net	Network infrastructure	5,206
5	.ru	Russia	5,179
6	.it	Italy	3,395
7	.ro	Romania	1,817
8	.uk	United Kingdom	1,812
9	.my	Malaysia	1,773
10	.nl	Netherlands	1,545

FIGURE 64. Websites victimized by SQL injection in 1H10, by ccTLD



- The .tr TLD, associated with Turkey, was the TLD with the most domains affected by automated SQL injection attacks in 1H10, both in absolute terms and as a percentage of all domains in the TLD.
- The list of the most affected TLDs can change significantly between periods, as victimized sites resolve their problems and attackers discover other vulnerable sites. The .tr TLD, which ranked first in 1H10, ranked 63rd in 2H09. In fact, with the exception of the heavily used generic TLDs .com, .net, and .org, none of the TLDs in the top 10 in 1H10 were also on the list in 2H09.

Guidance: Protecting Users from Unsafe Websites

Organizations can best protect their users from malicious and compromised websites by mandating the use of web browsers with appropriate protection features built in and by promoting safe browsing practices. For in-depth guidance, see the following resources in the Mitigating Risk section of the *Security Intelligence Report* website:

- Promoting Safe Browsing
- Protecting Your People

For information about how website owners can protect their sites from SQL injection attempts, see "Guarding Against SQL Injection" in the Mitigating Risk section of the *Security Intelligence Report* website.

Managing Risk

This section features information and tips from two groups at Microsoft that have practical, real-world experience managing malware outbreaks and safeguarding networks, systems, and people: Microsoft IT (MSIT), which manages the enterprise computing infrastructure at Microsoft, and Microsoft Customer Service and Support (CSS), which provides support information and services to Microsoft customers worldwide. The information presented here describes how these two groups have met the challenges posed by malware and security threats in their areas of responsibility. Not all of the details are likely to be relevant to security-related scenarios elsewhere, but Microsoft hopes that this information will give readers useful ideas for improving their own incident prevention and response plans. For comprehensive security guidance related to the aspects of security covered in this report, see the Managing Risk section of the Security Intelligence Report *website.*

Making Microsoft More Secure

Microsoft IT (MSIT)

Microsoft IT (MSIT) provides information technology services internally for Microsoft employees and resources. MSIT manages 900,000 devices for 180,000 end users across more than 100 countries and regions worldwide, with approximately 2 million remote connections per month. Safeguarding a computing infrastructure of this size requires implementation of strong security policies, technology to help keep malware off the network and away from mission-critical resources, and dealing with malware outbreaks swiftly and comprehensively when they occur.

The *Security Intelligence Report* typically focuses primarily on the technological aspects of malware and security, supported by in-depth telemetry data from multiple products and services. However, for IT departments looking to secure their networks, the non-technical aspects of security—policies, planning, education, awareness, and others—can be just as important. MSIT has had considerable experience on both sides of the equation, and we hope that information about the policies we've implemented can benefit others.

The IT Showcase section of the Microsoft TechNet Library (technet.microsoft.com) includes a variety of articles and papers from MSIT about all aspects of IT administration. In this section we present a small sample of the IT Showcase material we have published on the subject of security. See technet.microsoft.com/library/bb687780.aspx for the full Microsoft IT Showcase collection, and see technet.microsoft.com/library/bb687795.aspx for the full versions of these and other security-related articles.

Information Security Policies

Excerpt from "Information Security at Microsoft Overview" (technet.microsoft.com/library/bb671086.aspx), updated November 2007

Microsoft uses a layered approach to information security policies. This approach evolved out of business needs that remain fueled by an appreciation of the value of information assets, an evolving threat landscape with intentional and unintentional breaches and loss of information, and technology advancements enacted within and outside the company. The information security policies at Microsoft include:

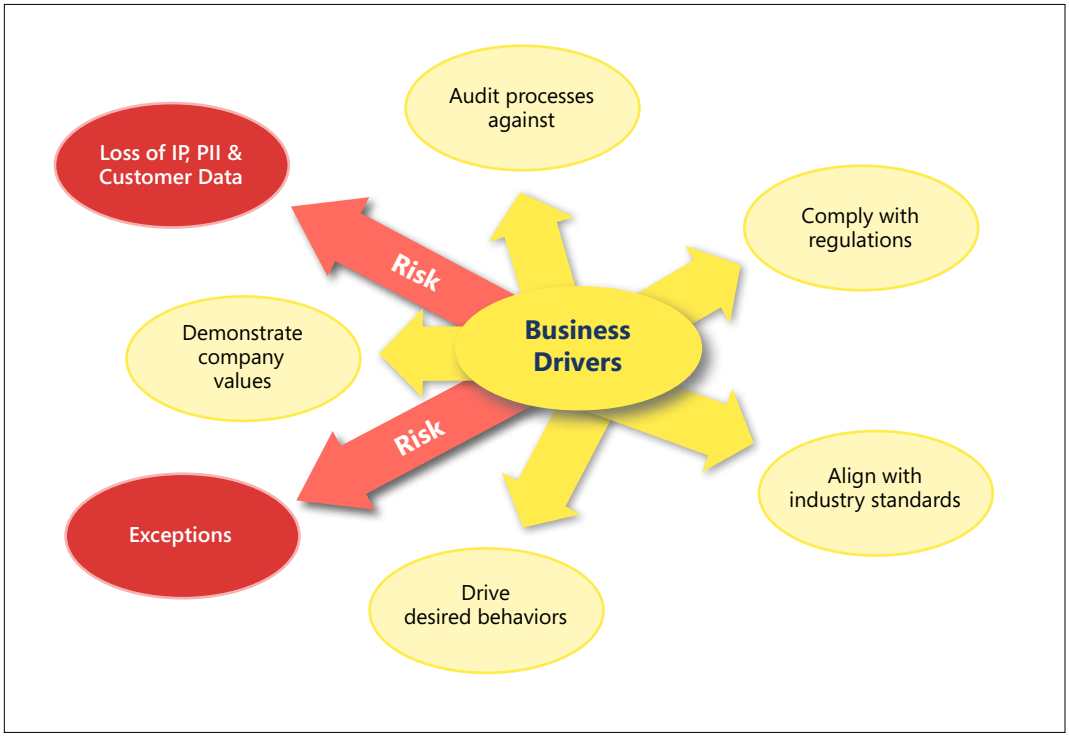
- **Microsoft Information Security Program (MISP) Policy.** This policy establishes accountabilities that require Microsoft to operate a security program. It also establishes a framework for a risk-based and policy-based approach to protecting assets.
- **Information Security Policy.** This policy contains principles for protecting and properly using corporate resources. It supports specific security standards, operating procedures, and guidelines for business units.
- **Information Security Standards.** This policy provides requirements and prescriptive guidance that enable users to comply with the Information Security Policy.

Business Drivers for Information Security Policies

Information security policies demonstrate company values and drive desired behaviors. They help ensure regulatory compliance and alignment with industry standards, and they are useful for conducting internal audits. Audits help ensure that company procedures support policies and that employees are following the procedures; they also help measure the overall security health of the organization. Without policies to govern the corporate infrastructure, the potential for loss of intellectual property, personally identifiable information (PII), and customer data increases dramatically.

Figure 65 illustrates how Microsoft manages risk by using security policies that drive behavior, support values, and limit exceptions.

FIGURE 65. How Microsoft uses information security policies



Policy Management

Microsoft IT must enforce all of its unique security policies consistently to maintain credibility. Involving key executives during the authorization process lends influence and credence. Implementing a repeatable process ensures that the appropriate roles, responsibilities, and administrative controls are in place.

Promoting awareness: If users are not aware of policies and standards, they cannot be held accountable for compliance. A scenario-based view of these requirements enables users to glean only those requirements that correspond to common usage scenarios. In the

future, corresponding scenario-based awareness tactics will help users learn about these requirements. Additionally, employees attend an orientation that introduces information security policies and standards and explains where to find them. An awareness team provides online training and monthly policy communications.

Monitoring and enforcement: A comprehensive security scorecard is being developed to help the businesses understand their progress against mitigating security risks.

Promoting Awareness

Excerpt from "Information Security at Microsoft Overview" (technet.microsoft.com/library/bb671086.aspx), updated November 2007

Strong security is a business enabler that helps improve productivity and protect assets. For any organization, awareness is one of the primary tools used to achieve strong security levels. However, raising security awareness among staff continues to be a key challenge.

Successful security efforts must address three key elements: *people*, *processes*, and *technology*. Developing clear and effective policies is an integral part of promoting security and compliance. Poor security awareness is one of the primary barriers to achieving strong security levels. Creating an awareness and understanding of those policies is an essential enterprise responsibility.

Security Awareness Program

Because human behavior is an unknown variable, making it the weakest link in the security chain, a security awareness program is required to encourage large numbers of employees to behave consistently with respect to security requirements. The program must inspire individuals to be proactive in preventing security incidents. The program must also be able to reach the constant influx of new employees, vendors, and contingent staff.

Components of the Microsoft IT Security Awareness Program include:

- **Creating partnerships.** The challenge of security awareness is creating strong and effective partnerships from which all groups can benefit in a collaborative effort. Each group must help the other achieve its individual goals. In these joint efforts, care should be taken to not dilute the message of any one group.
- **Mitigating risk.**
  - Keep security messages fresh and in circulation.
  - Target new employees and current staff members.
  - Set goals to ensure a high percentage of the staff is trained on security best practices.
  - Repeat the information to help raise awareness.

- **Communication vehicles.** Multiple communication vehicles should be used to reach as many people as possible. These include:
  - Mandatory online training.
  - In-depth learning guides.
  - Monthly newsletters.
  - Monthly and bi-monthly electronic magazine articles.
  - Printed collateral.
  - Websites.
- **Technologies that support Microsoft security awareness.** Use innovative media to "socialize" your security messaging from "no" to "how" by telling what users "can do" instead of what they "cannot." These include:
  - **Learning management system.** Host and track participation in online training sessions.
  - **Microsoft Office.** Create in-depth guides by using Microsoft Office PowerPoint®; deliver newsletters and electronic magazines by using Microsoft Office Word and Microsoft Office Outlook.
  - **Windows Media® Player (.wmv files).** Create security awareness videos or podcasts for online training, new-employee orientations, and on-demand content from websites.
  - **Windows SharePoint® Services.** Create an internal security website by using the integrated custom scenario tool.

Build a security awareness program in your organization today with the Microsoft Security Awareness Toolkit (go.microsoft.com/?Linkid=9510357) and TechNet program material (technet.microsoft.com/security/cc165442.aspx.)

Defending Against Malware

Excerpts from "Information Security at Microsoft Overview" and IT Showcase Productivity Guides

Malicious software is an ever-present threat, and the trend to target malicious software to specific companies and users has kept this a top priority for the Information Security team. By some measurements, the Microsoft network is one of the largest private sector cyberattack targets in the world.

Secure Infrastructure

Some of the essential defense-in-depth layers that Microsoft IT has implemented include the following:

- **Two-factor authentication.** Active Directory Domain Services policies that require certificates stored on smart cards for two-factor authentication for all remote, or VPN, connections to Microsoft. Microsoft IT deployed smart cards to help protect user identities from credential reuse and other malicious intent. Smart cards take advantage of Windows technologies, including the Certificate Services feature and Public Key Infrastructure (PKI) security, Microsoft Base Smart Card cryptographic service provider (CSP), and Extensible Authentication Protocol/Transport Layer Security (EAP/TLS).
- **Secure Remote User access to the network.** Remote access solutions that require only a user name and a password can allow untrustworthy devices to access the corporate network. Microsoft IT implemented a solution that consists of a number of technologies to help secure remote access connections on the corporate network as part of the Secure Remote User framework. After logon, if the systems do not meet configuration requirements, the users remain in the quarantine network.
- **Enforcement of strong passwords.** Passwords are the keys to the enterprise network. Microsoft IT enforces strong password policies for all network users. With strict policies and attributes in place, passwords are far less vulnerable.
- **Security-enhanced wireless access.** An upgrade to the wireless network provided security capabilities such as network segmentation, certificate-based network access, and centralized management and monitoring of network devices.
- **Implementation of network intrusion detection systems (NIDS).** The Information Security team employed a NIDS platform with real-time event correlation technology to achieve a high level of knowledge about the state of the network, presence of malicious activity, and threat exposure on global and local levels. Prior to this, the response to malicious network attacks was highly reactive and consumed a significant amount of resources and time.
- **Network segmentation.** Because Microsoft IT does not manage all computers on the Microsoft internal network, isolating trusted, domain-managed computers from unmanaged computers reduces the risk of network compromise. Deploying Internet Protocol security (IPsec) across the corporate network provides a better understanding of where unmanaged computers exist and why they are in use. These trusted computers can be configured to allow only incoming connections from other trusted computers.
- Network Access Protection (NAP). A Microsoft platform and solution that controls access to network resources based on a client computer's identity and compliance with an organization's governance policy. NAP allows network administrators to define specific levels of network access based on a client computer's identity, the groups to which the client belongs, and the degree to which that client is compliant

with an organization's governance policy. If a client is not compliant, its access to the network is limited. NAP also provides a mechanism to automatically make it compliant and then dynamically increase its level of network access.

- DirectAccess. A feature of Windows 7 and Windows Server 2008 R2 that can be used with NAP to allow remote users to safely and securely access enterprise shares, websites, and applications without connecting to a virtual private network (VPN).
- Microsoft System Center Configuration Manager (SCCM). A management solution for comprehensively assessing, deploying, and updating servers, clients, and devices across physical, virtual, distributed, and mobile environments.
- Microsoft System Center Operations Manager (SCOM). An end-to-end service-management product that enables operations and IT management teams to identify and resolve issues affecting the health of distributed IT services.
- **User Account Control (UAC).** UAC provides additional security for users who require administrative access at times. With UAC, users cannot run with their full administrator access token without giving explicit consent. By default, all users, even those with full administrative access, run as if their account has standard user access. When Windows Vista and Windows 7 determine that a particular action requires the full administrator access token, the UAC service alerts the user that the action requires consent to run with the user's full access token.

The best approach to combating malicious software is using a combination of these mechanisms. An organization should test and evaluate these mechanisms prior to implementation to ensure the best selection for a particular environment. After implementation, continuing to test and evaluate is critical to ensure that the best software and solutions are in use.

Protect Your Computer

Every computer connected to a corporate network is a gateway. Therefore, you must guard it against intruders trying to gain unauthorized access to corporate resources and intellectual property.

A number of the best practices Microsoft has implemented can help protect your organization from potential threats:

- **Install updates regularly.** Keep your software up to date at home and at the office. Microsoft Information Technology (IT) recommends using automatic updates to ensure you always have the latest software, updates, and virus protection. By default, when you connect to your domain, Microsoft Exchange resets your Windows Update settings so that it runs automatically.
- **Use passwords for security.** Select strong, hard-to-hack passwords, which act as your computer's first line of defense for protecting your data and intellectual property, and the organization's network.

- **Set a password for your screen saver.** MSIT recommends that you use your Windows password in combination with your screen saver to prevent unauthorized access to your computer and the corporate network when you are not working on it.
- **Lock your computer.** This enables you to leave programs open and running but helps protect the corporate network and resources from unauthorized access.

- **Install and enable anti-malware software.** Even for an expert, removing a virus from a computer can be a daunting task without the help of tools designed for the job. Malware programs can be designed to reinstall themselves after they have been detected and removed. Use anti-malware software to help remove (and prevent) unwanted software.
- **Windows BitLocker® Drive Encryption.** Uses hardware-based full-volume data encryption technology that requires a user to enter a personal identification number (PIN) or provide a startup key to start a computer. It allows access to your protected data only after you log on to computers running Windows Vista or newer. Additionally, BitLocker To Go™, which is available in Windows 7 only, prevents unauthorized data access on your portable storage devices, including a universal serial bus (USB) flash drive.
- **Install from trusted sources.** Do not install programs from the Internet unless you are familiar with the source. This includes freeware and shareware, which carry a high risk of containing malicious code. If you install software from sources that you do not know, you are compromising your computer and other computers on your network. Do not assume that an application or software is safe just because a trusted website contains a link to it.
  - **Click links after verifying source.** Even if the link is in an email or instant messaging (IM) conversation from someone you know it does not mean it was sent by them. Verify origin through the person or contact before you click as this is a common gateway for malware on the network.

Other Resources

MSIT has published a number of multimedia resources dedicated to planning, implementing, and managing security in a Windows-based environment, including the following:

- Managing Network Access Protection at Microsoft (Technical White Paper | IT Pro Webcast | WMA | MP3)
- Managing Network Health Using Network Access Protection (IT Pro Webcast)
- Addressing messaging threats with Forefront Security for Exchange Server (Technical White Paper | PowerPoint Presentation | IT Pro Webcast | WMA | MP3)
- Securing the Client Desktop using Forefront Client (Technical White Paper | PowerPoint Presentation | IT Pro Webcast | WMA | MP3)

Malware Response Case Study

Microsoft Customer Service and Support (CSS)

With more than 3.3 billion customer interactions a year spanning every inhabited continent, Microsoft Customer Service and Support (CSS) is one of the largest technical support providers in the world. CSS delivers a variety of preventive and reactive support offerings through the online self-help resources at support.microsoft.com, call center and online assisted support, and onsite support for enterprise customers with support agreements. CSS is often the first point of contact for Microsoft customers when they require assistance to deal with a malware infection.

CSS Security Support investigates and remediates malware outbreaks for many enterprise customers. This section describes the steps CSS support technicians followed to resolve a malware outbreak at a customer site in 2010. There really isn't any such thing as a "typical" remediation effort—every outbreak is different, and the steps described here shouldn't be taken as an instruction manual that needs to be followed. Rather, this section is intended to illustrate the kind of problem-solving approach that CSS uses to diagnose and remediate malware issues for customers.

Isolate the Computer

The first step in dealing with an outbreak usually involves removing the infected computer or computers from the network. Many malware infections include worm components that attempt to spread to other computers via removable drives, network shares, or other connections, so disconnecting an infected computer can help prevent other computers from becoming infected. Disconnecting the computer also prevents further communication between the malware and the attacker, such as sensitive information or additional malware payloads.

Identify the Malware

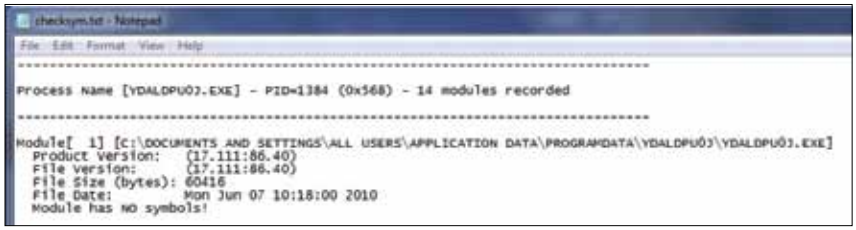
If there is reason to believe that malware might be installed on a computer and the customer's antivirus software is not able to detect it, the first step is to determine what file(s) or running processes are malware. CSS support technicians use a number of tools and utilities to diagnose and report problems, including Microsoft antivirus software such as Microsoft Security Essentials, the TechCenter security tools (technet.microsoft.com/security/cc297183.aspx), and Windows Sysinternals (technet.microsoft.com/sysinternals) tools such as Autoruns, Process Monitor, and Process Explorer.

In this case, the support technician runs the symbol checking utility Checksym to produce a report on all running processes and modules. The technician is looking for suspicious items such as:

- Files or processes without company or file header information.
- Files or processes with no symbols.
- Processes running from unusual paths.
- Loaded drivers with odd or random-seeming names.

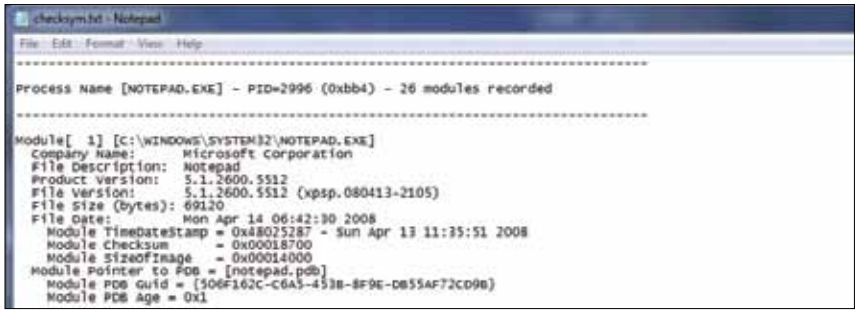
For example, Figure 66 shows a suspicious process, YDALDPUOJ.EXE, found on a customer's computer. This process is running from an unusual path and lacks any symbol or company information in the header.

FIGURE 66. A suspicious process running on a compromised computer



By contrast, a typical signed executable like Notepad.exe includes symbol, checksum, and company information in the file header, as shown in Figure 67.[1]

FIGURE 67. Checksym output for a legitimate program



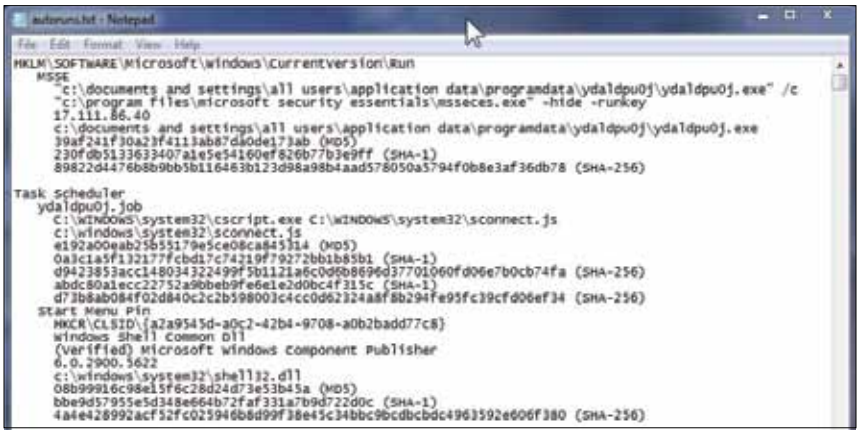
Determine How the Malware Starts

When we locate a suspicious process or file, we determine how it automatically starts at each reboot or logon by inspecting the auto start extensibility points (ASEPs) using tools such as Autoruns and Autorunsc from Windows Sysinternals. Autoruns details the filename, path, hash, and ASEP of the suspicious item.

As Figure 68 shows, this suspicious program starts from the registry key **HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run** and appears to target Microsoft Security Essentials. Figure 68 also shows a scheduled task, ydaldpuoj.job, with the same name as the suspicious executable. The scheduled task launches what appears to be a suspicious JavaScript file, sconnect.js.

[1] To verify the integrity of notepad.exe itself, the support technician can use a utility such as Sigcheck to verify the file signature or a utility such as the File Checksum Integrity Verifier to verify the file's MD5 or SHA1 hash1.

FIGURE 68. Autoruns output that shows how a malicious executable starts



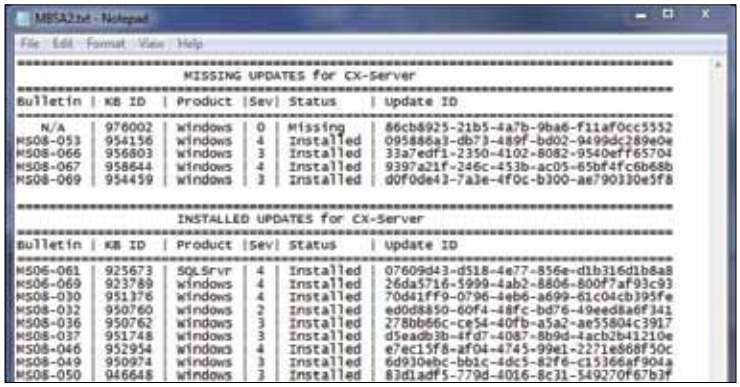
At this point, the file is submitted to the MMPC so researchers can perform additional analysis on the threats and create detections that can be added to Microsoft anti-malware signature files. (Support professionals and others can submit possible malware samples at https://www.microsoft.com/security/portal/Submission/Submit.aspx.) Microsoft currently detects the .exe and .js files as Backdoor:Win32/Qakbot.gen!A and TrojanDownloader:JS/Qakbot.D, respectively.

Now that we are certain that the suspicious files are malware, we ensure that the customer's antivirus software is updated to detect this particular variant.

How Was the Malware Installed?

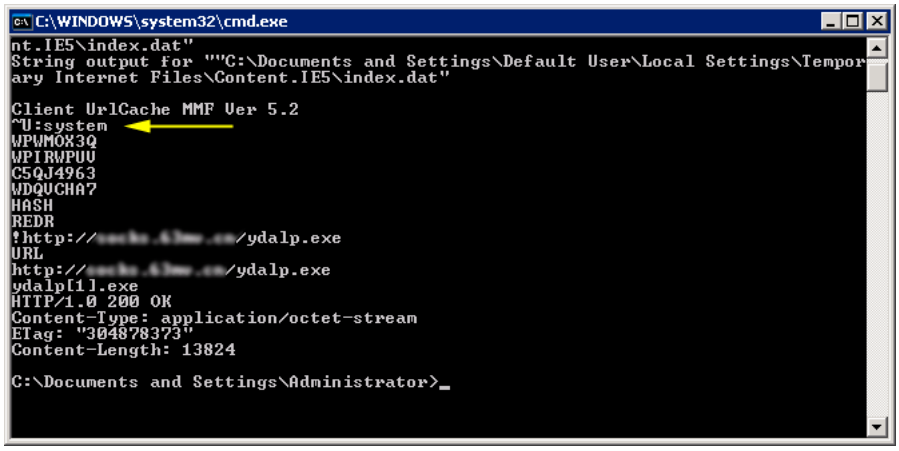
Next, we determine how the malware was installed on the computer. Did it come from another computer on the network, or did it come from an external source? Did a vulnerability in an installed program or component allow the malware onto the computer? Was the user enticed to click a malicious link on a website? To answer these questions, we collect and inspect various data, including event logs, firewall logs, timestamps, and registry dumps that can help us determine what was going on when the file appeared on the computer (assuming that the creation date and time of the file is correct). We can use the Microsoft Baseline Security Analyzer (MBSA) to determine which Microsoft security updates have and have not been installed on the computer. The success of these actions will vary depending on the complexity and nature of the malware. Large malware outbreaks require an incident plan and specialists who are trained to handle an emergency.

FIGURE 69. MBSA output showing missing security updates



We also inspect browser cache files to determine whether any suspicious downloads occurred around the time the file appeared on the computer, using tools such as Strings.exe, a Sysinternals utility that finds and locates text strings in binary files. In this case, the Strings.exe output from an Internet Explorer cache file (index.dat) appears to show the system account being used to download a file.

FIGURE 70. Evidence of suspicious activity in an Internet Explorer cache file



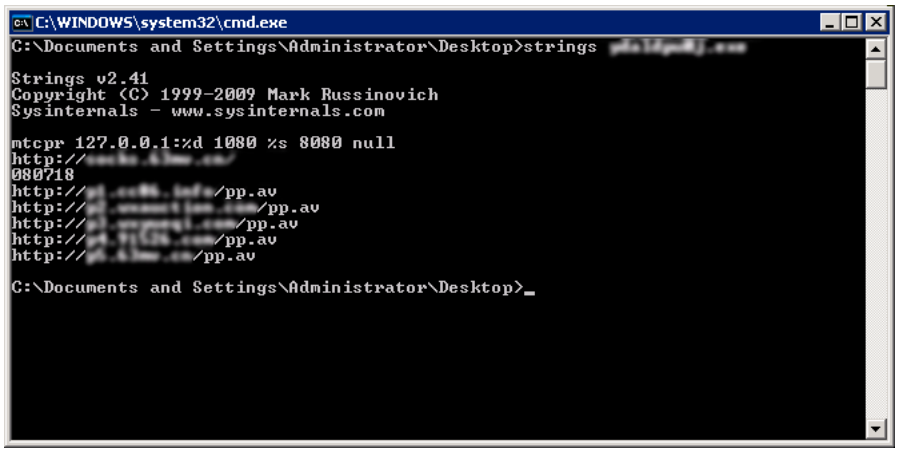
We'll also correlate the registry timestamp of all locations in the registry that were modified by the malware (in this case the **Run** key in HKLM, as explained earlier).

Determine Malware Connectivity

Next, we determine whether the malware attempts to connect to a remote host. This information can be ascertained by various methods, including:

- Monitoring network traffic in the customer's environment.
- Using Netstat or another network tool that details processes and their endpoints, such as TCPView from Sysinternals.
- Use Strings.exe to display the readable text output contained within the binary of the malware. These readable strings sometimes reveal remote locations, such as the following, from another trojan downloader:

FIGURE 71. String output from a trojan downloader



Remediate the Malware

In enterprise environments, user workstations are typically built from standard disk images. In such scenarios, the fastest way to recover from an infection is often to format the hard disk and rebuild the computer from the appropriate image. If that is impossible or infeasible, we take steps to remove the infection that incorporate best practices and are tailored to the specific malware being dealt with. As a general rule, the basic procedure is as follows:

1. Kill the malicious running processes.
2. Delete the auto start extensibility points (ASEPs) that are used to launch the malware.
3. Delete the malware files themselves, if possible.
4. Undo any registry changes that the malware had implemented, if possible.
5. Return the computer to the production environment only after it has been scanned with the customer's antivirus solution using the latest signatures and no further infections are found.

Recommendations

MSIT recommends the following preventive and reactive actions in the wake of an outbreak:

- Keep all computers up to date with the latest security updates from Microsoft and other software vendors, including updates for browser add-ins. Ensure that Automatic Update is enabled and connecting to the Microsoft Update service.
- Install and run MBSA to scan computers for common security misconfigurations and missing security updates. MBSA can be downloaded at www.microsoft.com/technet/security/tools/mbsahome.mspx
- Ensure that antivirus definition files are up to date on all computers. Consult the documentation provided by your antivirus software provider for more information.
- Advise any users whose computers were infected to change their passwords immediately. This includes not only Windows and domain passwords, but passwords for instant messaging applications, external websites, and other passwords that may have been stored or cached on any infected computers.
- Follow guidelines for requiring strong passwords and expiring passwords periodically. For more information, see "Password Best Practices" on Microsoft TechNet. For more information about strong passwords, see "Create strong passwords" from Microsoft Online Safety.
- Block all malicious websites that are discovered at the perimeter firewall.
- Configure the perimeter firewall to block all non-business-related outgoing ports to prevent malware from communicating with the attacker.
- Be aware of the details of privacy and breach notification laws in all regions in which you conduct business. Work closely with your general counsel to follow the proper procedure.

Appendices

Appendix A: Threat Naming Conventions

The MMPC malware naming standard is derived from the Computer Antivirus Research Organization (CARO) Malware Naming Scheme, originally published in 1991 and revised in 2002. Most security vendors use naming conventions based on the CARO scheme, with minor variations, although family and variant names for the same threat can differ between vendors.

A threat name can contain some or all of the components seen in Figure 72.

FIGURE 72. The Microsoft malware naming convention

The *type* indicates the primary function or intent of the threat. The MMPC assigns each individual threat to one of a few dozen different types based on a number of factors, including how the threat spreads and what it is designed to do. To simplify the presentation of this information and make it easier to understand, the *Security Intelligence Report* groups these types into 10 categories. For example, the TrojanDownloader and TrojanDropper types are combined into a single category, called Trojan Downloaders & Droppers.

The *platform* indicates the operating environment in which the threat is designed to run and spread. For most of the threats described in this report, the platform is listed as "Win32," for the Win32 API used by 32-bit and 64-bit versions of Windows desktop and server operating systems. (Not all Win32 threats can run on every version of Windows, however.) Platforms can include programming languages and file formats, in addition to operating systems. For example, threats in the ASX/Wimad family are designed for programs that parse the Advanced Stream Redirector (ASX) file format, regardless of operating system.

Groups of closely related threats are organized into *families,* which are given unique names to distinguish them from others. The family name is usually not related to anything the malware author has chosen to call the threat; researchers use a variety of techniques to name new families, such as excerpting and modifying strings of alphabetic characters found in the malware file. Security vendors usually try to adopt the name used by the first vendor to positively identify a new family, although sometimes different vendors use completely different names for the same threat, which can happen when two or more vendors discover a new family independently. The MMPC Encyclopedia (http://www.microsoft.com/security/portal) lists the names used by other major security vendors to identify each threat, when known.

Some malware families include multiple components that perform different tasks and are assigned different types. For example, the Win32/Frethog family includes variants designated PWS:Win32/Frethog.C and TrojanDownloader:Win32/Frethog.C, among others. In the *Security Intelligence Report*, the category listed for a particular family is the one that

Microsoft security analysts have determined to be the most significant category for the family (which in the case of Frethog is Password Stealers & Monitoring Tools).

Malware creators often release multiple *variants* for a family, typically in an effort to avoid being detected by security software. Variants are designated by letters, which are assigned in order of discovery—A through Z, then AA through AZ, then BA through BZ, and so on. A variant designation of "gen" indicates that the threat was detected by a generic signature for the family rather than as a specific variant. Any additional characters that appear after the variant provide comments or additional information.

In the *Security Intelligence Report,* a threat name consisting of a platform and family name (like "Win32/Taterf") is a reference to a family. When a longer threat name is given (like "Worm:Win32/Taterf.K!dll"), it is a reference to a more specific signature or to an individual variant. To make the report easier to read, family and variant names have occasionally been abbreviated in contexts where confusion is unlikely. Thus, Win32/Taterf is referred to simply as "Taterf" on subsequent mention in some places, and Worm:Win32/Taterf.K simply as "Taterf.K."

Appendix B: Data Sources

Microsoft Products and Services

Data included in the *Microsoft Security Intelligence Report* is gathered from a wide range of Microsoft products and services. The scale and scope of this telemetry allows the *Security Intelligence Report* to deliver the most comprehensive and detailed perspective on the threat landscape available in the software industry:

- Bing, the search and decision engine from Microsoft, contains technology that performs billions of webpage scans per year to seek out malicious content. Once detected, Bing displays warnings to users about the malicious content to help prevent infection.
- Windows Live Hotmail® has hundreds of millions of active email users in more than 30 countries/regions around the world.
- Forefront Online Protection for Exchange protects the networks of thousands of enterprise customers worldwide by helping to prevent malware from spreading through email. FOPE scans billions of email messages every year to identify and block spam and malware.
- Windows Defender is a program, available at no cost to licensed users of Windows, that provides real-time protection against pop-ups, slow performance, and security threats caused by spyware and other potentially unwanted software. Windows Defender runs on more than 100 million computers worldwide.
- The Malicious Software Removal Tool (MSRT) is a free tool designed to help identify and remove prevalent malware families from customer computers. The MSRT is primarily released as an important update through Windows Update, Microsoft Update, and Automatic Updates. A version of the tool is also available from the Microsoft Download Center. The MSRT was downloaded and executed 3.2 billion times in 1H10, or nearly 550 million times each month on average. The MSRT is not a replacement for an up-to-date antivirus solution because of its lack of real-time protection and because it uses only the portion of the Microsoft antivirus signature database that enables it to target specifically selected, prevalent malicious software.
- Microsoft Forefront Client Security is a unified product that provides malware and potentially unwanted software protection for enterprise desktops, laptops, and server operating systems. Like Windows Live OneCare, it uses the Microsoft Malware Protection Engine and the Microsoft antivirus signature database to provide real-time, scheduled, and on-demand protection.
- Windows Live OneCare is a real-time protection product that combines an antivirus and antispyware scanner with phishing and firewall protection. Microsoft has discontinued retail sales of Windows Live OneCare, but continues to make definition updates available to registered users.

- The Windows Live OneCare safety scanner (http://safety.live.com) is a free, online tool that detects and removes malware and potentially unwanted software using the same definition database as the Microsoft desktop anti-malware products. The Windows Live OneCare safety scanner is not a replacement for an up-to-date antivirus solution, because it does not offer real-time protection and cannot prevent a user's computer from becoming infected.
- Microsoft Security Essentials is a basic, consumer-oriented anti-malware product, offered at no charge to licensed users of Windows, which provides real-time protection against viruses, spyware, and other harmful software.
- The Phishing Filter (in Internet Explorer 7) and the SmartScreen Filter (in Internet Explorer 8) offer Internet Explorer users protection against phishing sites and sites that host malware. Microsoft maintains a database of phishing and malware sites reported by users of Internet Explorer and other Microsoft products and services. When a user attempts to visit a site in the database with the filter enabled, Internet Explorer displays a warning and blocks navigation to the page.

Product Name	Main Customer Segment		Malicious Software		Spyware and Potentially Unwanted Software		Available at No Additional Charge	Main Distribution Methods
	Consumer	Business	Scan and Remove	Real-Time Protection	Scan and Remove	Real-Time Protection		
Microsoft Forefront Server Security		•	•	•	•	•		Volume Licensing
Microsoft Forefront Client Security		•	•	•	•	•		Volume Licensing
Windows Live OneCare safety scanner	•		•		•		•	Web
Microsoft Security Essentials	•		•		•	•	•	Download Center
Windows Malicious Software Removal Tool	•		Prevalent Malware Families				•	Windows Update/ Automatic Updates Download Center
Windows Defender	•				•	•	•	Download Center Windows Vista Windows 7
Microsoft Forefront Online Protection for Exchange		•	•	•				Volume Licensing

Appendix C: Worldwide Bot Infection Rates

Figure 15 on page 40 displays the bot infection rates for locations worldwide as expressed in *bot CCM*, or the number of computers from which bot-related malware was removed by the MSRT for every 1,000 MSRT executions. For a more in-depth look at how infection rates in different places have changed over the past year, Figure 73 lists the bot CCM figures for 88 locations around the world for each quarter between 3Q09 and 2Q10. (See "Infection Rates" in the Reference Guide section of the *Security Intelligence Report* website for more information about the CCM metric and how bot CCM differs from malware CCM.)

FIGURE 73. Bot infection rates for locations around the world from 3Q09 to 2Q10, by bot CCM

Country/Region	3Q09	4Q09	1Q10	2Q10
Algeria	0.2	0.2	0.3	0.3
Argentina	2.8	2.7	4.4	3.8
Australia	2.4	2.4	3.4	2.8
Austria	1.1	1.3	1.4	1.1
Belarus	0.1	0.1	0.2	0.2
Belgium	2.9	1.8	5.3	3.4
Bolivia	1.4	1.6	3.5	3.1
Brazil	2.9	3.8	7.0	5.2
Bulgaria	2.5	4.0	4.4	3.8
Canada	1.7	1.3	1.6	1.4
Chile	2.3	4.5	7.2	5.1
China	1.4	1.0	1.3	1.0
Colombia	3.1	5.0	9.2	5.8
Costa Rica	2.7	5.0	11.2	7.2
Croatia	4.5	6.0	11.0	8.6
Czech Republic	2.5	1.7	1.8	1.4
Denmark	2.6	1.7	3.0	1.7
Dominican Republic	1.8	2.5	5.1	3.8
Ecuador	1.6	3.8	11.1	5.9
Egypt	1.6	2.8	3.6	2.7
El Salvador	2.3	3.8	11.9	10.9
Estonia	2.6	2.6	6.6	3.0
Finland	1.3	1.2	1.9	0.9
France	3.0	2.7	6.7	4.0
Germany	1.9	1.3	2.0	1.4
Greece	3.6	3.8	6.0	4.3
Guatemala	4.3	3.9	9.8	6.1
Honduras	3.0	5.2	7.9	6.5
Hong Kong S.A.R.	1.3	1.2	1.6	1.1

Country/Region	3Q09	4Q09	1Q10	2Q10
Hungary	5.7	3.9	7.7	4.8
Iceland	3.4	3.6	9.0	4.6
India	0.3	0.5	1.5	1.0
Indonesia	0.7	0.9	0.9	0.8
Ireland	2.0	2.7	3.1	2.6
Israel	4.7	5.3	6.8	4.3
Italy	3.2	2.5	4.3	2.6
Jamaica	0.5	1.3	2.9	1.8
Japan	0.6	0.5	0.8	0.6
Jordan	1.2	2.7	2.9	2.3
Kazakhstan	0.1	0.2	0.4	0.4
Kenya	0.1	0.2	0.2	0.3
Korea	6.3	6.1	17.4	14.6
Kuwait	1.1	3.6	5.2	4.5
Latvia	4.4	3.9	4.5	3.4
Lebanon	0.4	1.3	1.8	1.5
Lithuania	3.8	4.6	7.2	4.6
Luxembourg	1.4	1.4	2.1	1.8
Malaysia	0.5	0.8	1.5	1.2
Mexico	3.5	6.7	14.8	11.4
Morocco	0.1	0.1	0.3	0.2
Netherlands	2.8	2.0	4.6	2.5
New Zealand	1.3	1.4	1.7	1.3
Nigeria	0.0	0.1	0.2	0.2
Norway	2.0	2.0	3.0	2.2
Pakistan	0.0	0.1	0.1	0.1
Panama	2.2	4.1	8.6	5.8
Peru	1.9	3.4	7.8	8.3
Philippines	0.3	0.6	1.1	1.4
Poland	2.9	4.2	6.1	3.9
Portugal	4.1	8.3	9.3	5.7
Puerto Rico	0.7	2.8	2.5	1.8
Qatar	1.0	1.2	2.2	1.8
Romania	1.5	1.6	2.5	2.0
Russia	4.2	3.9	5.2	4.3
Saudi Arabia	2.4	3.6	5.4	5.5

Country/Region	3Q09	4Q09	1Q10	2Q10
Serbia and Montenegro	1.9	2.3	4.2	2.6
Singapore	0.3	1.2	1.5	1.4
Slovakia	2.4	2.3	2.7	2.1
Slovenia	3.6	3.1	9.7	5.9
South Africa	2.6	5.8	9.3	8.4
Spain	6.9	11.0	17.3	12.4
Sri Lanka	0.0	0.0	0.1	0.1
Sweden	2.5	1.8	4.4	2.4
Switzerland	1.4	1.5	1.9	1.4
Taiwan	1.6	1.3	4.5	3.4
Thailand	2.6	1.9	3.0	2.8
Trinidad and Tobago	1.0	2.5	2.5	2.3
Tunisia	0.2	0.2	0.4	0.2
Turkey	4.1	2.8	5.8	4.7
Ukraine	0.7	0.6	1.3	1.1
United Arab Emirates	0.5	1.4	1.8	1.6
United Kingdom	3.2	2.5	3.0	2.7
United States	5.9	4.5	5.6	5.2
Uruguay	1.0	1.0	1.4	1.3
Venezuela	1.3	2.3	5.3	3.9
Vietnam	0.3	0.4	0.4	0.4
Worldwide	**2.5**	**2.5**	**4.0**	**3.2**

Glossary

adware
A program that displays advertisements. Although some adware can be beneficial by subsidizing a program or service, other adware programs may display advertisements without adequate consent.

backdoor trojan
A type of trojan that provides attackers with remote access to infected computers. Bots are a sub-category of backdoor trojans. Also see *botnet*.

bot
A malware program that joins an infected computer to a *botnet*.

bot-herder
An operator of a *botnet*.

botnet
A set of computers controlled by a "command-and-control" (C&C) computer to execute commands as directed. The C&C computer can issue commands directly (often through Internet Relay Chat [IRC]) or by using a decentralized mechanism, like peer-to-peer (P2P) networking. Computers in the botnet are often called nodes or zombies.

C&C
See *botnet*.

CCM
Short for *computers cleaned per mille* (thousand). The number of computers cleaned for every 1,000 executions of the MSRT. For example, if the MSRT has 50,000 executions in a particular location in the first quarter of the year and removes infections from 200 computers, the CCM for that location in the first quarter of the year is 4.0 (200 ÷ 50,000 × 1,000).

clean
To remove malware or potentially unwanted software from an infected computer. A single cleaning can involve multiple disinfections.

command and control
See *botnet*.

coordinated disclosure
The practice of disclosing vulnerabilities privately to an affected vendor so it can develop a comprehensive security update to address the vulnerability before it becomes public knowledge.

definition
A set of *signatures* that can be used to identify malware using antivirus or antispyware products. Other vendors may refer to definitions as DAT files, pattern files, identity files, or antivirus databases.

denial of service (DoS)
A condition that occurs when the resources of a target computer are deliberately exhausted, effectively overwhelming the computer and causing it to fail to respond or function for its intended users. There are a number of different types of attack that may be used to result in a denial of service condition, utilizing different types of flood, or malformed network traffic. Also see *distributed denial of service (DDoS)*.

disclosure
Revelation of the existence of a vulnerability to a third party. Also see *responsible disclosure*.

disinfect
To remove a malware or potentially unwanted software component from a computer or to restore functionality to an infected program. Also see *clean*.

distributed denial of service (DDoS)
A form of denial of service (DoS) that uses multiple computers to attack the target. Considerable resources may be required to exhaust a target computer and cause it to fail to respond. Often multiple computers are used to perform these types of malicious attack and increase the attack's chances of success. This can occur, for example, when a number of compromised computers, such as those that comprise a botnet, are commandeered and ordered to access a target network or server over and over again within a small period of time.

downloader/dropper
See *trojan downloader/dropper*.

exploit
Malicious code that takes advantage of software vulnerabilities to infect a computer.

firewall
A program or device that monitors and regulates traffic between two points, such as a single computer and the network server, or one server to another.

generic
A type of signature capable of detecting a large variety of malware samples from a specific family, or of a specific type.

IFrame
Short for *inline frame*. An IFrame is an HTML document that is embedded in another HTML document. Because the IFrame loads another webpage, it can be used by criminals to place malicious HTML content, such as a script that downloads and installs spyware, into non-malicious HTML pages hosted by trusted websites.

in the wild
Said of malware that is currently detected in active computers connected to the Internet, as compared to those confined to internal test networks, malware research laboratories, or malware sample lists.

Internet Relay Chat (IRC)
A distributed real-time Internet chat protocol designed for group communication. Many botnets use the IRC protocol for C&C.

keylogger
See *password stealer (PWS)*.

Malicious Software Removal Tool
The Windows Malicious Software Removal Tool (MSRT) is designed to help identify and remove specifically targeted, prevalent malware from customer computers and is available at no charge to licensed Windows users. The main release mechanism of the MSRT is through Windows Update (WU), Microsoft Update (MU), or Automatic Updates (AU). A version of the tool is also available for download from the Microsoft Download Center. The MSRT is not a replacement for an up-to-date antivirus solution because the MSRT specifically targets only a small subset of malware families that are determined to be particularly prevalent. Further, the MSRT includes no real-time protection and cannot be used for the prevention of malware. More details about the MSRT are available at http://www.microsoft.com/security/malwareremove/default.mspx.

malware
Malicious software or potentially unwanted software installed without adequate user consent.

malware impression
A single instance of a user attempting to visit a page known to host malware and being blocked by the SmartScreen Filter in Internet Explorer 8. Also see *phishing impression*.

monitoring tool
Software that monitors activity, usually by capturing keystrokes or screen images. It may also include network sniffing software. Also see *password stealer (PWS)*.

P2P
See *peer-to-peer (P2P)*.

packer
A program that allows a user to package or bundle a file. This may be used by malware authors to obfuscate the structure of a malware file and thus avoid detection, as packing a single file using different packers results in different packages.

packet sniffer
A tool that logs traffic transmitted over a network. Packet sniffers are used by network administrators to maintain networks and diagnose problems, and by attackers to eavesdrop on sensitive or private information.

password stealer (PWS)
Malware that is specifically used to transmit personal information, such as user names and passwords. A PWS often works in conjunction with a *keylogger*, which sends keystrokes or screen shots to an attacker. Also see *monitoring tool*.

payload
The actions conducted by a piece of malware for which it was created. This can include, but is not limited to, downloading files, changing system settings, displaying messages, and logging keystrokes.

peer-to-peer (P2P)
A system of network communication in which individual nodes are able to communicate with each other without the use of a central server.

phishing
A method of credential theft that tricks Internet users into revealing personal or financial information online. Phishers use phony websites or deceptive email messages that mimic trusted businesses and brands to steal personally identifiable information (PII), such as user names, passwords, credit card numbers, and identification numbers.

phishing impression
A single instance of a user attempting to visit a known phishing page, with Internet Explorer 7 or Internet Explorer 8, and being blocked by the Phishing Filter or SmartScreen Filter. Also see *malware impression*.

polymorphic
Said of malware that can mutate its structure to avoid detection by antivirus programs, without changing its overall algorithm or function.

potentially unwanted software
A program with potentially unwanted behavior that is brought to the user's attention for review. This behavior may impact the user's privacy, security, or computing experience.

remote control software
A program that provides access to a computer from a remote location. These programs are often installed by the computer owner or administrator and are only a risk if unexpected.

rogue security software
Software that appears to be beneficial from a security perspective, but provides limited or no security capabilities, generates a significant number of erroneous or misleading alerts, or attempts to socially engineer the user into participating in a fraudulent transaction.

rootkit
A program whose main purpose is to perform certain functions that cannot be easily detected or undone by a system administrator, such as hide itself or other malware.

signature
A set of characteristics that can identify a malware family or variant. Signatures are used by antivirus and antispyware products to determine if a file is malicious or not. Also see *definition*.

social engineering
A technique that defeats security precautions in place by exploiting human vulnerabilities. Social engineering scams can be both online (such as receiving emails that ask you to click the attachment, which is actually malware) and offline (such as receiving a phone call from someone posing as a representative from your credit card company). Regardless of the method selected, the purpose of a social engineering attack remains the same—to get the targeted user to perform an action of the attacker's choice.

spam
Bulk unsolicited email. Malware authors may use spam to distribute malware, either by attaching the malware to the message or by sending a message containing a link to the malware. Malware may also harvest email addresses for spamming from compromised machines or may use compromised machines to send spam.

spyware
A program that collects information, such as the websites a user visits, without adequate consent. Installation may be without prominent notice or without the user's knowledge.

SQL injection
A technique in which an attacker enters a specially crafted Structured Query Language (SQL) statement into an ordinary web form. If form input is not filtered and validated before being submitted to a database, the malicious SQL statement may be executed, which could cause significant damage or data loss.

tool
Software that may have legitimate purposes but may also be used by malware authors or attackers.

trojan
A generally self-contained program that does not self-replicate but takes malicious action on the computer.

trojan downloader/dropper
A form of trojan that installs other malicious files to the infected system either by downloading them from a remote computer or by dropping them directly from a copy contained in its own code.

virus
Malware that replicates, commonly by infecting other files in the system, thus allowing the execution of the malware code and its propagation when those files are activated.

vulnerability
A weakness, error, or poor coding technique in a program that may allow an attacker to exploit it for a malicious purpose.

vulnerability broker
A company or other entity that provides software vendors with vulnerability information provided to it by external security researchers. In exchange for such compensation as the broker may provide, the security researchers agree not to disclose any information about the vulnerability to anyone other than the broker and the affected vendor.

wild
See *in the wild*.

worm
Malware that spreads by spontaneously sending copies of itself through email or by using other communication mechanisms, such as instant messaging (IM) or peer-to-peer (P2P) applications.

zombie
See *botnet*.

Threat Families Referenced in This Report

The definitions for the threat families referenced in this report are adapted from the Microsoft Malware Protection Center encyclopedia (http://www.microsoft.com/security/portal), which contains detailed information about a large number of malware and potentially unwanted software families. See the encyclopedia for more in-depth information and guidance for the families listed here and throughout the report.

Win32/AgoBot: A backdoor that communicates with a central server using IRC.

Win32/Alureon: A data-stealing trojan that gathers confidential information such as user names, passwords, and credit card data from incoming and outgoing Internet traffic. It may also download malicious data and modify DNS settings.

Win32/Autorun: A worm that attempts to spread by being copied into all removable drives.

Win32/Bagle: A worm that spreads by emailing itself to addresses found on an infected computer. Some variants also spread through P2P networks. Bagle acts as a backdoor trojan and can be used to distribute other malicious software.

Win32/BaiduSobar: A Chinese-language web browser toolbar that delivers pop-up and contextual advertisements, blocks certain other advertisements, and changes the Internet Explorer search page.

Win32/Bancos: A data-stealing trojan that captures online banking credentials and relays them to the attacker. Most variants target customers of Brazilian banks.

Win32/Banker: A family of data-stealing trojans that captures banking credentials such as account numbers and passwords from computer users and relays them to the attacker. Most variants target customers of Brazilian banks; some variants target customers of other banks.

Win32/Banload: A family of trojans that download other malware. Banload usually downloads Win32/Banker, which steals banking credentials and other sensitive data and sends them back to a remote attacker.

Win32/Bifrose: A backdoor trojan that allows a remote attacker to access the compromised computer and injects its processes into the Windows shell and Internet Explorer.

Win32/Bredolab: A downloader that is able to download and execute arbitrary files from a remote host.

Win32/Bubnix: A generic detection for a kernel-mode driver installed by other malware that hides its presence on an affected computer by blocking registry and file access to itself. The trojan may report its installation to a remote server and download and distribute spam email messages and could download and execute arbitrary files.

Win32/CeeInject: A generic detection for malicious files that are obfuscated using particular techniques to protect them from detection or analysis.

Win32/Chadem: A trojan that steals password details from an infected computer by monitoring network traffic associated with FTP connections.

WinNT/Citeary: A kernel mode driver installed by Win32/Citeary, a worm that spreads to all available drives including the local drive, installs device drivers and attempts to download other malware from a predefined website.

Win32/Conficker: A worm that spreads by exploiting a vulnerability addressed by Security Bulletin MS08-067. Some variants also spread via removable drives and by exploiting weak passwords. It disables several important system services and security products and downloads arbitrary files.

Win32/Cutwail: A trojan that downloads and executes arbitrary files, usually to send spam. Win32/Cutwail has also been observed to download the attacker tool Win32/Newacc.

Win32/FakeCog: A rogue security software family distributed under the names Defense Center, AntiMalware, and many others.

Win32/Fakeinit: A rogue security software family distributed under the names Internet Security 2010, Security Essentials 2010, and others.

Win32/FakeRean: A rogue security software family distributed under a large variety of randomly generated names, including Win 7 Internet Security 2010, Vista Antivirus Pro, XP Guardian, and many others.

Win32/FakeSpypro: A rogue security software family distributed under the names Antivirus System PRO, Spyware Protect 2009, and others.

Win32/FakeVimes: A rogue security software family distributed under the names Ultra Antivir 2009, Extra Antivirus, Virus Melt, and many others.

Win32/FakeXPA: A rogue security software family distributed under the names Antivirus 7, Personal Security, AntiVir2010, Antivirus BEST, Green AV, MaCatte, and many others.

Win32/FakeYak: A rogue security software family distributed under the names Antimalware Doctor and others.

Win32/FlyAgent: A backdoor trojan program that is capable of performing several actions depending on the commands of a remote attacker.

Win32/Frethog: A large family of password-stealing trojans that target confidential data, such as account information, from massively multiplayer online games.

Win32/Hamweq: A worm that spreads through removable drives, such as USB memory sticks. It may contain an IRC-based backdoor enabling the computer to be controlled remotely by an attacker.

Win32/Hotbar: Adware that displays a dynamic toolbar and targeted pop-up ads based on its monitoring of web-browsing activity.

Win32/Hupigon: A family of trojans that uses a dropper to install one or more backdoor files and sometimes installs a password stealer or other malicious programs.

Win32/IRCbot: A large family of backdoor trojans that drops other malicious software and connects to IRC servers to receive commands from attackers.

Win32/Koobface: A multi-component family of malware used to compromise computers and use them to perform various malicious tasks. It spreads through the internal messaging systems of popular social networking sites.

Win32/Lethic: A trojan that connects to remote servers, which may lead to unauthorized access to an affected system.

Win32/MoneyTree: A family of software that provides the ability to search for adult content on local disk. It may also install other potentially unwanted software, such as programs that display pop-up ads.

Win32/Nuwar: A family of trojan droppers that install a distributed P2P downloader trojan. This downloader trojan in turn downloads an email worm component.

Win32/Obfuscator: A generic detection for programs that have had their purpose obfuscated to hinder analysis or detection by antivirus scanners. They commonly employ a combination of methods, including encryption, compression, anti-debugging and anti-emulation techniques.

Win32/Oficla: A family of trojans that attempt to inject code into running processes in order to download and execute arbitrary files. It may download rogue security programs.

Win32/Parite: A family of viruses that infect .exe and .scr executable files on the local file system and on writeable network shares.

Win32/Pdfjsc: A family of specially crafted PDF files that exploit Adobe Acrobat and Adobe Reader vulnerabilities. These files contain malicious JavaScript that executes when the file is opened.

Win32/PrettyPark: A worm that spreads via email attachments. It allows backdoor access and control of an infected computer.

Win32/Prorat: A trojan that opens random ports that allow remote access from an attacker to the affected computer. This backdoor may download and execute other malware from predefined websites and may terminate several security applications or services.

Win32/Pushbot: A detection for a family of malware that spreads via MSN Messenger, Yahoo! Messenger, and AIM when commanded by a remote attacker. It contains backdoor functionality that allows unauthorized access and control of an affected machine.

Win32/Randex: A worm that scans randomly generated IP addresses to attempt to spread to network shares with weak passwords. After the worm infects a computer, it connects to an IRC server to receive commands from the attacker.

Win32/Rbot: A family of backdoor trojans that allows attackers to control the computer through an IRC channel.

AutoIt/Renocide: A detection for a worm written in the AutoIt scripting language that exhibits backdoor behavior and attempts to download additional files from remote servers. It spreads via removable drives and network shares.

Win32/Renos: A family of trojan downloaders that install rogue security software.

Win32/Rimecud: A family of worms with multiple components that spreads via fixed and removable drives and via instant messaging. It also contains backdoor functionality that allows unauthorized access to an affected system.

Win32/RJump: A worm that attempts to spread by copying itself to newly attached media, such as USB memory devices or network drives. It also contains backdoor functionality that allows an attacker unauthorized access to an affected machine.

Win32/Rugzip: A trojan that downloads other malware from predefined websites. Rugzip may itself be installed by other malware. Once it has performed its malicious routines, it deletes itself to avoid detection.

Win32/Rustock: A multi-component family of rootkit-enabled backdoor trojans that were first developed around 2006 to aid in the distribution of spam email.

Win32/Sality: A family of polymorphic file infectors that target executable files with the extensions .scr or .exe. They may execute a damaging payload that deletes files with certain extensions and terminates security-related processes and services.

Win32/SDBot: A family of backdoor trojans that allows attackers to control infected computers over an IRC channel.

Win32/Sdbot: A family of backdoor trojans that allows attackers to control infected computers. After a computer is infected, the trojan connects to an internet relay chat (IRC) server and joins a channel to receive commands from attackers.

Win32/Slenfbot: A family of worms that can spread via instant messaging programs, and may spread via removable drives. They also contain backdoor functionality that allows unauthorized access to an affected machine. This worm does not spread automatically upon installation but must be ordered to spread by a remote attacker.

Win32/Small: A generic detection for a variety of threats.

Win32/Swif: A trojan that exploits a vulnerability in Adobe Flash Player to download malicious files. Adobe has published security bulletin APSB08-11 addressing the vulnerability.

Win32/Taterf: A family of worms that spread through mapped drives in order to steal login and account details for popular online games.

Win32/Tofsee: A multi-component family of backdoor trojans that act as a spam and traffic relay.

Win32/VBInject: A generic detection for obfuscated malware. The loader is written in Visual Basic and the malicious code, which may have virtually any purpose, is encrypted.

Win32/Virut: A family of file-infecting viruses that target and infect .exe and .scr files accessed on infected systems. Win32/Virut also opens a backdoor by connecting to an IRC server.

Win32/Waledac: A trojan that is used to send spam. It also has the ability to download and execute arbitrary files, harvest email addresses from the local machine, perform denial-of-service attacks, proxy network traffic, and sniff passwords

Win32/Winwebsec: A rogue security software family distributed under the names Winweb Security, System Security, and others.

Win32/Zbot: A family of password stealing trojans that also contains backdoor functionality allowing unauthorized access and control of an affected machine.

Win32/Zwangi: A program that runs as a service in the background and modifies web browser settings to visit a particular website.

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