Security Incidents Related to the Great East Japan Earthquake

In this report we will examine malware observation implementations and techniques used by malware to avoid forensic detection, in addition to discussing the state of communications in Japan following the Great East Japan Earthquake and related security incidents.

1.1 Introduction

This report summarizes incidents to which IIJ responded, based on general information obtained by IIJ itself related to the stable operation of the Internet, information from observations of incidents, information acquired through our services, and information obtained from companies and organizations with which IIJ has cooperative relationships. This volume covers the period of time from January 1 through March 31, 2011. In this period a number of vulnerabilities related to Web browsers and their plug-ins continued to be exploited, and incidents relating to mobile phones and cloud computing were also on the rise. There were also attacks relating to political turmoil in the Middle East, and DDoS attacks utilizing malware in South Korea. Additionally, the state of domestic communications was subject to change due to the Great East Japan Earthquake, and attacks taking advantage of the disaster occurred. As seen above, the Internet continues to experience many security-related incidents.

1.2 Incident Summary

Here, we discuss the IIJ handling and response to incidents that occurred between January 1 and March 31, 2011. Figure 1 shows the distribution of incidents handled during this period*1.

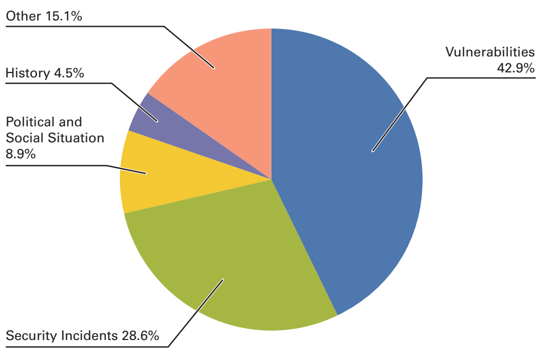

Figure 1: Incident Ratio by Category (January 1 to March 31, 2011)

*1 Incidents discussed in this report are categorized as vulnerabilities, political and social situation, history, security incident and other. Vulnerabilities: Responses to vulnerabilities associated with network equipment, server equipment or software commonly used over the Internet or in user environments. Political and Social Situations: Responses to incidents related to domestic and foreign circumstances and international events such as international conferences attended by VIPs and attacks originating in international disputes. History: Historically significant dates; warning/alarms, detection of incidents, measures taken in response, etc., related to attacks in connection with a past historical fact. Security Incidents: Unexpected incidents and related responses such as wide propagation of network worms and other malware; DDoS attacks against certain websites. Other: Security-related information, and incidents not directly associated with security problems, including highly concentrated traffic associated with a notable event.

Vulnerabilities

During this period a large number of vulnerabilities were discovered and fixed in Web browsers and applications such as Microsoft's Internet Explorer*2 and Windows*3*4*5, Adobe System's Adobe Reader and Acrobat*6*7, Flash Player*8*9, and Shockwave Player*10, and Oracle's JRE*11. Multiple vulnerabilities were also fixed in Apple's Mac OS X*12. Several of these vulnerabilities were exploited before patches were released.

Many vulnerabilities were also patched in server applications such as Microsoft's Internet Information Services (IIS) FTP service*13, the vsftpd FTP server*14 used in systems such as Linux, Oracle's Oracle Database*15 database server, the ISC BIND*16 DNS server, and the CMS platform WordPress*17. Additionally, vulnerabilities were discovered and fixed in Apple's iOS*18 platform for mobile phones.

Political and Social Situations

IIJ pays close attention to various political and social situations related to international affairs and current events. During this period Internet shutdowns*19 and large-scale DDoS attacks*20 occurring in connection with political turmoil in countries such as Tunisia and Egypt garnered considerable attention. However, IIJ did not detect any directly-connected attacks on IIJ facilities or our client networks.

History

The period in question included several historically significant days on which incidents such as DDoS attacks and website alterations have occurred. For this reason, close attention was paid to political and social situations. However, IIJ did not detect any direct attacks on IIJ facilities or our client networks.

Security Incidents

Unanticipated security incidents not related to political or social situations occurred, including the discovery overseas of a virus targeting the Android OS mobile phone platform*21, and reports of scareware that pretends to be legitimate

*2 Microsoft Security Bulletin MS11-003 - Critical: Cumulative Security Update for Internet Explorer (2482017) (http://www.microsoft.com/technet/security/bulletin/ms11-003.mspx).

*3 Microsoft Security Bulletin MS11-006 - Critical: Vulnerability in Windows Shell Graphics Processing Could Allow Remote Code Execution (2483185) (http://www.microsoft.com/technet/security/bulletin/ms11-006.mspx).

*4 Microsoft Security Advisory (2501696) Vulnerability in MHTML Could Allow Information Disclosure (http://www.microsoft.com/technet/security/advisory/2501696.mspx). This vulnerability was fixed in April through Microsoft Security Bulletin MS11-026 - Important: Vulnerability in MHTML Could Allow Information Disclosure (2503658) (http://www.microsoft.com/technet/security/bulletin/ms11-026.mspx).

*5 Microsoft Security Bulletin MS11-015 - Critical: Vulnerabilities in Windows Media Could Allow Remote Code Execution (2510030) (http://www.microsoft.com/technet/security/bulletin/ms11-015.mspx).

*6 APSB11-03 Security updates available for Adobe Reader and Acrobat (http://www.adobe.com/support/security/bulletins/apsb11-03.html).

*7 APSB11-06 Security updates available for Adobe Reader and Acrobat (http://www.adobe.com/support/security/bulletins/apsb11-06.html).

*8 APSB11-02 Security update available for Adobe Flash Player (http://www.adobe.com/support/security/bulletins/apsb11-02.html).

*9 APSB11-05 Security update available for Adobe Flash Player (http://www.adobe.com/support/security/bulletins/apsb11-05.html).

*10 APSB11-01 Security update available for Shockwave Player (http://www.adobe.com/support/security/bulletins/apsb11-01.html).

*11 JavaTM SE 6 Update Release Notes (http://www.oracle.com/technetwork/java/javase/6u24releasenotes-307697.html).

*12 About the security content of Mac OS X v10.6.7 and Security Update 2011-001 (http://support.apple.com/kb/HT4581).

*13 Microsoft Security Bulletin MS11-004 - Important: Vulnerability in Internet Information Services (IIS) FTP Service Could Allow Remote Code Execution (2489256) (http://www.microsoft.com/technet/security/bulletin/ms11-004.mspx).

*14 A vulnerability was found in vsftpd before 2.3.3. This information is managed as CVE-2011-0762 (http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2011-0762).

*15 Oracle Critical Patch Update Advisory - January 2011 (http://www.oracle.com/technetwork/topics/security/cpujan2011-194091.html).

*16 BIND: Server Lockup Upon IXFR or DDNS Update Combined with High Query Rate (http://www.isc.org/software/bind/advisories/cve-2011-0414).

*17 WordPress 3.0.5 (and 3.1 Release Candidate 4) (http://wordpress.org/news/2011/02/wordpress-3-0-5/).

*18 About the security content of iOS 4.3 (http://support.apple.com/kb/HT4564).

*19 Details of this incident can be found in the following Arbor Networks' security blog post, "Egypt Loses the Internet" (http://asert.arbornetworks.com/2011/01/egypt-loses-the-internet/).

*20 Details of this incident can be found in the following Sophos Naked Security blog post. "Egypt versus the internet - Anonymous hackers launch DDoS attack" (http://nakedsecurity.sophos.com/2011/01/26/egypt-versus-the-internet-anonymous-hackers-launch-ddos-attack/).

*21 Information-technology Promotion Agency, Japan (IPA) "Security alert for a virus targeted at Android OS" (http://www.ipa.go.jp/security/topics/alert20110121.html) (in Japanese).

software using validly signed files*[22]. SSL certificates for some major sites were also issued without authorization*[23], and an update released to revoke these certificates in Web browsers and prevent them from being exploited*[24].

Attacks targeting vulnerabilities in specific servers such as the Exim MTA*[25], and unauthorized communications with SIP servers*[26] continue to be uncovered, and unauthorized use of publicly accessible servers using these vulnerabilities has taken place*[27]. In South Korea, attacks similar to the DDoS attacks that occurred in July 2009 resurfaced again on March 3*[28]. There have also been many attempted malware infections utilizing email and SNS*[29], and attacks exploiting cloud environments*[30].

■ Other

As for other incidents, we focused on trends for incidents related to natural disasters such as the earthquake that struck New Zealand in February and the Great East Japan Earthquake in March. We confirmed SEO poisoning attacks*[31] and targeted attacks*[32] that took advantage of these major disasters. Regarding security-related trends, in December a DS record of the JP zone was registered into the root zone, and in January DNSSEC was implemented for JP domain name services*[33].

Additionally, unallocated IPv4 addresses managed by the IANA (Internet Assigned Numbers Authority) were all released, bringing IPv4 address exhaustion closer to becoming a reality*[34]. The IPA also issued a report titled "10 Major Security Threats for the Year 2011: Evolving Attacks - Are Your Countermeasures Adequate?" that summarized the security incidents that occurred in 2010*[35], and five telecommunications industry associations issued guidelines to help telecommunications carriers identify high volume communications such as DDoS attacks and implement suitable countermeasures titled "Guidelines for Dealing with High Volume Communications and Privacy at Telecommunications Carriers"*[36].

*22 Symantec Security Response Blog "Using Trusted Software to do the Dirty Work" (http://www.symantec.com/connect/blogs/using-trusted-software-do-dirty-work).

*23 Details can be found in the following F-Secure blog post. "Rogue SSL Certificates ('Case Comodogate')" (http://www.f-secure.com/weblog/archives/00002128.html).

*24 In this case, certificates for popular websites issued through unauthorized use of the systems of the affected certificate issuing institution were added to the certificate revocation list (CRL), but depending on Web browser implementation and settings there was a chance that fraudulent websites could be treated as legitimate, so a system for explicitly invalidating those individual certificates was distributed via a browser patch. For example, "Microsoft Security Advisory (2524375) Fraudulent Digital Certificates Could Allow Spoofing" (http://www.microsoft.com/technet/security/advisory/2524375.mspx), or Mozilla Firefox's "Firefox Blocking Fraudulent Certificates" (http://blog.mozilla.com/security/2011/03/22/firefox-blocking-fraudulent-certificates/).

*25 Details of this incident can be found in the following IBM Tokyo SOC Report. Tokyo SOC Report "Attacks Attempting to Infect Servers with Bots Exploiting an Exim Vulnerability" (https://www-304.ibm.com/connections/blogs/tokyo-soc/entry/exim_attack_20110309?lang=en_us) (in Japanese).

*26 cNotes provides SIP observation data on an irregular basis. For example, a list of IP addresses of attackers classified by country from 2011. "Fraudulent Incoming SIP 42 - From 2011 Forward" (http://jvnrss.ise.chuo-u.ac.jp/csn/index.cgi?p=%C9%D4%C0%B5%A4%CASIP%C3%E5%BF%AE+42+2011%C7%AF%A4%CB%C6%FE%A4%C3%A4%C6) (in Japanese).

*27 JPCERT Coordination Center (JPCERT/CC) "Security settings of Internet servers (mainly UNIX / Linux servers)" (http://www.jpcert.or.jp/english/at/2011/at110002.txt).

*28 "AhnLab Issues Alerts Concerning DDoS Attacks on 40 Websites in South Korea" (http://www.ahnlab.co.jp/company/press/news_release_view.asp?se%20archWord=&movePage=&seq=5568) (in Japanese).

*29 Details can be found in the following Trend Micro security blog post. "Malicious Programs with File Names including Earthquake, Tsunami, Nuclear Power Stations, and Power Conservation Spread in Japan" (http://blog.trendmicro.co.jp/archives/4001) (in Japanese).

*30 A detailed report on attacks from cloud environments in 2010 is given in the following IBM Tokyo SOC Report. Tokyo SOC Report "Attacks Exploiting the Cloud" (https://www-304.ibm.com/connections/blogs/tokyo-soc/entry/cloud-attack_20110216?lang=en_us) (in Japanese).

*31 Details can be found in the following Trend Micro malware blog post. "3/11 Japan Earthquake Disaster Scam Watch" (http://blog.trendmicro.com/most-recent-earthquake-in-japan-searches-lead-to-fakea/).

*32 For example, the following monthly report from Trend Micro. "March 2011 Monthly Report on Internet Threats: Cyber Attacks Taking Advantage of Earthquake - Beware of Techniques Capitalizing on Human Psychology" (http://jp.trendmicro.com/jp/threat/security_news/monthlyreport/article/20110406083423.html) (in Japanese).

*33 Japan Registry Services (JPRS) "JPRS Deploys DNSSEC in the JP Domain Name Service" (http://jprs.co.jp/en/press/2011/110117.html).

*34 Japan Network Information Center (JPNIC) "IANA's free pool of IPv4 address space depleted, and JPNIC's action hereafter" (http://www.nic.ad.jp/ja/topics/2011/20110204-01.html) (in Japanese).

*35 Information-technology Promotion Agency, Japan (IPA) "10 Major Security Threats for the Year 2011: Evolving Attacks - Are Your Countermeasures Adequate?" (http://www.ipa.go.jp/about/press/20110324.html) (in Japanese).

*36 The Council for Stable Operation of the Internet is comprised of five industry associations with links to the telecommunications business. Refer to the website below for details on the establishment of these guidelines. Japan Internet Provider's Association (JAIPA) "Revision to Guidelines for Dealing with High Volume Communications and Privacy at Telecommunications Carriers" (http://www.jaipa.or.jp/other/mtcs/info_110325.html) (in Japanese).

1.3 Incident Survey

Of incidents occurring on the Internet, IIJ focuses on those types of incidents that have infrastructure-wide effects, continually conducting research and engaging in countermeasures. In this section, we provide a summary of our survey and analysis results related to the circumstances of DDoS attacks, malware infections over networks, and SQL injections on Web servers.

1.3.1 DDoS Attacks

Today, DDoS attacks on corporate servers are almost a daily occurrence, and the methods involved vary widely. However, most of these attacks are not the type that utilize advanced knowledge such as that of vulnerabilities, but rather cause large volumes of unnecessary traffic to overwhelm network bandwidth or server processes for the purpose of hindering services.

■ Direct Observations

Figure 2 shows the circumstances of DDoS attacks handled by the IIJ DDoS Defense Service between January 1 and March 31, 2011. This information shows the number of traffic anomalies judged to be attacks based on IIJ DDoS Defense Service standards. IIJ also responds to other attacks, but these incidents are excluded from the figure due to the difficulty in accurately ascertaining the facts of each situation. There are many methods that can be used to carry out a DDoS attack, and the capacity of the environment attacked (bandwidth and server performance) will largely determine the degree of impact. Figure 2 categorizes DDoS attacks into three types: attacks on bandwidth capacity*37, attacks on servers*38, and compound attacks (several types of attacks on a single target conducted at the same time).

During the three months under study, IIJ dealt with 585 DDoS attacks. This averages to 6.5 attacks per day, indicating an increase in the average daily number of attacks compared to our prior report. Bandwidth capacity attacks accounted for 0% of all incidents, server attacks accounted for 76% of all incidents, and compound attacks accounted for the remaining 24%.

The largest attack observed during the period under study was classified as a compound attack, and resulted in 163Mbps of bandwidth using up to 57,000pps packets. Of all attacks, 85% ended within 30 minutes of commencement, and 15% lasted between 30 minutes and 24 hours. No attacks continued for longer than 24 hours. The longest sustained attack during the current period was a server attack that lasted for six hours. In most cases, we observed

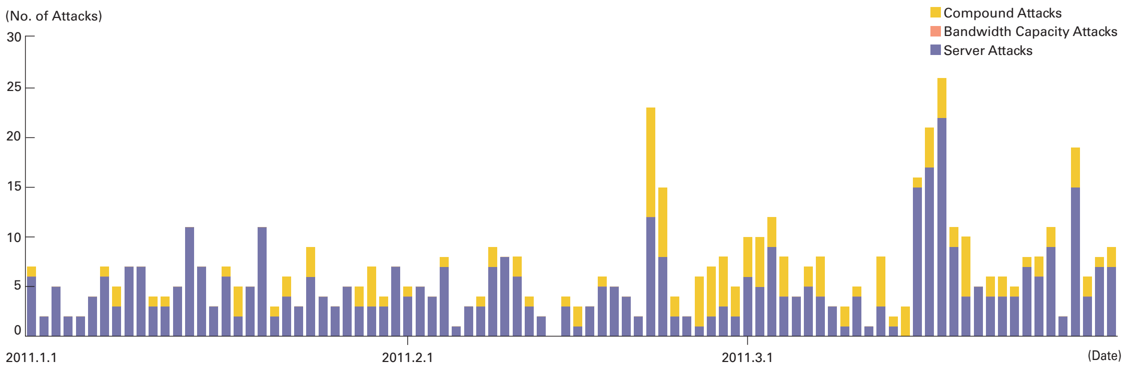

Figure 2: Trends in DDoS Attacks

*37 Attack that overwhelms the network bandwidth capacity of a target by sending massive volumes of larger-than-necessary IP packets and fragments. The use of UDP packets is called a UDP flood, while the use of ICMP packets is called an ICMP flood.

*38 TCP SYN flood, TCP connection flood, and HTTP GET flood attacks. TCP SYN flood attacks send mass volumes of SYN packets that signal the start of TCP connections, forcing the target to prepare for major incoming connections, causing the wastage of processing capacity and memory. TCP connection flood attacks establish mass volumes of actual TCP connections. HTTP GET flood attacks establish TCP connections on a Web server, and then send mass volumes of HTTP GET protocol commands, wasting processing capacity and memory.

an extremely large number of IP addresses, whether domestic or foreign. We believe this is accounted for by the use of IP spoofing*[39] and botnet*[40] usage as the method for conducting DDoS attacks.

Backscatter Observations

Next we present our observations of DDoS backscatter using the honeypots*[41] set up by the MITF, a malware activity observation project operated by IIJ*[42]. By monitoring backscatter it is possible to detect DDoS attacks occurring on external networks as a third party without any interposition. For the backscatter observed between January 1 and March 31, 2011, Figure 3 shows trends in packet numbers by port, and Figure 4 shows the sender's IP addresses classified by country.

The port most commonly targeted by the DDoS attacks observed was the 80/TCP port used for Web services, accounting for 34.0% of the total during the target period. Attacks on 3389/TCP used for remote desktop were also observed. Looking at the origin of backscatter thought to indicate IP addresses targeted by DDoS attacks by country in Figure 4, the United States, Argentina, and China accounted for large proportions at 26.4%, 21.4% and 21.3%, respectively, with other countries following in order.

From the second half of February we observed an increase in the number of attacks classified under other categories, but most were attacks targeted at a wide range of ports for multiple addresses in Argentina. Ports were attacked in ascending order for certain addresses, with communications appearing similar to a port scan, but because the attacker cannot receive responses due to IP spoofing the reason for this behavior is unclear.

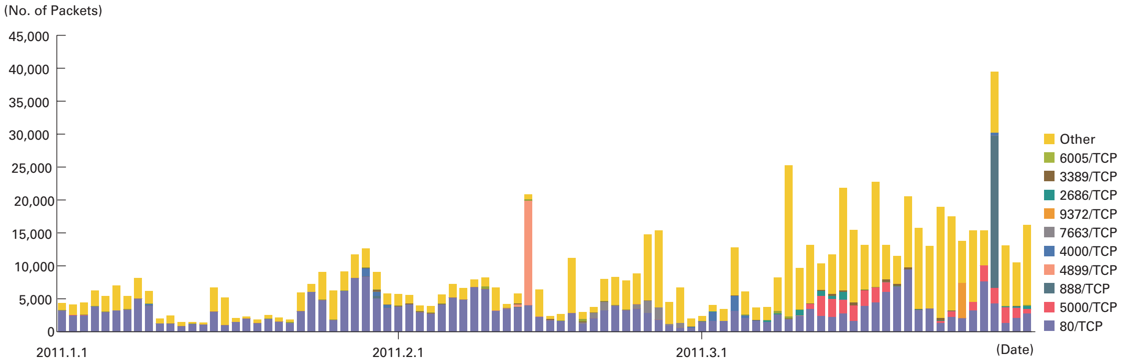

Figure 3: Observations of Backscatter Caused by DDoS Attacks (Observed Packets, Trends by Port)

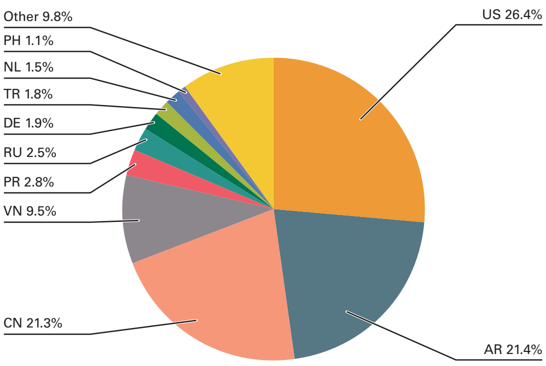

Figure 4: Distribution of DDoS Attack Targets According to Backscatter Observations (by Country, Entire Period under Study)

*39 Misrepresentation of a sender's IP address. Creates and sends an attack packet that has been given an address other than the actual IP address of the attacker in order to pretend that the attack is coming from a different location, or from a large number of individuals.

*40 A "bot" is a type of malware that institutes an attack after receiving a command from an external C&C server. A network constructed of a large number of bots acting in concert is called a "botnet."

*41 See also "1.3.2 Malware Activities."

*42 The mechanism and limitations of this observation method as well as some of the results of IIJ's observations are presented in Vol.8 of this report under "1.4.2 Observations on Backscatter Caused by DDoS Attacks" (http://www.iij.ad.jp/en/development/iir/pdf/iir_vol08_EN.pdf).

During the current period under study there were DDoS attacks on Middle-Eastern countries such as Egypt (second half of January), attacks on wordpress.com (early March), and DDoS attacks in South Korea (March 4), and we detected attacks on two sites in Egypt over the course of our observations. We believe that other attacks either did not involve IP spoofing, or used addresses other than those for IIJ observational equipment.

1.3.2 Malware Activities

Here, we present the results of the observations of the MITF*[43], IIJ's malware activity observation project. The MITF uses honeypots*[44] connected to the Internet in a manner similar to general users in order to observe communications arriving over the Internet. Most appear to be communications from malware selecting a target at random, or scanning behavior attempting to locate a target to attack.

■ Status of Random Communications

Figure 5 shows trends in the total volumes of communications coming into the honeypots (incoming packets) between January 1 and March 31, 2011. Figure 6 shows the distribution of sender's IP addresses by country. The MITF has set up numerous honeypots for the purpose of observation. We have taken the average per honeypot, showing the trends for incoming packet types (top ten) over the entire period subject to study.

Much of the communications arriving at the honeypots demonstrated scanning behavior targeting TCP ports utilized by Microsoft operating systems. We also observed scanning behavior for 1433/TCP used by Microsoft's SQL Server and 80/TCP used for HTTP. Additionally, communications of an unknown purpose were observed on ports not used by common applications, such as 2582/TCP, 9230/UDP, and 28002/TCP. Looking at the overall sender distribution by country in Figure 6, we see that attacks sourced to Japan at 31.9% and China at 9.8% were comparatively higher than the rest.

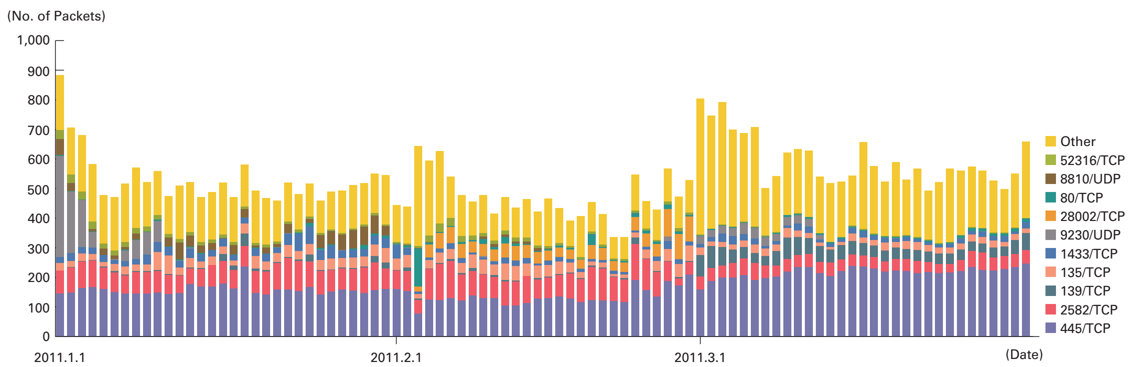

Figure 5: Communications Arriving at Honeypots (by Date, by Target Port, per Honeypot)

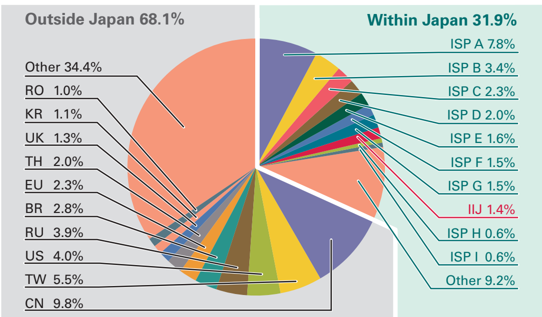

Figure 6: Sender Distribution (by Country, Entire Period under Study)

*43 An abbreviation of Malware Investigation Task Force. The Malware Investigation Task Force (MITF) began activities in May 2007 observing malware network activity through the use of honeypots in an attempt to understand the state of malware activities, to gather technical information for countermeasures, and to link these findings to actual countermeasures.

*44 A system designed to simulate damages from attacks by emulating vulnerabilities, recording the behavior of attackers, and the activities of malware.

Malware Network Activity

Figure 7 shows trends in the total number of malware specimens acquired during the period under study. Figure 8 shows the distribution of the specimen acquisition source for malware. In Figure 7, the number of acquired specimens show the total number of malware specimens acquired by the honeypots per day, while the number of unique specimens is the number of specimen variants categorized according to their digest of a hash function*45.

On average, 307 specimens were acquired per day during the period under study, representing 37 different malware variants. According to the statistics in our prior report, the average daily total for acquired specimens was 190, with 30 different variants.

The distribution of specimens according to source country in Figure 8 had Japan at 10.5%, with other countries accounting for the 89.5% balance. Taiwan was at 28.8%, maintaining the large ratio that it held during the previous period. This was due to the heightened activity of Mybot and its variants during this period, which was particularly predominant in Taiwan.

The MITF prepares analytical environments for malware, conducting its own independent analyses of acquired specimens. During the current period under observation 48.7% of the malware specimens acquired were worms, 44.3% were bots, and 7.0% were downloaders. In addition, the MITF confirmed through the analyses the presence of 48 botnet C&C servers*46 and 59 malware distribution sites.

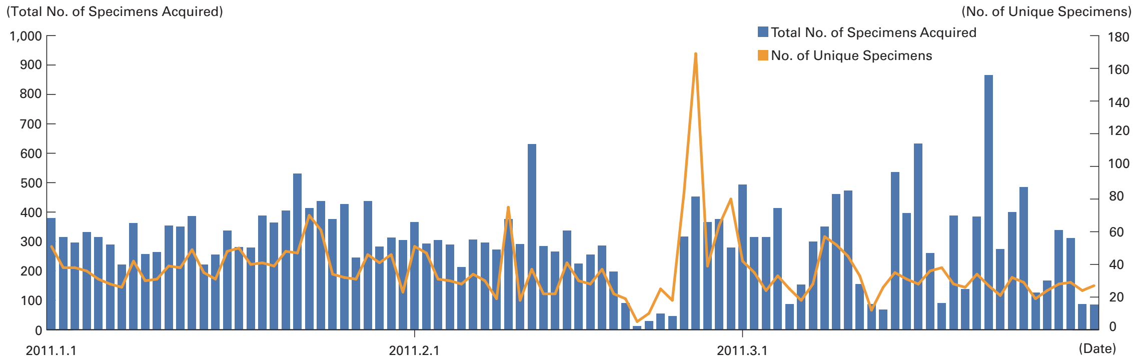

Figure 7: Trends in the Number of Malware Specimens Acquired (Total Number, Number of Unique Specimens)

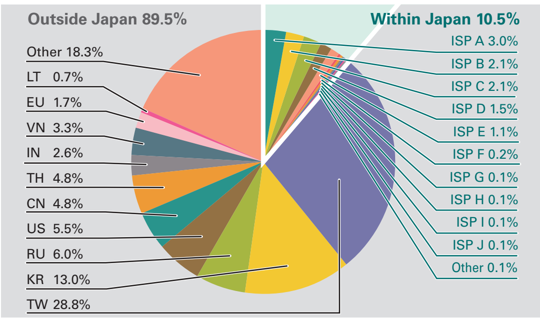

Figure 8: Distribution of Acquired Specimens by Source (by Country, Entire Period under Study)

*45 This figure is derived by utilizing a one-way function (hash function) that outputs a fixed-length value for various input. The hash function is designed to produce as many different outputs as possible for different inputs. While we cannot guarantee the uniqueness of specimens by hash value, given that obfuscation and padding may result in specimens of the same malware having different hash values, the MITF has expended its best efforts to take this fact into consideration when using this methodology as a measurement index.

*46 An abbreviation of "Command & Control." A server that provides commands to a botnet consisting of a large number of bots.

1.3.3 SQL Injection Attacks

Of the types of different Web server attacks, IIJ conducts ongoing surveys related to SQL injection attacks*47. SQL injections are known to occur in one of three attack patterns: those that attempt to steal data, those that attempt to overload database servers, and those that attempt to rewrite Web content.

Figure 9 shows trends in the numbers of SQL injection attacks against Web servers detected between January 1 and March 31, 2011. Figure 10 shows the distribution of attacks according to source. These are a summary of attacks detected by signatures on the IIJ Managed IPS Service.

Japan was the source for 48.2% of attacks observed, while the United States and China accounted for 21.2% and 5.1%, respectively, with other countries following in order. There was very little change from the previous period in the number of SQL injection attacks against Web servers that occurred. However, there were some focused attacks on a number of servers, such as a large-scale attack from the United States on a specific server on January 29, and attacks originating from both Japan and foreign sources on other servers on March 2, March 8, and March 22. They led to an increase in the overall ratios for Japan and the United States, and lowered the ratio of attacks from countries such as China and South Korea. The LizaMoon*48 attack that involved website alterations using SQL injections also drew attention during this period, with small-scale attack attempts made on multiple servers between February 4 and mid-February.

As previously shown, attacks of various types were properly detected and dealt with in the course of service. However, attack attempts continue, requiring ongoing attention.

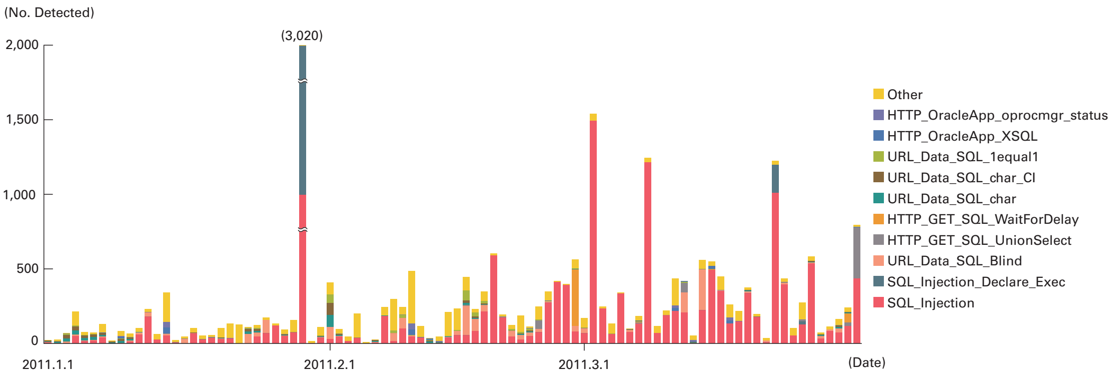

Figure 9: Trends in SQL Injection Attacks (by Day, by Attack Type)

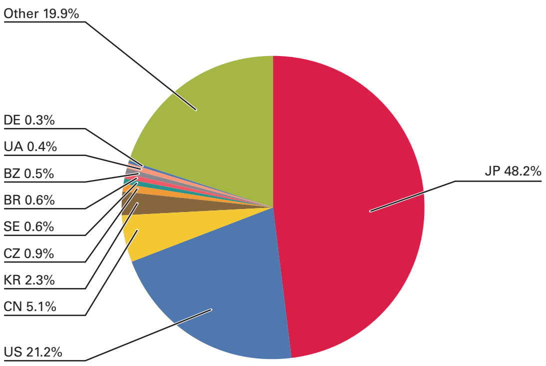

Figure 10: Distribution of SQL Injection Attacks by Source (by Country, Entire Period under Study)

*47 Attacks accessing a Web server to send SQL commands, thereby manipulating an underlying database. Attackers access or alter the database content without proper authorization, and steal sensitive information or rewrite Web content.

*48 Details of the LizaMoon attack can be found in the following IBM Tokyo SOC Report. Tokyo SOC Report "A New Type of Website Alteration SQL Injection Attack" (https://www-304.ibm.com/connections/blogs/tokyo-soc/entry/sqlinjection_20110401?lang=en_us) (in Japanese). Brief information in English is also available in the following blog article of IBM Internet Security Systems. Frequency X Blog "Analyzing a Mass SQL Injection Attack - Lizamoon" (http://blogs.iss.net/archive/lizamoon.html).

1.4 Focused Research

Incidents occurring over the Internet change in type and scope almost from one minute to the next. Accordingly, IIJ works toward taking countermeasures by continuing to perform independent surveys and analyses of prevalent incidents. Here we will discuss the newly-adopted Dionaea honeypot as well as malware anti-forensics, in addition to detailing Japan's communication circumstances after the Great East Japan Earthquake and attacks related to the disaster.

1.4.1 The Dionaea Honeypot

IIJ has carried out its MITF (Malware Investigation Task Force) anti-malware activities since May 2007*[49]. As part of these activities a honeypot*[50] system was constructed to directly observe the activity of worms and bots attacking IIJ's network. Until now Nepenthes*[51] was used for these observations. Here we discuss the functions and characteristics of the new Dionaea*[52] honeypot system that we have put into operation.

■ Characteristics of Dionaea

Dionaea is honeypot software still under active development that was released in late May 2009 as a successor to Nepenthes. Dionaea features improvements over Nepenthes in areas such as malware acquisition and logging. Other characteristics of Dionaea include support for IPv6 and a python-based implementation that makes expansion easy. Here we will provide an overview of the following characteristics of Dionaea.

- Malware acquisition
- Improved attack detection accuracy
- Improved logging

One improvement to malware acquisition is support for new vulnerabilities. Nepenthes was only able to emulate vulnerabilities up to MS05-017. In contrast, Dionaea discontinues support for older vulnerabilities no longer commonly used in attacks, and has switched to a detection method that supports new vulnerabilities such as MS08-067*[53].

Nepenthes used pattern matching on attack communications payloads to detect attacks. This led to the drawback of emulation being difficult when attacks were made after interaction using complex protocols such as SMB. Dionaea resolves this issue by implementing SMB and MSRPC protocol emulation. Additionally, by automatically detecting shellcode within a payload in conjunction with the Libemu*[54] x86 emulator, it is possible to detect the exploitation of unknown vulnerabilities.

*49 MITF is explained in IIR Vol.7 under "1.4.3 MITF Anti-Malware Activities" (http://www.iij.ad.jp/en/development/iir/pdf/iir_vol07_EN.pdf).

*50 Honeypots are systems for observing the techniques used by attackers, and include low-interaction types that emulate software with vulnerabilities and vulnerable systems, and high-interactions types that make use of actual OS and software implementations.

*51 Nepenthes (http://nepenthes.carnivore.it/) is a low-interaction server-based honeypot that mainly emulates known vulnerabilities in Microsoft's Windows. Its development has now been discontinued, and use of its successor Dionaea is recommended.

*52 Dionaea (http://dionaea.carnivore.it/).

*53 Microsoft Security Bulletin MS08-067 - Critical: Vulnerability in Server Service Could Allow Remote Code Execution (958644) (http://www.microsoft.com/technet/security/bulletin/ms08-067.mspx).

*54 Libemu (http://libemu.carnivore.it/).

Next we will take a look at log-related functions. Dionaea can output logs in database format using SQLite in addition to logs in text format, making it easier to parse trends and analysis outputs. Nepenthes was only able to output time series logs, making it difficult to associate data at a later date. Meanwhile, Dionaea makes it possible to associate which attacks were included in which communications, and which communications led to malware being obtained.

A number of other improvements have also been made. Nepenthes only supported C++ for the addition of functions, but Dionaea makes it possible to write modules using Python, making it easier to expand functionality. Many other improvements not mentioned here were also made, such as support for IPv6.

■ Evaluation and Adoption of Dionaea

Dionaea was initially unstable, making everyday use difficult. Because its source code was updated on a daily basis*[55], IIJ evaluated and tested Dionaea over time in tandem with Nepenthes. In these experimental observations we learned that the Conficker*[56] malware that spreads via networks was extremely active. However, partly because there were few infections on the IIJ network, we gave priority to observation environment stability and continued observations using Nepenthes despite the fact that it could not obtain this malware, while also proceeding with our appraisal of Dionaea to adopt it at the MITF. While evaluating Dionaea we also considered other honeypot implementations*[57]. After comprehensive assessment of factors such as honeypot capabilities, community activeness, and compatibility with existing systems, we decided to construct a honeypot system based on Dionaea.

We began formal operation of this new observation system from March 2011. IIJ expanded upon the implementation of the new system to resolve functional inadequacies that were identified during evaluation, such as the inability to associate attacks and acquired malware, and the ambiguity of MSRPC commands included in attack code. We also revised the source code in order to apply it to IIJ's observation system environment. As previously mentioned, because it is now possible to emulate complex protocols, we can now observe attacks that involve multiple sets of communications. Because observations of connections to specific ports have increased as a result of this, we corrected the values observed for March to remove this influence from the figures in "1.3.2 Malware Activates." Additionally, because it was established that some malware such as Conficker performs repeated attacks on specific honeypots, we revised the system affected by this issue.

*55 The following URL lists the revision history of Dionaea (http://src.carnivore.it/dionaea/log/). As can be seen here, the source code was updated almost every day between late May 2009 when Dionaea was first committed and the second half of 2010, demonstrating how active its development was.

*56 See IIR Vol.2 under "1.4.2 Malware that Exploits MS08-067" (http://www.iij.ad.jp/development/iir/pdf/iir_vol02.pdf) (in Japanese) and IIR Vol.4 under "1.4.1 Worldwide Outbreak of the Conficker Malware" (http://www.iij.ad.jp/en/development/iir/pdf/iir_vol04_EN.pdf) for more information on Conficker.

*57 For example, BotHunter (http://www.bothunter.net/), Amun (http://amunhoney.sourceforge.net/), and Argos (http://www.few.vu.nl/argos/).

■ Observations Using the New System

Figure 11 shows daily distribution and Figure 12 shows results by malware type for total specimens acquired in observation results using the new system. Malware names were identified using ClamAV and summarized in these figures. Comparing Figure 11 to the period up to February in Figure 7, we can see that acquisition status has changed significantly. The average total specimens acquired per day increased substantially from 307 under the old system to 25,246. This is due to the difference between Nepenthes and Dionaea in the number and types of vulnerability that can be emulated. The major difference between the two is that the new system makes it possible to obtain Conficker specimens.

Conficker is a worm that exploits the MS08-067 vulnerability to spread. Conficker (Worm.Kido and Worm.Downadup in the figure) accounts for a significant ratio of 71.4% of the total specimens acquired under the new system. Investigating the source of infection, 3.7% of sources were within Japan, with 0.03% from the IIJ network, showing that while it is not a major threat on the IIJ network, it remains very active on a global scale.

Thanks to this system change it is now easier to identify which malware is exploiting which vulnerability, enabling countermeasures to be implemented more swiftly. We can now also identify trends in malware that we could not obtain using Nepenthes. We are currently adjusting the system further with the aim of publishing data in this IIR on a regular basis. IIJ will continue to update our system in response to changes in circumstance and take appropriate measures to implement anti-malware activities.

1.4.2 Malware Anti-Forensics

When incidents such as unauthorized access or malware infections occur, digital forensic techniques*58 are used to investigate and analyze digital data on related devices. However, in recent years malware has begun to implement techniques called anti-forensics that hinder detection via analysis. Anti-forensics is carried out by deleting or changing

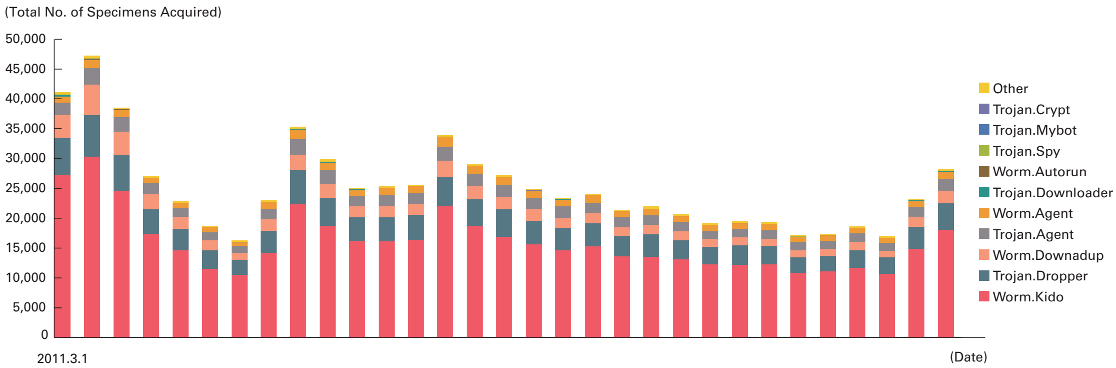

Figure 11: Trends in the Number of Malware Specimens Acquired (by Day, New System, by Specimen Type)

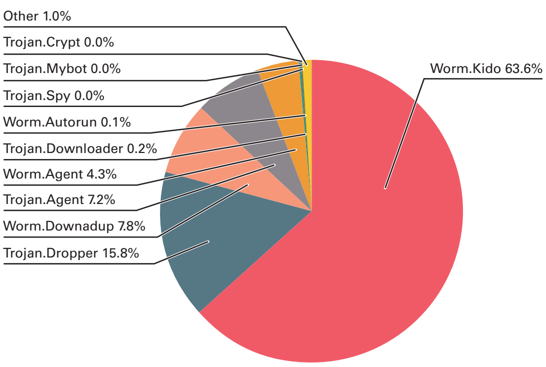

Figure 12: Distribution of Malware Specimens Acquired (March, by Specimen Type)

*58 See IIR Vol.9 under "1.4.3 An Overview of Digital Forensics" (http://www.iij.ad.jp/en/development/iir/pdf/iir_vol09.pdf) for more information about digital forensic techniques.

the data found on media such as disks or memory. Here we introduce anti-forensic techniques that target the disks most commonly examined using forensic analysis (Windows file system), and discuss the measures that should be taken from an analyst's perspective.

Deletion of Files

The anti-forensic technique seen most often involves simply deleting files related to malware activity. When files are deleted they can no longer be seen from commonly-used software such as Windows Explorer. However, data is not erased immediately after a file is deleted. In fact, only part of the metadata for the corresponding file managed by the file system is changed*[59]. This means that it is possible to examine deleted files with software used in forensic analysis*[60]. In other words, it is possible to deal with concealment through this technique even when a file has been deleted as long as it has not been overwritten with another file.

Changes to Time Stamps

Another common technique involves changing the time stamp metadata of files. Computer hard disk drive capacities continue to increase in size every year, and can contain a large amount of data. For this reason analysis is sometimes narrowed down to the period that an incident occurred to limit the number of files for examination to as few as possible. Time stamp information such as the creation time and modification time of a file is used to filter files for a given period. Malware attempts to evade analysis by setting the time stamp information in files it wants to conceal to a completely different time using the SetFileTime API, etc. This technique began to be used in many malware such as Conficker about three years ago.

There are two methods of dealing with this technique. One method is to investigate the time stamps associated with data other than the target files. For example, Windows registry keys contain information about the time they were last modified. This means that target files can be detected for malware registered as a service by also checking the times in the registry. Additionally, Windows uses files to speed up execution called Windows Prefetch files that are generated each time an .exe file is executed. It is possible to pinpoint the time an .exe file was executed by checking the time stamp information in these prefetch files.

Another method of dealing with this is to use minor time stamp information that is not usually referenced to filter the period of time. Windows NTFS file systems store metadata including file time stamps in a special file called the MFT (Master File Table). File metadata is managed as entry attributes in the MFT. The time stamp information normally referenced is found in a Standard Information attribute, and this can be changed easily using API such as SetFileTime. Meanwhile, time stamp information for the File Name attribute cannot be changed via API. This means it is possible to invalidate time stamp changes carried out by malware by using time stamp information from the File Name attribute for filtering.

Deletion by Overwriting

Simple file deletion only changes part of the metadata, so the data in the file itself is not deleted. For this reason some malware uses the technique of deleting the very data in a file by overwriting it with random data. At IIJ we confirmed that the malware used to carry out widespread DDoS attacks in South Korea in early March this year employed this technique*[61]. It is difficult to identify the nature of malware when the data itself is overwritten, because it is not possible to analyze the malware dynamically or statically after this has taken place. However, because the metadata remains, it is possible to investigate related activities based on this. Additionally, although the chance of success is not very high, deleted files may be recoverable through automated backups using system restore functions (such as a Windows System Restore Point), so it is worth the check.

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*59 When a file is deleted, the Windows NTFS file system only clears the flags that indicate the corresponding metadata and the disk space where the data is stored are in use. This means that as long as this disk space is not overwritten with another file, both the metadata and the file content remain.

*60 Examples of the software used for analysis include EnCase (http://www.guidancesoftware.com/), FTK (http://accessdata.com/), and TSK (http://www.sleuthkit.org/sleuthkit/).

*61 This malware was downloaded via file sharing sites, after which it launched a DDoS attack on specific sites and also destroyed the hard disk of the infected PC. Details of the behavior of this malware can be found in the following McAfee Blog post. McAfee Blog: "Malware in Recent Korean DDoS Attacks Destroys Systems" (http://blogs.mcafee.com/mcafee-labs/malware-in-recent-korean-ddos-attacks-destroys-systems).

Direct Access to File System

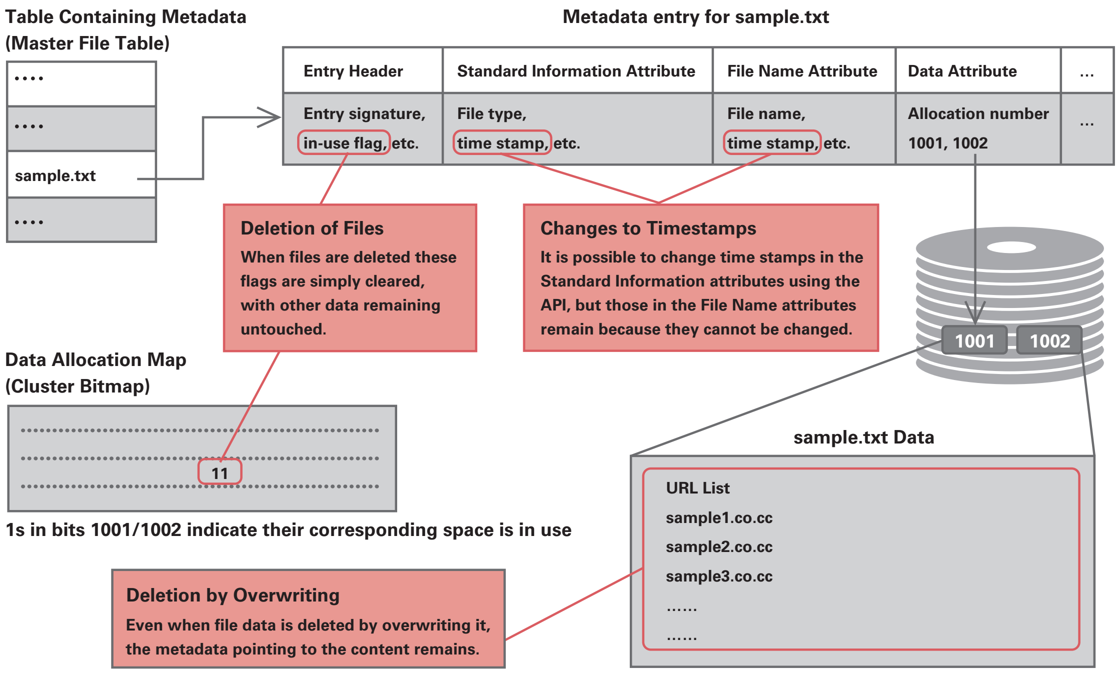
The anti-forensic techniques presented here all use system API to delete or change files. The data changed through these techniques is shown in Figure 13. As can be seen from this, regardless of which technique is used some traces are left in the file system metadata, and from this metadata it is possible to detect the affected files and investigate related activities.

However, recently malware that infects PC by analyzing the file system structure without using APIs has begun to appear. Backdoor.Prioxer*[62], which Symantec reported on in March of this year, opens hard disk drives in RAW mode and identifies the type of file system used before locating files to infect in accordance with the algorithm for that file system and writing malicious code.

Investigation methods using metadata are not effective for this technique, making analysis that focuses on data content necessary. One example of this is comparing the hash values of file data. Because the files targeted for infection include many executables that are system standard, if hash values are calculated in advance for these executables in their normal state*[63], it may be possible to detect infected files by comparing these hash values with those for the executables on an infected machine. IIJ has not observed any malware that uses this technique, but we are concerned that malware implementing such a technique may appear in the future.

Summary

Here we have presented a number of anti-forensic techniques used by malware. By implementing comprehensive analysis and avoiding one-sided analysis relying only on metadata or file content, analysts can deal with these to a certain extent no matter which technique is used*[64]. Here we have detailed countermeasures for detection using only



* This figure describes representative data. There are actually other attributes that are changed due to file handling, such as the NTFS metadata entry allocation map (MFT Entry Bitmap).

Figure 13: File Referencing Mechanisms and Anti-Forensic Techniques on Windows NTFS File Systems

*62 "Backdoor.Prioxer!inf: 'Accidentally' the Stealthiest File Infector Ever!" (http://www.symantec.com/connect/ja/blogs/backdoorprioxerinf-accidentally-stealthiest-file-infector-ever).

*63 Methods of obtaining normal hash values for system standard executables include calculating them in advance using a PC that is not infected or downloading a public hash value database. For example, NIST (National Institute of Standards and Technology) publishes a database that includes hash values for the executables of major OSes. "National Software Reference Library" (http://www.nsrl.nist.gov/new.html).

*64 Malware that only infects memory cannot continue to operate after a PC is rebooted, but also cannot be detected using the disk analysis techniques presented here because it leaves no traces on the disk. The technique known as memory forensics that analyzes data in memory is effective when dealing with this kind of malware.

the information within a terminal, but the chance of detecting an infection early is increased if communications over the network are also examined for abnormalities.

1.4.3 Circumstances Surrounding the Great East Japan Earthquake

The Great East Japan Earthquake that occurred on March 11 was a catastrophic disaster that caused great loss of life and local infrastructure due to the major earthquake followed by tsunami and a nuclear power station accident. This disaster affected not only the Tohoku district*[65] where the disaster struck, but also the Tokyo metropolitan district*[66] and other outlying areas, though not on the same scale. Major disruption was caused to lifelines such as power, gas, and the water supply, as well as public transportation systems and the distribution of goods including basic commodities and gasoline.

Here we examine activities related to this disaster, such as Internet-based communication status and associated activities, aid-related information that tends to get buried amongst daily reports on the disaster, and attacks connected to the earthquake.

■ Status of Communications Following the Disaster

After the earthquake struck, abnormal states of communications were observed in Japan and on the Internet. Communications and power facilities in the area struck by the disaster were damaged by the earthquake and tsunami, making normal communications impossible. There were also reports of damage to international submarine cables*[67]. Additionally, restrictions were temporarily placed on outgoing calls from land lines and mobile phones in the Tokyo metropolitan district due to the large volume of calls from those wishing to confirm the safety of their relatives, rendering these lines of communication unusable.

Under these circumstances communication methods that allow information to be accumulated on servers such as email, Twitter, and Facebook were invaluable for confirming the safety of others, and some companies used Twitter to contact employees*[68] to utilize such accumulation. Meanwhile, it was also pointed out that SNS played a role in spreading large amounts of unreliable information that did not specify sources*[69].

Also, although a drop in the volume of Internet communications was observed immediately after the earthquake, access from those seeking up-to-date information was concentrated on specific Web servers such as those of local public bodies and power companies, leading to some becoming temporarily inaccessible. The situation did not return to normal in the week following the disaster, with many companies deciding to have employees work from home because of those forced to walk home when public transportation systems were suspended on the day of the earthquake, and because transportation systems were expected to remain unreliable over the following week.

From the week after the earthquake struck, IT systems such as Web servers in buildings with no emergency power system were often interrupted due to rolling blackouts. Despite this post-earthquake situation multiple incidents occurred on the Internet as per normal, and it was necessary to maintain vigilance regarding malware and vulnerability countermeasures.

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*65 See the following New York Times summary for details regarding the area directly affected by the earthquake. “Map of the Damage From the Japanese Earthquake” (http://www.nytimes.com/packages/flash/newsgraphics/2011/0311-japan-earthquake-map/index.html?ref=europe).

*66 This refers to Tokyo and prefectures within commuting distance from Tokyo, such as Saitama, Chiba, Kanagawa, Ibaraki, Tochigi, Gunma, and Yamanashi. The population of this area is 42,920,000 according to Chapter 2, Section 1, “Population Status, etc.”, of the Tokyo Metropolitan District White Paper published by the Ministry of Land, Infrastructure, Transport and Tourism (http://www.mlit.go.jp/hakusyo/syutoken_hakusyo/h22/h22syutoken__files/zenbun.pdf) (in Japanese).

*67 See the following Network World report for information regarding the damage to international submarine cables. “Quake damage to Japan cables greater than thought Service is cut off on two segments of a trans-Pacific network” (http://www.networkworld.com/news/2011/031411-quake-damage-to-japan-cables.html).

*68 For example, at IBM Japan the following announcement was made to IBM group employees. “Request for employees to use Twitter for earthquake-related information” (http://www-06.ibm.com/jp/news/2011/03/1402.html) (in Japanese).

*69 For example, some information related to the nuclear power station accident suggested that drinking mouthwash would lessen the effects of exposure to radioactive materials, resulting in a warning being published by the National Institute of Radiological Substances. “Liquids such as disinfectant containing iodine should not be consumed - be wary of baseless claims spreading on the Internet” (http://www.nirs.go.jp/data/pdf/youso-3.pdf) (in Japanese).

■ Efforts toward Assisting Reconstruction and Rectifying the Status of Communications

In the aftermath of the earthquake multiple companies were involved in providing direct assistance such as relief supplies and donations to the quake hit area, as well as free use of message board systems for confirming the safety of individuals and software such as commercial OSes and map applications. Those in the disaster area were also granted exemption of service fees and free use of cloud servers*[70]. Likewise, there were many cases of action being taken to organize communications for distributing information appropriately. This includes the appearance of sites providing a comprehensive summary of useful information regarding earthquake response collected from various sources on the Internet*[71], cloud servers being provided to websites unable to distribute information effectively due to concentrated access or damage from the disaster, and the mirroring of content. Additionally, there was a series of TV and radio retransmitted broadcasts on the Internet in order to communicate accurate information to the maximum number of people.

It was recommended that text or CSV formats be used instead of or in addition to file formats that tend to be large in size in comparison to the content (PDF and formats used by applications such as Excel) for the publication of information*[72]. At the same time, official government agency-related information began to be distributed over SNS such as Twitter and Facebook*[73]. Meanwhile, the Ministry of Internal Affairs and Communications requested that unconfirmed information spreading over the Internet (false rumors, etc.) be voluntarily deleted by ISPs from bulletin boards, blogs, etc.*[74]

Direct support from overseas was also provided to the disaster-hit area, such as disaster relief teams, relief supplies, and donations. Additionally, overseas product vendors in particular gave special consideration to Japan's state of communications. Microsoft excluded Japan from the official release of Internet Explorer 9 that was planned for March 14 U.S. time in order to reduce the load on Japan's network following the disaster*[75]. Cisco, a vendor for the routers used by many network companies such as ISPs, announced they were delaying their regular twice yearly firmware update (planned for March 23 U.S. time) by six months in consideration of Japanese ISPs that were focused on maintaining communications after the earthquake*[76].

■ Attacks Linked to the Disaster

Meanwhile, attacks taking advantage of this disaster also occurred. First, immediately after the disaster there were SEO poisoning incidents targeting the earthquake in Japan and attacks originating from content designed to infect users with

*70 See the following for details regarding the reconstruction assistance activities of companies. Advanced Information Systems and Software Division, Information and Communications Bureau, Ministry of Internal Affairs and Communications "Status of Public and Private Initiatives in the Field of ICT regarding the Great East Japan Earthquake" (http://www.soumu.go.jp/main_content/000112455.pdf) (in Japanese). IIJ provided cloud environments for the transmission of information to the affected area and schedulers free of charge, announced exemption of its service fees through April 2011 to individual users in the quake-hit area, and also provided mirror sites for local authorities there (http://www.iij.ad.jp/news/pressrelease/2011/0316.html) (in Japanese).

*71 The government response included the disaster control site of the office of the Prime Minister (http://www.kantei.go.jp/saigai/) (in Japanese). Private sector initiatives included those from search service providers Google (http://www.google.co.jp/intl/en/crisisresponse/japanquake2011.html) and Yahoo! (http://notice.yahoo.co.jp/emg/en/).

*72 Local Authorities Systems Development Center "Regarding the file formats of important information distributed to citizens" (https://www.lasdec.or.jp/cms/12,22060,84.html) (in Japanese). The Ministry of Economy, Trade and Industry also published a similar announcement. "Regarding data formats for providing information regarding the Tohoku Region Pacific Coast Earthquake" (http://www.meti.go.jp/policy/mono_info_service/joho/other/2011/0330.html) (in Japanese).

*73 For example, information is provided via Twitter through the official accounts of the office of the Prime Minister (disaster information) (@kantei_saigai), the Ministry of Defense (disaster information) (@bouei_saigai), and the Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications (@FDMA_JAPAN). Information is also provided mostly in English on the official site of the office of the Prime Minister on Facebook (http://www.facebook.com/Japan.PMO). Additionally, the Ministry of Economy, Trade and Industry lists confirmed government and local authority Twitter accounts as well as guidelines and policies for public institutions operating a Twitter account on their Social Media Portal for Public Institutions (http://smp.openlabs.go.jp/) (in Japanese).

*74 Following the Cabinet Secretariat Working Team on Measures to Ensure Safety and Peace of Mind in the Disaster Area published "Measures to Ensure Safety and Peace of Mind in the Disaster Area" (http://www.cas.go.jp/jp/seisaku/hisaitiwg/honbun.pdf) (in Japanese), the Ministry of Internal Affairs and Communications published "A Request to Telecommunication Carrier Organizations regarding the Appropriate Response to False Rumors about the Great East Japan Earthquake on the Internet" (http://www.soumu.go.jp/menu_news/s-news/01kiban08_01000023.html) (in Japanese). As an example of the response to this request, the Telecom Services Association published "Provision of information regarding responses to false rumors regarding the Great East Japan Earthquake on the Internet" (http://www.telesa.or.jp/taisaku/) (in Japanese).

*75 Microsoft "Regarding postponement of the Japanese product release of Internet Explorer (R) 9 due to the Tohoku Region Pacific Coast Earthquake" (http://www.microsoft.com/japan/presspass/detail.aspx?newsid=3969) (in Japanese). Distribution of the Japanese version of IE9 began on April 26. "Japanese version of Windows (R) Internet Explorer (R) 9 released" (http://www.microsoft.com/japan/presspass/detail.aspx?newsid=3995) (in Japanese).

*76 "Cisco Security Advisories and Notices, March 2011 Bundled Publication Deferred" (http://www.cisco.com/en/US/products/products_security_advisories_listing.html).

malware*77. It has been reported that many domains containing English words such as Japan, Earthquake, and Tsunami were acquired for this reason. After the earthquake occurred many of these attacks used English search key words and content such as photos of the affected area or videos of the tsunami, so it is thought that they were targeted at non-Japanese people who had an interest in what was happening in Japan*78. Although this type of attack exploits the high profile nature of such disasters, new attacks were being discovered even a month after the Great East Japan Earthquake struck.

Incidents in Japan in which the Japanese people were targeted include a chain email relating to the earthquake*79 that started a week or two after the disaster, donation fraud using telephone and email to impersonate public agencies, and phishing involving redirection to a fraudulent donation site, with warnings issued as a result*80. During the same period targeted attacks via email that utilized information related to the earthquake and nuclear power station were also confirmed*81.

■ Summary

At the time of writing aftershocks are still occurring, and it may be premature to summarize the related trends with the threat of this disaster still ongoing. However, as shown here Japan's Internet and communications situation has been affected by the disaster and continues to undergo change, still remaining volatile. It is also possible that attacks taking advantage of this crisis will continue in the future, and we would recommend readers be aware of the occurrences of attacks and stay informed about relevant information.

1.5 Conclusion

This report has provided a summary of security incidents to which IIJ has responded. This time we introduced our new observation environment, gave an overview of malware anti-forensics, and discussed the impact of the Great East Japan Earthquake on Japan's communication circumstances as well as related attacks.

In closing we would like to send our warmest regards to all those who are striving to provide relief to disaster victims and rebuild, and to the international community for the aid and cooperation they have given. IIJ will also continue its efforts towards reconstruction.

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Hirohide Tsuchiya (1.2 Incident Summary)
Hirohide Tsuchiya, Hiroshi Suzuki, Tadaaki Nagao (1.3 Incident Survey)
Hiroshi Suzuki (1.4.1 The Dionaea Honeypot)
Takahiro Haruyama (1.4.2 Malware Anti-Forensics)
Mamoru Saito (1.4.3 Circumstances Surrounding the Great East Japan Earthquake)
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*77 Details of SEO poisoning incidents related to the disaster can be found in the following Trend Micro malware blog post. "3/11 Japan Earthquake Disaster Scam Watch" (http://blog.trendmicro.com/most-recent-earthquake-in-japan-searches-lead-to-fakea/).

*78 The following Kaspersky Lab blog post details the timeline of incidents occurring after the disaster from an international perspective. "The Japan crisis – an IT security timeline" (http://www.securelist.com/en/analysis/204792173/The_Japan_crisis_an_IT_security_timeline).

*79 The Anti-Spam Consultation Center was one of the organizations warning of the spam and chain emails related to the disaster (http://www.dekyo.or.jp/soudan/eq/index.html) (in Japanese).

*80 For example, Consumer Affairs Agency "Beware of Donation Fraud relating to the Earthquake" (http://www.caa.go.jp/jisin/110318gienkinsagi.html) (in Japanese), or the Council of Anti-Phishing Japan "Phishing under the guise of donations to Japan (3/14/2011)" (http://www.antiphishing.jp/news/alert/2011314.html) (in Japanese).

*81 Details can be found in the following IBM Tokyo SOC Report. Tokyo SOC Report "Trends in recent targeted attacks detected by Tokyo SOC" (https://www-304.ibm.com/connections/blogs/tokyo-soc/entry/targeted_attack_20110324?lang=en_us) (in Japanese).