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# Internet Infrastructure Review Vol.23

May 2014

## Infrastructure Security

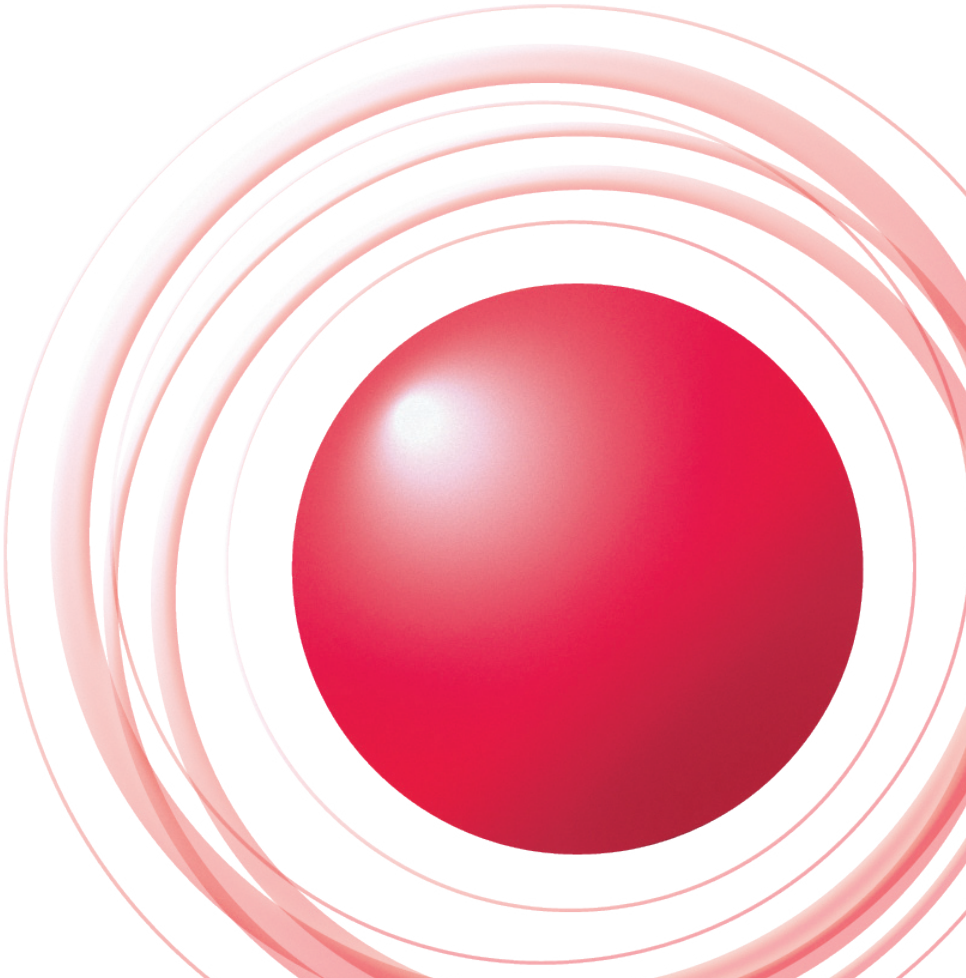
The Attackers Behind PlugX

## Messaging Technology

Sender Authentication Technology Implementation Status and Standardization Trends

## Technology Trends

The Current State of Big Data Analysis



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## Executive Summary

According to materials published by the Ministry of Internal Affairs and Communications on March 14, 2014, the total download traffic of broadband service subscribers in Japan was estimated to be approximately 2.5 Tbps in November 2013, which is 33.2% higher than the same month the previous year. As noted in the last volume of this report, we are seeing a trend in which traffic is gradually shifting to HTTP/Web applications. In Gartner's "Hype Cycle for Emerging Technologies, 2013" published in August 2013, the key theme is the evolving relationship between humans and machines. The Hype Cycle highlights technologies that support the following six areas: "Augmenting Humans with Technology," "Machines Replacing Humans," "Humans and Machines Working Alongside Each Other," "Machines Better Understanding Humans and the Environment," "Humans Better Understanding Machines," and "Machines and Humans Becoming Smarter." The report states that big data, which is a key technology for achieving these goals, is just reaching the peak of its hype cycle.

Ensuring the security of data related to the privacy of individuals is essential for the safe and secure use of the Internet. However, at the same time, proactively utilizing the data exchanged and accumulated on the Internet and cloud solutions is also considered necessary for furthering the trend of advancing human capabilities and society by increasing the utilization of computers.

This report discusses the results of the various ongoing surveys and analysis activities that IIJ carries out to support the Internet infrastructure and enable our customers to continue to use it safely and securely. We also regularly present summaries of technological development as well as important technical information.

In the "Infrastructure Security" section, we give a month-by-month chronological summary of major incidents observed during the three months from January 1 to March 31, 2014, and report on the results of our statistics gathering and analyses for the entire period. We also present our focused research for this period, including discussion of the results of an investigation that involved analyzing PlugX specimen groups to identify the kinds of targeted attack groups that were behind them. Additionally, we examine the attack technique known as DrDoS that has been on the rise since late last year and the countermeasures against it, and provide an explanation of the Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business.

In the "Messaging Technology" section, we report on our analysis of trends in spam for the 52 weeks from April 1, 2013 to March 30, 2014, with a focus on the 13 weeks between December 30, 2013 and March 30, 2014. In our discussion of email technology, we discuss the implementation status of sender authentication technology, and look at efforts to revise the SPF specification standardized as an experimental RFC in 2006.

In the "Technology Trends" section, we examine the current state of big data analysis, and also look at technological trends related to analysis platforms that demand a shift to real-time solutions, and the diversification of big data analysis techniques for which knowledge can be obtained from time-series data. Additionally, we examine the results of trend analysis using Wikipedia PVC as an example of analysis focused on the timeline of big data.

Through activities such as these, IIJ continues to strive towards improving and developing our services on a daily basis while maintaining the stability of the Internet. We will keep providing a variety of solutions that our customers can take full advantage of as infrastructure for their corporate activities.

Author:

**Toshiya Asaba**
President and CEO, IIJ Innovation Institute Inc. President and CEO, Stratosphere Inc. Mr. Asaba joined IIJ in its inaugural year of 1992, becoming involved in backbone construction, route control, and interconnectivity with domestic and foreign ISPs. He was named IIJ director in 1999, and executive vice president in charge of technical development in 2004. When the IIJ Innovation Institute Inc. was founded in June 2008, Mr. Asaba became its president and CEO. When Stratosphere Inc. was founded in April 2012, he also became president and CEO of that organization.

# The Attackers Behind PlugX

**In this report, we present survey results and background information on the attackers behind the PlugX malware used in targeted attacks. We also examine recent trends in DDoS attacks and their countermeasures, and discuss the Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business of the Ministry of Internal Affairs and Communications.**

## 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, 2014. In this period a number of hacktivism-based attacks were made by Anonymous and other groups, following on from those in the last survey period. DDoS attacks exploiting NTP also occurred frequently, and it was reported that one attack generated a volume of traffic as high as 400 Gbps. Domain hijacking incidents affecting whole countries, such as those where ccTLDs were hijacked, also continued. Additionally, financial damage stemming from the misuse of online banking, which has been on the rise in Japan since last year, is increasing steadily this year. Due to the significant impact of an incident that came to light in the United States at the end of last year, involving the theft of a large amount of information from the POS systems of retailers using malware, there was a great deal of debate regarding countermeasures. 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, 2014. Figure 1 shows the distribution of incidents handled during this period*1.

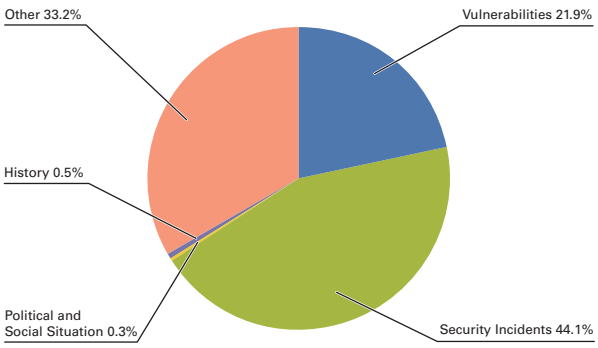


**Figure 1: Incident Ratio by Category (January 1 to March 31, 2014)**

### The Activities of Anonymous and Other Hacktivists

Attacks by hacktivists such as Anonymous continued during this period. DDoS attacks and information leaks occurred at government-related and company sites in a large number of countries stemming from a variety of incidents and causes. In January, a number of government-related sites in Brazil fell victim to Web alterations. Also in January, the website of the Massachusetts Institute of Technology (MIT) was defaced in memory of an activist who committed suicide last year (OpLastResort).

In relation to the situation in Ukraine, there were a number of DDoS attacks on government agencies, leaks of

*1 Incidents discussed in this report are categorized as vulnerabilities, political and social situations, history, security incidents or 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.

opposition diet member emails and credit card information, and attacks on media websites by groups such as Anonymous in the EU, Ukraine, Russia, and other neighboring countries. Additionally, in March there were DDoS attacks on the North Atlantic Treaty Organization (NATO) thought to be related to this*2.

There were also ongoing attacks by Anonymous and other groups on government and government-related sites in different countries around the world, with the focus on South America and Europe. Unknown attackers claiming affiliation with the Syrian Electronic Army also continued to hijack SNS accounts and deface websites, with affected companies including big names such as Microsoft and Skype.

### ■ Vulnerabilities and their Handling

During this period fixes were released for Microsoft's Windows*3*4*5*6 and Internet Explorer*7*8. Updates were also made to Adobe Systems' Flash Player, Adobe Reader, Acrobat, and Shockwave Player. A quarterly update was provided for Oracle's Java SE, fixing many vulnerabilities. This update included changes to the security functions, such as limiting the execution of unsigned Java applets to improve security under default settings*9. Several of these vulnerabilities were exploited in the wild before patches were released.

Regarding server applications, a quarterly update was released for a number of Oracle products, including the Oracle database server, fixing many vulnerabilities. A vulnerability in BIND9 DNS servers that caused named to terminate abnormally due to an issue with processing the receipt of DNS queries when operating it as an authoritative DNS server with a DNSSEC signed zone using NSEC3 was also discovered and fixed*10. An issue was also discovered and fixed in NTP, which is used for time synchronization. This issue could lead to DDoS attacks on third parties through the exploitation of a server's administrative functions. A number of attacks exploiting this issue have occurred, and warnings have been issued. See "1.4.2 DrDoS Attacks and Countermeasures" for more information.

In March a regular semi-annual update was released for Cisco Systems' IOS, fixing vulnerabilities including those that could cause system failure*11. An issue that could lead to DDoS attacks on third parties through the exploitation of the Pingback function was also discovered in the WordPress CMS. Attacks in which this issue was actually exploited have occurred*12.

### ■ Attacks on Web Services

During this period there were ongoing attempts to steal user IDs and passwords, which have occurred frequently since last year. There were also continued incidents of unauthorized login to Web services through identity fraud thought to use lists of the IDs and passwords obtained, as well as malware infections through website alterations.

A large number of incidents in which unauthorized login attempts were made using list-based attacks have occurred at a wide range of sites, including those for ISPs, games, transportation agencies, credit card companies, and SNS. Among these, unauthorized login attempts that targeted frequent flier programs for airline companies resulted in damages such as miles

*2 See the Twitter post of NATO spokesperson Oana Lungescu (@NATOpress) regarding these attacks (https://twitter.com/NATOpress/statuses/445112624578306048).
*3 "Microsoft Security Bulletin MS14-002 - Important: Vulnerability in Windows Kernel Could Allow Elevation of Privilege" (https://technet.microsoft.com/library/security/ms14-002).
*4 "Microsoft Security Bulletin MS14-07 - Critical: Vulnerability in Direct2D Could Allow Remote Code Execution" (https://technet.microsoft.com/library/security/ms14-007).
*5 "Microsoft Security Bulletin MS14-11 - Critical: Vulnerability in VBScript Scripting Engine Could Allow Remote Code Execution" (https://technet.microsoft.com/library/security/ms14-011).
*6 "Microsoft Security Bulletin MS14-13 - Critical: Vulnerability in Microsoft DirectShow Could Allow Remote Code Execution" (https://technet.microsoft.com/library/security/ms14-013).
*7 "Microsoft Security Bulletin MS14-010 - Critical: Cumulative Security Update for Internet Explorer" (http://technet.microsoft.com/en-us/security/bulletin/ms14-010).
*8 "Microsoft Security Bulletin MS14-012 - Critical: Cumulative Security Update for Internet Explorer" (http://technet.microsoft.com/en-us/security/bulletin/ms14-012).
*9 Oracle, "Developers - Java Content in the Browser — Security Manifest Changes" (http://www.java.com/en/download/faq/signed_code.xml).
*10 Internet Systems Consortium, "CVE-2014-0591: A Crafted Query Against an NSEC3-signed Zone Can Crash BIND" (https://kb.isc.org/article/AA-01078).
*11 "Cisco Event Response: Semiannual Cisco IOS Software Security Advisory Bundled Publication" (http://www.cisco.com/web/about/security/intelligence/Cisco_ERP_mar14.html).
*12 See the following Krebs on Security blog post for more information about these attacks. "Blogs of War: Don't Be Cannon Fodder" (http://krebsonsecurity.com/2014/03/blogs-of-war-dont-be-cannon-fodder/).

## January Incidents

**1st:** A backdoor in a number of Cisco Linksys devices that could allow the router to be reset remotely or the admin password to be obtained were discovered, and a researcher released details.
See the researcher's following GitHub for more information. "elvanderb/TCP-32764" (https://github.com/elvanderb/TCP-32764).

**2nd:** US-CERT issued a warning regarding malware that infects POS terminals, which caused information leaks at major retailer companies that came to light in December.
US-CERT, "Alert (TA14-002A) Malware Targeting Point of Sale Systems" (http://www.us-cert.gov/ncas/alerts/TA14-002A).

**4th:** A number of online games were targeted in DDoS attacks by unknown entities, causing service outages, etc. It has been indicated that these attacks may have targeted a specific user.

**6th:** The Japan Atomic Energy Agency announced that a PC used for clerical processing at the Monju fast-breeder reactor had been infected by a virus, and information may have leaked.
"Concerning Potential Information Leaks due to a Computer Virus Infection" (http://www.jaea.go.jp/02/press2013/p14010601/index.html) (in Japanese).

**6th:** U.S. company Yahoo! announced that over the year-end and New Year period some of the advertisements distributed on its European site had redirected users to malware from malicious sites.
See the following TrendLabs Security Intelligence Blog post for more information. "Malicious Yahoo Ads – Preventable With Patching, Security Solutions" (http://blog.trendmicro.com/trendlabs-security-intelligence/malicious-yahoo-ads-preventable-with-patching-security-solutions/).

**8th:** In South Korea, it was discovered that a total of 85 million pieces of credit card information had been leaked from three major credit card companies by an employee of a credit bureau that had contracts with the credit card companies.

**11th:** A service outage lasting two days occurred at the Dropbox online storage service due to issues during maintenance.
See the following official Dropbox blog post for more information about this outage. "Outage post-mortem" (https://tech.dropbox.com/2014/01/outage-post-mortem/).

**15th:** A warning was issued due to the possibility of the monlist function in ntpd causing a DoS.
US-CERT, "Alert (TA14-013A) NTP Amplification Attacks Using CVE-2013-5211" (http://www.us-cert.gov/ncas/alerts/TA14-013A).

**15th:** Microsoft published their Security Bulletin Summary for January 2014, and released four important updates including MS14-002.
"Microsoft Security Bulletin Summary for January 2014" (http://technet.microsoft.com/en-us/security/bulletin/ms14-jan).

**15th:** A number of vulnerabilities in Adobe Reader and Acrobat that could allow unauthorized termination and arbitrary code execution were discovered and fixed.
"APSB14-01 Security updates available for Adobe Reader and Acrobat" (http://helpx.adobe.com/security/products/acrobat/apsb14-01.html).

**15th:** A number of vulnerabilities in Adobe Flash Player that could allow arbitrary code execution were discovered and fixed.
"Security updates available for Adobe Flash Player" (http://helpx.adobe.com/security/products/flash-player/apsb14-02.html).

**15th:** Oracle released their quarterly scheduled update for a number of products including Oracle, fixing a total of 144 vulnerabilities, including 36 in Java SE.
"Oracle Critical Patch Update Advisory - January 2014" (http://www.oracle.com/technetwork/topics/security/cpujan2014-1972949.html).

**15th:** Symantec announced that the website of a major publisher in Japan had been altered, and users had been redirected to malware from a malicious site using Toolkit.
See the following Symantec Security Response blog post for more information. "Popular Japanese Publisher's Website led to Gongda Exploit Kit" (http://www.symantec.com/connect/blogs/popular-japanese-publisher-s-website-led-gongda-exploit-kit).

**23rd:** Security-related companies issued warnings regarding malware infections that fraudulently used the update function of the GOM Player video playback software.
This is thought to have been the cause of a virus infection incident at the Japan Atomic Energy Agency that was announced on January 6. See the following announcement from South Korea's GRETECH JAPAN Corp for more information. "Apology and report on survey results regarding malware (virus) infections" (http://www.gomplayer.jp/player/notice/view.html?intSeq=300) (in Japanese).

**29th:** An old root certificate for GMO GlobalSign expired, causing issues such as connection failure and warnings appearing on the client side if the updated certificate was not installed.
GlobalSign, "Expiration of old GlobalSign 2014 Root CA Certificate" (https://support.globalsign.com/customer/portal/articles/1426272-expiration-of-old-globalsign-2014-root-ca-certificate).

**30th:** IPA published their "Targeted Attack Email Trends and Case Studies <2013>" technical report, which analyzed targeted attack email between October 2012 and December 2013.
"Targeted Attack Email Trends and Case Studies <2013>" (http://www.ipa.go.jp/security/technicalwatch/20140130.html) (in Japanese).

**31st:** Some accounts on U.S. company Yahoo!'s Yahoo! Mail service were affected by incidents of unauthorized login stemming from list-based attacks.
Yahoo! Inc., "Important Security Update for Yahoo Mail Users" (http://yahoo.tumblr.com/post/75083532312/important-security-update-for-yahoo-mail-users).

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and other gift points being exchanged without authorization. Issues with the specifications of some of the affected sites were pointed out earlier, such as users being able to set passwords with too few characters. As shown here, unauthorized access incidents continue to occur frequently, and ongoing vigilance is required.

During this period there were also many website alterations, as well as incidents in which users were redirected to malware from altered websites. These also occurred on SNS-related sites and the websites of a number of publishing and broadcasting-related companies, as well as websites for transport agencies and financial institutions. Malware infection activity via drive-by download took place on the sites users were redirected to, involving the use of several vulnerabilities, including zero-day ones. These Web alterations have also occurred on the websites of well-known companies, so it will be necessary to remain vigilant in the future.

### ■ Attacks on ccTLD

Numerous attacks on domain registries including ccTLD continue to occur, along with associated domain hijackings and information leaks. In January, .me domains for Montenegro were accessed without authorization by an unknown entity, and approximately 3,500 domains were hijacked. The management tools for the MarkMonitor domain management service that manages domains for Google, Yahoo!, Amazon, and Facebook among others were accessed without authorization by someone claiming affiliation with the Syrian Electronic Army, leading to the information for some of these domains being overwritten.

In March, a Venezuelan ISP advertised the Google Public DNS (8.8.8.8) routing information, affecting traffic to the Google Public DNS on networks in Venezuela and Brazil. Regarding Google Public DNS, in Turkey it was discovered that communications were being carried out with servers other than the original ones, and it was pointed out that this may be due to government censorship*13. Additionally, in Turkey access to other sites such as Twitter and YouTube has been blocked, suggesting that government restrictions on the Internet are intensifying.

### ■ Bitcoin

As transactions using the Bitcoin*14 virtual currency become more widespread, a variety of incidents are occurring. During the current survey period, Bitcoin exchange Mt. Gox announced in February that they were temporarily suspending transactions due to a technical problem occurring. Several days later, another Bitcoin exchange, Bitstamp, also temporarily suspended transactions due to problems. It was announced that these exchanges had been targeted by DoS attacks exploiting an issue with Bitcoin transaction malleability*15. This issue could have interfered with transactions or made double spending possible through overwriting and advertising the unique transaction IDs used for Bitcoin transactions. Bitstamp resumed transactions after seemingly dealing with the issue, but Mt. Gox was apparently made bankrupt due to liabilities of about 6.5 billion yen in this incident when bitcoins in their possession were stolen, and they filed for protection under Japan's Civil Rehabilitation Act. However, because it had been pointed out before the collapse that their transactions lacked transparency, their application was rejected and bankruptcy procedures started on account of their business operations not being clear*16.

It has been revealed that although Mt. Gox had been made aware of this issue in 2011, they ignored it and did not make fixes to their system. Furthermore, it was announced that some of the assets said to have been stolen were discovered in an old-format Bitcoin wallet*17. A survey published by a third party also pointed out that of the 740,000 XBT of bitcoins affected by this issue, those stolen due to this issue may amount to only approximately 386 XBT.

There has also been a rash of other attacks on virtual currency exchanges and account management services, involving many DDoS attacks on websites, as well as server compromises in which bitcoins and site account information were stolen. Despite reports from a number of U.S. news outlets that Satoshi Nakamoto, believed to be the creator of Bitcoin, had been found, the individual identified denied he was the person in question. Lively discussions regarding the handling of Bitcoin are currently taking place all over the world. In March, the Japanese cabinet declared that it does not consider Bitcoin a currency.

*13 Google Online Security Blog. "Google's Public DNS intercepted in Turkey" (http://googleonlinesecurity.blogspot.jp/2014/03/googles-public-dns-intercepted-in-turkey.html).

*14 See Vol.21 (http://www.iij.ad.jp/en/company/development/iir/pdf/iir_vol21_EN.pdf) of this report under "1.4.3 The Bitcoin Virtual Currency" for more information about Bitcoin.

*15 Bitstamp, "BITCOIN WITHDRAWAL PROCESSING SUSPENDED" (http://www.bitstamp.net/article/bitcoin-withdraws-suspended/).

*16 MtGox Co., Ltd., "Announcement of Commencement of Bankruptcy Proceedings" (http://www.mtgox.com/img/pdf/20140424_announce_qa_en.pdf).

*17 MtGox Co., Ltd., "We inform you as follows with regard to the balance of bitcoins (BTC) held by MtGox Co., Ltd." (http://www.mtgox.com/img/pdf/20140320-btc-announce.pdf).

## February Incidents

1 S **3rd:** An incident occurred in which a member-oriented website for an airline company was accessed without authorization, and miles exchanged for e-commerce site points.

2 3 S **3rd:** The Kavli Institute for the Physics and Mathematics of the Universe announced its supercomputer system had been accessed without authorization from outside. Unauthorized access related to the system compromised in this incident was also confirmed at external research institutions, including the National Astronomical Observatory of Japan with which joint research was being carried out, so measures were taken at these institutions.
See the following announcement from Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU) for more information.
"Regarding unauthorized access to Kavli Institute for the Physics and Mathematics of the Universe research computer"
(http://www.ipmu.jp/ja/node/1831) (in Japanese).

4 5 V **5th:** A number of vulnerabilities in Adobe Flash Player that could allow unauthorized termination and arbitrary code execution were discovered and fixed.
"APSB14-08: Security updates available for Adobe Flash Player" (http://helpx.adobe.com/security/products/flash-player/apsb14-08.html).

6 7 O **5th:** The Ministry of Economy, Trade and Industry and the JPCERT Coordination Center held the "Control System Security Conference 2014" for evaluating security improvements to control systems by presenting domestic and international technological trends for control systems.
JPCERT Coordination Center, "Information about the Control System Security Conference 2014"
(https://www.jpcert.or.jp/event/ics-conference2014.html) (in Japanese).

8 9 S **6th:** The National Cancer Center announced that two computers in the National Cancer Center Hospital East had been infected with a virus, and patient and other information may have leaked.
See the following National Cancer Center announcement for more information. "Regarding computer virus infections stemming from a video playback software update program in the National Cancer Center Hospital East" (http://www.ncc.go.jp/jp/information/20140206.html) (in Japanese).

10 11 S **7th:** The Mt. Gox Bitcoin exchange temporarily suspended the payout of bitcoins to fix a technical issue. They subsequently filed for bankruptcy protection under the Civil Rehabilitation Act on February 28 after becoming insolvent due to the draining of their Bitcoin and bank deposits in a cyber attack.

12 13 S **12th:** Account withdrawals were temporarily suspended at Bitcoin exchanges such as Mt. Gox and Bitstamp after they were targeted in attacks that interfered with transactions by exploiting transaction malleability. This caused the Bitcoin to dollar exchange rate to temporarily drop sharply.
A research team at the University of Zurich also investigated Mt. Gox to verify this issue, and countered that the impact of this issue was limited. Christian Decker and Professor Roger Wattenhofer, "Bitcoin Transaction Malleability and MtGox" (http://arxiv.org/pdf/1403.6676v1.pdf).

14 V **12th:** Microsoft published their Security Bulletin Summary for February 2014, and released four critical updates including MS14-007, MS14-010, and MS14-011, as well as three important updates.
"Microsoft Security Bulletin Summary for February 2014" (http://technet.microsoft.com/en-us/security/bulletin/ms14-feb).

15 16 V **12th:** A number of vulnerabilities in Adobe Shockwave Player that could allow unauthorized termination and arbitrary code execution were discovered and fixed.
"APSB14-06: Security update available for Adobe Shockwave Player" (http://helpx.adobe.com/security/products/shockwave/apsb14-06.html).

17 O **12th:** The opening session of the trial for the suspect arrested in the "Remote Control Virus" incident that occurred two years ago was held at the Tokyo District Court.

18 O **13th:** The U.S. National Institute of Standards and Technology (NIST) published its "Framework for Improving Critical Infrastructure Cybersecurity," which serves as an index for implementing information security measures at organizations and companies in the field of critical infrastructure.
NIST, "NIST Releases Cybersecurity Framework Version 1.0" (http://www.nist.gov/itl/csd/launch-cybersecurity-framework-021214.cfm).

19 20 V **17th:** It was reported that there was a vulnerability in the CGI script of a number of U.S. Cisco Linksys routers, and this had been exploited in multiple infections of a malware known as TheMoon. See the following U.S. SANS ISC InfoSec Diary post for more information.
"Linksys Worm 'TheMoon' Summary: What we know so far"
(https://isc.sans.edu/forums/diary/Linksys+Worm+TheMoon+Summary+What+we+know+so+far/17633).

21 O **17th:** CODE BLUE, an international information security conference originating in Japan, was held over two days.
See the following official site for CODE BLUE for more information (http://www.codeblue.jp/en-index.html).

22 23 S **18th:** Measures were taken after it was discovered that advertisements accompanying search site results were being exploited to redirect users to a number of fraudulent financial institution sites.
See the following announcement for more information about this incident. "Follow-up regarding the exploitation of advertisements accompanying search results" (http://advertisingblog.yahoo.co.jp/2014/02/post_33.html) (in Japanese).

24 25 V **20th:** Microsoft released an advisory due to an unpatched vulnerability in Internet Explorer that could allow remote code execution when exploited. It was confirmed that this vulnerability had already been exploited at the time of the announcement.
"Microsoft Security Advisory (2934088): Vulnerability in Internet Explorer Could Allow Remote Code Execution"
(http://technet.microsoft.com/en-us/security/advisory/2934088).

26 27 V **21st:** A number of vulnerabilities in Adobe Flash Player that could allow unauthorized termination and arbitrary code execution were discovered and fixed.
"Security updates available for Adobe Flash Player" (http://helpx.adobe.com/security/products/flash-player/apsb14-07.html).

28 S **24th:** Hatena alerted its users to change their password and check registered details due to the possibility of external unauthorized login to the services they provide.
Hatena Co., Ltd., "Check your password and registered details to prevent unauthorized login"
(http://hatena.g.hatena.ne.jp/hatena/20140224/1393211701) (in Japanese).

O **27th:** IPA published "Improper release of information by the growing number of Internet-connected devices and measures to prevent it," which summarized new threats due to the Internet connection of office devices and home appliances, as well as procedures for confirming whether information is being made public inadvertently.
"IPA Technical Watch 'Improper release of information by the growing number of Internet-connected devices and measures to prevent it'"
(http://www.ipa.go.jp/security/technicalwatch/20140227.html) (in Japanese).

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### ■ Attacks on Business Systems

In incidents involving the leak of credit card information for customers of major retailers in the United States in November of last year, a subsequent investigation determined that 40 million sets of credit card information and 70 million sets of customer data may have been stolen. It also came to light that special POS malware that targeted credit card readers and registers had been used to carry out this theft. Additionally, it has been announced that a number of other companies were targeted in similar attacks, including high-end department stores*18.

The malware used in these attacks is designed to steal information by targeting the moment that credit card and other data encrypted for a transaction is decrypted on the register when processing payment. It then sent the stolen data to external servers*19.

Because IDs loaned to traders of affected business operators were stolen and used maliciously in these incidents, it is believed that attacks were carried out after compromising the internal networks of these business operators. It is said that the equipment management systems and customer information management systems were linked by networks at these business operators, and insufficient information security measures are thought to have contributed to the large scale of the information leaks.

Because business terminals such as industrial systems and POS systems are sometimes not directly connected to the Internet, they are not properly managed in many cases, including security measures and software updates not being implemented in contrast to PCs used at companies. It is thought that attacks on business systems such as POS terminals will continue due to these conditions, so caution is required.

### ■ Attacks Via Legitimate Software

In January, it was announced that a virus had been found on a PC shared by employees at the Japan Atomic Energy Agency's Monju fast-breeder reactor*20. In February it was reported that two PCs at the National Cancer Center Hospital East were also infected by a virus*21. These virus infections were caused by exploiting a legitimate update function in video playback software. In these incidents, an update server used by legitimate software installed by users had been accessed without authorization and altered. This caused users to be redirected to a third-party site not intended by the update server when performing a software update, where malware presented as an update program for the corresponding software could be downloaded and executed*22.

Other examples of legitimate software management systems being exploited include system failures on a large number of PCs at multiple broadcasters and financial institutions in South Korea in March 2013. In these incidents, the update management server (patch management system) within affected companies was accessed without authorization, and malware that crashes systems was distributed to PCs throughout the company*23. There have also been recent cases in which legitimate apps or browser extensions were acquired and embedded with unauthorized functions which were then distributed as updates*24.

To deal with issues such as these, it will be necessary to implement systems for verifying whether or not updates to installed software are legitimate, and increase security for software update servers within companies.

*18 Krebs on Security, "Hackers Steal Card Data from Neiman Marcus" (http://krebsonsecurity.com/2014/01/hackers-steal-card-data-from-neiman-marcus/).

*19 See the following Kaspersky Lab blog post for more information. "RAM Scrapers and Other Point-of-Sale Malware" (http://blog.kaspersky.com/ram-scrapers-and-other-point-of-sale-malware/).

*20 The Japan Atomic Energy Agency, "Concerning Potential Information Leaks due to a Computer Virus Infection" (http://www.jaea.go.jp/02/press2013/p14010601/index.html) (in Japanese).

*21 National Cancer Center, "Regarding computer virus infections stemming from a video playback software update program in the National Cancer Center Hospital East" (http://www.ncc.go.jp/jp/information/20140206.html) (in Japanese).

*22 Gretech Japan Corporation, "Apology and report on survey results regarding malware (virus) infections" (http://www.gomplayer.jp/player/notice/view.html?intSeq=300&page=1) (in Japanese).

*23 See Vol.19 (http://www.iij.ad.jp/en/company/development/iir/pdf/iir_vol19_EN.pdf) of this report under "1.4.1 The 3.20 Cyber Attack in South Korea" for more information about this incident.

*24 Regarding this incident, the aftermath of actually selling a Chrome extension with 30,000 users was reported on the blog of its author, Amit Agarwal. "Selling a Google Chrome Extension is Easy but Monetizing is Tricky" (http://www.labnol.org/internet/sold-chrome-extension/28377/).

## March Incidents

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

V **5th:** Security researchers at the French Institute for Research in Computer Science and Automation (INRIA) disclosed a new method for attacking TLS that may have had client certificates stolen through a MITM attack.
See the following announcement for more information. "Triple Handshakes Considered Harmful Breaking and Fixing Authentication over TLS" (https://secure-resumption.com/).

V **6th:** A vulnerability in GnuTLS that could allow MITM attacks through the impersonation of legitimate websites due to an issue with certificate validation under specific circumstances was discovered and fixed.
US-CERT, "GnuTLS Releases Security Update" (http://www.us-cert.gov/ncas/current-activity/2014/03/05/GnuTLS-Releases-Security-Update).

O **7th:** In response to a Memorandum on Questions regarding Bitcoin, the Japanese government reached a cabinet decision and announced that it does not consider Bitcoin a currency in Japan.
House of Councilors, "Memorandum on Questions Regarding Bitcoin" (http://www.sangiin.go.jp/japanese/joho1/kousei/syuisyo/186/meisai/m186028.htm) (in Japanese).

七 **10th:** It was announced that unauthorized login incidents had occurred at a member-oriented website for another airline company, and miles were exchanged for other points.

O **10th:** IPA announced a Web application version of the "AppGoat" vulnerability learning tool, which enables vulnerability discovery methods and countermeasures to be studied systematically in a practical format. This version added new study topics and exercises for patching vulnerabilities.
"The AppGoat Vulnerability Hands-On Learning Tool" (http://www.ipa.go.jp/security/vuln/appgoat/index.html) (in Japanese).

V **12th:** Microsoft published their Security Bulletin Summary for March 2014, and released two critical updates including MS14-012 and MS14-013, as well as three important updates.
"Microsoft Security Bulletin Summary for March 2014" (http://technet.microsoft.com/en-us/security/bulletin/ms14-mar).

V **12th:** A number of vulnerabilities in Adobe Flash Player including those that could allow information leaks were discovered and fixed.
"APSB14-08: Security updates available for Adobe Flash Player" (http://helpx.adobe.com/security/products/flash-player/apsb14-08.html).

V **12th:** A number of vulnerabilities in Adobe Shockwave Player that could allow unauthorized termination and arbitrary code execution were discovered and fixed.
"APSB14-08: Security updates available for Adobe Flash Player" (http://helpx.adobe.com/security/products/flash-player/apsb14-08.html).

七 **12th:** A large-scale DDoS attack occurred. This exploited the Pingback function that notifies users that one of their posts has been linked to on the WordPress CMS.
Sucuri Blog, "More Than 162,000 WordPress Sites Used for Distributed Denial of Service Attack" (http://blog.sucuri.net/2014/03/more-than-162000-wordpress-sites-used-for-distributed-denial-of-service-attack.html).

V **13th:** It was announced that the Samsung Galaxy series included a function that could allow the execution of remote file operations.
See the following Free Software Foundation blog post for more information. "Replicant developers find and close Samsung Galaxy backdoor" (http://www.fsf.org/blogs/community/replicant-developers-find-and-close-samsung-galaxy-backdoor).

七 **17th:** A temporary BGP hijacking of the Google Public DNS route occurred in Brazil and Venezuela.
See the following BGP Mon tweet for more information about this incident. (https://twitter.com/bgpmon/status/445266642616868864/photo/1).

V **18th:** An issue that allowed a caller's number to be misrepresented was found in the IP telephony function of a messaging app, attracting a lot of attention.

O **18th:** Approximately 100 personnel from all government ministries, the National Information Security Center, and critical infrastructure providers came together to undergo training in collecting and sharing information across ministries and conducting emergency responses.
National Information Security Center, "Large-scale government cyber attack countermeasure training by participants from across all government agencies - [3/18 Training] -" (http://www.nisc.go.jp/active/kihon/pdf/318.pdf) (in Japanese).

V **19th:** A number of vulnerabilities in the Apache HTTP Server were discovered and fixed, including those that could allow DoS attacks.
The Apache Software Foundation, "Apache HTTP Server 2.2.27 Released" (http://www.apache.org/dist/httpd/Announcement2.2.html).

O **19th:** The Full Disclosure mailing list established in 2002 that had been used as a forum for disclosing and discussing vulnerability information was closed. On March 25, another administrator resumed the mailing list under the same name.
seclists.org, "Administrivia: The End" (http://seclists.org/fulldisclosure/2014/Mar/332). seclists.org, "Administrivia: A Fresh Start" (http://seclists.org/fulldisclosure/2014/Mar/333).

O **20th:** The Internet Content Safety Association announced that from April 1 they would launch an initiative to prevent the distribution of child pornography using file sharing software by sending email to corresponding users.
"Countermeasures for the distribution of child pornography using file sharing software" (http://www.netsafety.or.jp/p2p/index.html) (in Japanese).

V **25th:** Microsoft published an advisory confirming that targeted attacks had been made by exploiting an unpatched vulnerability in Microsoft Word that could allow arbitrary code execution.
"Vulnerability in Microsoft Word Could Allow Remote Code Execution" (https://technet.microsoft.com/library/security/2953095)

O **26th:** The Ministry of Defense formed a new Cyber Defense Unit for responding to cyber attack threats that continue to grow more sophisticated and complex.
Ministry of Defense, "Regarding the formation of a new Cyber Defense Unit" (http://www.mod.go.jp/j/press/news/2014/03/25d.html) (in Japanese).

O **27th:** The National Police Agency announced details of the status of cyber crime arrests made in 2013. A record 8,113 arrests were made, which was 10.6% higher than the previous year.
National Police Agency, "Regarding the status of cyber crime arrests made within 2013" (https://www.npa.go.jp/cyber/statics/h25/pdf01-2.pdf) (in Japanese).

O **31st:** IPA published "10 Major Security Threats for the Year 2014."
"10 Major Security Threats for the Year 2014." (https://www.ipa.go.jp/security/vuln/10threats2014.html).

[Legend] V Vulnerabilities | S Security Incidents | P Political and Social Situation | H History | O Other

*Dates are in Japan Standard Time

### ■ Government Agency Initiatives

Government agency initiatives included the "38th Assembly of the Information Security Policy Council" held in January. Here, a basic policy was put together regarding the understanding and evaluation of data based on the performance index for the "Cyber Security Strategy"*25 that was decided in June of last year, as well as "Cyber Security 2013"*26 that determined the efforts of each ministry for FY2013. There was also discussion of a unification model for information security measures at government agencies. Furthermore, to cultivate a better understanding of cyberspace threats that continue to grow in complexity and sophistication, as well as their countermeasures, it has been decided that the first work day in February will be designated "Cyber Security Day," placing the focus on initiatives that contribute to the safety of cyberspace. The "Overall Strategy Promotion Committee for IT Use and Application Security" was also held in February. Here, the overall and strategic promotion of information security policies that take into account future IT utilization was discussed. On March 18, training was implemented for information gathering and sharing between the National Information Security Center, various government agencies, and critical infrastructure providers, in addition to emergency response training of CYMAT personnel, based on a hypothetical situation in which a number of government agencies had been targeted by simultaneous cyber attacks.

### ■ Other

In January ICANN approved "TOKYO" and "NAGOYA" as new gTLDs. "OKINAWA" was also approved in March*27. This was due to the new gTLD approval process*28 that ICANN has been working on since January 2012. Currently close to 2,000 new gTLD applications have been made from around the world, and new gTLDs are likely to appear one after another in the future.

The National Police Agency released "Status of Incidents of Illegal Remittance Related to Internet Banking in 2013"*29. This reported that 1,315 of these incidents occurred during 2013, reaching a total of approximately 1,406,000,000 yen in damages, which was higher than ever before. The number of incidents also rose sharply in June and beyond in particular, with techniques used to obtain IDs and passwords including a large number of cases in which users were prompted to enter their details on a fraudulent screen displayed by a virus to steal them. From November onward there were reports of many incidents of redirection to phishing sites through email.

In February the president of a company that ran a proxy server and two others were arrested on suspicion of violating the Act on Prohibition of Unauthorized Computer Access by accessing an ISP using IDs and passwords obtained without authorization. Because the proxy server run by this company did not record logs and was not able to track users, it is thought to have been used for unauthorized remittances via Internet banking, as well as the sending of targeted attack emails.

Also in February, there was the opening session of the trial of a suspect charged with forcible obstruction of business, who was arrested in relation to a series of incidents linked to the "Remote Control Virus" that made headlines last year. The suspect is maintaining his innocence.

In March, the Ministry of Internal Affairs and Communications published a summary of the November 2013 results for its periodic tally/estimate of Internet traffic, which it carries out with the cooperation of ISPs, Internet exchanges, and researchers*30. According to these results, the estimated total download traffic of broadband service subscribers was approximately 2.6 Tbps as of November 2013, which is an increase of 35.6% compared to the same month the previous year. Additionally, total upload traffic was estimated at approximately 834 Gbps, which is also a 25.2% increase over the same month the previous year.

*25 National Information Security Center, "Information Security Policy Council - 35th Assembly" (June 10, 2013) (http://www.nisc.go.jp/conference/seisaku/index.html#seisaku35) (in Japanese).

*26 National Information Security Center, "Information Security Policy Council - 36th Assembly" (June 27, 2013) (http://www.nisc.go.jp/conference/seisaku/index.html#seisaku36) (in Japanese).

*27 See the following ICANN "DELEGATED STRINGS" (http://newgtlds.icann.org/en/program-status/delegated-strings) for more information about the approved gTLDs.

*28 ICANN, "New gTLDs Update: Applications Accepted Today; New Guidebook Posted; Financial Assistance for Qualifying Applicants" (http://www.icann.org/en/news/announcements/announcement-11jan12-en.htm).

*29 National Police Agency, "Status of Incidents of Illegal Remittance Related to Internet Banking in 2013" (http://www.npa.go.jp/cyber/pdf/H260131_banking.pdf) (in Japanese).

*30 Ministry of Internal Affairs and Communications, "Summary/Estimate of Internet Traffic in Japan" (http://www.soumu.go.jp/menu_news/s-news/01kiban04_02000077.html) (in Japanese).

## 1.3 Incident Survey

### 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 Protection Service between January 1 and March 31, 2014. This information shows traffic anomalies judged to be attacks based on IIJ DDoS Protection Service standards. IIJ also responds to other DDoS 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*31, attacks on servers*32, 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 495 DDoS attacks. This averages to 5.5 attacks per day, indicating almost no change in the average daily number of attacks compared to our prior report. Server attacks accounted for 61% of all incidents, while compound attacks accounted for 20.8%, and bandwidth capacity attacks 18.2%.

The largest attack observed during the period under study was classified as a compound attack, and resulted in 2.86 Gbps of bandwidth using up to 601,000 pps packets. Of all attacks, 90.5% ended within 30 minutes of commencement, 9.5% lasted between 30 minutes and 24 hours, and none lasted over 24 hours. The longest sustained attack was a server attack that lasted for 10 hours and 55 minutes. The NTP-based attacks that garnered a lot of attention during this survey period peaked with an attack that generated 1.8 Gbps of traffic using up to 517,000 pps packets.

In most cases, we observed an extremely large number of IP addresses, whether domestic or foreign. We believe this is accounted for by the use of IP spoofing*33 and botnet*34 usage as the method for conducting DDoS attacks.

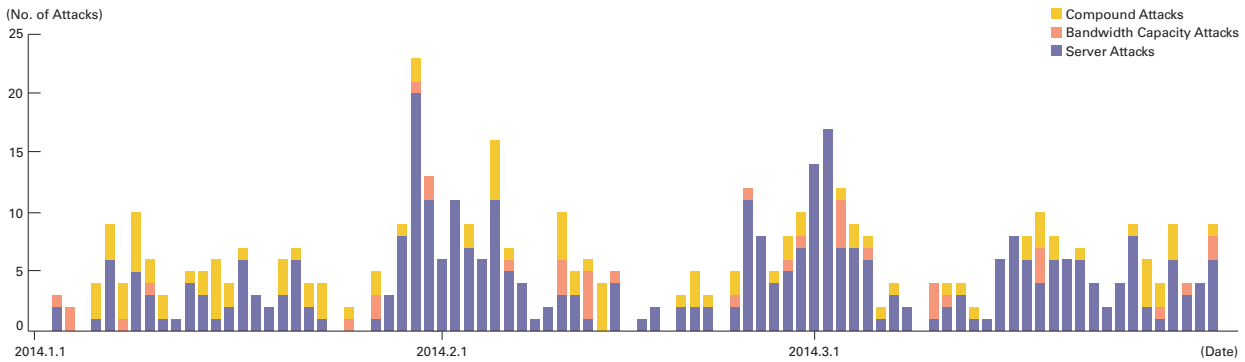



**Figure 2: Trends in DDoS Attacks**

*31 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.

*32 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.

*33 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 to make it appear as if the attack is coming from a different location, or from a large number of individuals.

*34 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.

### ■ Backscatter Observations

Next we present our observations of DDoS attack backscatter using the honeypots*35 set up by the MITF, a malware activity observation project operated by IIJ*36. By monitoring backscatter it is possible to detect some of the DDoS attacks occurring on external networks as a third party without any interposition.

For the backscatter observed between January 1 and March 31, 2014, Figure 3 shows the sender's IP addresses classified by country, and Figure 4 shows trends in packet numbers by port.

The port most commonly targeted by the DDoS attacks observed was the 80/TCP port used for Web services, accounting for 33.1% of the total during the target period. Attacks were also observed on 53/UDP used for DNS, 3389/TCP used for remote desktop, and 22/TCP used for SSH, as well as 8010/TCP and 8000/TCP, which are normally not used.

Looking at the origin of backscatter thought to indicate IP addresses targeted by DDoS by country in Figure 3, the United States accounted for the largest ratio at 15.2%. Chile and Germany followed at 9.6% and 9.0%, respectively. Continuing on from the last survey, many Chilean IP addresses were observed. This was due to the fact that packets from multiple IP addresses targeting 445/TCP on multiple honeypots had been observed a total of over 72,000 times during the current survey period.

Regarding particularly large numbers of backscatter packets observed, attacks on Web servers (80/TCP) targeting a U.S. hosting provider were observed between January 2 and 4, a German hosting provider on February 18, and IP addresses in Belize owned by a Hong Kong hosting provider between February 23 and 24. On January 23 we observed attacks on 8400/TCP targeting servers in China, and on March 24 there were attacks on 8000/TCP targeting a Russian site in Germany. We also observed attacks on 8010/TCP targeting the IP addresses of an ISP in the British Virgin Islands between March 26 and 27.

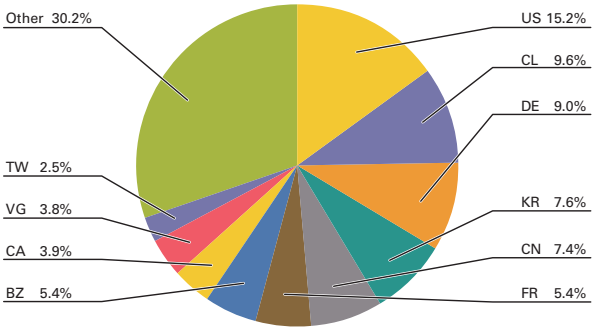



**Figure 3: Distribution of DDoS Attack Targets According to Backscatter Observations (by Country, Entire Period under Study)**

During the current survey period we noted an increase in DNS (53/UDP) backscatter from February 4. Most of these packets were thought to be the result of querying domain names including random character strings to a large number of IP addresses. Although it is not clear whether

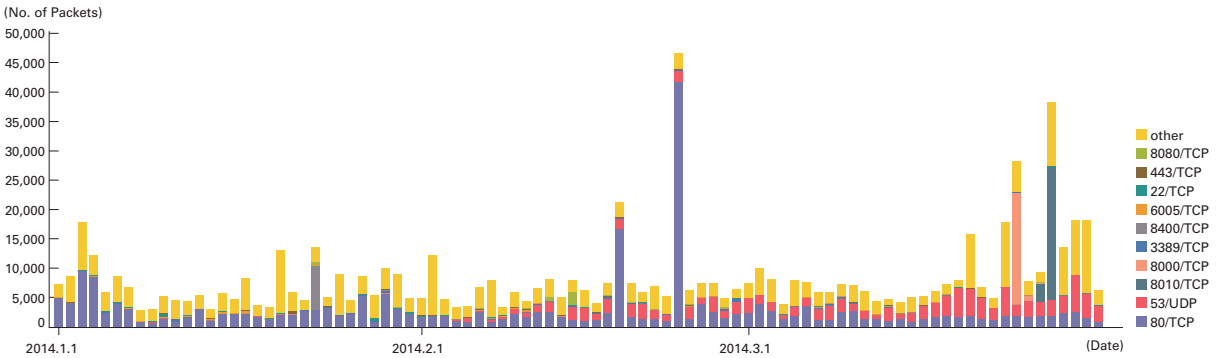



**Figure 4: Observations of Backscatter Caused by DDoS Attacks (Observed Packets, Trends by Port)**

*35 Honeypots established by the MITF, a malware activity observation project operated by IIJ. See also "1.3.2 Malware Activities."

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

directly-related to these packets, an alert regarding the increasing dangers of cache poisoning attacks was issued by JPRS on April 15*37. It will be necessary to double check DNS server configuration and keep an eye on future trends.

On January 4 attacks on servers related to online games were observed, and these were part of attacks that were reported on a number of game and technology-related news sites.

### 1.3.2 Malware Activities

Here, we will discuss the results of the observations of the MITF*38, a malware activity observation project operated by IIJ. The MITF uses honeypots*39 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 by malware selecting a target at random, or scans attempting to locate a target for attack.

#### ■ Status of Random Communications

Figure 5 shows the distribution of sender's IP addresses by country for communications coming into the honeypots between January 1 and March 31, 2014. Figure 6 shows trends in the total volumes (incoming packets). 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. Additionally, in these observations we corrected data to count multiple TCP connections as a single attack when the attack involved multiple connections to a specific port, such as attacks on MSRPC.

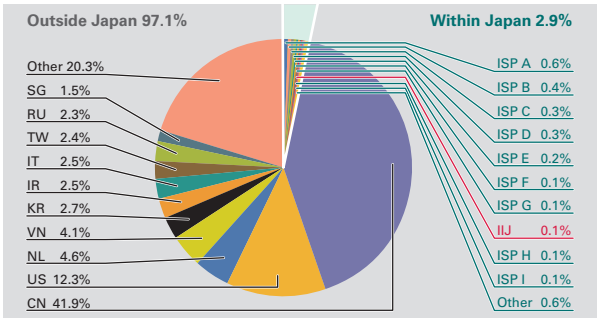



**Figure 5: Sender Distribution (by Country, Entire Period under Study)**

Much of the communications arriving at the honeypots demonstrated scanning behavior targeting TCP ports utilized by Microsoft operating systems. We also observed scanning behavior targeting 1433/TCP used by Microsoft's SQL Server, 3389/TCP used by the RDP remote login function for Windows, 22/TCP used for SSH, 80/TCP used for HTTP, ICMP echo requests, 53/UDP used for DNS, and 23/TCP used for Telnet.

Communications thought to be SSH dictionary attacks also occurred sporadically during the current period. For example, communications that occurred on March 20 was from Singapore and South Korea, and communications that occurred between March 24 and 25 were from IP addresses

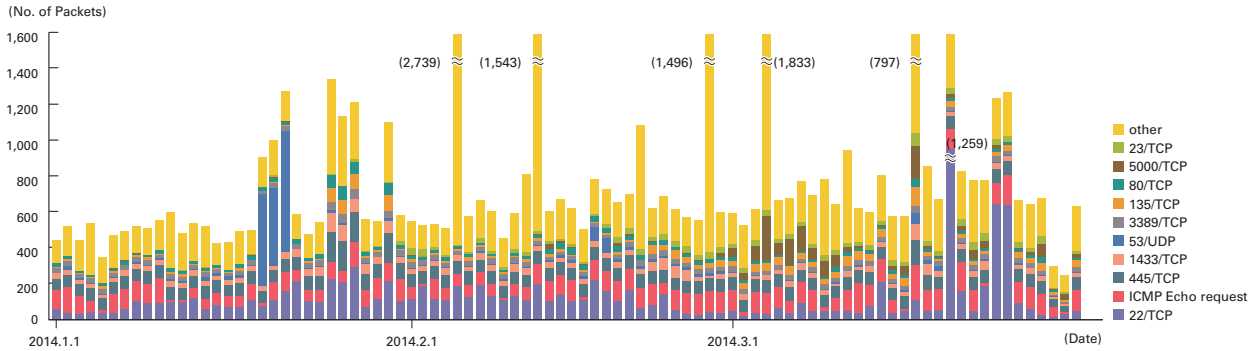



**Figure 6: Communications Arriving at Honeypots (by Date, by Target Port, per Honeypot)**

*37 JPRS, "(Critical) Regarding the double checking of DNS server configurations in light of the increasing danger of cache poisoning attacks" (http://jprs.jp/tech/security/2014-04-15-portrandomization.html) (in Japanese).

*38 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.

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

allocated to Italy. Additionally, between mid-January and February the volume of SSH communications was higher compared to the previous survey period. This was mainly due to an increase in communications from IP addresses allocated to China.

Between January 19 and 21, there was an increase in DNS communications. Examining the details of communications, we learned an IP address allocated to the Netherlands had been making repeated ANY record query attempts targeting 28 domains. After investigating further, from the comparatively large size of responses from each of the 28 domains, IIJ believes the attacker had been attempting to make DNS Amp attacks on these IP addresses by spoofing the Dutch IP address and sending repeated queries*40.

Extensive repeated scanning behavior was carried out from an IP address allocated to Vietnam on February 5, and from an IP address allocated to China on February 12 and 27, as well as March 4. This targeted TCP ports between 1000 and 9999, as well as some UDP ports.

### ■ Scanning and Attacks Targeting Embedded Devices (NAS, DVR)

During the current survey period, scanning behavior targeting 5000/TCP began to increase from mid-February, and rose dramatically in March. Figure 7 shows trends (average value per honeypot) in the total volume (incoming packets) for the source IP addresses of 5000/TCP communications arriving at the honeypots.

This is believed to be scanning behavior or attacks on vulnerabilities in Synology NAS or Hikvision DVR (Digital Video Recorder) products. Vulnerabilities that could allow arbitrary code execution on these products were discovered in 2013, and exploits have also already been disclosed. Incidents involving similar events have also been noted a number of times by the National Police Agency and on the SANS ISC blog*41, and there have been reports of programs thought to be malware that were not originally present being detected in products believed to have been attacked.

### ■ Malware Network Activity

Figure 8 shows the distribution of the specimen acquisition source for malware during the period under study, while Figure 9 shows trends in the total number of malware specimens acquired. Figure 10 shows trends in the number of unique specimens. In Figure 9 and Figure 10, the trends in the number of acquired specimens show the total number of specimens acquired per day*42, while the number of unique specimens is the number of specimen variants categorized according to their digest of a

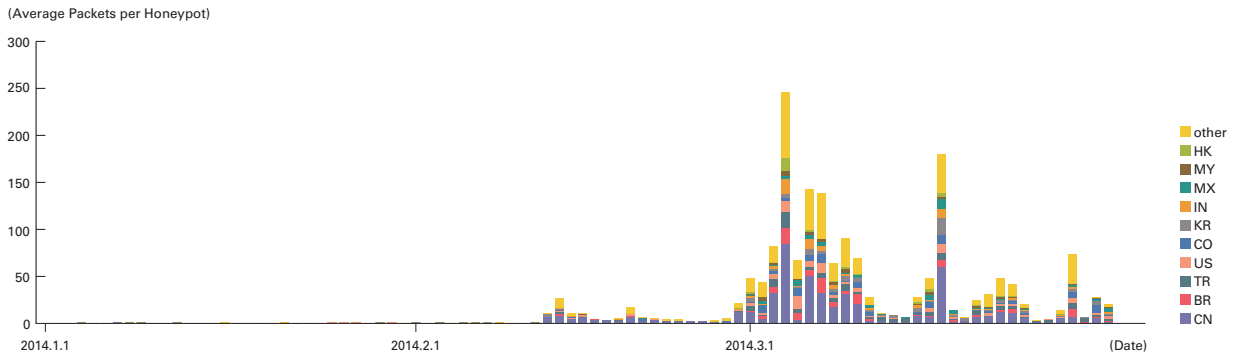



**Figure 7: Country-by-Country Trends in the Source IP Addresses of 5000/TCP Communications Arriving at Honeypots (Average by Honeypot)**

*40 Because the honeypots reject DNS queries, amplified responses are not delivered to the corresponding IP address.

*41 See the following National Police Agency announcement. "Regarding the sharp increase in access targeting port 5000/TCP believed to be scanning for NAS with vulnerabilities" (http://www.npa.go.jp/cyberpolice/detect/pdf/20140305.pdf) (in Japanese). SANS ISC reported honeypot data and malware survey results regarding this phenomena in the following four blog entries. "TCP/5000 - The OTHER UPNP Port" (https://isc.sans.edu/diary/TCP5000+-+The+OTHER+UPNP+Port/17763). "Port 5000 traffic and snort signature" (https://isc.sans.edu/diary/Port+5000+traffic+and+snort+signature/17771). "Let's Finally 'Nail' This Port 5000 Traffic - Synology owners needed." (https://isc.sans.edu/diary/Let%27s+Finally+%22Nail%22+This+Port+5000+Traffic+-+Synology+owners+needed./17859). "More Device Malware: This is why your DVR attacked my Synology Disk Station (and now with Bitcoin Miner!)" (https://isc.sans.edu/diary/More+Device+Malware%3A+This+is+why+your+DVR+attacked+my+Synology+Disk+Station+%28and+now+with+Bitcoin+Miner!%29/17879).

*42 This indicates the malware acquired by honeypots.

hash function*43. Specimens are also identified using anti-virus software, and a breakdown of the top 10 variants is displayed color coded by malware name. As with our previous report, for Figure 9 and Figure 10 we have detected Conficker using multiple anti-virus software packages, and removed any Conficker results when totaling data.

On average, 114 specimens were acquired per day during the period under study, representing 21 different malware. The "Other" category was higher on January 25 and March 17. These were due to an increase in the Allaple*44 family of malware from IP addresses allocated to Brazil and Taiwan, respectively. Allaple is known as polymorphic malware, and shows up more prominently in Figure 10.

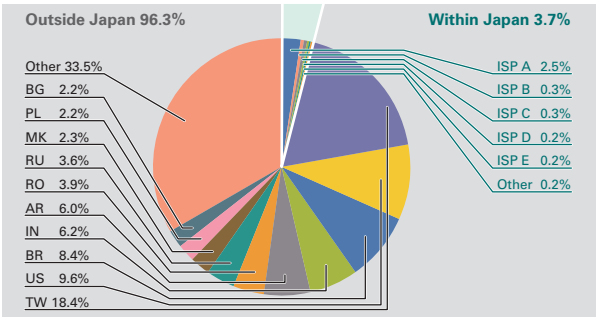



**Figure 8: Distribution of the Total Number of Malware Specimens Acquired**

After investigating the undetected specimens more closely, worms*45 were observed from IP addresses allocated to a number of countries, including India. Additionally, about 71% of undetected specimens were text format. Because many of these text format specimens were HTML 404 or 403 error responses from Web servers, we believe this was due to infection behavior of malware such as old worms continuing despite the closure of download sites that newly-infected PCs access to download malware.

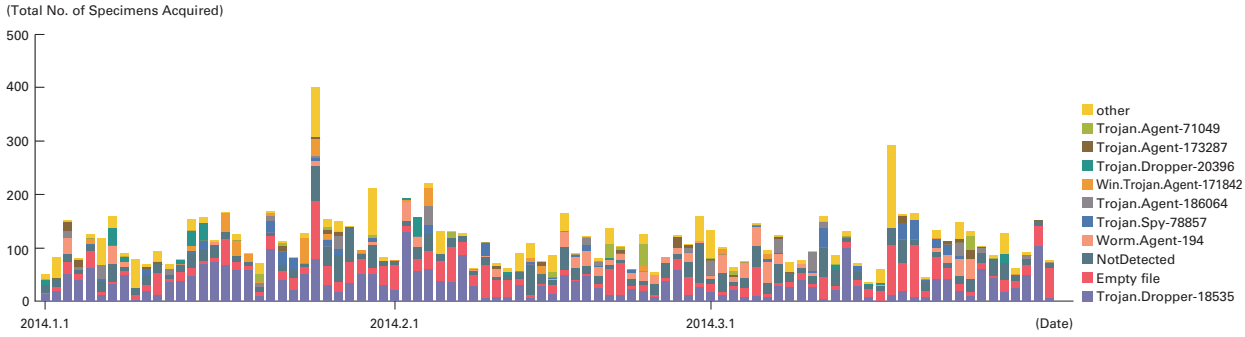



**Figure 9: Trends in the Total Number of Malware Specimens Acquired (Excluding Conficker)**

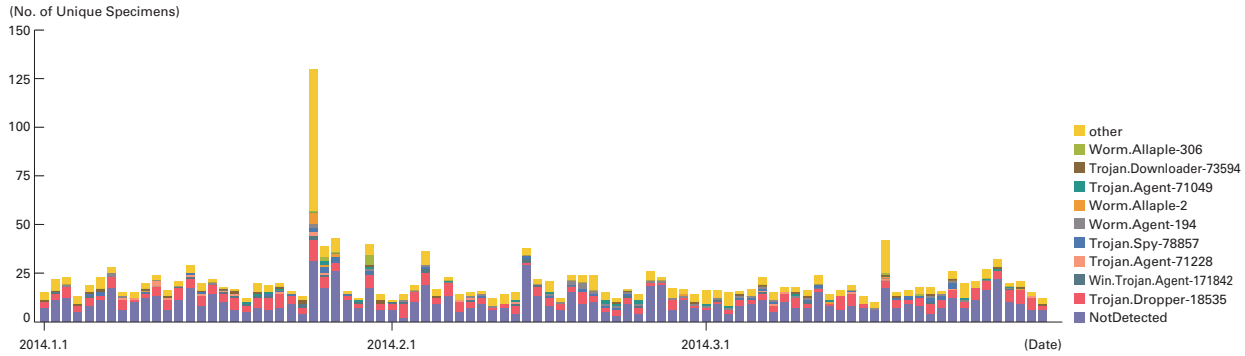



**Figure 10: Trends in the Number of Unique Specimens (Excluding Conficker)**

*43 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.

*44 Win32/Allaple (http://www.microsoft.com/security/portal/threat/encyclopedia/entry.aspx?name=Win32%2fAllaple).

*45 WORM_ATAK (http://about-threats.trendmicro.com/archiveMalware.aspx?language=jp&name=WORM_ATAK.D).

Under the MITF's independent analysis, during the current period under observation 92.4% of malware specimens acquired were worms, 4.6% were bots, and 3.0% were downloaders. In addition, the MITF confirmed the presence of 16 botnet C&C servers*46 and 7 malware distribution sites.

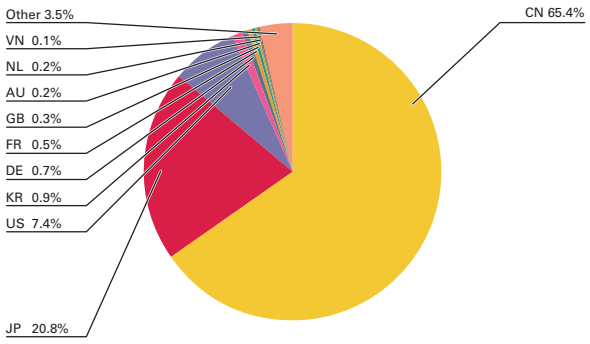
### ■ Conficker Activity

Including Conficker, an average of 35,739 specimens were acquired per day during the period covered by this report, representing 787 different malware. While figures rise and fall over short periods, Conficker accounts for 99.7% of the total number of specimens acquired, and 97.3% of unique specimens. This demonstrates that Conficker remains the most prevalent malware by far, so we have omitted it from figures in this report. The total number of specimens acquired during the period covered by this report decreased slightly by approximately 2% compared to the previous survey period. Unique specimens increased by about 4%. According to the observations of the Conficker Working Group*47, as of March 31, 2014, a total of 1,277,911 unique IP addresses are infected. This is a drop of approximately 40% compared to the 3.2 million PCs observed in November 2011, but it demonstrates that infections are still widespread.

## 1.3.3 SQL Injection Attacks

Of the types of different Web server attacks, IIJ conducts ongoing surveys related to SQL injection attacks*48. SQL injection attacks have flared up in frequency numerous times in the past, remaining one of the major topics in the Internet security. 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 11 shows the distribution of SQL injection attacks against Web servers detected between January 1 and March 31, 2014. Figure 12 shows trends in the numbers of attacks. These are a summary of attacks detected by signatures on the IIJ Managed IPS Service.




China was the source for 65.4% of attacks observed, while Japan and the United States accounted for 20.8% and 7.4%, respectively, with other countries following in order. There was a significant increase in the number of SQL injection attacks on Web servers compared to the previous report. However, this was due to a number of large-scale attacks from China that occurred during the current survey period, and when these are excluded there is little change in detection trends.

**Figure 11: Distribution of SQL Injection Attacks by Source**

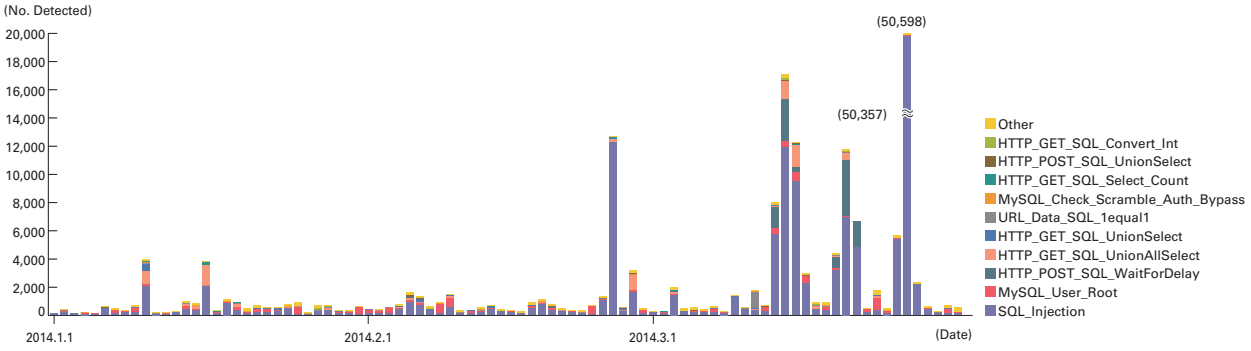



**Figure 12: Trends in SQL Injection Attacks (by Day, by Attack Type)**

*46 An abbreviation of Command & Control Server. A server that provides commands to a botnet consisting of a large number of bots.
*47 Conficker Working Group Observations (http://www.confickerworkinggroup.org/wiki/pmwiki.php/ANY/InfectionTracking).
*48 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.

During this period, attacks from a specific attack source in China directed at specific targets took place on February 25. Between March 13 and 15, there were attacks from a number of other attack sources in China on other specific targets. Attacks including those from the same specific attack sources in China on the same specific targets were also made between March 19 and 21. Between March 25 and 27, there were large-scale attacks from another specific attack source in China on another specific target. These attacks are thought to have been attempts to find vulnerabilities on Web servers.

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.

### 1.3.4 Website Alterations

Here we indicate the status of website alterations as surveyed through the MITF Web crawler (client honeypot)*49 (Figure 13). This Web crawler accesses tens of thousands of websites on a daily basis, with a focus on well-known and popular sites in Japan. We also add new target sites on a regular basis. Websites with temporary spikes in access numbers are also included in our observations. By surveying websites thought to be viewed frequently by typical users in Japan, it is easier to speculate on trends regarding fluctuations in the number of altered sites, as well as the vulnerabilities exploited and malware distributed.

Between January and mid-February 2014, the Sweet Orange Exploit Kit and Ramayana Exploit Pack (also known as DatkaChef or the DotCacheF Exploit Kit) were used in the majority of attacks. This is a trend that has continued since the end of last year, and most of the websites altered and used in attacks were comparatively small in scale, such as those for small and medium-sized enterprises, or online shops From exploit kit trends, we believe these attacks mainly targeted vulnerabilities such as those in older versions of JRE.

Meanwhile, from the second half of February onward, the total number of attacks declined sharply, and those using the Sweet Orange Exploit Kit were no longer observed at all. Instead, attacks using the Infinity Exploit Kit (also known as Red Kit v2 or Goon Exploit Kit) increased, and we observed attacks exploiting a vulnerability in Microsoft Internet Explorer (CVE-2014-0322) that was disclosed on February 20, for which a patch was not available at the time. During this period, there were a number of website alterations at comparatively well-known major companies, and in most of these cases the attacks exploited the aforementioned vulnerability in Internet Explorer.

In late March, a converging trend was seen in attacks, with drive-by download attacks estimated to be on the decline in Japan. However, this trend may abruptly change based on the intentions of attackers, so website operators and visitors must continue to be careful.

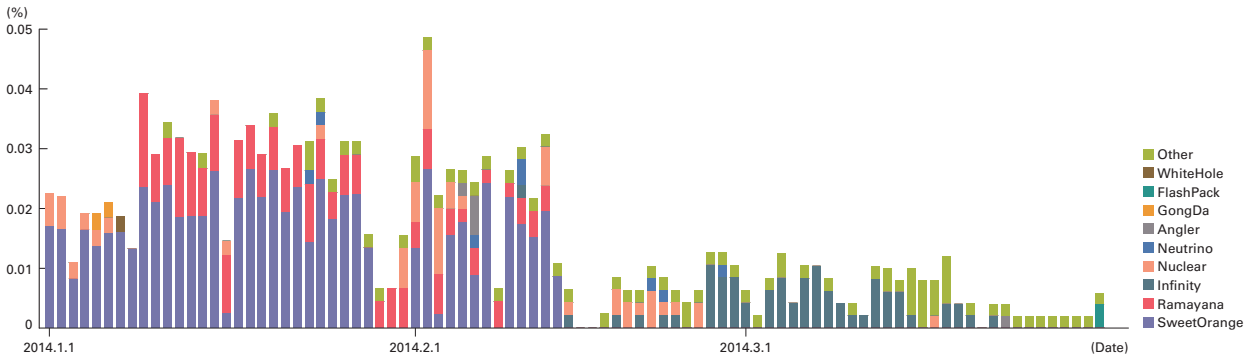



**Figure 13: Rate of Drive-By Download Incidence When Viewing Websites (%) (by Exploit Kit)**

* Covers several tens of thousands of sites in Japan.
  In recent years, exploit kits have been configured to change attack details and whether or not attacks are made based on the client system environment or session information, source address attributes, and the quota achievement status of factors such as number of attacks. This means that results can vary at times depending on the trial environment and timing of crawler access.
* Because the Web crawler was not operating between February 15 and 16, no attacks were detected.

*49 See "1.4.3 Website Defacement Surveys Using Web Crawlers" in Vol.22 of this report (http://www.iij.ad.jp/en/company/development/iir/pdf/iir_vol22_EN.pdf) for an explanation of Web crawler observation methods.

## 1.4 Focused Research

Incidents occurring over the Internet change in type and scope from one minute to the next. Accordingly, IIJ works toward implementing countermeasures by continuing to perform independent surveys and analyses of prevalent incidents. Here we will present information from the surveys we have undertaken during this period, including discussion of the attackers behind PlugX, a look at DrDoS attacks and their countermeasures, and an explanation of the Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business.

### 1.4.1 The Attackers Behind PlugX

In March 2014, IIJ gave a presentation at Black Hat Asia 2014*50 regarding PlugX*51. The presentation involved finding points in common between PlugX specimens and classifying them into groups by extracting and analyzing C&C server config information from PlugX specimens, and investigating which kinds of targeted attack groups were behind each PlugX group. In this section, we share these results, and also explain why we carried out this investigation.

#### ■ PlugX Variants

PlugX is an RAT*52 discovered in March 2012 that has frequently been used in targeted attacks. IIJ has confirmed the existence of three broadly-defined types of PlugX variant at the time of writing. Here we will refer to these as Type I, II, and III. Type I is the specimen type that has been found most often since the discovery of PlugX, and we previously discussed it in Vol.21 of this report*51. Type II is a new variant of PlugX*53 as reported in the IIJ-SECT Security Diary. This variant was discovered in the third quarter of 2013. This is significantly more advanced than Type I, and includes changes such as the elimination of the "GULP" signature that was a characteristic of PlugX, and implementation of a function for passing through proxies with basic authentication. Type III has existed since before Type I, and it has been reported that as a previous incarnation of PlugX*54 it was used in past incidents. Although the commands for processing instructions from C&C servers and communication characteristics are almost identical to Type I and II, its code characteristics are significantly different, and it has stronger anti-analysis functions. It also continues to be updated now, like Type I and II.

#### ■ Extracting Config Information from Each PlugX Specimen

Each PlugX variant has extremely different code characteristics. Consequently, IIJ created extraction scripts corresponding to each variant, making it possible to extract useful config information (the C&C server and auto start details such as the service name, and registry values) from all variants. Because we were able to standardize a lot of the processing for Type I and II, we implemented this as a single Immunity Debugger*55 script. Because we could not identify PlugX code for Type III in the process memory due to its anti-analysis functions such as obfuscation, we implemented this as an IDAPython*56 script that performs semi-automatic extraction. Using these scripts, we attempted to extract config information from PlugX specimens with 150 unique hash values. Of these, 27 specimens were demo versions*57 that did not contain config information. As a result, we used the remaining 123 specimens for classification.

*50 Black Hat (https://www.blackhat.com/) is the world's largest IT security conference. It is held each year, mainly in the United States, Europe, and Asia. IIJ gave a presentation at Black Hat Asia 2014, which was held in the Asian region.

*51 PlugX is discussed in detail in IIR Vol.21 (http://www.iij.ad.jp/en/company/development/iir/pdf/iir_vol21_EN.pdf).

*52 An abbreviation of Remote Administration Tool, which is a type of malware used mainly to control hosts remotely. Because this type of malware is a starting point for the targeted attacks that are carried out, IIJ keeps a watchful eye on it and conducts regular analysis. Some experts define it as an abbreviation for Remote Access Tool or Remote Access Trojan.

*53 IIJ Security Diary "New Types of PlugX Appear" (https://sect.iij.ad.jp/d/2013/11/197093.html) (in Japanese). This touches upon each of the Type II and Type III variants.

*54 According to "SK Hack by an Advanced Persistent Threat" (https://www.commandfive.com/papers/C5_APT_SKHack.pdf), it was reported that a RAT called Destory RAT was used in an attack in 2011. IIJ has confirmed that this is almost identical to PlugX Type III.

*55 Immunity Debugger is a debugger for Windows provided by Immunity, Inc. (https://www.immunityinc.com/products-immdbg.shtml). It was created based on OllyDbg, and features Python extensions. Plug-ins and scripts can be written in Python.

*56 IDAPython is a Python extension for automating processes in the IDA Pro (https://www.hex-rays.com/products/ida/) disassembler and debugger provided by Hex-Rays.

*57 See the following site for more information about the demo version of PlugX: "An Analysis of PlugX" (http://lastline.com/labs/plugx). Because config information is often padded with "XXXX" strings in the demo version, it is not possible to extract this information. However, we also confirmed some specimens have config information without padding even though the demo version flag is set. Specimens such as these are included in our analysis.

### ■ PlugX Classification

Figure 14 illustrates the classification techniques used for PlugX. After extracting config information using the scripts mentioned earlier, we find the points in common for each specimen and classify them.

In the first stage, we classified specimens based on the service name. Upon infection PlugX registers itself as a service or adds a value to the Run key in the registry so it can continue to operate even if the infected host is rebooted. We grouped those with distinguishing values*58. In the second stage, we carried out further grouping based on C&C server information (FQDN, IP address*59, domain name, and email address of domain owner) and debug strings in the code*60.

Table 1 shows the groups that emerged after repeating these processes. We were able to classify two-thirds of all PlugX specimens into seven groups. Furthermore, in this case we define a group as having at least four specimens.

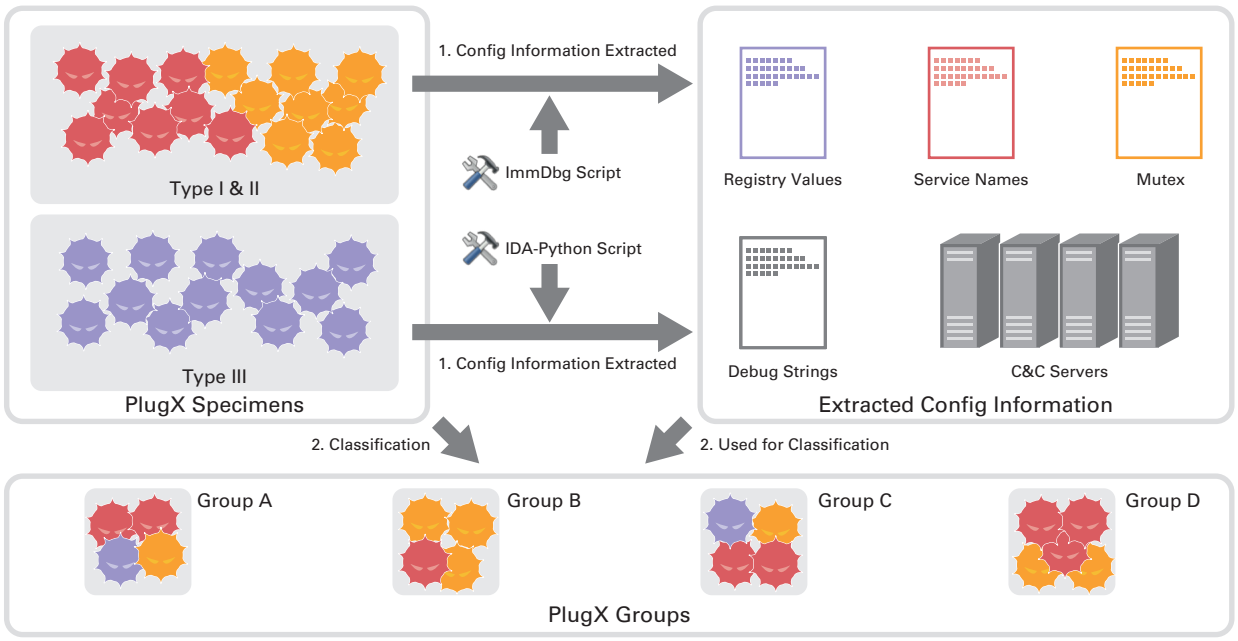
**Table 1: PlugX Specimen Classification Results**

| PlugX Group Name | Type I | Type II | Type III | Group Total | |
|---|---|---|---|---|---|
| *Sys | 15 | 0 | 5 | 20 | About two-thirds of all specimens (67%) |
| *Http | 12 | 3 | 0 | 15 | |
| Starter | 13 | 7 | 4 | 24 | |
| Graphedt | 8 | 0 | 0 | 8 | |
| WS | 6 | 1 | 0 | 7 | |
| 360 | 4 | 0 | 0 | 4 | |
| cochin | 0 | 0 | 4 | 4 | |
| - (Others) | 30 | 8 | 3 | 41 *Note | |

* Note: 8 of these specimens were confirmed to be associated with a targeted attack group.

### ■ Comparison with Known Targeted Attacker Groups

Last of all, we investigated whether the PlugX groups generated in the previous steps were associated with known targeted attacker groups. Specifically, we looked at whether the specimens written in external reports for targeted attacks had matching hash values or C&C server information. Figure 15 summarizes these relationships. In




1. Config information is extracted from each PlugX specimen using a script corresponding to its type.
2. Based on the extracted config information, specimens with config information values that match or correlate with others are grouped together for classification.

**Figure 14: PlugX Classification Method**

*58 When grouping by service name, default values such as "SxS," "XXX," and "TVT" were excluded from the grouping key. Meanwhile, most of the specimens classified as being in the same group by service name had matching or similar C&C server information. For this reason, it is considered likely that individual service names are used for a certain period of time or are set by each attacker.

*59 Including the IP address resolved from the FQDN.

*60 Most PlugX specimens are still currently under active development. Perhaps as a result of this, there are many specimens compiled with debugging enabled. When an error occurs during some kind of processing in PlugX, there is a routine that records the details of the error including version details that indicate which version the error occurred in, as well as path information along with Chinese-language characters. Because many different patterns exist for this path information string, we believe this information can also be used to indicate when the same attacker was responsible. The following website introduces many examples of the debug strings used. "CASSIDIAN CyberSecurity Blog PlugX: some uncovered points" (http://blog.cassidiancybersecurity.com/post/2014/01/plugx-some-uncovered-points.html?2014/01/plugx-some-uncovered-points.html).

this survey, we learned that five of the seven PlugX groups identified were connected to an existing incident of some sort. The survey results pointed to the fact that four of these five groups in particular were associated with an attacker group called APT1*61. This either indicates that many attackers using PlugX belong to APT1, or at least different attacker groups are sharing infrastructure. Furthermore, we discovered that eight of the PlugX specimens we could not classify into groups were associated with some form of known targeted attacker group, such as APT1 or Winnti*62.

### ■ Considering New Countermeasure Techniques

This survey was carried out using PlugX as an example. Because targeted attacks are aimed at a small number of specific organizations, it is often difficult to see the big picture, such as the attacker's intentions, the scale of the group, and the tools and infrastructure used in attacks. Because each organization can only obtain a limited number of specimens, they tend to implement countermeasures by relying on information gained from a small number of specimens. On the other hand, when a large number of specimens are collected it may shed new light on matters as we have here, such as identifying that many PlugX groups are associated with APT1. Once this is known, it could be possible to implement multifaceted countermeasures corresponding to the progress of the attack, such as detection and countermeasures based on the characteristics of the attack methods or attack tools an APT1 attacker uses after compromising an organization via a RAT.

During the presentation at Black Hat Asia, in addition to the presentation materials and scripts for extracting config information, we also handed out a correlation diagram*63 showing links between each PlugX specimen and known targeted attacker groups. This is in an image format called SVG. While an SVG is an image, it actually uses XML format, and by analyzing this it is possible to extract all the information disclosed here such as the C&C servers, etc. That means this data could be used for countermeasures with exit controls.

Wider and more comprehensive sharing of information by each organization affected in targeted attacks will lead to countermeasures becoming available. IIJ will continue to conduct analysis and surveys like those mentioned here, and actively disclose information to promote measures for combating targeted attacks.

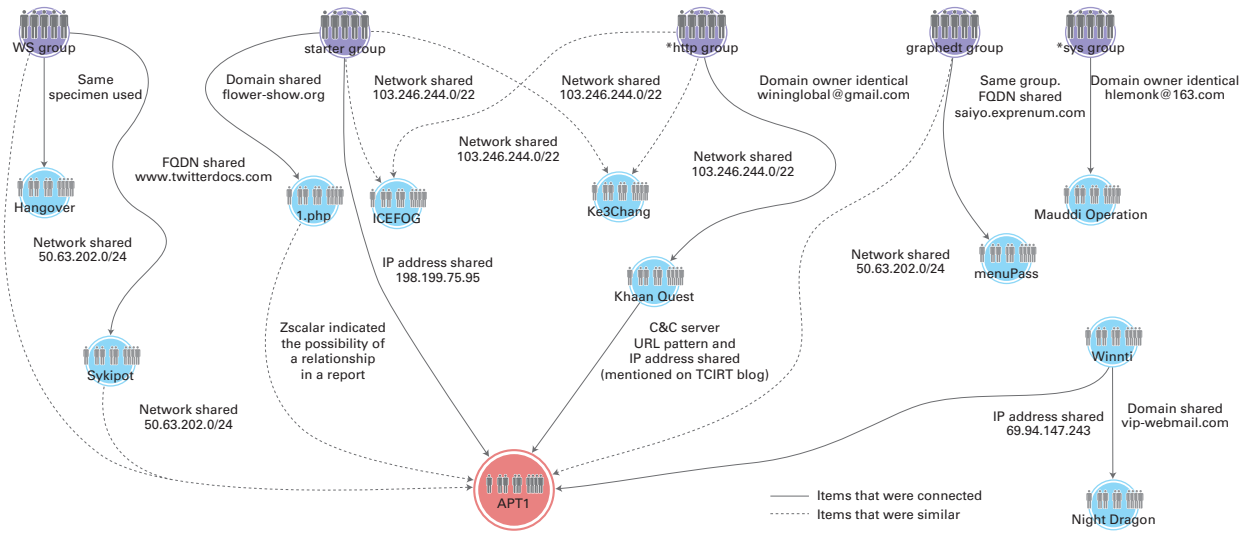



**Figure 15: Correlation Between PlugX Groups and Targeted Attacker Groups**

*61 APT1 is a group carrying out targeted attacks that was reported by Mandiant (http://intelreport.mandiant.com/).

*62 Winnti is a targeted attack aimed at the game industry that was reported by Kaspersky Lab (https://www.securelist.com/en/downloads/vlpdfs/winnti-more-than-just-a-game-130410.pdf).

*63 The presentation materials, extraction script, and correlation chart can be obtained from the Black Hat archive site (https://www.blackhat.com/asia-14/archives.html#Haruyama). Updated versions of the scripts are also available from the following link (http://takahiroharuyama.github.io/blog/2014/03/27/id-slash-idapython-scripts-extracting-plugx-configs/).

### 1.4.2 DrDoS Attacks and Countermeasures

In March 2013, DDoS attacks that exploited DNS open resolvers became an issue*64. These attacks exploited DNS cache servers that allow recursive queries from external sources, sending queries with the source IP address spoofed to appear as the attack target's IP address to flood the target server with responses as a DDoS attack.

In around October, NTP-based DDoS attacks were observed*65, and in December a report regarding NTP-based DDoS attacks was posted on the blog of U.S. company Symantec*66. In these NTP-based DDoS attacks, the monlist management function in NTP was exploited to carry out DDoS attacks by sending queries with the source IP address spoofed, just like with the DNS-based attacks. In January 2014, a number of organizations in Japan such as the JPCERT Coordination Center also issued alerts due to the high likelihood of this problem being exploited in DDoS attacks*67. A number of incidents in which these attacks caused damages or were used as stepping stones have actually been confirmed. Furthermore, a number of NTP-based DDoS attacks have been made by an unknown entity on game-related sites in the United States and Europe since around December 2013. These peaked at 80 Gbps, and were reported on the blog of U.S. DDoS protection provider Staminus*68. Cloud provider CloudFlare also reported that attacks of up to 400 Gbps had been made on their customers*69, and ArborNetworks noted NTP-based traffic of up to 800 Gbps in observation data they obtained from a number of ISP networks*70.

These are called Distributed Reflection Denial of Service attacks (DrDoS attacks), and they have become an issue due to the ease of carrying them out and the significant potential impact though amplification. In this section we explain DrDoS attacks and also look into countermeasures.

#### ■ The DrDoS Attack Mechanism

As their name suggests, DrDoS attacks are those that exploit responses to certain communications (reflection). UDP services such as DNS and NTP are often exploited due to UDP being a connectionless protocol, which makes it easy to attack. Because attacks appear to be coming from the IP address of a vulnerable device that is used as a stepping stone, the victim does not know who the real attacker is. This means that even if communications from the attack source are blocked, it is possible to find a new stepping stone and continue the attack, so measures taken on the victim's side may not always deal with the root cause of the attack.

Furthermore, DrDoS attacks take advantage of the fact that the data volume of responses to queries is greater than attacking a target directly, amplifying the scale of an attack by several times to several dozen times. For example, with DNS it is theoretically possible to amplify by up to 70 times*71. The NTP monlist function exploited in the attacks that have recently become a problem can lead to data approximately 200 times larger than the original query being sent if the theoretical maximum value was returned. This demonstrates that the amplification rate is extremely high for NTP*72. DrDoS attacks use this to generate a volume of traffic that exceeds the target's bandwidth capacity.

*64 See Vol.21 of this report under "2. Internet Operation - DNS Open Resolver Issues" (http://www.iij.ad.jp/en/company/development/iir/pdf/iir_vol21_EN.pdf) for more information about the issue of DNS open resolvers.

*65 This can be confirmed in a report from the CERT team of Lithuanian research and education institution LITNET. LITNET CERT, "NTP DoS reflection attacks" (https://cert.litnet.lt/en/docs/ntp-distributed-reflection-dos-attacks).

*66 Symantec Cyber Readiness & Response Blog, "Hackers Spend Christmas Break Launching Large Scale NTP-Reflection Attacks" (http://www.symantec.com/connect/blogs/hackers-spend-christmas-break-launching-large-scale-ntp-reflection-attacks).

*67 JVN, "JVNVU#96176042 Issues with NTP being used as a stepping stone in DDoS attacks" (http://jvn.jp/vu/JVNVU96176042/) (in Japanese).

*68 Staminus Communications, "Mitigating 80 Gbps Attacks – NTP Amplification Attacks on the Rise" (https://blog.staminus.net/mitigating-80-gbps-attacks-ntp-amplification-attacks-on-the-rise).

*69 CloudFlare, "Technical Details Behind a 400 Gbps NTP Amplification DDoS Attack" (http://blog.cloudflare.com/technical-details-behind-a-400gbps-ntp-amplification-ddos-attack).

*70 ArborNetworks, "NTP attacks continue – a quick look at traffic over the past few months" (http://www.arbornetworks.com/asert/2014/03/ntp-attacks-continue-a-quick-look-at-traffic-over-the-past-few-months/).

*71 Because amplification is actually limited by the cache DNS server configuration, etc., the maximum is between 8 times and 40 times.

*72 An alert regarding the amplification of protocols used in attacks has also been issued in a CERT/CC advisory. "Alert (TA14-017A) UDP-based Amplification Attacks" (https://www.us-cert.gov/ncas/alerts/TA14-017A).

### ■ NTP-Based DrDoS Attacks and Their Impact

The potential for DrDoS attacks via the NTP monlist command that are now an issue was pointed out by a developer community involved in the implementation of NTP in 2010, and in May of that year the issue was fixed*73. However, this fix was only applied to the Development version, and the Stable version remained unpatched at 4.2.6p5. Consequently, this fix was not applied to devices such as routers and UNIX-based OSes that used certain ntpd implementations*74.

Figure 16 illustrates the NTP-based DrDoS attacks that have now become an issue. In some NTP implementations such as ntpd, a monlist command that returns a list of client IP addresses it is referenced from is implemented for management purposes. If a device such as a router or server that responds to external queries is in place, responses are returned to the attack target by sending queries with the source spoofed to appear as the attack target's IP address. Attackers perform attacks by directing communications like this to a large number of devices. Because ntpd has lists of up to 600 client IP addresses that it is referenced from, it is thought that in these attacks the attacker remotely sent successive queries using spoofed IP addresses to boost the list to its maximum size, and then spoofed the actual attack target to make the attack.

Regarding this NTP issue, there are two points to take note of regarding NTP servers. The first is the fact that they may be exploited as stepping stones in DrDoS attacks. When used as a stepping stone in these attacks, you are both a victim and perpetrator of the attack at the same time. The other point is the potential for information leaks. This issue involves the monlist command, which is a management function that returns a list of client IP addresses it is referenced from. For this reason, responding to external queries could lead to information such as the IP addresses of clients on the network used by the NTP server being leaked externally.

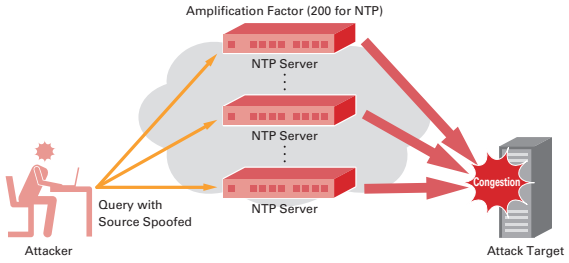



**Figure 16: DrDoS Attack Overview (NTP)**

### ■ Honeypot Observation Status

Figure 17 shows the sender's IP addresses classified by country for NTP (123/UDP) communications that reached our honeypots between early October last year and late March this year. We can see from this that communications were carried out from a source in Germany from mid-November. The figure also indicates that communications have occurred on an ongoing basis since the disclosure of vulnerability information by CERT/CC and others in mid-January*75. Looking at these results by country, the United States was the most common at 36.8%, followed by the Netherlands at 25% and Germany at 14.3%, demonstrating

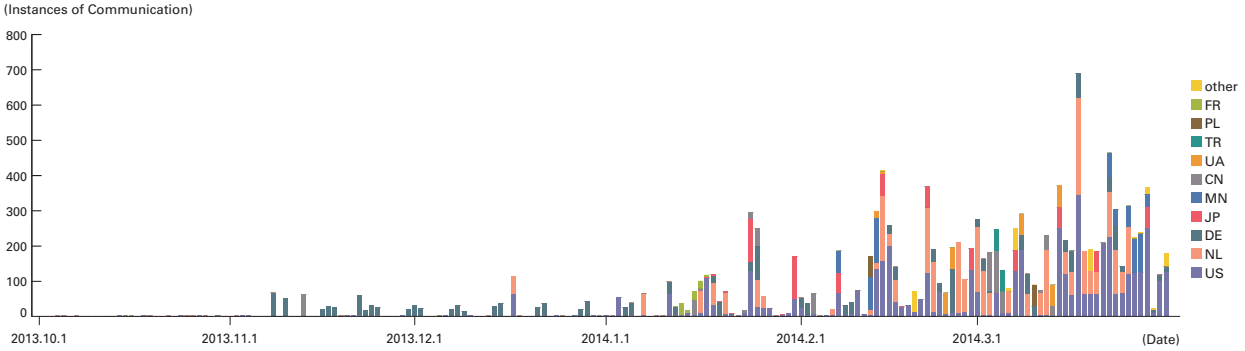



**Figure 17: NTP (123/UDP) Traffic Delivered to Honeypots**

*73 Version 4.2.7p26 of ntpd and earlier are affected by this vulnerability. See the following ntp.org bug report for more information about the fix. "Bug 1532 - remove ntpd support for ntpdc's monlist (use ntpq's mrulist)" (http://bugs.ntp.org/show_bug.cgi?id=1532).

*74 For example, this applies to FreeBSD. The FreeBSD Project, "ntpd distributed reflection Denial of Service vulnerability" (http://www.freebsd.org/security/advisories/FreeBSD-SA-14:02.ntpd.asc).

*75 CERT/CC, "Vulnerability Note VU#348126 NTP can be abused to amplify denial-of-service attack traffic" (http://www.kb.cert.org/vuls/id/348126).

that much of the traffic originates from Europe and the United States. Japan was the fourth highest source of communications, at 5.9%. From this, we can estimate that verification of the issue and attack attempts increased after the problem was disclosed. Additionally, although queries with the sender misrepresented are sent to exploitable servers in DrDoS attacks, because the total volume of communications observed during this period was not that high, we were unable to determine whether this was scanning behavior for servers or routers that allowed external queries, or attacks targeting the originating host. However, because some sources were IP addresses thought to provide services related to games, we believe that both attacks and scanning behavior were carried out.

### ■ Dealing with DrDoS Attacks

Because DrDoS attacks are comparatively easy to carry out by spoofing an IP address, when an exploitable vulnerability or new attack method is disclosed, attempts to exploit them tend to be made right away. It is necessary to take note of information about the occurrence of DrDoS attacks, identify whether systems you manage can be exploited in these attacks, and make an effort to deal with any issues.

Additionally, although NTP is identified as the issue in these incidents, protocols such as DNS, SNMP, ECHO, and Chargen could also be exploited in DrDoS attacks. When connecting servers or router devices to the Internet, you must first check vulnerability information for the device, and use a version of firmware, etc., that has no security issues. Furthermore, there are also cases in which services running on devices under default settings are used as stepping stones without users being aware. To avoid this situation, terminate any unnecessary services when installing a device, and configure appropriate access control. After installation, regularly check the running services from the Internet side to detect configuration errors at an early stage, and reduce the likelihood of them being exploited by external third parties.

Because DrDoS attacks involve spoofing the sender, it is possible to limit their impact by implementing suitable communication control. For example, using technology that prevents spoofed communications from flowing into a network, such as source address validation*76, can prevent attacks such as these in which the sender's IP address is spoofed.

A Ministry of Internal Affairs and Communications workshop is also looking into blocking this communication on ISP networks. See "1.4.3 Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business" for more information about this discussion.

### ■ Summary

As explained here, DrDoS attacks can have a significant impact despite the ease that they can be carried out, so they are a threat that should be taken note of. Meanwhile, although they have been known for a comparatively long time, the fact that there had been few specific threats has meant that sufficient countermeasures have not yet been implemented. We believe that new attacks using similar techniques will appear in the future. To prepare for these, it is essential to properly manage the devices we use on a daily basis. IIJ will continue to play an active role in implementing appropriate measures through industry associations, etc.

## 1.4.3 Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business*77

Here we discuss the topics covered by the Ministry of Internal Affairs and Communications' "Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business," which was held between November 2013 and March 2014. This workshop is formed from key figures and associations related to telecommunications, and a working group for evaluating technical details is organized under it. Various related associations also assigned their own working groups to evaluate the situation, with many people taking part in a large range of discussions at a number of locations over a short period of time. Only a summary of the topics covered by the workshop are made public, but here we introduce the points discussed based on an initial report that has been made available.

*76 See the following IIJ article for more information about source address validation. "Source Address Validation" (http://www.iij.ad.jp/en/company/development/tech/sav/).

*77 "Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business" (http://www.soumu.go.jp/main_sosiki/kenkyu/denki_cyber/index.html) (in Japanese).

### Five Issues Under Scrutiny

This workshop is evaluating the following five issues that relate to recent attacks.

- Blocking access to malware distribution sites*78
- Expanding malware removal based on information obtained from C&C servers
- Preventing new DNSAmp DDoS attacks
- Dealing with spam that exploits SMTP authentication information
- Preventing attacks before they occur, and preventing damages from spreading

Many of these kinds of attacks occur via communications. Communication infrastructure itself may be exposed to attacks, so it is necessary to implement functions for dealing with attacks during the course of communications to a certain degree. Additionally, by dealing with attacks at the ISPs that provide communication services, it is possible to effectively prevent the significant damages that occur. Meanwhile, dealing with attacks over the course of communications involves obtaining information on all communications (including the communication content, and information denoting who carried out communications when and where), using this information to determine whether or not an attack is underway and what its status is, and stopping the attack communications appropriately. This would violate the secrecy of communications as laid out in the Telecommunication Business Act. In other words, it would be unlawful behavior.

In light of this, to deal with attacks in the communications industry it will be necessary to confirm the cause of each attack and its impact, and review the legal justifiability of measures that can be taken. First, it is possible to implement measures to cope with attacks using communications information with the consent of the communicating party concerned, but how to effectively obtain their permission is a large point of contention. Additionally, regardless of whether or not a user has given their permission, implementing measures to cope with attacks could fall under the category of self-defense, averting present danger, or legitimate business operations for providers. These matters are also discussed by this workshop with regard to the five issues. We provide an overview of each of these below*79.

### Blocking Access to Malware Distribution Sites

Of the attempts to prevent infection by Web infection malware implemented by the Ministry of Internal Affairs and Communications through their ACTIVE project, the potential for implementing comprehensive URL filtering for all users using a device that intervenes in communications has been evaluated. Conventionally it was deemed that countermeasures using information related to user communications would require individual permission due to the chance that they could be disadvantageous to subscribers in the future. In discussion of this issue, it was decided that blanket permission based on terms and conditions could be considered effective agreement if conditions such as the following were met:

- Users can change their details of consent (can change settings) even after agreeing to the contract clause
- Regardless of changes to the details of consent, other conditions for providing communication services would not change
- It would be implemented by detecting only the necessary minimum amount of communications
- The fact that details of consent can be changed, as well as the method for doing this, would be explained along with an alert screen

Examples of items that should be listed in the contract clause and the alert screen have also been indicated.

*78 This was evaluated as one of the development plans of ACTIVE, a public-private coordination project that conducts proof-of-concept tests for preventing access to malware distribution sites before it occurs, etc. ACTIVE (Advanced Cyber Threats response InitiatiVE), "About ACTIVE" (http://www.active.go.jp/en/active/index.html). Ministry of Internal Affairs and Communications, "Implementing ACTIVE and Holding ACTIVE Promotion Forum" (http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/Releases/Telecommunications/131001_04.html).

*79 As the case study discussion at this workshop involves legal interpretations with many conditions set, see the workshop's initial report for a more accurate picture of the points discussed.

### Expanding Malware Removal Based on Information Obtained From C&C Servers

There are more and more cases in which servers that control malware are seized as a result of the anti-malware activities of a variety of organizations. There was discussion about identifying users that do not know they are infected based on the information stored on these servers, and implementing warnings to convey this fact along with removal methods. In this case, identifying users by searching customer information at ISPs based on source IP addresses and time stamps in information related to communications stored on C&C servers amounts to infringement of the secrecy of communications (external information). During these discussions, there was debate regarding countermeasure methods using records left on C&C servers when the corresponding PCs and devices are actually infected with the malware, and damages are suffered from it. In the end, it was concluded that when information on users identified from their corresponding IP address is only used for the purpose of sending an alert, this constitutes averting present danger, and would be legally justifiable.

### Preventing DNSAmp DDoS Attacks

DDoS attacks that generate large volumes of communications using DNS resolvers with insecure configurations as stepping stones (DNSAmp attacks) were observed often in 2013. DNSAmp attacks are made up of several types of communications: those from the attacker to the DNS resolver, those from the DNS resolver to the ISP's DNS server, and amplified responses from Internet-based servers. Here, after debating the status of each type of communication, as well as the effects of implementing measures based on them, we discussed measures for blocking communications from the attacker to the DNS resolver that serves as a stepping stone and prompts amplification. Additionally, because there are a large number of DNS resolvers in the dynamic IP address range that cannot identify a user under normal circumstances, we imagine a situation in which blocks must be implemented comprehensively.

During these discussions, it was decided that with regard to blocking DNS query communications targeting the dynamic IP address space, as long as the results of confirming the target IP address and port number are not used for purposes other than preventing DNSAmp attacks, this constitutes legitimate business operations and is legally justifiable.

### Dealing with Spam That Exploits SMTP Authentication Information

SMTP authentication is widely used as a spam countermeasure, but recently due to users reusing the same passwords, etc., it has been targeted in unauthorized access via list-based and other attacks, and in some cases third parties may be exploiting the email transmission function. Here, we discussed two methods for resolving the issue:

- Measures for cases that are highly likely to involve unauthorized use of SMTP authentication IDs and passwords, such as when the connected party shifts to an overseas location instantly. Use is temporarily suspended, and the user is asked to change their password.
- Prevention of attempts to steal IDs and passwords through dictionary attacks, which make many password attempts on specific IDs during the SMTP authentication connection process. When a large number of failed SMTP authentications coming from a specific IP address is detected, SMTP authentication from that IP address is temporarily suspended.

Both cases involve detection based on information related to the status of communication with the server, and temporary suspension of communications. However, as long as this only applies until the unauthorized use is resolved by the user changing their password, or while attacks continue, it was determined that it constitutes legitimate business operations, and is legally justifiable.

### Preventing Cyber Attacks Before They Occur and Preventing Damages from Spreading

Discussion of this issue revolved around countermeasures for preventing attacks before they occur by detecting communications including content that exploits system vulnerabilities, and not delivering them to the target destination, as well as countermeasures via coordination between ISPs in simultaneous DDoS attacks or situations in which domestic ISP users are attacking each other. However, because the former involves directly detecting the content of communications, and is an issue that depends on systems with vulnerabilities, and the latter requires preparation work regarding the aspects for which coordination will be necessary before it can be considered, for this initial report it was determined that further discussion would need to be carried out.

As indicated above, this workshop involved discussion of five set issues. For a number of countermeasures in particular, it was concluded that some of them are deemed to have obtained users' consent through blanket permission if it is based on terms and conditions, and that the direct measures against attacks that have been permitted as legitimate self-defense or averting present danger only after the occurrence of attacks were accepted as a legitimate business operation. It can be said that these results will have a significant impact on future consideration of attack countermeasures at ISPs.

### Future Activities

The circumstances surrounding Internet-based attacks are changing day-by-day, and even among the specific situations discussed at the workshop, the DDoS attacks that use NTP servers as stepping stones are merely mentioned as an example of those they are aware of occurring. For this reason we believe we should continue this workshop in the future, and evaluate new attacks and their countermeasures.

Additionally, it will be necessary to provide more detailed guidelines for the issues discussed here in situations where they will actually be applied by providers such as ISPs. For example, we need to look into which organizations can be trusted with regard to information when implementing a takedown of C&C servers. Furthermore, regarding anomalies in communications for SMTP authentication, we must attempt to create quantitative standards that make sense to as many users and providers as possible.

For this reason, we will continue to pursue the creation of guidelines for applying the results of this workshop to the practical circumstances of providers, such as at the Council for the Stable Operation of the Internet*80.

## 1.5 Conclusion

This report has provided a summary of security incidents to which IIJ has responded. In this report, we gave an overview of an investigation into the attackers behind PlugX, and looked into DrDoS attacks and their countermeasures. We also discussed the Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business. IIJ makes every effort to inform the public about the dangers of Internet usage by identifying and publicizing incidents and associated responses in reports such as this. IIJ will continue striving to provide the necessary countermeasures to allow the safe and secure use of the Internet.

Authors:

**Mamoru Saito**
Manager of the Office of Emergency Response and Clearinghouse for Security Information, Service Operation Division, IIJ. After working in security services development for enterprise customers, Mr. Saito became the representative of the IIJ Group emergency response team, IIJSECT in 2001, participating in FIRST, an international group of CSIRTs. Mr. Saito serves as a steering committee member of several industry groups, including Telecom-ISAC Japan, Nippon CSIRT Association, and Information Security Operation providers Group Japan.

**Hirohide Tsuchiya** (1.2 Incident Summary)
**Tadaaki Nagao, Hirohide Tsuchiya, Hiroshi Suzuki, Hisao Nashiwa** (1.3 Incident Survey)
**Hiroshi Suzuki, Takahiro Haruyama** (1.4.1 The Attackers Behind PlugX)
**Hirohide Tsuchiya** (1.4.2 DrDoS Attacks and Countermeasures)
**Mamoru Saito** (1.4.3 Workshop on the Appropriate Way to Handle Cyber Attacks in the Telecommunications Business)
Office of Emergency Response and Clearinghouse for Security Information, Service Operation Division, IIJ

Contributors:
**Masahiko Kato, Yuji Suga, Masafumi Negishi, Tadashi Kobayashi, Yasunari Momoi, Minoru Kobayashi**
Office of Emergency Response and Clearinghouse for Security Information, Service Operation Division, IIJ

*80 The Council for the Stable Operation of the Internet is a council formed from communications-related organizations including the Telecommunications Carriers Association, the Telecom Services Association, the Japan Internet Provider's Association, Japan Cable and Telecommunication, and the Telecom Information Sharing and Analysis Center Japan. It draws up the "Guidelines for Dealing with High Volume Communications and Privacy at Telecommunications Carriers." JAIPA, "Revision to Guidelines for Dealing with High Volume Communications and Privacy at Telecommunications Carriers" (http://www.jaipa.or.jp/topics/?p=400) (in Japanese).

# Sender Authentication Technology Implementation Status and Standardization Trends

**In this volume we report on analysis results incorporating the 52 weeks' worth of data from week 14 of 2013 to week 13 of 2014, while referencing data from IIR Vol.1.**

**In our discussion of email technology, we also report on changes to the SPF sender authentication technology.**

## 2.1 Introduction

In this report we discuss the latest trends in spam and email-related technologies, and examine a variety of anti-spam measures in which IIJ is involved. We presented ongoing reports between IIR Vol.1 and Vol.19, but in the future we are planning to present irregular reports about once a year. In this volume our report focuses on data from week 1 of 2014 (December 30, 2013 to January 5, 2014) to week 13 (March 24 to March 30, 2014), which corresponds to the fourth quarter of FY2013 in Japan. We also examine analysis results that include 52 weeks of data for the period of about a year since the last report (Vol.19), covering week 14 of 2013 (April 1 to April 7, 2013) to week 13 of 2014. Additionally, we reference the 304 weeks' worth of data since IIR Vol.1, covering almost six years, as necessary. In our discussion of email technologies, we examine the implementation status of the sender authentication technology that we have discussed to date, and report on changes to the SPF sender authentication technology that is currently undergoing standardization.

## 2.2 Spam Trends

In this section, we will report on spam trends, focusing on historical ratios of spam detected by the Spam Filter provided through IIJ's email services and the results of our analysis concerning spam sources. In this report, we show transitions in the ratios from IIR Vol.1 (June 2, 2008) in Figure 1, to examine long-term changes in spam ratios.

### 2.2.1 Ratios Have Declined Since Around the Middle of 2010

In 2008 and 2009, average spam ratios for the year came to 82.3% and 81.8%, respectively, indicating that the majority of email received was spam. This situation changed from the second quarter of 2010 (June 28 to October 3, 2010), when ratios started to gradually decline. The average ratio for 2010 was 79.4%, with the ratio of over 80% for the first quarter of 2010 dropping to 78.7% in the second quarter, falling below 80% for the first time since we began these surveys. The ratio subsequently continued to decline, and has remained in the 40% range since the second quarter of 2011.

As we have already reported a number of times in this IIR, the drop in spam ratios and actual spam volumes is estimated to be due to a decline in the botnet activity from which spam originates.

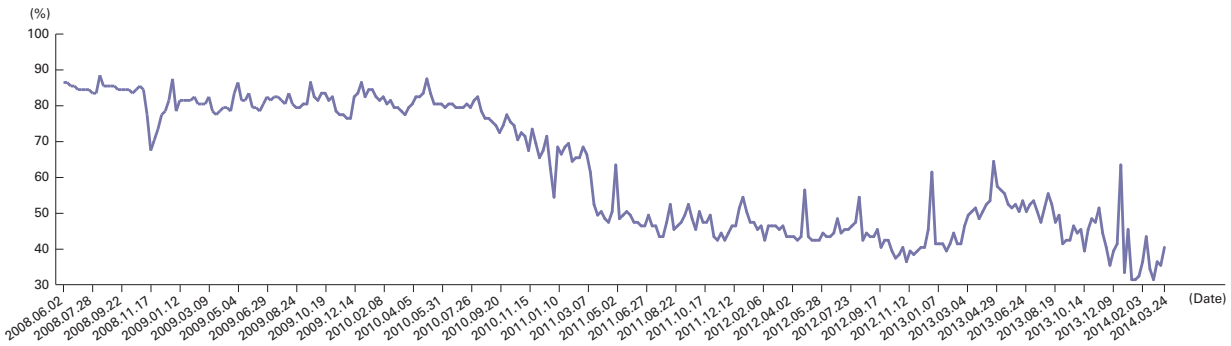



**Figure 1: Spam Ratio Trends**

PCs that have been infected with malicious software*1 and are being controlled from outside are called bots. Collectively these bots are known as botnets, and the servers that control them are referred to as C&C servers*2. One effective method of stopping botnet activity is to shut down these C&C servers to prevent commands being sent to a botnet. It is said that government agencies in various countries suppressing botnet activity by forcing the shutdown of these C&C servers using legal means led to a decrease in spam volumes. There is also information about the appearance of P2P (Peer-to-Peer) botnets that do not have specific C&C servers, so continued vigilance is necessary.

### 2.2.2 Recent Spam Ratios on the Decrease

In the fourth quarter of FY2013, from week 1 of 2014 (December 30, 2013 to January 5, 2014) to week 13 (March 24 to March 30, 2014), the average spam ratio was 38.5%. The average for the same period the previous year (the fourth quarter of FY2012) was 45.5%, so this represents a drop of 7%. During this period, the spam ratio was highest in week 1 of 2014, at 63.5%. The volume of spam during this period was also quite high, but because it was the year-end and New Year holiday period, the volume of normal mail was low, increasing the relative spam ratio. The only other weeks with an average ratio of over 40% were week 3, week 8, and week 13.

### 2.2.3 An Increase in Threats Triggered by Email

The ratio of spam among email received, as well as spam volumes, are both significantly lower than previous levels. However, the level of threat resulting from spam seems to be increasing. In the past email was mostly used as an advertising tool for some kind of product (including illegal ones), but recently there have been more and more cases in which it is suspected that email was used as a route for compromising PCs within an organization.

For example, a report*3 published by the National Police Agency on January 30, 2014 indicated there were 1,315 incidents of illegal remittance in 2013, reaching an unprecedented total of approximately 1.406 billion yen in damages. Furthermore, it has been reported that incidents in which users were redirected to phishing sites via email are on the rise. In other words, it could be said that spam is transforming from something that is simply a nuisance due to the time it takes to delete, to something more dangerous that can trigger incidents of financial crime. Considering that this kind of online banking crime is currently occurring, we believe it is also likely that the same techniques are being used to steal a variety of IDs and passwords. This stolen information includes IDs and passwords for sending email, and there have been many incidents in which legitimate mail servers were used as stepping stones to send spam.

### 2.2.4 Trends in the Regional Sources of Spam

Figure 2 shows our analysis results of regional sources of spam in the fourth quarter of FY2013. The data used in this analysis does not cover all the email services IIJ provides, so not all the sources of spam shown in Figure 1 are targeted. Because of this, note that there may be slight differences.

China (CN) was the number one source of spam for this survey period, accounting for 19.1% of total spam. China has remained the most common source of spam since IIR Vol.11 (the fourth quarter of FY2010). Japan (JP) was second at 13.4%. Japan has also held the second place since IIR Vol.16 (the first quarter of FY2012), and regularly appeared in the upper rankings from about a year before that. These regions have been practically fixed in the upper rankings since the ratio of spam to overall received email declined around the middle of 2010 (see Figure 1), so we believe it likely they are static sources not affected much by the drop in botnet activity.

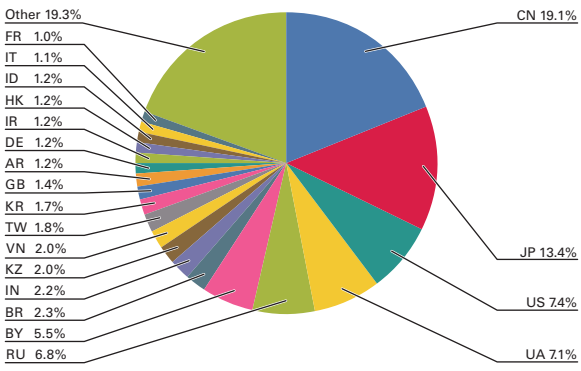



**Figure 2: Regional Sources of Spam**

*1 Software created for certain malicious purposes, such as the sending of spam, is sometimes called malicious software or malware to differentiate it from the more widely-used term "viruses."

*2 C&C server (Command & Control Server).

*3 Status of Incidents of Illegal Remittance Related to Internet Banking in 2014 (http://www.npa.go.jp/cyber/pdf/H260131_banking.pdf) (in Japanese).

The United States was third (US, 7.4%), and the Ukraine was fourth (UA, 7.1%), with Russia in fifth (RU, 6.8%) and Belarus in sixth (BY, 5.5%). Until now Asian regions were the main sources of spam, but from the results this time we identified that regions in Eastern Europe and Central Asia (Kazakhstan (KZ) was ninth) are also on the rise.

Figure 3 shows trends for the top six regions (CN, JP, US, UA, RU, BY) over 65 weeks, including this survey period and the year before it. This graph demonstrates that the top two regions (CN, JP) maintained a high ratio throughout. Additionally, changes in the ratios for China (CN) and Japan (JP) seem to be linked in the most recent results (the fourth quarter of FY2013). Japan has been involved in spam sent from China in the past, as demonstrated by the Takumi Tsushin arrests in 2007, and this relationship may have deepened.

## 2.3 Trends in Email Technologies

Here we will examine a variety of technological trends relating to email. This time we report the implementation status of sender authentication technology, which shows promise as an anti-spam measure. Additionally, when technology is standardized and used widely, it becomes more effective. We cover trends in standardization later in this section.

### 2.3.1 Sender Authentication Technology Adoption Rates

Sender authentication technology was made so that it could be implemented without directly affecting existing SMTP*4 email delivery systems. Emails are authenticated on the recipient side, but authentication is only possible when the sender has implemented sender authentication technology. In other words, it is possible to implement sender authentication technology based on the judgment and timing of each email sender and recipient, but authentication results are only obtained when both sender and recipient have the technology set up.

Sender authentication technologies include SPF*5, which performs authentication based on the email sender's IP address, and DKIM*6, which creates a digital signature from the email body text, and performs authentication by verifying this. Figure 4 and Figure 5 show the sender implementation status for each technology on the sender side. These recipient authentication ratios were taken from emails received on IIJ's main email services between January and March, 2014.

To implement SPF on the email sender side, you publish (configure) SPF records in the DNS TXT resource records for domains to use (or not use) for email. One great advantage of SPF is that once you have configured an SPF record, you don't need to do anything else unless the IP address for the mail server using that domain name changes.

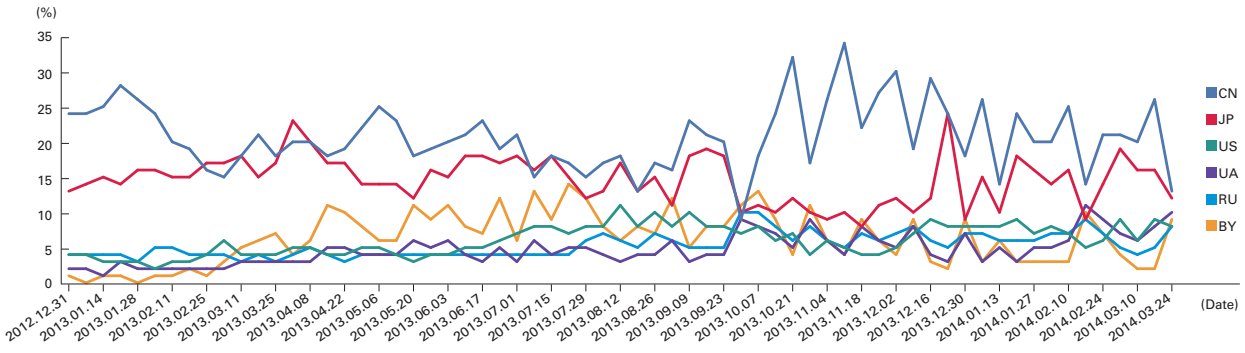



**Figure 3: Trends in Ratios for the Main Regional Sources of Spam**

*4 SMTP (Simple Mail Transfer Protocol) has been revised a number of times, and the latest version is available as RFC5321.
*5 SPF (Sender Policy Framework) was first published as RFC4408 in the Experimental category, and was later revised as RFC7208 (Standards Track).
*6 DKIM (DomainKeys Identified Mail) was published as RFC6376, and later became an Internet standard as STD76.

In part due to this benefit, SPF has an extremely high implementation ratio, as can be seen in Figure 4. The ratio of cases in which SPF is implemented on the sender side are those with an authentication result other than "none" (could not authenticate), and for this survey period the ratio was 73.2%. The "pass" authentication result (47.7%) indicates the ratio of email that was correctly authenticated. The "hardfail" (2.2%) and "softfail" (21.0%) results make up the ratio of authentication failures, indicating that the domain was spoofed, or that authentication failed because the delivery route changed, such as when email was forwarded.

Meanwhile, DKIM requires additional processing for each email sent, to create digital signature information from elements such as the email body text, and insert this into the email headers. This means that new functions must be added to outgoing mail servers, and a greater burden is placed upon resources due to the extra processing that signature creation involves. In other words, there are factors that make it more difficult to implement on the sender side compared to SPF, and it is believed that as a result its implementation tends to lag behind on the recipient side as well. However, it does have the benefit of authentication failures due to changes in the mail delivery route that we touched upon in the SPF authentication results almost never occurring. Additionally, because the digital signature is created from email body text, it is said to be a more robust sender authentication technology than SPF, as this enables features such as the detection of alterations to be made to body text at some point on the delivery route.

In the current survey period, DKIM authentication results showed the ratio of sender-side implementation to be 11.6%. We believe measures must be taken to increase this ratio.

### 2.3.2 Sender Authentication Technology Adoption Trends

Figure 6 shows trends in the ratio of SPF authentication results, and Figure 7 shows trends in the ratio of DKIM authentication results.

The SPF implementation ratio has grown steadily since we began these surveys (August 2009). Since 2013 growth in implementation has slowed, but the implementation ratio remains over 70%. Over this period, the implementation ratio has increased by a maximum of around 32.7%. DKIM implementation ratios have not increased as rapidly as SPF, but even so, its ratio is gradually growing. Over this period, its implementation ratio increased by about 11.1%.

According to data presented by Google, which provides the Gmail service, in December 2013*7, 91.4% of email they received that was not spam could be authenticated using either SPF or DKIM. The sender authentication ratios given in this IIJ report cover all email received (including spam), so the original data has different characteristics than the Google report. This means they cannot simply be compared, but in any case the ratios were very high.

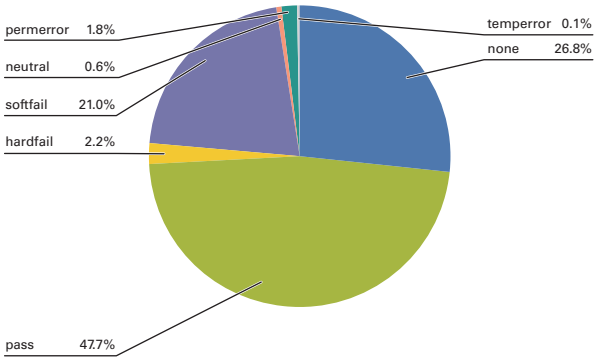



**Figure 4: SPF Authentication Result Ratios**

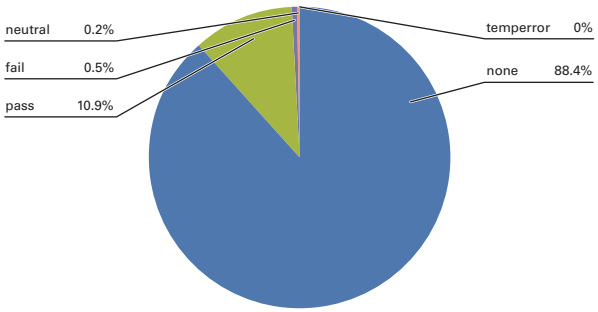



**Figure 5: DKIM Authentication Result Ratios**

*7 Internet-wide efforts to fight email phishing are working (http://http://googleonlinesecurity.blogspot.sg/2013/12/internet-wide-efforts-to-fight-email.html).

The Google report states that SPF authentication was possible in 89.1% of cases, and for DKIM this ratio was 76.9%. In 74.7% of cases both SPF and DKIM authentication were possible, but domains that only implement SPF or DKIM also exist, and totaling these together apparently results in the figure of 91.4%.

Google is a company that promotes DMARC, which uses both SPF and DKIM authentication results, so by presenting high implementation ratios like these, it demonstrates that the world is already prepared for implementing DMARC. It is also reported in this document that 80,000 domains already state a policy of blocking email that cannot be authenticated using DMARC, and that every week several hundred million emails are blocked according to this policy.

Some areas of the DMARC specifications are left incompatible with the mailing list delivery methods that are currently used, so in certain cases it is difficult to advertise rejection of receipt based on the DMARC policy, and this must be taken into account.

### 2.3.3 SPF Standardization Trends

SPF technology is standardized as an experimental RFC. Currently, efforts are being made to revise this SPF. SPF was originally technology that underwent lengthy evaluation within the IETF's marid Working Group, with the intention to integrate it with Sender ID*[8], which was also published as an experimental RFC at around the same time (April 2006). In the end, the integration fell through due to issues such as the original proposing company asserting intellectual property rights over PRA (Purported Responsible Address), which is a characteristic of Sender ID.

However, as already shown in the data, SPF is a widely prevalent sender authentication technology, so the IEFT's spfbis Working Group began discussions from November 2011 with the aim of standardization using their accumulated experience. In April 2014, SPF was published as a Proposed Standard (Standards Track) in RFC7208. Here, we will explain the differences between RFC7208 and the previous RFC4408.

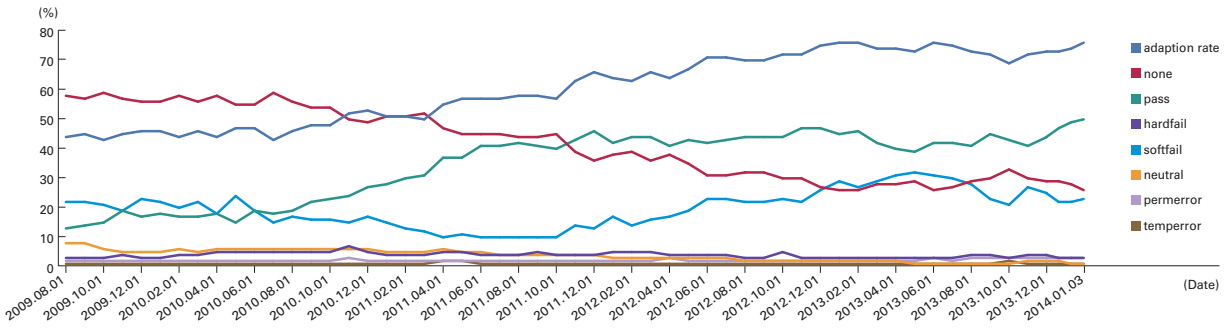



**Figure 6: SPF Authentication Result Ratio Trends**

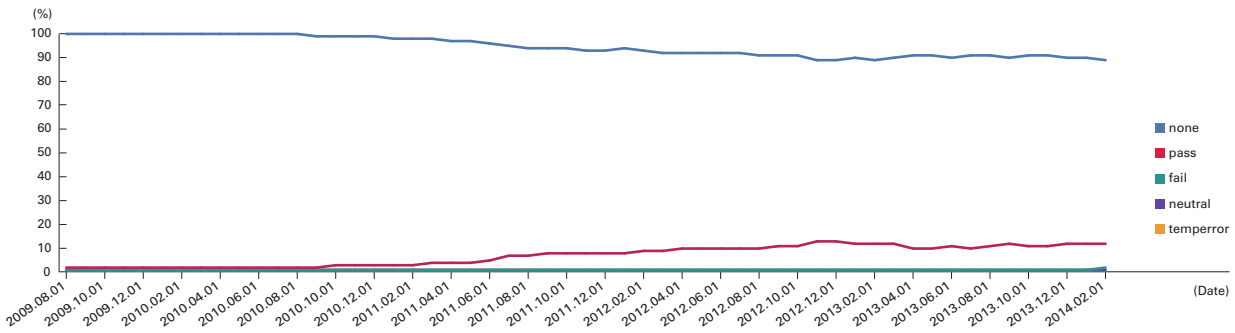



**Figure 7: DKIM Authentication Result Ratio Trends**

*8 Sender ID: RFC4406, RFC4407

First, as a starting point for discussion, the following views are expressed.

- SPF was successful, but Sender ID was not (so Sender ID should not be incorporated)
- The key to revising the SPF specifications is to fix errors, delete functions that are not used, and add expansions that are already widely in use, etc.
- Do not expand SPF itself or delete functions that are used

Consequently, no significant changes were added through the spfbis Working Group ID. The main changes indicated in the current ID are as follows.

1. SPF records should use TXT RR (16) rather than SPF RR type (99) on DNS
2. Authentication results should be saved to both the “Received-SPF” and “Authentication-Results” email headers

Changes other than these included fixes to minor errors, etc. In the end, it was decided that a policy for email handling when authentication fails was not specified in the RFC, and that this policy should be determined on the recipient side. Although I don’t believe the SPF macro functions that enable comparatively complex formats to be written are actively used by many domains, it was decided to leave these in the specifications.

No clear measures were indicated for coping with the forwarding of email, which was an issue for SPF. Instead, proposed solutions involved rewriting the RFC5321. From (Envelope-From) when forwarding, or configuring a white list for receipt of mail at the forwarding destination. The SPF Internet-Draft was revised to Version 21, and this took a lot of time considering how few points were actually changed. SPF has a high adoption rate due to the ease of implementation on the sender side, and this standardization work is expected to further promote the utilization of SPF authentication results.

## 2.4 Conclusion

This is the first Messaging Technology article in a year, so we examined spam trends and sender authentication technology in more detail than usual. As mentioned in the report, although spam volumes are on the decrease, the threats that can result from spam are becoming more serious.

For example, the other day there was a commercial for a major bank on TV warning of phishing emails. We believe this indicates that the number of victims has increased to the point where it is necessary to send warnings out to the general public via media such as the television. The commercial also mentioned that the techniques used are becoming more devious. With security threats on the Internet growing, both organizations such as companies and private individuals now carry out a variety of measures. However, current email systems are one of few applications that can deliver a range of information directly to recipients. With attacks targeting these systems ongoing, there is a limit to the methods for avoiding threats based on the judgment of individual email recipients. As someone involved with email systems, every day we strive towards providing a system that identifies these major threats and prevents them from reaching email users as soon as possible.

Author:

**Shuji Sakuraba**

Mr. Sakuraba is a Senior Engineer in the Service Development Section of the Application Development Department of the IIJ Product Division. He is engaged in the research and development of communication systems. He is also involved in various activities in collaboration with external related organizations for securing a comfortable messaging environment. He has been a member of M³AAWG since its establishment. He is deputy chairperson of the Anti-Spam mail Promotion Council (ASPC), and a member of the administrative group. He is also chief examiner for the Sender Authentication Technology Workgroup, and chairperson of the LAP 10 Tokyo Committee. Additionally, he is a member of Internet Association Japan's Anti-Spam Measures Committee.

# The Current State of Big Data Analysis

**In this report we discuss the current state of big data, which is estimated to already exist in the exabyte range. We also examine trends in analysis platform technology, and look at changes in the analysis of big data that accompany the shift to real-time solutions.**

## 3.1 The Current State of Big Data

The term "big data" has become a common word recently, but it is still very hard to paint a precise picture of what it is. The main reasons for this are the fact that the meaning of "big data" differs substantially depending on the standpoint or opinion of the speaker, and the fact that it can be effectively applied in a broad array of cases across a range of industries. In a 2013 survey conducted by the Ministry of Internal Affairs and Communications that attempted to provide a comprehensive understanding of the current state of big data, it was reported that the amount of big data traffic in Japan is increasing year by year.

Looking at the amount of traffic by media type, we can see that a high total volume of data is obtained from POS, RFID, and GPS, and over the years the amount of medical data (electronic health records, diagnostic imaging) and M2M data (GPS, RFID) has grown significantly. The survey states that data is generated in a variety of ways and covers a range of media types, and explains that data falls under three categories in different data formats (Figure 1).

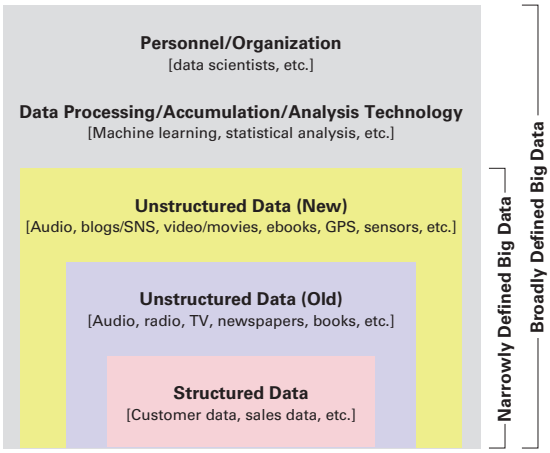
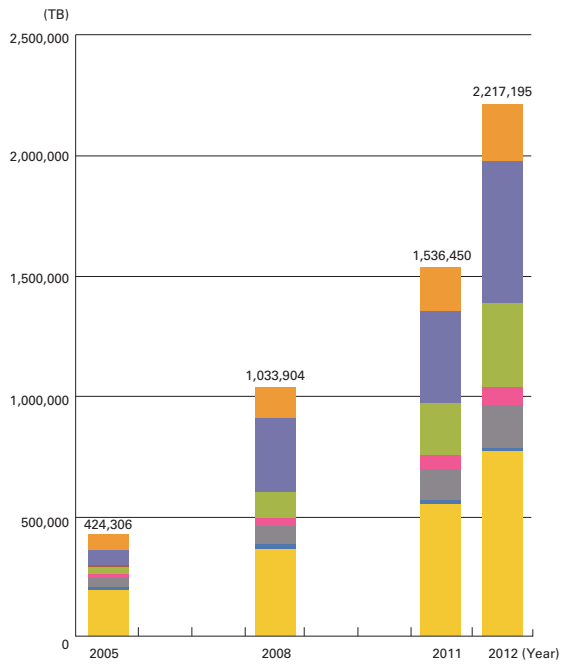



**Figure 1: Three Types of Data in Different Formats**




(Unit: TB)

| | 2005 | 2008 | 2011 | 2012 (Year) |
|---|---|---|---|---|
| Access logs | 521 | 1,008 | 1,566 | 2,147 |
| Blog and SNS posts | 155 | 379 | 721 | 1,129 |
| Email | 64,566 | 121,085 | 178,501 | 238,048 |
| Weather data | 877 | 1,958 | 4,176 | 6,229 |
| RFID data | 64,519 | 309,559 | 370,440 | 583,942 |
| GPS data | 33,116 | 104,928 | 228,801 | 348,143 |
| E-commerce sales logs | 12 | 28 | 50 | 69 |
| Mobile phones | 17,765 | 36,068 | 56,544 | 75,881 |
| Static IP phones | 38,035 | 80,958 | 132,017 | 178,474 |
| CTI audio log data | 2,509 | 5,662 | 10,878 | 15,019 |
| Image diagnosis | 71 | 191 | 445 | 630 |
| Electronic health records | 227 | 636 | 1,032 | 1,635 |
| Business logs | 1 | 2 | 4 | 6 |
| Electronic receipts | 2 | 4 | 5 | 7 |
| POS data | 201,823 | 371,272 | 551,026 | 765,424 |
| Accounting data | 100 | 161 | 234 | 397 |
| Customer databases | 4 | 7 | 11 | 16 |
| TOTAL | 424,306 | 1,033,904 | 1,536,450 | 2,217,195 |

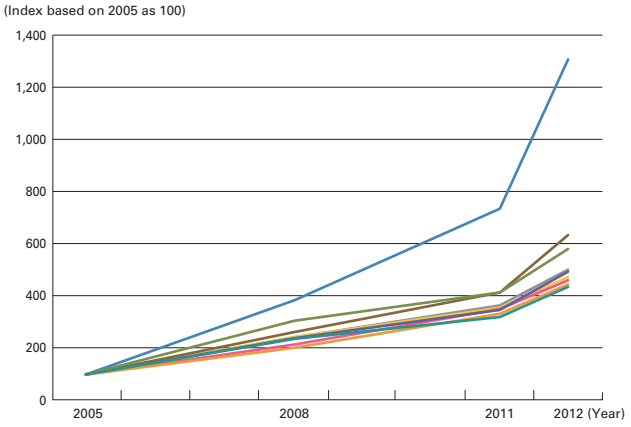
**Figure 2: Big Data Traffic Estimates*1**

*1 http://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h25/html/nc113220.html (in Japanese)

However, from a data analysis perspective, the unstructured data (new) group includes data with standard formats specified such as POS, RFID, and GPS (in other words, structured data) in some cases. In other cases streamed data such as video, audio, and text includes metadata including the title or author. This suggests we should actually consider these examples as mixed data that includes both structured and unstructured data. Figure 2 indicates that big data traffic in Japan is dominated by structured data rather than unstructured data.

The figures below show estimated big data traffic by industry type (Figure 3) and accumulated volume (Figure 4), as reported in the Ministry of Internal Affairs and Communications survey.

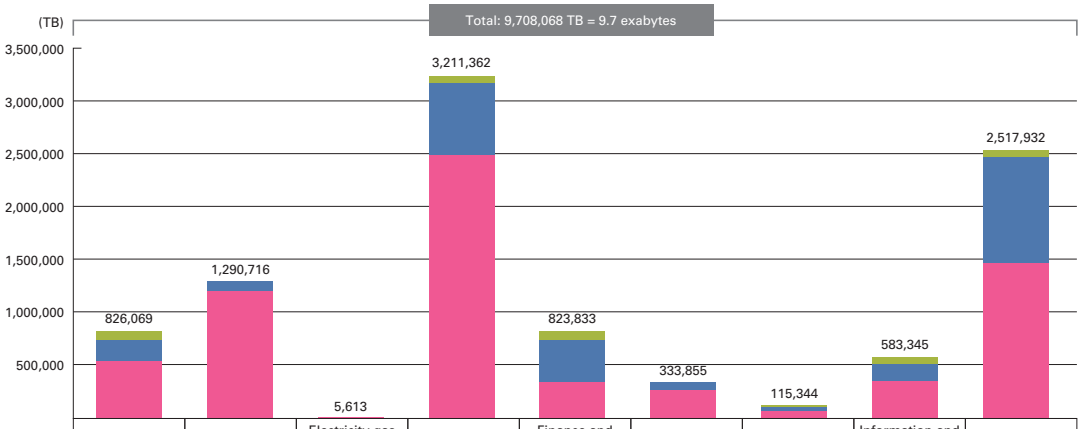
One thing of great interest regarding these estimates is that despite traffic amounts increasing with roughly the same characteristics (except for the real estate industry), accumulated amounts vary drastically for each industry. Assuming that the amount of big data accumulated shows the degree of utilization, it can also be surmised that this indicates a difference in commitment to initiatives for the application of big data in each industry. However, it may be that this just reflects that each




(Index based on 2005 as 100)

| | 2005 | 2008 | 2011 | 2012 (Year) |
|---|---|---|---|---|
| Manufacturing | 100 | 233 | 320 | 431 |
| Construction | 100 | 303 | 411 | 576 |
| Power/Gas/Water | 100 | 200 | 327 | 436 |
| Commerce | 100 | 239 | 345 | 496 |
| Finance/Insurance | 100 | 211 | 349 | 459 |
| Real estate | 100 | 378 | 732 | 1,310 |
| Transportation | 100 | 260 | 410 | 632 |
| Telecommunications | 100 | 242 | 351 | 462 |
| Service | 100 | 236 | 363 | 499 |

**Figure 3: Trends in Big Data Distribution Volume (By Industry)*2**




| | Manufacturing | Construction | Electricity gas and water supply | Commerce | Finance and insurance | Real estate | Transportation | Information and communicaitons | Services |
|---|---|---|---|---|---|---|---|---|---|
| Accumulation inside enterprises | 543,156 | 1,194,956 | 3,722 | 2,468,219 | 334,843 | 270,270 | 76,887 | 350,485 | 1,455,067 |
| Accumulation outside enterprises, inside Japan | 203,562 | 90,900 | 1,376 | 678,545 | 412,397 | 63,237 | 30,258 | 167,949 | 990,394 |
| Accumulation outside enterprises, outside Japan | 79,350 | 4,860 | 515 | 64,598 | 76,594 | 348 | 8,199 | 64,911 | 72,472 |
| Total | 826,069 | 1,290,716 | 5,613 | 3,211,362 | 823,833 | 333,855 | 115,344 | 583,345 | 2,517,932 |

**Figure 4: Big Data Accumulation Volume (By Industry, in 2012)*3**

*2 http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2013/chapter-1.pdf#page=19
*3 http://www.soumu.go.jp/johotsusintokei/whitepaper/eng/WP2013/chapter-1.pdf#page=20

industry has different practices. Looking at the amount of accumulated data by industry, it is evident that B2C industries accumulate more data than B2B ones, and that most big data is kept private by its owners.

Given that exabytes of data is already in circulation according to the Ministry of Internal Affairs and Communications survey results, it is fair to say that the use and application of big data has started. However, it is becoming clear that the primary utilization of big data, namely to gain new knowledge by sorting and analyzing the big data collected and accumulated from vast data sources, is only now beginning to happen.

With regard to discussion of issues relevant to big data for promoting and accelerating its future utilization and application, two issues often raised are how to promote the sharing of big data, and how to obtain new knowledge through its analysis. In this context, three key words that are frequently encountered are M2M, IoT, and CPS. To briefly cover the definitions of each of these, Machine-to-Machine (M2M) is technology that enables communication between devices of the same type using wired or wireless communication systems, while the Internet of Things (IoT) involves uniquely identifiable objects represented virtually in an Internet-like structure. A Cyber-Physical System (CPS) is a system of cooperative computational elements that control physical entities. Rather than independent concepts, it may be best to think of these as presenting three perspectives on networks comprised of devices such as sensors. For example, package pickup and delivery management using RFID tags involves attaching an RFID tag to each package, and when a package passes near an RFID reader, data with location information added is generated. By collecting this data and tracing the location information for a particular package, it is possible to check the route that package has taken, and where it is currently stored. Furthermore, if you trace all the packages handled by the pickup and delivery management system, you can accurately ascertain the delivery centers where packages are concentrated. With the proliferation of smartphones these days, the activities of people can also be tracked using the same method. Collecting the data generated by each device creates big data, which it is believed would provide knowledge useful for work optimizations and marketing.

## 3.2 Technology Trends in Big Data Analysis Platforms: A Shift to Real-Time Solutions

The analysis of big data generated from device networks based on the M2M, IoT, and CPS concepts described earlier obviously demands immediacy. That means big data analysis platforms must accommodate the need for real-time analysis.

For many, platform technology for big data analysis calls to mind distributed processing platforms based on MapReduce, in particular. However, applying MapReduce architecture designed for batch processing to real-time analysis presents difficulties. Because the process results are not determined until a job finishes, a delay equal to the processing time occurs. One solution for reducing this time is to optimize and speed up the processing itself, but naturally there are limitations. Another measure is to reduce the size of batch processing, but when too small batch processing becomes meaningless. Normally, MapReduce jobs require anywhere between a few minutes to a few hours to process, and reducing this to the response time of a few seconds that is acceptable for web services is practically impossible.

Two approaches have been evaluated in research into real-time big data analysis platforms. The first involves responding to user requests in real time, and this covers cases in which response performance is improved by enhancing the functions of a MapReduce platform itself, as well as cases envisaged as platform systems that incorporate MapReduce, with MapReduce used internally, and improvements to response performance made in other areas. The other approach is to actually execute data processing in real time, using platform technology that implements so-called “real-time stream processing” in place of MapReduce.

MapReduce Online*4 is an example of enhancing the functions of the MapReduce platform itself. In this case, pipelines are used to handle the delivery of data between Map processes and Reduce processes with a heavily modified version of Hadoop. These enhancements enable users to check job status details during processing, in other words making event monitoring possible. It also allows stream processing to be written into MapReduce applications.

Examples of platform systems that incorporate MapReduce include the two open source clones that follow the idea of Google's Dremel*5: "Apache Drill*6" and "Cloudera Impala*7." Neither carry out data processing in real time, but they demonstrate equivalent low delay query response performance.

Apache Storm (Twitter Storm)*8 is an example of real-time stream processing. Storm was originally a system developed by BackType, which conducted Twitter analytics. After Twitter acquired BackType, Storm was made open source via the Apache Project, but it is a versatile big data processing platform.

Storm incorporates a stream engine that enables Complex Event Processing (CEP), ensuring that lossless data streams are supplied to the entities known as Spouts/Bolts that carry out big data processing. Storm stream flow is expressed in units called tuples, with overall stream processing implemented by defining topologies that connect Spouts and Bolts. Spouts are entities that represent data sources, and Bolts are entities that govern the conversion or processing of data. Their definitions and functions are completely different, but they could be thought of as Map and Reduce in MapReduce.

Like Hadoop, Storm can be comprised of clusters, and it operates four types of software: the Nimbus, Zookeepers, Supervisors, and Workers. The Nimbus is the master node that handles the scheduling and monitoring of Workers. Zookeepers are the distributed lock managers that are also used in Hadoop. Supervisors receive requests from the Nimbus and control the launch and termination of Workers. Workers function as the processes that carry out actual processing. Placing these pieces of software appropriately in nodes within a cluster achieves high scalability and fault-tolerance. Storm itself is written in a Lisp-like language called Clojure, and runs on a Java VM. Accordingly, Spouts and Bolts can be written using a variety of development languages that run on Java VMs, such as Java.

Here we have introduced the challenges of enabling real-time big data analysis platforms, as well as a number of examples, but it appears that more and more are seeing the appearance of Apache Storm as a trend towards a de facto standard for these platforms. It seems a simple programming model in common with Hadoop (MapReduce) and Twitter analytic performance are requirements expected of a versatile platform.

So, will Storm replace Hadoop as an open source big data analysis platform? The answer to this question seems likely to be that both will continue to become compartmentalized. This is because immediacy is not required for all big data analysis. As mentioned, those demanding big data analysis with a real-time response will transition to Storm, but those for which conventional batch processing is sufficient (or necessary) will probably continue to use Hadoop. Hybrid system architecture methods that utilize Storm for the preprocessing of Hadoop analysis (data shaping, filtering, and matching), or combine batch processing with stream processing in what is known as Lambda architecture, have also been proposed. Currently, it is generally accepted that both are mutually complementary.

*4 http://db.cs.berkeley.edu/papers/nsdi10-hop.pdf
*5 http://research.google.com/pubs/pub36632.html
*6 http://incubator.apache.org/drill/
*7 http://blog.cloudera.com/blog/2012/10/cloudera-impala-real-time-queries-in-apache-hadoop-for-real/
*8 http://storm.incubator.apache.org/

## 3.3 Changes in Big Data Analysis Due to the Shift to Real-Time Solutions

The shift towards real-time big data analysis platforms is understood to be a response to improve velocity, which is one of the often-quoted "3Vs" that define big data (Volume, Variety, and Velocity). According to Gartner, which coined the 3Vs definition, velocity is the speed of data creation and processing. For example, the analysis of sensor and log data, the analysis of spatiotemporal data using GPS information, and the analysis of stream data obtainable from social media are all specific examples in which this velocity requirement must be met. For existing analysis cases such as these, there are well-known examples of obtaining new knowledge from previously accumulated data, including records of abnormal behavior detection and spatial migration, as well as sentiment analysis. However, due to improvements in the immediacy of real-time big data analysis platforms, in the future it is thought that analysis methods will become more diverse, such as time-series analysis that places more emphasis on timelines, and estimates based on this.

### 3.3.1 Wikipedia as Social Big Data

We are trying out trend analysis using Wikipedia Pageview Count (Wikipedia PVC: http://www.gryfon.iij-ii.co.jp/ranking/) (in Japanese) as an example of analysis focused on the timeline of big data. As everyone knows, Wikipedia is the most successful Internet encyclopedia. It has adopted an extremely open administration policy, and because its databases can be obtained charge-free, it is utilized for research and a variety of other purposes. The Wikipedia PVC is part of the information published, and has been available since around January 2013. It indicates the number of page views for each Wikipedia page over the last hour, with updates posted every hour or two. By combining Wikipedia PVC and the Wikipedia database, they are usable as time-series data for indicating social trends, and this can be considered as an example of social big data obtainable via the Internet. Because it has the properties of an encyclopedia, the following characteristics apply compared to typical social media sites (SNS or blogs).

- Users are allowed to make alterations themselves, but because there are measures in place to prevent venting through article content using guidelines, etc., it is possible to find common denominators regarding society as a whole.
- Because it is an encyclopedia, the content is very thorough, with linked data formed within a close space.
- The service has high public recognition, and users use it to learn the details of topics they don't know about, and discover related information.
- It supports many languages, and in many cases each page is clearly mapped out for each language.

When performing text analysis using messages obtained from general social media for trend analysis, etc., the lack of consistent terminology can hinder data analysis. However, this is less likely to be a problem with Wikipedia data that keeps meaning-related outbursts in check, and as a result we believe that analysis results that are easily understandable by people can be obtained.

### 3.3.2 Analysis of Wikipedia PVC Time-Series Fluctuations

For Wikipedia, which is well-known as an encyclopedia, the dominant usage pattern likely involves users finding the page they want by searching for the topic they are interested in from the main page or a search engine.

By focusing on a certain Wikipedia page, and observing the time-series fluctuations in its PVC, we can confirm that a peak is reached at some point, after which activity gradually subsides. In particular, after investigating a number of pages with notable peaks further, we learned that pages dealing with topics reported on TV broadcasts or Internet news showed large responses. In other words, this supports the hypothesis that viewers of TV programs and readers of Internet news look up topics they don't know about on Wikipedia when they arise.

To verify this hypothesis, we focused on serial dramas, surveying the relationship between each broadcast time and time-series fluctuations in the Wikipedia PVC. We concentrated on serial dramas because we had confirmed it was highly likely for the PVC peak for the Wikipedia page to occur at the same time as each episode was broadcast. Television dramas also have viewer ratings, a widely-known index of viewer numbers, and it was important to investigate the relationship between this and the Wikipedia PVC.

Wikipedia PVC provides data on all 334 serial dramas broadcast on commercial stations since 2008. Of these, we used the following method to analyze 244 dramas with complete sets of Wikipedia PVC data.

1. Assuming a broadcast time of one hour for each drama episode, we extracted a single set of time-series data for the 168 hours between the broadcast time and an hour before the next broadcast.
2. We performed regression analysis on the extracted time-series data, and used the coefficient obtained as the social interest level of that episode.
3. We investigated the correlation between the social interest level and average viewer ratings for each episode, and confirmed the significance of this.

For the regression analysis in step two, we used the regression formula pvc $=\alpha^* \exp(\beta^* t) + \gamma$, based on knowledge in econometrics that "social events fluctuate exponentially." We also adjusted peak values to take into consideration broadcast time delays or expansion.

Non-linear regression analysis results indicate a high peak during broadcast times in each case, which subsequently converges with the $\gamma$ value. After looking into the correlation between the coefficients $\alpha$, $\beta$, and $\gamma$ obtained from analysis and average viewer ratings, correlation was seen with the Y value. Figure 5 shows the correlation analysis results between the $\gamma$ value for each episode of the TV drama Hanzawa Naoki, and its average viewer ratings.

At the time of writing, we had analyzed the correlation between the $\gamma$ value and average viewer ratings for 40 of 244 sets of valid data, and results showed significant correlation. We will analyze correlation for the remaining 204 cases, but because we have found cases in which Wikipedia PVC fluctuations and viewer behavior did not match, particularly for dramas with low viewer ratings, we plan to clarify the number of cases in which significant valid data can be confirmed, as well as the range of Wikipedia PVC values for which this analysis method can be applied.

## 3.4 Summary

In this report, we examined the current state of big data through the lens of the key words M2M, IoT, and CPS. We also looked at technological trends related to analysis platforms that demand a shift to real-time solutions, and the diversification of big data analysis techniques for which knowledge can be obtained from time-series data.

We imagine that attempts to obtain detailed data live and utilize it in processing platforms with high immediacy to identify what is happening right at this moment will make it possible to obtain dynamic, micro-knowledge vastly different from big data analysis that obtains conventional static macro-knowledge. This new knowledge may even contain signs of what is yet to come. Finding these signs before anyone else could be the challenge for big data in the future.

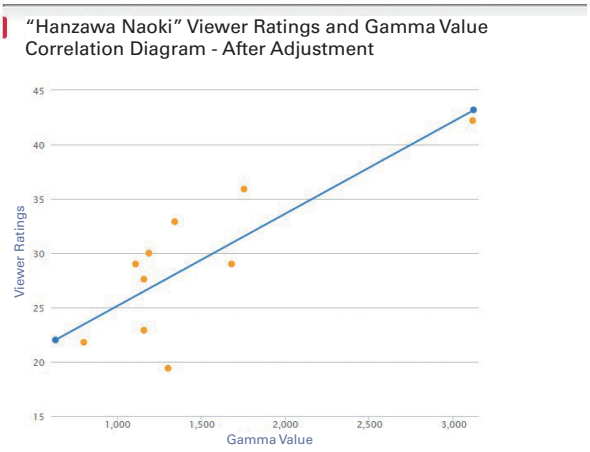



**Figure 5: Correlation Analysis Results for $\gamma$ Value and Viewer Ratings of Each "Hanzawa Naoki" Episode**

Author:

**Akito Fujita**
Chief Architect, Business Strategy and Development Center, IIJ Innovation Institute Inc. (IIJ-II). Mr. Fujita joined IIJ in 2008. He is engaged in the research and development of cloud computing technology utilizing knowledge gained through structured overlay research.

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**About Internet Initiative Japan Inc. (IIJ)**

IIJ was established in 1992, mainly by a group of engineers who had been involved in research and development activities related to the Internet, under the concept of promoting the widespread use of the Internet in Japan.

IIJ currently operates one of the largest Internet backbones in Japan, manages Internet infrastructures, and provides comprehensive high-quality system environments (including Internet access, systems integration, and outsourcing services, etc.) to high-end business users including the government and other public offices and financial institutions.

In addition, IIJ actively shares knowledge accumulated through service development and Internet backbone operation, and is making efforts to expand the Internet used as a social infrastructure.

**Internet Initiative Japan Inc.**
Address: Iidabashi Grand Bloom, 2-10-2 Fujimi, Chiyoda-ku, Tokyo 102-0071, Japan
Email: info@iij.ad.jp URL: http://www.iij.ad.jp/en/



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