

Cisco Applied Mitigation Bulletin: Identifying and Mitigating Exploitation of the Cisco ONS Platform Crafted Packet Vulnerability

<http://www.cisco.com/warp/public/707/cisco-amb-20090114-ons.shtml>

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Cisco Response

This Applied Mitigation Bulletin is a companion document to the PSIRT Security Advisory *Cisco ONS Platform Crafted Packet Vulnerability* and provides identification and mitigation techniques that administrators can deploy on Cisco network devices.

Vulnerability Characteristics

The TCP socket process on the Cisco ONS 15300 Series Edge Optical Transport Platform, the Cisco ONS 15454 Optical Transport Platform, the Cisco ONS 15454 SDH Multiservice Platform, and the Cisco ONS 15600 Multiservice Switching Platform contains a vulnerability that may result in a reload of the device control card. This reload may occur when these products process a stream of specially crafted TCP packets sent to the control card in an ONS device. This vulnerability can be exploited remotely without authentication and without end-user interaction. Exploitation of this vulnerability requires the completion of a three-way TCP handshake. Successful exploitation of this vulnerability may cause the control cards in an ONS device to crash. Repeated attempts to exploit this vulnerability could result in a sustained DoS condition. The attack vector for exploitation is through TCP packets.

This vulnerability has been assigned CVE identifier CVE-2008-3818.

Information about vulnerable, unaffected, and fixed software is available in the PSIRT Security Advisory: <http://www.cisco.com/warp/public/707/cisco-sa-20090114-ons.shtml>.

Mitigation Technique Overview

Cisco devices provide several countermeasures for this vulnerability. Administrators are advised to consider these protection methods to be general security best practices for infrastructure devices and the traffic that transits the network. This section of the document provides an overview of these techniques.

Cisco IOS Software can provide effective means of exploit prevention using infrastructure access control lists (iACLs). This protection mechanism filters and drops packets that are attempting to exploit this vulnerability.

Effective exploit prevention can also be provided by the Cisco ASA 5500 Series Adaptive Security Appliance, the Cisco PIX 500 Series Security Appliance, and the Firewall Services Module (FWSM) for Cisco Catalyst 6500 Series switches and Cisco 7600 Series routers using transit access control lists (tACLs). This protection mechanism filters and drops packets that are attempting to exploit this vulnerability.

Cisco IOS NetFlow can provide visibility into network-based exploitation attempts using flow records.

Cisco IOS Software, Cisco ASA appliances, Cisco PIX security appliances, and FWSM firewalls can provide visibility through syslog messages and the counter values displayed in the output from **show** commands.

Risk Management

Organizations are advised to follow their standard risk evaluation and mitigation processes to determine the potential impact of this vulnerability. Triage refers to sorting projects and prioritizing efforts that are most likely to be successful. Cisco has provided documents that can help organizations develop a risk-based triage capability for their information security teams. [Risk Triage for Security Vulnerability Announcements](#) and [Risk Triage and Prototyping](#) can help organizations develop repeatable security evaluation and response processes.

Device-Specific Mitigation and Identification



Caution: The effectiveness of any mitigation technique depends on specific customer situations such as product mix, network topology, traffic behavior, and organizational mission. As with any configuration change, evaluate the impact of this configuration prior to applying the change.

Specific information about mitigation and identification is available for these devices:

- [Cisco IOS Routers and Switches](#)
- [Cisco IOS NetFlow](#)
- [Cisco ASA, PIX, and FWSM Firewalls](#)

Cisco IOS Routers and Switches

Mitigation: Infrastructure Access Control Lists

To protect infrastructure devices and minimize the risk, impact, and effectiveness of direct infrastructure attacks, administrators are advised to deploy infrastructure access control lists (iACLs) to perform policy enforcement of traffic sent to infrastructure equipment. Administrators can construct an iACL by explicitly permitting only authorized traffic sent to infrastructure devices in accordance with existing security policies and configurations. For the maximum protection of infrastructure devices, deployed iACLs should be applied in the ingress direction on all interfaces to which an IP address has been configured. An iACL workaround cannot provide complete protection against this vulnerability when the attack originates from a trusted source address.

The iACL policy denies unauthorized TCP packets that are sent to affected devices. In the following example, 192.168.60.0/24 is the IP address space that is used by the affected devices, and the host at 192.168.100.1 is considered a trusted source that requires access to the affected devices. Care should be taken to allow required traffic for routing and administrative access prior to denying all unauthorized traffic. Whenever possible, infrastructure address space should be distinct from the address space used for user and services segments. Using this addressing methodology will assist with the construction and deployment of iACLs.

Additional information about iACLs is in [Protecting Your Core: Infrastructure Protection Access Control Lists](#).

```
ip access-list extended Infrastructure-ACL-Policy

!
!-- When applicable, include explicit permit statements for trusted
!-- sources that require access on the vulnerable protocol
!

permit tcp host 192.168.100.1 192.168.60.0 0.0.0.255

!
!-- The following vulnerability-specific access control entry
!-- (ACE) can aid in identification of attacks
!

deny tcp any 192.168.60.0 0.0.0.255

!
!-- Explicit deny ACE for traffic sent to addresses configured within
!-- the infrastructure address space
!

deny ip any 192.168.60.0 0.0.0.255

!
!-- Permit/deny all other Layer 3 and Layer 4 traffic in accordance
!-- with existing security policies and configurations
!

!-- Apply iACL to interfaces in the ingress direction
!

interface GigabitEthernet0/0
 ip access-group Infrastructure-ACL-Policy in
```

Note that filtering with an interface access list will elicit the transmission of ICMP unreachable messages back to the source of the filtered traffic. Generating these messages could have the

undesired effect of increasing CPU utilization on the device. In Cisco IOS Software, ICMP unreachable generation is limited to one packet every 500 milliseconds by default. ICMP unreachable message generation can be disabled using the interface configuration command **no ip unreachables**. ICMP unreachable rate limiting can be changed from the default using the global configuration command **ip icmp rate-limit unreachable *interval-in-ms***.

Identification: Infrastructure Access Control Lists

After the administrator applies the iACL to an interface, the **show ip access-lists** command will identify the number of TCP packets that have been filtered on interfaces on which the iACL is applied. Administrators should investigate filtered packets to determine whether they are attempts to exploit this vulnerability. Example output for **show ip access-lists Infrastructure-ACL-Policy** follows:

```
router#show ip access-lists Infrastructure-ACL-Policy
Extended IP access list Infrastructure-ACL-Policy
 10 permit tcp host 192.168.100.1 192.168.60.0 0.0.0.255 (61 matches)
 20 deny tcp any 192.168.60.0 0.0.0.255 (72 matches)
 30 deny ip any 192.168.60.0 0.0.0.255 (59 matches)
router#
```

In the preceding example, access list *Infrastructure-ACL-Policy* has dropped **72 TCP** packets for access control list entry (ACE) line 20.

For additional information about investigating incidents using ACE counters and syslog events, reference the [Identifying Incidents Using Firewall and IOS Router Syslog Events](#) Applied Intelligence white paper.

Administrators can use Embedded Event Manager to provide instrumentation when specific conditions are met, such as ACE counter hits. The Applied Intelligence white paper [Embedded Event Manager in a Security Context](#) provides additional details about how to use this feature.

Identification: Access List Logging

The **log** and **log-input** access control list (ACL) option will cause packets that match specific ACEs to be logged. The **log-input** option enables logging of the ingress interface in addition to the packet source and destination IP addresses and ports.

Caution: Access control list logging can be very CPU intensive and must be used with extreme caution. Factors that drive the CPU impact of ACL logging are log generation, log transmission, and process switching to forward packets that match log-enabled ACEs.

For Cisco IOS Software, the **ip access-list logging interval *interval-in-ms*** command can limit the effects of process switching induced by ACL logging. The **logging rate-limit *rate-per-second* [except *loglevel*]** command limits the impact of log generation and transmission.

The CPU impact from ACL logging can be addressed in hardware on the Cisco Catalyst 6500 Series switches and Cisco 7600 Series routers with Supervisor Engine 720 or Supervisor Engine 32 using optimized ACL logging.

For additional information about the configuration and use of ACL logging, reference the [Understanding Access Control List Logging](#) Applied Intelligence white paper.

Cisco IOS NetFlow

Identification: Traffic Flow Identification Using NetFlow Records

Administrators can configure Cisco IOS NetFlow on Cisco IOS routers and switches to aid in the identification of traffic flows that may be attempts to exploit the vulnerability. Administrators are advised to investigate flows to determine whether they are attempts to exploit the vulnerability or whether they are legitimate traffic flows.

```
router#show ip cache flow
IP packet size distribution (132534914 total packets):
  1-32   64   96  128  160  192  224  256  288  320  352  384  416  448  48
  .002 .263 .250 .076 .075 .017 .070 .029 .073 .001 .001 .000 .001 .000 .00
    512  544  576 1024 1536 2048 2560 3072 3584 4096 4608
    .000 .002 .059 .051 .016 .000 .000 .000 .000 .000 .000
```

```
IP Flow Switching Cache, 4456704 bytes
  445 active, 65091 inactive, 13130729 added
  408766378 aget polls, 0 flow alloc failures
  Active flows timeout in 2 minutes
  Inactive flows timeout in 60 seconds
IP Sub Flow Cache, 533256 bytes
  445 active, 15939 inactive, 13130729 added, 13130729 added to flow
  0 alloc failures, 0 force free
  1 chunk, 48 chunks added
  last clearing of statistics never
```

Protocol	Total Flows	Flows /Sec	Packets /Flow	Bytes /Pkt	Packets /Sec	Active(Sec) /Flow	Idle(Se) /Flow
TCP-Telnet	32402	0.0	9	46	0.0	3.5	29.3
TCP-FTP	6081	0.0	1	49	0.0	2.7	46.9
TCP-FTPD	3882	0.0	2219	500	2.1	0.2	41.9
TCP-WWW	207392	0.0	18	322	0.9	13.5	42.6
TCP-SMTP	6915	0.0	2	94	0.0	3.6	37.4
TCP-X	3859	0.0	1	42	0.0	0.0	43.4
TCP-BGP	3825	0.0	1	42	0.0	0.0	42.5
TCP-NNTP	3818	0.0	1	42	0.0	0.0	42.5
TCP-Frag	193	0.0	1	40	0.0	0.0	60.6
TCP-other	9288386	2.3	6	223	14.1	0.7	23.9
UDP-DNS	297998	0.0	3	65	0.2	26.2	50.2
UDP-NTP	461984	0.1	1	76	0.1	5.9	58.2
UDP-TFTP	373	0.0	1	60	0.0	0.2	60.4
UDP-other	1233452	0.3	46	129	14.3	26.3	50.6
ICMP	1085188	0.2	1	82	0.3	0.3	60.4
IGMP	189666	0.0	2	37	0.1	57.0	38.6
IP-other	304870	0.0	9	91	0.7	94.4	15.3
Total:	13130284	3.3	10	196	33.3	7.0	31.6

SrcIf	SrcIPAddress	DstIf	DstIPAddress	Pr	SrcP	DstP	Pk
Gi0/0	192.168.100.76	Gi0/1	192.168.60.10	06	84EB	6A8E	
Gi0/0	192.168.100.209	Gi0/1	192.168.60.10	06	0618	EB86	
Gi0/0	192.168.100.33	Gi0/1	192.168.60.53	06	D00A	33DB	
Gi0/0	192.168.1.99	Gi0/1	192.168.60.166	06	0618	1F21	
Gi0/1	192.168.150.70	Gi0/0	192.168.208.80	11	0035	0E94	
Gi0/0	192.168.1.38	Gi0/1	192.168.60.10	06	0618	0050	
Gi0/0	192.168.1.11	Gi0/1	192.168.60.9	06	0618	0050	
Gi0/0	192.168.1.1	Gi0/1	192.168.60.10	06	0618	0050	
Gi0/0	192.168.1.2	Gi0/1	192.168.60.10	06	0618	0050	
Gi0/0	192.168.1.1	Gi0/1	192.168.60.96	06	0618	0050	
Gi0/0	192.168.1.1	Gi0/1	192.168.60.78	06	0618	0050	
Gi0/0	192.168.1.59	Gi0/1	192.168.60.128	06	0618	0050	
Gi0/0	192.168.100.1	Gi0/1	192.168.60.176	06	FDBD	0050	
Gi0/0	192.168.208.127	Gi0/0	172.18.104.132	06	85BE	1A29	
Gi0/0	192.168.100.1	Gi0/1	192.168.60.252	06	F135	0050	
Gi0/1	192.168.132.44	Gi0/0	10.89.245.149	11	007B	007B	

```
router#
```

In the preceding example, there are multiple flows for **TCP (Protocol (Pr) hex value 06)**. This traffic is sourced from untrusted hosts (that is, not from 192.168.100.1) and sent to addresses within the 192.168.60.0/24 address block, which is used for infrastructure devices. Administrators are advised to compare these flows to baseline utilization for TCP traffic sent to the infrastructure devices and also investigate the flows to determine whether flows that are sourced from untrusted hosts or networks are legitimate.

To view only the traffic flows for TCP packets sent to or from infrastructure devices, the command **show ip cache flow | include SrcIf|192.168.60.*_06_** will display the related TCP NetFlow records as shown here:

```
router#show ip cache flow | include SrcIf|192.168.60.*_06_
SrcIf      SrcIPAddress      DstIf      DstIPAddress      Pr SrcP DstP  P
Gi0/0     192.168.1.1       Gi0/1      192.168.60.233   06 0618 1410
Gi0/0     192.168.1.6       Gi0/1      192.168.60.199   06 81E7 91A0
Gi0/0     192.168.1.156    Gi0/1      192.168.60.189   06 1825 0050
Gi0/0     192.168.1.1      Gi0/1      192.168.60.52    06 21BE 38BA
Gi0/0     192.168.1.1      Gi0/1      192.168.60.49    06 0618 0050
Gi0/0     192.168.1.1      Gi0/1      192.168.60.30    06 0618 0050
Gi0/0     192.168.1.1      Gi0/1      192.168.60.10    06 0618 0050
Gi0/0     192.168.1.1      Gi0/1      192.168.60.123   06 0618 0050
router#
```

Cisco ASA, PIX, and FWSM Firewalls

Mitigation: Transit Access Control Lists

To protect the network from traffic that enters the network at ingress access points, which may include Internet connection points, partner and supplier connection points, or VPN connection points, administrators are advised to deploy tACLs to perform policy enforcement. Administrators can construct a tACL by explicitly permitting only authorized traffic to enter the network at ingress access points or permitting authorized traffic to transit the network in accordance with existing security policies and configurations. A tACL workaround cannot provide complete protection against this vulnerability when the attack originates from a trusted source address.

The tACL policy denies unauthorized TCP packets that are sent to affected devices. In the following example, 192.168.60.0/24 is the IP address space that is used by the affected devices, and the host at 192.168.100.1 is considered a trusted source that requires access to the affected devices. Care should be taken to allow required traffic for routing and administrative access prior to denying all unauthorized traffic.

Additional information about tACLs is in [Transit Access Control Lists: Filtering at Your Edge](#).

```
!
!-- Include any explicit permit statements for trusted sources
!-- that require access on the vulnerable protocol
!

access-list tACL-Policy extended permit tcp host 192.168.100.1 192.168.60.0

!
!-- The following vulnerability-specific access control entry
!-- (ACE) can aid in identification of attacks
!
```

```

access-list tACL-Policy extended deny tcp any 192.168.60.0 255.255.255.0

!
!-- Permit/deny all other Layer 3 and Layer 4 traffic in accordance
!-- with existing security policies and configurations
!

!-- Explicit deny for all other IP traffic
!

access-list tACL-Policy extended deny ip any any

!
!-- Apply tACL to interface(s) in the ingress direction
!

access-group tACL-Policy in interface outside

```

Identification: Transit Access Control Lists

After the tACL has been applied to an interface, administrators can use the **show access-list** command to identify the number of TCP packets that have been filtered. Administrators are advised to investigate filtered packets to determine whether they are attempts to exploit this vulnerability. Example output for **show access-list tACL-Policy** follows:

```

firewall#show access-list tACL-Policy
access-list tACL-Policy; 3 elements
access-list tACL-Policy line 1 extended permit tcp host 192.168.100.1 192.16
access-list tACL-Policy line 2 extended deny tcp any 192.168.60.0 255.255.25
access-list tACL-Policy line 3 extended deny ip any any (hitcnt=638)
firewall#

```

In the preceding example, access list *tACL-Policy* has dropped **62 TCP** packets destined for infrastructure devices and received from an untrusted host or network. In addition, syslog message *106023* can provide valuable information, which includes the source and destination IP address, the source and destination port numbers, and the IP protocol for the denied packet.

Identification: Firewall Access List Syslog Messages

Firewall syslog message *106023* will be generated for packets denied by an access control entry (ACE) that does not have the **log** keyword present. Additional information about this syslog message is in [Cisco Security Appliance System Log Message - 106023](#).

Information about configuring syslog for the Cisco ASA 5500 Series Adaptive Security Appliance or the Cisco PIX 500 Series Security Appliance is in [Monitoring the Security Appliance - Configuring and Managing Logs](#). Information about configuring syslog on the FWSM for Cisco Catalyst 6500 Series switches and Cisco 7600 Series routers is in [Monitoring the Firewall Services Module](#).

In the following example, the **show logging | grep regex** command extracts syslog messages from the logging buffer on the firewall. These messages provide additional information about denied packets that could indicate potential attempts to exploit the vulnerability that is described in this document. It is possible to use different regular expressions with the **grep** keyword to search for specific data in the logged messages.

Additional information about regular expression syntax is in [Creating a Regular Expression](#).

```

firewall#show logging | grep 106023

```

```
Dec 05 2008 08:42:07 R1-A050-ASA5520 : %ASA-4-106023: Deny t
dst inside:192.168.60.27/80 by access-group "tACL-Po
Dec 05 2008 08:42:07 R1-A050-ASA5520 : %ASA-4-106023: Deny t
dst inside:192.168.60.10/54527 by access-group "tAC
Dec 05 2008 08:42:33 R1-A050-ASA5520 : %ASA-4-106023: Deny t
dst inside:192.168.60.10/80 by access-group "tACL-Po
```

firewall#

In the preceding example, the messages logged for the tACL *tACL-Policy* show **TCP** packets sent to the address block assigned to the infrastructure devices.

Additional information about syslog messages for ASA and PIX security appliances is in [Cisco Security Appliance System Log Messages](#). Additional information about syslog messages for the FWSM is in [Catalyst 6500 Series Switch and Cisco 7600 Series Router Firewall Services Module Logging System Log Messages](#).

For additional information about investigating incidents using syslog events, reference the [Identifying Incidents Using Firewall and IOS Router Syslog Events](#) Applied Intelligence white paper.

Additional Information

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Revision History

Revision 1.0	2009-January-14	Initial public release
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Cisco Security Procedures

Complete information on reporting security vulnerabilities in Cisco products, obtaining assistance with security incidents, and registering to receive security information from Cisco, is available on Cisco's worldwide website at http://www.cisco.com/en/US/products/products_security_vulnerability_policy.html. This includes instructions for press inquiries regarding Cisco security notices. All Cisco security advisories are available at <http://www.cisco.com/go/psirt>.

Related Information

- [Cisco Applied Mitigation Bulletins](#)
- [Cisco Guide to Harden Cisco IOS Devices](#)
- [Cisco Security Center](#)
- [Understanding Cross-Site Scripting \(XSS\) Threat Vectors](#)
- [Cisco IOS NetFlow - Home Page on Cisco.com](#)
- [Cisco IOS NetFlow White Papers](#)
- [NetFlow Performance Analysis](#)
- [Cisco Network Foundation Protection White Papers](#)

- [Cisco Network Foundation Protection Presentations](#)
 - [TTL Expiry Attack Identification and Mitigation](#)
 - [A Security-Oriented Approach to IP Addressing](#)
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