DDOS Prevention Configuration for SIP Peering environments

Technical Application Note

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2 Intended Audience

This document is intended for use by Oracle Systems Engineers, third party Systems Integrators, Oracle Enterprise customers and partners and end users of the Oracle Enterprise Session Border Controller (SBC). It is assumed that the reader is familiar with basic operations of the Oracle Enterprise Session Border Controller.

3 Document Overview

This document is designed to provide a basic framework for DDoS configuration in SIP Peering environments across all hardware. The scope of this document is limited to providing a minimum set of configuration settings to enable basic protection. The contents herein cannot be considered advanced or customer specific in any way. Where appropriate, limitations of this protection will be addressed throughout the course of this document. This document will not go into any detail pertaining to the underlying SIP configuration.

All base configurations used during testing were created according to Best Current Practices

4 General Approach

This document is designed to provide minimal DDoS settings for SIP peering SBC environments across all hardware.
The software release used for the testing is R SCZ8.3.0. The SBC model used here is Policy Based Realm Bridging Model(PBRB).

4.1 Supported Platforms

Here is the list of supported platforms for DDoS configuration.

Platform	Flow Table Size	Memory
AP 6350	2000000	48G
AP6300	1000000	16G
AP4600	1000000	16G
AP6100	1000000	16G
VME720	720	4G
AP1100	720	4G
AP3900	16000	16G

4.2 Traffic Terminologies Used in SBC

1. Flow- An individual conversation between two endpoints (may or may not be policed) –finest layer
2. Queue - A bundle of flows coming from the same IP/port
3. Pipe -A bundle of queues that represent a class of traffic (Untrusted, trusted…)
4. Port - Port is located between the wire-speed fabric and the path to the CPU. The coarsest layer of the framework

4.2.1 Queues allocation in SBC

- Untrusted pipe-Max value :1024 shared queues
- Fragment packet pipe- 1024 shared queue (fixed, additional 1K from untrusted pipe).Depends on fragment-msg-bandwidth.
- ARP pipe: 16 flows (fixed).Depends on arp-msg-bandwidth in SBC.
- Control pipe-For telnet, FTP, QoS, and latch msgs
- Eight trusted pipes with 8096 queues each.

4.3 Endpoints Promotion and Demotion

Endpoints, irrespective of whether or not they are defined as session-agents are promoted/demoted between hardware-enforced trusted, untrusted, and denied Access Control List traffic queues based on trust level configuration. Static ACLs are also configurable to further classify signaling traffic as being permanently assigned to the appropriate trust queue. Trust is assigned through several mechanisms including the access-control-trust-level parameter of the realm the session-agent or end point is a member

of, trust-level of provisioned ACLs, and the allow-anonymous setting on the applicable sip-interface. The SBC will demote an endpoint if:

- It receives too many signaling messages within the configured time window (maximum-signal-threshold in the realm or static ACL)
- It receives too many invalid signaling messages within the configured time window (invalid-signal-threshold in the realm or static ACL)
- It receives too many signaling messages from an untrusted source within the configured time window (untrusted-signal-threshold in the realm or static ACL)
- A trusted endpoint exceeds the call admission controls and the cac-failurethreshold defined in an ACL (the call admission control limits are defined in media profiles)
- An untrusted endpoint exceeds call admission controls and the untrust-cac-failurethreshold defined in an ACL.

The SBC will promote an endpoint if:

- It received a 200 OK response to a registration
- The registration overload protection (reg-overload-protect) option has been set globally in the sip-config element (this is temporary, and only if a 401 or 407 response is received)
- The deny-period has expired.

4.3.1 Statistics

Each promotion and demotion event, between trusted, untrusted, and deny queues is counted and kept as an ACL statistic. These counts are maintained separately for signaling applications. Statistics for ACL status and operations can be seen using the ACLI commands show sipd acls.

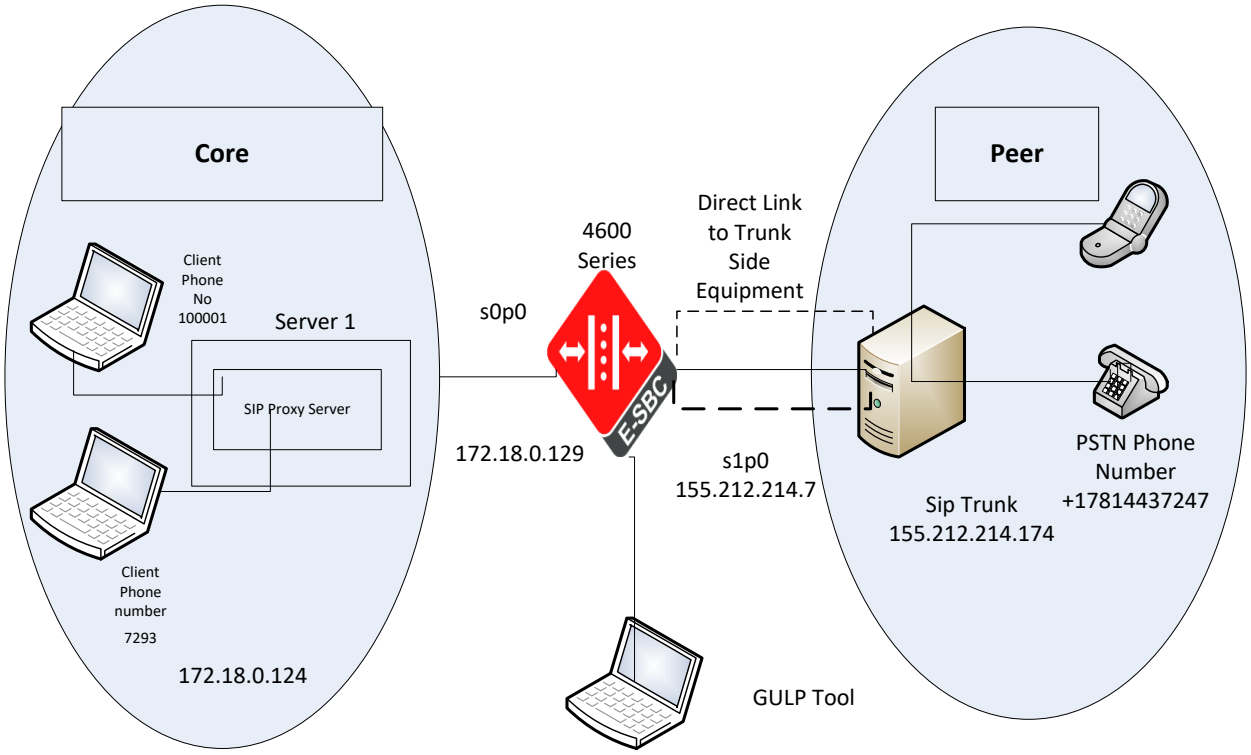
```
OraceSBC-# show sipd acls
22:20:15-102
SIP ACL Status              -- Period -- -------- Lifetime --------
                  Active    High   Total      Total  PerMax    High
Total Entries          1       1       0          2       1       2
Trusted                1       1       0          2       1       2
Blocked                0       0       0          0       0       0
Blocked NATs           0       0       0          0       0       0

ACL Operations                  ---- Lifetime ----
                       Recent       Total  PerMax
ACL Requests                0         174       2
Bad Messages                0           0       0
Promotions                  0         174       2
Demotions                   0           1       1
Trust->Untrust              0           1       1
Untrust->Deny               0           0       0
```

5 DDoS Prevention for Peering Environments

5.1 Test Environment

The test network used for SIP Peering with basic DDoS configuration is shown below.



5.2 Test Methodology

The chosen test methodology aims to determine the maximum signaling bandwidth required per platform to keep the CPU usage below 90%. Throughout the testing, parameters from the media-manager configuration object are modified to limit the amount of traffic entering the SD to a point where no more than 89% of CPU resources are consumed.

5.2.1 Maximum Signaling Bandwidth (max-signaling-bandwidth)

The maximum signaling bandwidth (max-signaling-bandwidth) is calculated per platform by sending SIP OPTIONS packets with the max-forwards header set to 0. The SD will process this packet and response with a 483 “Too Many Hops”.

max-signaling-bandwidth = OPTIONS/sec * Bytes/OPTIONS

Hardware platforms utilize bytes per second and VNF platforms utilize packets per second. VNF platforms (COTS,VM,1100) derive max-signaling from number of signaling cores. A value of 0 represents dynamic max-signaling applied which can be overwritten by customer.
Hardware platforms have a max signaling rate typically 40M for 6xxx and 10M for 4600.

5.2.2 Max and Min Untrusted Signaling Percentages (max-untrusted-signaling & min-untrusted-signaling)

In a SIP Peering environment, all of the network elements external to the Net-Net SD are known and trusted. Both “max-untrusted-signaling” and “min-untrusted-signaling” parameters are set to the smallest value allowed, which is “1”, to ensure optimal detection.

5.2.3 DDoS Attacks

DDoS attacks were generated from a PC running the Acme Packet tool GULP. GULP can be located on any untrusted IP routable to the SIP interface of the peer realm. The DDoS attack applied for this testing is a SIP INVITE flood which creates a barrage of SIP signaling to the Net-Net SD’s sip-interface IP address.

Without the application of DDoS prevention configuration, the host CPU would quickly spike to 100% in an attempt to process and respond to these rogue INVITE methods with a 403 Forbidden response.

With DDoS prevention configuration, the SD silently drops packet from these attacks at the hardware level (protecting the host CPU from overload

The following are Media Manager parameters that have platform specific defaults (not configurable).
• min-media-allocation
• min-trusted-allocation
• Deny-allocation
For this test environment ,these defaults will be used and are indicated in the platform results later by system model.

5.3 SBC Configuration for DDoS Prevention in Peering Environment

The following parameters are configured in the SBC for DDOS Prevention in peering environment

- Realm Configuration
- Sip Interface
- Session Agent and Access-Control

5.3.1 Realm Configuration

To configure DDOS settings in SBC for a particular realm ,Go to configure terminal->media-manager->realm-config and select the realm.

```
OraceSBC# con t
OraceSBC(configure)# media-manager
OraceSBC(media-manager)# realm-config
```

```
OraceSBC(realm-config)# select
identifier:
 1: Peer  s0p3:0 0.0.0.0
 2: Core    s0p0:0 0.0.0.0
 3: Genesys s0p0:0 0.0.0.0
 4: Nice    s0p3:0.4 0.0.0.0
 5: public  s1p0:0.4 0.0.0.0

selection: 1

OraceSBC(realm-config)# access-control-trust-level high
OraceSBC(realm-config)# done
```

The following realm-config parameters are used in the basic DDoS configuration.

Parameter	Peer Realm	Core Realm
access-control-trust-level	high	high
invalid-signal-threshold	0	0
average-rate-limit	0	0
maximum-signal-threshold	0	0
untrusted-signal-threshold	0	0

5.3.2 SIP Interface

To configure DDOS settings in SBC for a particular sip-interface ,go to configure terminal ->session-router->sip-interface and select the SIP interface.

```
OraceSBC# con t
OraceSBC (configure)# session-router
OraceSBC(session-router)# sip-interface
OraceSBC(sip-interface)# select
<RealmID>:
 1: Peer  192.168.1.94:5060
 2: Core    172.18.0.129:5060
 3: Genesys 172.18.0.255:5060
 4: Nice    192.168.1.25:5060
 5: public  141.146.36.72:5080

selection: 1
OraceSBC(sip-interface)# sip-ports
OraceSBC(sip-port)# select
<address>:
1: 192.168.1.94:5060/UDP
2: 192.168.1.94:5060/TCP

selection: 1

OraceSBC(sip-port)# allow-anonymous agents-only
OraceSBC(sip-port)# done
```

sip-ports parameter SHOULD be used for Peering environments. Setting "allow-anonymous" to agents-only will allow the SBC to reject requests sent by any IP which has not yet been defined as a "Session-Agent" in the SBC configuration. In Peering configurations, the customer SHOULD define each IP of a peer's device as a "session-agent" for optimal purpose.

Parameter	Peer Realm	Core Realm
allow-anonymous	agents-only	all

Although it is not recommended, but it is still possible to allow packets from an IP that has not yet defined as a Session-Agent, by setting "allow-anonymous" to "all". In this setup, the SBC will simply allow the request under DDoS threshold opposed to rejecting it with a 403 Forbidden response.

5.3.3 Session Agent and Access-Control

Any peering signaling device SHOULD be defined as a Session-Agent in SBC configuration. Further, for proper DDoS prevention, it requires explicitly configuring one access control per address of each Session-Agent address or other address (that has not yet been defined as a session-agent).

Following parameters highlighted are configured in the session agent for DDoS settings.

realm-id	peer
constraints	enabled
max-sessions	X
max-burst-rate	Y
max-sustain-rate	Z
time-to-resume	60 sec
burst-rate-window	1 sec
sustain-rate-window	30 sec

To configure DDoS setting per session agent , Go to configure terminal->session-router>session-agent

```
OraceSBC(configure)# session-router
OraceSBC(session-router)# session-agent
OraceSBC(session-agent)# select
<hostname>:
 1: 10.232.50.11 realm=Peer
 2: 10.232.50.50 realm=Peer
 3: 172.18.0.124 realm=Core
 4: 172.18.0.133 realm=Core
 5: 155.212.214.174 realm=Peer

selection: 5

OraceSBC(session-agent)# max-sessions 10
```

There is no demotion event when access-control-trust-level in the realm-config is set “high” as packets from the trusted peer endpoint are always allocated in the trusted queue for processing. It becomes a concern when there is excessive amount of SIP traffic sent by a customer which is beyond the SLA. Session constraints under session-agent can be deployed to further mitigate this problem. Listed above are a small set of constraints to provide basic level of call admission control in order to ensure that a session-agent’s capacity is not exceeded, or the Net-Net SD will reject the service with 503 Exceed Constraints. Please be advised that these settings are only optional. Customers may consider them when deploying their service in a Peering environment with or without DDoS configuration.

max-sessions –X Define a maximum number of sessions (inbound and outbound) allowed by the session agent. Once the session limit is reached, the Net-Net SD will start rejecting new service with 503 Exceed Constraints until the number of seconds in time-to-resume has elapsed.

max-burst-rate –Y Define a number to set the maximum rate of call (per second) this session agent will allow. Once the rate limit is reached, the Net-Net SD will start rejecting new service with 503 Exceed Constraints until the number of seconds in time-to-resume has elapsed.

max-sustain-rate - Z In general, set this to the average call rate (per second) which that SA can sustain. Once the average rate limit calculated in (Calls made in current + previous window) / Delta (current second – start of previous window), exceeds the limit Z , the Net-Net SD will be start rejecting new service with 503 Exceed Constraints until the number of seconds in time-to-resume has elapsed.

For access control configuration,go to configure terminal->session-router->access-control

Parameter	**Realm**	**Realm**
realm-id	peer	core
source-address	n.n.n.n/[mask bit is optional] (peer SA IP, or non-SA IP)	[m.m.m.m]/ [mask bit is optional] (core SA IP or non-SA IP)
application-protocol	SIP	SIP
trust-level	high	high

In core realm, it is recommended to configure an access-control on per session-agent basis instead of putting it into a single source-subnet/mask. That will give the core session-agent its own flow versus sharing one flow for multiple devices or the entire subnet.

5.4 DDoS Configuration Settings per Platform in Peering Environments

Below are the recommended parameters settings that are derived from the above test results for each platform in a SIP Peering model. Changes under media-manager require system reboot to take effect. Be sure to follow precautions to reboot SBC(s) to unnecessary service outage during this execution.

5.4.1 Acme Packet 4600 1000000 Flow Table 16G memory - copper single GigE

Platform	AP4600
Flow Table	1000000
Memory	16GB
Software Release	SCZ 8.3.0

The following table lists the five parameters germane to DDoS Configuration Settings in Peering Environments for the Acme Packet 4600 and their settings on the core and peer realms.

Parameter	Core realm-config	Peer-realm-config
access-control-trust-level	high	high
average-rate-limit	0	0
invalid-signal-threshold	0	0
maximum-signal-threshold	0	0
untrusted-signal-threshold	0	0

The media-manager configuration should be set as suggested in the following table for the Acme Packet 4600 in PBRB Model.

Parameter	PBRB Model
max-signalingbandwidth	2651610
max-untrustedsignaling	1
min-untrustedsignaling	1
tolerance-window	30

5.4.2 Acme Packet 6100 1000000 Flow Table 16G memory - copper single GigE

Platform	AP6100
Flow Table	1000000
Memory	16GB
Software Release	SCZ 8.3.0

The following table lists the five parameters germane to DDoS Configuration Settings in Peering Environments for the Acme Packet 6100 and their settings on the core and peer realms.

Parameter	Core realm-config	Peer-realm-config
access-control-trust-level	high	high
average-rate-limit	0	0
invalid-signal-threshold	0	0
maximum-signal-threshold	0	0
untrusted-signal-threshold	0	0

The media-manager configuration should be set as suggested in the following table for the Acme Packet 6100 in the PBRB model.

Parameter	PBRB Model
max-signalingbandwidth	7070960
max-untrustedsignaling	1
min-untrustedsignaling	1
tolerance-window	30

5.4.3 Acme Packet 6350 2000000 Flow Table 48G memory - copper single GigE

Platform	AP6350
Flow Table	2000000
Memory	48GB
Software Release	SCZ 8.3.0

The following table lists the five parameters germane to DDoS Configuration Settings in Peering Environments for the Acme Packet 6350 and their settings on the core and peer realms

Parameter	Core realm-config	Peer-realm-config
access-control-trust-level	high	high
average-rate-limit	0	0
invalid-signal-threshold	0	0
maximum-signal-threshold	0	0
untrusted-signal-threshold	0	0

The media-manager configuration should be set as suggested in the following table for the Acme Packet 6350 in the PBRB model.

Parameter	PBRB Model
max-signalingbandwidth	7070960
max-untrustedsignaling	15
min-untrustedsignaling	14
tolerance-window	30

5.4.4 Acme Packet 6300 1000000 Flow Table 16G memory - copper single GigE

Platform	AP6300
Flow Table	1000000
Memory	16GB
Software Release	SCZ 8.3.0

The following table lists the five parameters germane to DDoS Configuration Settings in Peering Environments for the Acme Packet 6300 and their settings on the core and peer realms.

Parameter	Core realm-config	Peer-realm-config
access-control-trust-level	high	high
average-rate-limit	0	0
invalid-signal-threshold	0	0
maximum-signal-threshold	0	0
untrusted-signal-threshold	0	0

The media-manager configuration should be set as suggested in the following table for the Acme Packet 6100 in the PBRB model.

Parameter	PBRB Model
max-signalingbandwidth	7070960
max-untrustedsignaling	1
min-untrustedsignaling	1
tolerance-window	30

6 Appendix A

The following is a sample configuration from the lab environment in PBRB model.

```
OraceSBC#  sh con sh

capture-receiver
        state                                   enabled
        address                                 172.18.0.125
        network-interface                       s0p0:0
access-control
        realm-id                                Peer
        source-address                          155.212.214.0/16
        application-protocol                    SIP
        trust-level                             high


local-policy
        from-address                            *
        to-address                              *
        source-realm                            Peer
        policy-attribute
                next-hop                                172.18.0.124
                realm                                   Core
local-policy
        from-address                            *
        to-address                              *
        source-realm                            Core
        policy-attribute
                next-hop                                155.212.214.7
                realm                                   Peer
media-manager
        latching                                disabled
        max-signaling-bandwidth                 2651610
        max-untrusted-signaling                 1
        min-untrusted-signaling                 1
        tolerance-window                        30
network-interface
        name                                    s0p0
        ip-address                              172.18.0.129
        netmask                                 255.255.0.0
        gateway                                 172.18.0.1
        hip-ip-list                             172.18.0.129
        icmp-address                            172.18.0.129

network-interface
        name                                    s1p0
        ip-address                              155.212.214.7
        netmask                                 255.255.255.0
        gateway                                 155.212.214.1
        hip-ip-list                             155.212.214.7
        icmp-address                            155.212.214.7
phy-interface
        name                                    s0p0
        operation-type                          Media

phy-interface
        name                                    s1p0
        operation-type                          Media
```

```
        slot                                    1

realm-config
        identifier                              Core
        network-interfaces                      s0p0:0
        mm-in-realm                             enabled
        out-translationid                       change1
        access-control-trust-level              high
        refer-call-transfer                     enabled
        session-recording-server                NiceAir2


realm-config
        identifier                              Peer
        network-interfaces                      s1p0:0.4
        access-control-trust-level              low

session-agent
        hostname                                172.18.0.124
        ip-address                              172.18.0.124
        port                                    4080
        realm-id                                Core
        description                             Genesys Agent
        options                                 refer-reinvite
        refer-call-transfer                     enabled
        refer-notify-provisional                all
session-agent
        hostname                                172.18.0.133
        ip-address                              172.18.0.133
        port                                    8080
        realm-id                                Core
session-agent
        hostname                                155.212.214.174
        ip-address                              155.212.214.174
        port                                    5060
        realm-id                                Peer
        description                             Peer Agent
        options                                 refer-reinvite
        refer-call-transfer                     enabled
        refer-notify-provisional                all
        max-sessions                            [X vakue in 5.3.3]
        max-burst-rate                          [Y value in  5.3.3]
        max-sustain-rate                        [Z value in 5.3.3]
        time-to-resume                          50
        burst-rate-window                        1
        sustain-rate-window                      1

sip-config
        home-realm-id                           Core

        options                                 max-udp-length=0
        refer-src-routing                       enabled

sip-interface
        realm-id                                Core
        sip-port
                address                                 172.18.0.129
                allow-anonymous                         all
        sip-port
                address                                 172.18.0.129
                transport-protocol                      TCP
                allow-anonymous                         all
        out-manipulationid                      ACME_NAT_TO_FROM_IP
```

```
sip-interface
        realm-id                                Peer
        sip-port
                address                                 155.212.214.7
                port                                    5080
                allow-anonymous                         agents-only


steering-pool
        ip-address                              155.212.214.7
        start-port                              20000
        end-port                                29999
        realm-id                                Peer
steering-pool
        ip-address                              172.18.0.129
        start-port                              10000
        end-port                                10999
        realm-id                                Core


system-config
        comm-monitor
                state                                   enabled
                monitor-collector
                        address                                         10.232.50.200
        default-gateway                         10.138.194.129
```

7 Appendix B

7.1 DDoS-2 show commands

DDoS-2 is supported for platforms: Acme Packet 4600, Acme Packet 6100, Acme Packet 6300, Acme Packet 6350, and Acme Packet VNF platforms.
DDoS-2 increases the number of trusted endpoints to a maximum of 500K for Acme Packet 4600/6100/6300 and 750K for Acme Packet 6350. It also increases the number of denied endpoints to a maximum 96K for Acme Packet 6350 and 64K for Acme Packet 4600/6100/6300
The command show acl info provides information about present usage of the HASH table.

Static ALC's are stored in both TCAM and HASH table. The fully qualified flows are stored in HASH table and the non –fully qualified flows are stored in the TCAM table.

```
OraceSBC# show acl info

Access Control List Statistics:

                |   # of entries  |   % utilization   |   Reserved Entry Count
-------------------------------------------------------------------------
Denied          |          0              0.0%                 32768
Trusted         |          5                0.1%                  8192
Media           |          0                0.0%                 64000
Untrusted       |          7                0.2%                  4096
Dynamic Trusted |          0              0.0%                250000
-----------------------------------------------------------------
Total table space used = 12 of 359056 (99.99% free)
-----------------------------------------------------------

Media Entries not allocated due to ACL constraints:      0
Trusted Entries not allocated due to ACL constraints:    0
Untrusted Entries not allocated due to ACL constraints:  0
Denied Entries not allocated due to ACL constraints:     0



OraceSBC# show acl all
TRUSTED entries:
intf:vlan Source-IP/mask                                port/mask Destination-
IP/m                                                                        ask
                port/mask   prot type    index  recv    drop
0/0:0     0.0.0.0                                                172.18.0.129

              icmp static  105257 0       0
0/3:0     0.0.0.0                                                192.168.1.94

              icmp static  105258 0       0
0/2:0     0.0.0.0                                                141.146.36.106

              icmp static  105259 9195    0
0/0:0     0.0.0.0                                                172.18.0.129

              tcp  static  105261 0       0
0/0:0     0.0.0.0                                                172.18.0.129

   5060       udp  static  105262 219     0
UNTRUSTED entries:
```

```
intf:vlan Source-IP/mask                                  port/mask Destination-
IP/m                                                                          ask
                  port/mask   prot type    index  recv    drop
0/3:0     0.0.0.0                                                 192.168.1.94

                tcp  static  101162 0       0
0/3:0     0.0.0.0                                                 192.168.1.94

   5060         udp  static  101163 0       0
0/0:0     0.0.0.0                                                 172.18.0.255

                tcp  static  101165 3158    0
0/0:0     0.0.0.0                                                 172.18.0.255

   5060         udp  static  101166 135     0
0/3:0     0.0.0.0                                                 192.168.1.25

                tcp  static  101168 0       0
0/3:0     0.0.0.0                                                 192.168.1.25

   5060         udp  static  101169 0       0
0/2:0     0.0.0.0                                                 141.146.36.72

   5080         udp  static  101170 0       0
Total deny entries:         0  (0 dropped)
Total media entries:        0
Total trusted entries:      5  (0 dropped)
Total untrusted entries:    7  (0 dropped)
Media Entries not allocated due to ACL constraints:      0
Trusted Entries not allocated due to ACL constraints:    0
Untrusted Entries not allocated due to ACL constraints:  0
Denied Entries not allocated due to ACL constraints:  0
Trusted Endpoints not allocated due to ACL constraints:  0
```


Oracle Corporation, World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065, USA

Worldwide Inquiries
Phone: +1.650.506.7000
Fax: +1.650.506.7200

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