4-4-5 DNS Rate Limiting and UDP Attacks a Hard Lesson

First Symptoms

- I was in a boring meeting and dealing with email
- Service to my email server was suddenly unusable
- The PoP in trouble also contained my MRTG and other measurement <blush>
- But I could log into the 'outside' IP address of one of the border routers

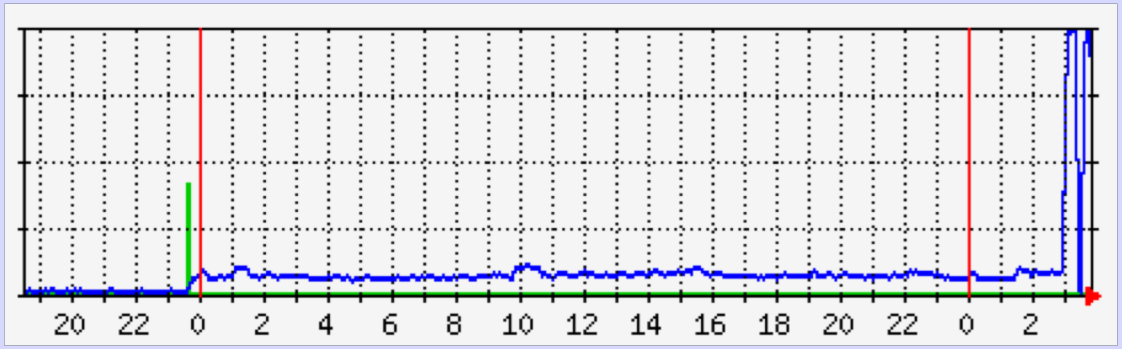
I am the Attacker?

5 minute input rate 720000 bits/sec, 210 packets/sec

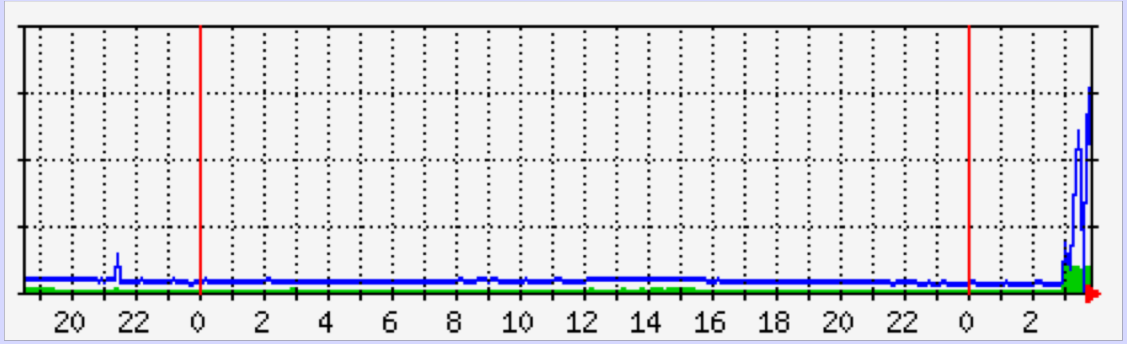
5 minute output rate **740230000** bits/sec, **72520** packets/sec

But it was Very Hard to reach MRTG and Other Tools

MRTG for Router



and a DNS Server



Really My Server?

- Managed to get to APC Power Bar which supplied server
- Shut the Server Down
- Problem Went Away!!!
- Powered Server Back Up
- OK for a Minute, but Then Back to Bad

SSH To Server - Took Three Tries Over 15 Minutes

tcpdump

```
06:28:26.448024 IP rip.psg.com.domain > 108.178.55.192.9463: 54533*- 19/0/14 SOA,
RRSIG, RRSIG, Type51, RRSIG, RRSIG, RRSIG, RRSIG, RRSIG, DNSKEY[|domain]
06:28:26.448026 IP rip.psg.com > 108.178.55.192: udp
06:28:26.448071 IP rip.psg.com.domain > 108.178.55.192.9463: 54533*- 19/0/14 SOA,
RRSIG, RRSIG, Type51, RRSIG, RRSIG, RRSIG, RRSIG, RRSIG, DNSKEY[|domain]
06:28:26.448072 IP rip.psg.com > 108.178.55.192: udp
06:28:26.448168 IP rip.psg.com.domain > 108.178.55.192.9463: 54533*- 19/0/14 SOA,
RRSIG, RRSIG, Type51, RRSIG, RRSIG, RRSIG, RRSIG, RRSIG, DNSKEY[|domain]
06:28:26.448171 IP rip.psg.com > 108.178.55.192: udp
06:28:26.448174 IP rip.psg.com.domain > 108.178.55.192.9463: 54533*- 19/0/14 SOA,
RRSIG, RRSIG, Type51, RRSIG, RRSIG, RRSIG, RRSIG, RRSIG, DNSKEY[|domain]
06:28:26.448176 IP rip.psg.com > 108.178.55.192: udp
06:28:26.448234 IP rip.psg.com.domain > 108.178.55.192.9463: 54533*- 19/0/14 SOA,
RRSIG, RRSIG, Type51, RRSIG, RRSIG, RRSIG, RRSIG, RRSIG, DNSKEY[|domain]
06:28:26.448237 IP rip.psg.com > 108.178.55.192: udp
06:28:26.448247 IP rip.psg.com.domain > 108.178.55.192.9463: 54533*- 19/0/14 SOA,
RRSIG, RRSIG, Type51, RRSIG, RRSIG, RRSIG, RRSIG, RRSIG, DNSKEY[|domain]
```

So It Was a DNS Reflector Attack!

But the Server Was NOT a Recursive Resolver

Turned off DNS

- Used /etc/ipfw.conf, IP Firwall to

```
add deny udp from any to any 53
```

- I Could Now Breathe and Think
- But the Server was Critical to DNS, serving 20 ccTLDs
- A Quick Mailing List Question Showed that this was a DNSsec-based Query Reflector Attack

With a Highly Signed CH ccTLD One Byte of Query Produced > 1KB of DNSsec Response

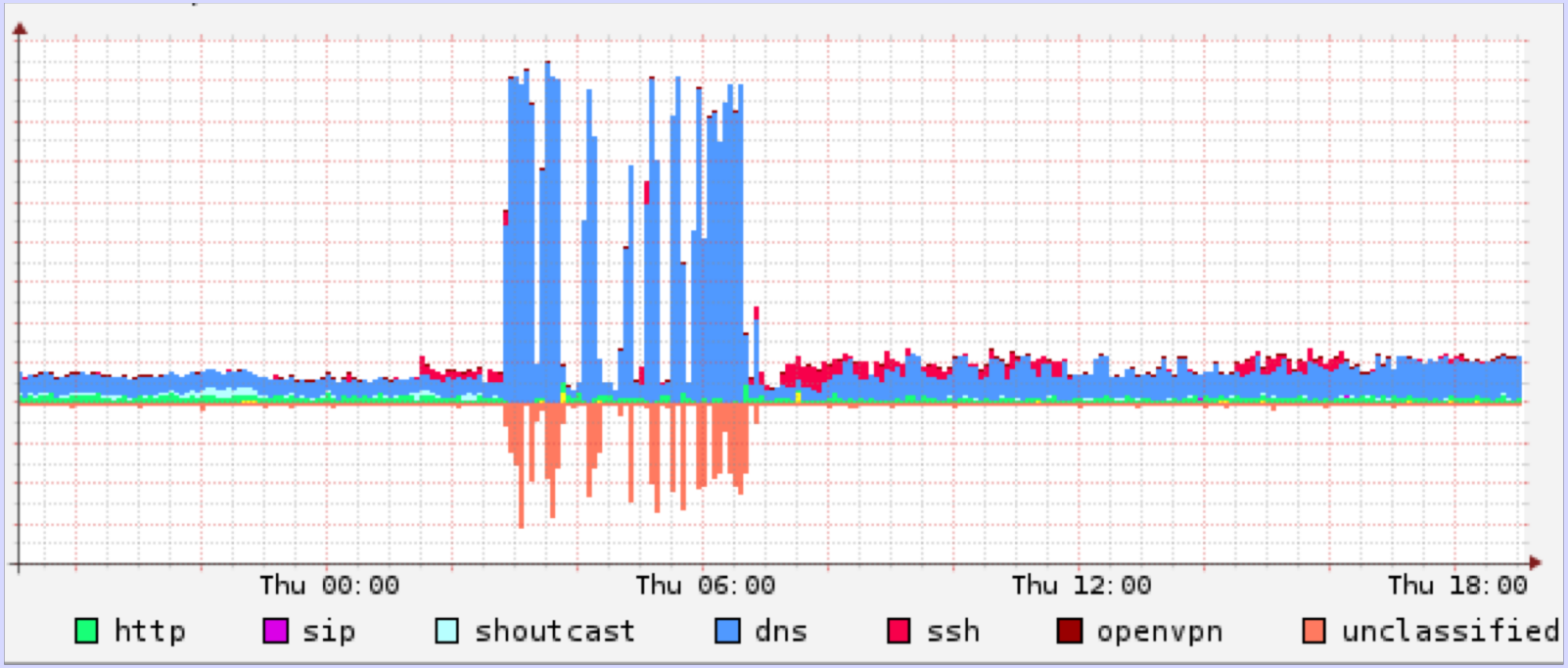
Attacker Used Spoofed Source Address, the Address of the Victim, for UDP Query

The Solution Would Be Rate-Limiting

Throttle Queries From a Single Source

Upgraded BIND to 9.9.2 with Patch rl005.12-P1

```
Options {
   rate-limit {
      responses-per-second 5;
      window 5;
      };
   };
```



The Problem Was Solved!

From: CH ccTLD Admin

As you have seen today the CH-zone got hit with a DNS ANY query storm. I assume the traffic has been sent to most CH secondary name-servers.

We saw the following kind of query towards our name-servers which resulted in an amplification factor of 75:

```
dig +edns=0 +bufsize=9000 CH. ANY
```

Lessons

- OOB Access Really Needed to Be Out Of Band <blush>
- Set Up a Second Measurement System to Measure the First?

- Install and Configure DNS Flow-Limiting Before This Happens to You!!

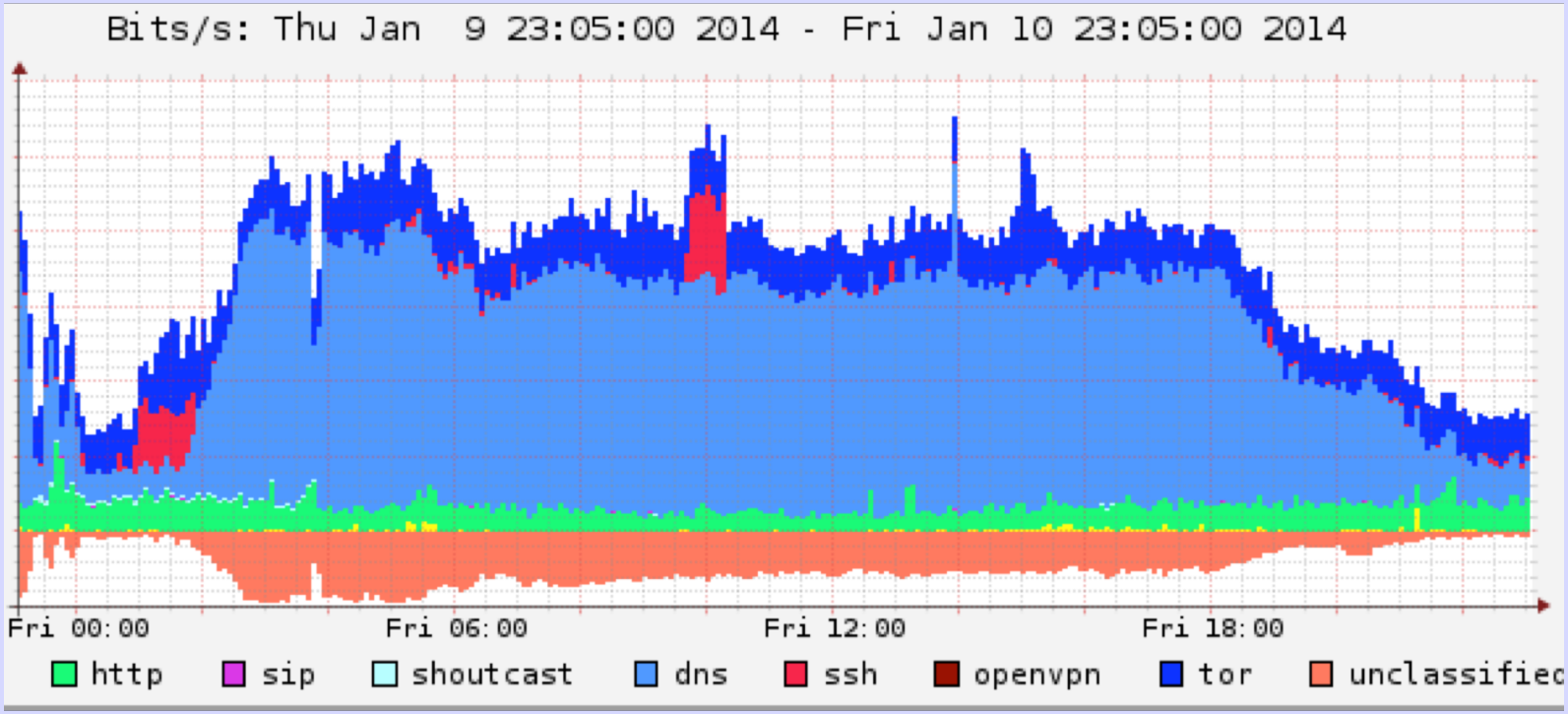
NSD

Use the configure script option

```
./configure –enable-ratelimit
```

The default parameters are a good start

Attacking Me



But ...

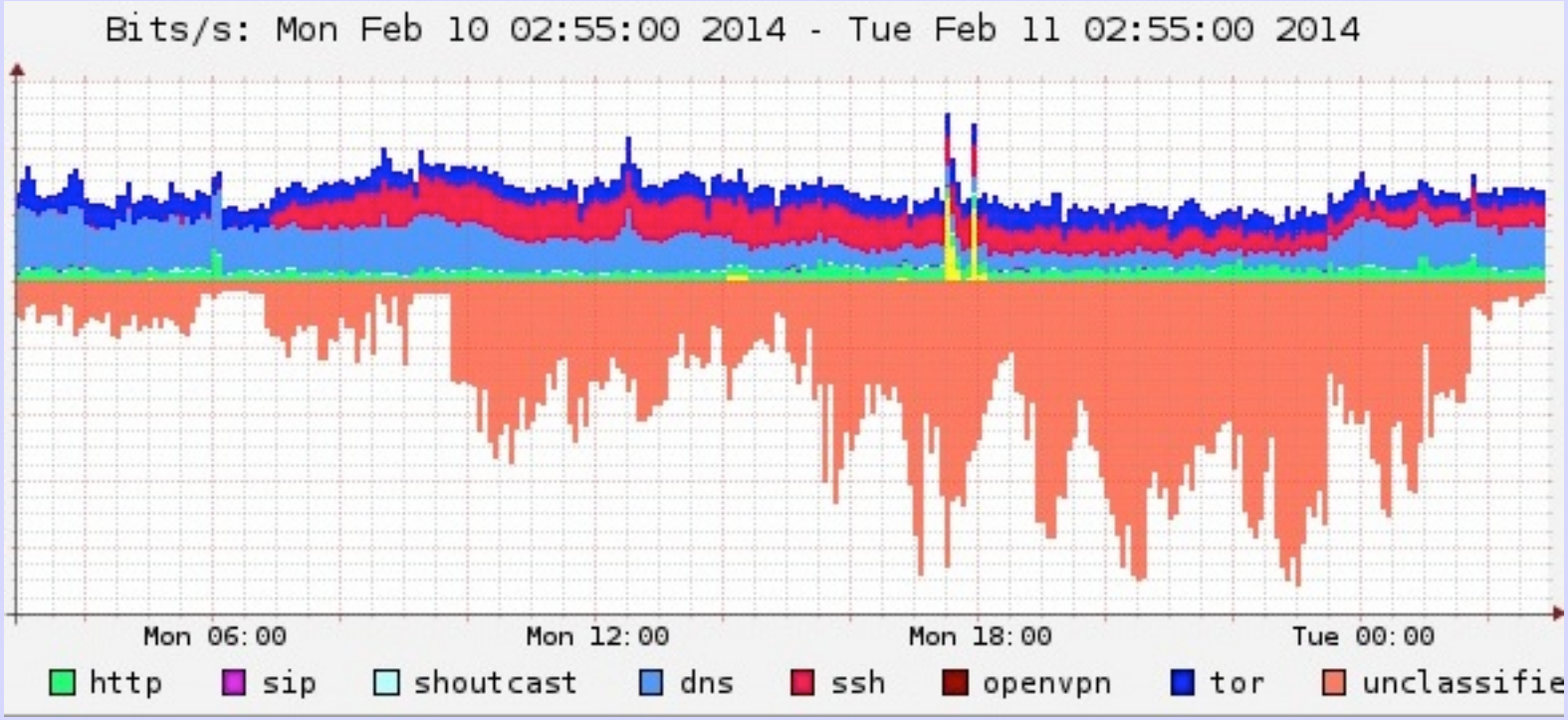
It is NOT Only DNS

DNS is One of Many UDP-Based Protocols Which Allow Amplification Attacks

NTP Has Amplification

```
$ ntpdc -c monlist tankgirl.kurtis.pp.s
remote address          port local address      count m ver rstr avgint  lstint
===============================================================================
180.200.233.250        50820 194.15.141.69         13 7 2     0      8       0
v-209-98-138-61.ip.vis    80 194.15.141.69       1290 7 2     0      1       0
198.15.112.190         25565 194.15.141.69      10278 7 2     0      0       0
162.243.92.39             80 194.15.141.69        133 7 2     0      0       0
web.safe-node.com         80 194.15.141.69        271 7 2     0      0       0
lb03.us-west.hashfaste    80 194.15.141.69       5938 7 2     0      0       0
cpe-1-121-138-201.qwl9    80 194.15.141.69         61 7 2     0      4       0
162.218.54.28          29000 194.15.141.69      63108 7 2     0      0       0
joylynn.indoplanethost    80 194.15.141.69       5602 7 2     0      0       0
124-170-32-156.dyn.iin    80 194.15.141.69       1055 7 2     0      1       0
cpe-76-182-155-229.nat    80 194.15.141.69        460 7 2     0      0       0
c-50-158-5-167.hsd1.il    80 194.15.141.69         16 7 2     0      2       0
s0106001fcf507566.dr.s    53 194.15.141.69        652 7 2     0     10       0
198.50.129.50          3218 194.15.141.69       4522 7 2     0      1       0
178-32-59-1.kimsufi.co    80 194.15.141.69       2261 7 2     0      4       0
37.123.97.5               80 194.15.141.69        136 7 2     0      0       0
c80-216-31-118.bredban    80 194.15.141.69       1280 7 2     0      2       0
d206-116-203-41.bchsia  3074 194.15.141.69        131 7 2     0      1       0
198.50.180.205         29000 194.15.141.69     132865 7 2     0      0       1
cpe-74-76-232-195.nyca  1026 194.15.141.69       1369 7 2     0      3       1
70.38.71.244              80 194.15.141.69      12978 7 2     0      0       1
pool-71-122-77-191.tam    80 194.15.141.69        569 7 2     0      0       1
10554.kriter.com.tr     1905 194.15.141.69       7209 7 2     0      1       1
168.63.55.14              80 194.15.141.69       5528 7 2     0      0       1
136-14-12-198.static.d 25565 194.15.141.69        291 7 2     0      0       1
m5-240-220-121.cust.te    80 194.15.141.69       2407 7 2     0      1       1
46.105.254.28             80 194.15.141.69       2134 7 2     0      2       1
pool-108-13-78-10.lsan    80 194.15.141.69          7 7 2     0     15       1
148.197.184.211           80 194.15.141.69      97186 7 2     0      0       1
bas5-kingston08-124252    80 194.15.141.69        693 7 2     0      2       1
74-141-253-2.dhcp.insi  3074 194.15.141.69        683 7 2     0      5       1
mceu14.envioushost.com 25565 194.15.141.69       3817 7 2     0      1       1
192.184.13.233         25565 194.15.141.69       3698 7 2     0      0       1
172-13-170-159.lightsp    80 194.15.141.69        280 7 2     0      1       1
94.23.146.204             80 194.15.141.69       3588 7 2     0      1       1
cpe-24-167-18-198.rgv.  8080 194.15.141.69         18 7 2     0      7       2
bas1-montreal46-127937    80 194.15.141.69       4614 7 2     0      0       2
189.38.59.130.static.u 27017 194.15.141.69       8506 7 2     0      1       2
24-182-76-210.dhcp.hck    80 194.15.141.69       4102 7 2     0      1       2
c-50-183-97-88.hsd1.co    80 194.15.141.69         55 7 2     0      2       2
108.61.239.221.choopa.  3074 194.15.141.69         74 7 2     0     13       2
117.3.103.211             80 194.15.141.69        245 7 2     0    202       2
host-92-20-241-79.as13  3074 194.15.141.69          1 7 2     0      0       2
cpe-142-136-125-66.soc    80 194.15.141.69        105 7 2     0      6       2
c-69-250-180-142.hsd1.    80 194.15.141.69        221 7 2     0      6       2
199.58.147.81             80 194.15.141.69        174 7 2     0      1       3
ns4009551.ip-192-99-9.    22 194.15.141.69       1053 7 2     0      1       3
199.83.128.97.ip.incap    80 194.15.141.69        752 7 2     0      8       3
cpe-142-136-8-105.soca    80 194.15.141.69         24 7 2     0      3       3
cpe-72-228-146-57.buff  3074 194.15.141.69         27 7 2     0     15       3
176.57.141.243          2302 194.15.141.69        132 7 2     0     10       4
cpc14-hart10-2-0-cust9    80 194.15.141.69        122 7 2     0      3       4
204.static.sea.rackd.n 25565 194.15.141.69       4601 7 2     0      2       4
24-52-227-112.cable.te    80 194.15.141.69          5 7 2     0      0       5
adsl-75-46-30-7.dsl.sf    80 194.15.141.69        123 7 2     0      3       6
37.221.175.38.reserved    80 194.15.141.69        710 7 2     0      5       6
aol-44c0e6a8.dyn.opton  3074 194.15.141.69         41 7 2     0     17       6
70.49.207.126             53 194.15.141.69        646 7 2     0      9       7
adsl-184-38-223-230.ms    80 194.15.141.69       1235 7 2     0      9       7
75-137-148-0.dhcp.gwnt    90 194.15.141.69        607 7 2     0     23       8
eagle715.startdedicate    80 194.15.141.69        226 7 2     0      7       8
cpc11-shep12-2-0-cust1    53 194.15.141.69        188 7 2     0      5       8
c12571h20597.vilayer.c  2302 194.15.141.69        156 7 2     0     13      10
cpe-192-136-252-78.tx.    80 194.15.141.69          7 7 2     0      7      10
c-50-151-74-71.hsd1.in  3074 194.15.141.69        240 7 2     0     14      14
c122-106-251-57.belrs3    80 194.15.141.69         74 7 2     0      6      14
lon036.multiplay.co.uk    80 194.15.141.69         33 7 2     0      8      15
107-212-125-251.lights    80 194.15.141.69         66 7 2     0      7      16
137.116.32.32             80 194.15.141.69       3371 7 2     0      0      19
cpe-74-69-109-238.roch  3070 194.15.141.69        112 7 2     0     42      25
140.101.123.37.salay.c    80 194.15.141.69       3411 7 2     0      1      27
70-56-146-208.bois.qwe    80 194.15.141.69        224 7 2     0      0      28
68-204-165-85.res.bhn.    80 194.15.141.69         16 7 2     0      1      30
cpe-24-193-145-48.nyc.  3074 194.15.141.69          5 7 2     0     18      33
c
-24-118-21-238.hsd1.m  3074 194.15.141.69         60 7 2     0      2      44
209-76-178-47.lightspe  3074 194.15.141.69         13 7 2     0     29      49
168.62.23.92              80 194.15.141.69          3 7 2     0     57      49
5e0f8613.bb.sky.com       80 194.15.141.69         66 7 2     0      1      50
70-56-151-99.bois.qwes    80 194.15.141.69       2659 7 2     0      0      65
pool-71-190-169-81.nyc    80 194.15.141.69        129 7 2     0      1      72
88.243.108.185.dynamic    80 194.15.141.69       2392 7 2     0      2      77
119-224-73-172.callplu    80 194.15.141.69         13 7 2     0     32      93
cpe-144-137-66-77.lnse  6500 194.15.141.69         40 7 2     0     21      98
94.23.184.100           6000 194.15.141.69         17 7 2     0      9     103
162.255.212.162.in-add 25565 194.15.141.69      38791 7 2     0      0     110
239.246.154.177.deltai    80 194.15.141.69         16 7 2     0      8     114
pool-173-71-75-209.cmd    80 194.15.141.69         19 7 2     0      2     115
201.171.243.177.dsl.dy    80 194.15.141.69          3 7 2     0     16     120
host86-174-38-212.rang  3074 194.15.141.69          1 7 2     0      0     124
cpe-172-251-214-27.soc  3074 194.15.141.69          1 7 2     0      0     125
cpe-72-182-50-237.aust    80 194.15.141.69          2 7 2     0     25     137
66-169-191-142.dhcp.ft    67 194.15.141.69        287 7 2     0      3     141
ip68-14-142-149.ri.ri.    80 194.15.141.69         13 7 2     0     42     163
affordable.high-perfor  9987 194.15.141.69         34 7 2     0     14     175
c-98-239-104-190.hsd1.  3074 194.15.141.69          4 7 2     0     27     176
cpc2-hari14-2-0-cust33    80 194.15.141.69       2206 7 2     0      5     190
ntp1.mmo.netnod.se       123 194.15.141.69      45196 4 4     0   1039     203
110-174-130-135.static  6500 194.15.141.69         17 7 2     0      6     204
c-24-35-112-153.custom    80 194.15.141.69        136 7 2     0      5     209
c-50-149-194-70.hsd1.t    80 194.15.141.69          4 7 2     0      3     217
ntp1.sth.netnod.se       123 194.15.141.69      45022 4 4     0   1020     218
cpc2-perr13-2-0-cust93    80 194.15.141.69        152 7 2     0      1     223
101.167.22.79           6500 194.15.141.69         23 7 2     0      3     225
172-9-192-130.lightspe    80 194.15.141.69        166 7 2     0      0     231
108-222-193-172.lights  3074 194.15.141.69          6 7 2     0     16     247
v-74-91-123-196.unman- 27025 194.15.141.69         65 7 2     0      1     272
65.52.24.110              80 194.15.141.69       2108 7 2     0      0     280
198.24.187.41             80 194.15.141.69         30 7 2     0     39     287
pool-71-183-222-135.ny    80 194.15.141.69          5 7 2     0    104     303
94.23.184.200           6000 194.15.141.69          2 7 2     0      0     310
ns394890.ip-176-31-117    80 194.15.141.69        595 7 2     0      1     318
24-119-20-63.cpe.cable  3074 194.15.141.69          1 7 2     0      0     321
c-75-72-118-222.hsd1.m  3074 194.15.141.69          7 7 2     0     15     324
                       25565 194.15.141.69        618 7 2     0      2     325
88.247.203.8.static.tt    80 194.15.141.69       2509 7 2     0      0     343
wsip-70-184-76-130.tc.  3074 194.15.141.69          5 7 2     0     13    3667
76-220-29-27.lightspee    80 194.15.141.69         70 7 2     0      1    3687
142-196-165-57.res.bhn 40031 194.15.141.69          7 7 2     0      4    3688
c-24-22-71-132.hsd1.or  3074 194.15.141.69          2 7 2     0      0    3692
172.56.6.23             3074 194.15.141.69          4 7 2     0     14    3711
datacenter.lqvhost.com  9987 194.15.141.69         45 7 2     0     25    3713
c122-104-144-26.rochd6  6500 194.15.141.69         27 7 2     0      4    3747
122.sub-70-195-0.myvzw  3074 194.15.141.69         20 7 2     0     24    3752
50-89-149-133.res.bhn.    80 194.15.141.69        113 7 2     0      1    3756
99-72-206-4.lightspeed    80 194.15.141.69        209 7 2     0      1    3759
ip22-169-15-186.ct.co.    80 194.15.141.69        324 7 2     0      1    3761
97-86-112-243.dhcp.euc  3074 194.15.141.69         62 7 2     0      4    3767
172.56.15.46              80 194.15.141.69         78 7 2     0      1    3606
cpc4-leic15-2-0-cust14    80 194.15.141.69        173 7 2     0      2    3613
gamma.irc.socialgamer.    80 194.15.141.69       1445 7 2     0      0    3645
ip68-224-152-140.lv.lv  3074 194.15.141.69          4 7 2     0     14    3655
bom1-83-221-145-187.bo    80 194.15.141.69      29998 7 2     0      0    3657
252.190-155-29.uio.sat  3074 194.15.141.69         99 7 2     0      3    3667
ip68-100-248-179.dc.dc    53 194.15.141.69         16 7 2     0      6    3728
cmcust1a-71.214.nulink    80 194.15.141.69        291 7 2     0      4    3728
aorleans-552-1-42-41.w  3074 194.15.141.69         15 7 2     0      4    3728
0279e267.bb.sky.com       80 194.15.141.69        793 7 2     0      0    3733
c-71-195-67-115.hsd1.p    80 194.15.141.69        144 7 2     0      1    3740
host-46-20-4-51.router  8040 194.15.141.69       3488 7 2     0      1    3743
69.171.233.113            80 194.15.141.69       3868 7 2     0      0    3785
pool-72-74-164-54.bstn    80 194.15.141.69         14 7 2     0      3    3790
host5-81-81-238.range5    80 194.15.141.69          9 7 2     0     10    3795
d58-106-36-74.rdl801.q  6500 194.15.141.69         29 7 2     0      3    3796
198.50.220.127          6010 194.15.141.69       2658 7 2     0      1    3801
99-182-17-46.lightspee  3074 194.15.141.69          2 7 2     0     15    3801
93.174.95.41           25565 194.15.141.69          6 7 2     0     24    3805
host-184-167-144-23.cd  3074 194.15.141.69          2 7 2     0      0    3805
162.220.9.56              80 194.15.141.69       1408 7 2     0      2    3811
24-180-129-11.dhcp.ald    80 194.15.141.69        333 7 2     0      1    3812
68-202-176-195.res.bhn    80 194.15.141.69          7 7 2     0     14    3827
147-92-169-192.static. 28015 194.15.141.69       3213 7 2     0      0    3838
24.49.207.15              80 194.15.141.69       1035 7 2     0      1    3857
beach.ecgnetwork.co     27960 194.15.141.69      11498 7 7     0      0    3861
c95054ec.virtua.com.br  33592 194.15.141.69        715 7 2     0      1    3865
c-50-166-161-241.hsd1.    80 194.15.141.69        100 7 2     0     15    3870
66-55-129-154.constant 30365 194.15.141.69         13 7 2     0     15    3880
ns317118.ip-37-187-133  4101 194.15.141.69      20368 7 2     0      0    3881
23.235.23.228             53 194.15.141.69         22 7 2     0      2    3891
blk-212-116-184.eastli    80 194.15.141.69       3477 7 2     0      0    3891
adsl-76-202-133-1.dsl.  3074 194.15.141.69        131 7 2     0      3    3907
108.170.47.10           25565 194.15.141.69        325 7 2     0      0    3907
```

3 Vulnerable Servers



Check Any Host

```
ntpdc -c monlist hostname
```

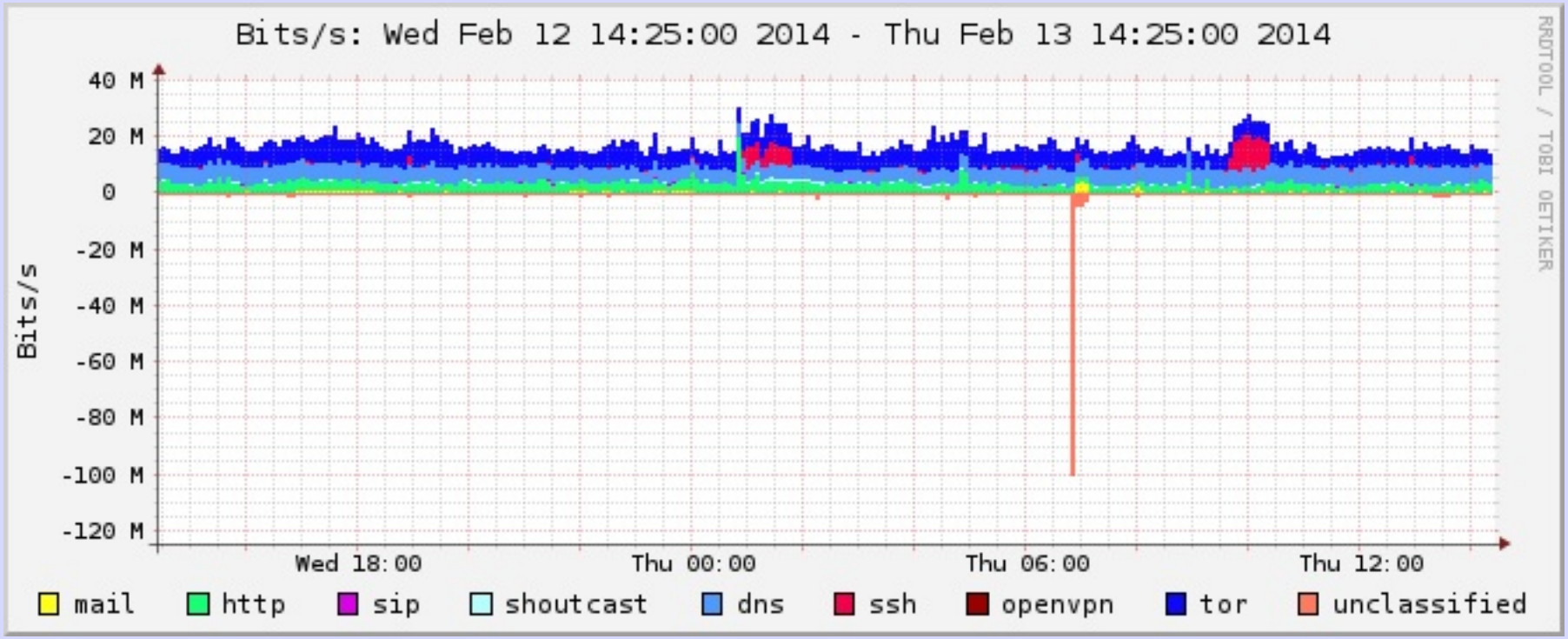
Block Bad NTP

```
# By default, exchange time with everybody, but don't
# allow configuration.
#
restrict -4 default kod notrap nomodify nopeer noquery
restrict -6 default kod notrap nomodify nopeer noquery
#
# Local users may interrogate the ntp server closely.
restrict 127.0.0.1
restrict ::1
```

Cisco Router

```
! Core NTP configuration
ntp server 24.16.172.107                        ! ntp.psg.com
ntp server 147.28.0.36                          ! rip.psg.com
ntp server 147.28.0.62                          ! psg.com
!
access-list 46 remark utility ACL to block everything
access-list 46 deny any
!
access-list 47 remark NTP peers/servers we sync to/with
access-list 47 permit 24.16.172.107
access-list 47 permit 147.28.0.36
access-list 47 permit 147.28.0.62
access-list 47 deny any
!
! NTP access control
ntp access-group query-only 46   ! deny all NTP control queries
ntp access-group serve 46        ! deny all NTP time and control by default
ntp access-group peer 47         ! permit sync to configured peer(s)/server(s)
ntp access-group serve-only 46  ! deny NTP time sync requests
```

chargen is Vulnerable



NetFlow Told Me

Dst IP Addr	Bytes(%)	pps	bps	bpp
98.128.37.190	3.7 G(98.7)	3020	28.0 M	1157

Src IP Addr	Bytes(%)	pps	bps	bpp
124.158.127.250	26.0 M(0.7)	600	6.0 M	1241
111.1.20.239	21.1 M(0.6)	474	4.9 M	1277
218.75.208.104	20.6 M(0.5)	484	4.7 M	1222
198.180.150.9	18.3 M(0.5)	30	318398	1287
202.100.85.51	18.0 M(0.5)	418	4.1 M	1237
210.245.86.132	17.7 M(0.5)	416	4.1 M	1223
222.188.10.160	17.7 M(0.5)	407	4.1 M	1248
61.143.139.34	16.8 M(0.4)	391	3.9 M	1233
119.97.222.23	16.8 M(0.4)	390	3.9 M	1231
211.140.116.106	16.6 M(0.4)	377	3.8 M	1269

Src Port	Bytes(%)	pps	bps	bpp
0	2.2 G(58.9)	1588	13.9 M	1093
19	1.5 G(40.0)	1152	11.3 M	1228

Dst Port	Bytes(%)	pps	bps	bpp
0	2.2 G(58.8)	1152	11.3 M	1228

All UDP Services are Vulnerable

But
Do NOT Block
UDP

Look at Each Service Throttle, Manage, or Disable