



Welcome to

DDoS Testing Introduction

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Slides are available as PDF, kramshoej@Github

Agenda



Intro

Graphs and Dashboards!

Taxonomy of DDoS Attacks

Netflow NFSen

Defense in depth - multiple layers of security

Routing RTBH

Troubleshooting

Intro

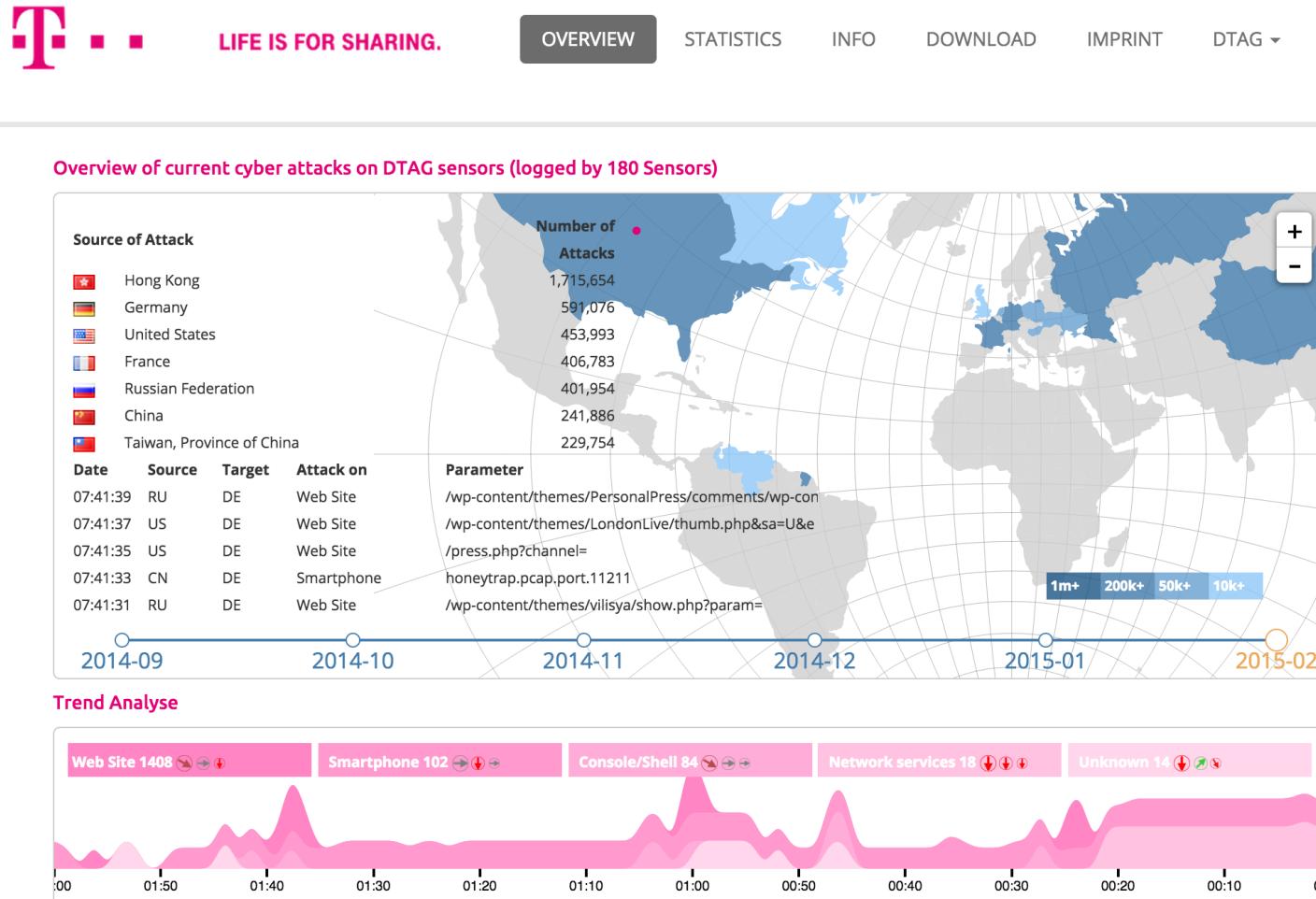


DDoS is very much in the media

Vendors say:

Prolexic did mitigate a 130 Gbps attack in March and more than 10 percent of attacks directed at Prolexic's global client base exceeded 60 Gigabits per second (Gbps). Source: Prolexic Quarterly Global DDoS Attack Report Q1 2013

Attack overview



<http://www.sicherheitstacho.eu/?lang=en>



Blocklists

Safe DNSBLs for safe filters

SBL Advisory

XBL Advisory

PBL Advisory

DBL Advisory

禪 ZEN

Blocklist Removal

Blocked? To check, get info and resolve listings go to
► Blocklist Removal Center

Blocklist Use

► DNSBL Usage Terms
► How Blocklists Work

Documents

► Consumer Protection
► The Definition of "Spam"
► Email Marketing Guide

Datafeed

► Datafeed service for ISPs and commercial users

ROKSO

► Register of Known Spam Operations
► ROKSO Policy & FAQs

ISP Area

► ISP Area
► ISP Abuse Desk FAQs

Source: <http://www.spamhaus.org/>

Massive DDoS



Title: Massive DDoS against Spamhaus reaches 300Gbps Description: Following a dispute between Dutch hosting provider Cyberbunker and anti-spam group Spamhaus, the latter suffered what initially began as a relatively small - 10 Gbps - DDoS, which escalated over the course of last week to a 300Gbps flood.

Source: <http://blog.cloudflare.com/the-ddos-that-almost-broke-the-internet>



Massive DDoS a lie

CloudFlare CEO Matthew Prince said he was sure of the 300Gbps figure, pointing to an online comment from Richard Steenbergen, CTO of nLayer, one of the upstream network providers of CloudFlare. Although Steenbergen said the company saw a 300Gbps hit going after CloudFlare, which targeted "pieces" of the core network, it was nothing "record smashing" or "game changing"

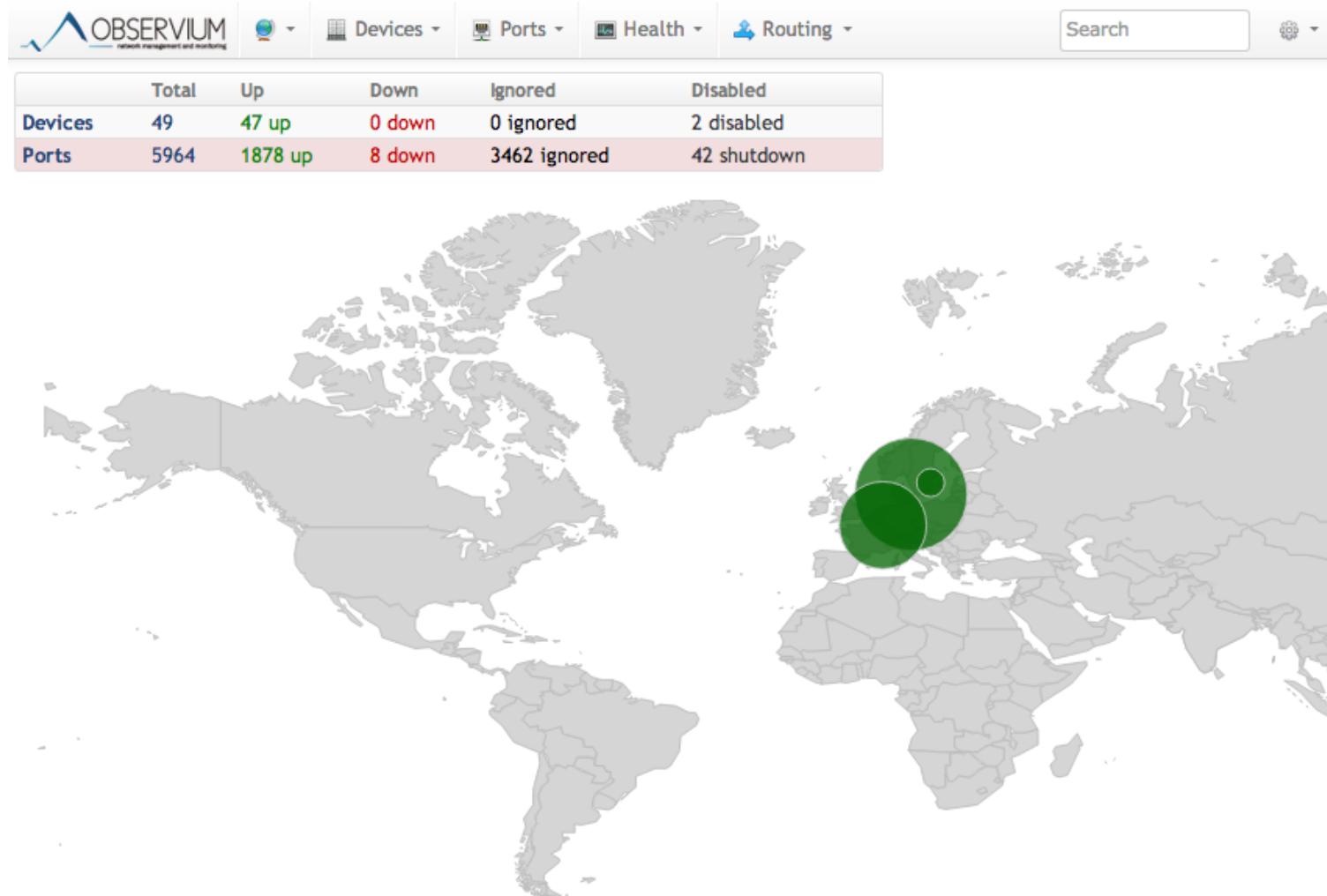
Actual data proving a 300Gbps hit remains thin on the ground. Hammack said his firm had not seen anything above 160Gbps in a single DDoS, with 144 million packets sent per second, and he doesn't believe there has been one higher. He won't be convinced otherwise unless someone shows him proof one organisation's network took more traffic in an attack.

Source: Prolexic CEO: Biggest Cyber Attack Ever Was Built On Lies

<http://www.techweekeurope.co.uk/news/prolexic-ceo-scott-hammack-biggest-cyber-attack-lies-spam>

Ohhh only 160Gbps ☺

Graphs and Dashboards!



<https://observium.solido.net/>

Riorey Taxonomy of DDoS Attacks



What are DDoS? and DoS?

Denial of Service attack - prevents authorized users access to resources

Can be a single request to HTTP service, sequence of network packets

Distributed Denial of Service attack - many (spoofed) sources

https://en.wikipedia.org/wiki/Denial-of-service_attack



Denial of Service description

OSVDB

Search OSVDB | Browse | Vendors | Project Info | Help OSVDB! | Sponsors | Account

Quick Searches

General Search Title Search OSVDB ID Lookup Vendor Search

Search Results by year

Year	Count
06	2
07	2
08	3
09	10
10	20
11	15
12	22
13	18

Refine Search

Displayed Fields

Show:
CVE ID
CVSSv2 Base Score
Percent Complete

Alter Search

Results: 103 : [Show Descriptions](#) Sort by: [Score](#) [Disclosure](#) [OSVDB_ID](#)

Search Query: **text_type: alltext vuln_title: junos**

ID Disc Date Title

[95107](#) 2013-07-10 [Juniper Junos Malformed PIM Packet Handling Remote DoS](#)

Juniper Junos contains a flaw that may allow a remote denial of service. The issue is triggered when handling a specially crafted PIM packet that is subject to Network Address Translation (NAT). This may allow a remote attacker to repeatedly crash the Flow Daemon (flowd).

[95108](#) 2013-07-10 [Juniper Junos flowd Crafted HTTP Request Handling Buffer Overflow](#)

[95109](#) 2013-07-10 [Juniper Junos Malformed ARP Request Handling Remote DoS](#)

Juniper Junos contains a flaw that may allow a remote denial of service. The issue is triggered when handling malformed ARP requests. This may allow a remote attacker to crash the Flow Daemon (flowd).

[95110](#) 2013-07-10 [Juniper Junos flowd Malformed TCP Packet Handling Remote DoS](#)

[95111](#) 2013-07-10 [Juniper Junos flowd Malformed MSRPC Request Handling Remote DoS](#)

[95112](#) 2013-07-10 [Juniper Junos Ethernet Packet Padding Data Remote Information Disclosure](#)

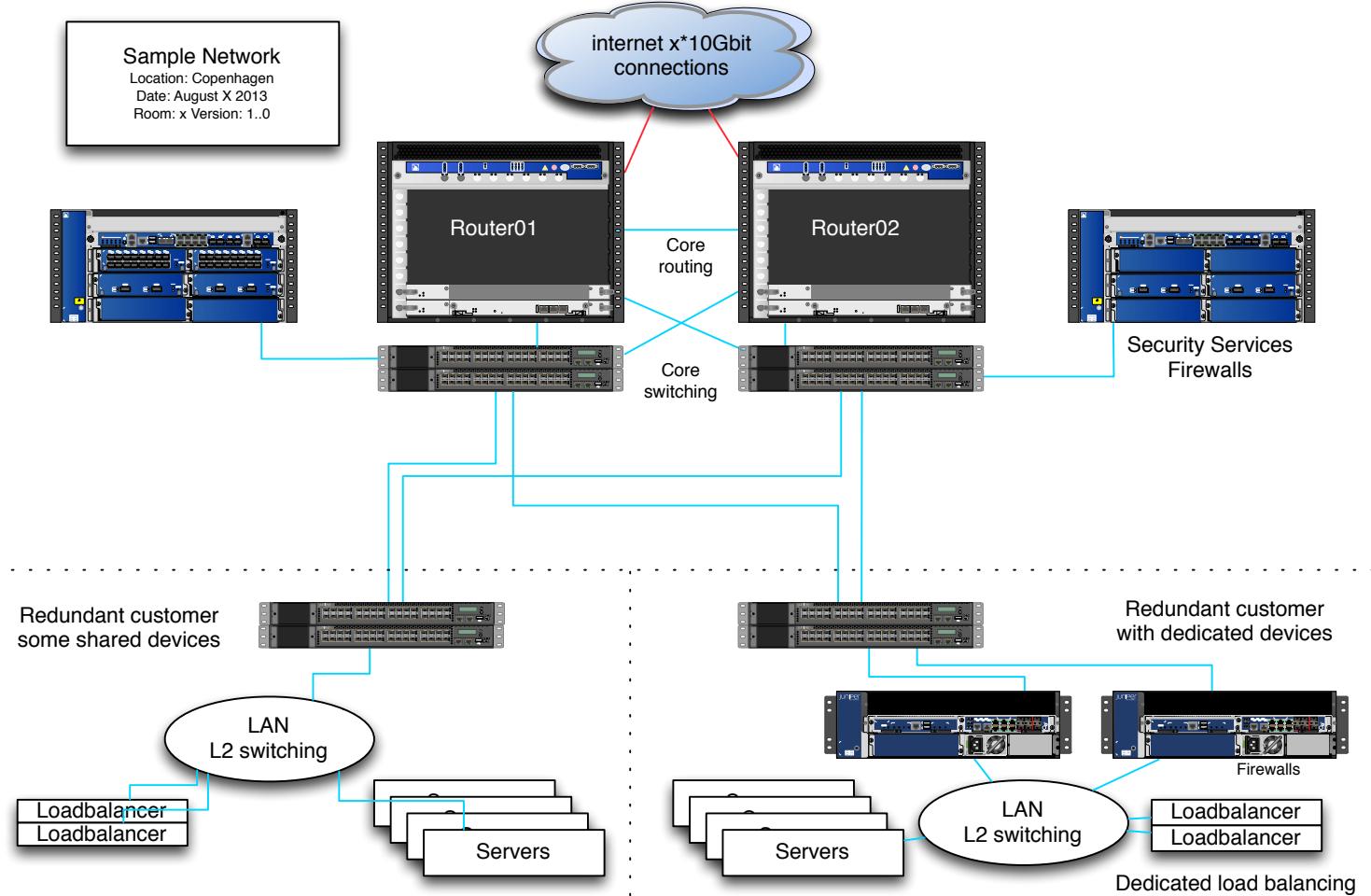
Source: <http://osvdb.org/>

Cisco DoS exploit script



```
#!/bin/sh
# 2003-07-21 pdonahue
# cisco-44020.sh
# -- this shell script is just a wrapper for hping (http://www.hping.org)
# with the parameters necessary to fill the input queue on
# exploitable IOS device
# -- refer to "Cisco Security Advisory: Cisco IOS Interface Blocked by
# IPv4 Packets"
# (http://www.cisco.com/warp/public/707/cisco-sa-20030717-blocked.shtml)
#for more information
...
for protocol in $PROT
do
    $HPING $HOST --rawip $ADDR --ttl $TTL --ipproto $protocol
        --count $NUMB --interval u250 --data $SIZE --file /dev/urandom
done
```

Networks today



Taxonomy of DDoS Attacks



RioRey Taxonomy of DDoS Attacks

Attack Types		Attack Matrix Dimensions									
		Nature of IP	Handshake	Source IP Range	Packet Rate	Packet Size	Packet Content	Fragmenting	Session Rate	Session Duration	VERB Rate
TCP BASED	1 SYN Flood	Spoofed	None	Large	High	Small	---	---	---	---	---
	2 SYN-ACK Flood	Spoofed	None	Large	High	---	---	---	---	---	---
	3 ACK & PUSH ACK Flood	Spoofed	None	Large	High	---	---	---	---	---	---
	4 Fragmented ACK	Spoofed	None	Large	Moderate	Large	---	High	---	---	---
	5 RST or FIN Flood	Spoofed	None	Large	High	---	---	---	---	---	---
	6 Synonymous IP	Spoofed	None	Single IP	High	---	---	---	---	---	---
	7 Fake Session	Spoofed	None	Large	Low	---	---	---	---	---	---
	8 Session Attack	Non-Spoofed	Yes	Small	Low	---	---	---	Low	Long	---
	9 Misused Application	Non-Spoofed	Yes	Small	Variable	---	---	---	High	Short	---



	10 HTTP Fragmentation	Non-Spoofed	Yes	Small	Very Low	Small	Valid	High	Very Low	Very Long	Very Low
TCP HTTP BASED	11 Excessive VERB	Non-Spoofed	Yes	Small	High	---	Valid	---	High	Short	High
	12 Excessive VERB Single Session	Non-Spoofed	Yes	Small	Low	---	Valid	---	Low	Moderate	High
	13 Multiple VERB Single Request	Non-Spoofed	Yes	Small	Very Low	Large	Valid	---	Low	Long	High
	14 Recursive GET	Non-Spoofed	Yes	Small	Low	---	Valid	---	Low	Short	Low
	15 Random Recursive GET	Non-Spoofed	Yes	Small	Low	---	Valid	---	Low	Short	Low
	16 Faulty Application	Non-Spoofed	Yes	Small	Low	---	Valid	---	Low	Short	Low



UDP and ICMP

U D P B A S E D	17 UDP Flood	Spoofed	---	Very Large	Very High	Small	Not Valid	---	---	---	---	---
	18 Fragmentation	Spoofed	---	Moderate	Very High	Large	Not Valid	High	---	---	---	---
	19 DNS Flood	Spoofed	---	Very Large	Very High	Small	Valid	---	---	---	---	---
	20 VoIP Flood	Spoofed	---	Very Large	Very High	Small	Valid	---	---	---	---	---
	21 Media Data Flood	Spoofed	---	Very Large	Very High	Moderate	Valid	---	---	---	---	---
	22 Non-Spoofed UDP Flood	Non-Spoofed	---	Small	Very High	---	Valid	---	---	---	---	---

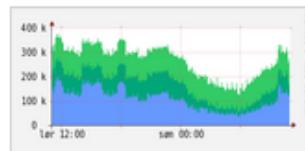
I C M P B A S E D	23 ICMP Flood	Spoofed	---	Very Large	Very High	Variable	Not Valid	---	---	---	---	---
	24 Fragmentation	Spoofed	---	Moderate	Very High	Large	Not Valid	High	---	---	---	---
	25 Ping Flood	Spoofed	---	Very Large	Very High	Small	Valid	---	---	---	---	---

Netflow NFSen

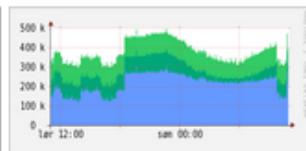


Profile: live

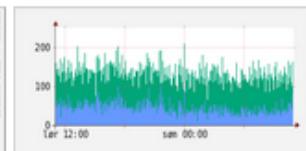
TCP



any



ICMP



other



Profileinfo:

Type: live

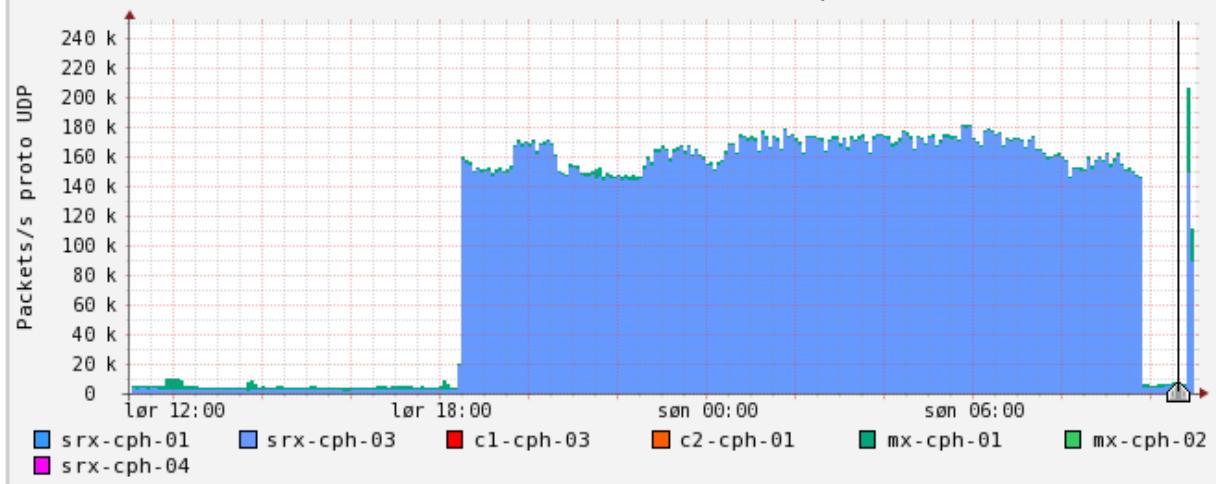
Max: unlimited

Exp: never

Start: Jun 23 2011 - 13:10 CEST

End: Jul 21 2013 - 11:00 CEST

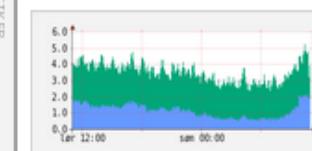
Sun Jul 21 10:35:00 2013 Packets/s proto UDP



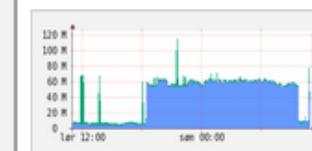
tstart 2013-07-21-10-35

tend 2013-07-21-10-35

Flows



Traffic



Lin Scale Stacked Graph
 Log Scale Line Graph

Select

Single Timeslot

Display:

1 day

<<

<

|

^

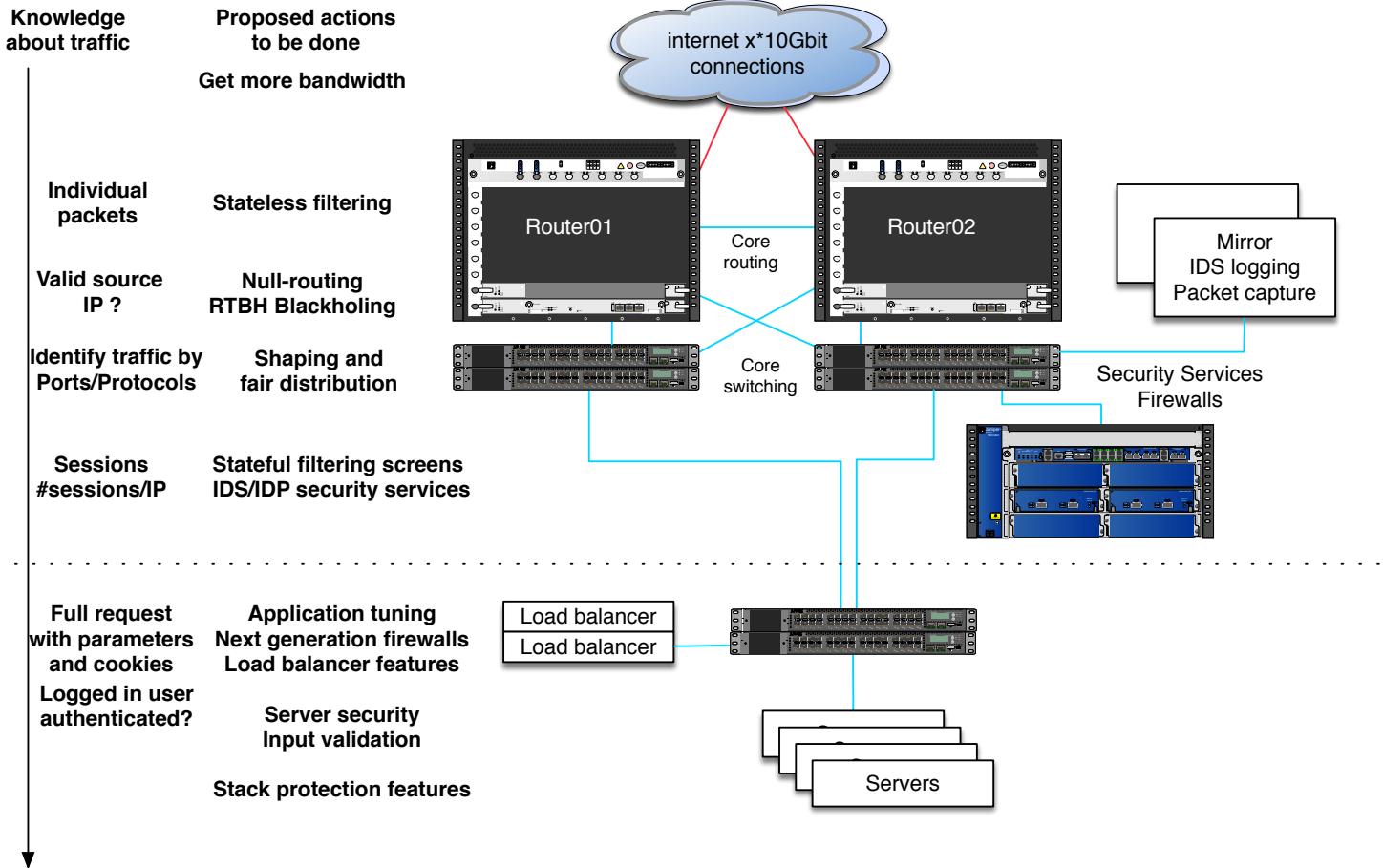
>

>>

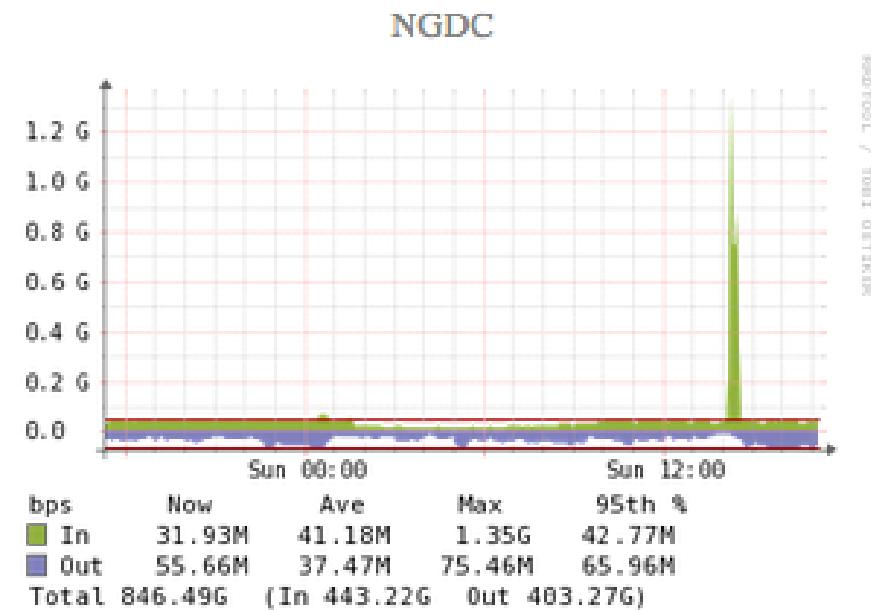
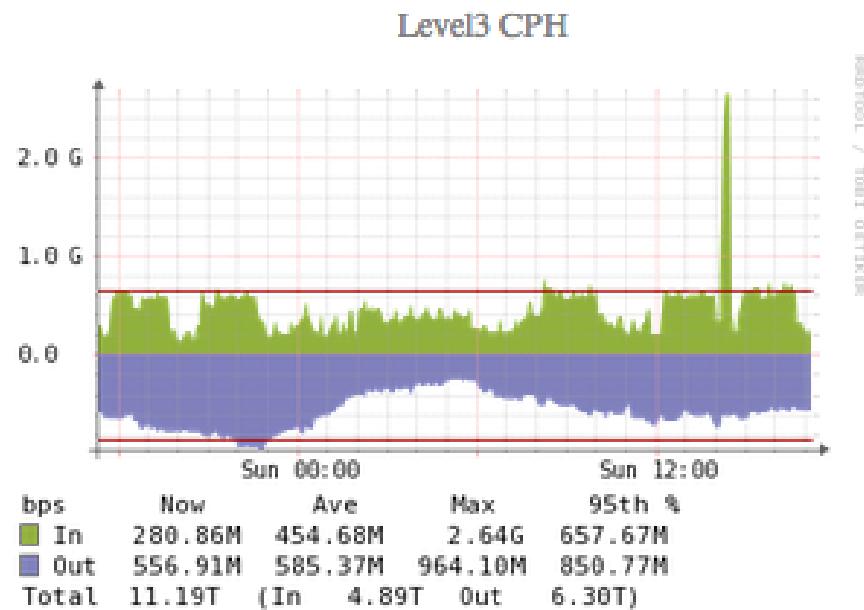
>|

An extra 100k packets per second from this netflow source (source is a router)

Defense in depth - multiple layers of security



DDoS traffic before filtering



Only two links shown, at least 3Gbit incoming for this single IP

DDoS traffic after filtering



Link toward server (next level firewall actually) about 350Mbit outgoing



Stateless firewall filter throw stuff away

```
hlk@MX-CPH-02> show configuration firewall filter all | no-more
/* This is a sample, better to use BGP flowspec and RTBH */
inactive: term edgeblocker {
    from {
        source-address {
            84.180.xxx.173/32;
...
            87.245.xxx.171/32;
        }
        destination-address {
            91.102.91.16/28;
        }
        protocol [ tcp udp icmp ];
    }
    then {
        count edge-block;
        discard;
    }
}
```

Hint: can also leave out protocol and then it will match all protocols



Stateless firewall filter limit protocols

```
term limit-icmp {  
    from {  
        protocol icmp;  
    }  
    then {  
        policer ICMP-100M;  
        accept;  
    }  
}  
term limit-udp {  
    from {  
        protocol udp;  
    }  
    then {  
        policer UDP-1000M;  
        accept;  
    }  
}
```

Routers have extensive Class-of-Service (CoS) tools today



Strict filtering for some servers, still stateless!

```
term some-server-allow {  
    from {  
        destination-address {  
            109.238.xx.0/xx;  
        }  
        protocol tcp;  
        destination-port [ 80 443 ];  
    }  
    then accept;  
}  
term some-server-block-unneeded {  
    from {  
        destination-address {  
            109.238.xx.0/xx;  
        }  
        protocol-except icmp;  
    }  
    then {  
        discard;  
    }  
}
```

Wut - no UDP, yes UDP service is not used on these servers



Firewalls - screens, IDS like features

When you know regular traffic you can decide:

```
hlk@srx-kas-05# show security screen ids-option untrust-screen
icmp {
    ping-death;
}
ip {
    source-route-option;
    tear-drop;
}
tcp {      Note: UDP flood setting also exist
    syn-flood {
        alarm-threshold 1024;
        attack-threshold 200;
        source-threshold 1024;
        destination-threshold 2048;
        timeout 20;
    }
    land;
}
```

Always select your own settings YMMV

Routing RTBH



What about a really big DDoS?
and routers can do more

uRPF unicast Reverse Path Forwarding

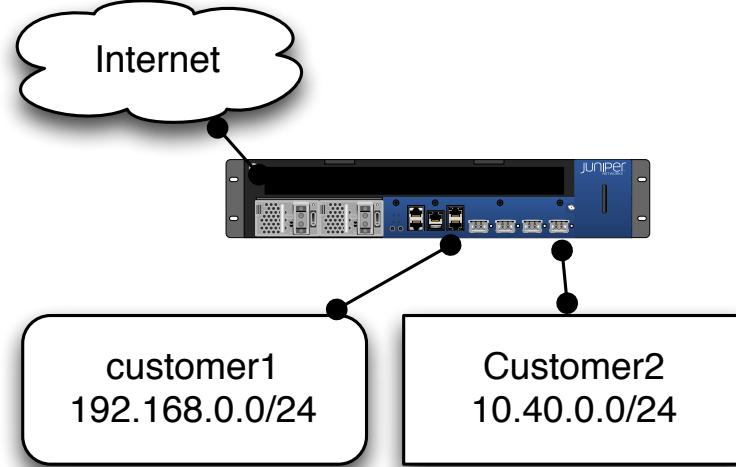


Reverse path forwarding (RPF) is a technique used in modern routers for the purposes of ensuring loop-free forwarding of multicast packets in multicast routing and to help prevent IP address spoofing in unicast routing.

Source: http://en.wikipedia.org/wiki/Reverse_path_forwarding



Strict vs loose mode RPF



```
user@router# show interfaces
ge-0/0/0 {
    unit 2 {
        family inet {
            rpf-check fail-filter rpf-special-case-dhcp;
            address 192.168.0.254/24;
        }
    }
}
ge-0/0/1 {
    unit 2 {
        family inet {
            rpf-check fail-filter rpf-special-case-dhcp;
            address 10.40.0.254/24;
        }
    }
}
```

Configuring Unicast RPF Strict Mode

In strict mode, unicast RPF checks whether the incoming packet has a source address that matches a prefix in the routing table, **and whether the interface expects to receive a packet with this source address prefix.**



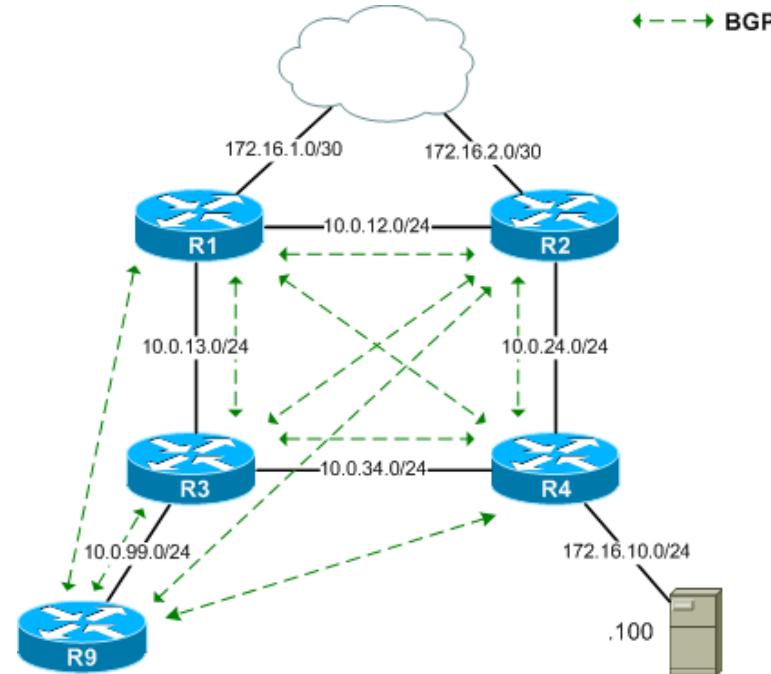
uRPF Junos config with loose mode

```
xe-5/1/1 {  
    description "Transit: Blah (AS65512)";  
    unit 0 {  
        family inet {  
            rpf-check {  
                mode loose;  
            }  
            filter {  
                input all;  
                output all;  
            }  
            address xx.yy.xx.yy/30;  
        }  
        family inet6 {  
            rpf-check {  
                mode loose;  
            }  
            address 2001:xx:yy/126;  
        }  
    }  
}
```

See also: <http://www.version2.dk/blog/den-danske-internettrafik-og-bgp-49401>



Remotely Triggered Black Hole Configurations



Picture from packetlife.net showing R9 as a standalone "management" router for route injection.

<http://packetlife.net/blog/2009/jul/6/remotely-triggered-black-hole-rtbh-routing/>

<https://ripe65.ripe.net/presentations/285-inex-ripe-routingwg-amsterdam-2012-09-27.pdf>

<https://www.inex.ie/rtbh>



Remotely Triggered Black Hole at upstreams

6. Black Hole Server (Optional)

```
#####
#                               NOTE
#   The Cogent Black Hole server will allow customers to announce a /32 route
#   to Cogent and have all traffic to that network blocked at Cogents backbone.
#   All peers on the Cogent black hole server require a password and IP address
#   from your network for Cogent to peer with.
#####
```

[] Please set up a BGP peer on the Cogent Black Hole server

Black Hole server password:

Black Hole server peer IP:

North American Black Hole Peer: 66.28.8.1

European Black Hole Peer: 130.117.20.1

Source:

http://cogentco.com/files/docs/customer_service/guide/bgpq.sample.txt

Better drop single /32 host than whole network!



BGP speaking software

Example BGP speakers - which can be used for RTBH

OpenBGPD from OpenBSD easy to install, also on FreeBSD, NetBSD

BIRD <http://bird.network.cz/> great BGP daemon, used as Router Server in some internet exchanges

Vyatta <http://www.vyatta.org/> complete BGP routing, firewall etc.

Exabgp <http://code.google.com/p/exabgp/> BGP engine useful for injecting routes and flowspec

Unfortunately there is not a lot of open source "scrubbing" software

BCP38 Network Ingress Filtering



Network Working Group

Request for Comments: 2827

Obsoletes: 2267

BCP: 38

Category: Best Current Practice

P. Ferguson

Cisco Systems, Inc.

D. Senie

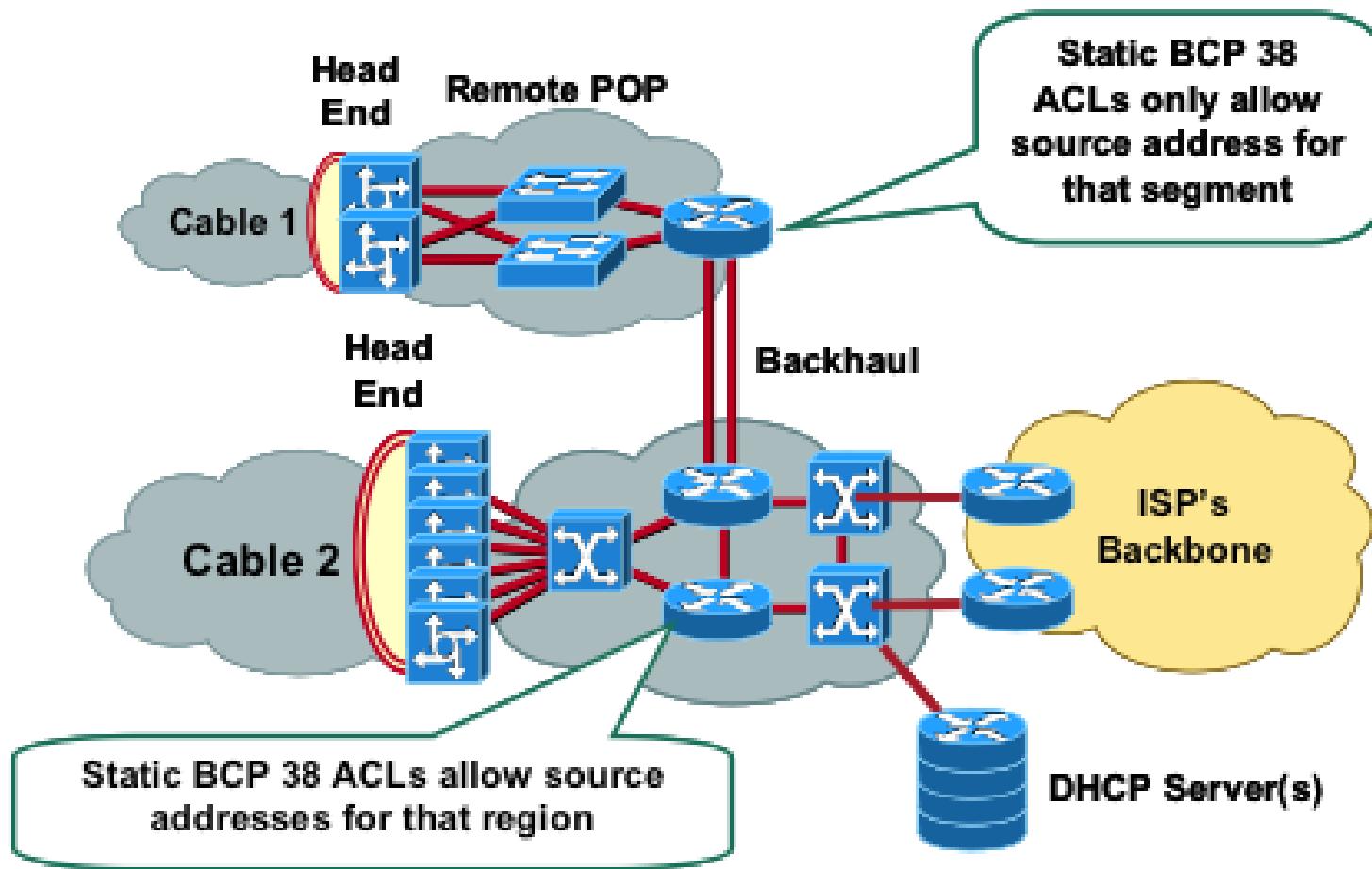
Amaranth Networks Inc.

May 2000

Network Ingress Filtering:
Defeating Denial of Service Attacks which employ
IP Source Address Spoofing

Note: you should try validating INCOMING traffic from customers, also note the date!

<http://tools.ietf.org/html/bcp38>



Source: http://www.bcp38.info/index.php/Main_Page

Remember those BGP import filters, perhaps try bgpq3



```
h1k@katana:bpq3-0.1.16$ ./bpq3 -Jl larsen-data AS197495
policy-options {
    replace:
        prefix-list larsen-data {
            91.221.196.0/23;
            185.10.8.0/22;
        }
}
```

<http://snar.spb.ru/prog/bpq3/>

The Spamhaus Don't Route Or Peer Lists



The Spamhaus Don't Route Or Peer Lists

DROP (Don't Route Or Peer) and EDROP are advisory "drop all traffic" lists, consisting of stolen 'hijacked' netblocks and netblocks controlled entirely by criminals and professional spammers. DROP and EDROP are a tiny subset of the SBL designed for use by firewalls and routing equipment.

<http://www.spamhaus.org/drop/>



Flowspec Self inflicted DoS

```
+ route 173.X.X.X/32-DNS-DROP {
+   match {
+     destination 173.X.X.X/32;
+     port 53;
+     packet-length [ 99971 99985 ];
+   }
+   then discard;
+ }
```

Resulted in router crashes - ooopps

<http://blog.cloudflare.com/todays-outage-post-mortem-82515>

<http://www.slideshare.net/sfouant/an-introduction-to-bgp-flowspec>

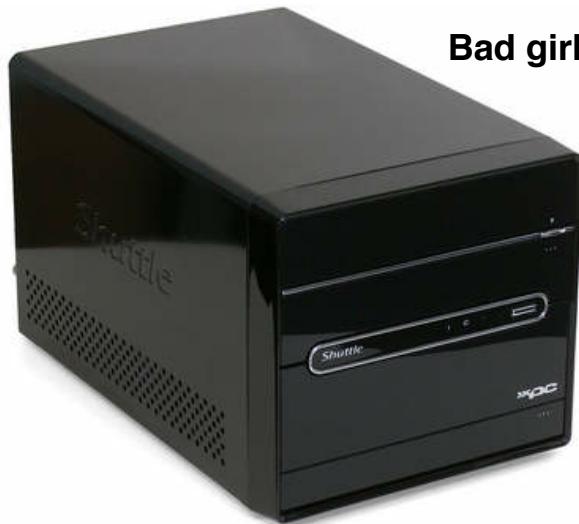
<https://code.google.com/p/exabgp/wiki/flowspec>

<http://www.slideshare.net/junipernetworks/flowspec-bay-area-juniper-user-group>

Demo network



Intel Core i7 - 960 (3.2GHz)
16Gb memory Gbit + 10G NIC



Bad girl!

Juniper SRX220H
Firewall performance (max) 950 Mbps
Maximum concurrent sessions 96K



Nice Web
server Nginx

Beagleboard Black
Processor: AM335x 1GHz ARM®
Cortex-A8 512MB DDR3L





Getting SNMP data from Juniper SRX:

```
hlk@srx-kas-05> show snmp mib walk jnxJSPUMonitoringObjectsTable
jnxJSPUMonitoringFPCIIndex.0 = 0
jnxJSPUMonitoringSPUIIndex.0 = 0
jnxJSPUMonitoringCPUUsage.0 = 0
jnxJSPUMonitoringMemoryUsage.0 = 50
jnxJSPUMonitoringCurrentFlowSession.0 = 20
jnxJSPUMonitoringMaxFlowSession.0 = 65536
jnxJSPUMonitoringCurrentCPSession.0 = 0
jnxJSPUMonitoringMaxCPSession.0 = 0
jnxJSPUMonitoringNodeIndex.0 = 0
jnxJSPUMonitoringNodeDescr.0 = single
```



SNMP OID value

You should download and install MIBs, but quick and dirty:

```
hlk@srx-kas-05> show snmp mib walk jnxJsSPUMonitoringObjectsTable | display xml
<rpc-reply xmlns:junos="http://xml.juniper.net/junos/11.4R8/junos">
    <snmp-object-information xmlns="http://xml.juniper.net/junos/11.4R8/junos-snmp">
...
<snmp-object>
    <name>jnxJsSPUMonitoringCurrentFlowSession.0</name>
    <index>
        <index-name>jnxJsSPUMonitoringIndex</index-name>
        <index-value>0</index-value>
    </index>
    <object-value-type>gauge</object-value-type>
    <object-value>20</object-value>
    <oid> 1.3.6.1.4.1.2636.3.39.1.12.1.1.1.6.0</oid>
</snmp-object>
```

```
hlk@katana:hlk$ snmpget -v 2c -c public 192.168.18.236 1.3.6.1.4.1.2636.3.39.1.12.1.1.1.6.0
SNMPv2-SMI::enterprises.2636.3.39.1.12.1.1.1.6.0 = Gauge32: 26
```



With installed MIBs

You can use better descriptive references:

```
hlk@katana:hlk$ snmpget -v 2c -c public 192.168.18.236 jnxJsSPUMonitoringCurrentFlowSession.0
JUNIPER-SRX5000-SPU-MONITORING-MIB::jnxJsSPUMonitoringCurrentFlowSession.0 = Gauge32: 45
```



Ruby SNMP

```
#!/usr/bin/env ruby
require 'net-snmp'
router='192.168.18.236'

#snmpget -v 2c -c public 192.168.18.236 1.3.6.1.4.1.2636.3.39.1.12.1.1.1.6.0
session = Net::SNMP::Session.open(:peername => router, :community => "public" )
begin
  pdu = session.get("1.3.6.1.4.1.2636.3.39.1.12.1.1.1.6.0")
  puts pdu.varbinds.first.value
rescue Net::SNMP::Error => e
  puts e.message
end
session.close

hlk@katana:ruby-snmp-graph$ ./test2.rb
```

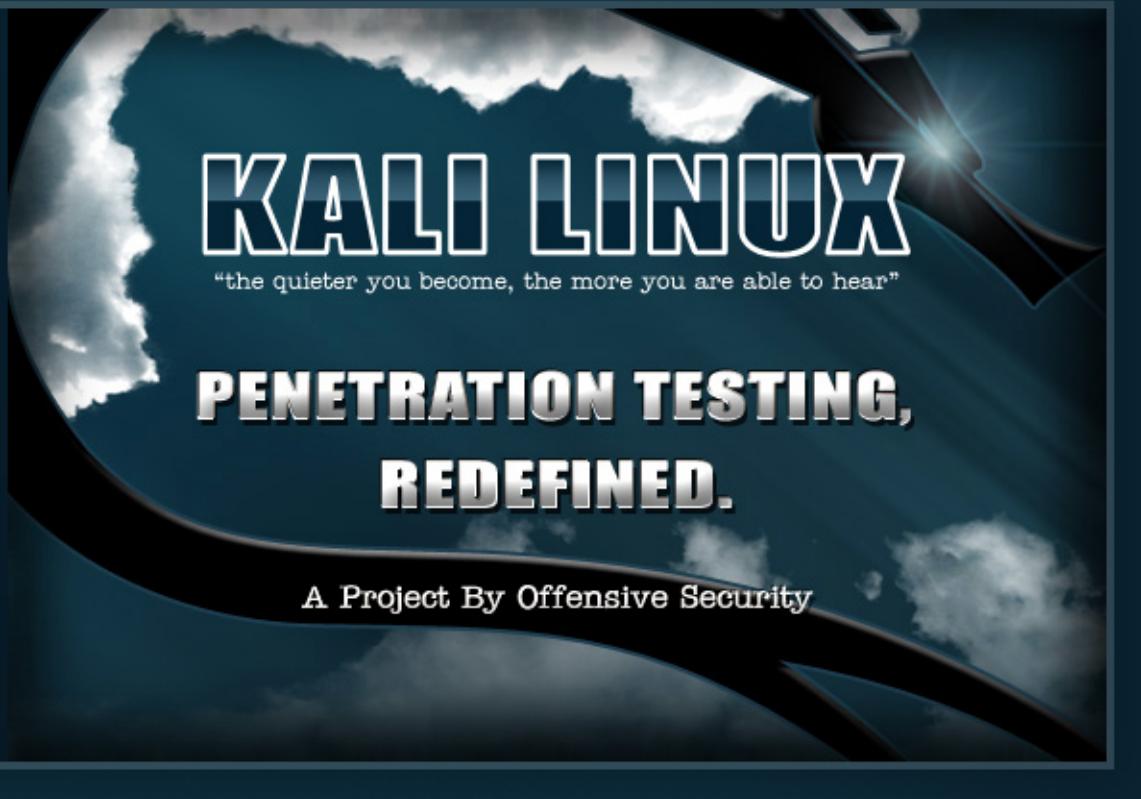
18

Kali Linux the new backtrack



The most advanced penetration testing distribution, ever.

From the creators of BackTrack comes Kali Linux, the most advanced and versatile penetration testing distribution ever created. BackTrack has grown far beyond its humble roots as a live CD and has now become a full-fledged operating system. With all this buzz, you might be asking yourself: - What's new ?



BackTrack <http://www.backtrack-linux.org>

Kali <http://www.kali.org/>

it's a Unix system, I know this



frednecksec Matt Franz  by kramse

Painful interview with a junior candidate today "wanting to get into security" yet who didn't build their own network  home or run Linux!!

1 Mar

Getting into security?

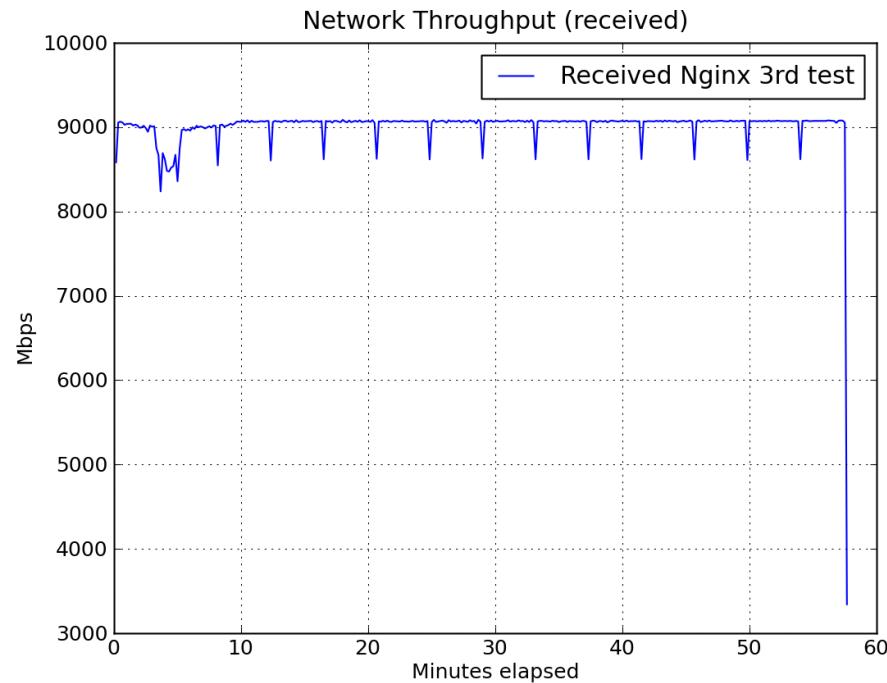
Configure your own network, perhaps just a small virtualized VMware, Virtualbox, Parallels, Xen, GNS3, ...

Use Kali/BackTrack, watch youtube videos

Quote from Jurassic Park <http://www.youtube.com/watch?v=dFULAQZB9Ng>



More application testing



Tsung can be used to stress HTTP, WebDAV, SOAP, PostgreSQL, MySQL, LDAP and Jabber/XMPP servers <http://tsung.erlang-projects.org/>

Apache benchmark included with Apache

Security Onion



securityonion.blogspot.dk

BRO IDS



The Bro Network Security Monitor

Bro is a powerful network analysis framework that is much different from the typical IDS you may know.

While focusing on network security monitoring, Bro provides a comprehensive platform for more general network traffic analysis as well. Well grounded in more than 15 years of research, Bro has successfully bridged the traditional gap between academia and operations since its inception.

<http://www.bro.org/>

BRO more than an IDS



The key point that helped me understand was the explanation that Bro is a domain-specific language for networking applications and that Bro-IDS (<http://bro-ids.org/>) is an application written with Bro.

Why I think you should try Bro

<https://isc.sans.edu/diary.html?storyid=15259>

Next steps



In our network we are always improving things:

More Suricata IDS <http://www.openinfosecfoundation.org/>

More graphs, with automatic identification of IPs under attack

More identification of short sessions without data - spoofed addresses

ARP sponge, ARP watch etc.

Conclusion: use anything you can! Combine tools!

See also:

<http://www.version2.dk/blog/hvad-er-ddos-distributed-denial-of-service>

Problems and Troubleshooting



Note: some security features does not work well when DDoS hits

For instance firewall sessions can be depleted by attack traffic

Questions?



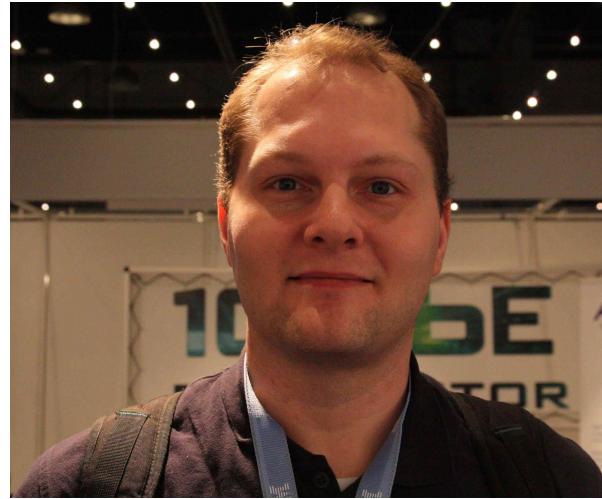
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Need DDoS testing or pentest, ask me!

You are always welcome to send me questions later via email

Did you notice how a lot of the links in this presentation use HTTPS - encrypted

Contact information



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you are welcome to drop me an email afterwards