Logging & Monitoring

Syslog, Timestamp, SNMP, Visualization, NMS

version : 2.0

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Acknowledgement

- Original slides prepared by Randy Bush

In your network

- Traffic/access trend of this month
- Packets discarded yesterday
- Reason of the recent outage
- Person who changed the configuration
- … and so on

Back Tracable

- What's happened in the past
- Syslog
  - to record messages from software
- SNMP
  - to monitor resources
- Netflow
  - to monitor packet flows

Syslog Message

```
Nov  9 15:19:14.390 UTC:
config[65775]: %MGBL-SYS-5-
CONFIG_I : Configured from
console by maz on vty0
(2001:db8:120:100:e1dd:
97f3:fd98:a51f)
```

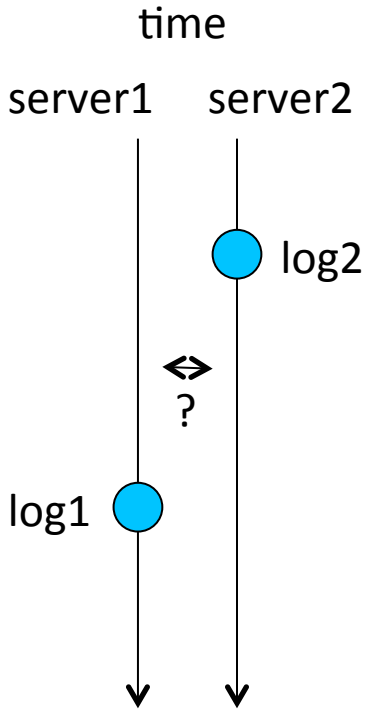
```
Nov 12 13:53:38 maz sudo:
maz : user NOT in sudoers ;
TTY=pts/3 ; PWD=/home/maz ;
USER=root ; COMMAND=/bin/bash
```

Syslog Message

```
61547: Jan 18 05:41:07.636 UTC: %SEC-6-IPACCESSLOGP:
list AUTHORIZED_IPV4_HOST denied tcp
61.160.247.225(6000) -> 0.0.0.0(22), 1 packet


761548: Jan 18 05:56:37.735 UTC: %SEC-6-
IPACCESSLOGP: list AUTHORIZED_IPV4_HOST denied tcp
61.160.247.225(6000) -> 0.0.0.0(22), 46 packets


761549: Jan 18 06:00:53.626 UTC: %SEC-6-
IPACCESSLOGP: list AUTHORIZED_IPV4_HOST denied tcp
61.160.215.227(6000) -> 0.0.0.0(22), 1 packet


761550: Jan 18 06:30:07.280 UTC: %SEC-6-
IPACCESSLOGP: list AUTHORIZED_IPV4_HOST denied tcp
193.107.16.206(54630) -> 0.0.0.0(22), 1 packet
```

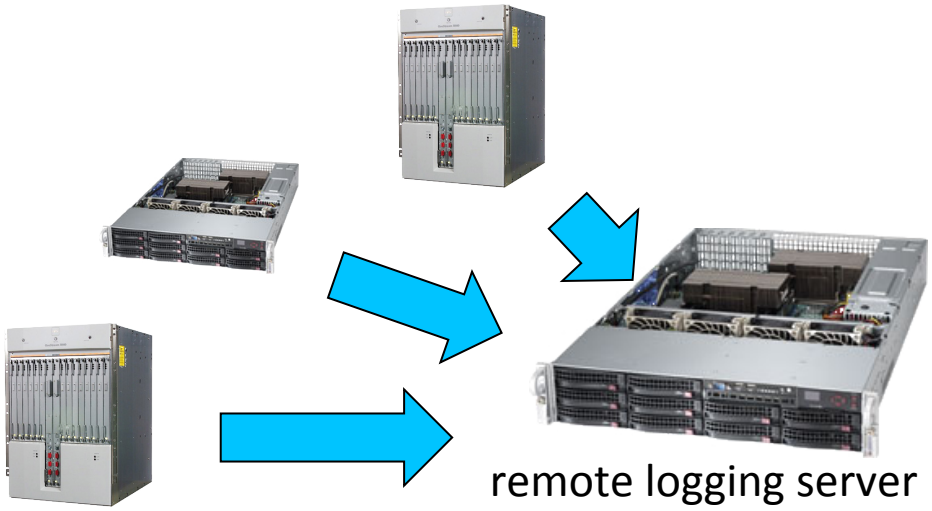
Timestamp

- Useful if system clock is synchronized
- ntp (network time protocol)
  - ntpd
- Timezone
  - UTC/GMT is scalable

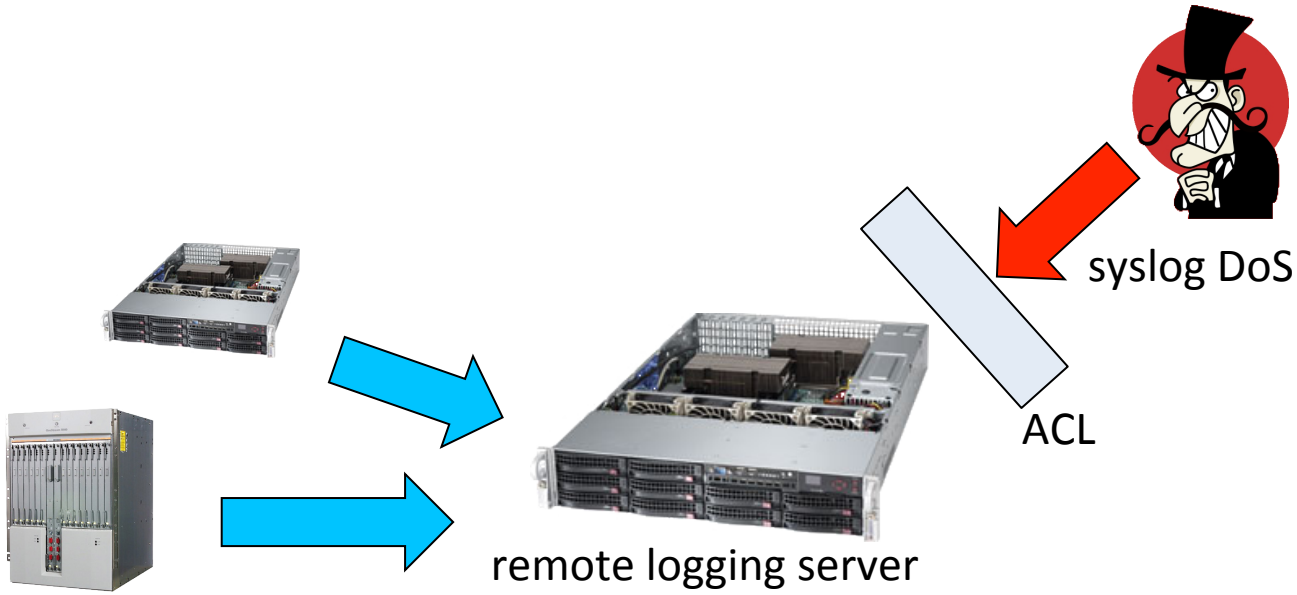


Remote Logging

- log messages could be modified/deleted
  - if the system is compromised
- remote logging servers
  - receive log messages from other devices
  - syslogd/syslog-ng



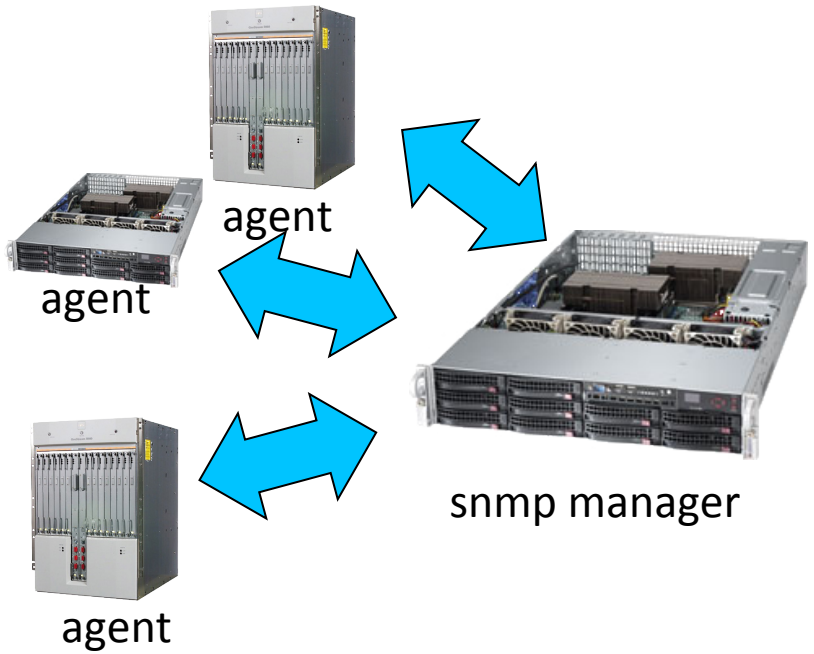
Protecting Syslog



ensure the correctness of log entries

SNMP

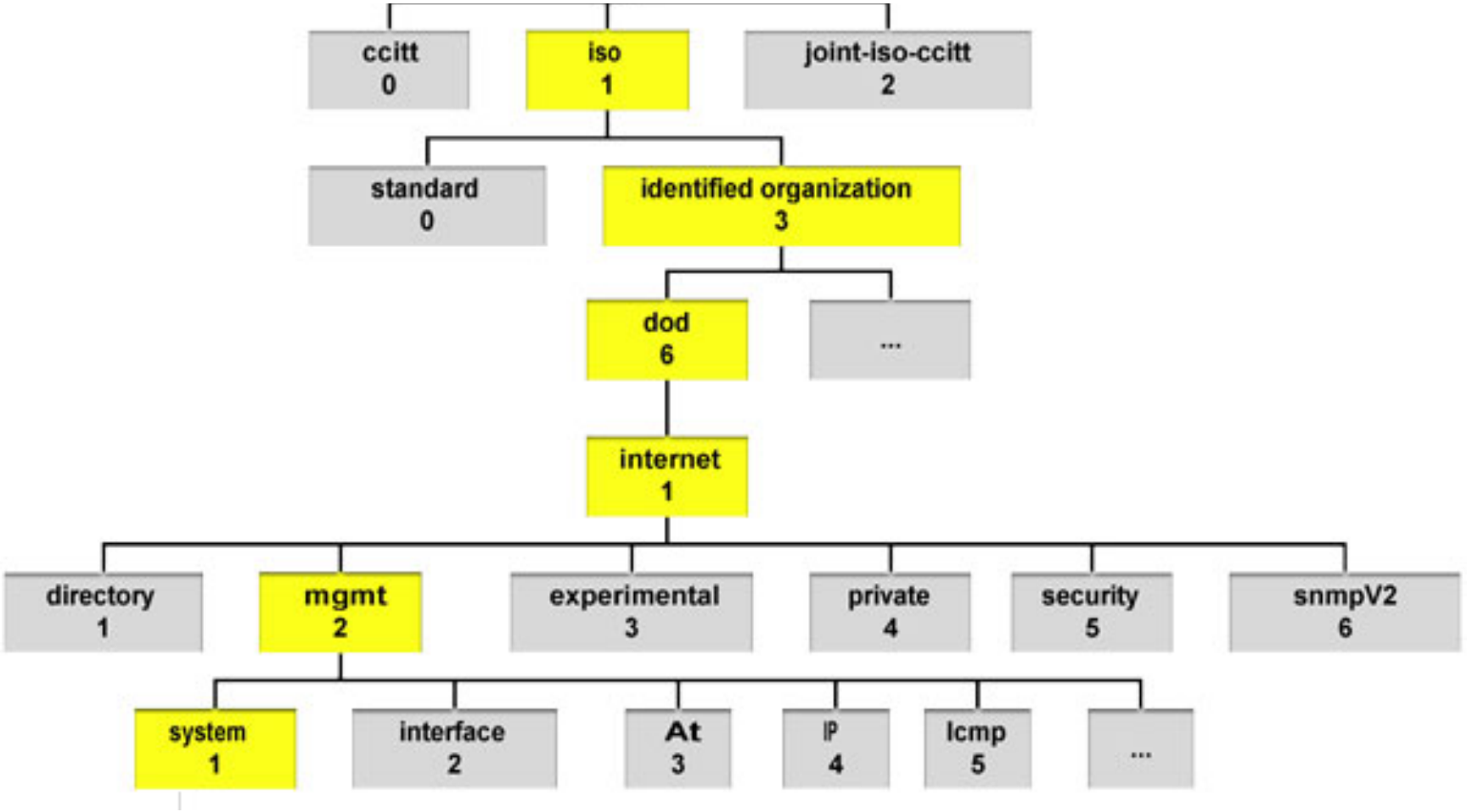
- Can read/write information and send a trap
  - use version 3, and set password
  - prevent ‘write’ function, or just disable it on agents
  - snmp agent/manager
- net-snmp/bsnmpd



SNMP MIB

- Management information base
  - MIB-2, IF-MIB, vender-specific MIB
  - You can get information if an agent supports the MIB you want
- You can specify the information by OIDs
- ifHCinOctets = .1.3.6.1.2.1.31.1.1.1.6
- ifHCOutOctets = .1.3.6.1.2.1.31.1.1.1.10

SNMP MIB


ccitt
0
iso
1
joint-iso-ccitt
2
standard
0
identified organization
3
dod
6
...
internet
1
directory
1
mgmt
2
experimental
3
private
4
security
5
snmpV2
6
system
1
interface
2
At
3
IP
4
Icmp
5
...

SNMP Counters

- Frequency of updating counters
  - Depends on agents (0-30sec)
  - 5min is widely used as snmp polling time
- Counter overflow
  - 32bit counters(ifIn/OutOctets) could wrap in 5.7min at 100Mbps
  - Consider 64bit counters(ifHCInOctets) for 1Gbps or more interfaces

Netflow

```
interface GigabitEthernet0/1
 description Connected with CORE01
 ...
 ip flow ingress

ip flow-export source Loopback0
ip flow-export version 5
ip flow-cache timeout active 5
ip flow-export destination
147.28.0.666 42
```

cache flow

```
ROUTER#show ip cache flow
IP packet size distribution (490668M total packets):
   1-32   64   96  128  160  192  224  256  288  320  352  384  416  448  480
   .027 .379 .119 .029 .018 .009 .124 .005 .004 .003 .021 .002 .003 .002 .001

    512  544  576 1024 1536 2048 2560 3072 3584 4096 4608
   .001 .001 .003 .017 .222 .000 .000 .000 .000 .000 .000

IP Flow Switching Cache, 278544 bytes
  4081 active, 15 inactive, 1512415762 added
  3296743739 ager polls, 0 flow alloc failures
  Active flows timeout in 30 minutes
  Inactive flows timeout in 15 seconds
IP Sub Flow Cache, 34056 bytes
  0 active, 1024 inactive, 0 added, 0 added to flow
  0 alloc failures, 0 force free
  1 chunk, 1 chunk added
  last clearing of statistics never
```

cache flow (cont)

Protocol	Total Flows	Flows /Sec	Packets /Flow	Bytes /Pkt	Packets /Sec	Active(Sec) /Flow	Idle(Sec) /Flow
TCP-Telnet	7663265	1.7	12	56	21.8	0.0	0.9
TCP-FTP	42868722	9.9	4	55	42.0	0.4	0.4
TCP-FTPD	9159818	2.1	10	917	22.8	0.4	0.3
TCP-WWW	11050914413	2572.9	6	775	15507.4	0.3	0.4
TCP-SMTP	221463325	51.5	10	705	529.1	0.3	0.3
TCP-X	109028816	25.3	24	40	613.2	0.0	0.8
TCP-BGP	8448184	1.9	4	379	9.0	0.2	0.5
TCP-NNTP	167143	0.0	7	543	0.2	0.2	0.3
TCP-Frag	3453638	0.8	2	585	2.0	0.0	0.6
TCP-other	23446865011	5459.1	4	522	25183.1	0.2	0.5
UDP-DNS	971690745	226.2	2	73	494.8	0.0	0.8
UDP-NTP	12749722	2.9	7	77	23.1	0.0	0.9
UDP-TFTP	128546	0.0	6	192	0.1	0.3	0.8
UDP-Frag	62728581	14.6	9	771	144.5	0.4	0.4
UDP-other	24867360713	5789.8	7	334	45182.5	0.2	0.5
ICMP	2722517003	633.8	20	55	12923.4	0.0	0.7
IPINIP	56078918	13.0	66	1106	868.3	0.5	0.1
IPv6INIP	24870880	5.7	2	422	16.0	0.2	0.7
GRE	1962929974	457.0	26	405	12124.9	0.3	0.5
IP-other	355858828	82.8	6	333	533.8	0.2	0.5
Total:	65936946245	15352.1	7	417	114242.9	0.2	0.5

cache flow (cont)

SrcIf	SrcIPaddress	DstIf	DstIPaddress	Pr	SrcP	DstP	Pkts
Gi0/0	68.67.176.23	Gi0/2.3207	118.179.151.13	06	0050	D59B	1
Gi0/2.6	118.179.218.28	Gi0/0*	103.4.110.173	06	C8AB	01BB	1
Gi0/2.8	118.179.151.67	Gi0/0*	217.76.78.143	01	0000	0300	1
Gi0/1.16	202.4.111.18	Gi0/0*	190.6.233.117	11	B6F1	C903	1
Gi0/2.8	118.179.151.67	Gi0/0*	81.39.204.17	11	2D6D	8143	2
Gi0/2.9	118.179.220.130	Gi0/0*	103.7.249.141	06	C4D5	01BB	2
Gi0/2.9	118.179.220.130	Gi0/0*	197.230.82.11	11	39B4	F3AB	1
Gi0/0	202.4.96.201	Gi0/1.36	10.6.4.15	11	3454	863C	21
Gi0/2.3207	118.179.151.12	Gi0/0	178.164.247.38	11	80B0	FD07	1
Gi0/0	82.227.60.18	Gi0/2.8	118.179.151.67	11	B1D5	2D6D	1
Gi0/0	124.6.236.250	Gi0/2.8	118.179.151.58	06	684D	5A6F	1
Gi0/2.24	118.179.175.2	Gi0/0*	192.111.149.74	06	C1D2	0D3D	3
Gi0/2.24	118.179.175.2	Gi0/0*	74.125.200.189	06	D93B	01BB	2
Gi0/0	10.111.102.10	Gi0/1.34	10.111.10.10	2F	0000	0000	3
Gi0/0	94.23.145.27	Gi0/2.9	118.179.220.130	06	0050	55F2	4
Gi0/2.9	118.179.220.130	Gi0/0*	23.67.252.171	06	D87A	01BB	1
Gi0/0	188.0.193.173	Gi0/2.8	118.179.151.67	11	8B6B	E070	1
Gi0/0	184.26.162.11	Gi0/2.8	118.179.151.67	06	01BB	0FC5	1

Top Talker

```
ip flow-top-talkers
top 50
sort-by bytes | packets
```

ROUTER#show ip flow top-talkers

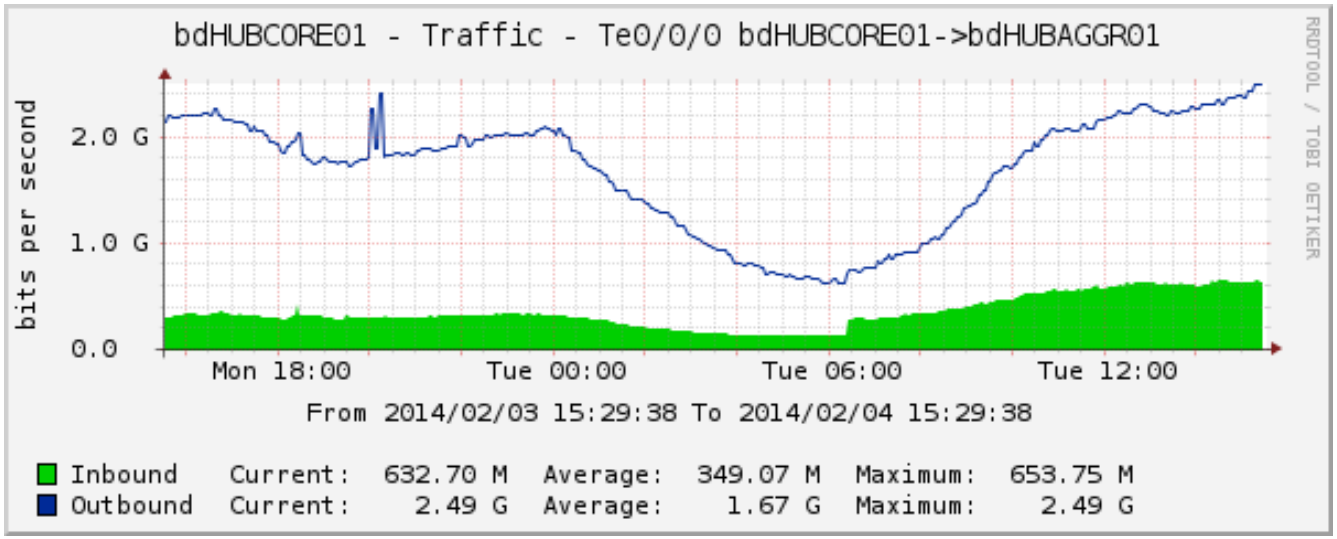
```
SrcIf         SrcIPaddress    DstIf         DstIPaddress    Pr SrcP DstP Bytes
Gi0/0         185.19.212.92   Gi0/2.6       118.179.218.253 06 0050 301D   573K
Gi0/2.9       118.179.220.131 Gi0/0*        118.179.208.186 2F 0000 0000   174K
Gi0/1.16      202.4.105.236   Gi0/0*        83.138.133.170  06 D128 C3C7   134K
Gi0/0         118.179.136.50  Gi0/0         10.10.13.18     04 0000 0000   115K
Gi0/0         118.179.136.50  Gi0/0         10.10.13.10     04 0000 0000   107K
Gi0/0         118.179.136.50  Gi0/0*        10.10.13.10     04 0000 0000   107K
```

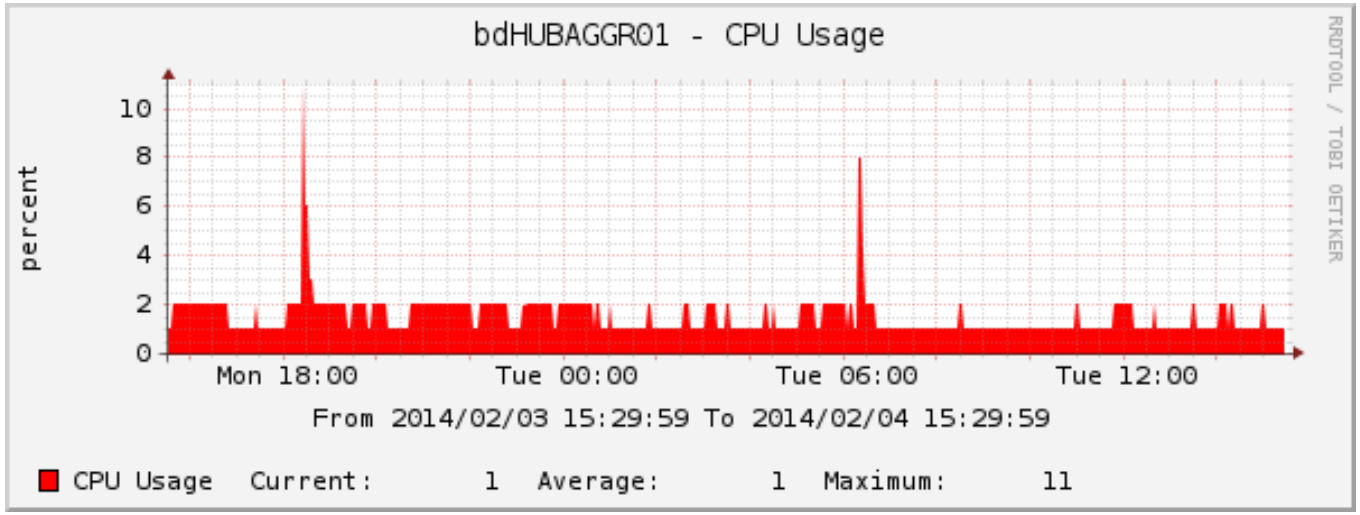
Too much CLI

Visualization

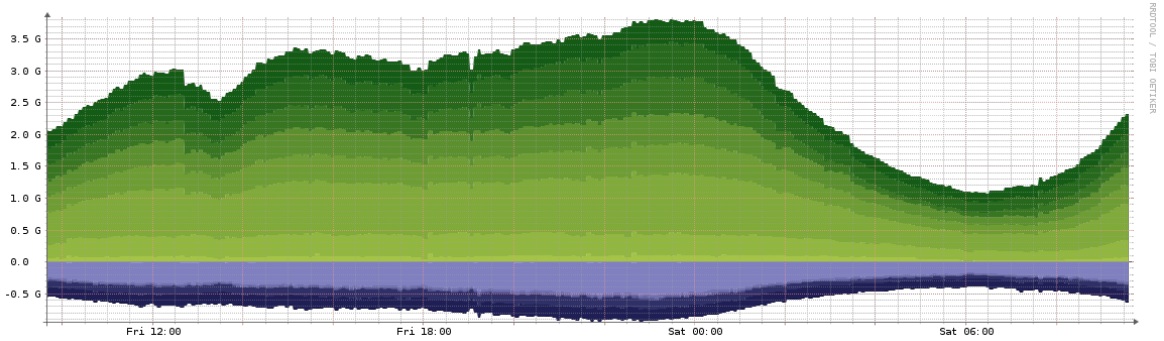
- Helps to understand a trend
  - cpu load, disk space, bps, pps, etc
  - also helps to convince your boss to upgrade ;)
- Visualization tools
  - MRTG
  - RRDtool

Visualization (MRTG/CACTI)





Visualization (Observium)

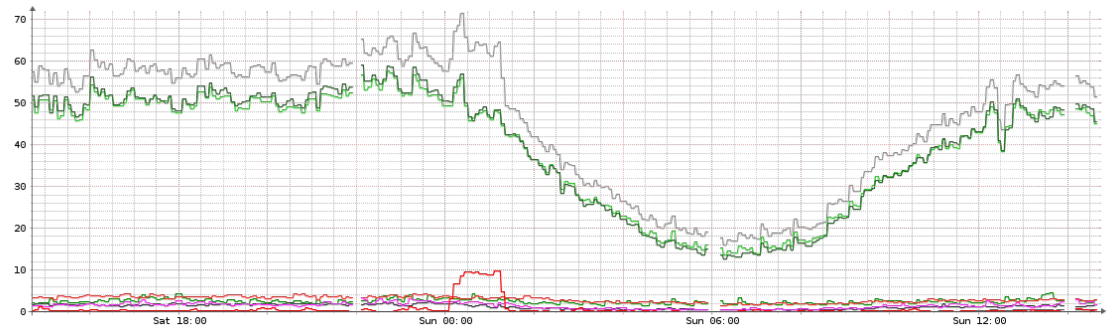


bps		Current	Average	Maximum	Total
core01.bdhub.com	<	0.00 b	0.00 b	0.00 b	0.00 B
Gi0/1/2	>	0.00 b	0.00 b	0.00 b	0.00 B
aggr01.newtexbd.co	<	67.45Mb	73.45Mb	145.12Mb	6.28TB
Gi0/3/5	>	21.54Mb	17.22Mb	36.19Mb	1.47TB
core02.bdhub.com	<	275.18Mb	284.37Mb	393.41Mb	24.57TB
Pos0/2/1	>	301.37Mb	334.78Mb	526.07Mb	28.93TB
core02.bdhub.com	<	567.92Mb	663.72Mb	958.01Mb	57.35TB
Po1	>	31.54Mb	26.38Mb	42.42Mb	2.28TB
core02.bdhub.com	<	281.63Mb	332.89Mb	480.75Mb	28.76TB
Gi0/3/6	>	16.04Mb	12.49Mb	21.83Mb	1.08TB
core02.bdhub.com	<	286.94Mb	332.78Mb	488.19Mb	28.75TB
Gi0/3/7	>	15.46Mb	13.89Mb	25.46Mb	1.20TB
core01.bdhub.com	<	1.67 b	4.65 b	26.82 b	401.69kB
Gi0/1/0	>	3.53 b	1.43 b	3.76 b	123.84kB
core01.bdhub.com	<	236.24Mb	298.98Mb	607.57Mb	25.83TB
Pos3/0/0	>	102.08Mb	110.39Mb	171.33Mb	9.54TB
core02.bdhub.com	<	293.28Mb	369.63Mb	566.14Mb	31.94TB
Pos0/2/0	>	150.40Mb	159.15Mb	211.14Mb	13.75TB
core01.bdhub.com	<	303.42Mb	307.77Mb	436.79Mb	26.59TB
Pos3/0/1	>	6.14kb	9.35kb	268.78kb	807.67MB

Aggregate Totals

28.76TB	<	0.00 b	2.65Gb	3.80Gb
7.28TB	>	0.00 b	671.80Mb	948.79Mb

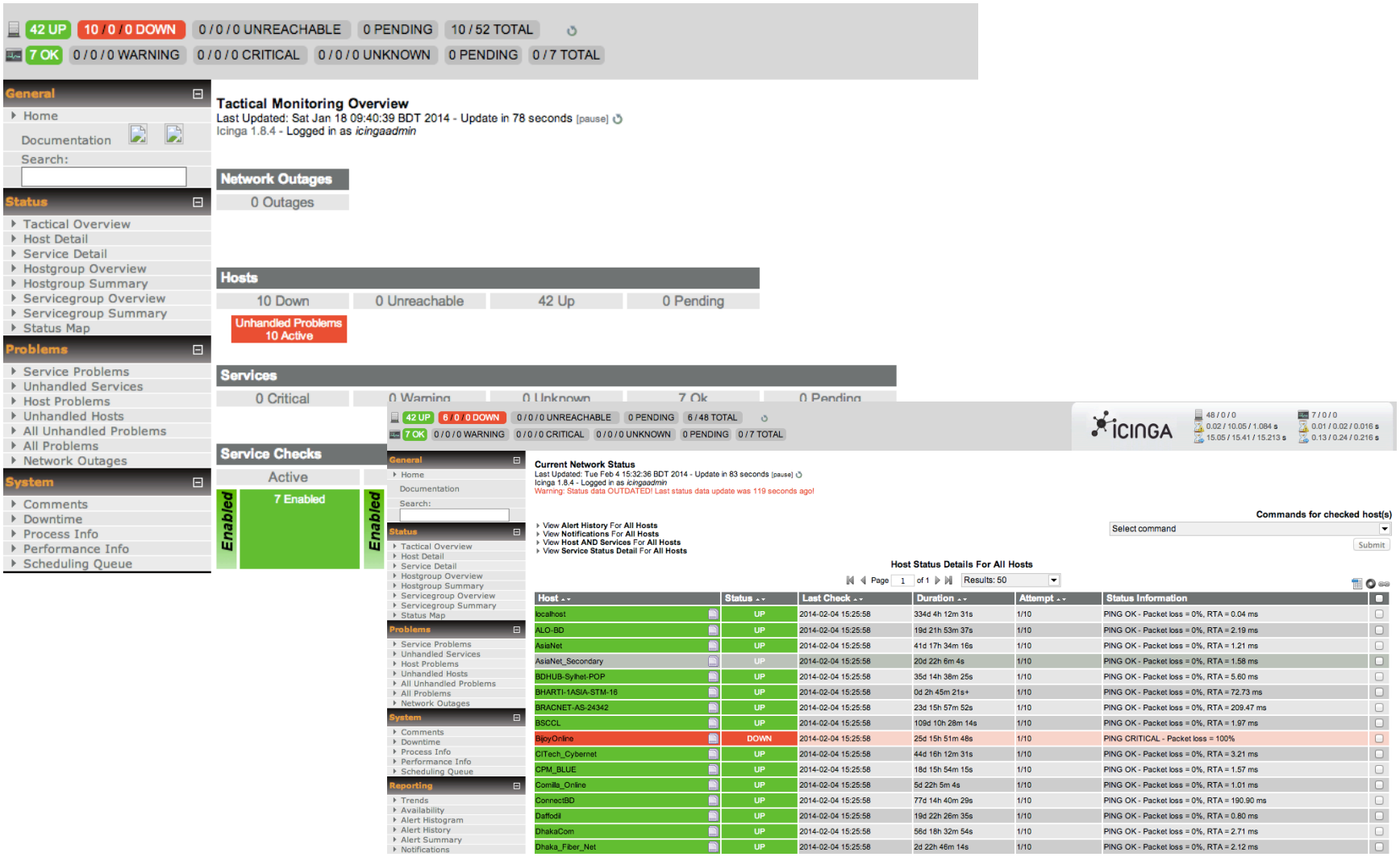
< Observium / system health



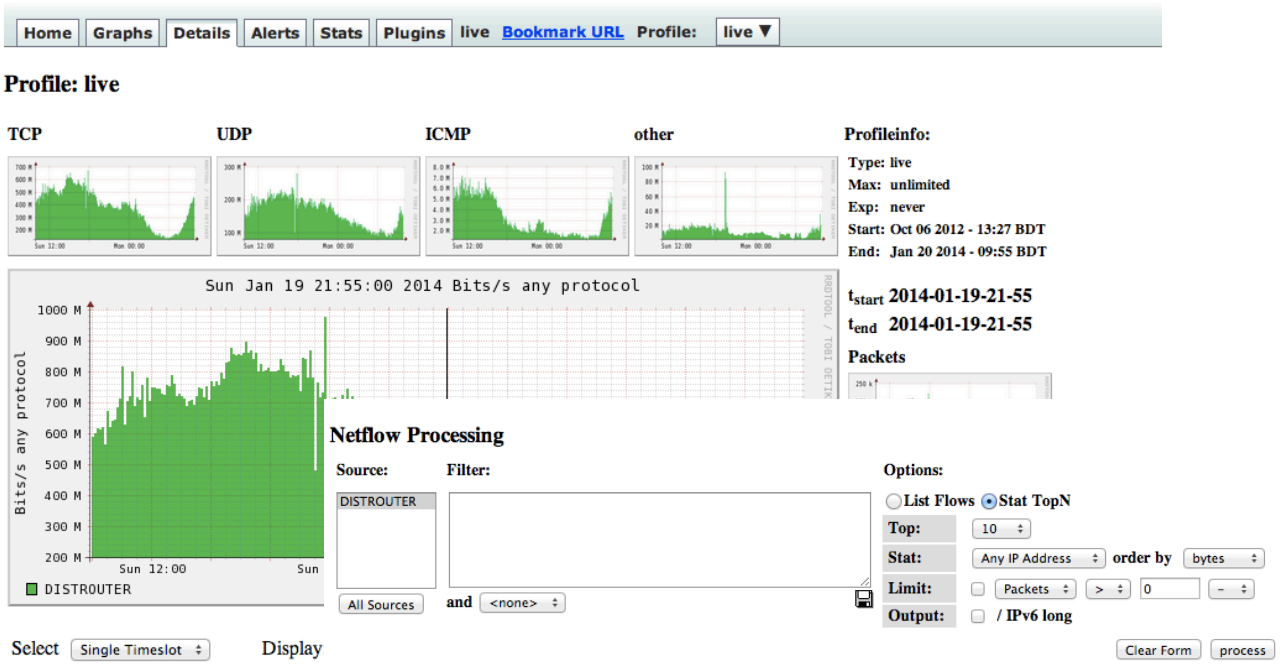
Count	Last	Avg	Min	Max
Responses sent	51.6	45.7	15.9	71.5
Successful answers	45.0	39.4	13.6	57.7
Authoritative answer	2.8	2.5	1.5	4.5
Non-authoritative answer	45.5	39.6	12.5	59.0
Referral answer	0.0	0.0	0.0	0.0
Empty answers	1.6	1.2	310.2m	2.9
SERVFAIL answer	2.9	3.0	1.5	4.4
FORMERR answer	0.0	0.0	0.0	0.0
NXDOMAIN answers	1.8	1.5	377.7m	3.3
Dropped queries	394.2m	59.3m	0.0	580.3m
Failed queries	371.8m	674.4m	19.4m	9.8
Transfers completed	0.0	0.0	0.0	0.0

Observium / > Application Monitoring

Visualization (Icinga/Nagios)



Visualization (Netflow)




```
** nfdump -M /usr/local/nfsen/profiles-data/live/DISTROUTER  -T  -R 2014/01/19/nfcapd.201401191740:2014/01/19/nfcapd.201401191755 -n 10 -s ip/bytes
nfdump filter:
any
Top 10 IP Addr ordered by bytes:
Date first seen          Duration Proto           IP Addr    Flows(%)     Packets(%)       Bytes(%)         pps      bps   bpp
2014-01-19 17:41:00.980  1454.982 any        202.4.114.18   226291( 2.0)    8.3 M( 3.8)    6.9 G( 6.0)      5737   38.0 M   828
2014-01-19 17:40:33.951  1483.004 any      118.179.151.67   942935( 8.4)   10.5 M( 4.8)    5.7 G( 4.9)      7105   30.8 M   542
2014-01-19 17:40:31.153  1485.450 any      118.179.201.251   405171( 3.6)    9.4 M( 4.3)    5.1 G( 4.4)      6336   27.4 M   540
2014-01-19 17:40:37.581  1479.406 any      118.179.133.146   622080( 5.6)    8.0 M( 3.6)    5.0 G( 4.3)      5399   26.8 M   620
2014-01-19 17:40:34.318  1482.413 any       202.4.116.178   324428( 2.9)    5.9 M( 2.7)    3.8 G( 3.3)      4002   20.6 M   644
2014-01-19 17:40:37.165  1478.789 any      118.179.151.58    72285( 0.6)    4.9 M( 2.2)    3.8 G( 3.3)      3320   20.6 M   775
2014-01-19 17:40:43.393  1473.210 any         202.4.97.11    23036( 0.2)   16.3 M( 7.5)    3.2 G( 2.7)     11088   17.3 M   194
2014-01-19 17:40:52.726  1463.461 any      180.211.201.12     5400( 0.0)    2.6 M( 1.2)    2.3 G( 2.0)      1774   12.8 M   900
2014-01-19 17:41:36.049  1410.259 any       202.4.116.242     1219( 0.0)    8.6 M( 3.9)    2.3 G( 2.0)      6081   13.1 M   268
2014-01-19 17:40:46.017  1468.963 any        202.4.96.69     6595( 0.1)    1.6 M( 0.7)    2.2 G( 1.9)      1069   12.1 M  1414

Summary: total flows: 11205509, total bytes: 115.9 G, total packets: 218.9 M, avg bps: 623.8 M, avg pps: 147320, avg bpp: 529
Time window: 2014-01-19 17:40:31 - 2014-01-19 18:05:16
Total flows processed: 11205509, Blocks skipped: 0, Bytes read: 761983424
Sys: 3.820s flows/second: 2933058.4   Wall: 4.650s flows/second: 2409412.8
```

Visualization (Netflow)

Getting NTP reflection attack.

```
** nfdump -M /opt/nfsen/profiles-data/live/CORE01:AGGR01:CORE02  -T  -r 2014/02/18/nfcapd.201402180805 -o long -c 50
nfdump filter:
dst net 223.27.112.11/32
```

Date flow start	Duration	Proto	Src IP Addr:Port		Dst IP Addr:Port	Flags	Tos	Packets	Bytes	Flows
2014-02-18 08:01:06.942	3.552	UDP	180.250.83.170:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.941	3.552	UDP	180.92.184.252:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.938	3.552	UDP	180.240.180.1:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.969	3.520	UDP	182.161.78.165:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.968	2.976	UDP	120.192.76.9:123	->	223.27.112.11:123	.....	32	9	4212	1
2014-02-18 08:01:06.968	3.136	UDP	207.210.126.66:123	->	223.27.112.11:123	.....	0	5	180	1
2014-02-18 08:01:06.966	2.976	UDP	211.140.5.53:123	->	223.27.112.11:123	.....	0	7	3276	1
2014-02-18 08:01:06.966	3.552	UDP	182.161.78.169:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.966	3.456	UDP	211.73.23.2:123	->	223.27.112.11:123	.....	0	6	216	1
2014-02-18 08:01:06.966	3.136	UDP	207.7.131.58:123	->	223.27.112.11:123	.....	0	5	180	1
2014-02-18 08:01:06.963	3.552	UDP	182.161.78.155:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.962	3.136	UDP	207.210.122.18:123	->	223.27.112.11:123	.....	0	5	180	1
2014-02-18 08:01:06.962	3.552	UDP	182.161.78.48:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.960	3.552	UDP	182.171.233.72:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.959	3.168	UDP	208.111.165.39:123	->	223.27.112.11:123	.....	0	5	180	1
2014-02-18 08:01:06.958	3.552	UDP	182.171.245.163:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.957	3.552	UDP	182.161.78.196:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.933	3.840	UDP	188.64.50.12:123	->	223.27.112.11:123	.....	0	467	215532	1
2014-02-18 08:01:06.933	3.584	UDP	182.173.178.170:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.962	2.976	UDP	35.8.223.116:123	->	223.27.112.11:123	.....	0	289	135252	1
2014-02-18 08:01:06.961	3.552	UDP	182.18.194.20:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.960	3.616	UDP	184.22.229.50:123	->	223.27.112.11:123	.....	0	407	187452	1
2014-02-18 08:01:06.960	2.976	UDP	182.173.178.170:123	->	223.27.112.11:123	.....	0	600	280800	1
2014-02-18 08:01:06.958	3.552	UDP	182.24.124.244:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.955	0.000	UDP	219.121.145.218:123	->	223.27.112.11:123	.....	16	100	46800	1
2014-02-18 08:01:06.954	3.584	UDP	182.55.103.96:123	->	223.27.112.11:123	.....	0	7	252	1
2014-02-18 08:01:06.952	3.584	UDP	182.55.116.234:123	->	223.27.112.11:123	.....	0	7	252	1

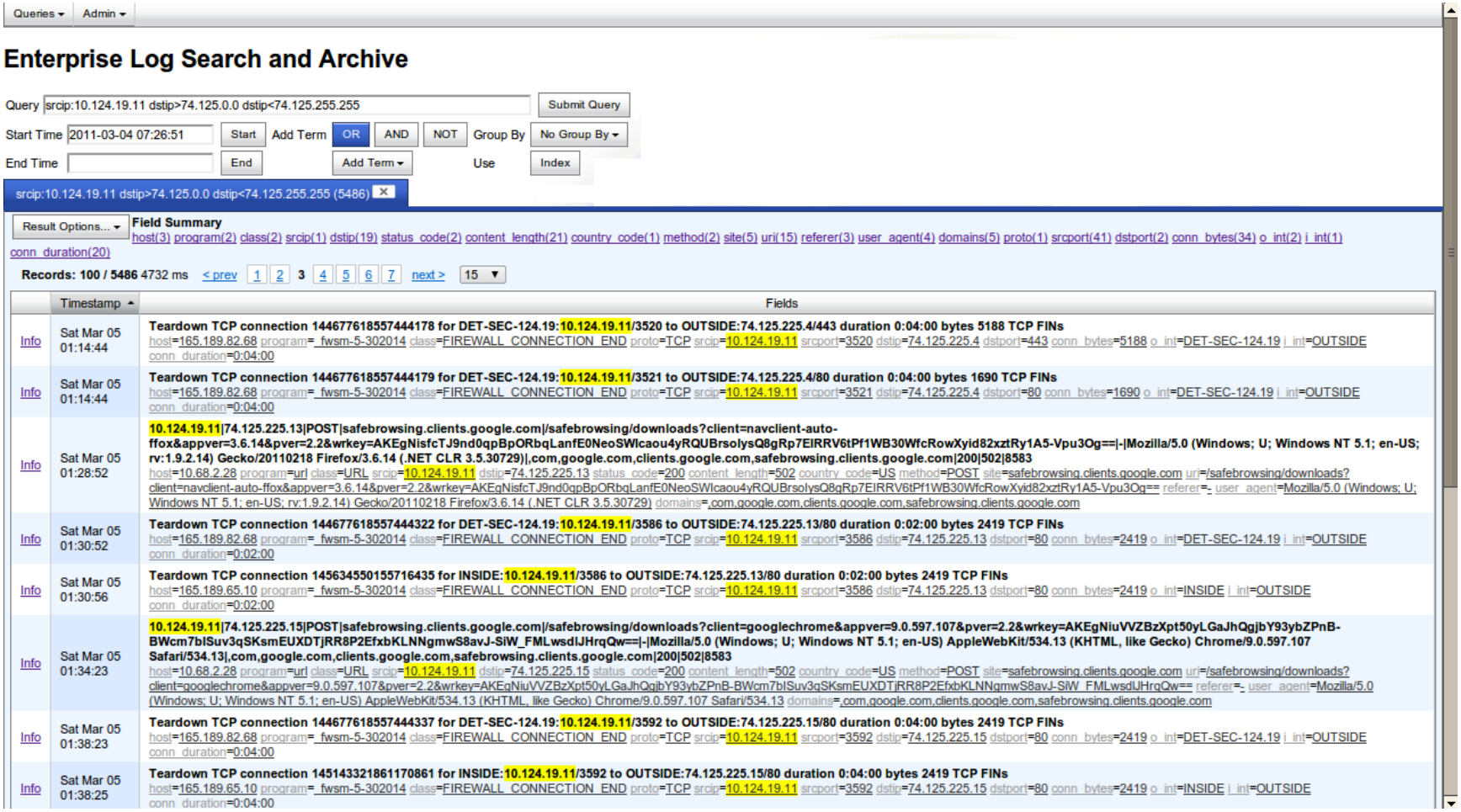
Visualize Log

- ELSA (enterprise-log-search-and-archive)
  - Syslog framework build on Syslog-NG, MySql
  - High-volume receiving/indexing (a single node can receive > 30k logs/sec, sustained)
  - Dashboards using Google Visualizations
  - Email alerting, scheduled reports
  - Plugin architecture for web interface
  - Distributed architecture for clusters
  - Ships with normalization for some Cisco logs, Snort/Suricata, Bro, and Windows via Eventlog-to-Syslog or Snare

- https://code.google.com/p/enterprise-log-search-and-archive/

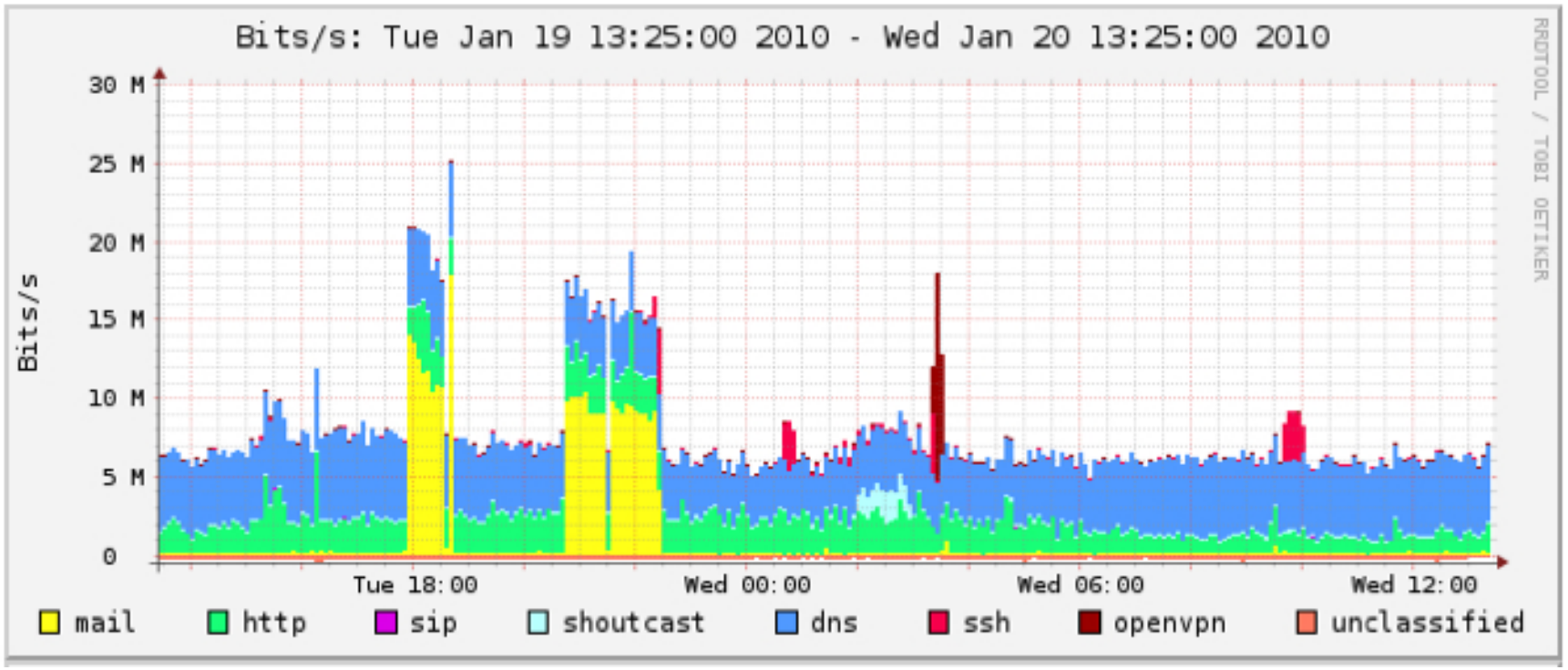
Visualize Log

- ELSA (enterprise-log-search-and-archive)

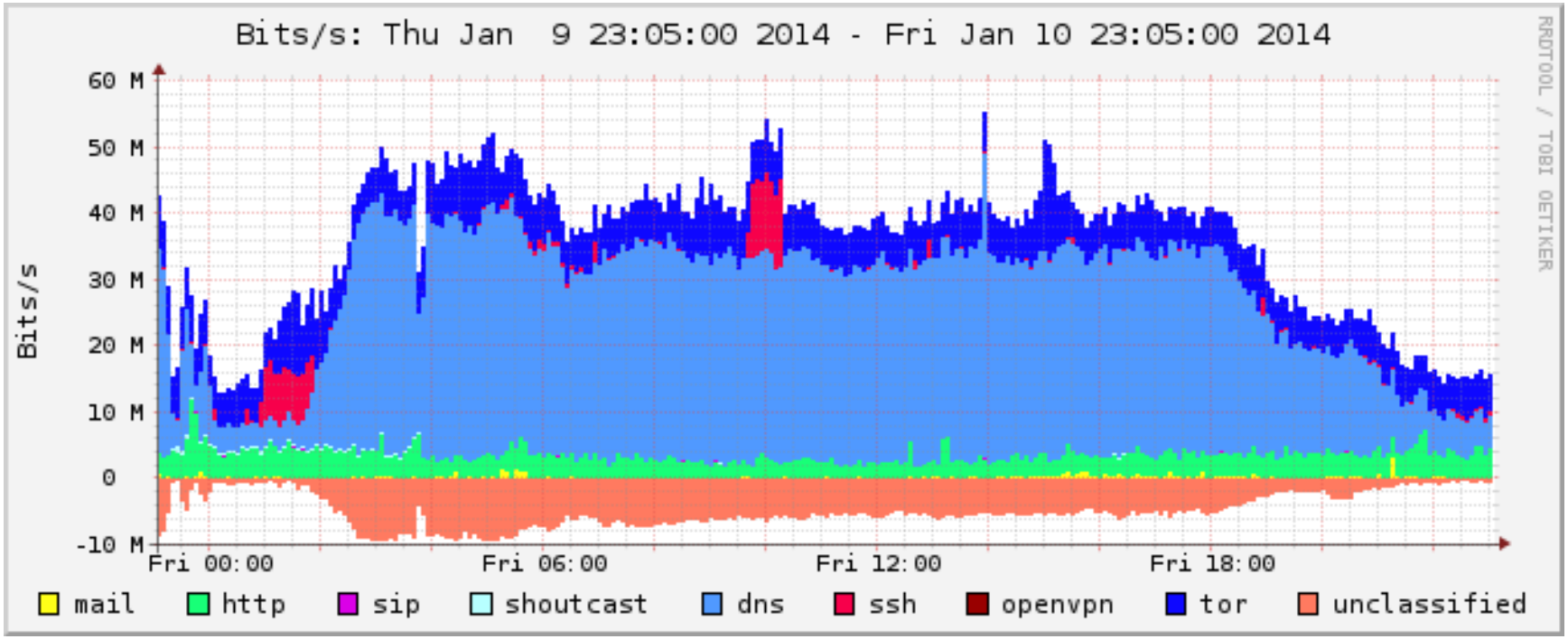


Know Your Traffic

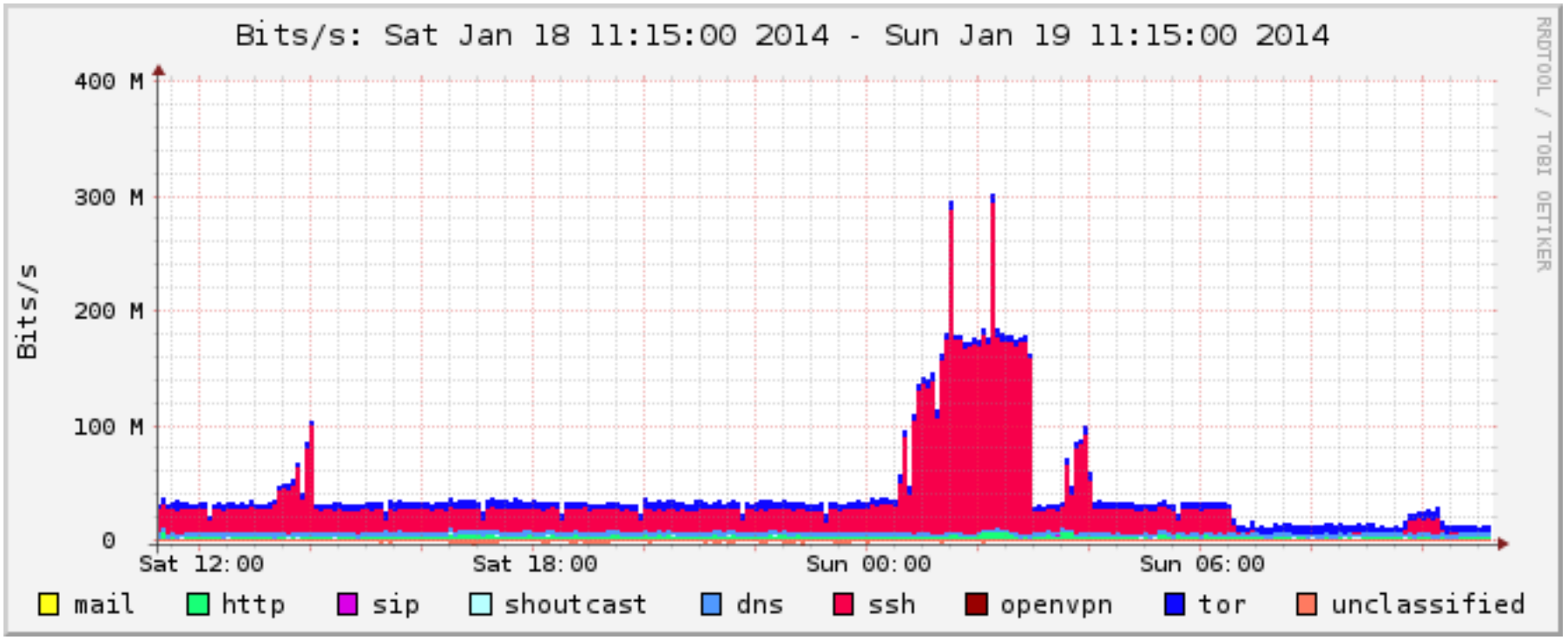
Sudden Spikes in Mail Volume



Too Much DNS Traffic



It’s Not an Attack (It is Backup)



Visualization

- Provide monitoring your devices, and notify you in case of troubles
  - even if you are sleeping
  - syslog, snmp, ping, service(http, smtp, dns)
- Many implementations
  - Nagios, Cacti, Observium etc.
- It's really important to know your traffic pattern.