

Network Management System Debian 12

Pertemuan 7

Workshop Administrasi Jaringan

Fitri Setyorini

Semester Genap

2023-2024

Tools

- Iperf3
- Iptraf-ng
- Nload
- Iftop
- SNMP
- Cacti

1. IPERF3

Iperf3

- iPerf3 adalah tool untuk mengukur bandwidth max, loss dan parameter network lainnya secara aktif
- Iperf3 mendukung tuning beberapa parameter yang berhubungan dengan timing, buffers dan protocols (TCP, UDP, SCTP with IPv4 and IPv6).
- Perf3 dikembangkan oleh ESnet / Lawrence Berkeley National Laboratory.
- Iperf3 dapat digunakan gratis dan termasuk software opensource
- Iperf3 client dapat ditesting dengan iperf3 server yang ada di <https://iperf.fr/iperf-servers.php>
- Iperf3 berjalan di Windows, Linux, Android

Opsi iperf

-f, --format [kmKM]

- format to report: Kbits, Mbits, KBytes, MBytes

-h, --help

- print a help synopsis

-i, --interval n

- pause n seconds between periodic bandwidth reports

-l, --len n[KM]

- set length read/write buffer to n (default 8 KB)

-m, --print_mss

- print TCP maximum segment size (MTU - TCP/IP header)

-o, --output <filename>

- output the report or error message to this specified file

-p, --port n

- set server port to listen on/connect to n (default 5001)

-u, --udp

- use UDP rather than TCP

-w, --window n[KM]

- TCP window size (socket buffer size)

-B, --bind <host>

- bind to <host>, an interface or multicast address

-C, --compatibility

- for use with older versions does not send extra msgs

-M, --mss n

- set TCP maximum segment size (MTU - 40 bytes)

-N, --nodelay

- set TCP no delay, disabling Nagle's Algorithm

-v, --version

- print version information and quit

Opsi Iperf Client

-b, --bandwidth n[KM]

- set target bandwidth to n bits/sec (default 1 Mbit/sec).
- This setting requires UDP (-u).

-c, --client <host>

- run in client mode, connecting to <host>

-d, --dualtest

- Do a bidirectional test simultaneously

-n, --num n[KM]

- number of bytes to transmit (instead of -t)

-r, --tradeoff

- Do a bidirectional test individually

-t, --time n

- time in seconds to transmit for (default 10 secs)

-l, --stdin

- input the data to be transmitted from stdin

-L, --listenport n

- port to receive bidirectional tests back on

-P, --parallel n

- number of parallel client threads to run

-T, --ttl n

- time-to-live, for multicast (default 1)

-Z, --linux-congestion <algo>

- set TCP congestion control algorithm (Linux only)

-F, --fileinput <name>

- input the data to be transmitted from a file

Persyaratan

- Untuk menggunakan iperf, anda harus menyiapkan 2 PC/VM
 - Satu VM sebagai server
 - Satu VM sebagai client
- Anda dapat juga bekerjasama dengan teman anda untuk percobaan ini, satu menjadi server dan satu client, sepanjang berada di dalam satu network

Workshop Iperf

1. Menginstall iperf di PC Server dan Client

- Update Debian

#apt update

- Install iperf di server

#apt install iperf3

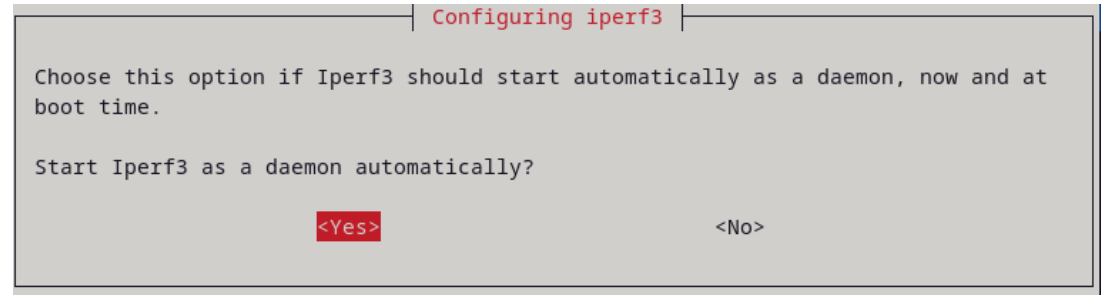
- Ketika anda mengklik Yes, maka iperf3 akan dijalankan secara background

- Cek iperf

#systemctl status iperf

Ternyata iperf3 sudah berjalan secara background

- Lakukan hal yang sama untuk VM client



```
root@debian12:~# systemctl status iperf3
• iperf3.service - iperf3 server
   Loaded: loaded (/lib/systemd/system/iperf3.service; enabled; preset: enabled)
   Active: active (running) since Tue 2024-04-16 05:01:56 PDT; 18s ago
     Docs: man:iperf3(1)
  Main PID: 4336 (iperf3)
    Tasks: 1 (limit: 2244)
   Memory: 832.0K
      CPU: 11ms
   CGroup: /system.slice/iperf3.service
           └─4336 /usr/bin/iperf3 --server --interval 0

Apr 16 05:01:56 debian12 systemd[1]: Started iperf3.service - iperf3 server.
```

- Jika iperf3 bekerja secara background, anda dapat mengecek pid dan pada port berapa iperf3 bekerja
 - Pid iperf3 adalah 4336
 - Nampak iperf3 server bekerja pada port 5201

```
root@debian12:~# ss -nlptu | grep iperf3
tcp    LISTEN 0      4096      *:5201      *:*        users:(("iperf3",pid=4
336,fd=3))
```

2. Menjalankan iperf server

- Matikan dulu iperf3 server yg bekerja secara background
#systemctl stop iperf3
- Nyalakan lagi iperf3 secara foreground

#iperf3 -s

```
root@debian12:~# iperf3 -s
```

```
-----  
Server listening on 5201 (test #1)  
-----
```

- Biarkan server menunggu permintaan koneksi di client.
- Nampak port yang dipakai server adalah 5201

- Untuk mematikan iperf3 server anda menggunakan ctrl c
- Merubah iperf3 server bekerja pada port 7575

#iperf3 -s -p 7575

```
root@debian12:~# iperf3 -s -p 7575
-----
Server listening on 7575 (test #1)
-----
^Ciperf3: interrupt - the server has terminated
```

3. Menjalankan iperf client

- Di Client

Karena port telah diubah ke 7575, tambahkan `-p <nomor port>`

```
#iperf3 -c <nomor-ip-server> -p 7575
```

```
#iperf3 -c <nomor-ip-server> -i 1 -t 10 -p 7575
```

Client akan mengirim paket ke server dengan interval 1 detik, selama 10 x

```
fitri@debian11-server: ~  
root@debian11-server:~# iperf3 -c 192.168.220.128 -p 7575  
Connecting to host 192.168.220.128, port 5201  
[ 5] local 192.168.220.129 port 40986 connected to 192.168.220.128 port 5201  
[ ID] Interval      Transfer    Bitrate      Retr  Cwnd  
[ 5]  0.00-1.00    sec   346 MBytes  2.90 Gbits/sec  12   1.16 MBytes  
[ 5]  1.00-2.00    sec   354 MBytes  2.97 Gbits/sec   0   1.36 MBytes  
[ 5]  2.00-3.00    sec   365 MBytes  3.06 Gbits/sec   0   1.55 MBytes  
[ 5]  3.00-4.00    sec   412 MBytes  3.46 Gbits/sec   0   1.71 MBytes  
[ 5]  4.00-5.00    sec   334 MBytes  2.80 Gbits/sec  10   1.32 MBytes
```

```
fitri@debian11-server: ~  
root@debian11-server:~# iperf3 -c 192.168.220.128 -i 1 -t 10 -p 7575  
Connecting to host 192.168.220.128, port 5201  
[ 5] local 192.168.220.129 port 43176 connected to 192.168.220.128 port 5201  
[ ID] Interval      Transfer    Bitrate      Retr  Cwnd  
[ 5]  0.00-1.00    sec   334 MBytes  2.80 Gbits/sec  36   1.52 MBytes  
[ 5]  1.00-2.00    sec   322 MBytes  2.70 Gbits/sec   0   1.67 MBytes  
[ 5]  2.00-3.00    sec   361 MBytes  3.03 Gbits/sec  13   1.29 MBytes  
[ 5]  3.00-4.00    sec   362 MBytes  3.04 Gbits/sec   0   1.48 MBytes  
[ 5]  4.00-5.00    sec   345 MBytes  2.89 Gbits/sec   0   1.64 MBytes  
[ 5]  5.00-6.00    sec   356 MBytes  2.99 Gbits/sec   0   1.80 MBytes  
[ 5]  6.00-7.00    sec   366 MBytes  3.07 Gbits/sec   2   1.43 MBytes  
[ 5]  7.00-8.00    sec   342 MBytes  2.88 Gbits/sec   0   1.60 MBytes  
[ 5]  8.00-9.00    sec   345 MBytes  2.90 Gbits/sec   0   1.75 MBytes  
[ 5]  9.00-10.00   sec   355 MBytes  2.97 Gbits/sec   6   1.38 MBytes  
-----  
[ ID] Interval      Transfer    Bitrate      Retr  
[ 5]  0.00-10.00   sec   3.41 GBytes  2.93 Gbits/sec  57  
[ 5]  0.00-10.05   sec   3.41 GBytes  2.91 Gbits/sec  
iperf Done.
```

- Tampilan di server, setelah dites client

```
fitri@debian11: ~  
root@debian11:~# iperf3 -s -p 7575  
-----  
Server listening on 7575  
-----  
Accepted connection from 192.168.220.129, port 40984  
[ 5] local 192.168.220.128 port 7575 connected to 192.168.220.129 port 40986  
[ ID] Interval      Transfer    Bitrate  
[ 5]  0.00-1.00  sec    330 MBytes  2.77 Gbits/sec  
[ 5]  1.00-2.00  sec    351 MBytes  2.94 Gbits/sec  
[ 5]  2.00-3.00  sec    364 MBytes  3.05 Gbits/sec  
[ 5]  3.00-4.00  sec    415 MBytes  3.48 Gbits/sec  
[ 5]  4.00-5.00  sec    333 MBytes  2.80 Gbits/sec  
[ 5]  5.00-6.00  sec    346 MBytes  2.91 Gbits/sec  
[ 5]  6.00-7.00  sec    355 MBytes  2.98 Gbits/sec
```

2. Iptraf-ng

IPTraf-ng

- IPTraf-ng adalah utilitas untuk menampilkan statistic jaringan berupa konsol
- Iptraf-ng mengumpulkan informasi seperti paket koneksi TCP, jumlah byte, statistic interface, trafik TCP/UDP, dll

Netcat

- Nama Netcat adalah singkatan dari network dan concatenate, yang mana concatenate berarti menggabungkan beberapa string menjadi satu string
- Netcat adalah salah satu network tool yang powerful dan serbaguna yang tersedia untuk komputer Linux, Mac, dan Windows.
 - Netcat mudah digunakan dan penting untuk dipelajari untuk semua orang yang tertarik dengan komunikasi jaringan.
- Netcat dikenal sebagai “Pisau Swiss Army” dalam IT karena fungsinya yang luas.
 - Netcat bisa digunakan untuk mengirim file sederhana, chatting, portscan, membuat backdoor, dll

Persyaratan

- Untuk menggunakan iptraf-ng, anda harus menyiapkan 2 VM
 - Satu VM sebagai server
 - Satu VM sebagai client
- Anda dapat juga bekerjasama dengan teman anda untuk percobaan ini, satu PC menjadi server dan satu PC client, sepanjang berada di dalam satu network

1. Install iptraf-ng

- Update Debian

`#apt update`

- Install iptraf-ng

`#apt install iptraf-ng`

2. Menjalankan iptraf-ng

- Ketikkan `#iptraf-ng`
- Pilih Detailed interface statistics, klik Enter
- Pilih interface, klik ens33, klik Enter
- Tutup iptraf-ng dengan ketik x

```
IP traffic monitor
General interface statistics
Detailed interface statistics
Statistical breakdowns...
LAN station monitor

Filters...

Configure...

About...

Exit
```

```
Select Interface
ens33
lo
tatistics
statistics
WNS...
```

```
iptraf-ng 1.2.1
Statistics for ens33

      Total      Total      Incoming      Incoming      Outgoing      Outgoing
      Packets    Bytes      Packets      Bytes      Packets      Bytes
Total:      47      6613        17        872         30      5741
IPv4:       47      6601        17        860         30      5741
IPv6:        0         0         0         0         0         0
TCP:        32      3918        17        860         15      3058
UDP:        15      2683         0         0         15      2683
ICMP:        0         0         0         0         0         0
Other IP:    0         0         0         0         0         0
Non-IP:      0         0         0         0         0         0
Broadcast:   0         0         0         0         0         0

Total rates:      0.45 kbps      Broadcast rates:      0.00 kbps
                  0 pps                                0 pps

Incoming rates:   0.08 kbps
                  0 pps

Outgoing rates:   0.37 kbps
                  0 pps

Time: 0:00      Drops: 0

X-exit
```

Test iptraf-ng

1. Install netcat di client dan server

#apt install ncat

2. Cek ip server

#ip addr | grep ens33

```
root@debian12:~# ip addr | grep ens33
2: ens33: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    inet 192.168.173.81/24 brd 192.168.173.255 scope global dynamic noprefixroute ens33
```

3. Coba lakukan pengiriman string dari server (192.168.173.81) ke client.

Perintah ini akan mengirimkan string Hello world ke client lewat port 1234 di sisi server

#echo "Hello World !" | nc -l -p 1234



4. Pada PC Client, siapkan client untuk menerima packet dari server

```
#nc [no-ip-server] [no-port-server] > hello.txt
```

```
#nc 192.168.173.81 1234 > hello.txt
```

Tunggu beberapa detik, kemudian lakukan ctrl c

5. Kita cek isi file hello.txt yang telah didownload client

```
#cat hello.txt
```

Anda dapat melihat string tersebut terkirim ke client

```
Client fitri@debian12: ~
root@debian12:~# nc 192.168.173.81 1234 > hello.txt
^C
```

```
root@debian12:~# cat hello.txt
Hello World !
root@debian12:~#
```

A terminal window titled 'server' with the user 'fitri@debian11-server: ~'. The terminal shows the execution of a 'dd' command to create a 1GB file named 'file.out' from '/dev/zero'. The output indicates that 1024000 records (1048576000 bytes) were copied at a rate of 89.4 MB/s in 11.7233 seconds.

```
server      Fitri@debian11-server: ~
root@debian11-server:~# dd if=/dev/zero of=file.out bs=1024 count=1024000
1024000+0 records in
1024000+0 records out
1048576000 bytes (1.0 GB, 1000 MiB) copied, 11.7233 s, 89.4 MB/s
```

5. Di Server, buka tab/window baru, jalankan iptraf anda.

#iptraf-ng

6. Di Server, buka tab/window baru, buatlah file berukuran 1Gb, bernama file.out

#dd if=/dev/zero of=file.out bs=1024 count=1024000

Jika anda lihat, file yang terbentuk berukuran 1,048,576,000 byte

7. Kita akan mengirim file.out tersebut lewat netcat.

8. Di Server, coba lakukan pengiriman dari server ke client

#cat file.out | nc -l -p 1234

```
root@debian12:~# cat file.out | nc -l -p 1234
```

9. Siapkan client untuk menerima packet dari server menjadi client.out

```
#nc [no-ip-server] [port-server] > client.out
```

```
root@debian12:~# nc 192.168.173.81 1234 > client.out
```

10. Coba buka iptraf anda di server dan client.

Perhatikan terjadi perubahan pada kolom berikut

Pada kolom server, outgoing packet dan outgoing bytes akan terus berubah, karena server mengirim file file.out yang berukuran 1048MB atau 1G

Pada kolom client, incoming packet dan incoming bytes akan terus berubah, karena client menerima file file.out yang berukuran 1048MB atau 1G

Ketika semua byte sudah diterima client, maka Incoming Bytes, mencapai 1053MB, pada server, Outgoing bytes mencapai 1053 Bytes.

Client fitri@debian12: ~

iptraf-ng 1.2.1

Statistics for ens33

	Total Packets	Total Bytes	Incoming Packets	Incoming Bytes	Outgoing Packets	Outgoing Bytes
Total:	117860	1054M	89962	1053M	27898	1465752
IPv4:	117833	1054M	89936	1053M	27897	1465696
IPv6:	27	2973	26	2917	1	56
TCP:	117698	1054M	89859	1053M	27839	1447680
UDP:	161	35383	103	17367	58	18016
ICMP:	1	56	0	0	1	56
Other IP:	0	0	0	0	0	0
Non-IP:	0	0	0	0	0	0
Broadcast:	44	9896	44	9896	0	0

Total rates: 0.00 kbps 0 pps Broadcast rates: 0.00 kbps 0 pps

Incoming rates: 0.00 kbps 0 pps

Outgoing rates: 0.00 kbps

Time: 0:12 0 pps Drops: 0

X-exit

Server fitri@debian12: ~

iptraf-ng 1.2.1

Statistics for ens33

	Total Packets	Total Bytes	Incoming Packets	Incoming Bytes	Outgoing Packets	Outgoing Bytes
Total:	115325	1054M	27913	1459025	87412	1053M
IPv4:	115282	1054M	27893	1457421	87389	1053M
IPv6:	43	4070	20	1604	23	2466
TCP:	115163	1054M	27839	1447680	87324	1053M
UDP:	146	25859	74	11345	72	14514
ICMP:	7	360	0	0	7	360
Other IP:	9	640	0	0	9	640
Non-IP:	0	0	0	0	0	0
Broadcast:	29	7860	29	7860	0	0

Total rates: 0.00 kbps 0 pps Broadcast rates: 0.00 kbps 0 pps

Incoming rates: 0.00 kbps 0 pps

Outgoing rates: 0.00 kbps

Time: 0:12 0 pps Drops: 0

X-exit

Nload

nload

- nload is a command-line tool to keep an eye on network traffic and bandwidth usage in real time.
- It helps you to monitor incoming and outgoing traffic using graphs and provides additional information such as the total amount of transferred data and min/max network usage.

Persyaratan

- Untuk menggunakan iperf, anda harus menyiapkan 2 PC/VM
 - Satu VM sebagai server
 - Satu VM sebagai client

1. Install dan jalankan nload

- Update Debian

`#apt update`

- Install nload di server dan client

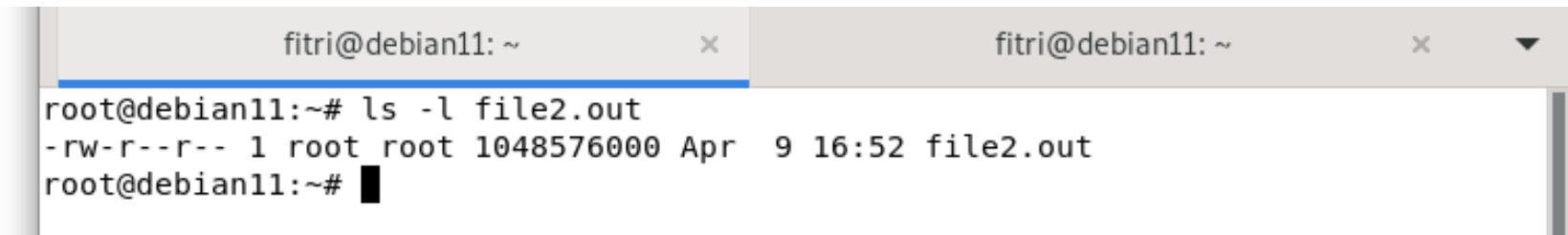
`#apt install nload`

- Di sisi server, buka window baru, jalankan nload

`#nload`

2. Testing nload

- Di Server, kita akan mengirim file.out yang telah dibuat pada saat praktikum iptraf-ng dengan perintah dd
- Buka tab baru di directory dimana file.out dibuat
#ls -l file.out



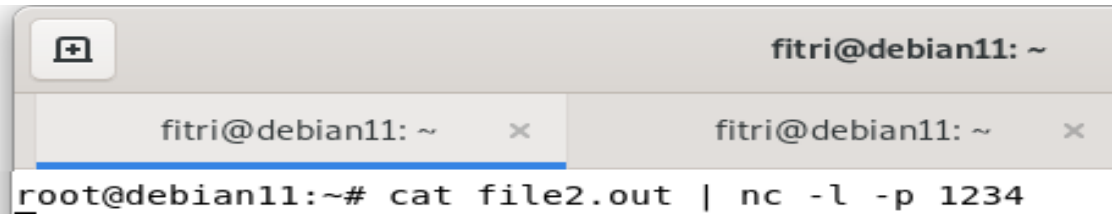
```
fitri@debian11: ~ x fitri@debian11: ~ x ▼
root@debian11:~# ls -l file2.out
-rw-r--r-- 1 root root 1048576000 Apr  9 16:52 file2.out
root@debian11:~# █
```

4. Sekarang buka tab baru, jalankan nload di 192.168.220.128

```
#nload
```

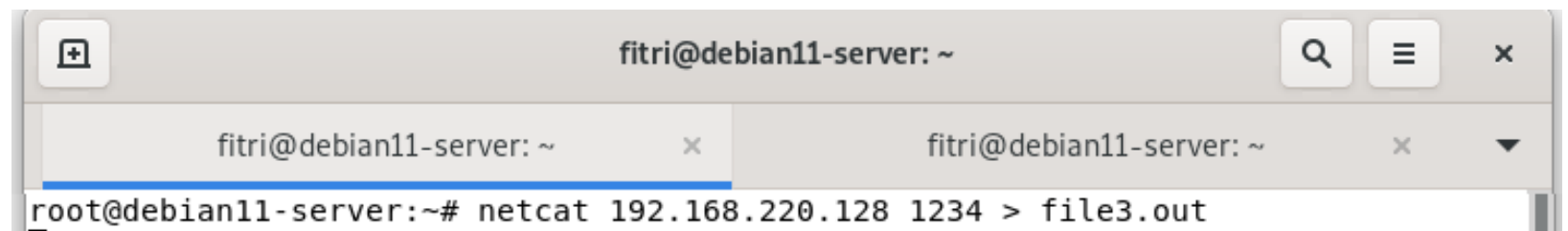
5. Buka tab baru. Pada 192.168.220.128, jalankan netcat untuk mengirim file2.out ke 192.1

```
#cat file2.out | nc -l -p 1234
```



6. Pada 192.168.220.129, jalankan netcat untuk menerima file2.out menjadi file3.out

```
#netcat 192.168.220.128 1234 > file3.out
```



7. Pada 192.168.220.128, buka tab yang berisi nload dan lihat bagaimana 192.168.220.128 mengirim paket berukuran 1G ke 192.168.220.129. Lihat pada bagian outgoing. #### menunjukkan berapa byte yang dikirim dari interface ens33

```
fritri@debian11: ~ x      fritri@debian11: ~ x      fritri@debian11: ~ x ▼
```

```
Device ens33 [192.168.220.128] (1/1):  
=====
```

```
Incoming:
```

```
..|##..#          Curr: 0.00 Bit/s  
#####|         Avg: 260.98 kBit/s  
#####          Min: 0.00 Bit/s  
#####          Max: 5.96 MBit/s  
#####          Ttl: 2.05 GByte
```

```
Outgoing:
```

```
#####  
#####  
#####  
#####  
#####  
#####          Curr: 0.00 Bit/s  
#####          Avg: 109.68 MBit/s  
#####          Min: 0.00 Bit/s  
#####          Max: 2.40 GBit/s  
#####          Ttl: 3.07 GByte
```

```
fritri@debian11: ~ x      fritri@debian11: ~ x      fritri@debian11: ~ x ▼
```

```
Device ens33 [192.168.220.128] (1/1):  
=====
```

```
Incoming:
```

```
.| .                               Curr: 0.00 Bit/s  
## #.                             Avg: 354.86 kBit/s  
.##. ###                          Min: 0.00 Bit/s  
#### |###                        Max: 4.91 MBit/s  
|#####|                         Ttl: 2.05 GByte
```

```
Outgoing:
```

```
#####  
#####  
#####  
#####  
#####  
#####                                Curr: 0.00 Bit/s  
#####                                Avg: 191.70 MBit/s  
#####                                Min: 0.00 Bit/s  
#####                                Max: 2.40 GBIt/s  
#####                                Ttl: 2.05 GByte
```


7. Perhatikan ada pergeseran dari kanan ke kiri, sebelum akhirnya ##### semakin habis.

```
fitri@debian11: ~xfitri@debian11: ~x▼
```

```
Device ens33 [192.168.220.128] (1/1):  
=====
```

Incoming:

Curr: 0.00 Bit/s
Avg: 105.77 kBit/s
Min: 0.00 Bit/s
Max: 1.88 MBit/s
Ttl: 2.05 GByte

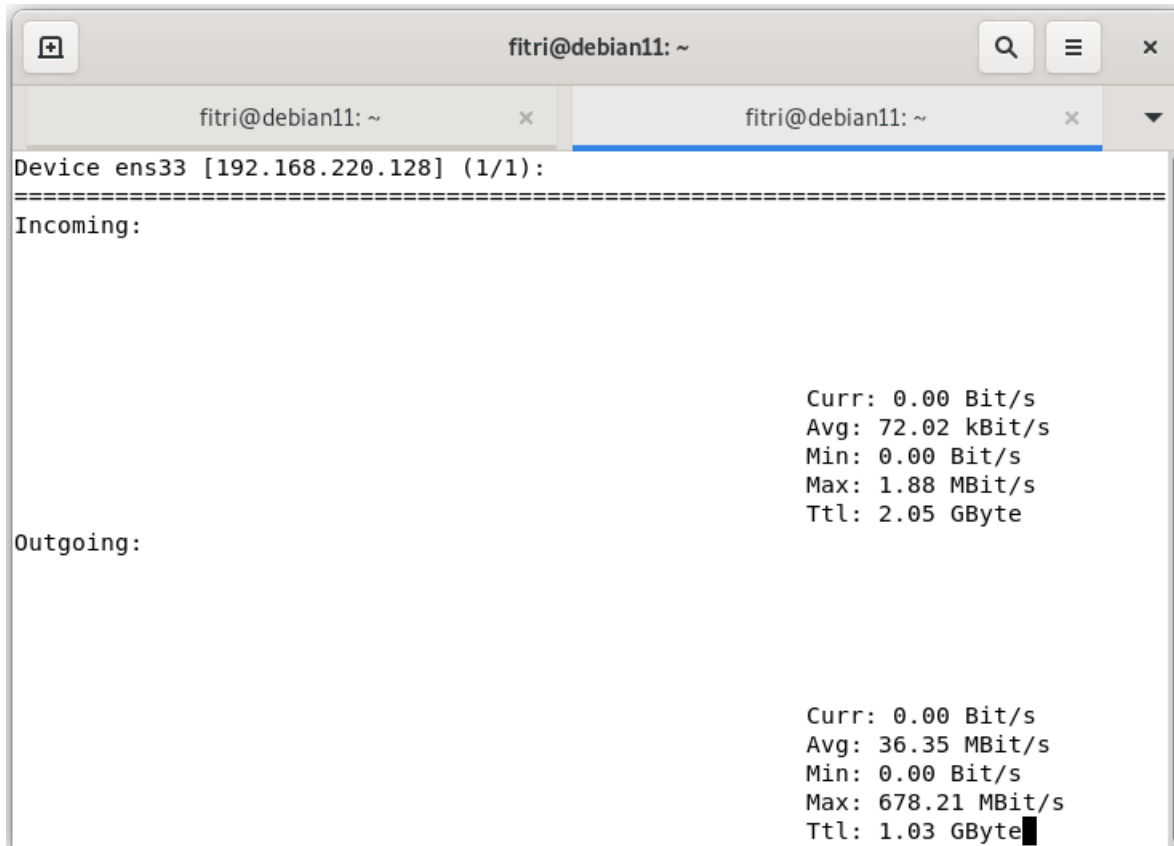
.|||. ...##....#####.
Outgoing:

Curr: 0.00 Bit/s
Avg: 53.50 MBit/s
Min: 0.00 Bit/s
Max: 678.21 MBit/s
Ttl: 1.03 GByte

█

```
fitri@debian11: ~  
Device ens33 [192.168.220.128] (1/1):  
===== Incoming:  
  
| Curr: 1.48 kBit/s  
# Avg: 235.99 kBit/s  
# Min: 0.00 Bit/s  
## Max: 5.96 MBit/s  
Ttl: 2.05 GByte  
  
Outgoing:  
##  
##  
##  
##  
##  
##  
##  
Curr: 0.00 Bit/s  
Avg: 98.75 MBit/s  
Min: 0.00 Bit/s  
Max: 2.40 GBit/s  
Ttl: 3.07 GByte
```

7. Pada saat pengirima selesai, ##### sudah tidak nampak lagi



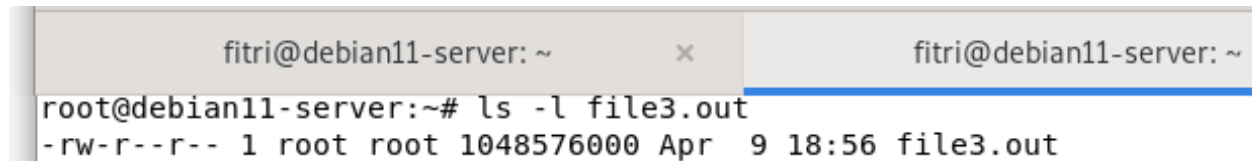
```
fitri@debian11: ~
Device ens33 [192.168.220.128] (1/1):
=====
Incoming:

                                Curr: 0.00 Bit/s
                                Avg: 72.02 kBit/s
                                Min: 0.00 Bit/s
                                Max: 1.88 MBit/s
                                Ttl: 2.05 GByte

Outgoing:

                                Curr: 0.00 Bit/s
                                Avg: 36.35 MBit/s
                                Min: 0.00 Bit/s
                                Max: 678.21 MBit/s
                                Ttl: 1.03 GByte
```

8. Cek ukuran file di 192.168.220.129, ukuran paket yang diterima, yaitu file3.out sebesar 1GB

A terminal window with two tabs. The left tab is titled 'fitri@debian11-server: ~' and contains the command 'ls -l file3.out' and its output. The right tab is also titled 'fitri@debian11-server: ~' but is empty. The terminal output shows the file 'file3.out' has a size of 1048576000 bytes (1GB).

```
fitri@debian11-server: ~  
root@debian11-server:~# ls -l file3.out  
-rw-r--r-- 1 root root 1048576000 Apr  9 18:56 file3.out
```

lftop

iftop

- iftop is a network analyzing tool used by system administrators to view the bandwidth related stats.
- It shows a quick overview of the networking activities on an interface.
- It stands for Interface TOP and the top is derived from top command in Linux.
- It even acts as a diagnostics to diagnose which program is causing the problem to the network.

Persyaratan

- Untuk menggunakan iftop, anda harus menyiapkan 2 PC/VM
 - Satu VM sebagai server
 - Satu VM sebagai client

Workshop Iftop

- Install iftop di server dan client

`#apt install iftop`

- Buka tab baru, jalankan iftop di 192.168.220.129

`#iftop`

- Kita akan mengirim file3.out yang berukuran 1G ke 192.168.220.128

- Kita cek file3.out pada 192.168.220.128

`#ls -l file3.out`

4. Pada VM yang sama, sekarang buka tab baru, jalankan iftop di 192.168.220.128

```
#iftop
```

5. Buka tab baru. Pada 192.168.220.128, jalankan netcat untuk mengirim file3.out ke 192.168.220.129

```
#cat file3.out | nc -l -p 1234
```


6. Pada 192.168.220.129, jalankan netcat untuk menerima file3.out menjadi file4.out

```
#netcat 192.168.220.129 1234 > file4.out
```

7. Pada 192.168.220.128, buka tab yang berisi iftop dan lihat bagaimana 192.168.220.129 mengirim paket berukuran 1G ke 192.168.220.128. Lihat ke bagian TX di bawah

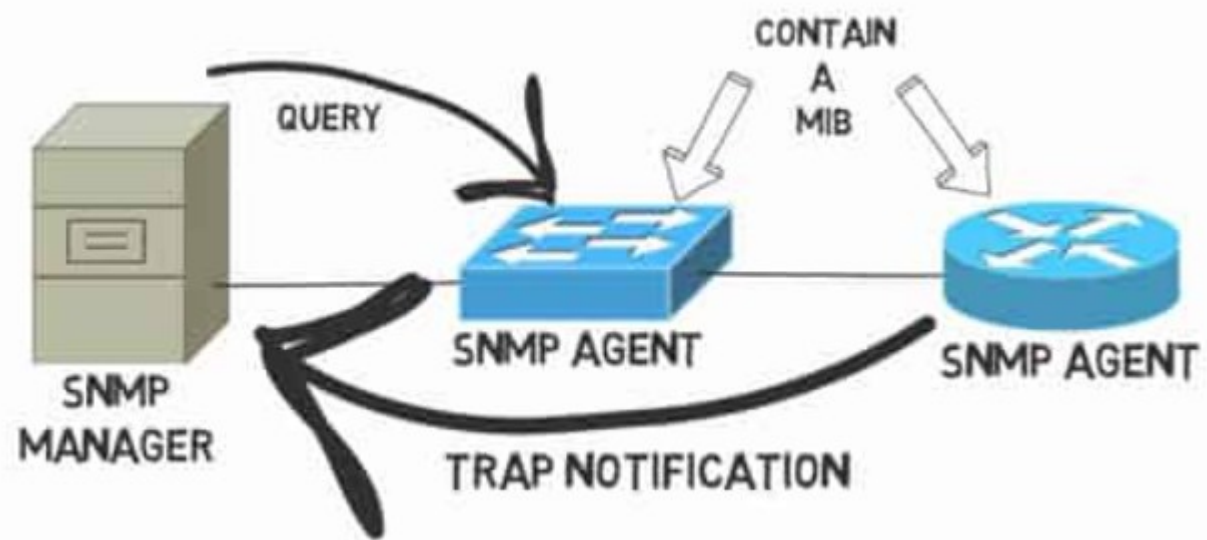
Simple Network Management Protocol (SNMP)

SNMP

- SNMP adalah protocol yang digunakan untuk memonitor dan memanipulasi beberapa aspek konfigurasi dan trafik jaringan
- SNMP memiliki beberapa versi, dari v1 yang paling lama, v2c, dan v3 yang paling baru dan paling secure
- SNMP terdiri dari 2 bagian : SNMP manager dan SNMP agent.
- SNMP manager bertugas mengumpulkan informasi dari SNMP agent

How SNMP works

- On SNMP-enabled devices, an SNMP agent collects information from the device and stores it within a Management Information Base (MIB)
- MIB job is for storing data so that it can be accessed whenever the SNMP manager polls the SNMP agent.
- When the SNMP Manager queries the SNMP agent, data is taken from the MIB and sent to the SNMP Manager where it can be viewed with a network monitoring tool.
- There are many different commands that you can use to query an SNMP agent.
- The most common ways are through the use of the GET or the GET-Next command.
- The GET command is used to take an Object Identifier (OID) from the MIB.
- The GET-Next command is a little more advanced and goes through a MIB tree from OID to OID pulling information.



1. Install snmp

- Update linux anda
#apt update
- Install software berikut
#apt install snmpd snmp libsnmp-dev
- Cek versi snmp
#snmpd -v
- Begitu diinstall, service snmpd akan berjalan
#systemctl status snmpd

```
fitri@debian11-server: ~  
root@debian11-server:~# snmpd -v  
NET-SNMP version: 5.9  
Web: http://www.net-snmp.org/  
Email: net-snmp-coders@lists.sourceforge.net
```

```
fitri@debian11-server: ~  
root@debian11-server:~# systemctl status snmpd  
● snmpd.service - Simple Network Management Protocol (SNMP) Daemon.  
   Loaded: loaded (/lib/systemd/system/snmpd.service; enabled; vendor preset: enabled)  
   Active: active (running) since Fri 2023-04-07 11:42:59 WIB; 9min ago  
     Process: 2219 ExecStartPre=/bin/mkdir -p /var/run/agentx (code=exited, status=0/SUCCESS)  
    Main PID: 2220 (snmpd)  
      Tasks: 1 (limit: 2278)  
     Memory: 9.0M  
        CPU: 461ms  
    CGroup: /system.slice/snmpd.service  
            └─2220 /usr/sbin/snmpd -Low -u Debian-snmp -g Debian-snmp -I -smux  
  
Apr 07 11:42:59 debian11-server systemd[1]: Starting Simple Network Management Protocol (SNMP) Daemon: /usr/sbin/snmpd.  
Apr 07 11:42:59 debian11-server systemd[1]: Started Simple Network Management Protocol (SNMP) Daemon: /usr/sbin/snmpd.  
root@debian11-server:~#
```

- Direktory konfigurasi snmp ada di /etc/snmp/. Cek isi directory tersebut

```
#ls -l /etc/snmp/
```

- Ada 2 file konfigurasi.
 - Untuk agent, yang dipakai snmp.conf.
 - Untuk snmp manager, yang dipakai snmpd.conf.

- Backup file konfigurasi snmp

```
#cp /etc/snmp/snmpd.conf /etc/snmp/snmpd.conf.orig
```

- Lakukan konfigurasi snmp

```
#nano /etc/snmp/snmpd.conf
```

2. Konfigurasi smpd.conf

- Carilah kata : agentaddress dan rocommunity dengan ctrl w, lalu beri tanda # pada baris agentaddress dan rocommunity
- Tambahkan baris dibawah
- Simpan dan exit
- Ubah parameter agent addres dan rocommunity
- Beri tanda # pada nilai agent addres
- Ketik :
agentaddress udp:<nomor-ip-server>:161

- Artinya kita mengaktifkan snmp server pada nomor ip <nomor-ip-server> dan port 161
- Beri tanda # pada nilai rocommunity sebelumnya
- Ketik :
rocommunity public

Artinya, community yang dipakai bernama public dan bersifat readonly

```
fitri@debian11: ~  
GNU nano 5.4 /etc/snmp/snmpd.conf  
master agentx  
  
# agentaddress: The IP address and port number that the agent will listen on.  
# By default the agent listens to any and all traffic from any  
# interface on the default SNMP port (161). This allows you to  
# specify which address, interface, transport type and port(s) that you  
# want the agent to listen on. Multiple definitions of this token  
# are concatenated together (using ':'s).  
# arguments: [transport:]port[@interface/address],...  
  
#agentaddress 127.0.0.1,[:1]  
agentaddress udp:192.168.220.128:161
```

```
fitri@debian11: ~  
GNU nano 5.4 /etc/snmp/snmpd.conf  
# arguments: community [default|hostname|network/bits] [oid | -V view]  
  
# Read-only access to everyone to the systemonly view  
#rocommunity public default -V systemonly  
#rocommunity6 public default -V systemonly  
rocommunity public  
# SNMPv3 doesn't use communities, but users with (optionally) an
```

3. Restart snmpd

- Restart snmpd

#systemctl restart snmpd

- Cek statusnya

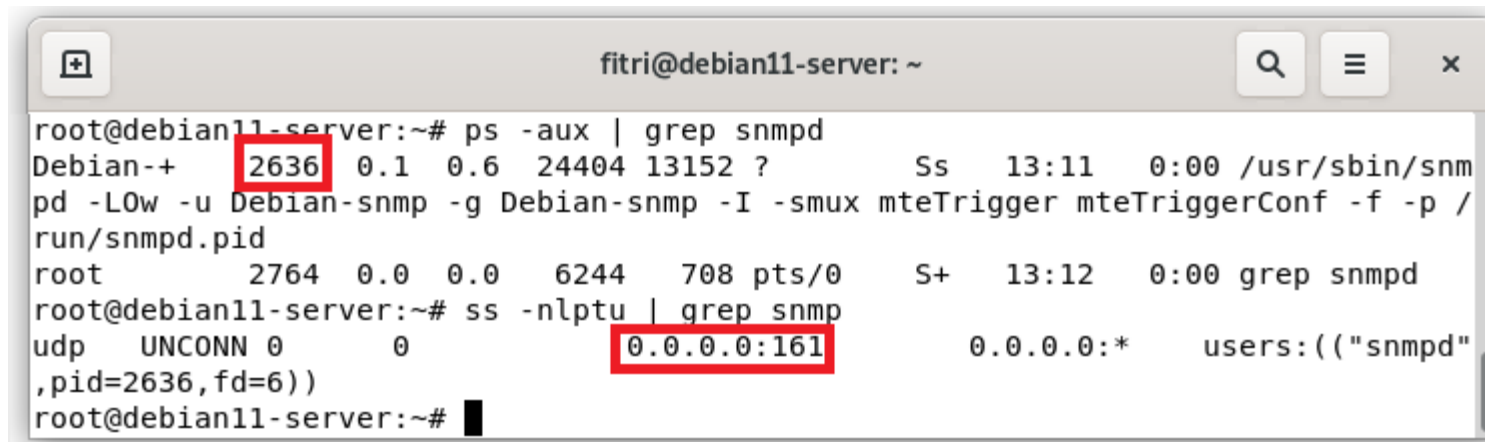
#systemctl status snmpd

```
fitri@debian11-server: ~  
root@debian11-server:~# systemctl restart snmpd
```

```
fitri@debian11-server: ~  
root@debian11-server:~# systemctl status snmpd  
● snmpd.service - Simple Network Management Protocol (SNMP) Daemon.  
   Loaded: loaded (/lib/systemd/system/snmpd.service; enabled; vendor preset: en  
   Active: active (running) since Fri 2023-04-07 13:11:26 WIB; 8s ago  
   Process: 2635 ExecStartPre=/bin/mkdir -p /var/run/agentx (code=exited, stat  
   Main PID: 2636 (snmpd)  
     Tasks: 1 (limit: 2278)  
    Memory: 4.7M  
       CPU: 70ms  
    CGroup: /system.slice/snmpd.service  
            └─2636 /usr/sbin/snmpd -LOW -u Debian-snmp -g Debian-snmp -I -smux>  
  
Apr 07 13:11:26 debian11-server systemd[1]: Starting Simple Network Management >  
Apr 07 13:11:26 debian11-server systemd[1]: Started Simple Network Management P>  
Apr 07 13:11:26 debian11-server snmpd[2636]: /etc/snmp/snmpd.conf: line 50: War>
```

4. Cek snmp

- Cek pid proses snmpd. Perhatikan bahwa pid sama seperti ketika dicek dengan `systemctl status snmpd`
- Cek status netstat, perhatikan bahwa socket yang dipakai adalah udp dengan port 161



```
fitri@debian11-server: ~  
root@debian11-server:~# ps -aux | grep snmpd  
Debian-+ 2636 0.1 0.6 24404 13152 ? Ss 13:11 0:00 /usr/sbin/snmp  
pd -LOW -u Debian-snmp -g Debian-snmp -I -smux mteTrigger mteTriggerConf -f -p /  
run/snmpd.pid  
root 2764 0.0 0.0 6244 708 pts/0 S+ 13:12 0:00 grep snmpd  
root@debian11-server:~# ss -nlptu | grep snmp  
udp UNCONN 0 0 0.0.0.0:161 0.0.0.0:* users:(("snmpd"  
,pid=2636,fd=6))  
root@debian11-server:~#
```

The screenshot shows a terminal window with the following commands and output:

- `ps -aux | grep snmpd` output shows the `snmpd` process with PID 2636.
- `ss -nlptu | grep snmp` output shows a UDP socket on port 161.

5. snmpwalk

- SNMP walk is an SNMP application that uses SNMP GETNEXT requests to collect SNMP data from network and infrastructure SNMP-enabled devices, such as switches and routers.
- Performing an SNMP walk can help you troubleshoot missing or inaccurate stats for networking devices and other devices polled via SNMP by confirming SNMP communication with remote devices and which object identifiers (OIDs) are responding.

- Cek dulu nomor IP anda

```
#ip addr
```

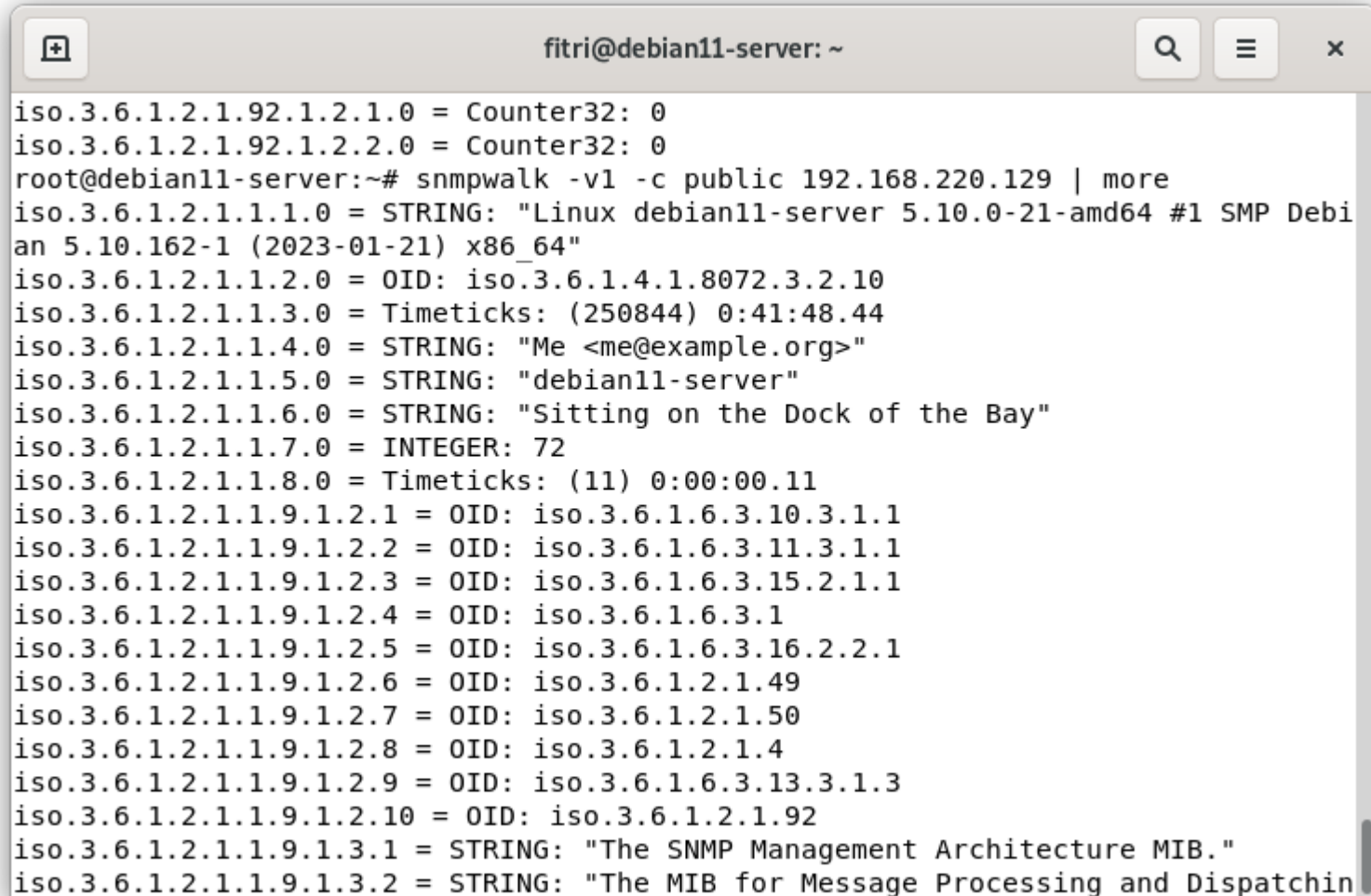
- Lakukan snmpwalk

```
#snmpwalk -v 1 -c public <nomor-ip-server>
```

- Agar tidak scrolldown, gunakan more

```
#snmpwalk -v 1 -c public <nomor-ip-server> | more
```

Output snmpwalk

A terminal window titled 'fitri@debian11-server: ~' with search, menu, and close buttons. It displays the output of an 'snmpwalk' command. The output lists various SNMP objects and their values, including counters, strings, and OIDs. The text is wrapped in the terminal window.

```
fitri@debian11-server: ~
iso.3.6.1.2.1.92.1.2.1.0 = Counter32: 0
iso.3.6.1.2.1.92.1.2.2.0 = Counter32: 0
root@debian11-server:~# snmpwalk -v1 -c public 192.168.220.129 | more
iso.3.6.1.2.1.1.1.0 = STRING: "Linux debian11-server 5.10.0-21-amd64 #1 SMP Debi
an 5.10.162-1 (2023-01-21) x86_64"
iso.3.6.1.2.1.1.2.0 = OID: iso.3.6.1.4.1.8072.3.2.10
iso.3.6.1.2.1.1.3.0 = Timeticks: (250844) 0:41:48.44
iso.3.6.1.2.1.1.4.0 = STRING: "Me <me@example.org>"
iso.3.6.1.2.1.1.5.0 = STRING: "debian11-server"
iso.3.6.1.2.1.1.6.0 = STRING: "Sitting on the Dock of the Bay"
iso.3.6.1.2.1.1.7.0 = INTEGER: 72
iso.3.6.1.2.1.1.8.0 = Timeticks: (11) 0:00:00.11
iso.3.6.1.2.1.1.9.1.2.1 = OID: iso.3.6.1.6.3.10.3.1.1
iso.3.6.1.2.1.1.9.1.2.2 = OID: iso.3.6.1.6.3.11.3.1.1
iso.3.6.1.2.1.1.9.1.2.3 = OID: iso.3.6.1.6.3.15.2.1.1
iso.3.6.1.2.1.1.9.1.2.4 = OID: iso.3.6.1.6.3.1
iso.3.6.1.2.1.1.9.1.2.5 = OID: iso.3.6.1.6.3.16.2.2.1
iso.3.6.1.2.1.1.9.1.2.6 = OID: iso.3.6.1.2.1.49
iso.3.6.1.2.1.1.9.1.2.7 = OID: iso.3.6.1.2.1.50
iso.3.6.1.2.1.1.9.1.2.8 = OID: iso.3.6.1.2.1.4
iso.3.6.1.2.1.1.9.1.2.9 = OID: iso.3.6.1.6.3.13.3.1.3
iso.3.6.1.2.1.1.9.1.2.10 = OID: iso.3.6.1.2.1.92
iso.3.6.1.2.1.1.9.1.3.1 = STRING: "The SNMP Management Architecture MIB."
iso.3.6.1.2.1.1.9.1.3.2 = STRING: "The MIB for Message Processing and Dispatchin
```

- <https://www.solarwinds.com/resources/it-glossary/snmp-walk>
- <https://www.ittsystems.com/what-is-snmp/#wbounce-modal>

Cacti

Software yang dibutuhkan

- Cacti : cacti
- Apache :apache2 , libapache2-mod-php
- PHP : php-xml, php-ldap, php-mbstring, php-gd ,php-gmp ,php-mysql
- Snmp : snmpd, php-snmp
- RRD Tool : rrdtool, librrds-perl
- Mariadb : mariadb-server, mariadb-client

1. Instalasi apache

- Update Linux anda
#apt update
- Install apache.
apt install apache2 libapache2-mod-php

2. Instalasi PHP

- Install php.
`#apt install php php-xml php-ldap php-mbstring php-gd php-gmp php-mysql php-snmp`
- Cek versi php. Versi php yang kita pakai adalah 7.4
`#php -v`
- Sebelumnya cek di waktu local. Lihat zona yang kita pakai, yaitu Asia/Jakarta
`#timedatectl`
- Lakukan setting konfigurasi apache di `/etc/php/7.4/apache2/php.ini`
`#nano /etc/php/7.3/apache2/php.ini`
- Cari baris dibawah dengan ctrl w lalu ubah sesuai kebutuhan :
`date.timezone, memory_limit, max_execution_time`
- Simpan dg ctrl o dan keluar ctrl x

- Lakukan setting konfigurasi yg sama dengan diatas untuk php di /etc/php/7.4/cli/php.ini
- Parameter yang harus diubah adalah : date.timezone, memory_limit, max_execution_time

date.timezone = Asia/Jakarta

memory_limit = 128M

max_execution_time = 30

```
[Date]
; Defines the default timezone used by the date functions
; http://php.net/date.timezone
date.timezone = Asia/Jakarta
```

```
; Maximum amount of memory a script may consume (128MB)
; http://php.net/memory-limit
memory_limit = 128M
```

```
; Maximum execution time of each script, in seconds
; http://php.net/max-execution-time
; Note: This directive is hardcoded to 0 for the CLI SAPI
max_execution_time = 30
```

3. Instalasi RRD Tool & SNMP

- Install rrdtool dan librrds-perl
#apt install rrdtool librrds-perl
- Install snmp. Skip perintah ini jika anda sudah melakukan sebelumnya
#apt install snmpd snmp

4. Install mariadb

- Install mariadb server dan client

```
#apt install mariadb-server mariadb-client
```

5. Restart Mariadb

- Restart mariadb

#systemctl restart mariadb

#systemctl status mariadb

```
root@debian10New:/home/fitri# systemctl status mariadb
● mariadb.service - MariaDB 10.3.31 database server
   Loaded: loaded (/lib/systemd/system/mariadb.service; enabled; vendor preset: enabled)
   Active: active (running) since Thu 2022-03-17 14:41:00 WIB; 11s ago
     Docs: man:mysqld(8)
           https://mariadb.com/kb/en/library/systemd/
   Process: 3139 ExecStartPre=/usr/bin/install -m 755 -o mysql -g root -d /var/lib/mysql
   Process: 3140 ExecStartPre=/bin/sh -c systemctl unset-environment _WSREP_STATUS
   Process: 3142 ExecStartPre=/bin/sh -c [ ! -e /usr/bin/galera_recovery ] && V
   Process: 3303 ExecStartPost=/bin/sh -c systemctl unset-environment _WSREP_STATUS
   Process: 3305 ExecStartPost=/etc/mysql/debian-start (code=exited, status=0/SUCCESS)
  Main PID: 3229 (mysqld)
    Status: "Taking your SQL requests now..."
     Tasks: 74 (limit: 4659)
    Memory: 91.3M
    CGroup: /system.slice/mariadb.service
            └─3229 /usr/sbin/mysqld

Mar 17 14:40:58 debian10New systemd[1]: Starting MariaDB 10.3.31 database server: [mysqld]
Mar 17 14:40:58 debian10New mysqld[3229]: 2022-03-17 14:40:58 0 [Note] /usr/sbin/mysqld: ready for connections. Please use 'mysql' command to connect.
Mar 17 14:41:00 debian10New systemd[1]: Started MariaDB 10.3.31 database server: [mysqld]
Mar 17 14:41:00 debian10New /etc/mysql/debian-start[3307]: Upgrading MySQL tables for 'MariaDB 10.3.31'
Mar 17 14:41:00 debian10New /usr/bin/mysql_upgrade[3307]: /usr/bin/mysql_upgrade: 0: Looking for 'mysql' as being secure
Mar 17 14:41:00 debian10New /usr/bin/mysql_upgrade[3307]: 0: Looking for 'mysql' as being secure
```

6. Buat database cacti

- Login dulu ke database mariadb.

Masukkan password root anda

```
#mysql -u root -p
```

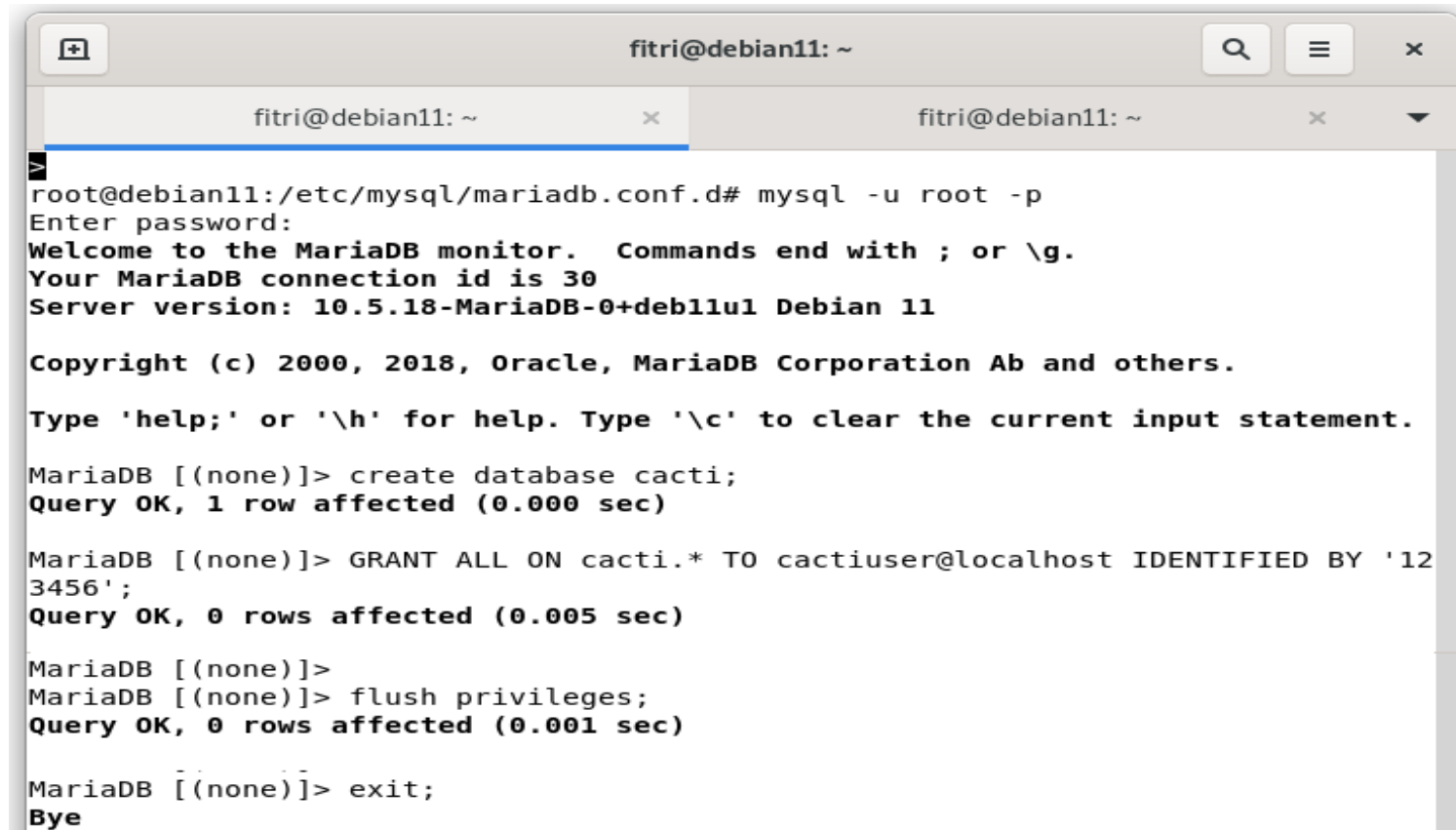
- Buat database : cacti, user : cactiuser dan password cacti:123456

```
MariaDB[(none)]>create database cacti;
```

```
MariaDB[(none)]>GRANT ALL ON cacti.* TO cactiuser@localhost IDENTIFIED BY  
'123456';
```

```
MariaDB[(none)]>flush privileges;
```

```
MariaDB[(none)]>exit;
```

A terminal window titled 'fitri@debian11: ~' with two tabs. The active tab shows the execution of 'mysql -u root -p' from the file '/etc/mysql/mariadb.conf.d'. The output displays the MariaDB monitor interface, including a welcome message, connection ID (30), and server version (10.5.18-MariaDB-0+deb11u1 Debian 11). The user then executes three SQL commands: 'create database cacti;', 'GRANT ALL ON cacti.* TO cactiuser@localhost IDENTIFIED BY '123456';', and 'flush privileges;'. Each command is followed by a confirmation message indicating the number of rows affected. Finally, the user exits the monitor with 'exit;', and the terminal displays 'Bye'.

```
fitri@debian11: ~
fitri@debian11: ~
root@debian11:/etc/mysql/mariadb.conf.d# mysql -u root -p
Enter password:
Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 30
Server version: 10.5.18-MariaDB-0+deb11u1 Debian 11

Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [(none)]> create database cacti;
Query OK, 1 row affected (0.000 sec)

MariaDB [(none)]> GRANT ALL ON cacti.* TO cactiuser@localhost IDENTIFIED BY '123456';
Query OK, 0 rows affected (0.005 sec)

MariaDB [(none)]>
MariaDB [(none)]> flush privileges;
Query OK, 0 rows affected (0.001 sec)

MariaDB [(none)]> exit;
Bye
```

7. Import table timezone

- Import table timezone ke sql database

```
#mysql -u root -p mysql < /usr/share/mysql/mysql_test_data_timezone.sql
```

```
root@debian10New:/home/fitri# mysql -u root -p mysql < /usr/share/mysql/mysql_test_data_timezone.sql
```

- Jika ada error :

```
root@debian11:/etc/mysql/mariadb.conf.d# mysql -u root -p mysql < /usr/share/mysql/mysql_test_data_timezone.sql
Enter password:
ERROR 1062 (23000) at line 17: Duplicate entry 'MET' for key 'PRIMARY'
```

- Tidak usah dihiraukan. Langsung saja ke Langkah berikutnya

8. Berikan hak untuk cactiuser ke database

- Berikan hak untuk cactiuser ke mariadb database.
- Untuk itu login dulu dan masukkan password root anda

```
#mysql -u root -p
```

- Ketikkan baris berikut

```
MariaDB[(none)]> GRANT SELECT ON mysql.time_zone_name TO  
cactiuser@localhost;
```

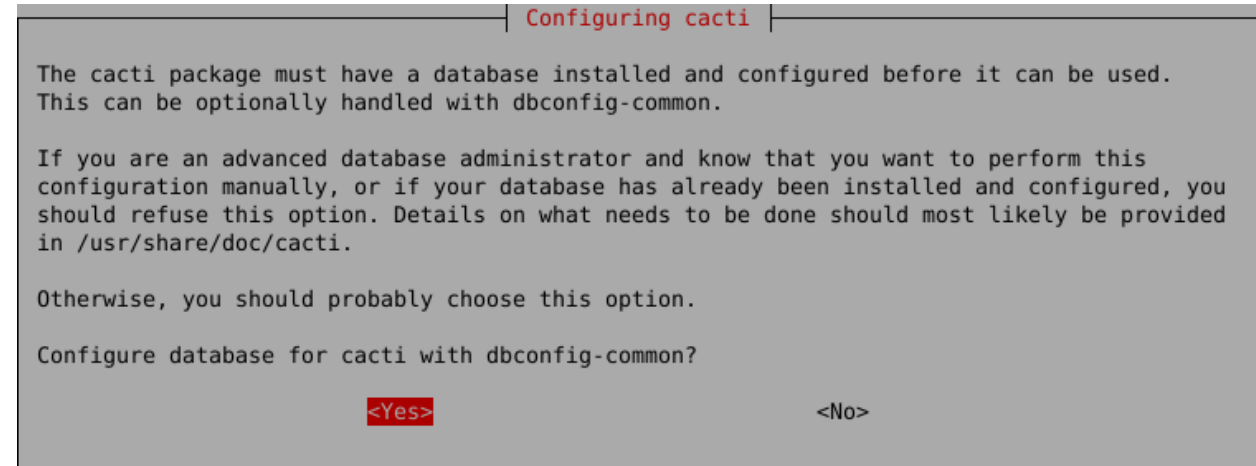
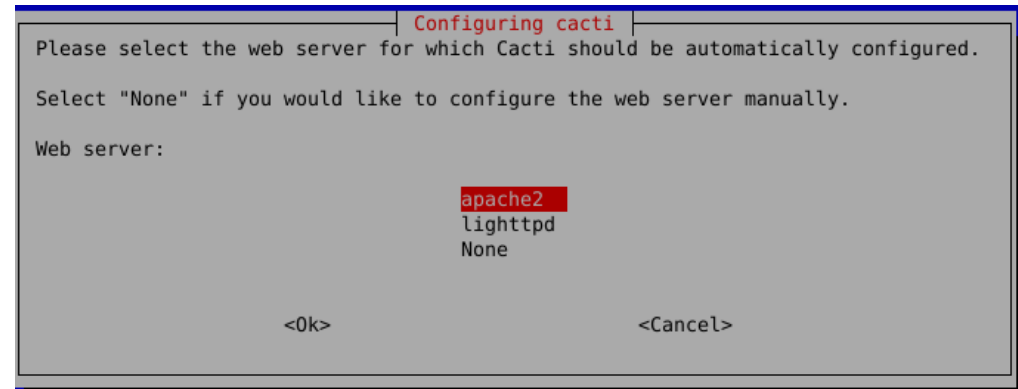
```
MariaDB[(none)]> flush privileges;
```

```
MariaDB[(none)]> exit;
```

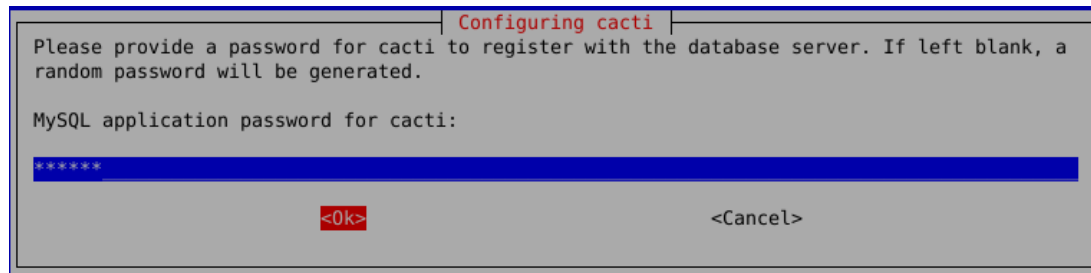
```
MariaDB [(none)]> GRANT SELECT ON mysql.time_zone_name TO cactiuser@localhost;  
Query OK, 0 rows affected (0.025 sec)  
MariaDB [(none)]> flush privileges;  
Query OK, 0 rows affected (0.000 sec)  
MariaDB [(none)]> exit  
Bye
```

9. Install cacti

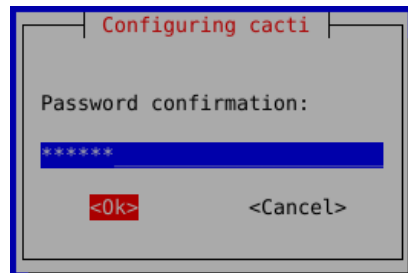
- Install cacti
#apt install cacti
- Configure database
 - Setting password untuk mysql dan lakukan konfirmasi
 - Pilih webserver : apache2, klik Ok
 - Configure database for cacti with dbconfig-common
 - Pilih Yes



- Berika password cacti yang sudah anda setting yaitu 123456



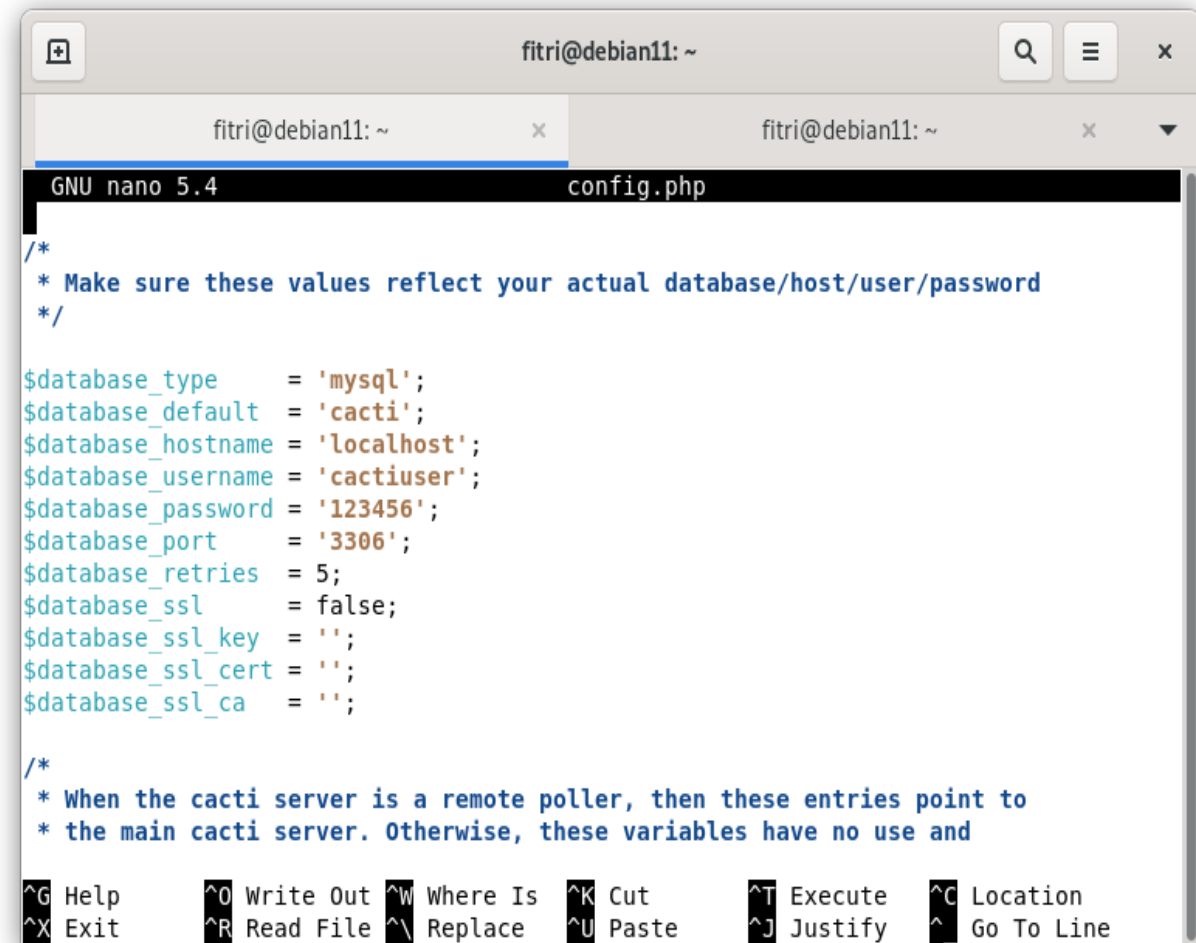
- Konfirmasi password



10. Setting user,password dan database di Cacti

- Import tabel timezone table ke database cacti
#mysql -u root -p cacti < /usr/share/doc/cacti/cacti.sql
- Configure username, password and database name for Cacti.
#nano /usr/share/cacti/site/include/config.php
- Cari baris berikut, cocokkan database default, username dan password yang anda buat.
- Pada konfigurasi yg saya lakukan, database default : cacti, datapassword :123456

```
$database_type = 'mysql';  
$database_default = 'cacti';  
$database_hostname = 'localhost';  
$database_username = 'cactiuser';  
$database_password = '123456';  
$database_port = '3306';  
$database_ssl = false;  
$database_ssl_key = '';  
$database_ssl_cert = '';  
$database_ssl_ca = '';
```



```
fitri@debian11: ~  
fitri@debian11: ~  
GNU nano 5.4 config.php  
/*  
 * Make sure these values reflect your actual database/host/user/password  
 */  
  
$database_type      = 'mysql';  
$database_default   = 'cacti';  
$database_hostname   = 'localhost';  
$database_username   = 'cactiuser';  
$database_password   = '123456';  
$database_port       = '3306';  
$database_retries    = 5;  
$database_ssl        = false;  
$database_ssl_key     = '';  
$database_ssl_cert    = '';  
$database_ssl_ca      = '';  
  
/*  
 * When the cacti server is a remote poller, then these entries point to  
 * the main cacti server. Otherwise, these variables have no use and  
  
^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location  
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^_ Go To Line
```

11. Ubah ownership cacti untuk Apache user

- Ubah ownership directory Cacti untuk apache user (www-data)

```
#chown -R www-data:www-data /usr/share/cacti/site/resource/snmp_queries/
```

```
#chown -R www-data:www-data /usr/share/cacti/site/resource/script_server/
```

```
#chown -R www-data:www-data /usr/share/cacti/site/resource/script_queries/
```

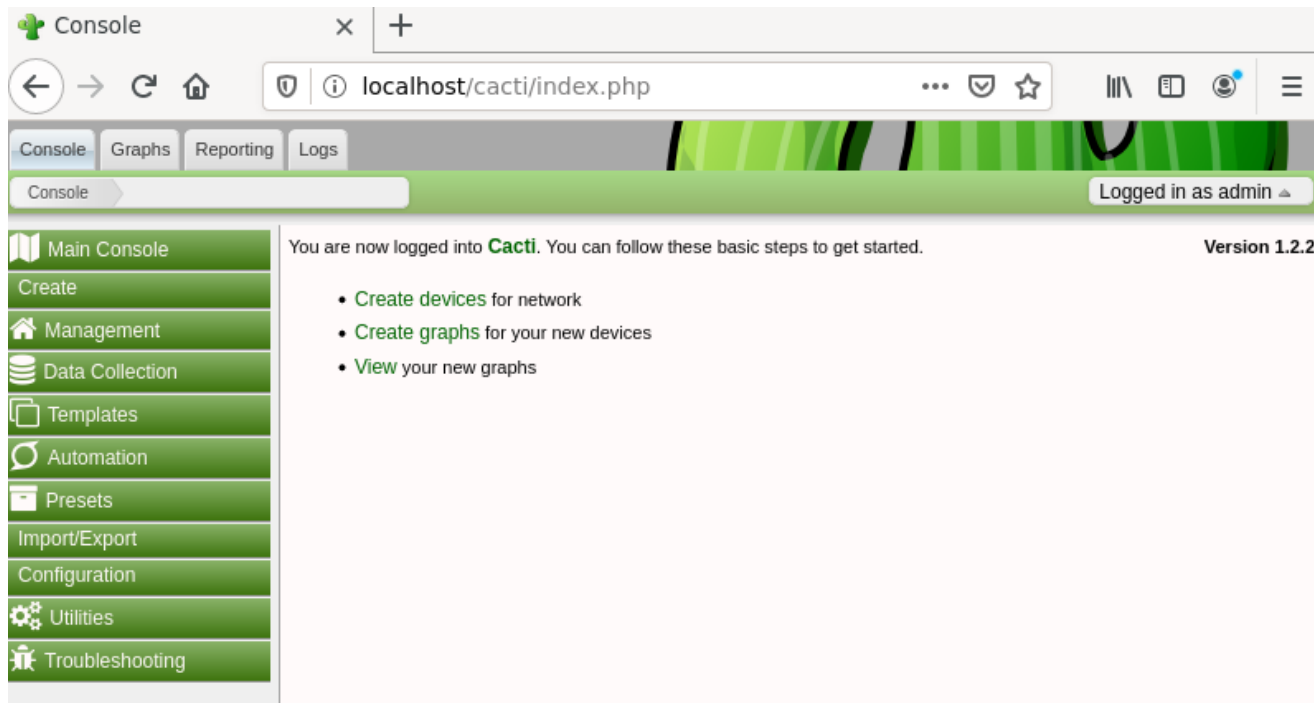
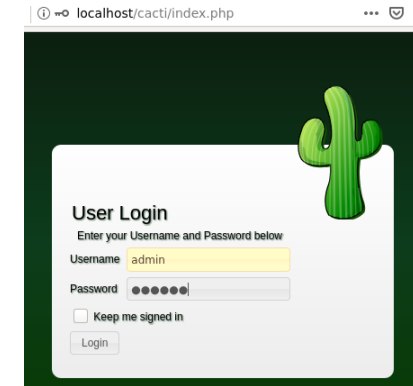
```
#chown -R www-data:www-data /usr/share/cacti/site/scripts/
```


12. Cek cron

- Cron bertugas menjadwalkan cacti untuk bekerja tiap selang waktu tertentu
- Buka file `/etc/cron.d/cacti`. Pastikan seperti ini isinya :
MAILTO=root
`*/5 * * * * www-data php /usr/share/cacti/site/poller.php 2>&1 >/dev/null | if
[-f /usr/bin/ts] ; then ts ; else tee ; fi >> /var/log/cacti/poller-error.log`
- Artinya tiap 5 menit, user `www-data` menggunakan `poller.php` untuk menuliskan data, jika ada error, maka akan ditulis di `/var/log/cacti/poller-error.log`

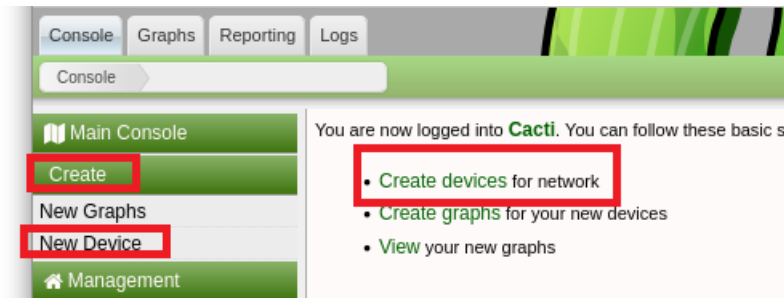
13. Login ke cacti

- Buka browser. Ketikkan <http://localhost/cacti>
- Masukkan username admin, password adalah password untuk database mariadb, yaitu 123456



14. Create Devices

- Klik Create, klik New devices
- Atau klik Create devices for network



- Kemudian lakukan setting di
 - Description
 - Hostname
 - Device Template
- Klik Create

Device [new]

General Device Options

Description ?

webserver

Hostname ?

192.168.26.143

Location ?

None

Poller Association ?

Main Poller

Device Site Association ?

Edge

Device Template ?

Generic SNMP Device

Number of Collection Threads ?

1 Thread (default)

Disable Device ?

☒

SNMP Options

SNMP Version ?

Version 2

SNMP Community String ?

public

SNMP Port ?

161

SNMP Timeout ?

500

Maximum OID's Per Get Request ?

10

Availability/Reachability Options

Downed Device Detection ?

SNMP Uptime

Ping Timeout Value ?

400

Ping Retry Count ?

1

Additional Options

Notes ?

External ID ?

Cancel

Create

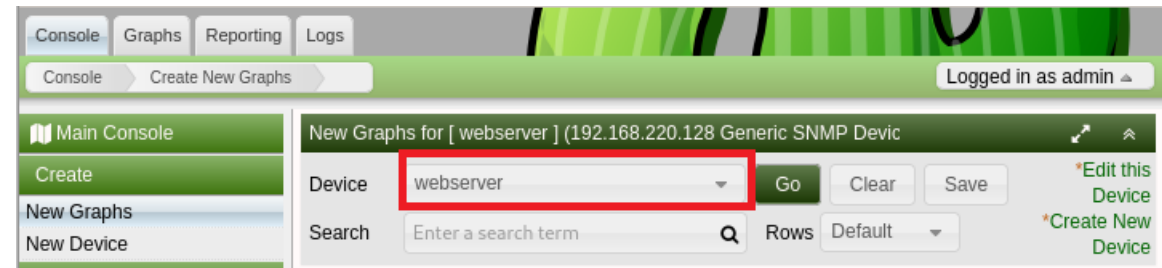
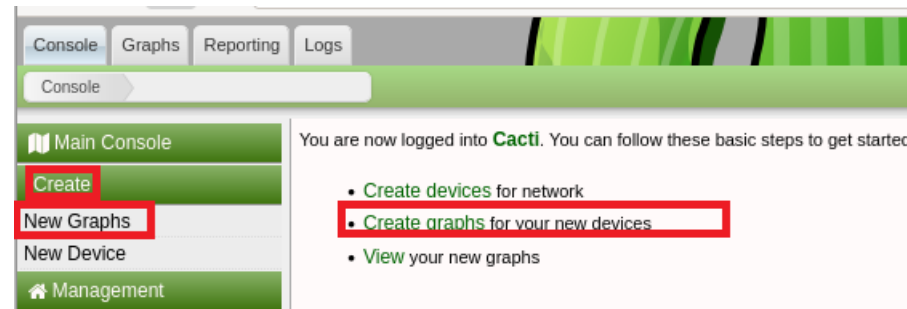
- Jika berhasil, muncul informasi ini di bagian paling atas

```
webserver (192.168.26.143)
SNMP Information
system: 2021-09-29) x86_64
uptime: 621753 (0days, 1hours, 43minutes)
hostname: debian10New
location: Sitting on the Dock of the Bay
contact: Me me@example.org
```

```
*Create New Device
*Create Graphs for this Device
*Enable Device Debug
  *Data Source List
  *Graph List
```

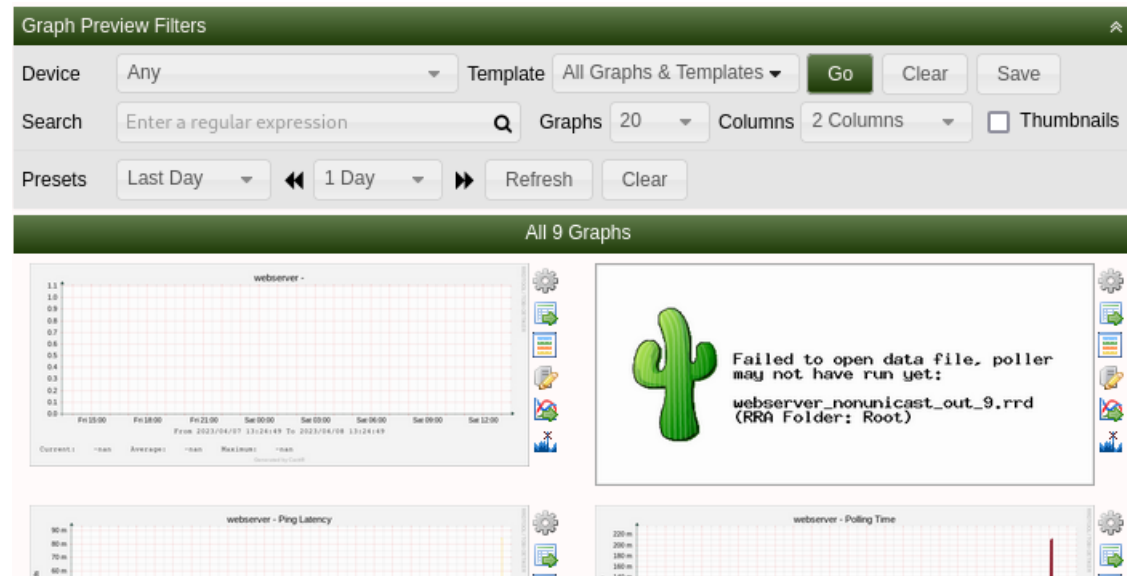
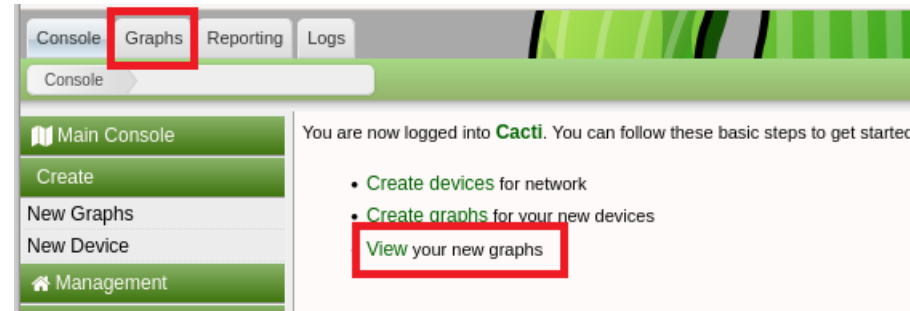
15. Create Graphs

- Klik Create, klik New graphs
- Lakukan setting :
 - Device
 - Data Query
- Setting di bagian paling atas Isi devais dengan nama devais yang baru kita buat
- Pada bagian Data Query, klik dibagian paling kiri dari interface anda (ens33)
- Klik Create

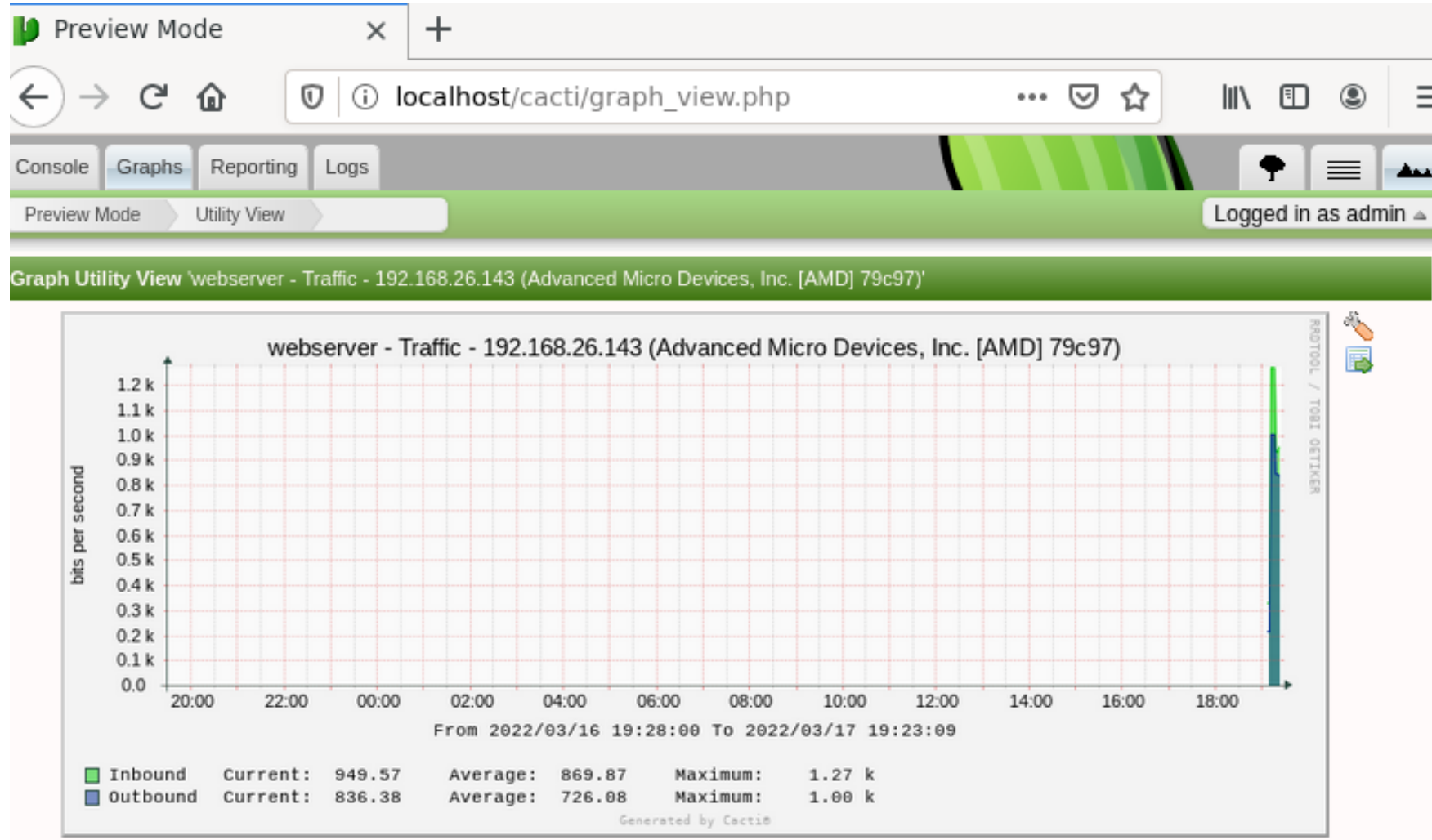


16. Show Graph

- Klik Graphs
- Atau View your new graphs
- Device : Webserver



Output cacti

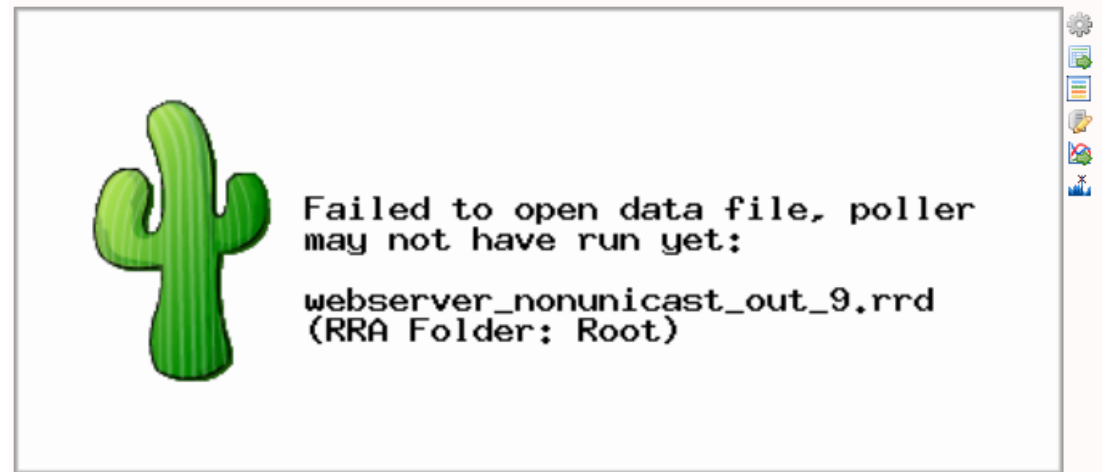


Error : Graph

- Ini disebabkan file `webserver_nonunicast_out_9.rrd` tidak terbentuk
- Jalankan poller

```
#/usr/bin/php /usr/share/cacti/site/poller.php
```

- Hapus devices
- Hapus graph
- Create new devices
- Create new graphs
- Kemudian lihatlah graph yang terbentuk



17. Testing Cacti

- Testing cacti anda dengan melakukan ping dari cacti server ke gateway

```
fitri@debian10New:~$ ping 192.168.26.2
PING 192.168.26.2 (192.168.26.2) 56(84) bytes of data.
64 bytes from 192.168.26.2: icmp_seq=1 ttl=128 time=0.160 ms
64 bytes from 192.168.26.2: icmp_seq=2 ttl=128 time=0.192 ms
64 bytes from 192.168.26.2: icmp_seq=3 ttl=128 time=0.167 ms
64 bytes from 192.168.26.2: icmp_seq=4 ttl=128 time=0.185 ms
64 bytes from 192.168.26.2: icmp_seq=5 ttl=128 time=0.176 ms
```

- Tunggu beberapa saat, minimal 5-10 menit. Cek grafik anda. Perhatikan muncul grafik baru
- Atau kirimlah file 1G dengan menggunakan netcat menuju ke cacti server
- Lihat perubahan grafik cacti

Source

- Iperf :
<https://iperf.fr/iperf-doc.php>
- Instalasi Cacti di Debian 12 dapat menggunakan cara instalasi di Debian10 dengan beberapa penyesuaian
<https://startdoits.blogspot.com/2020/03/how-to-install-cacti-on-debian-10.html>