

APPLICATION NOTE

GAUGES - METERS

Presenting Xena tester results in gauges/meters

This Application Note describes how Xena test results can be presented in gauges, using Graphite and Grafana installed in a virtual Linux machine.

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APPLICATION NOTE

The ValkyrieBay and ValkyrieCompact test chassis equipped with the relevant test modules provide comprehensive test results for the Ethernet lines and devices that are under test. The results are presented in tables and can also be shown in charts and histograms. In some cases it can however also be useful to see selected parameters in gauges – or analog meters with a needle that indicates the value of the parameter. This application note describes how Xena test results can be presented in gauges, using Graphite and Grafana installed in a virtual Linux machine.

THE SETUP

Adding gauge presentation to Ethernet results ValkyrieBay and ValkyrieCompact test chassis requires a setup as illustrated in figure 1.

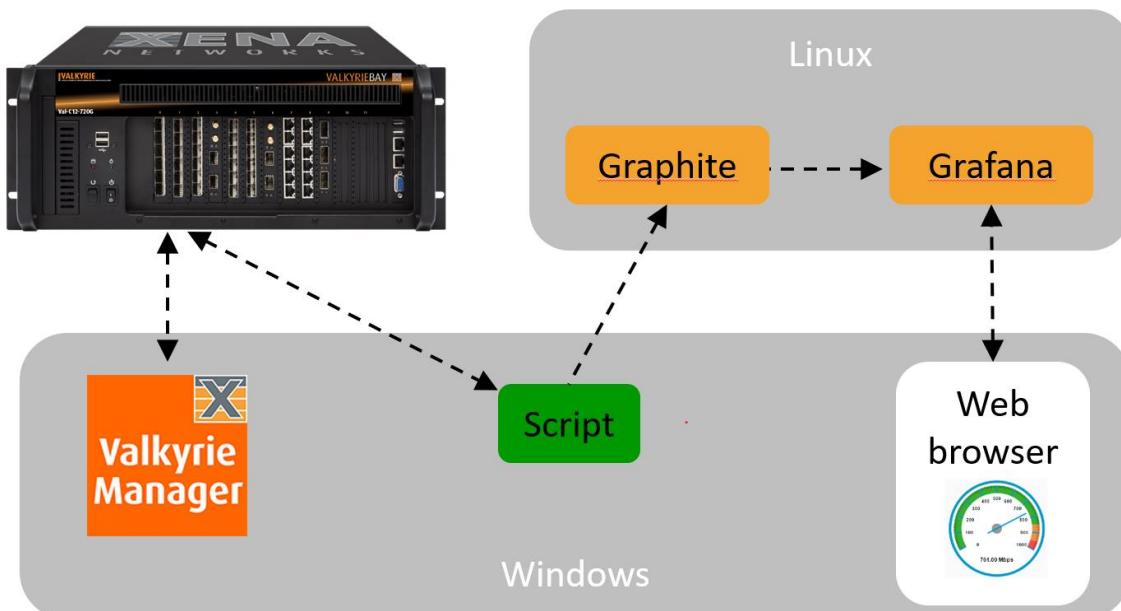


Figure 1: Setup for adding gauge presentation

Data flow

The [ValkyrieManager](#) controls the Xena test chassis. It is used for setting up the test and starting and stopping the test.

The [Script](#) extracts the relevant test results from the Xena test chassis and forwards it to Graphite. In this application note a Tcl script is used.

[Graphite](#) is a monitoring tool often used by IT departments that want to get statistics on status and performance of their networks and equipment. Graphite receives data from relevant sources and can present the results; many find however the presentation part of Graphite to be somewhat unattractive. Graphite can forward collected data to various presentation software packages, including Grafana.

[Grafana](#) can present data in smarter-looking graphs than Graphite. Grafana presents data in dashboards, which can be equipped with gauges. Grafana accepts data from various sources, including Graphite.

The [Windows web browser](#) is used to see the Grafana gauges in the Windows environment where you have the ValkyrieManager installed. The web browser is also used for configuring Grafana. In this application note the [Chrome Web Browser](#) is used; it seems to work better with Grafana than the Internet explorer.

As you can see in figure 1 both Graphite and Grafana runs on Linux. You don't need to have both a Windows and a Linux PC to run the setup in figure 1: You can install a virtual machine on a Windows PC. In the virtual machine you can install Linux, allowing you to run Graphite and Grafana. In this application note Oracle VM VirtualBox is used as the virtual machine, where Linux Ubuntu 14.04 is installed.

In summary: To get the gauge presentation of results you will go through the following steps:

- Install the Oracle VM VirtualBox
- Install Linux Ubuntu 14.04 in a virtual machine in the Oracle VM VirtualBox
- Install and configure Graphite
- Install and configure Grafana
- Install a Grafana plugin that can present data in gauges as shown in figure 2
- Get the installed parts to communicate together
- Install the dashboard with gauges in Grafana

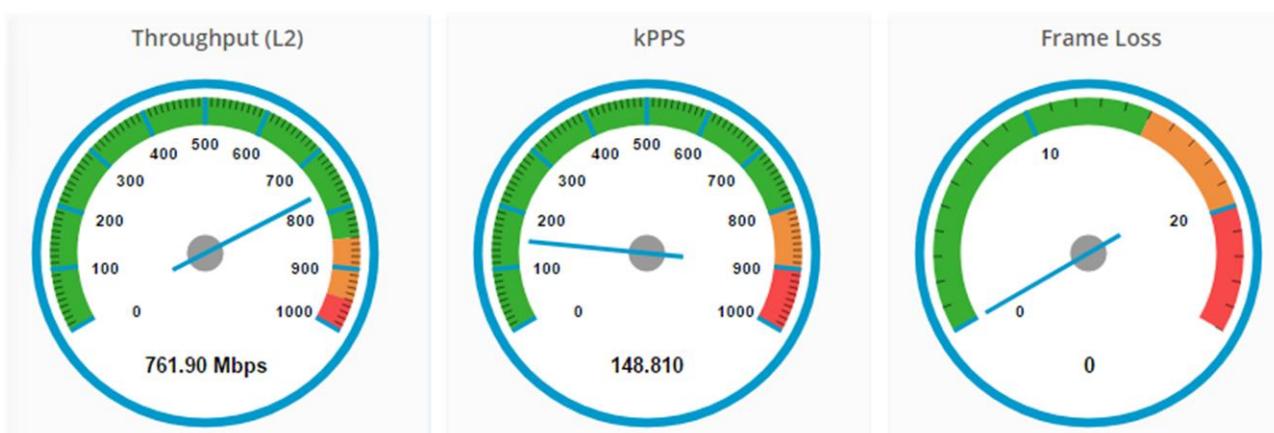


Figure 2: Data presented with gauges in a Grafana dashboard

INSTALL THE ORACLE VM VIRTUALBOX AND LINUX UBUNTU 14.04

Download software and install Oracle VM VirtualBox

To install the Oracle VM VirtualBox and Linux Ubuntu 14.04 on a PC running Windows 10 you first need to download the software that is required:

- Download the Ubuntu 14.04.3 LTS iso file from this [link](#)
- Download the Oracle VM VirtualBox Extension Pack from this [link](#)
- Download the Guest Edition iso file from this [link](#)
- Go to the site at this [link](#). In the “VirtualBox 5.1.22 platform packages” section select the “Windows hosts” link and “Run” the .exe file at the link. This will guide you through the basic installation of the VirtualBox.

Install the Oracle VM VirtualBox Extension Pack

To install the Oracle VM VirtualBox Extension Pack you open the VirtualBox, which was installed in the previous section. Select File, Preferences and Extensions in the screens that open. Click  in the right side of the Extensions screen and you now get a browser where you select and install the Oracle VM VirtualBox Extension Pack you have downloaded. The Extensions screen should end up looking as shown in figure 3.

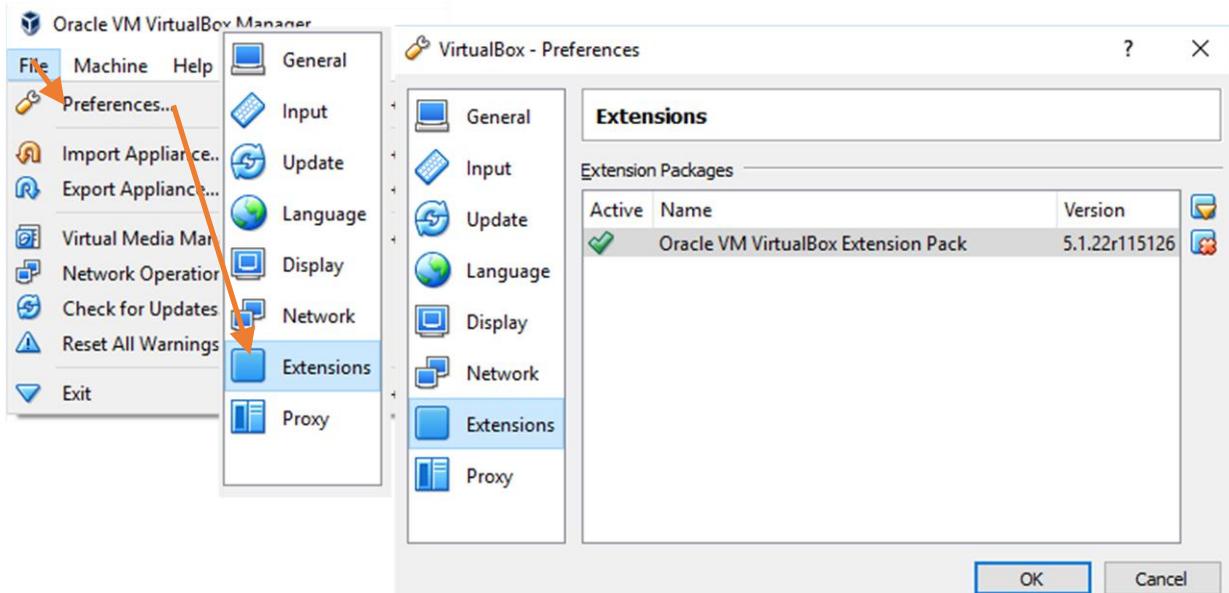
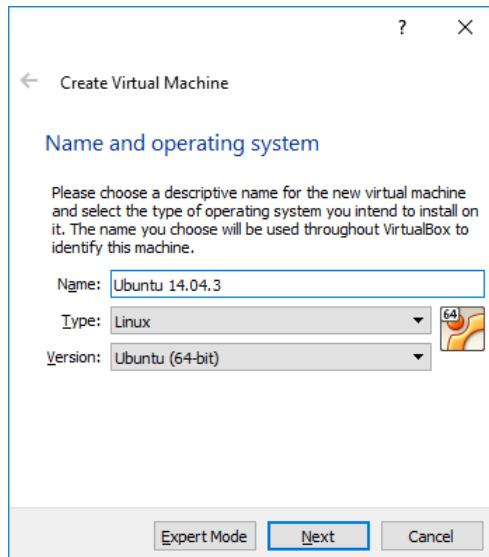


Figure 3: Install the Oracle VM VirtualBox Extension Pack

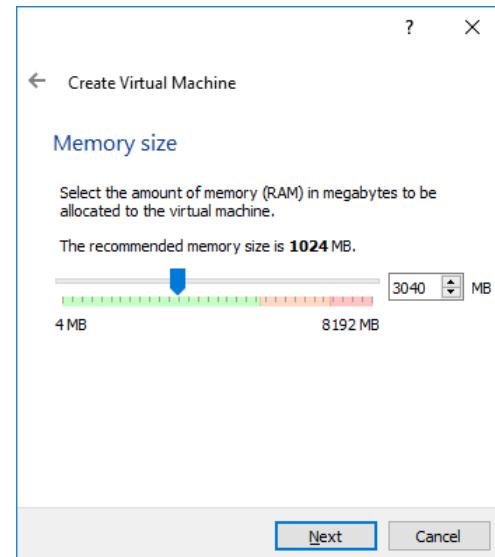
Create Virtual Machine for the Linux Ubuntu

Click  in the VirtualBox main screen.

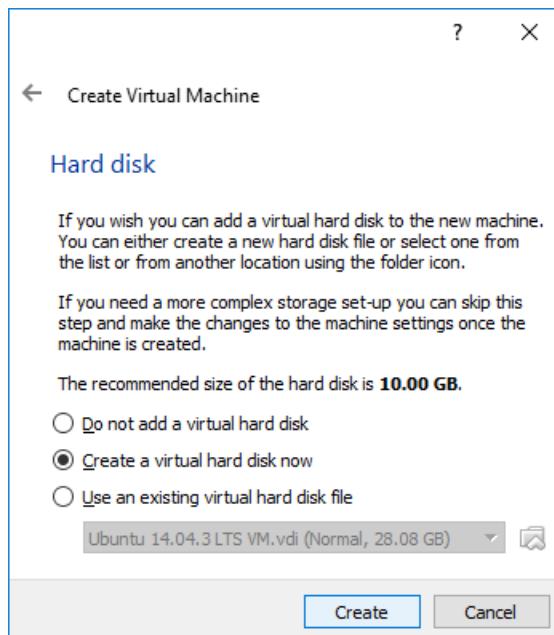
You will now be taken through a number of steps that will create the virtual machine.



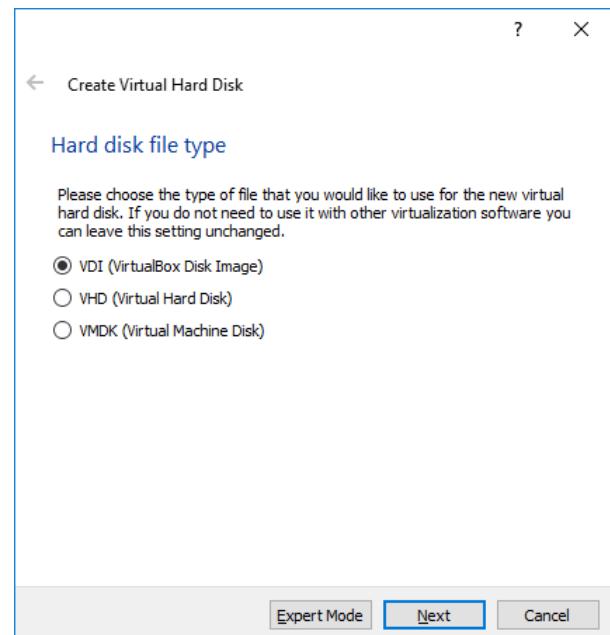
Give the virtual machine a name. Make sure that the “Version” shown is Ubuntu.



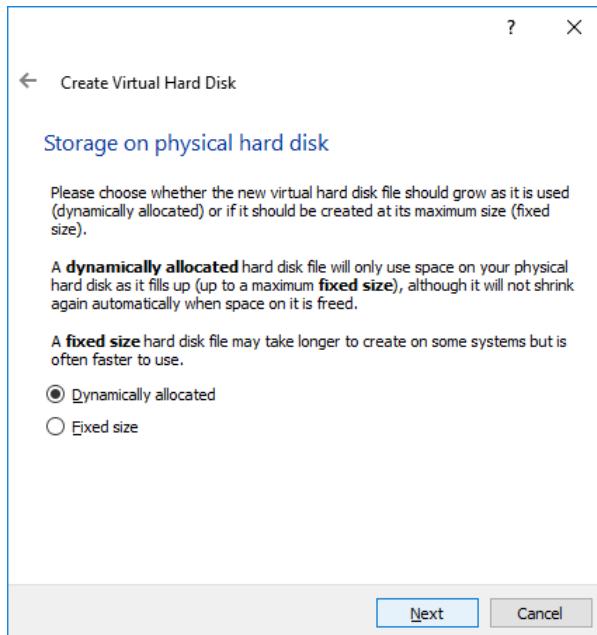
Set virtual memory size. For the creation of this application note a memory size of approx. 3 Gbyte has been used.



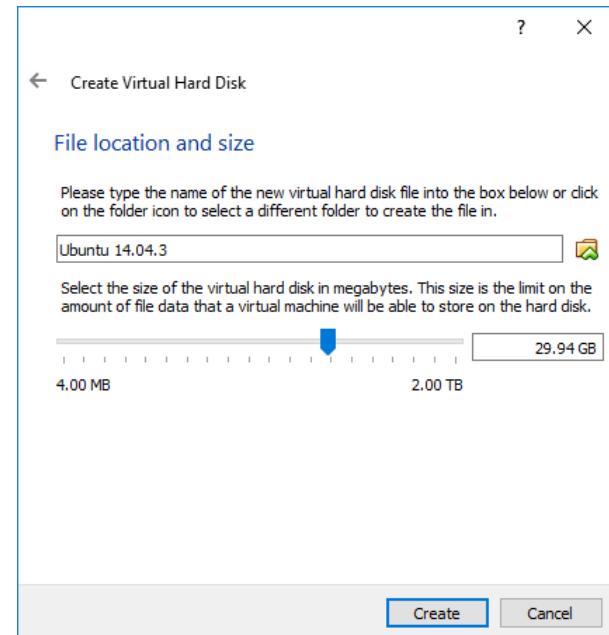
Create virtual hard disk - step 1



Create virtual hard disk - step 2



Create virtual hard disk - step 3



Create virtual hard disk - step 4. For the creation of this application note a hard disk size of approx. 30 Gbyte has been used. Press "Create".

Configure the Virtual Machine

Click  , then "Storage" and the "Empty" text that appears. You now get the screen in figure 4.

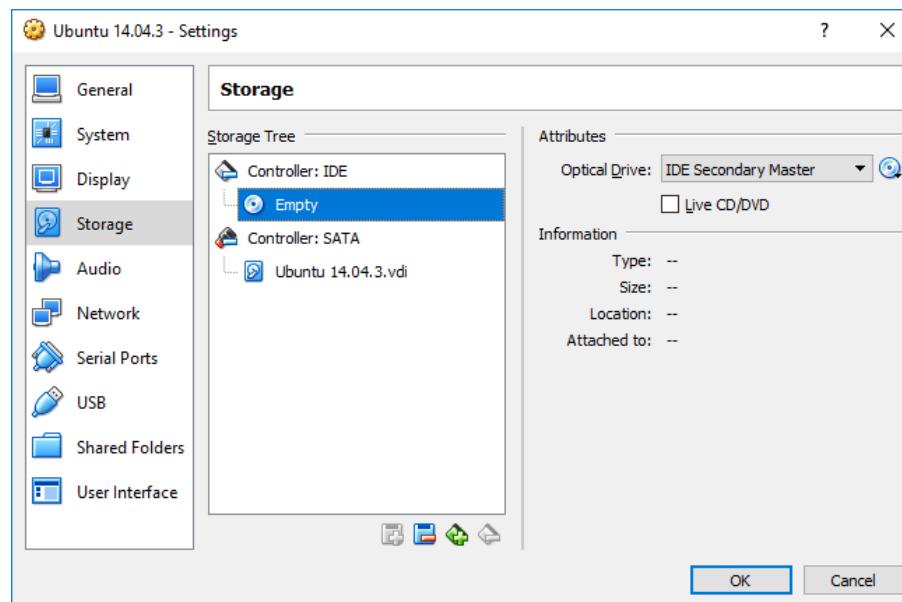


Figure 4: Storage setup screen

Click on the  symbol in the right side of the Storage setup screen.

Click  [Choose Virtual Optical Disk File...](#) and select the ubuntu-14.04.3-desktop-amd64.iso file. Hereby the virtual machine to boot with Linux Ubuntu 14.04.3 when it is started.

Now select Networks in the Ubuntu – Settings screen. In the Networks setup screen change “Attached to” from NAT to “Bridged Adapter” as shown in figure 5. With this you get an IP address via a DHCP server, allowing the Windows part and the Linux part of the setup in figure 1 to communicate together.

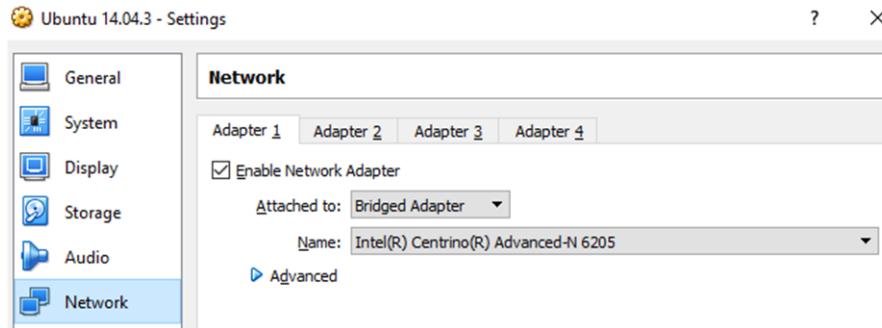


Figure 5: Networks setup screen

Finally select “General” and “Advanced” to get to the page shown in figure 6. Change “Shared Clipboard” and “Drag’n’Drop” settings as shown in figure 6. This will allow you to copy-paste text strings between the Windows part and the Linux part of the setup in figure 1.

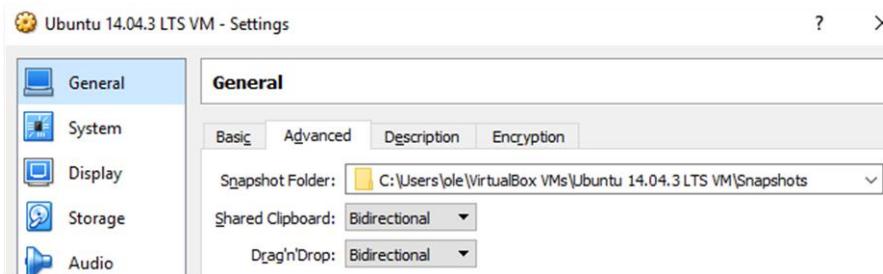


Figure 6: Recommended Shared Clipboard and Drag’n’Drop settings.

Click OK after updating the “Shared Clipboard” and “Drag’n’Drop” settings.

Install Linux Ubuntu 14.04.3 in the Virtual Machine

Click  in the VirtualBox main screen.

The Linux Ubuntu 14.04.3 you have downloaded will now be installed in the virtual machine. You will probably see some error messages during the installation process; you shouldn't bother about that. You will get to a point where you can choose to either “Try Ubuntu” or “Install Ubuntu” (see figure 7). Select “Install Ubuntu” to activate the actual installation.

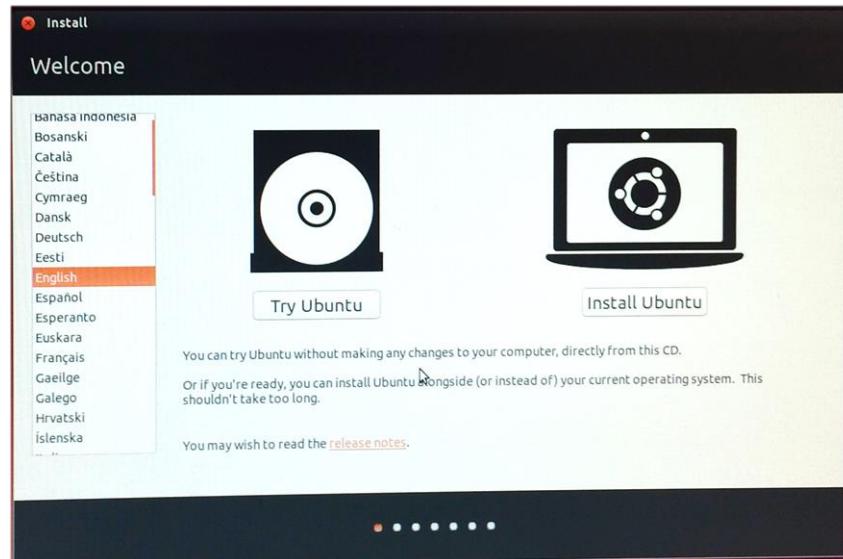


Figure 7: Select “Install Ubuntu” in the dialog above

During the installation process, after a while (after you have restarted your “computer” i.e. the virtual Linux machine) it seemed that the process stopped – the screen looked like figure 8 and nothing further happened. At that time it was necessary Close the Virtual Machine – click on the X in the top right of the virtual machine and the select “Power off the machine” (see figure 9) and start it again with the “Start” softkey in the VirtualBox main screen. During a second installation pressing the “Enter” key was sufficient!

```
* speech-dispatcher disabled; edit /etc/default/speech-dispatcher
* Asking all remaining processes to terminate... [ OK ]
* All processes ended within 2 seconds... [ OK ]
* modemManager[1291]: Caught signal 15, shutting down...
* modemManager[1291]: <info> Caught signal, shutting down...
* modemManager[1291]: <warn> Could not acquire the 'org.freedesktop.ModemManager1' service name
* Unmounting temporary filesystems... [ OK ]
* Deactivating swap... [ OK ]
* Stopping early crypto disks... [ OK ]
```

Figure 8: Screen when the installation seemed to stop.

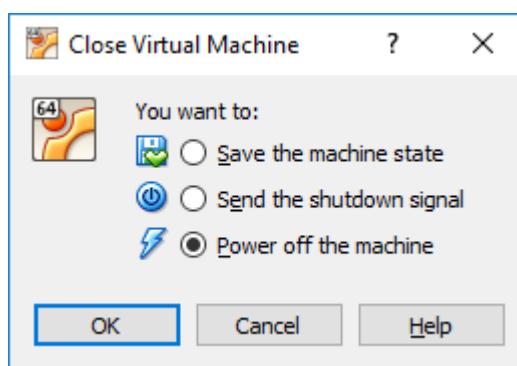


Figure 9: Close Virtual Machine dialog

Install Guest Additions

In the VirtualBox application menu click “Devices” and select “Insert GuestAdditions CD image” (se figure 10). Click Run in the dialog that opens.

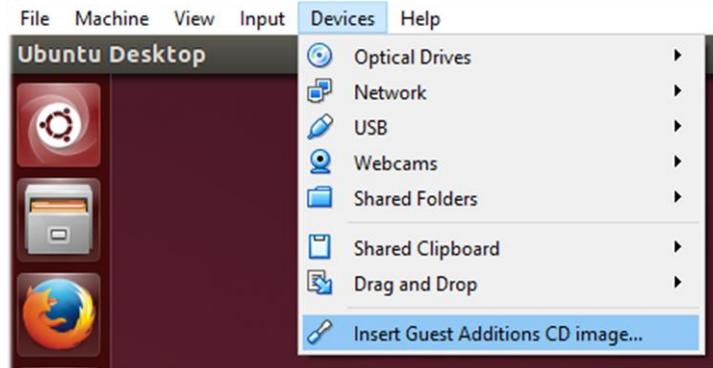


Figure 10: Install Guest Additions

Changing screen resolution in the Linux Ubuntu 14.04 installation

When Linux Ubuntu 14.04 was installed as a part of creating this application note the screen resolution was fixed to 640x480. During the process described above you are guided to install the VirtualBox guest additions. This can provide other screen resolutions than 640x480; you need however to mount the VirtualBox Guest edition in the Linux environment. You can use the following command in the Linux terminal:

```
sudo apt-get install virtualbox-guest-additions-iso
```

Closing down (“power off”) the Linux machine and turning it on again (see figure 9) is required to enable the additional screen resolutions. After starting the Linux machine again you should be able to drag the window to change screen size.

Guides on how to install Linux Ubuntu 14.04 in Oracle VM VirtualBox

On the web you can find a number of guides on how to install the Oracle VM VirtualBox and then Linux Ubuntu 14.04 in a virtual machine in the Oracle VM VirtualBox.

When creating this application note the following guide was used from step 3 to 7:

[How To Install Ubuntu 14.04.3 LTS On VirtualBox | Unixmen](#)

You can also get the instructions in the following video:

[How to Install Ubuntu 14.04 LTS on Oracle Virtual Box - YouTube](#)

INSTALL AND CONFIGURE GRAPHITE

The following guide can assist you to install and configure Graphite:

<https://www.digitalocean.com/community/tutorials/how-to-install-and-use-graphite-on-an-ubuntu-14-04-server>

In the section “Configuring Storage Schemas” the guide explains how to update the /etc/carbon/storage-schemas.conf file. For the test script used in this application note the following lines should be added as the first non-comment lines:

```
[xena]
pattern = ^xena\.
retentions = 1s:1m
```

The easiest way to create this text block may be to copy one of the existing blocks line by line (in the Linux nano editor you cut the line at the cursor with <ctrl>k and uncut it again with <ctrl>u) and then change the contents of the copied block to the above.

INSTALL AND CONFIGURE GRAFANA

In the [Grafana installation page](#) select “Download” in the “You Run It” section, then select Linux in the page that opens and execute the instructions in the “Ubuntu & Debian” section. As you will see in the screen you must type the following at the command line in the Linux terminal after Grafana is installed:

```
sudo service grafana-server start
```

The Grafana dashboards will by default use a dark background. You can change this to light in the Grafana.ini file. At the command line in the Linux terminal type:

```
sudo nano /etc/grafana/grafana.ini
```

Find and uncomment default_theme line and set and set default_theme to light:

```
default_theme = light
```

The background will change when you restart Grafana.

INSTALL THE GRAFANA GAUGE PLUGIN

Click on the link below to install the Grafana Gauge plug-in that is used in this application note:



[D3-based Gauge panel for Grafana](#)

Click on the “Installation” tab in the page that opens and follow the instructions in the “Install the Panel” section. NB: When this was done in the process of creating this application note, installation was refused due to lack of privileges. After taking Super User privileges (write **sudo su** at the command line in the Linux terminal) the installation could however take place.

CONNECTING THE PIECES

You now have a number of elements that needs to be connected.

Connecting Graphite and Grafana to the Firefox web browser in Linux

Open the Firefox web browser in Linux.

- Use the address 127.0.0.1 to connect to Graphite
- Use the address LocalHost:3000 to connect to Grafana

You should now have Graphite and a Grafana tab in the Firefox web browser. Grafana will ask you to login:

- User: admin
- Password: admin

Connecting Graphite and Grafana together

You now need to establish Graphite as a data source for Grafana.

Click on the Grafana icon  in the Grafana page and select “Data Sources”.

Click **+ Add data source** in the page that opens and fill in the “Edit data source” page as shown here:

Edit data source

Config Dashboards

Name	Xena	Default	<input checked="" type="checkbox"/>
Type	Graphite		

Http settings

Url	http://127.0.0.1:80/
Access	proxy

Http Auth

Basic Auth	<input type="checkbox"/>	With Credentials	<input type="checkbox"/>
TLS Client Auth	<input type="checkbox"/>	With CA Cert	<input type="checkbox"/>

Save & Test **Delete** **Cancel**

Figure 11: Configuration of the Xena data source in Grafana

Click **Save & Test** and after a short while you should see the following message:

Success
Data source is working

Connecting Graphite and Grafana to the Chrome web browser and the script in Windows

You can run both Graphite and Grafana on Linux alone; however the Grafana gauge plug-in seems to only work properly when you connect to Grafana through the Chrome web browser in Windows. You therefore need to identify the IP addresses to use to access Graphite and Grafana from the Windows part of the setup. This can be achieved by typing **ifconfig** at the command line in the Linux terminal. You will then get a message similar to the one shown in figure 12. The highlighted IP address (192.168.1.86) is the one use:

- Use the address 192.168.1.86 to connect to Graphite from the Chrome web browser
- Use the address 192.168.1.86:3000 to connect to Grafana from the Chrome web browser
- Use the address 192.168.1.86 port 2003 to send data from the tcl script to Graphite

```
eth0      Link encap:Ethernet HWaddr 08:00:27:ec:94:8f
          inet addr:192.168.1.86 Bcast:192.168.1.255 Mask:255.255.255.0
          inet6 addr: fe80::a00:27ff:feec:948f/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:396635 errors:0 dropped:0 overruns:0 frame:0
            TX packets:402624 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:181701989 (181.7 MB) TX bytes:115834002 (115.8 MB)

lo       Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
            UP LOOPBACK RUNNING MTU:65536 Metric:1
            RX packets:3286834 errors:0 dropped:0 overruns:0 frame:0
            TX packets:3286834 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:0
            RX bytes:786534340 (786.5 MB) TX bytes:786534340 (786.5 MB)
```

Figure 12: Result of an ifconfig command

Please observe that the address can change, so if the communication stops working you should use the ifconfig command again to get the new IP addresses.

SENDING DATA FROM THE XENA TESTER TO GRAPHITE

For the creation of this application note a tcl script has been made to get data from a Xena test chassis and send it to Graphite. The script is available at this link:

[xena_test.tcl](#)

The script, which runs approx. 2 minutes, assumes that the Xena test chassis has been setup and configured manually through the ValkyrieManager. The IP address, port number, test ports and streams used are set and can be seen in the script. The script will forward measurements of layer 2 throughput, packets per second and frame loss for a stream on two ports in the Xena test chassis. Latency and a test counter are

also forwarded, but these parameters are not shown in the example on the next pages. For troubleshooting purposes the forwarded parameters are shown on the screen of the PC running the script. The script could be extended to also setup the ports on the test chassis, but that is outside the scope of this document.

To execute the script you need a tcl interpreter. For the creation of this application note ActiveTcl version 8.6.4.1 was used; it can be downloaded from this link:

<http://downloads.activestate.com/ActiveTcl/releases/>

After installing the tcl interpreter you should:

- Download the script (xena_test.tcl)
- Modify the script with the information that is relevant for your setup
- Run the script

When ActiveTcl is installed the command tclsh will execute test scripts— so to run the script you need to type the following at the Windows Prompt:

```
tclsh xena_test.tcl
```

After a while (less than a minute) you should be able to see the names of the data transferred from Xena_test.tcl script in the tree in the Graphite page in the Linux installation (see figure 13).

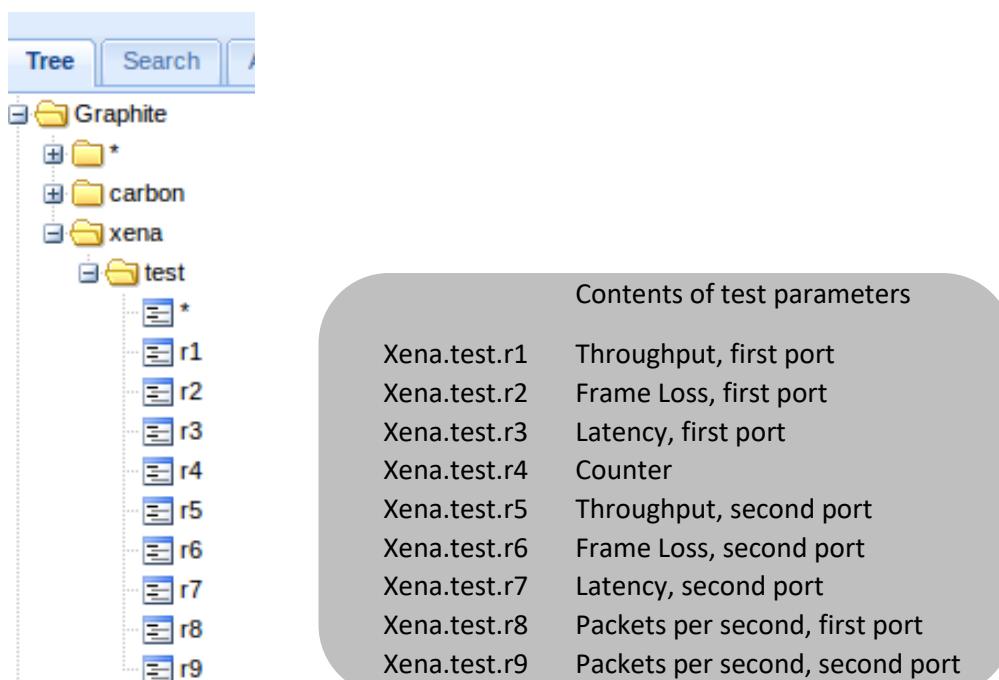


Figure 13: Graphite Tree with Xena test data names

GETTING DATA INTO A GRAFANA DASHBOARD

You now need to configure Grafana to show you data in a dashboard with gauges. This is simplest done by importing downloading a pre-configured dashboard from this link:

[Xena_Gauges.zip](#)

Unpack the Xena_Gauges.json file from the Xena_Gauges.zip file.

Now open Grafana with the Chrome web browser (in the Windows part of the PC) using the address you identified in the “Connecting Graphite and Grafana to the Chrome web browser in Windows” section above.

The Grafana Home dashboard will now appear.

Click on the Grafana icon 

In the menu that appears (see figure 14) select “Dashboards” and then “Import”.

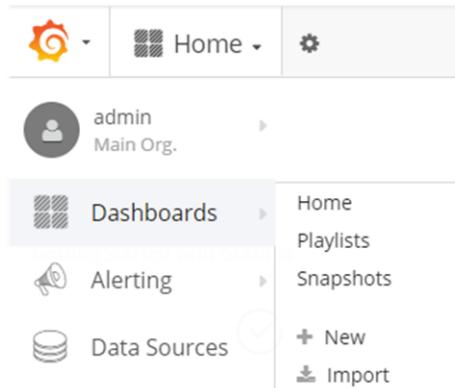
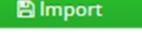


Figure 14: Activate Grafana Dashboard Import

In the page that opens select



A file browser will open. You here select the Xena_Gauges.json file that you just downloaded. This will open a window as shown in figure 15. Select “Xena” as Graphite data source and press 

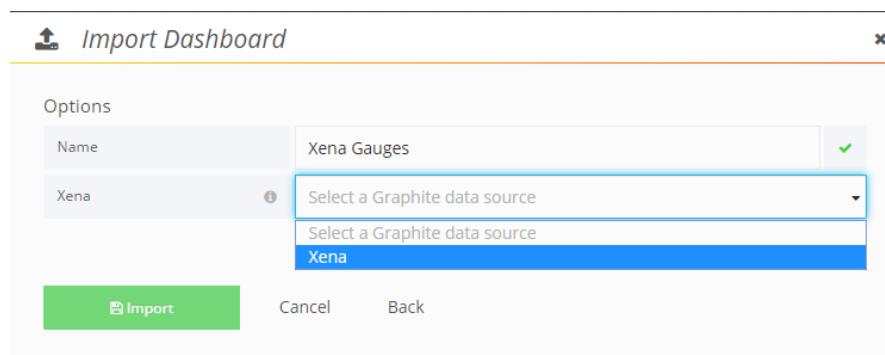


Figure 15: Import the Xena_Gauges.json file

After this a dashboard with 6 gauges will appear (see figure 16).

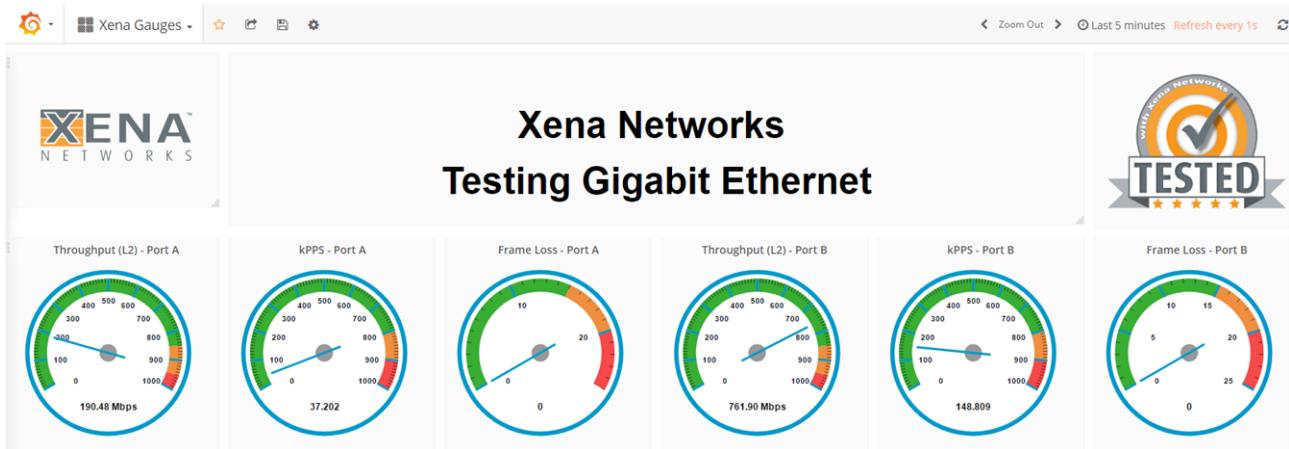


Figure 16: The dashboard with gauges in the Xena_Gauges.json file

The gauges are set to display data from 1 Gbps ports. If ports with other data rates are used the Throughput and the kPPS gauges needs to be reconfigured. To do that you click on the text above the gauge (“kPPS” in the screen shot in figure 17). A menu will appear for a short while as shown in figure 17.

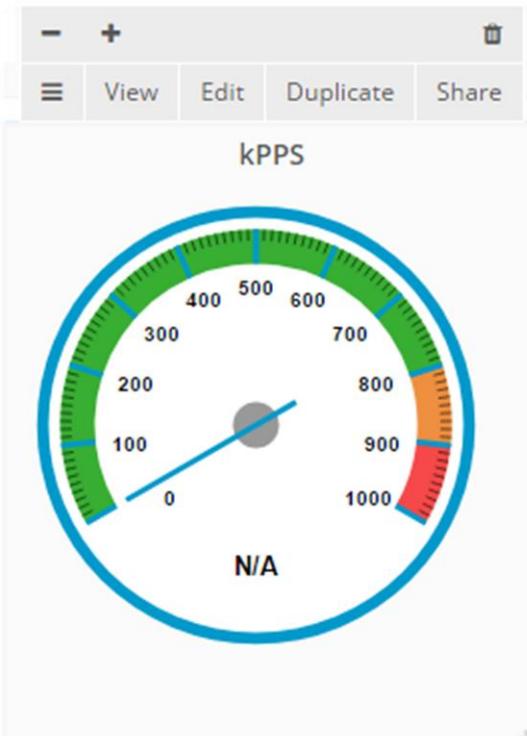


Figure 17: Reconfiguring the gauges

Click “Edit” in the menu in figure 17. The lower part of the screen will change as shown in figure 18.

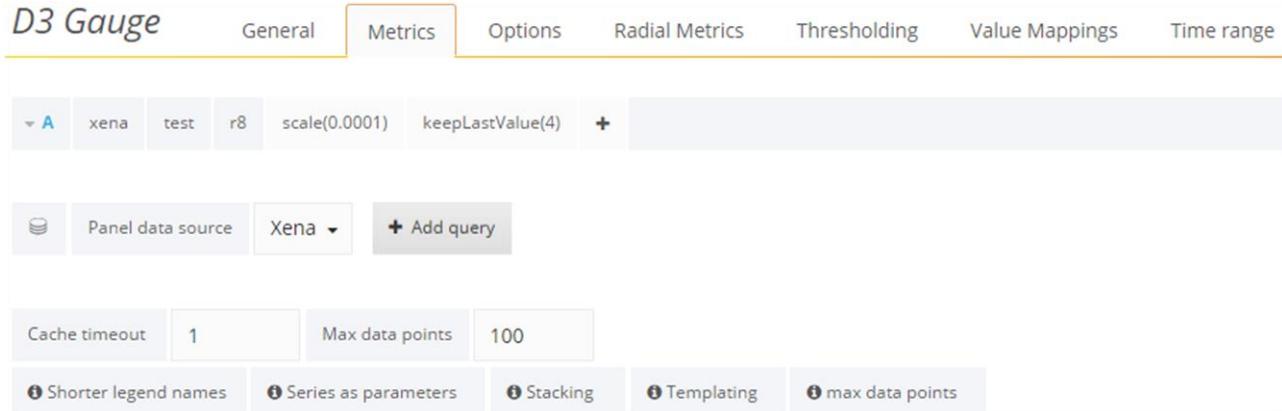


Figure 18: Editing the parameters for gauges

Table 1 presents items that it are relevant to edit for this application note.

The text and the Xena icons in the row above the gauges are set up with HTML codes in 3 separate panels. You can edit them similar to the way the gauge panels are configured. If you point at the top of each box you will again get the possibility to edit the panel. Click “Edit” and select the “Options” tab in the page that opens. Here you can change what is shown in the top row of the Xena Gauges dashboard.

To get the optimal presentation of the gauges, you will need to get them updated once every second. This is not supported by default in Grafana, but it can be achieved by changing the dashboard settings in Grafana. Click on the  -icon in the top of the Grafana screen to open the general Settings page for the selected dashboard. In the general Settings page add the text “1s” in the beginning of “Auto-refresh” options line as illustrated in figure 19.

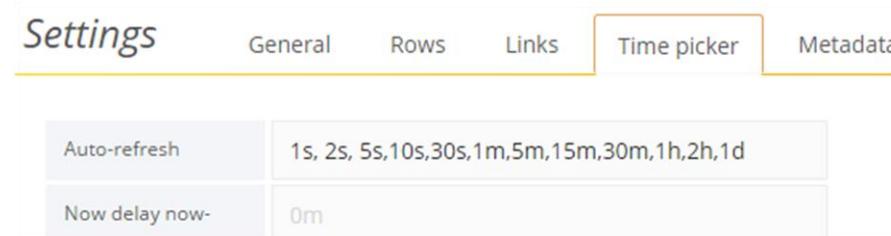


Figure 19: Configuration of dashboard Auto-refresh in Grafana

SHUTTING DOWN

If you want to close the virtual Linux machine after you have started Graphite and Grafana you should use the “Save the machine state” option (see figure 4). Otherwise you may need to start the Graphite and Grafana services again when you start the virtual machine again.

Tab	Editable items relevant for this application note
General	Set the “Title” of the panel
Metrics	<p>Select the parameter from the Xena tester to display in the gauge</p> <p>“Scale” the displayed parameter. In figure 12 “scale” is set to 0.0001, which means that the parameter value is multiplied by 0.0001 before it is shown in the gauge. For the kPPS (kilo Packets Per Second) parameter is may be relevant to show it without scaling i.e. as PPS. This would however require that you set the Maximum value to 1000000 in the options tab. If you do that Grafana freezes! Therefore the parameter is instead shown as kPPS.</p> <p>“Cache timeout” is set to 1 to minimize the response time of the gauge.</p> <p>“KeepLastValue(4)” prevents flickering in the presentation of data. You may however need to use a higher value (e.g. “KeepLastValue(20)” to be able to use the “Data Operator” “Current” (see the Options row).</p>
Options	<p>“Data Operator” is set to “Current” to show current value of the parameter</p> <p>“Unit” can be set if relevant for the parameter</p> <p>Number of “Decimals” can be set as relevant for the parameter</p> <p>“Maximum” value to show in the gauge must be set to a value relevant for the parameter</p> <p>The “Fonts Setting” and “Coloring” sections enable customizing of the visual appearance of the gauge.</p>
Radial Metrics	Distance between minor and major ticks in the gauge can be set.
Thresholding	Set the thresholds (what is indicated as green, orange and red) and set what colors that are used (if colors are used at all)
Value Mappings	Not used for the creation of this application note
Time range	Not used for the creation of this application note

Table 1: Parameters for the gauge panels

NEXT STEPS

Once you have the gauges up and running as implemented in the example in this application note you can modify the script and the Grafana dashboard to include other parameters and maybe show them as graphs in other panels if that is relevant for your applications. The Xena Scripting API is used to get parameters from the Xena testers. At this link [Statistics Parameters](#) you will find information on how to program the Xena_test.tcl script to get other parameters from the Xena tester. You can change the script to run longer than approx. 2 minutes by changing the “test_count” parameter in the script.

The upper text box in the dashboard (currently showing “Test results from Xena tester”) can be edited similar to the gauge panels.

SHOWING THE GAUGES IN THE FUTURE

When you want to see the gauges in the future you need to start the Oracle VM VirtualBox and in there start the virtual Linux Ubuntu machine with Graphite and Grafana installed. You can then access the gauges from the Chrome web browser in the Windows part of your PC. You don’t need to access Graphite at all or to access Grafana from the virtual Linux Ubuntu machine.

Please observe however that it may be required to run ifconfig again and update the test script and the IP address to use to access Grafana from the Chrome web browser as described in the “Connecting Graphite and Grafana to the Chrome web browser in Windows” section in this application note. If the IP address is correct and you still can’t access Grafana or Graphite you may need to type the following at the command lines in the Linux terminal:

- sudo service grafana-server start
- sudo service carbon-cache start

APPENDIX

Software versions

Table 2 shows the software versions used in the creation of this application note. The software was installed on a PC running Windows 10.

Name	Version
ActiveTcl	8.6.4.1
Chrome web browser	Version 58.0.3029.96 (64-bit)
Grafana	4.2.0
Grafana Gauge plug-in	0.0.3
Graphite	1.0.1
Linux	Ubuntu 14.04.3 LTS
Oracle VM VirtualBox	Version 5.1.22 r115126 (Qt5.6.2)
Oracle VM VirtualBox Extension Pack	5.0.4-102546
VBoxGuestAdditions	5.0.0_RC3
ValkyrieManager	Version 1.43

Table 2: Software versions