ORACLE

Monitoring & Alerting Capabilities in an Oracle Private Cloud Appliance X9-2

An overview of the built-in Monitoring and Alerting Framework available with the Oracle Private Cloud Appliance X9-2

February 16, 2023 | Version v2.01

Classification – Public

PURPOSE STATEMENT

This document provides an overview of the enhanced monitoring and alerting features included with the latest systems software release, 3.0.1, of Oracle Private Cloud Appliance. It is intended solely to help you assess the business benefits of using releasewith the latest systems software release, 3.0.1, of Oracle Private Cloud Appliance to plan your Information Technology infrastructure projects.

VERSION HISTORY - NEW

The initial version of this document (v1.01 – 30 March 2022), provided an overview of the features available with the Oracle Private Cloud Appliance with system software release 3.0.1

This version of the document (v2.01 – 16 Feb 2023), provides an update to the initial document to cover the new features available in Oracle Private Cloud Appliance with the latest systems software, release 3.0.2.

Where the document has been revised, the relevant section header has been flagged as either 'NEW', for new content. Or 'UPDATED' for amended content.

Further updates will be provided using the same approach as additional features and functionality are made available.

DISCLAIMER

This document in any form, software, or printed matter, contains proprietary information that is the exclusive property of Oracle. Your access to and use of this confidential material is subject to the terms and conditions of your Oracle software license and service agreement, which has been executed and with which you agree to comply. This document and information contained herein may not be disclosed, copied, reproduced, or distributed to anyone outside Oracle without prior written consent of Oracle. This document is not part of your license agreement, nor can it be incorporated into any contractual agreement with Oracle or its subsidiaries or affiliates.

This document is for informational purposes only and is intended solely to assist you in planning for the implementation and upgrade of the product features described. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described in this document remains at the sole discretion of Oracle.

Due to the nature of the product architecture, it may not be possible to safely include all features described in this document without risking significant destabilisation of the code.

TABLE OF CONTENTS

List of images

List of tables

INTRODUCTION

This Technical Brief provides an overview of the default monitoring and alerting framework contained in Oracle Private Cloud Appliance X9-2, abbreviated to Private Cloud Appliance within this document.

The Private Cloud Appliance administrative experience is very different from previous generations of PCA. A key new feature of Private Cloud Appliance is that it delivers private cloud infrastructure and architecture consistent with Oracle Cloud Infrastructure (OCI). As a result of this change, the mechanism used to provide monitoring and alerting capabilities in the Private Cloud Appliance differs significantly from earlier generations of the PCA platform.

Previous generations of the PCA platform made use of the following tools, in various combinations:

- Oracle Enterprise Manager; plus, the VT / PCA plugin and/or VI plugin
- Oracle VM Manager
- 'pca-admin' tools (various)
- 'ovmcli' tools (various)
- Web service API calls (various)
- SNMP services
- Syslog collector services (various)

Traditionally, the PCA platform has required an externally-based Oracle Enterprise Manager instance, and a number of plugins, to provide role-based access control access into PCA systems.

Private Cloud Appliance now delivers a fully integrated, internal monitoring and alerting framework in the PCA Service Enclave control plane, based on the following components: -

- Prometheus - a metrics collection and alerting tool
  - Acts as the central collection and collation point for various monitored systems metrics
  - Provides an alerting framework, triggering alerts when designated events are detected
- Grafana Loki - a log aggregation tool
  - Provides visibility into physical and virtual component log files
- Grafana - a visualization and alerting framework
  - Provides a centralized graphical dashboard to present the various data sources, outlined above, to Private Cloud Appliance administrators
- Oracle Auto Service Request (ASR) – an optional hardware fault monitoring system
  - Integrates directly into the My Oracle Support framework
  - Automatically opens service requests when specific Oracle Private Cloud Appliance hardware faults occur

The following sections, in this Technical Brief, will describe the basic architecture, default services and capabilities of the Private Cloud Appliance monitoring and alerting framework.

In addition, basic instructions are included for the creation of customer specific Grafana Dashboards and onward integration to existing external, data center, services such as:

- Messaging
- Email
- Identity Management

Where limitations within the current Private Cloud Appliance systems software release for integration with external services are present, these will be identified in the appropriate section.

MONITORING AND ALERTING BASICS

This section outlines the monitoring and alerting framework architecture and default services and capabilities available in a Private Cloud Appliance.

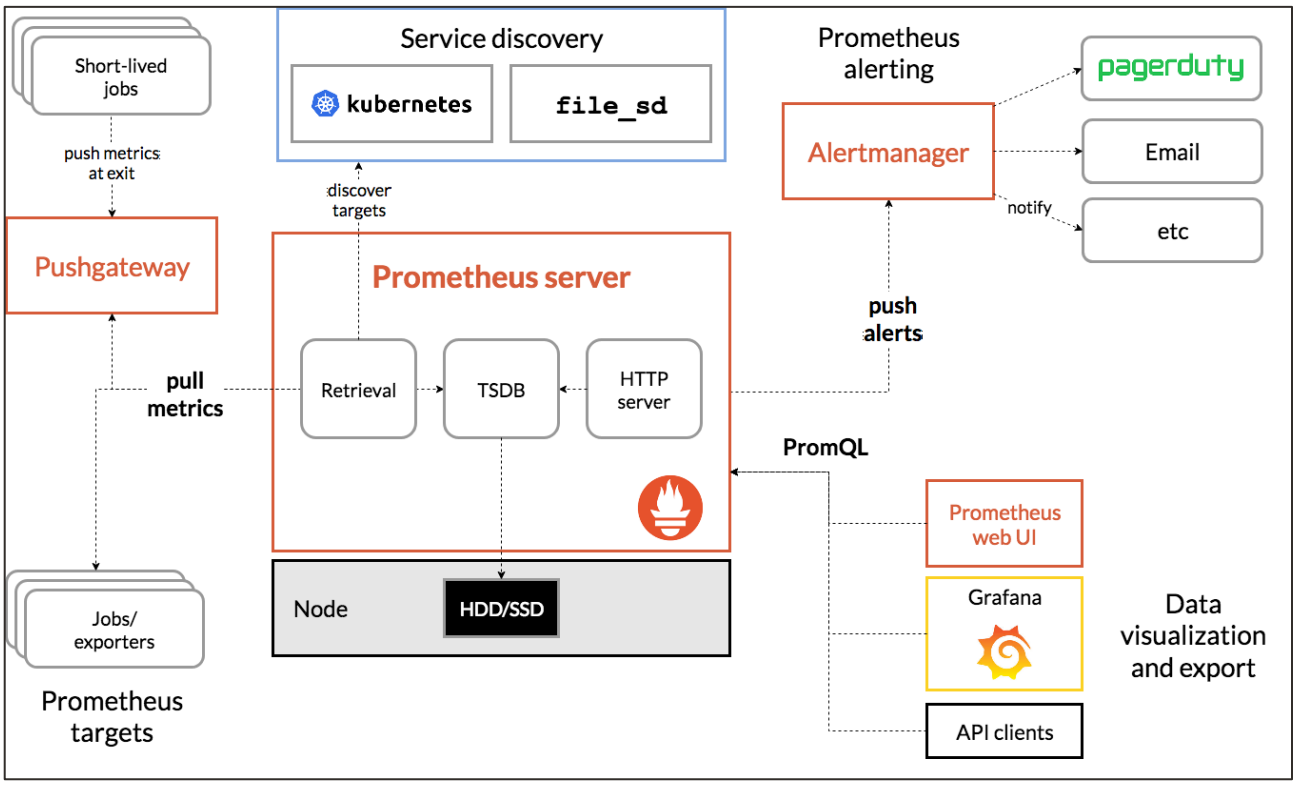
Monitoring & Alerting Architecture - Updated

Overview - Updated

As mentioned in the introduction, the Private Cloud Appliance monitoring and alerting framework consists of three main elements:

- Metrics collection and collation using Prometheus
- Log collection and aggregation using Grafana Loki
- Data Visualisation and Alerting using Grafana

The diagram below shows how Prometheus and Grafana interact.



Prometheus Architecture Diagram

The Prometheus service collects metrics from designated sources, or targets. Both push and pull options are available.

- Data being "pushed to the Prometheus Service makes use of configured Push Gateways.
- Data being pulled from the designated sources make use of locally running jobs or exporters to provide the connectivity.

Prometheus then stores all collected data locally and runs rules over this data to either aggregate or record new time series information.

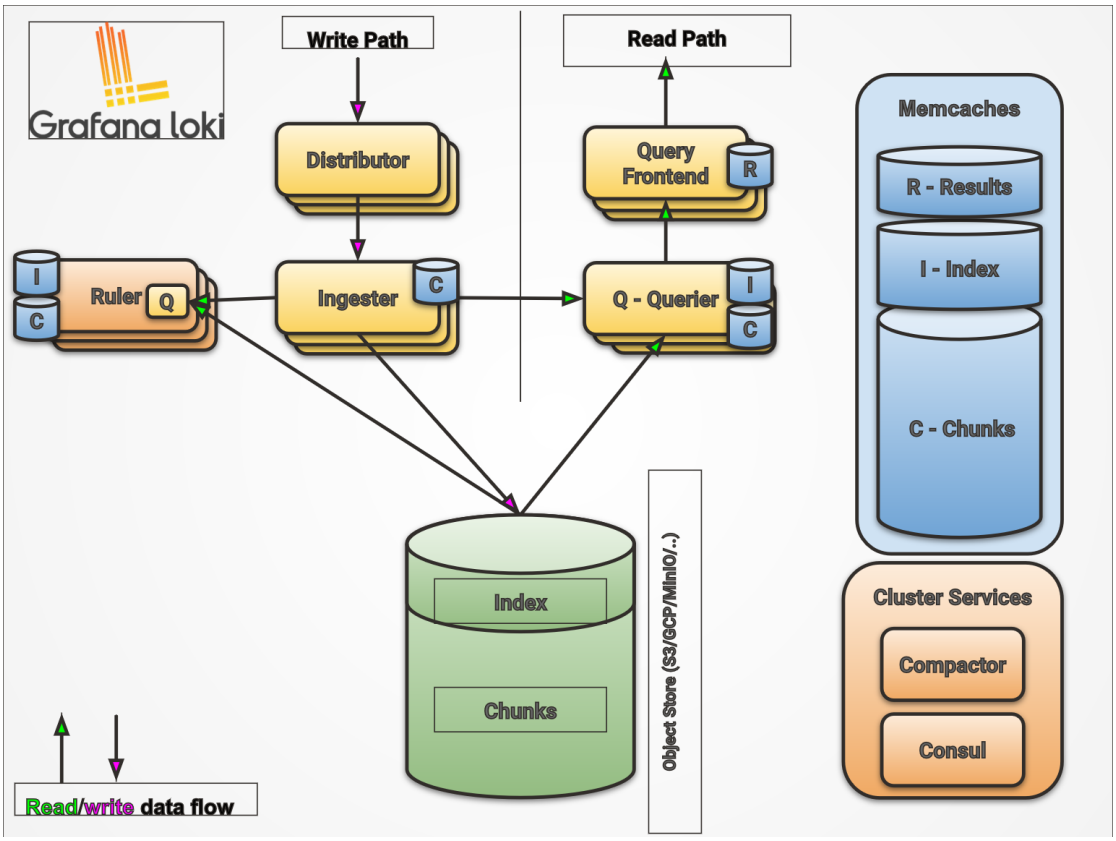
Metric-based alerting rules in the Prometheus service can push alerts to the Prometheus Alertmanager for onward processing and notification.

Grafana is used to provide a visualization interface for the collected data.

The Grafana service makes use of both the Prometheus Server service **AND** the Prometheus Alertmanager service as default data sources.

In addition, Grafana accesses a third data source, Loki, to provide access to individual component log files which are centrally collected, collated, and indexed in the centralized Grafana Loki instance.

The diagram below shows how this collection and collation takes place.



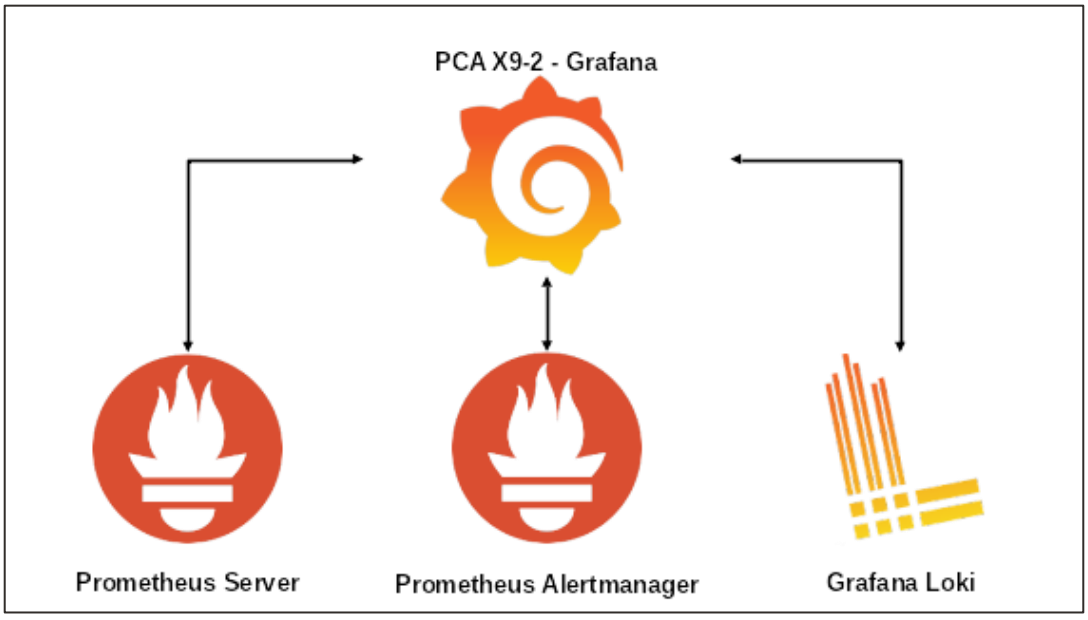
Loki Architecture Diagram

In a similar manner to Prometheus, Loki collects, collates, and stores the designated log entries from its configured sources.

Rules are applied to the incoming logs as they are ingested to de-duplicate where necessary before being stored within Loki's own object store.

Access to the stored data is then made available to the Grafana services.

In summary, a central Grafana Server instance provides access to three separate internal data sources in the Private Cloud Appliance system, as illustrated in the diagram below.



Private Cloud Appliance Grafana Data Sources

With Private Cloud Appliance release 3.0.2, a fourth data source named ProLoki is now available but currently unused.

Versions

The following component versions are used in the Private Cloud Appliance release 3.0.2 systems software stack:

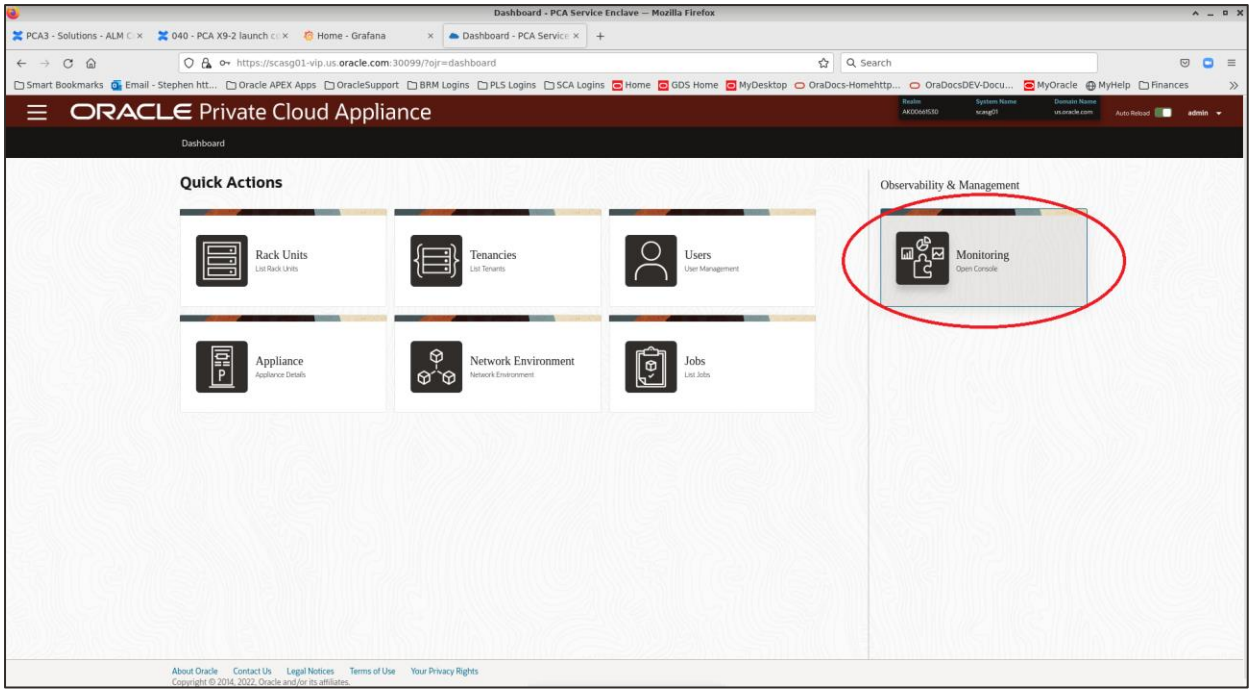
- Grafana – v7.3.7
- Prometheus – v2.20.0
- Prometheus Alertmanager – v0.21.0
- Loki – v2.2.1

Accessing the Grafana Homepage

The Grafana environment is provided as one of the Private Cloud Appliance Management microservices running in the Private Cloud Appliance Service Enclave. Access to this environment is possible using one of two methods—from the Service Enclave User Interface (SEUI) component and by direct browser call to the Grafana URL

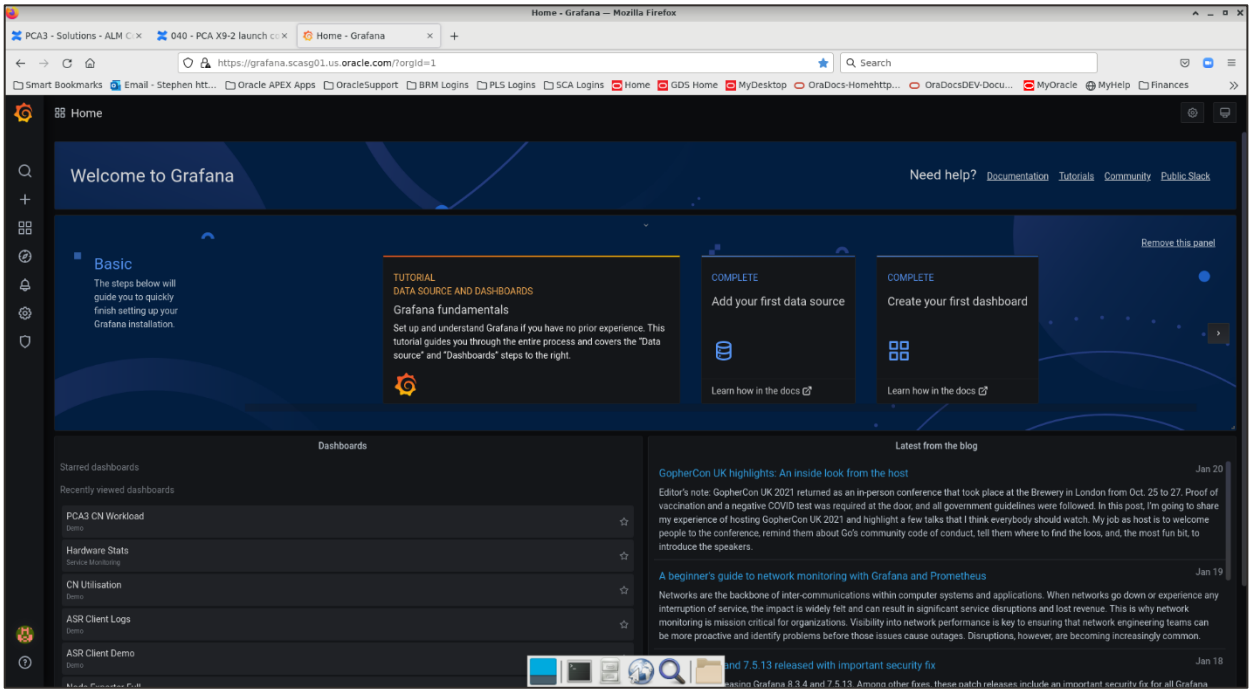
From the Service Enclave User Interface (SEUI)

Access to the Grafana Homepage is available on the far right-hand side of the Service Enclave Dashboard.



Private Cloud Appliance Service Enclave User Interface (SEUI)

Click to launch the Grafana Homepage.



Grafana Home Page

Direct browser call to the Grafana URL

In addition to accessing the Grafana Homepage via the Service Enclave, a direct call to this site is also possible using the URL https://grafana.<Private Cloud Appliance FQDN>

This will display the same Grafana Homepage as when using the SEUI method.

Signing into Grafana

The default installation provides a single local user, admin, to access the Grafana services.

Default Grafana Services - Updated

The initial configuration for the Private Cloud Appliance includes the following Grafana services, enabled and configured from the outset:

- One local user (admin) account
- Four internal data sources
  - Prometheus
  - Prometheus Alertmanager
  - Prometheus ProLoki - **NEW**
  - Grafana Loki
- Grafana Dashboards, 41 predefined dashboards are organized into a series of folders
  - Kubernetes Monitoring (13)
  - Kubernetes Monitoring Containers (4)
  - Kubernetes Monitoring Nodes (7)
  - My Sauron - as Read Only access (4)
  - PCA 3.0 Service Advisor (6)
  - Service Monitoring (7)
- Grafana Alerts
  - 27 Grafana Dashboard-based alerts are provided with the initial base installation
- Grafana Notification Channels
  - Internal channel to Private Cloud Appliance own Prometheus Alertmanager
  - External call, using Slack, to an Oracle internal Slack hosting service - as an example configuration

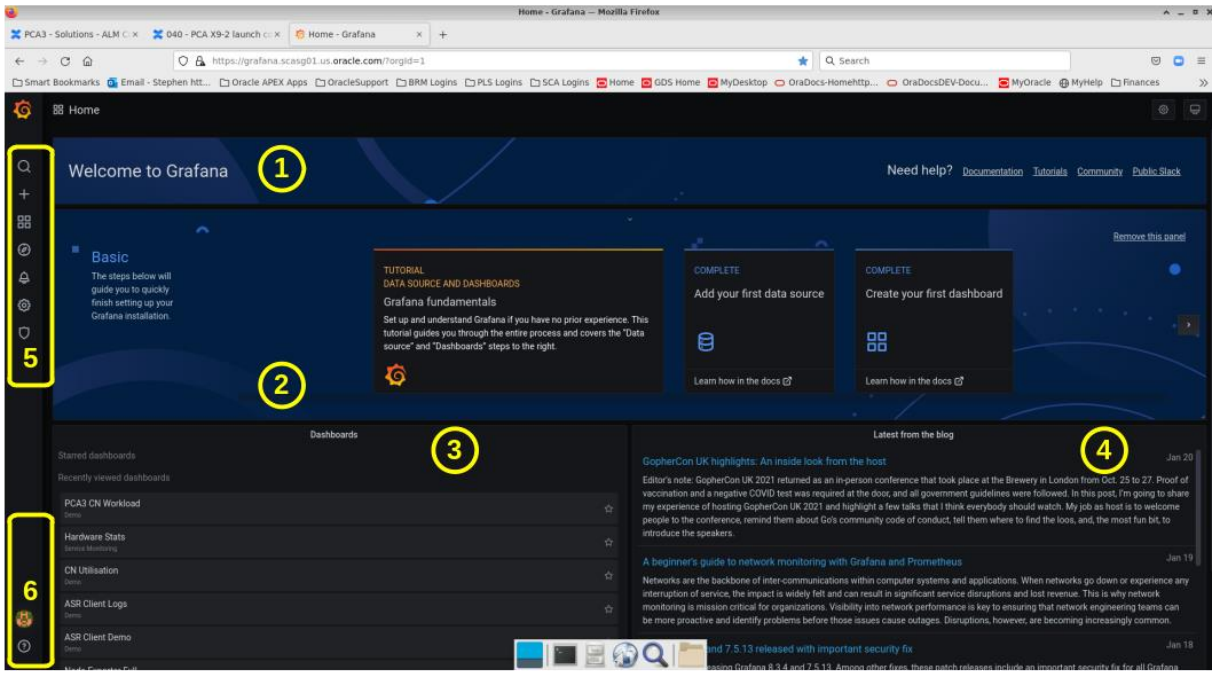
Below are further details on each of these elements.

Getting Started

This section provides a high-level description of the Grafana services available after the initial, Day0, configuration.

Grafana Home

The default Grafana Home page consists of the following six elements:



Grafana Home Page Elements

1 - Grafana Welcome Banner

A simple Welcome Banner is provided with links to the documentation libraries, tutorials, and Grafana Community pages. This is persistent in the default home page.

2 - Grafana Getting Started panel

The Getting Started panel provides access to the public Grafana Tutorials and documentation links for initial set up and configuration. The Private Cloud Appliance has already had these initial set up tasks completed, but this panel is provided for completeness.

NOTE: The panel can be removed (permanently) from the Grafana Home Page dashboard when no longer required.

3 - Grafana Dashboards

The left-hand panel provides shortcut access to recently viewed Grafana dashboards.

Where a dashboard is of particular interest, in can be "starred", in the dashboard screen and will be permanently "pinned" to the topmost section of this panel.

4 - Grafana Blog Feed

The right-hand panel provides a rolling updated stream of the latest Grafana Blog entries.

5 - Grafana Menu Bar

The Grafana Menu Bar will be the primary point of entry for accessing Grafana services.

6 - Grafana User and Help Menu Bar

The Grafana System Menu Bar will be the primary point of entry for accessing Grafana administration services.

NOTE: Because the default user, "admin", is the local Grafana instance administrator, all Menu Bar options are displayed.

Grafana Menu Bar

The Grafana menu bar includes:

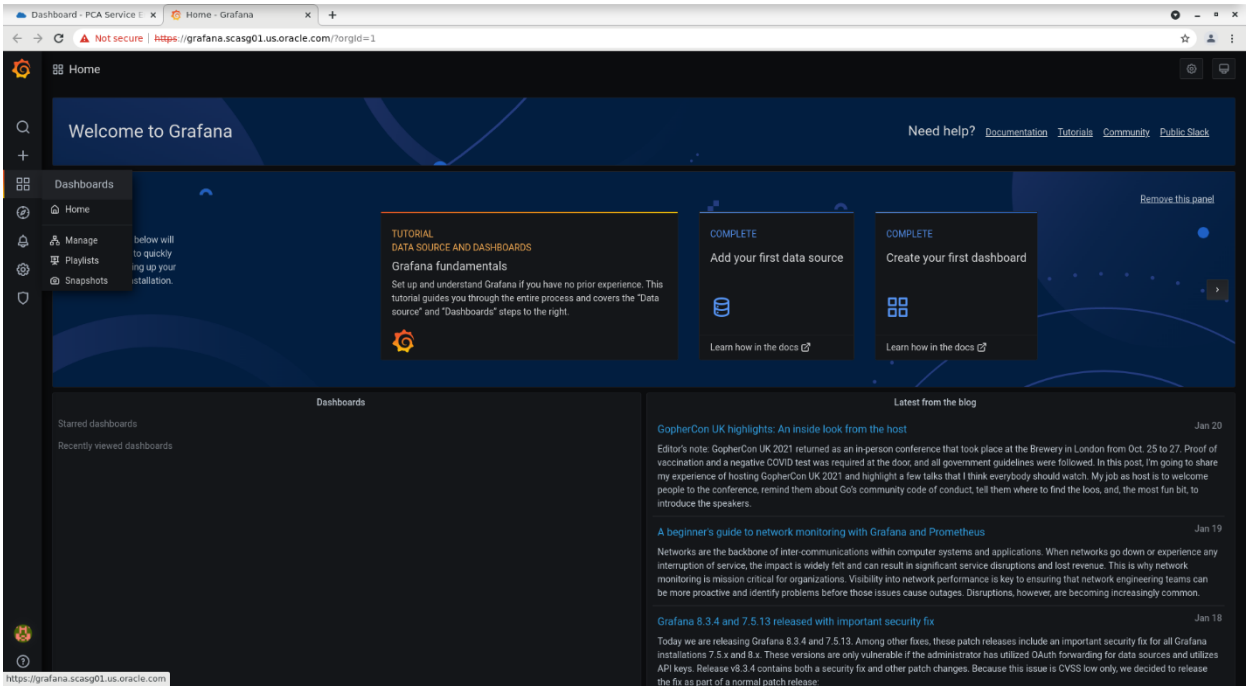
Grafana Menu Bar Icons

MENU BAR ICON	DESCRIPTION / PURPOSE
	Home Icon - returns the user to the Grafana Home Page
	Search Icon - Enables Dashboards to be searched for by name
	Create Icon - Enables the creation of new Folders and Dashboards
	Dashboard Icon - Enables the management of available Grafana Dashboards
	Explore Icon - Enables the "Exploration" of the available data sources
	Alerting Icon - Enables the management of Grafana Alerts and Notification Channels
	Configuration Icon - Enables the management of the Grafana services Data sources, Users, Teams (groups) etc
	Server Admin Icon - Enables the management of the Grafana Server environment
	User Icon – Enables access to User settings
	Help Icon – Enables access to the Grafana Help & Support web pages

Grafana Menu Bar Icons & purpose

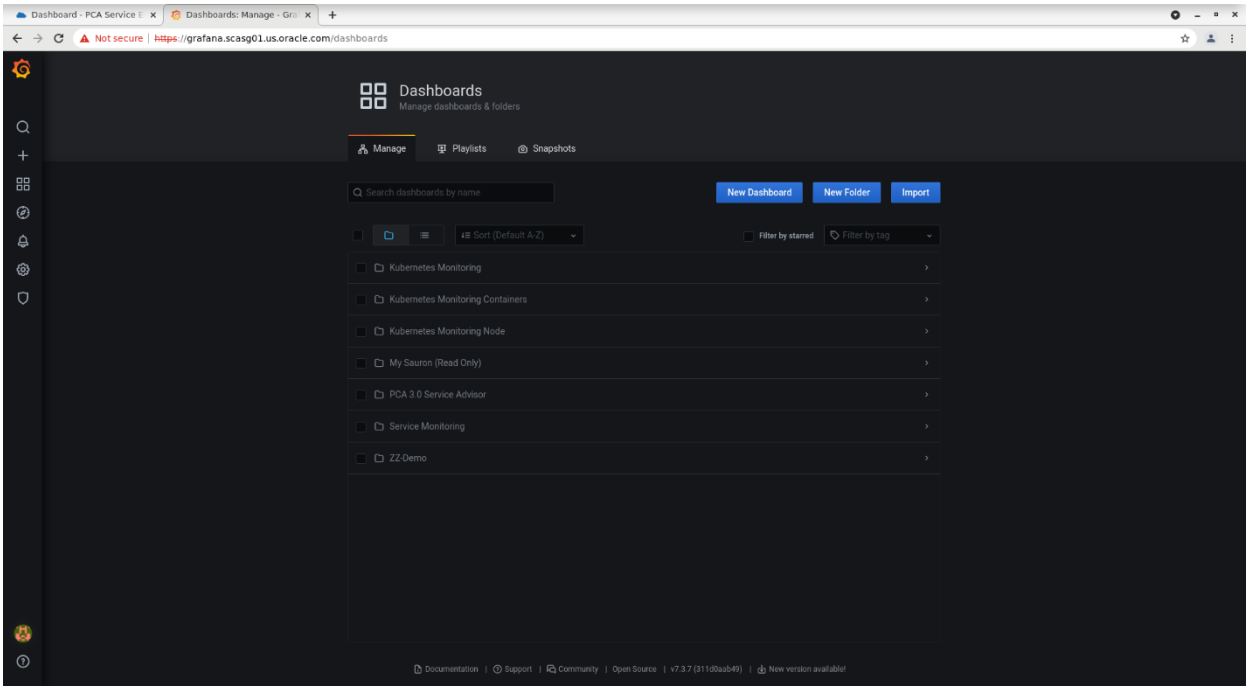
Accessing the default dashboards

From the Grafana Menu Bar, click on the Dashboard Icon.



Grafana Dashboard Navigation - Dashboard

Select the Manage option



Grafana Dashboard Navigation - Manage

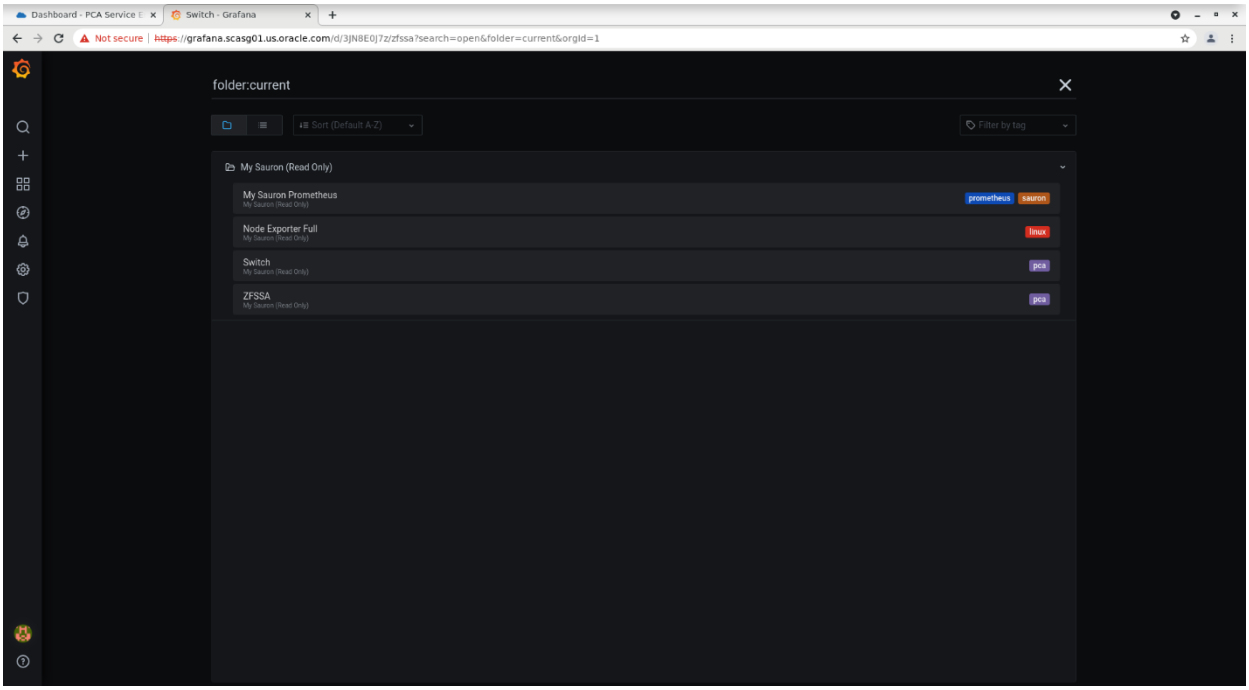
This displays the available folders within which the Grafana Dashboards have been organized. The default folders are displayed, consisting of 41 predefined dashboards organized into six Grafana folders: -

- Kubernetes Monitoring (13)
  - Provides an overview of the Private Cloud Appliance Management, or Service Enclave, Kubernetes Framework core services
- Kubernetes Monitoring Containers (4)
  - Provides a detailed view into the Private Cloud Appliance Management K8S Container services
- Kubernetes Monitoring Nodes (7)
  - Provides a detailed view into the Private Cloud Appliance Management K8S Pod services
- My Sauron - as Read Only access (4)

  - Provides visibility of the Private Cloud Appliance physical components
- PCA 3.0 Service Advisor (6)
  - Provides a summary Dashboard with preconfigured Grafana Alerting Rules for the overall health of the Private Cloud Appliance system
- Service Monitoring (7)
  - Provides a detailed view into the Private Cloud Appliance non-K8S Management services

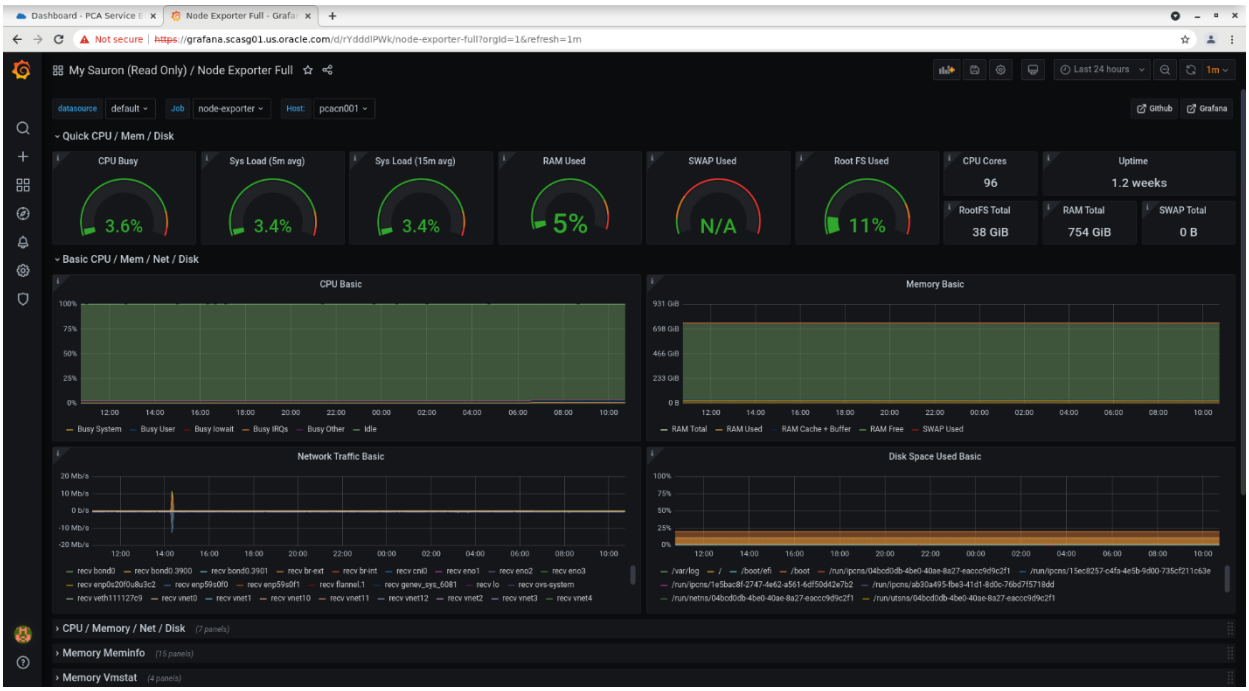
NOTE: The Kubernetes Grafana Dashboards are for K8S-based services running within the Private Cloud Appliance management node cluster (Service Enclave) and cannot be used for Kubernetes-based services within the Compute Enclave.

To illustrate this further, expand the My Sauron folder.



Grafana Dashboard Navigation – My Sauron folder

A list of four available Dashboards can be seen. Selecting the Node Exporter Full presents the following Dashboard:



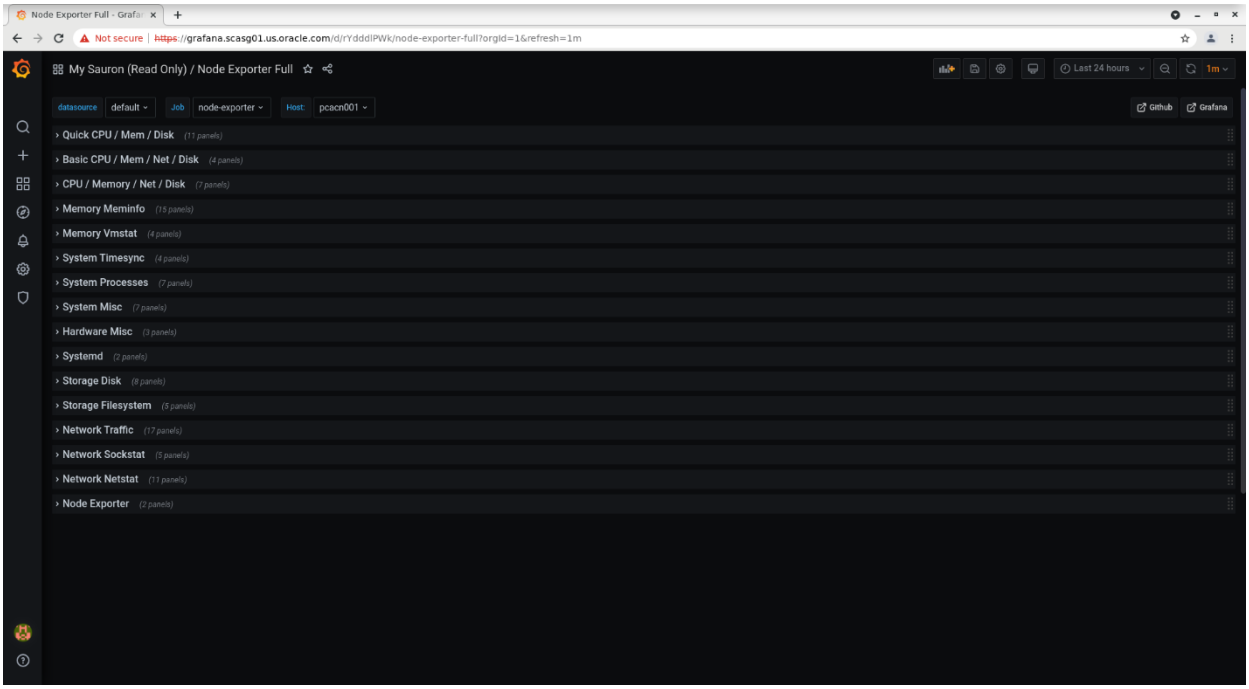
Grafana Dashboard Navigation – My Sauron Node Exporter

This is where the capabilities of the Private Cloud Appliance monitoring and alerting framework can start to be seen.

This Dashboard provides a single window for each physical Compute and Management Node within the Private Cloud Appliance system.

The dashboard itself shows the detailed metrics being collected. In this example, they are for the compute node pcacn001.

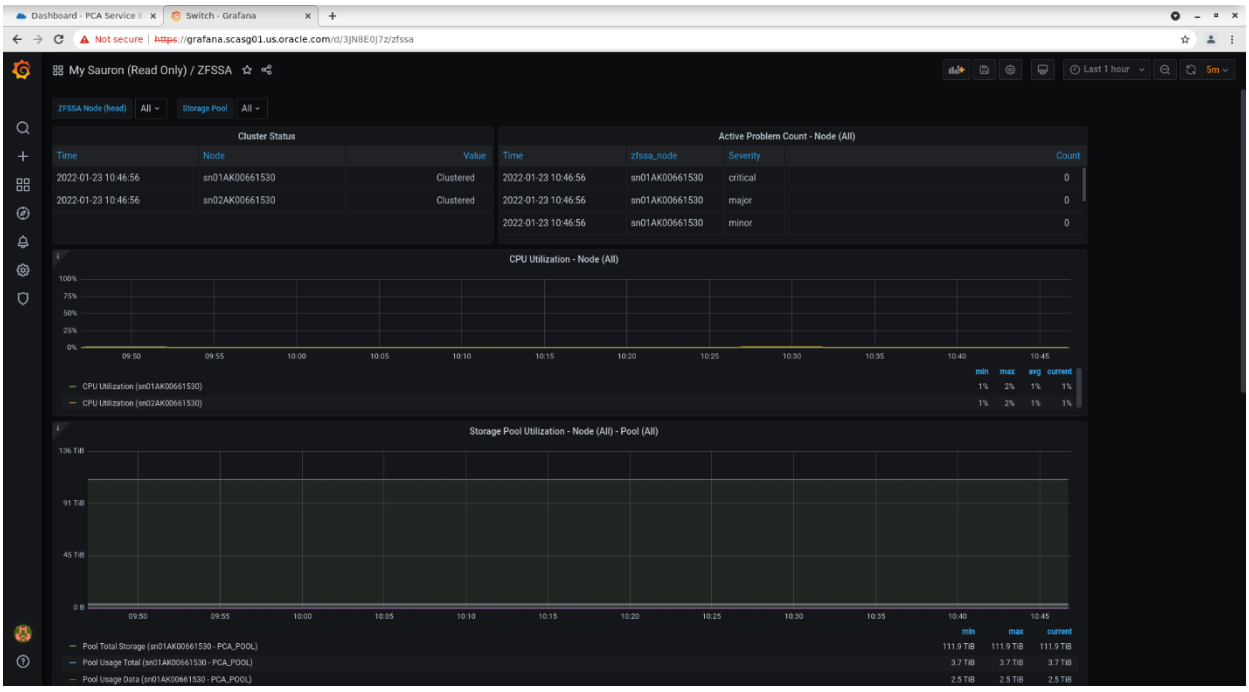
A comprehensive list of metrics is displayed in a series of grouped panels within this dashboard. The screenshots below shows the summarized view of available metrics and panels within the dashboard.



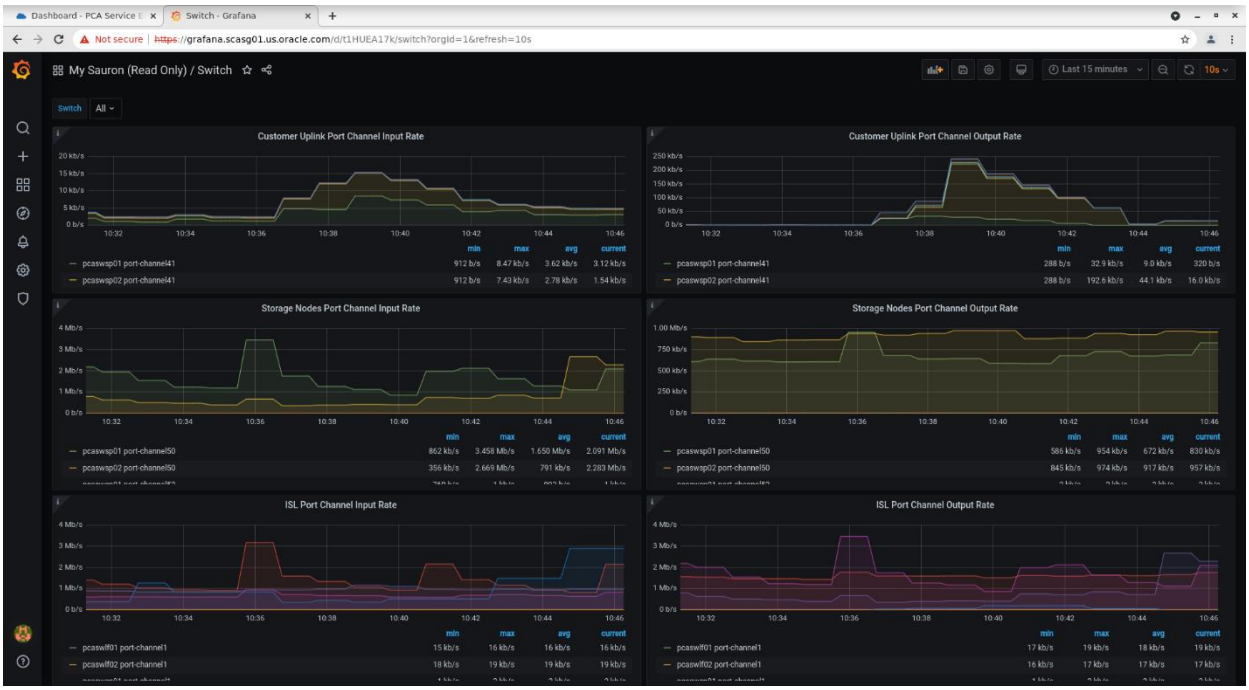
Grafana Dashboard Navigation – My Sauron Node Exporter – full summary list

In total, some 112 panels covering individual node CPU, memory, storage, and networking metrics are available within sixteen metric type groupings.

In a similar manner, the same level of detailed views into the Private Cloud Appliance utilization is available for both the internal Oracle ZFS Storage Appliance and the internal Cisco network switches.

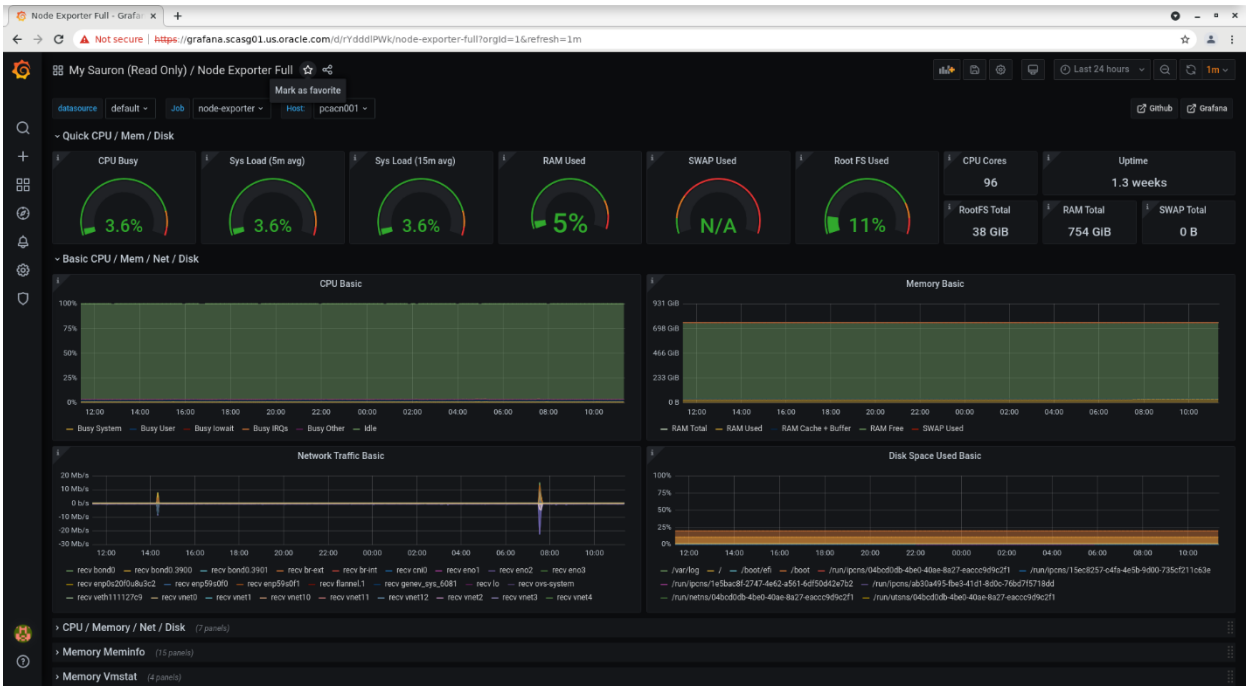


Grafana Dashboard Navigation – My Sauron – Oracle ZFS Storage Appliance



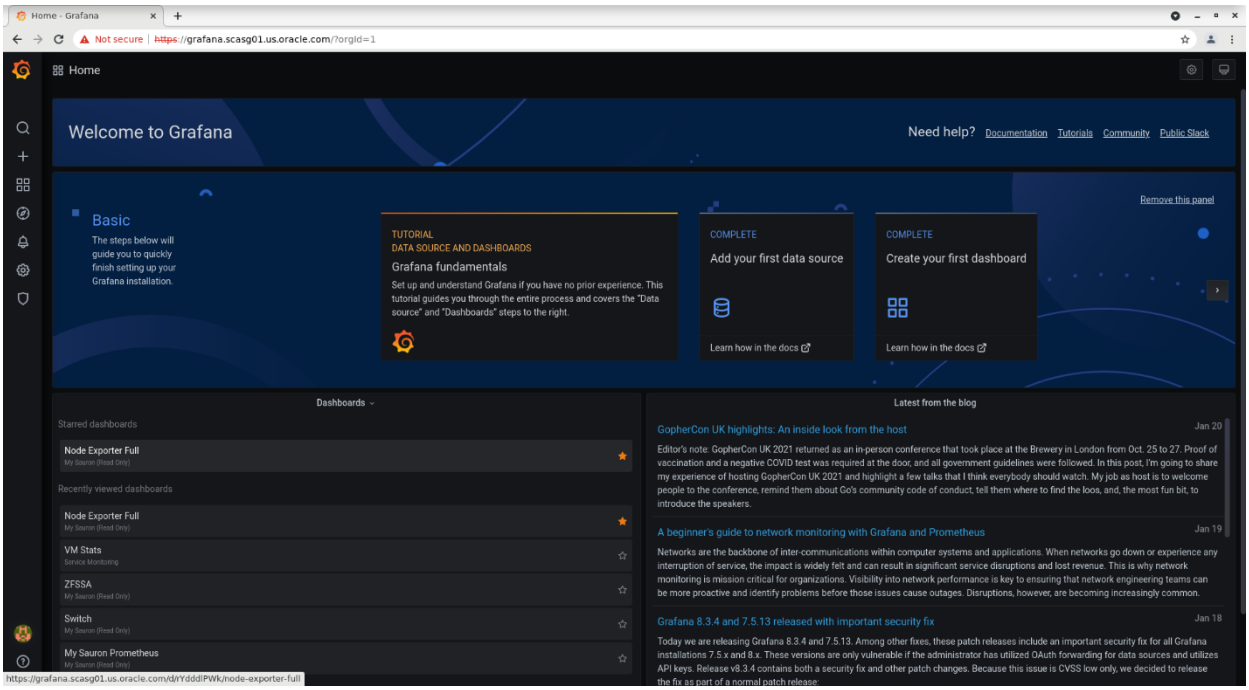
Grafana Dashboard Navigation – My Sauron – Networking Switches

Review all the available Grafana dashboards and determine which would be of greatest interest. These dashboards can then be pinned to the Grafana Home page by marking as a favourite when viewing the dashboard itself.



Grafana Dashboard Navigation – My Sauron – Marking a Favourite Dashboard

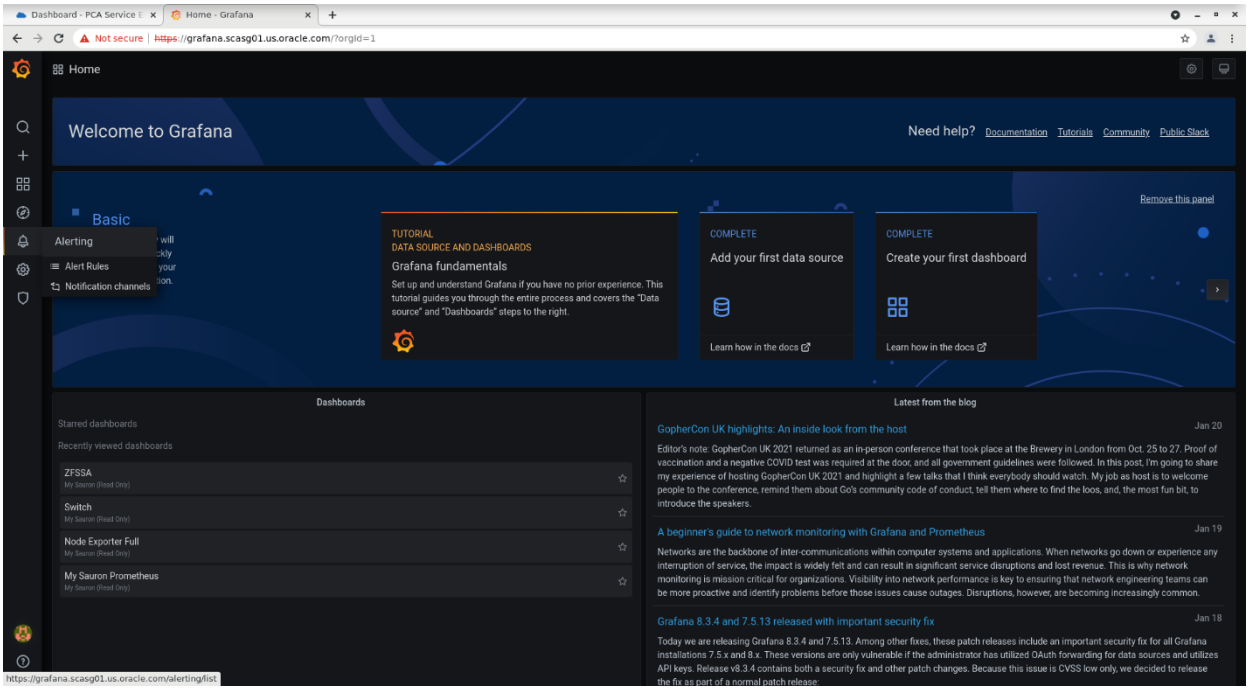
In the example above, this dashboard is pinned to the Grafana Home page as a starred Dashboard.



Grafana Dashboard Navigation – "starred" favorite dashboard

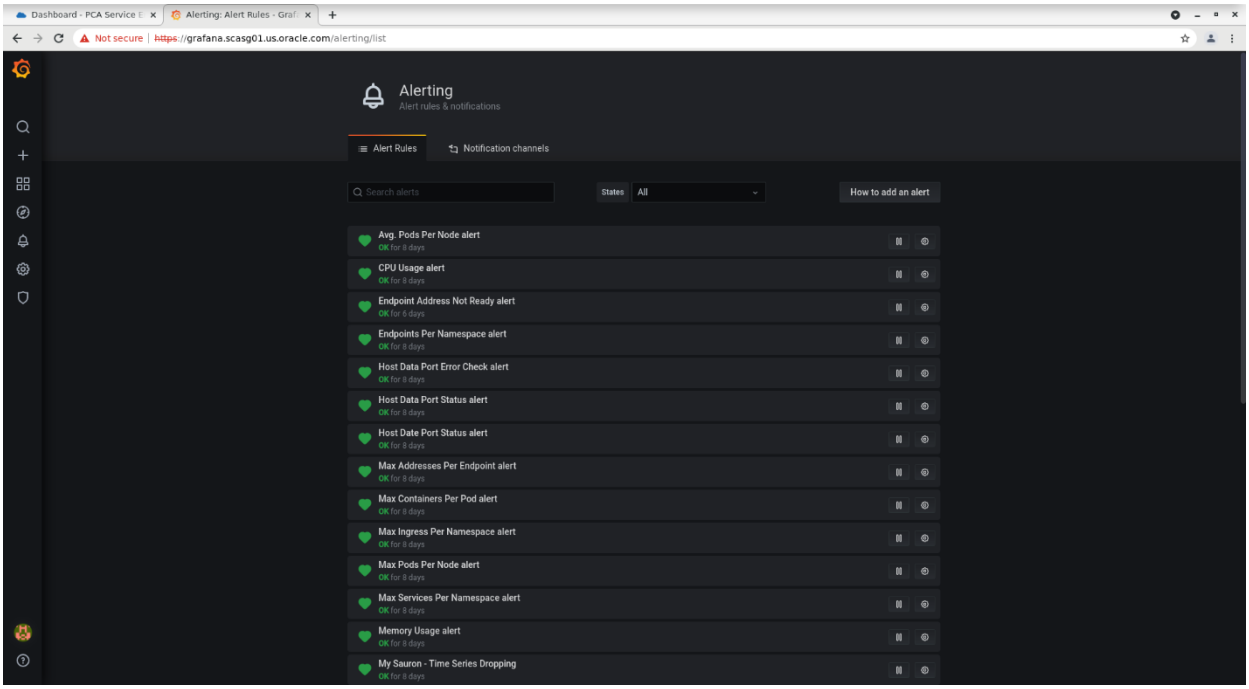
Accessing the default alerts

From the Grafana Menu Bar, click on the Alerting Icon.



Grafana Alerts Navigation – accessing the Alert Rules

Select the Alert Rules option.



Grafana Alerts Navigation – accessing the default Alerts

A list of each preconfigured Alert Rule can be seen.

Each Alert Rule can be paused or edited by using the icons to the far right.

Clicking on an Alert Rule will take you to the Grafana Dashboard panel used to monitor and track that Alerting Rule.

NOTE: Editing a rule will make a direct change to the underlying Grafana Dashboard.

Grafana basics and further reading

Continue to explore the available Grafana Dashboard content to become familiar with the default dashboards and alerts.

Comprehensive documentation is available for the following Open Source Software (OSS) elements used to construct the Private Cloud Appliance monitoring and alerting framework. The following URL's point to the relevant documentation libraries:

- Grafana
  - Dashboards - (https://grafana.com/docs/grafana/v7.3/dashboards/)
  - Alerting - (https://grafana.com/docs/grafana/v7.3/alerting/)
  - Best Practices - (https://grafana.com/docs/grafana/v7.3/best-practices/)
  - Documentation Library Home - (https://grafana.com/docs/grafana/v7.3/)
  - Tutorials – (https://grafana.com/tutorials/grafana-fundamentals/?utm_source=grafana_gettingstarted)
- Prometheus
  - Documentation – (https://prometheus.io/docs/prometheus/2.25/getting_started/)
  - Querying - (https://prometheus.io/docs/prometheus/2.25/querying/basics/)
  - Alertmanager – (https://prometheus.io/docs/alerting/0.21/overview/)
- Loki
  - Documentation – (https://grafana.com/docs/loki/v2.2.1/)
  - Querying – (https://grafana.com/docs/loki/v2.2.1/logql/)

CUSTOMISING GRAFANA - UPDATED

As with any newly installed system, a series of basic administration tasks need to be completed initially to help ensure that there is a solid foundation for the development and use of the features and functions.

These include

- Organization Administration
- Group Administration (Teams)
- User and Role Administration
- Separation of Grafana Dashboards by purpose / function (Folders)
- Alerting Notification mechanisms (Notification Channels)

Each of these elements is addressed below:

Organization Administration – New

Grafana permits the use of multiple organizations within each Grafana Server instance.

The following definition is used by Grafana to describe the role of an organization:

> An organisation is an entity that helps isolate users and resources such as dashboards, annotations, and data sources from each other. Their purpose is to provide completely separate experiences, which look like multiple instances of Grafana, within a single instance. Multiple organisations are easier and cheaper to manage than multiple instances of Grafana.
>
> Users, configuration settings, and Grafana Enterprise licenses are shared between organisations. Other resources, like dashboards, data sources, annotations, folders, Teams, and Alerts, are isolated within each organisation and cannot be easily shared with another organisation.

The following table summarizes the resources that can be shared and/or isolated using organizations.

Resource	Mode
Users	Share or isolate
Folders	Isolate only
Dashboards	Isolate only
Data sources	Isolate only
Alerts	Isolate only
Notification channels	Isolate only
Annotations	Isolate only
Reports	Isolate only
API keys	Isolate only
Authentication providers	Share only
Configuration settings	Share only
Licenses	Share

Grafana Organisation Resource Isolation

The member of one organization cannot view dashboards assigned to another organization. However, a user can belong to multiple organizations.

Grafana Server administrators are responsible for creating organizations.

The use of multiple organizations in a Private Cloud Appliance would enable the creation of tenancy-specific Grafana dashboards and named users, however, the fact the Grafana data sources *cannot* be shared between organizations precludes this as a viable option.

Currently, the use of a single organization structure is the only supportable option.

Group Administration - Updated

Grafana permits the grouping of users into teams.

The following definition is used by Grafana to describe the role of a team:

> A team is a group of users within an organisation that have common dashboard and data source permission needs. For example, instead of assigning five users access to the same dashboard, A team can be created that consists of those users and assign dashboard permissions to the team. A user can belong to multiple teams.
>
> A user can be a Member or an Administrator for a given team. Members of a team inherit permissions from the team, but they cannot edit the team itself. Team Administrators can add members to a team and update its settings, such as the team name, team member's team roles, UI preferences, and home dashboard.

The team preferences set the default home -age, colour scheme and team email address for its members.

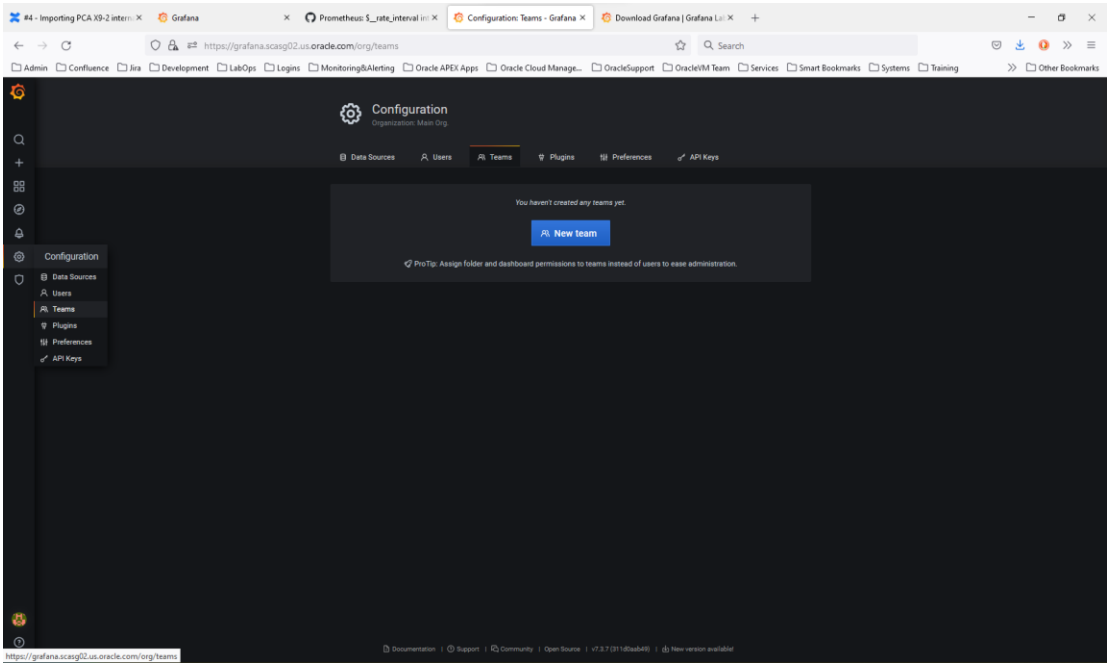
A user can be associated with multiple teams.

By default, no teams (Groups) have been defined in the Private Cloud Appliance Grafana Server instance.

Create team - New

The creation of a customised team structure is highly recommended to segregate any end-user role specific Grafana dashboards from the default dashboards provided.

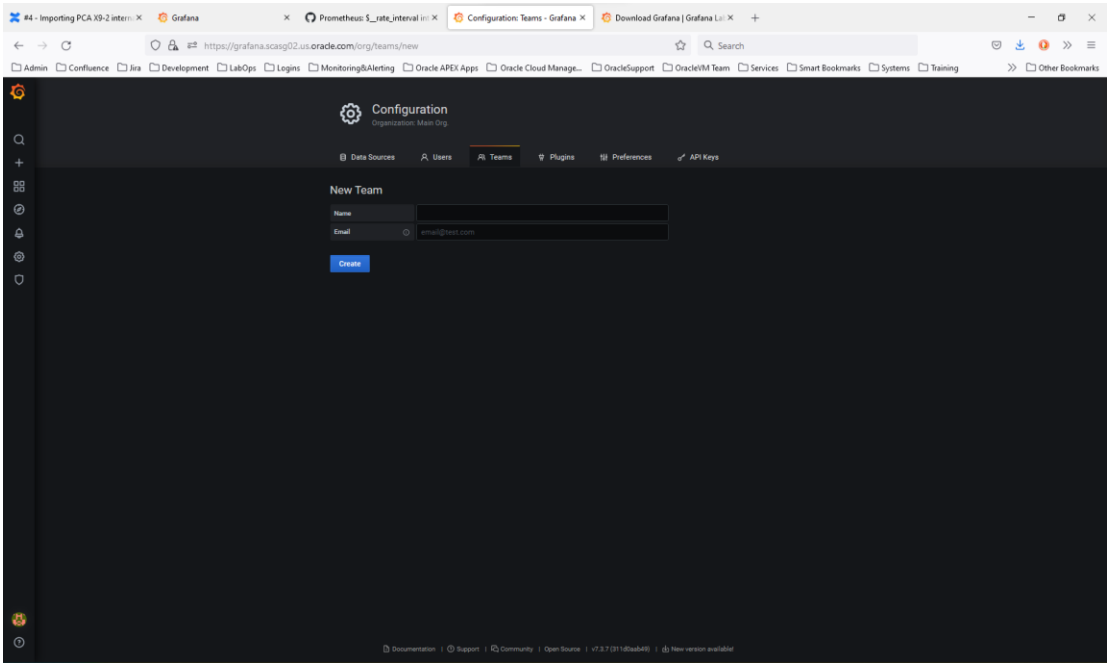
To this end, from the Configuration menu, display the existing teams:



Grafana Teams Administration – Empty List

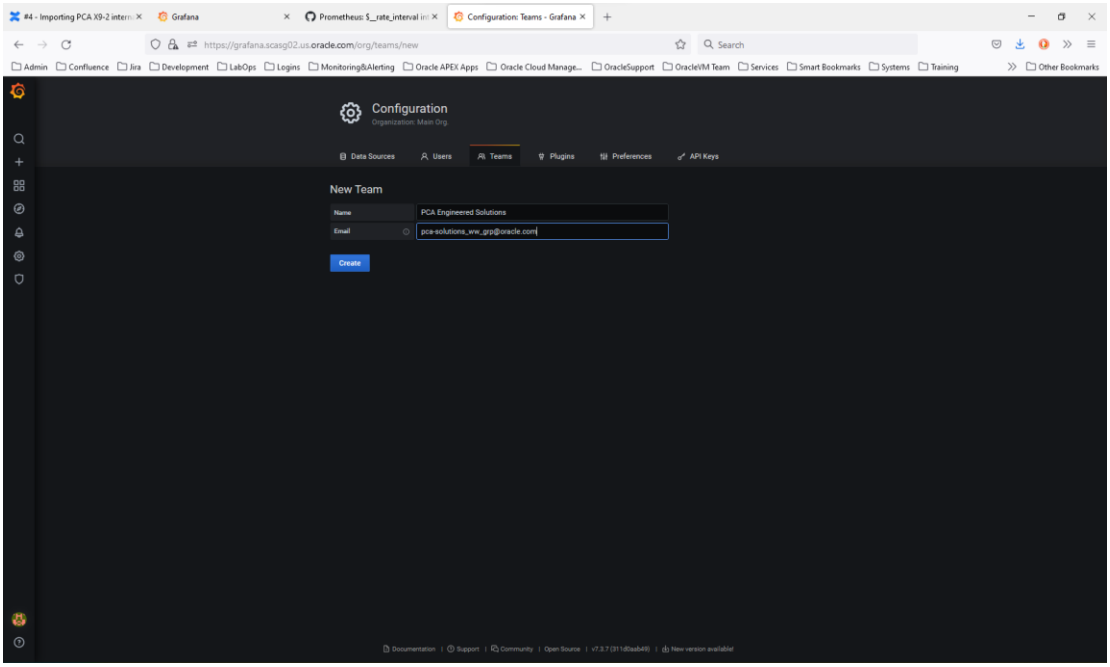
No teams are defined by default.

To create a new team, click the ‘New team’ button. -



Grafana Teams Administration – Create New Team

Creating a new team consists of completing two fields, a team name and an email address.

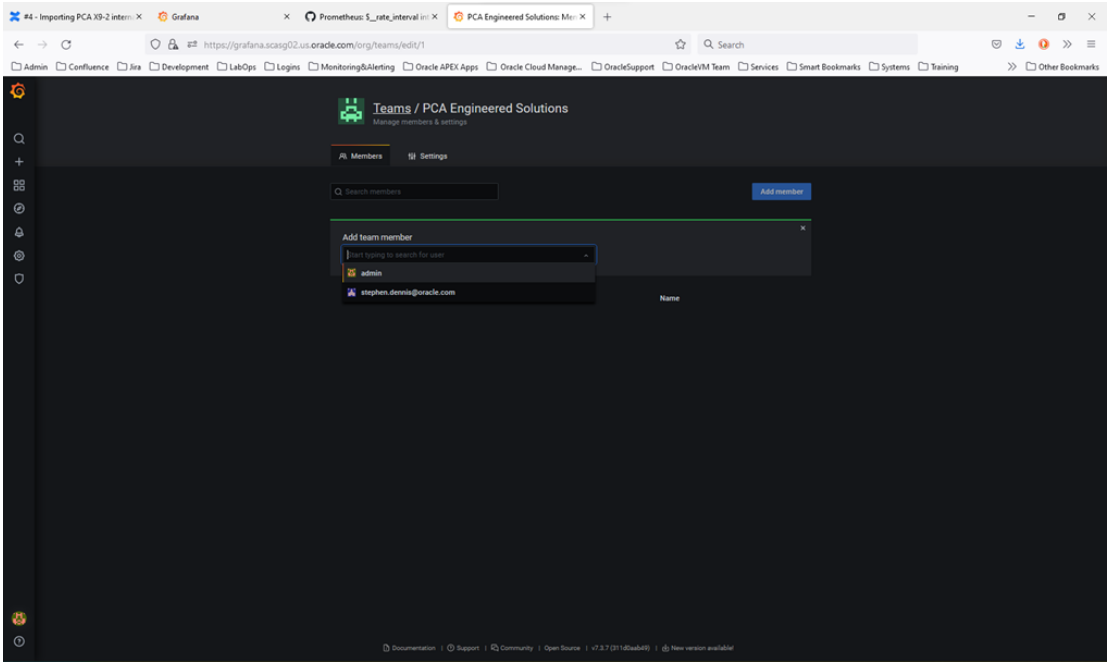


Grafana Teams Administration – New Team Details

Complete the entries required and click the ‘Create’ button.

Team Users - New

Upon creating a new team, the Grafana Server workflow will automatically move to the next Team screen to associate users with this team. -

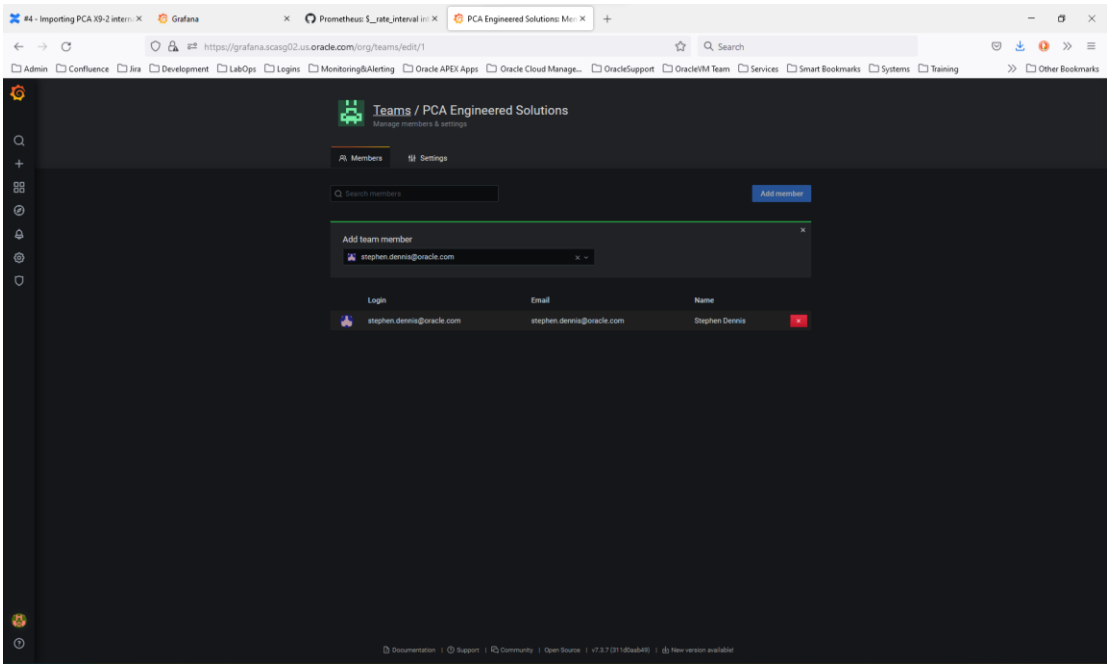


Grafana Teams Administration – Add Users to Team

A drop-down list of available users is displayed. In this case, the named user created within the User Administration section of this document is displayed.

Select the required named user(s) and save by clicking the 'Add to Team' button.

The Team User list will now reflect these additions.



Grafana Teams Administration – Team User List

Repeat as required to add each user to the required team.

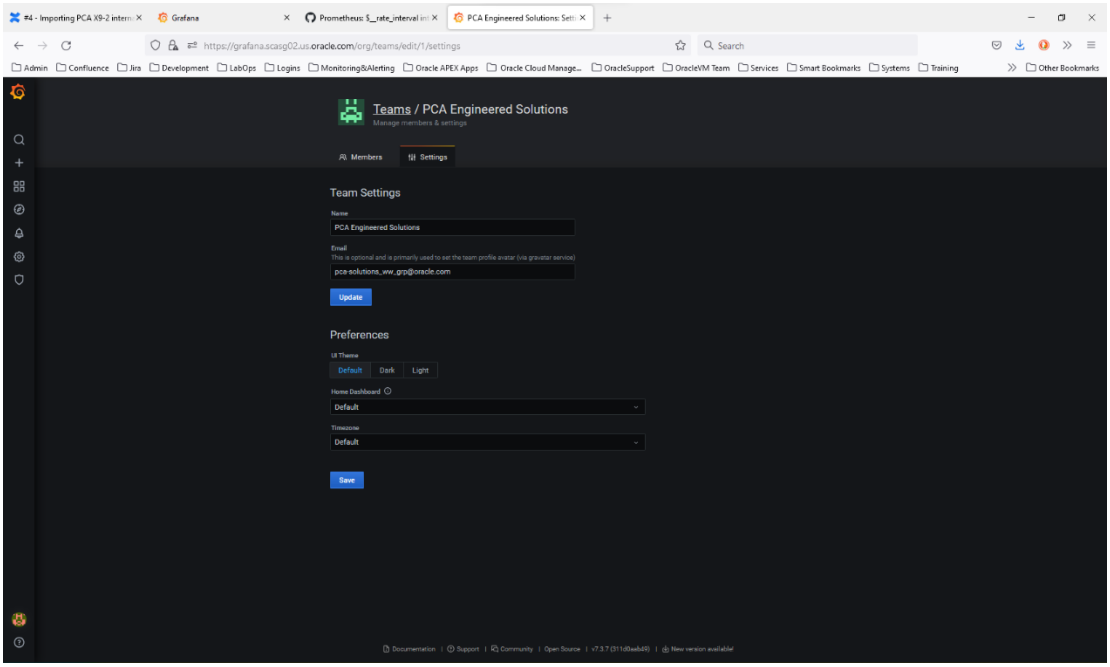
A named user can be a member of more than one team.

Team settings - New

The final step for team administration is to configure any team-specific settings required.

From the Teams option on the Grafana Configuration menu, select a team and choose the Settings tab.

The following screen will be displayed:



Grafana Teams Administration – Team Settings

Any changes made to the team settings will take precedence over the organization settings.

These only need to be amended where necessary.

User Administration - Updated

User roles

Within Grafana, named user and role assignment provide fine-level access control for users accessing the Grafana Server instance. Three levels of user role are available:

- Viewer
- Editor
- Admin

In addition, there is a fourth role available only to the default admin user (admin@localhost) account:

- Grafana Admin

The table below shows the access and menu options available for each user role:

Grafana user role access

MENU BAR ICON	MENU BAR LABEL	VIEWER OPTIONS	EDITOR OPTIONS	ADMIN OPTIONS	GRAFANA ADMIN OPTIONS (ADMIN@LOCALHOST)
	Home Icon	Homepage	Homepage	Homepage	Homepage
	Search Icon	Search Dashboards	Search Dashboards	Search Dashboards	Search Dashboards
	Create Icon		Dashboard	Dashboard	Dashboard
			Folder	Folder	Folder
			Import	Import	Import
	Dashboard Icon	Home	Home	Home	Home
		Browse	Browse	Browse	Browse
		Playlists	Playlists	Playlists	Playlists
		Snapshots	Snapshots	Snapshots	Snapshots
	Explore Icon		Explore	Explore	Explore
	Alerting Icon	Alert Rules	Alert Rules	Alert Rules	Alert Rules
			Notification Channels	Notification Channels	Notification Channels
	Configuration Icon			Data Sources	Data Sources
				Users	Users
				Teams	Teams
				Plugins	Plugins
				Preferences	Preferences
				API Keys	API Keys
	Server Admin Icon				Users
					Orgs

MENU BAR ICON	MENU BAR LABEL	VIEWER OPTIONS	EDITOR OPTIONS	ADMIN OPTIONS	GRAFANA ADMIN OPTIONS (ADMIN@LOCALHOST)
					Settings
					Stats
					Upgrade
	User Icon	Preferences	Preferences	Preferences	Preferences
		Change Password	Change Password	Change Password	Change Password
		Sign Out	Sign Out	Sign Out	Sign Out
	Help Icon	Documentation	Documentation	Documentation	Documentation
		Support	Support	Support	Support
		Community	Community	Community	Community
		Keyboard Shortcuts	Keyboard Shortcuts	Keyboard Shortcuts	Keyboard Shortcuts

Grafana User Role Access rights

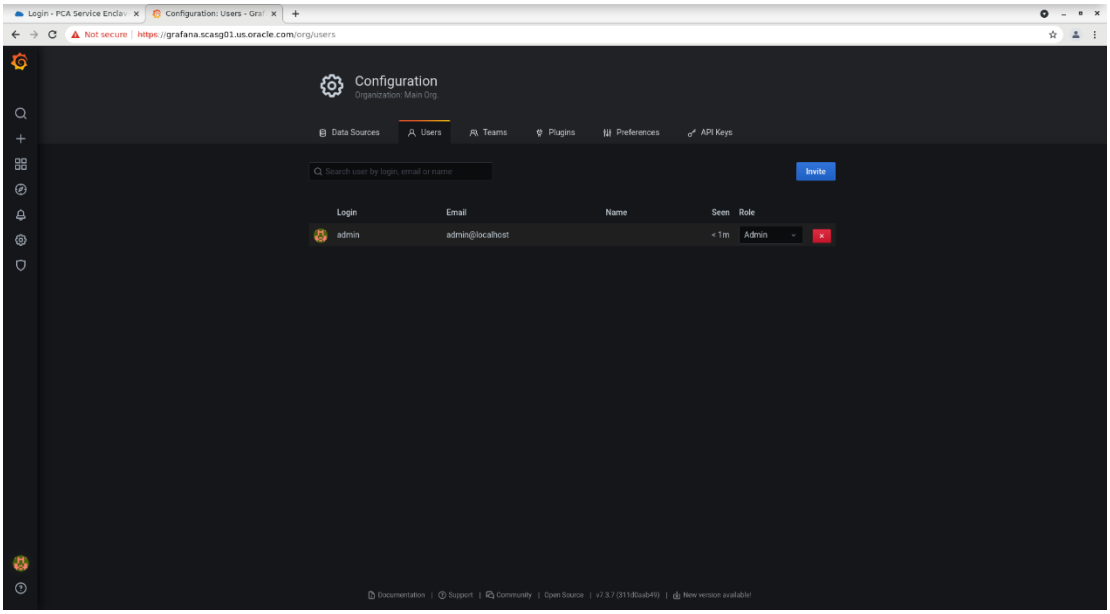
As noted previously, a single default local user, admin, provides the entry point into the Grafana environment and acts as the administrator to the Grafana environment. This user has the Grafana Admin role and acts as the 'super user' for the Grafana environment.

As such, great care must be taken when accessing the Private Cloud Appliance Grafana service since it is possible to inadvertently amend or delete the default dashboards and alerts while connected as the Grafana Server superuser.

User access

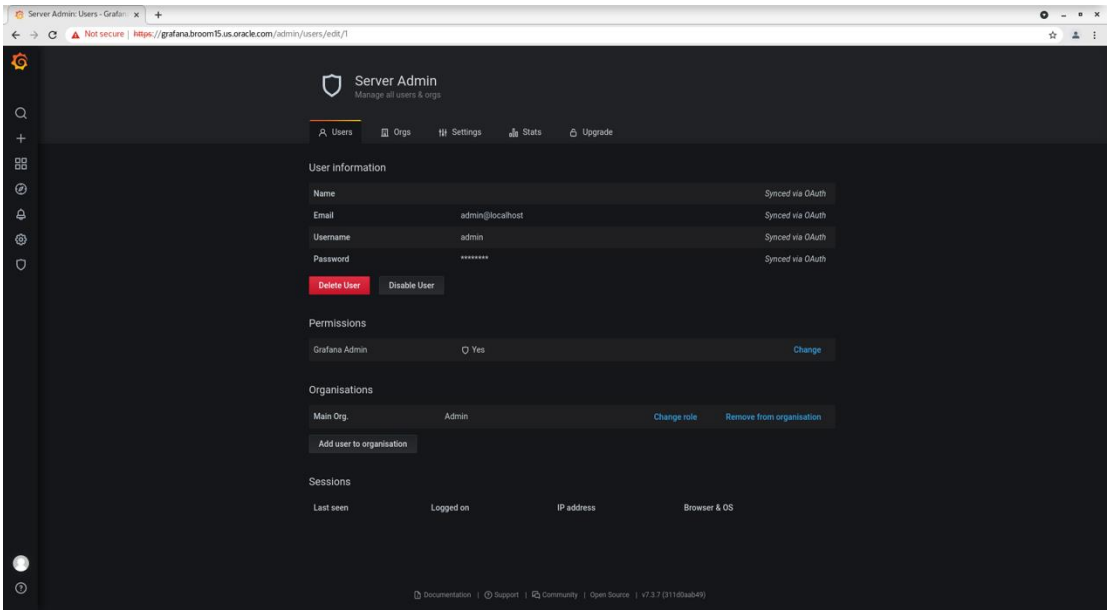
Within the Private Cloud Appliance a single local user, admin, provides the entry point into the Grafana environment and acts as the administrator to the Grafana environment.

From the Configuration menu under the Users option, there is a single, default admin user account:



Grafana User Administration

Additional information about this user can be viewed under the User option of the Server Admin menu.



Grafana User Information

The user admin role uses an internal OAUTH, or SSO, authentication service to manage the adminuser information.

Note: Access to this OAUTH service is currently unavailable.

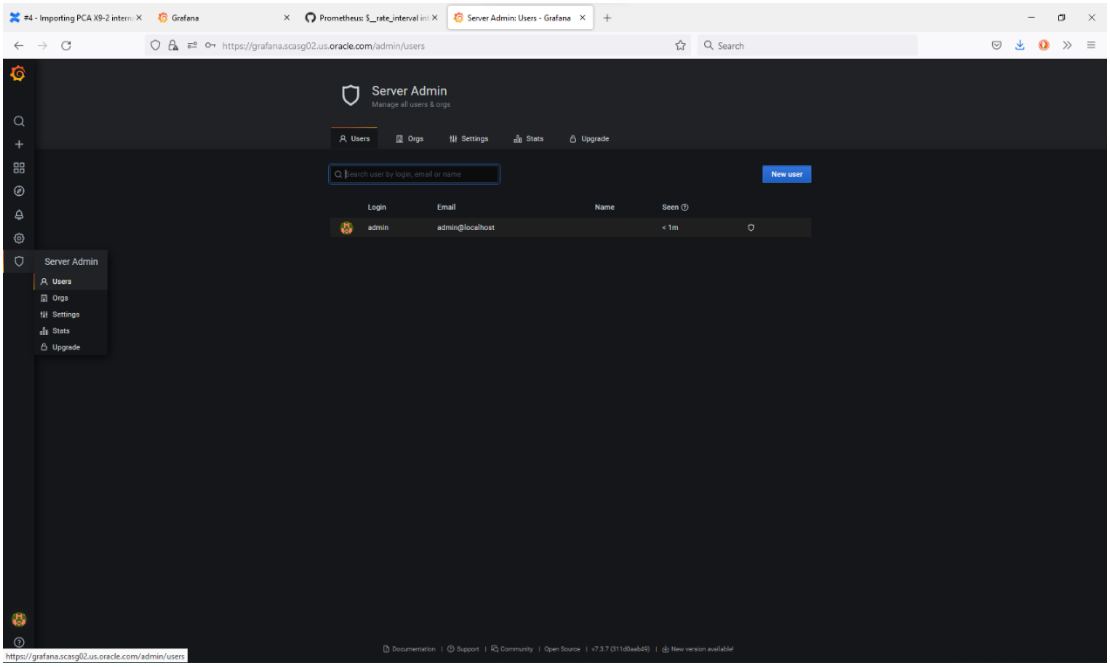
Creating Users - New

With the latest Oracle Private Cloud Appliance system software release, 3.0.2, it is now possible to create additional local user accounts.

Only the Grafana Server admin user can create new local user accounts. By default, all new local user accounts created will be granted the Viewer user role. This can be updated after the new local user account has been created.

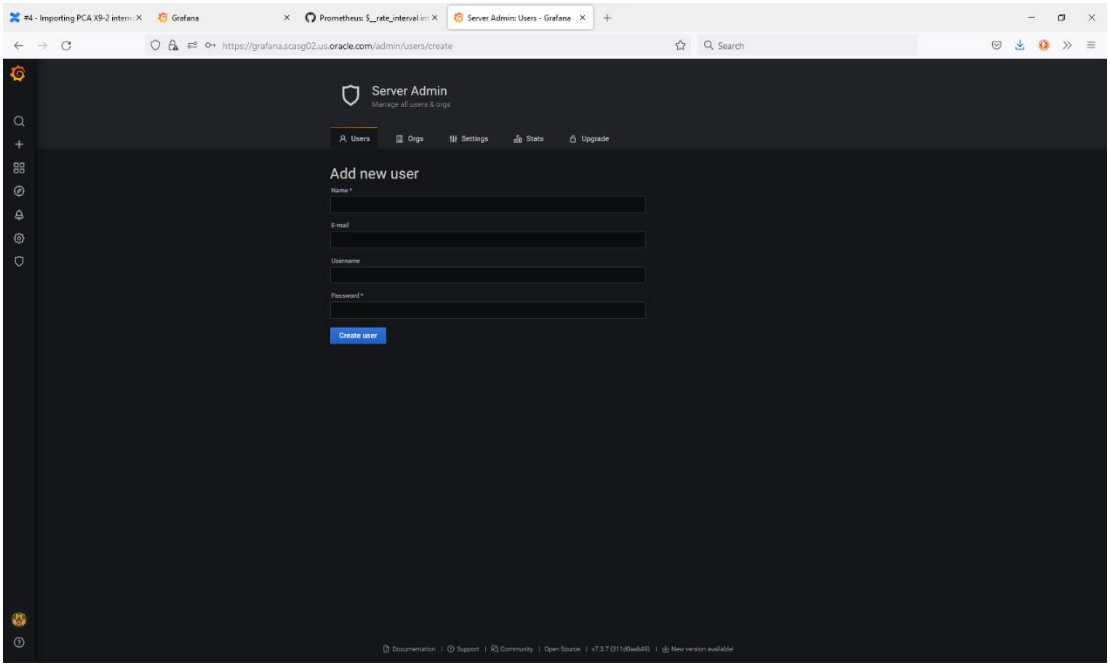
The following screens show the creation of a single, new local user account.

As the admin user, select the Users option from the Server Admin menu and click the Create User button:



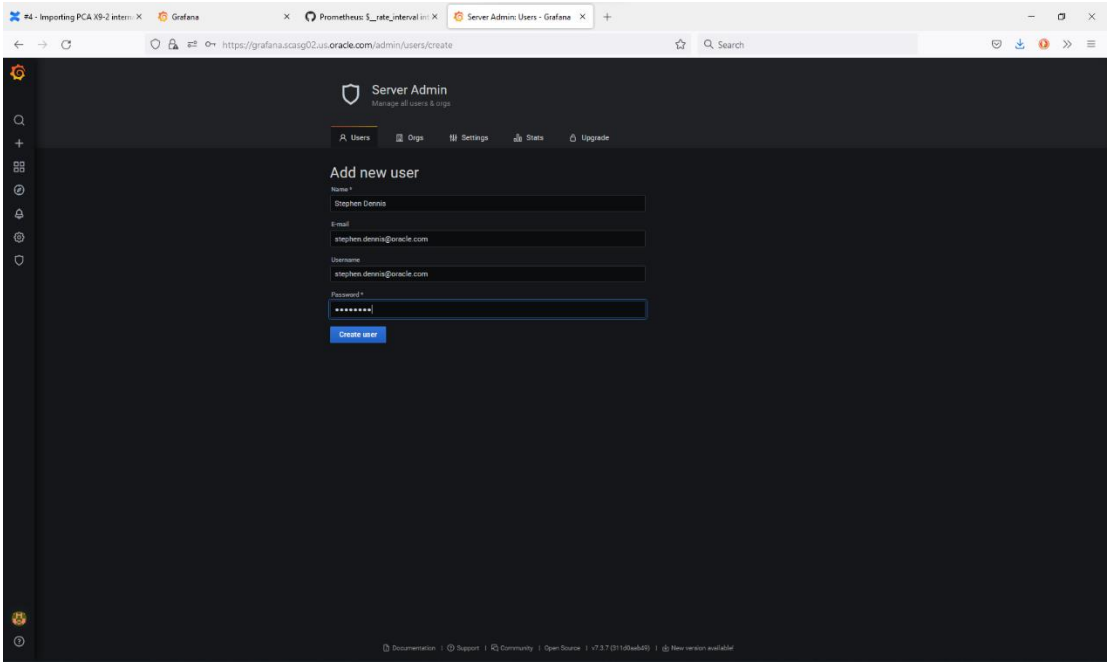
Grafana User Administration – Show Users – NEW

The New User screen is displayed.



Grafana User Administration – Add New User – NEW

Fill in the required fields.



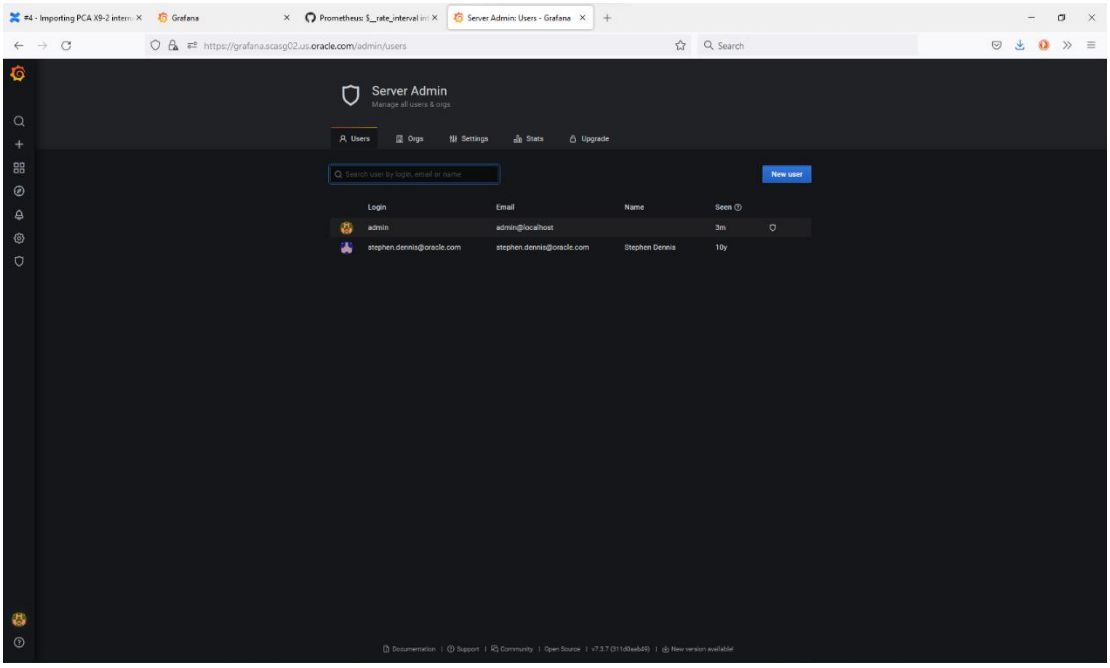
Grafana User Administration – Completed New User – NEW

An initial local user password will be required to create the new user. Set this to a default (easy to remember) value. The named user will have the opportunity to change their password when the user first accesses the Grafana Server with their named user local account.

Click Create User to complete this process.

The Grafana Server screen will return to the Server Admin -> Users screen.

The newly created user can now be seen.



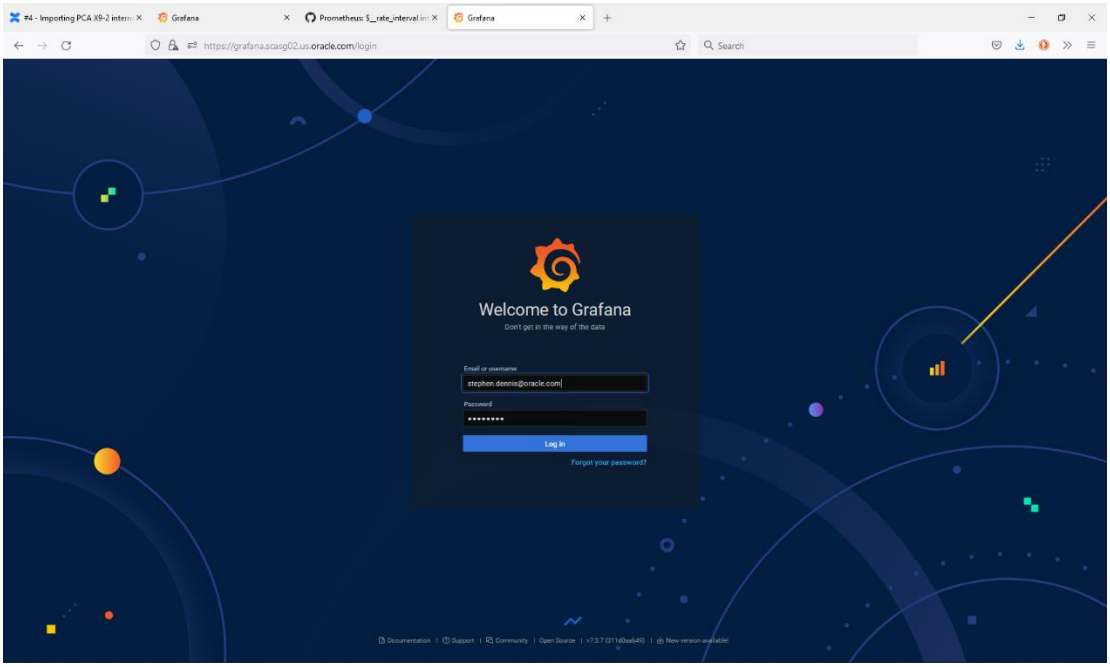
Grafana User Administration – Updated User List – NEW

Both the default admin user account and the newly created additional user are now displayed.

The user credentials (username / password) could now be distributed but for completeness, a simple connectivity test can be performed.

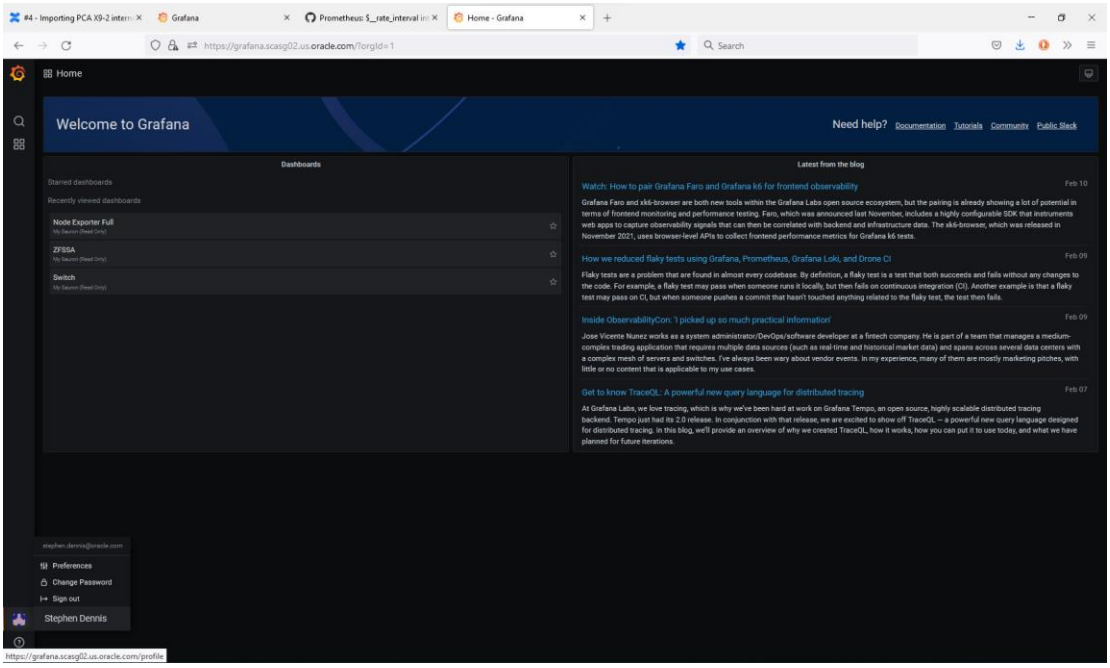
Testing the new User Account - New

To test the new user credentials, open a second browser window to the Private Cloud Appliance Grafana Server service.



Grafana User Administration – New User Login – NEW

Using the newly created local user credentials, sign into the Private Cloud Appliance Grafana Server instance.



Grafana User Administration – New User Home Page – NEW

The first obvious difference is that the User menu now displays the new local username, not admin as it did previously.

Secondly, because this new local user was created with the Viewer user role, the number of menu options available from the Grafana Menu Bar is restricted as defined for any user with the viewer role.

The User menu also offers the option for the new named user to change their password.

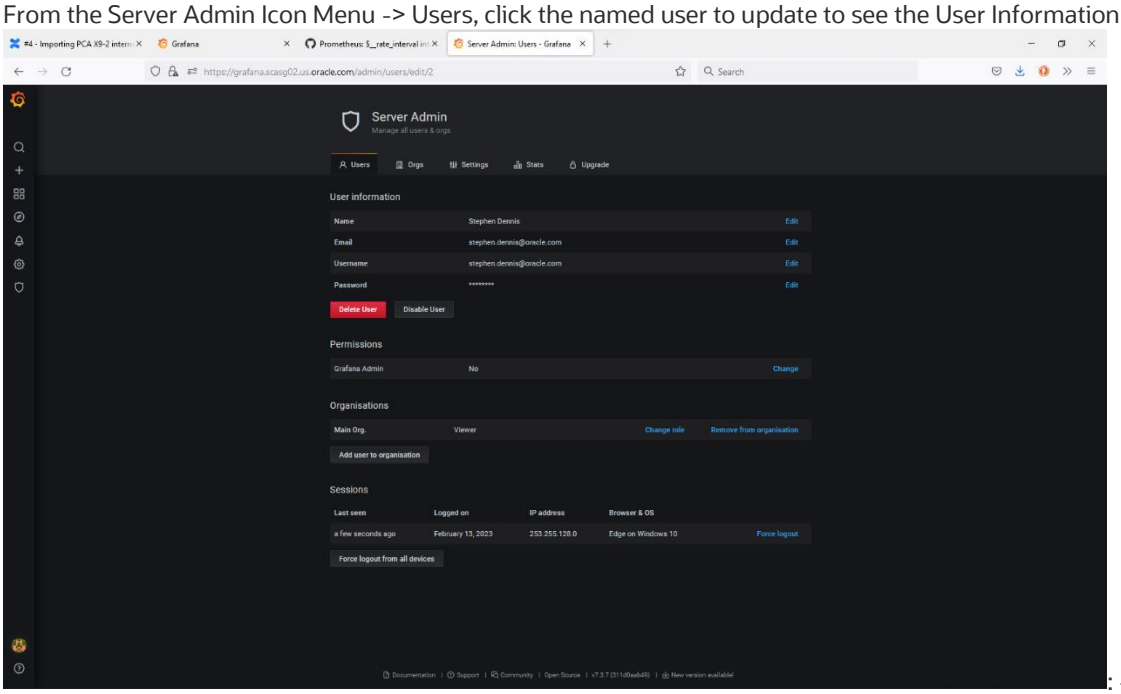
With the current Private Cloud Appliance Grafana Server configuration, enforced password changes cannot be enabled at this time.

Updating a Local User - New

It's possible that updates to the local user account might be required prior to the user credentials being circulated.

To make changes to a user requires the Grafana Server admin account.

From the Server Admin Icon Menu -> Users, click the named user to update to see the User Information screen:

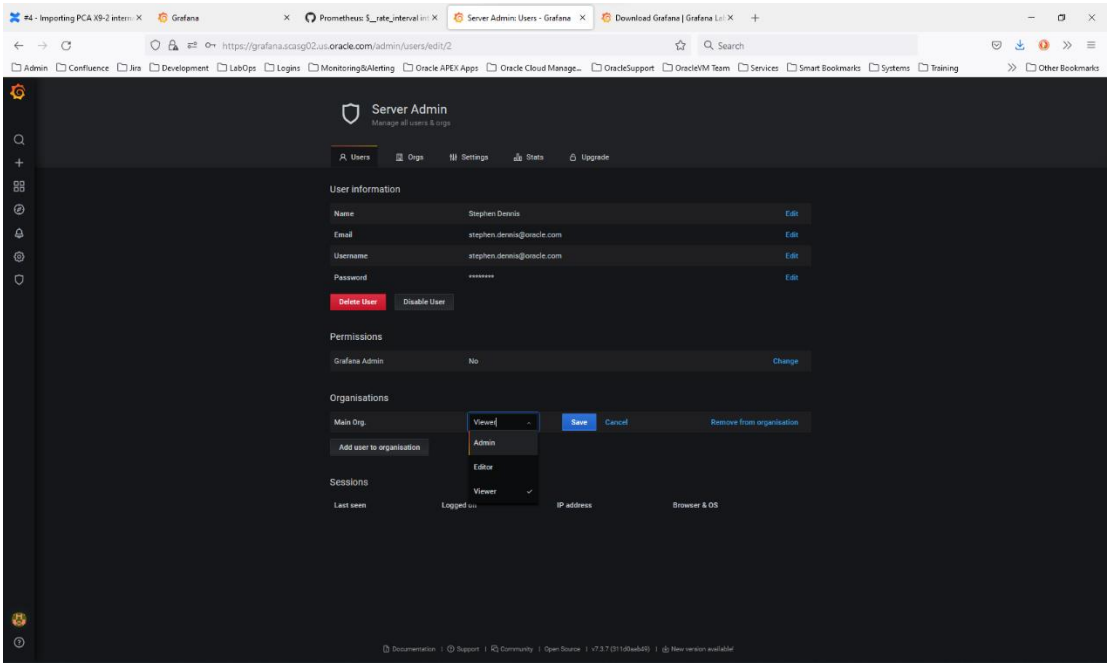


: -

Grafana User Administration – Edit Local User – NEW

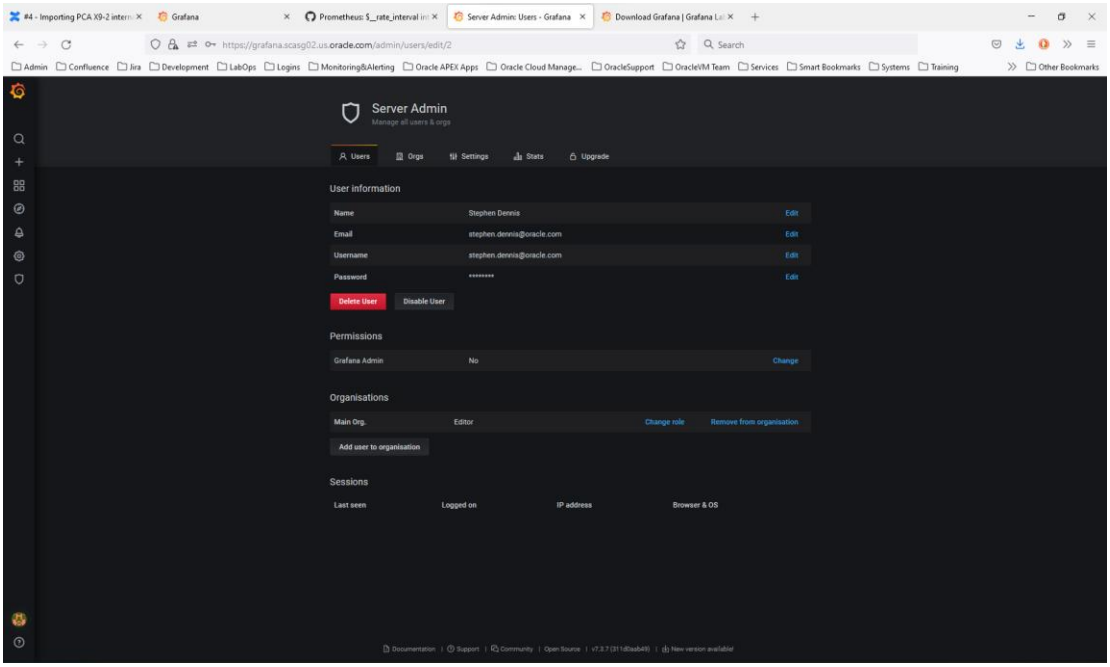
In this case, the named user's role will be changed from Viewer to Editor.

Click on the ‘change role’ link and select the new role from the drop-down menu.



Grafana User Administration – Local User Change Role – NEW

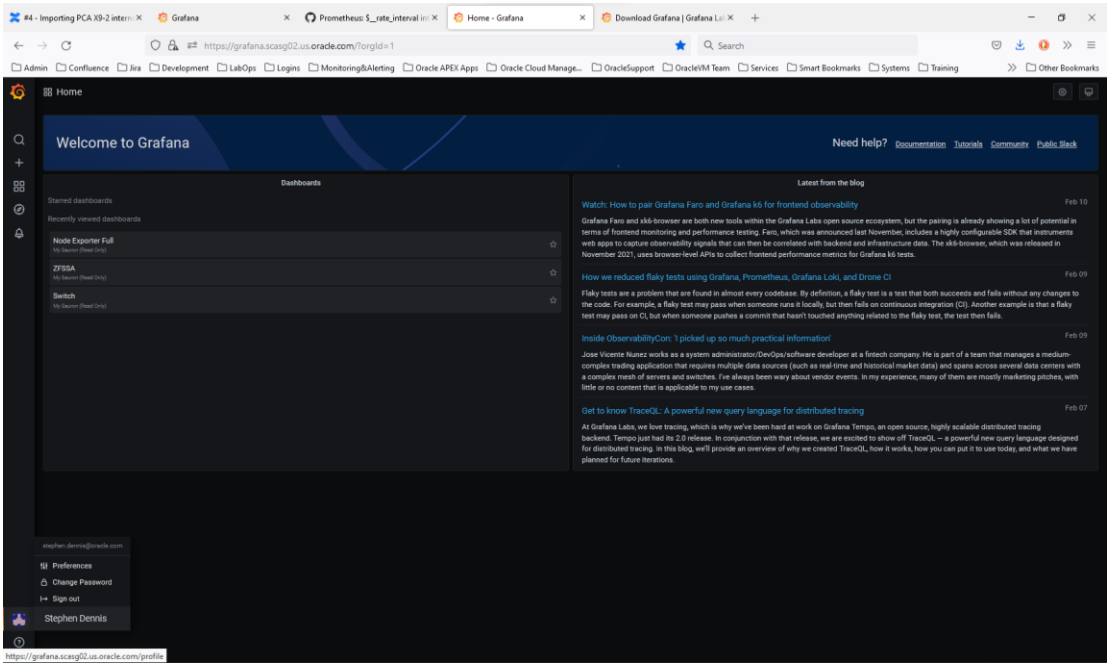
Select the Editor role.



Grafana User Administration – Local User Editor Role – NEW

The new user role is now displayed.

To test this out, log in again as the new Named User and the amended role will show as an additional Grafana Menu Bar option.



Grafana User Administration – Local User - Editor – NEW

The User menu is still displaying the new local username; however because this new local user has now been assigned the Editor role, the Grafana Menu now shows the options defined for the Editor role.

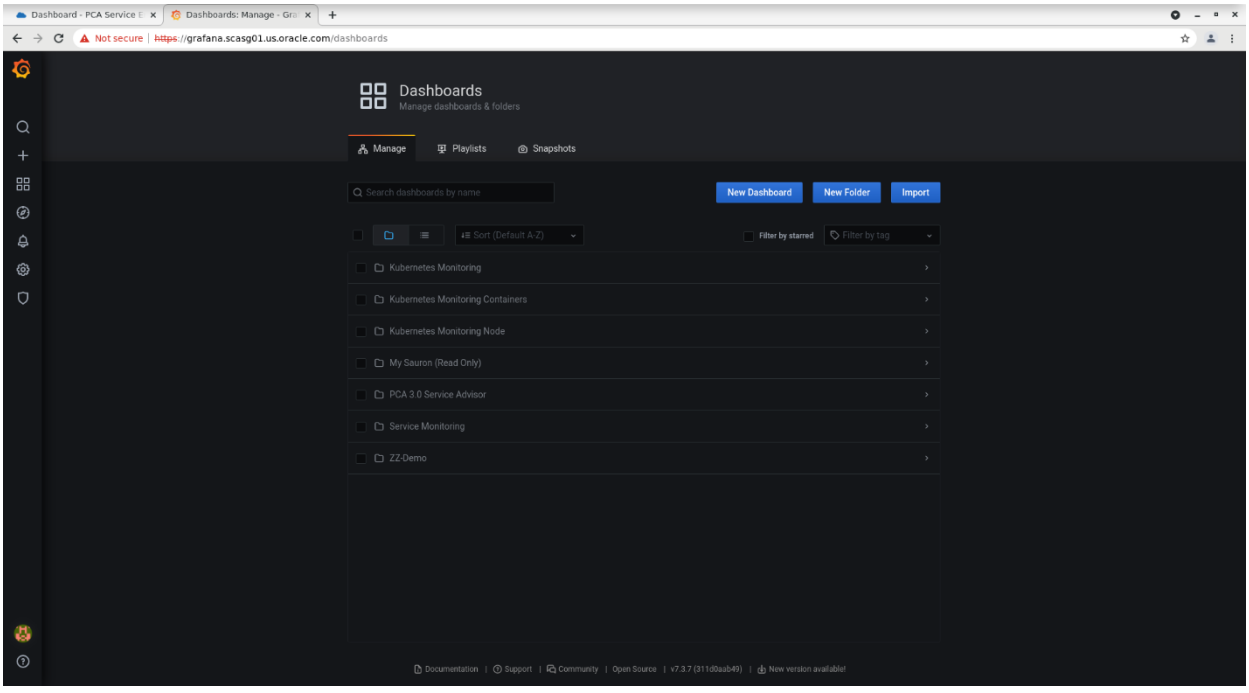
Folder administration - Updated

As noted previously within this document, the base installation of the Private Cloud Appliance provides 41 Dashboards, organized into six folders.

Create Folder

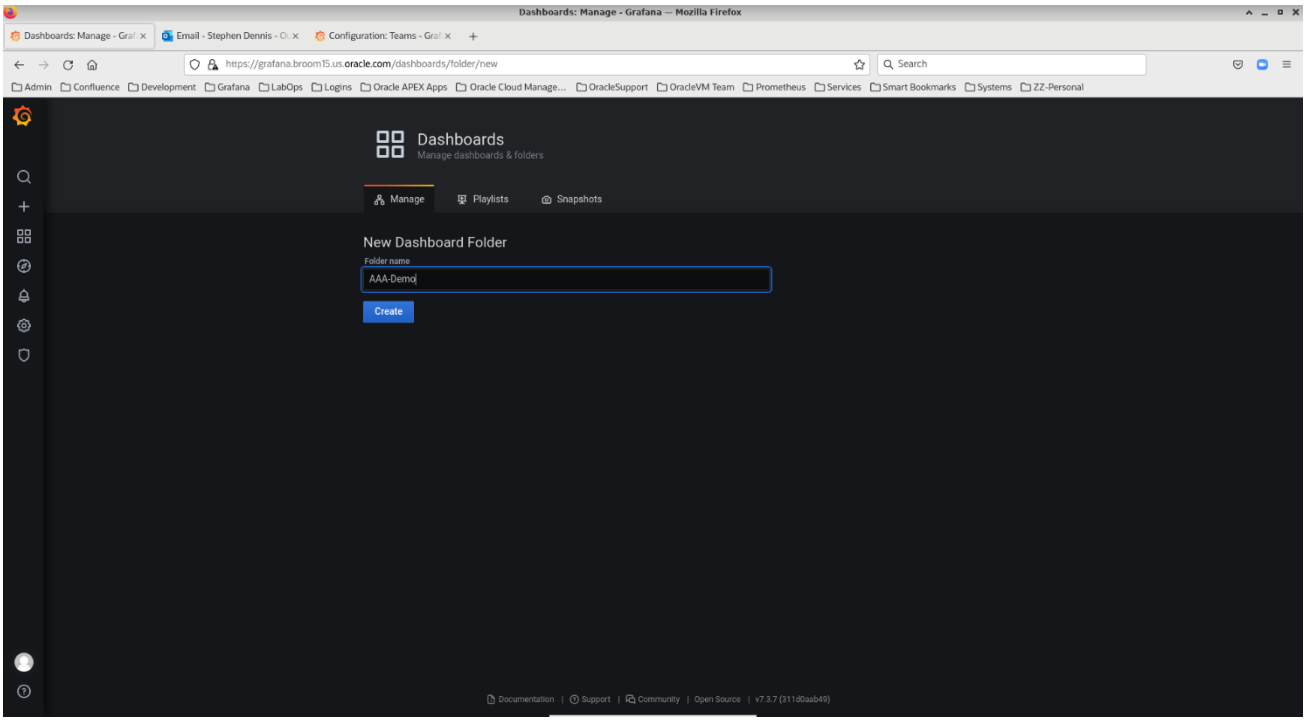
The creation of a customized folder structure is highly recommended to segregate any customer specific Grafana Dashboards from the default Dashboards provided.

To this end, from the Manage menu, display the existing folders.



Grafana Folder Administration – List Folders

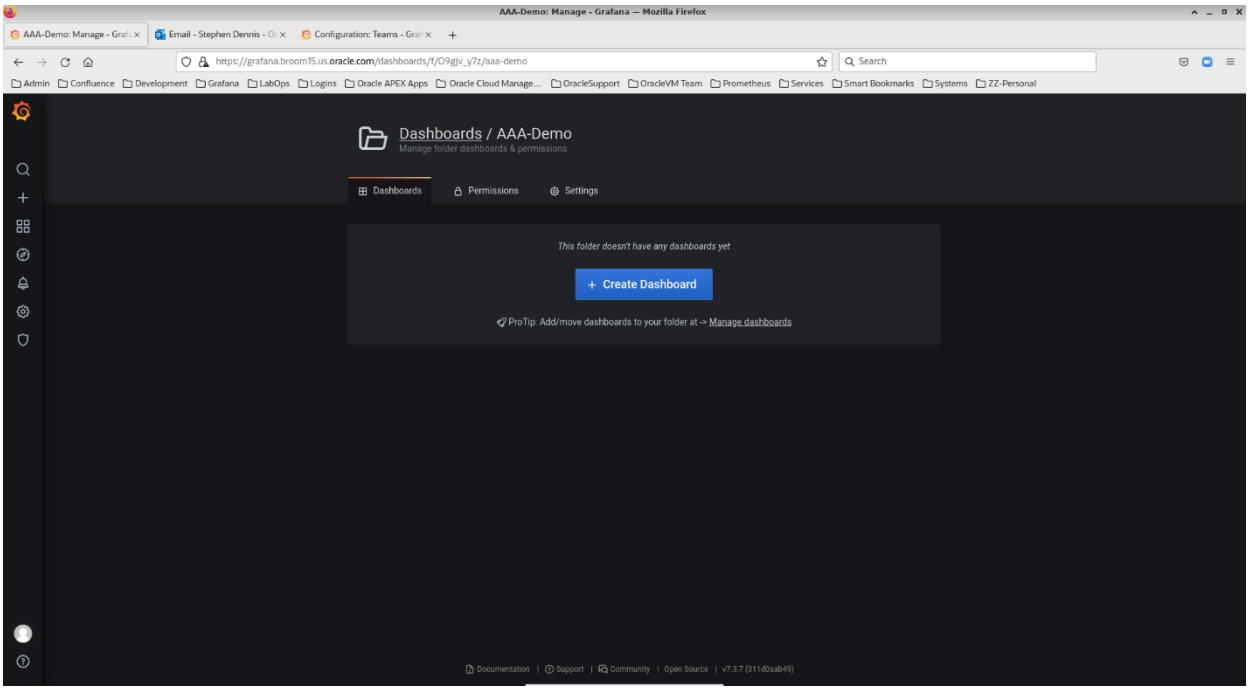
Click the New Folder button.



Grafana Folder Administration – Create Folder

Provide a name for the new folder. In this case, the name 'AAA-Demo' has been used to allow it to be displayed at the top of the Folder list.

Click the Create button.

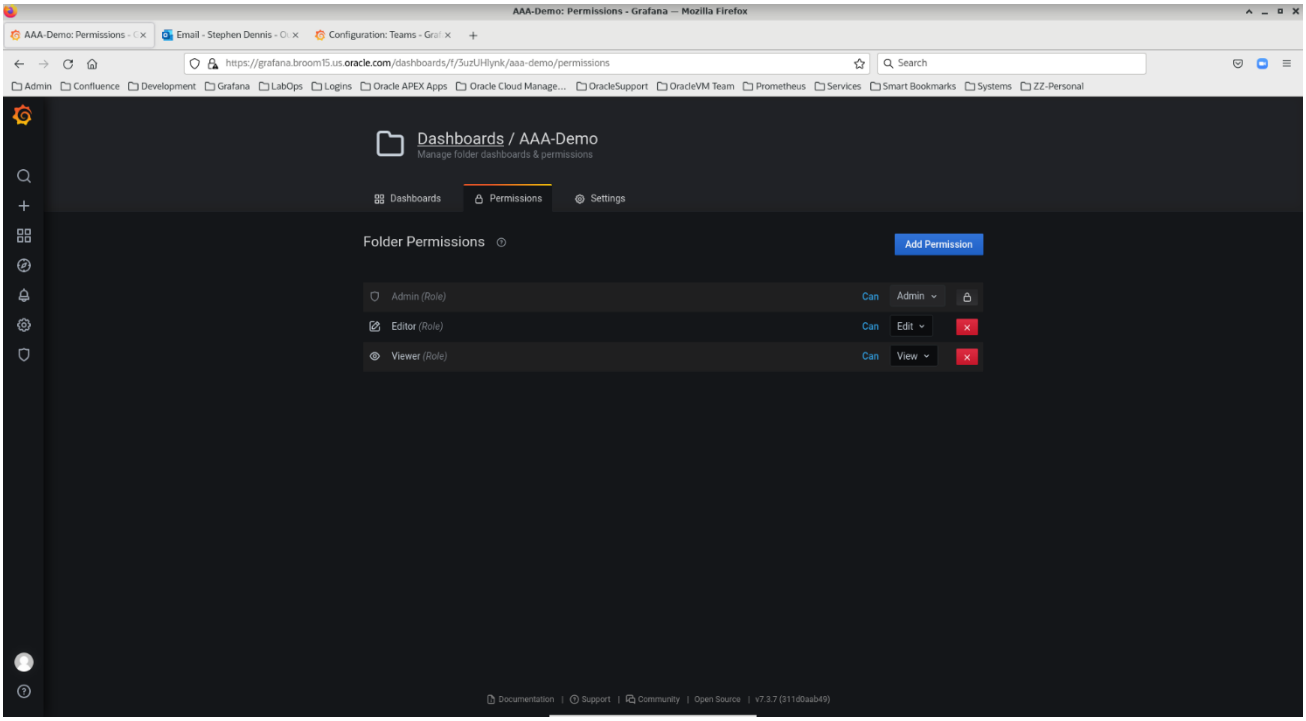


Grafana Folder Administration – Created New Folder

The new folder is created and ready for Grafana Dashboards to be created. This step will be covered below.

Folder permissions - Updated

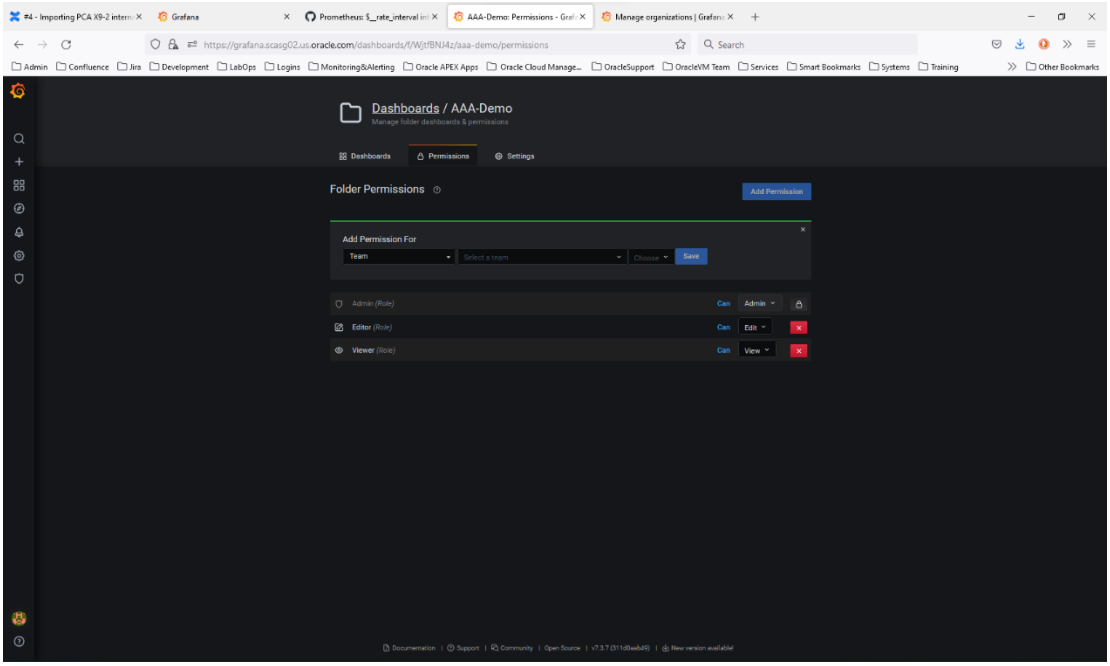
Click on the Permissions tab to display the permissions for this new folder.



Grafana Folder Administration –View Folder Permissions

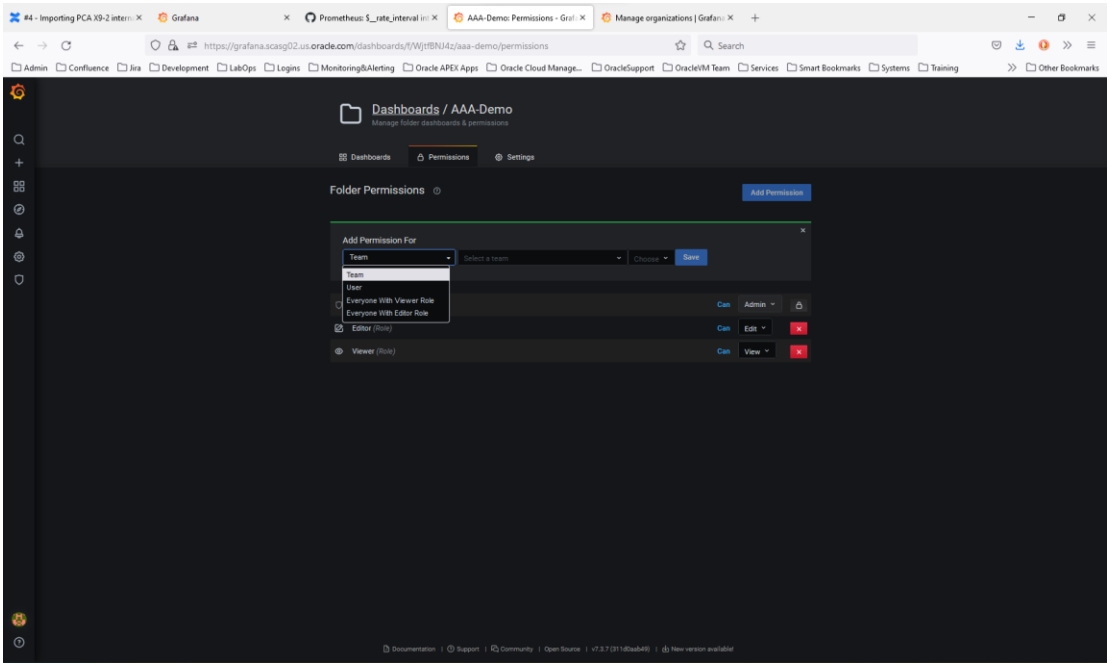
The User Role permissions for this folder can be modified at this stage. The Editor and Viewer Role permissions can be amended as needed.

In addition, new permissions can be added to each folder. Selecting the 'Add Permission' button displays a more detailed screen.



Grafana Folder Administration –View Folder Permissions - NEW

Folder specific permissions can be set on both a user and team basis.

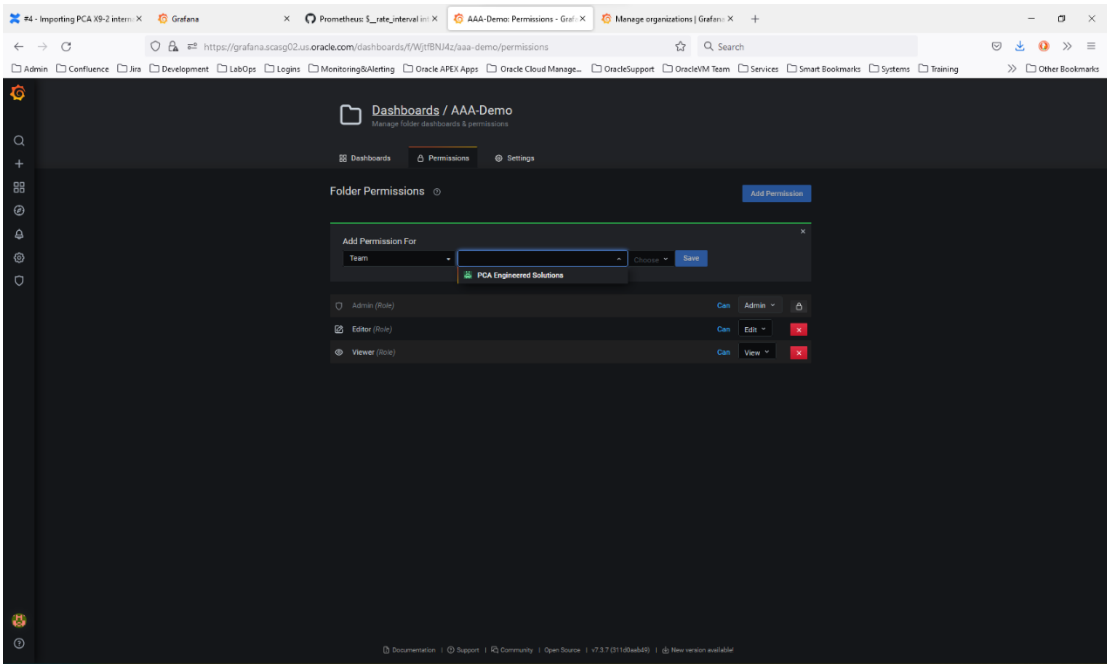


Grafana Folder Administration –View Folder Permissions – By Type - NEW

The following options are available:

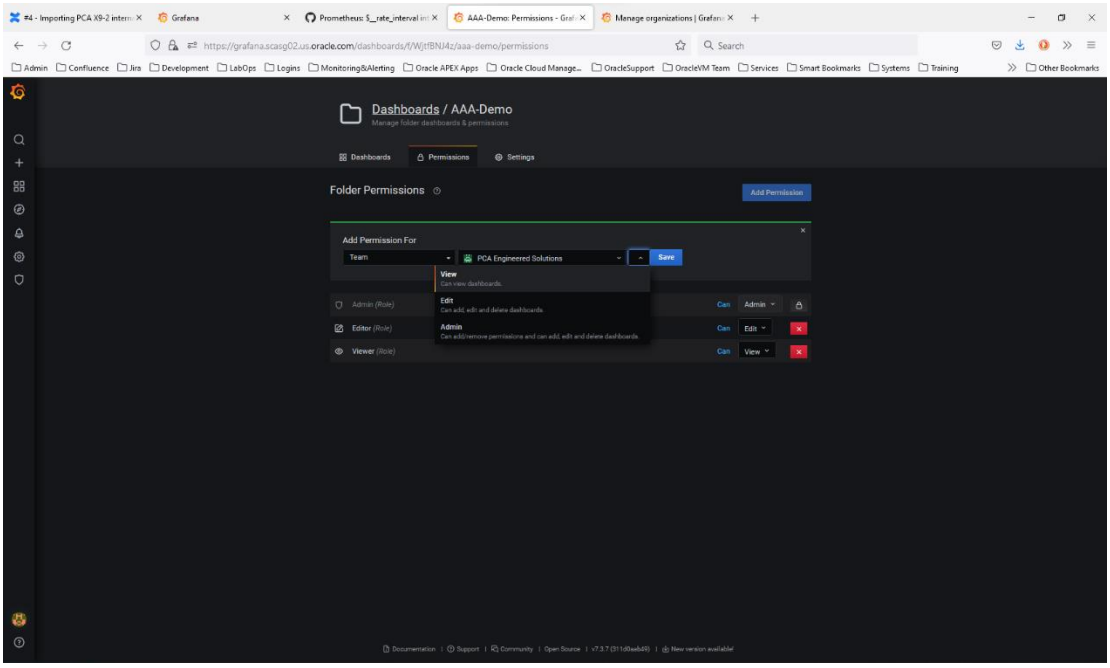
- Team
- User
- Everyone with Viewer Role
- Everyone with Editor Role

Using Team as the example, select the team to be used.



Grafana Folder Administration –View Folder Permissions - Team - NEW

Once the team has been selected, then select the amended role at which the folder permissions are required to be set.



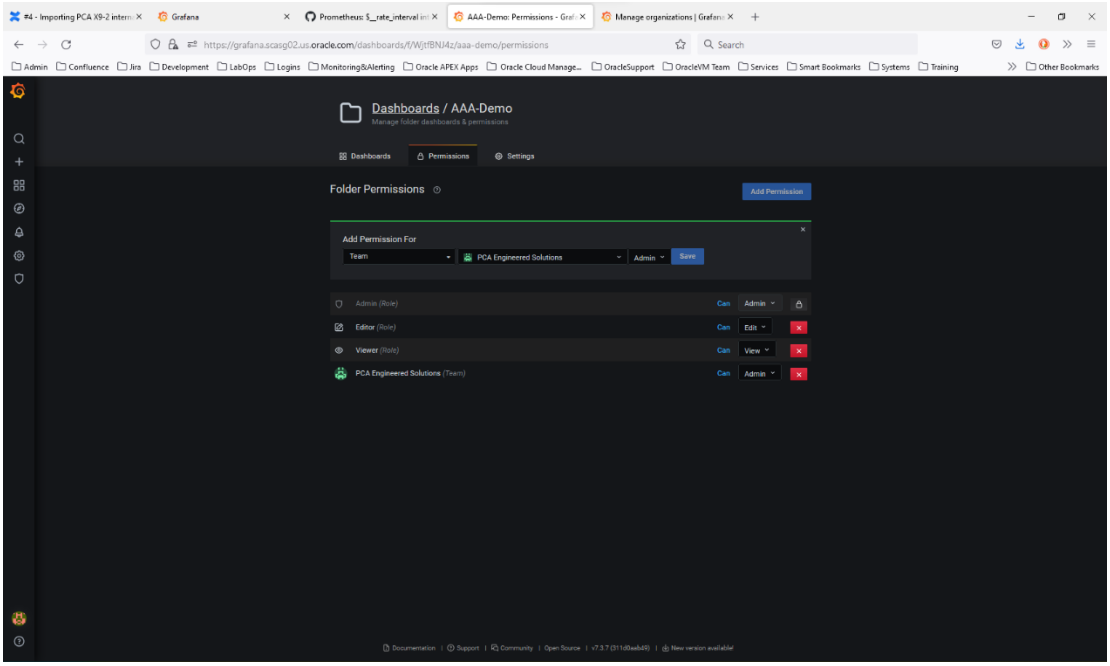
Grafana Folder Administration –View Folder Permissions - Role - NEW

Three permission options are available:

- View
- Edit
- Admin

For this example, the Admin role was selected for any members of the PCA Engineered Solutions team.

Save the changes, then click the Dashboards tab above and display the list of folders once more.



Grafana Folder Administration – List New Folder

The newly created folder is now visible.

In addition, the amended folder permissions show that there is a team level override for the Admin role.

Repeat as necessary.

NOTE: There is only one level of Grafana folders permitted. The creation of subfolders within a folder is not a feature currently available.

Dashboards

Grafana dashboards are the primary means by which the metrics and log data gathered within the Private Cloud Appliance are displayed, or visualized. This section describes the following:

- Grafana dashboard basics
- Creating a new dashboard from scratch
- Creating a new dashboard from an existing one
- Importing a dashboard

In all cases, the definitive instructions, training, and tutorial materials can be accessed from the Grafana website.

Prometheus Queries are used to select and aggregate the Prometheus time series metrics into a form that the Grafana Dashboard panels can display. This uses a functional query language, called PromQL

For further reference on creating the Prometheus Queries used to present the Prometheus metrics within a Grafana Dashboard, please reference the Prometheus PromQL documentation.

Grafana dashboard basics

Grafana dashboards are highly configurable but consist of just a few elements. These are stored as JSON files both within Grafana and externally when required.

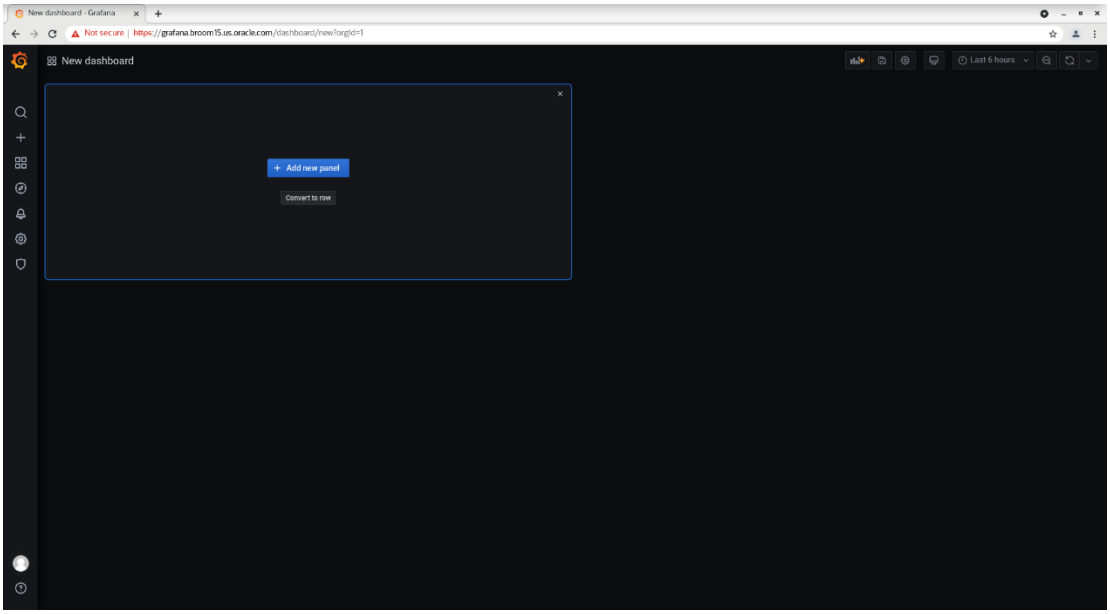
In summary, these are:

- Rows
  - Provides a separator function between multiple panels within a dashboard. Use is optional.
- Panels
  - The primary visualization engine. Each dashboard can consist of one or more panels.
- Dashboard Plugins
  - Provides different visualization templates to display the selected metrics. The available types are
    - Graph
    - Gauge
    - Table
    - Heatmap
    - Dashboard list
    - Logs
    - Stat
    - Bar Gauge
    - Text
    - Alert list
    - News
    - Plugin list
- Variables
  - Variables can be defined at the dashboard level to enable filtering of the metrics being presented.

Please see the Grafana documentation links in the Reference Materials section (page 55) below for further details.

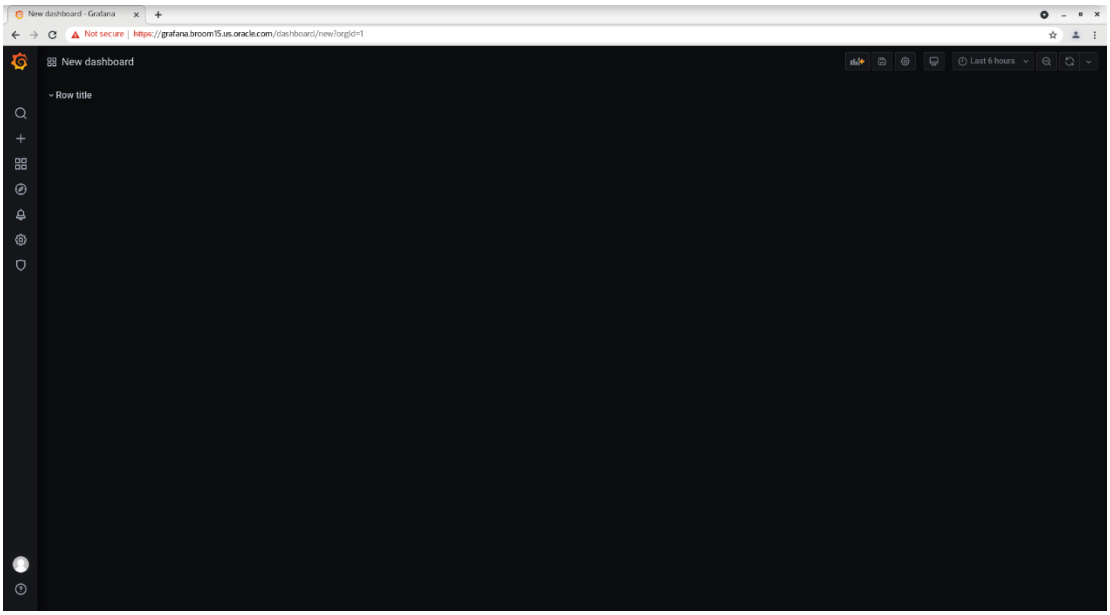
Creating a new dashboard from scratch

To create a new Grafana dashboard, click Create from the Grafana Menu Bar.



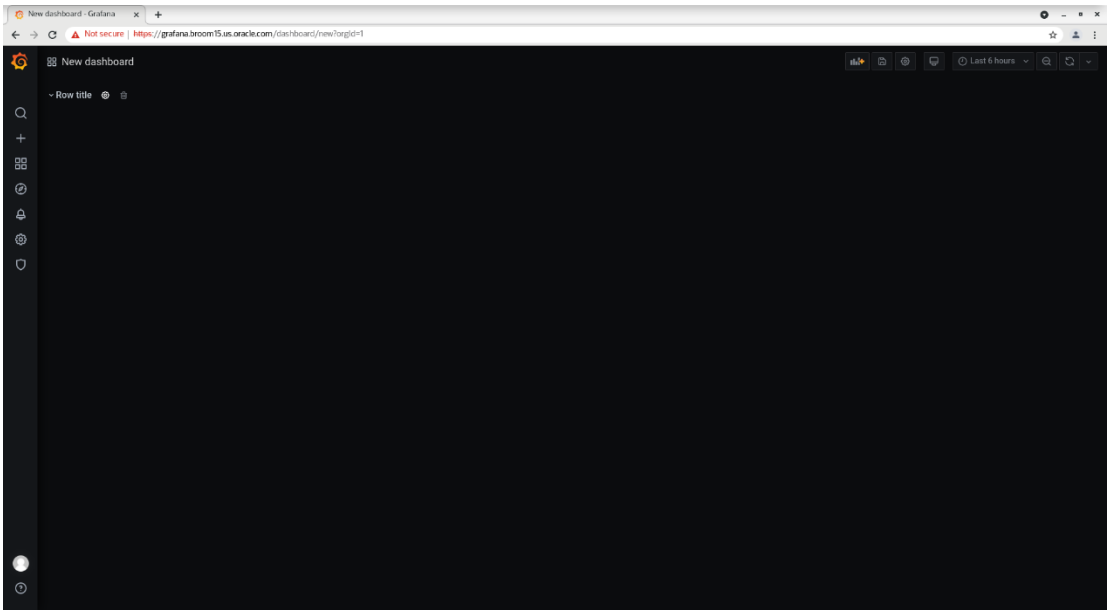
Grafana New Dashboard - Create

In the first instance, create a Row element, by clicking the 'Convert to row' option.



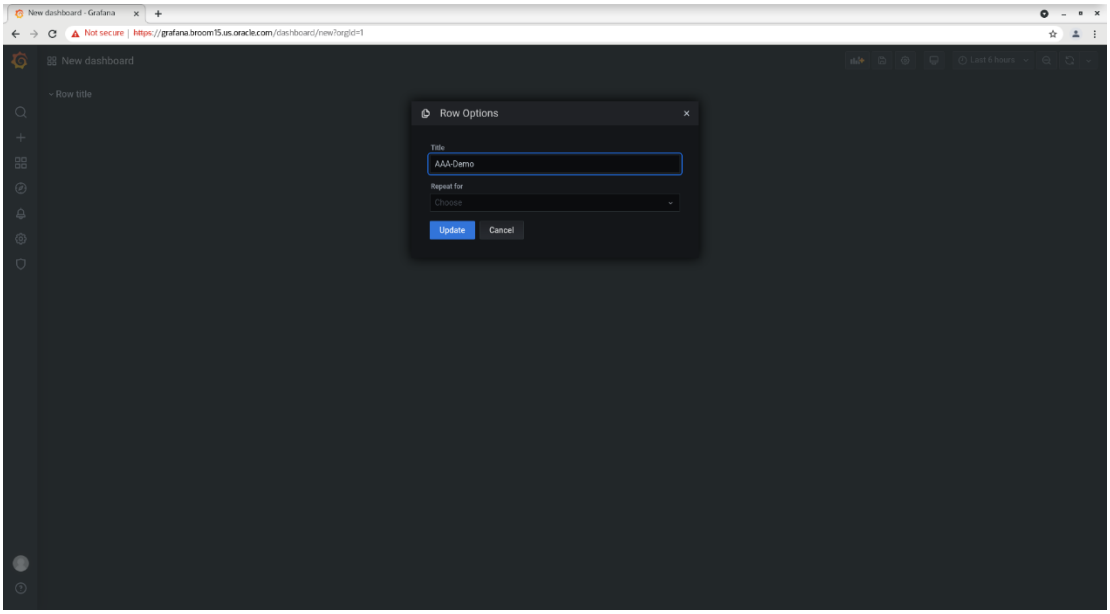
Grafana New Dashboard – New Row

The new row is shown, with the default name 'Row title'. Click on the edit button to the immediate right of the Row title.



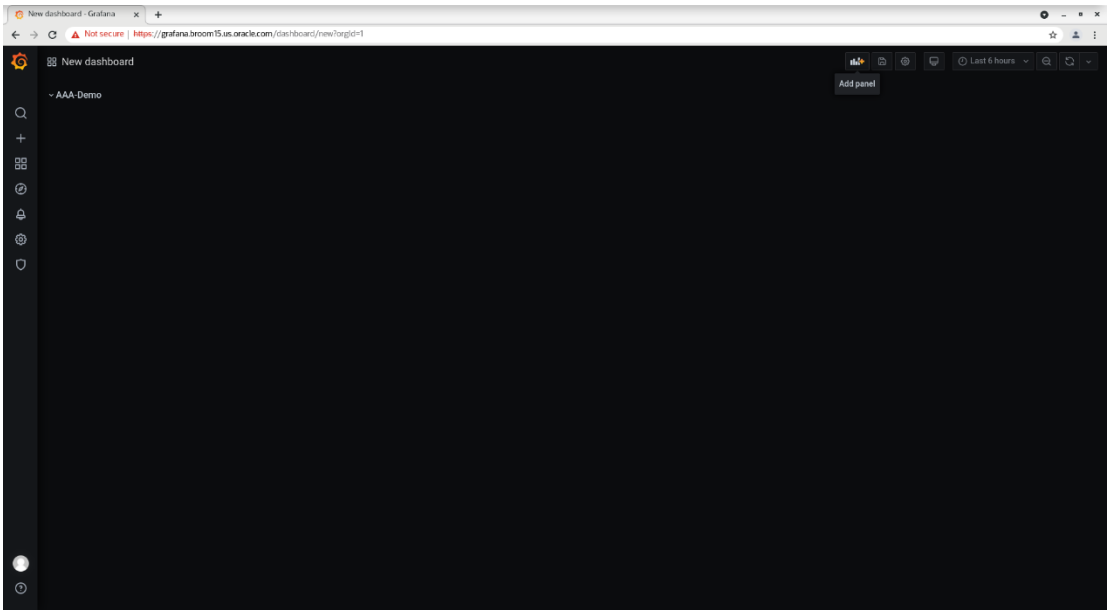
Grafana New Dashboard – Edit Row

The Row Options window will open.



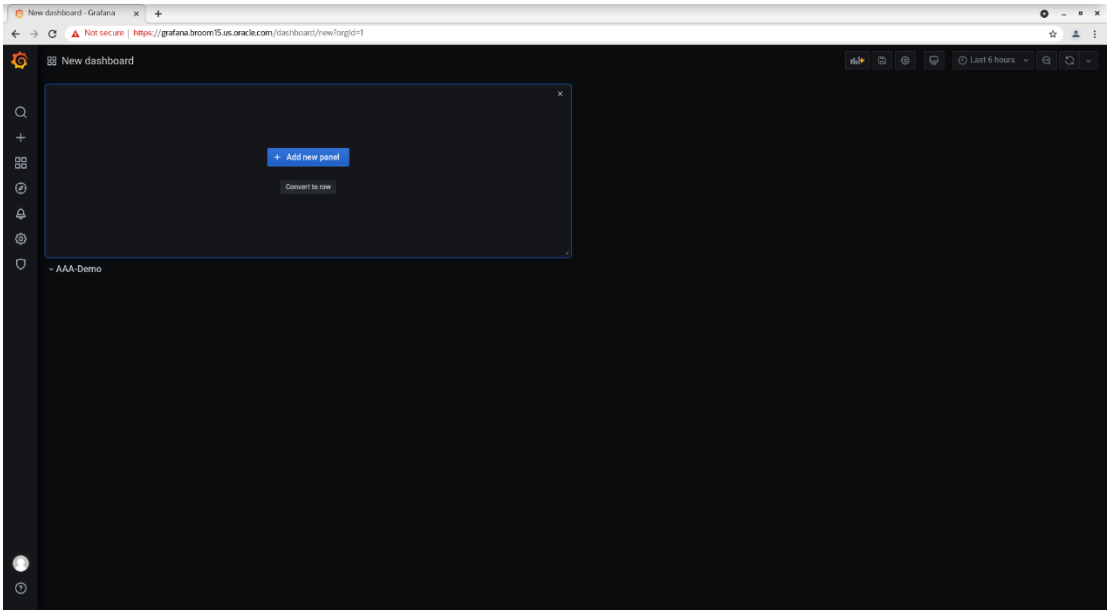
Grafana New Dashboard – Edit Row Title

Provide a meaningful name. In this case, 'AAA-Demo' and update.



Grafana New Dashboard – Amended Row Title

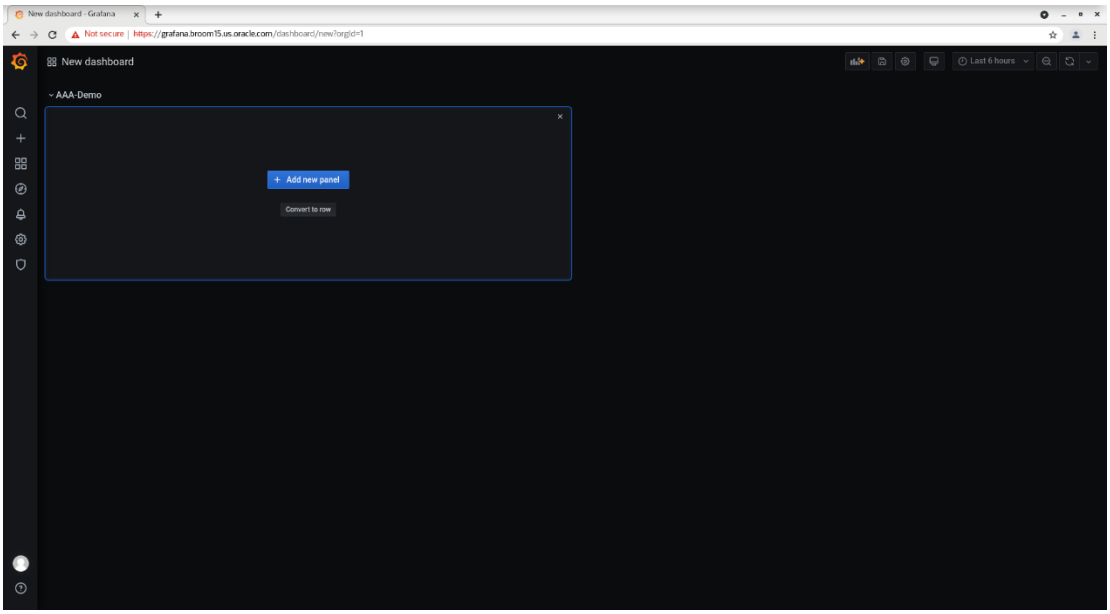
The Row Title has changed. Now add a panel to the dashboard by clicking on the 'Add panel' button as highlighted.



Grafana New Dashboard – New Panel Window

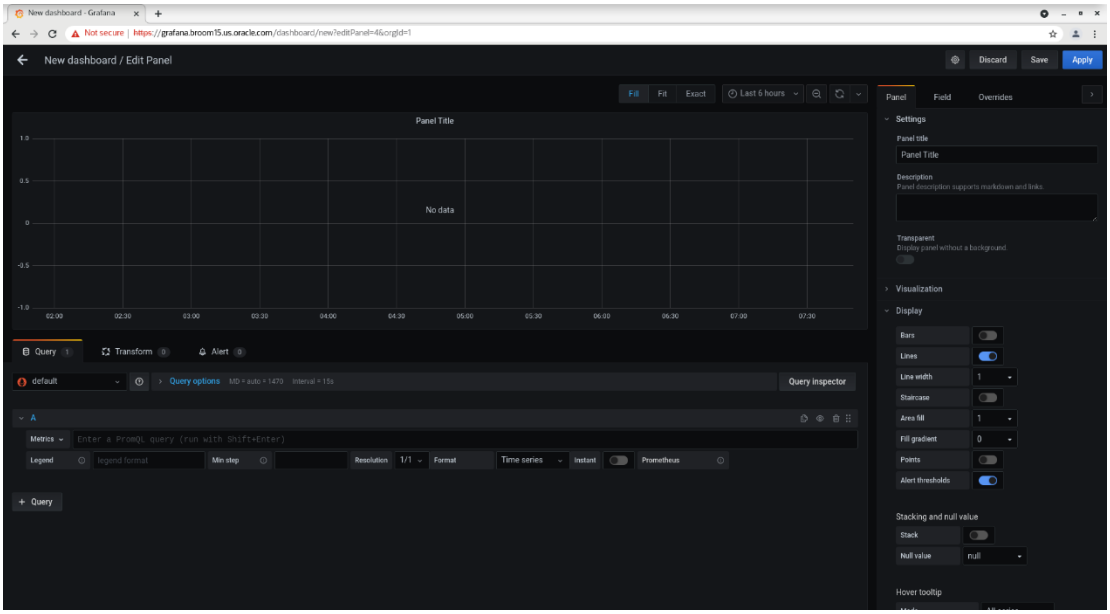
The new panel window is displayed. By default, all new dashboard elements are created at the top of the dashboard page.

The panel window can be 'dragged' to below the Row Tile as shown below.



Grafana New Dashboard – Repositioned Panel Window

Now click on the 'Add new panel' button. A default Panel will now be created.



Grafana New Dashboard – New Panel

This new panel needs to be populated with some data. The lower section of the panel shows the query options. The default data source will be Prometheus. The default query options will be sufficient in most circumstances.

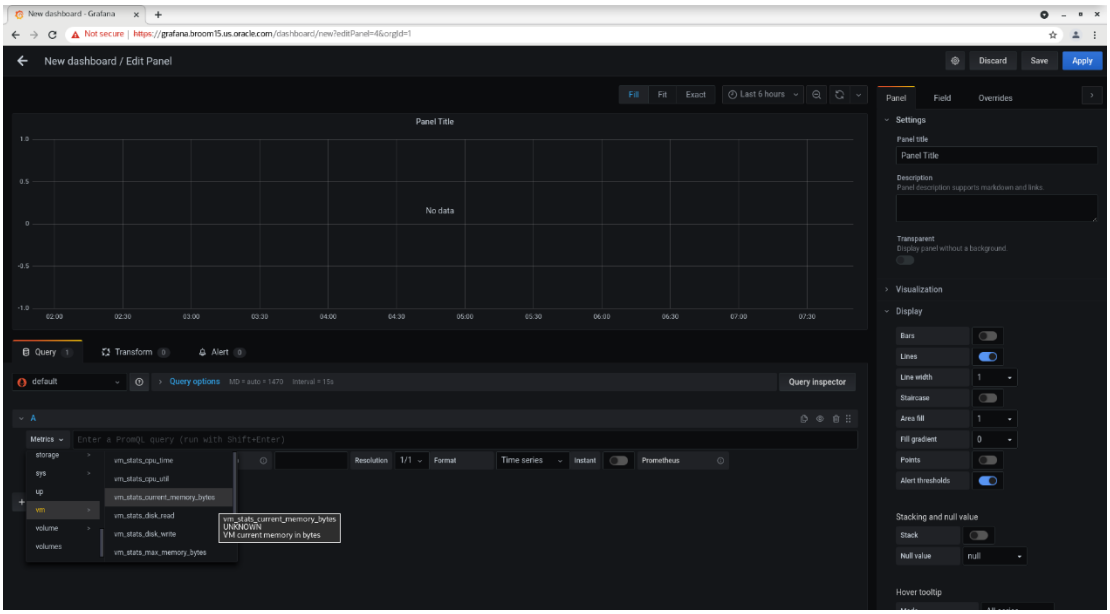
Click the Metrics label, a drop-down menu will be displayed showing the Prometheus Metric Types available.

This is grouped initially by Metrics Type, then a side menu is displayed with each individual metric available within that Metrics Type.

The appendix of this document includes tables outlining the Prometheus Metrics collected for

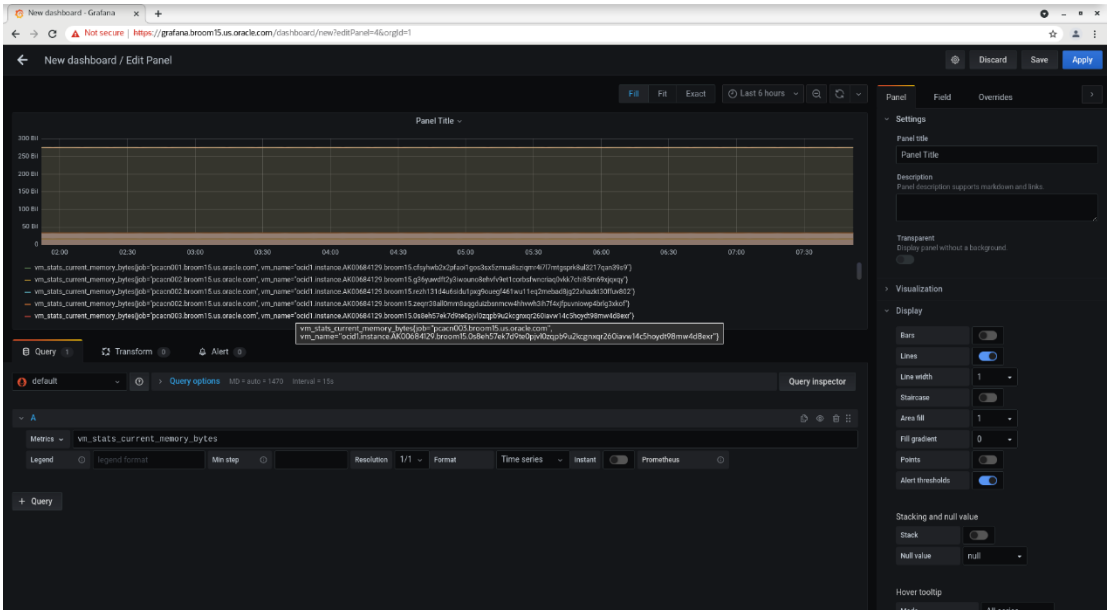
- Virtual machine instance
- Internal ZFS ZS9-2 storage appliance
- Server nodes – both compute and management

For the example below, the selection uses VM metrics, and the specific Metric 'vm_stats_current_memory_bytes'.



Grafana New Dashboard – Panel Query Metrics

Having selected 'vm_stats_current_memory_bytes', the Panel will now display a default graph of these metrics.

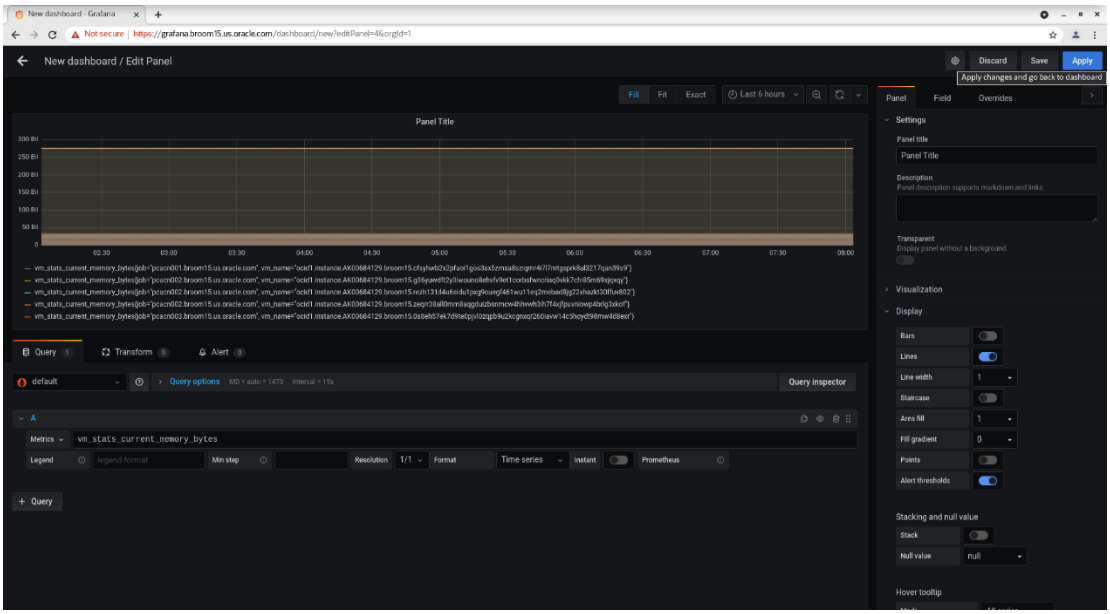


Grafana New Dashboard – vm_stats_current_memory_bytes

Multiple customizations of this dashboard can then be made, such as panel title, type of graph, where and whether a legend is displayed, etc.

Please see the relevant Grafana documentation URL links provided in the Reference Materials section (page 55) for further details of the options available.

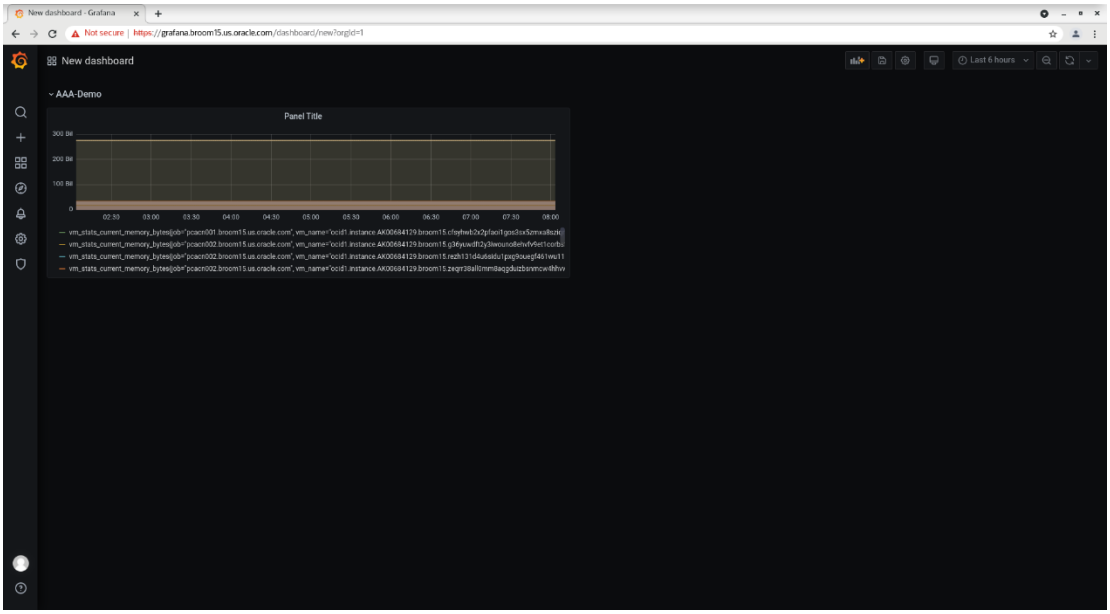
Once any required customizations are made, click the Apply button.



Grafana New Dashboard – Apply Panel Changes

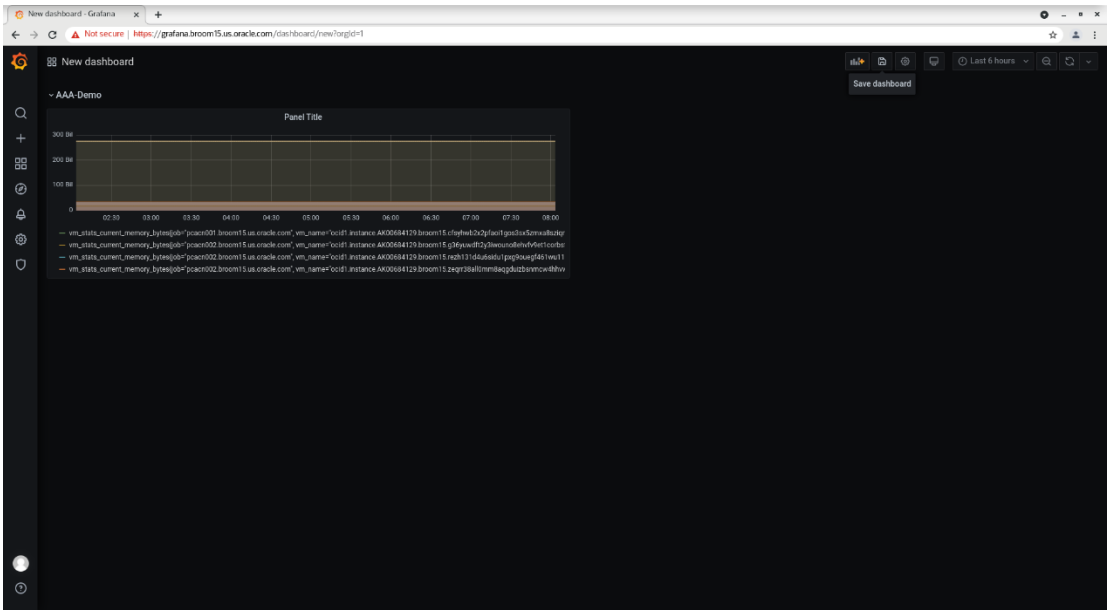
The dashboard will now return to the initial dashboard page and panel, and its contents are displayed.

At this point, the size of the panel can be changed both in terms of height and width, by simply dragging the corner of the panel to the preferred size and shape.



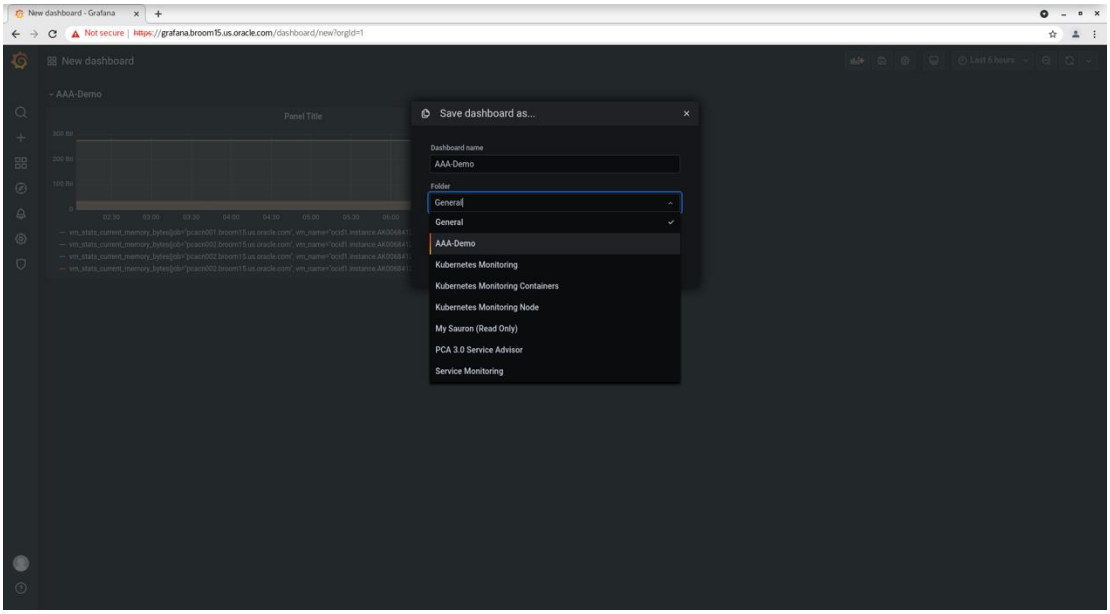
Grafana New Dashboard – Updated Dashboard

Once the final changes have been made. Save the dashboard.



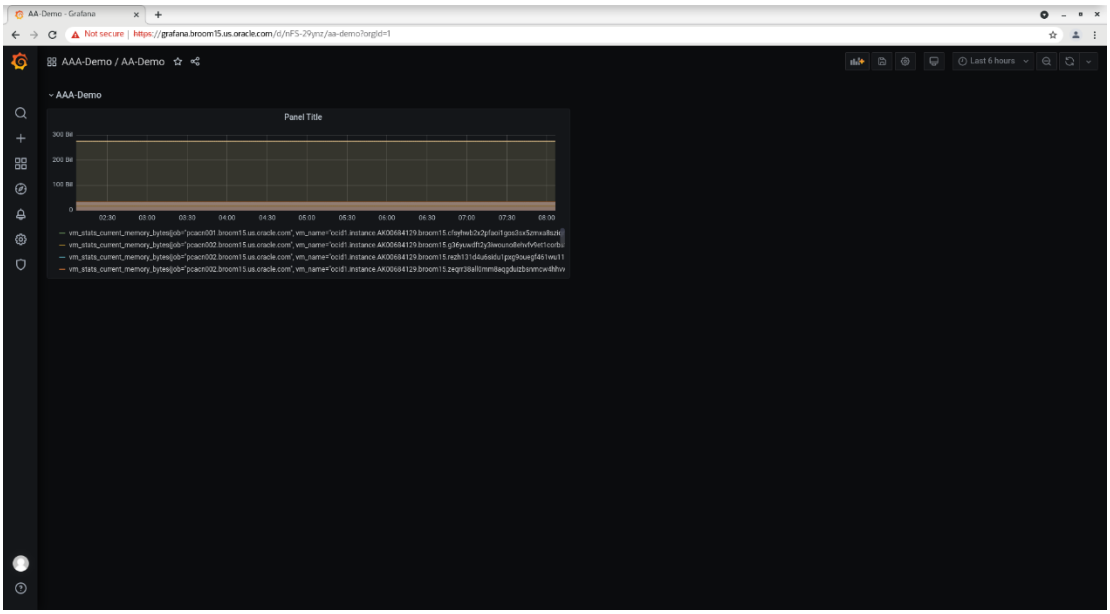
Grafana New Dashboard – Save Dashboard

Click the 'save' icon as highlighted above.



Grafana New Dashboard – Save Dashboard Window

A Save Dashboard window will be displayed, offering the chance to both provide a Dashboard Name ('AA-Demo') and select the folder in which to save it ('AAA-Demo').



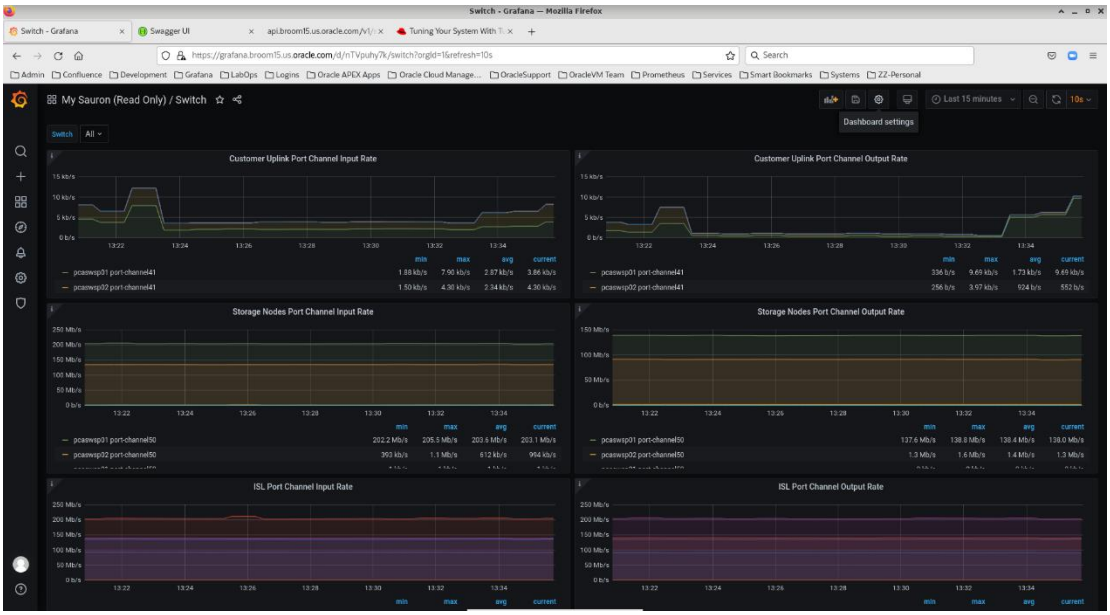
Grafana New Dashboard – Completed Dashboard

The final saved dashboard is now displayed. The Top Left Title shows that it has been saved to the 'AAA-Demo' Folder as a dashboard name 'AA-Demo'.

Creating a new dashboard from an existing one

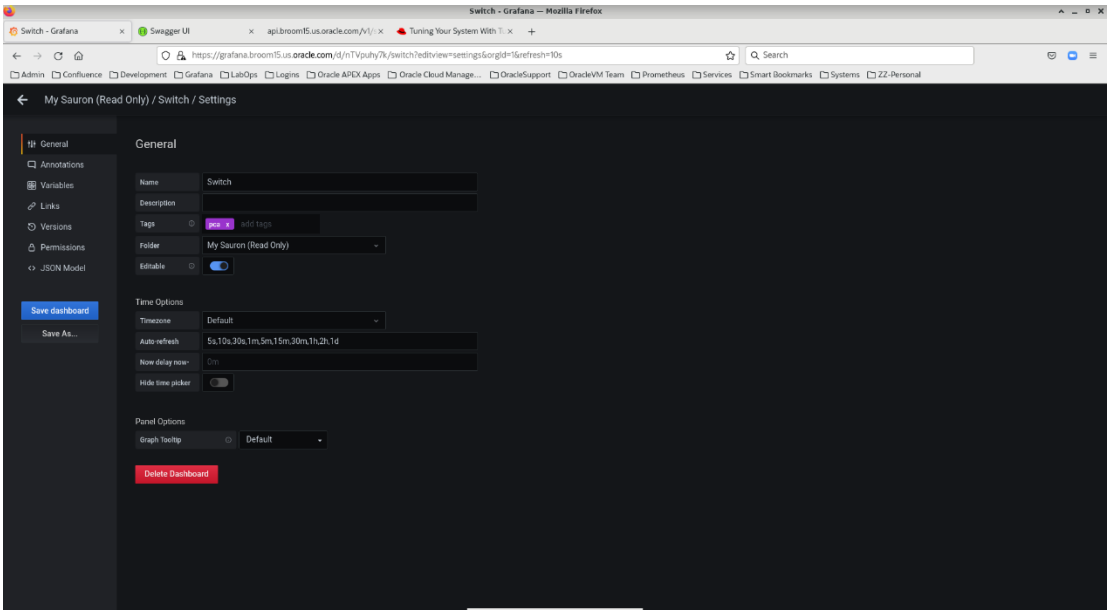
The process to take an existing Grafana Dashboard and 'Save As' a copy of the original, in another folder for modification, is more straightforward than creating one from scratch.

Using the My Sauron / Switch Dashboard as an example, first open the dashboard in question and click on the Dashboard Settings icon as highlighted below.



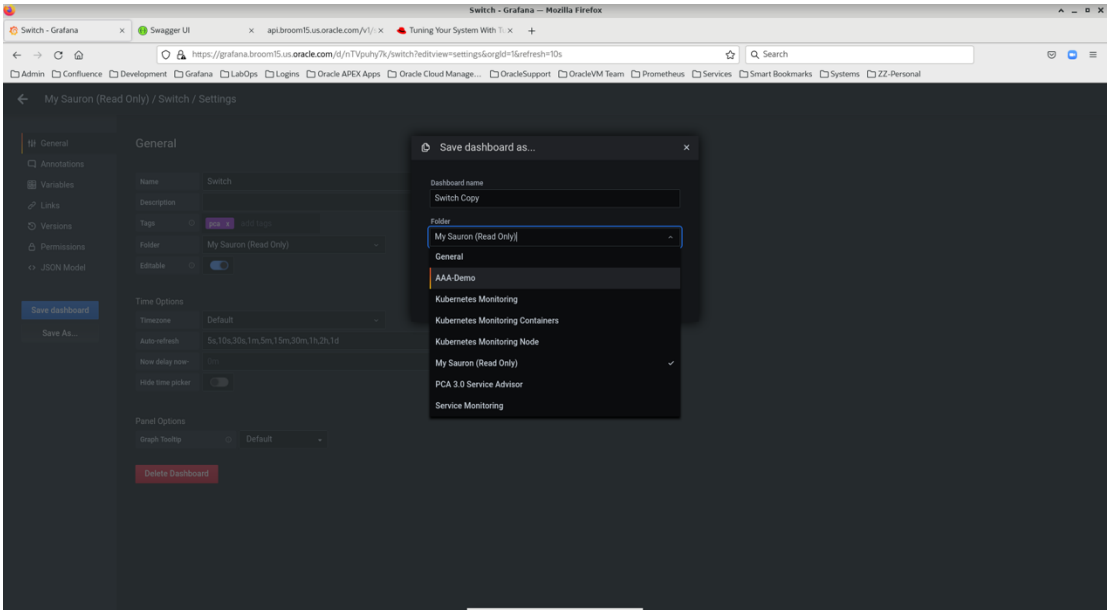
Grafana Copy Dashboard – Open Original

The Dashboard Settings window will open.



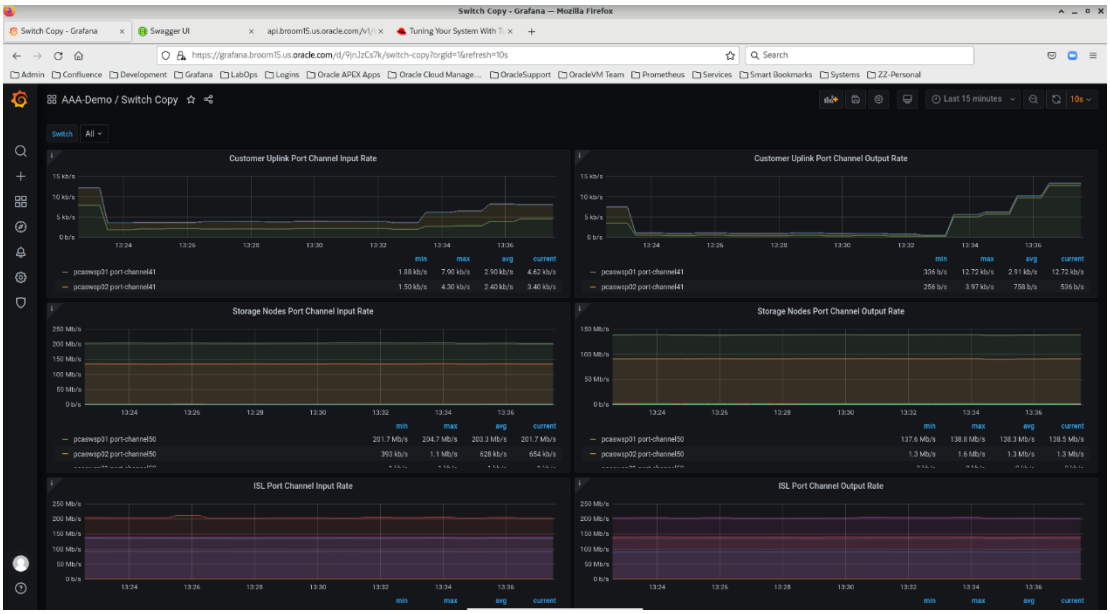
Grafana Copy Dashboard – Dashboard Settings

Then click on the Save As button.



Grafana Copy Dashboard – Save As

Save with a relevant dashboard name and to the folder of choice. In this example, saving the 'Switch Copy' dashboard to the 'AAA-Demo' folder.



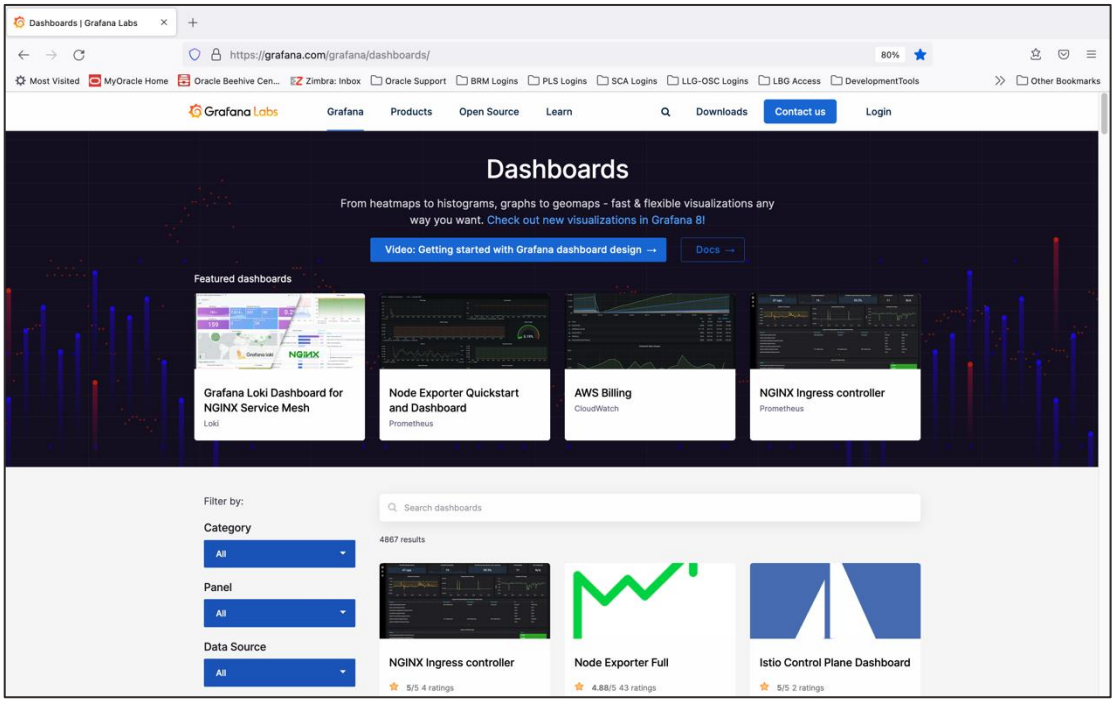
Grafana Copy Dashboard – Saved Copy in new Folder

The dashboard is now saved with the settings given.

Importing a dashboard

Since a Grafana Dashboard uses a JSON file-based definition, dashboards can be both exported and imported to provide a common set of dashboards across multiple systems.

The Grafana website hosts a dashboards page where other Grafana users can upload copies of any dashboards developed for their own purposes to be shared with the wider community.



Grafana Import Dashboard – Download from Grafana Dashboard website

Please note the following criteria before selecting any third-party dashboards for use in the Private Cloud Appliance:

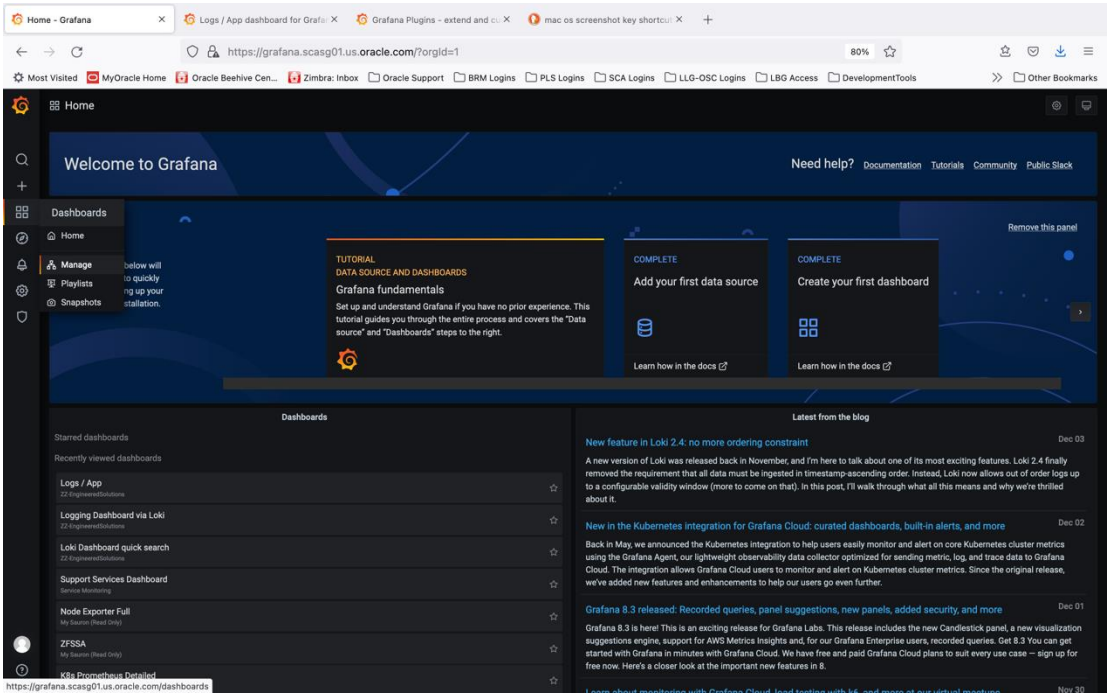
- Data sources are currently limited to
  - Prometheus
  - Loki
- Collector types are limited to
  - Node Exporter

Filter the available third-party dashboards, using the filter option by

- Grafana Version (v7)
- Category
- Panel
- Data source
- Collector type

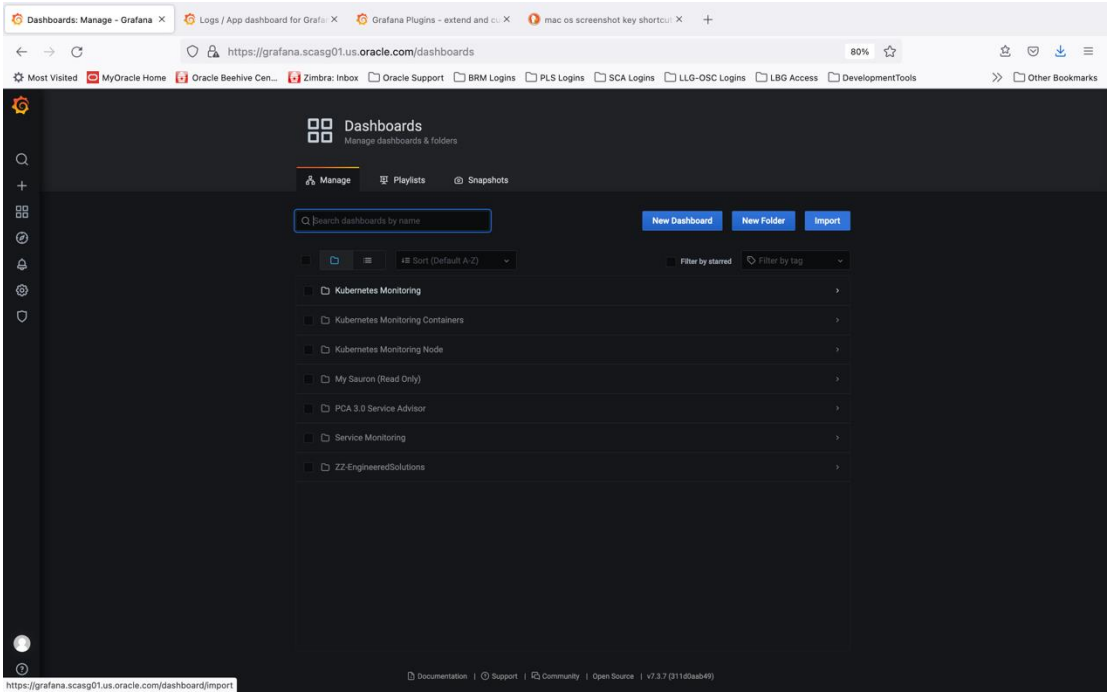
Download the associated JSON file and save locally.

Open the Grafana homepage for the Private Cloud Appliance.



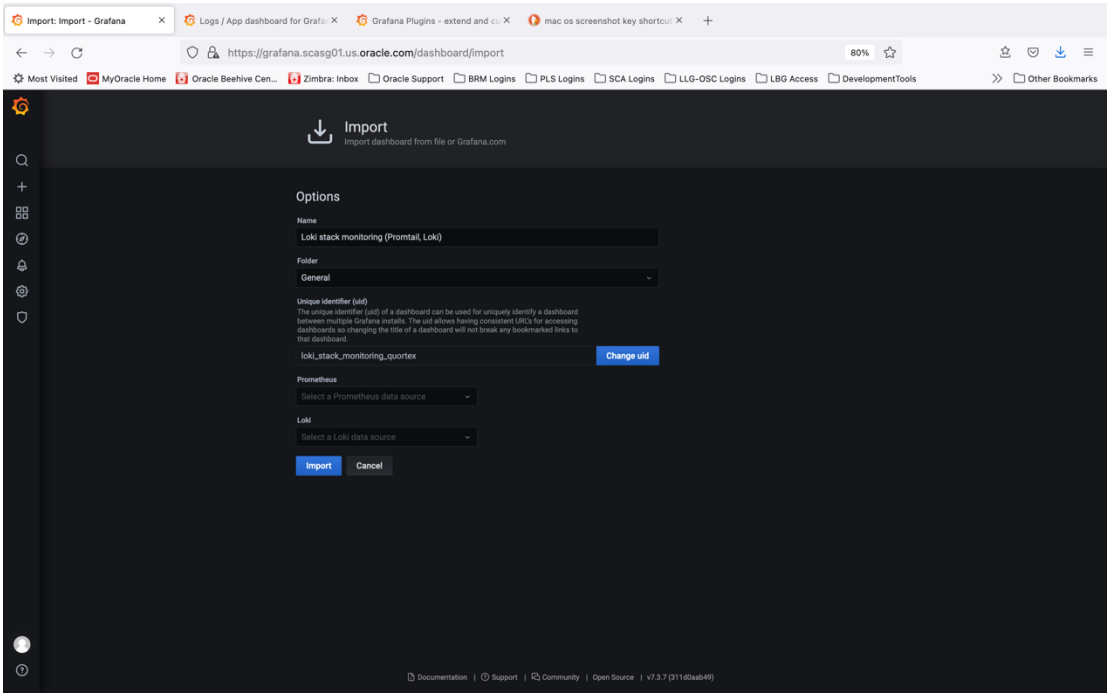
Grafana Import Dashboard – Private Cloud Appliance Grafana Homepage

Select the Manage Icon, then the Manage Tab.



Grafana Import Dashboard – Dashboard Management

Click the Import button, an Import window will be displayed.



Grafana Import Dashboard – Dashboard Import Window

Provide a suitable name and save to the correct folder.

Alerts

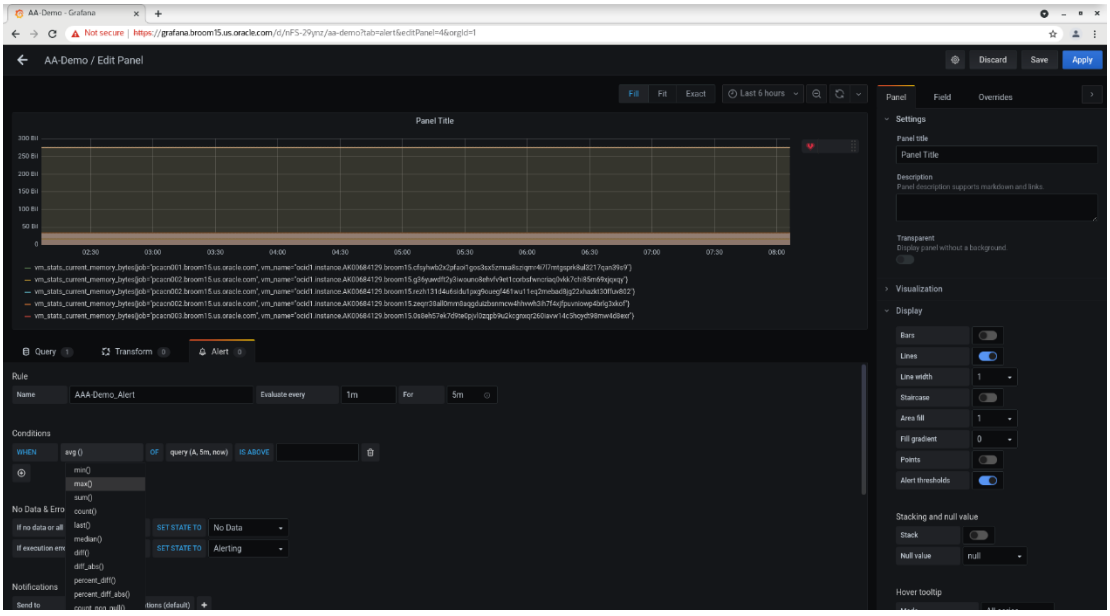
Grafana will provide Alert Events through a designated notification channel whenever a metric exceeds a defined threshold.

Alerting currently only functions on the base Metric value. If aggregation, grouping, or any level of metric transformation has occurred within the dashboard, alerts cannot be defined.

Please see the Grafana Alert documentation for more details.

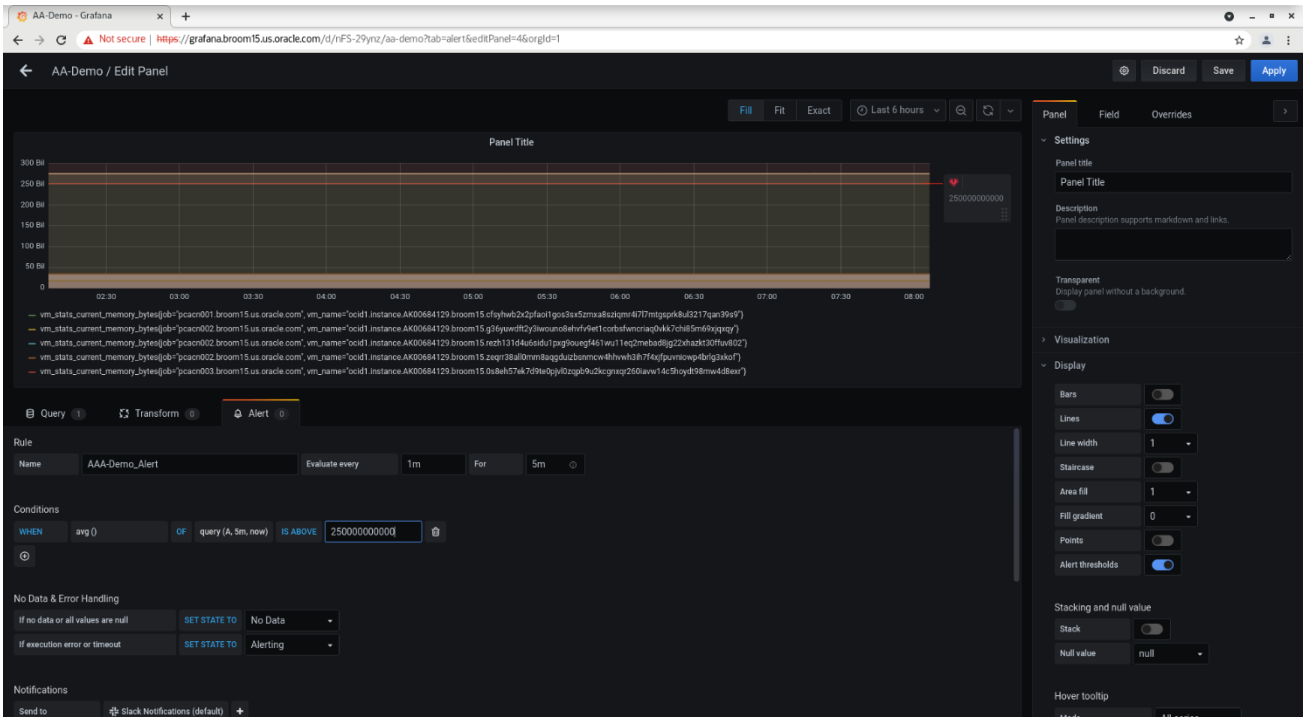
- Grafana Alerting

Using the example dashboard 'AA-Demo' created previously, open the dashboard in Edit mode and select the Alert tab in the Query window.



Grafana Alerts – Edit Dashboard

Set the Alert criteria, as shown below.



Grafana Alerts – Set Alerting Rule Criteria

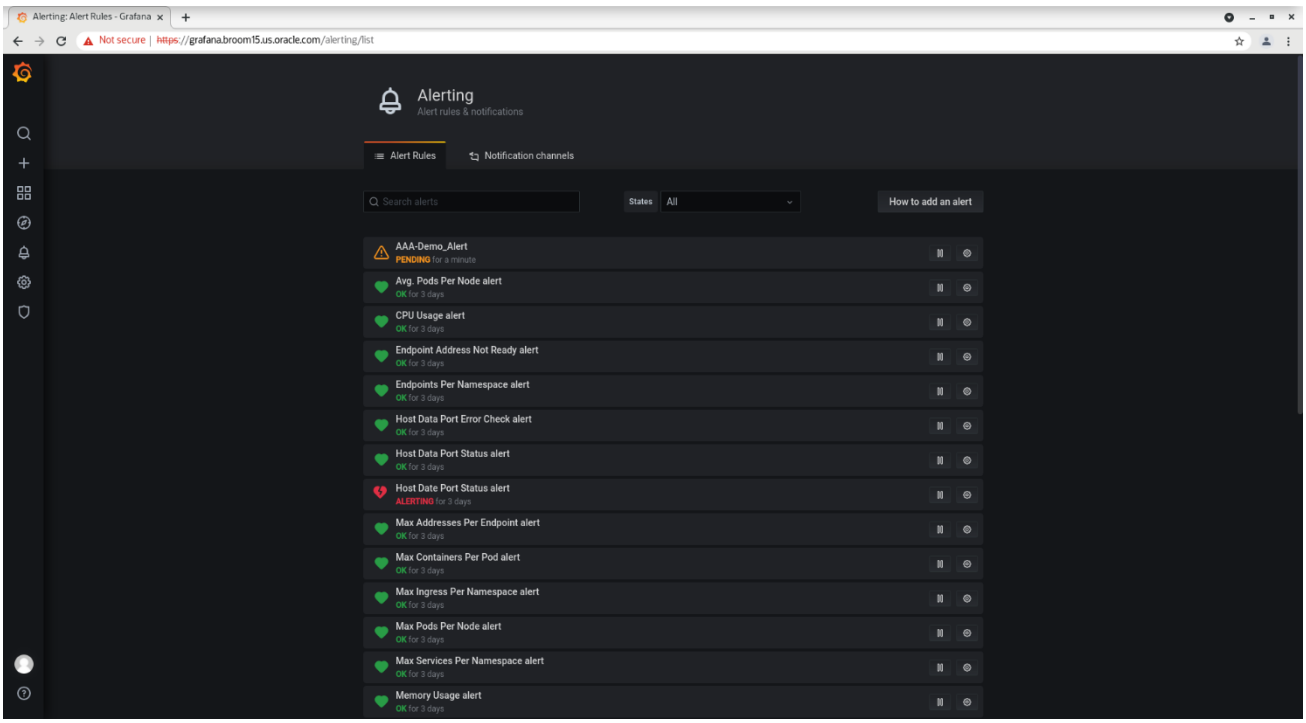
In this case, the alert has been set to trigger when the metric 'vm_stats_current_memory_bytes' value exceeds 270 billion over a five-minute window.

NOTE: Make sure both the Alert Rule AND the required Notification Channel(s) have been selected.

NOTE: The dashboard now displays an Alert Threshold line on the chart with a little red (broken) heart alongside it.

Apply and Save the changes.

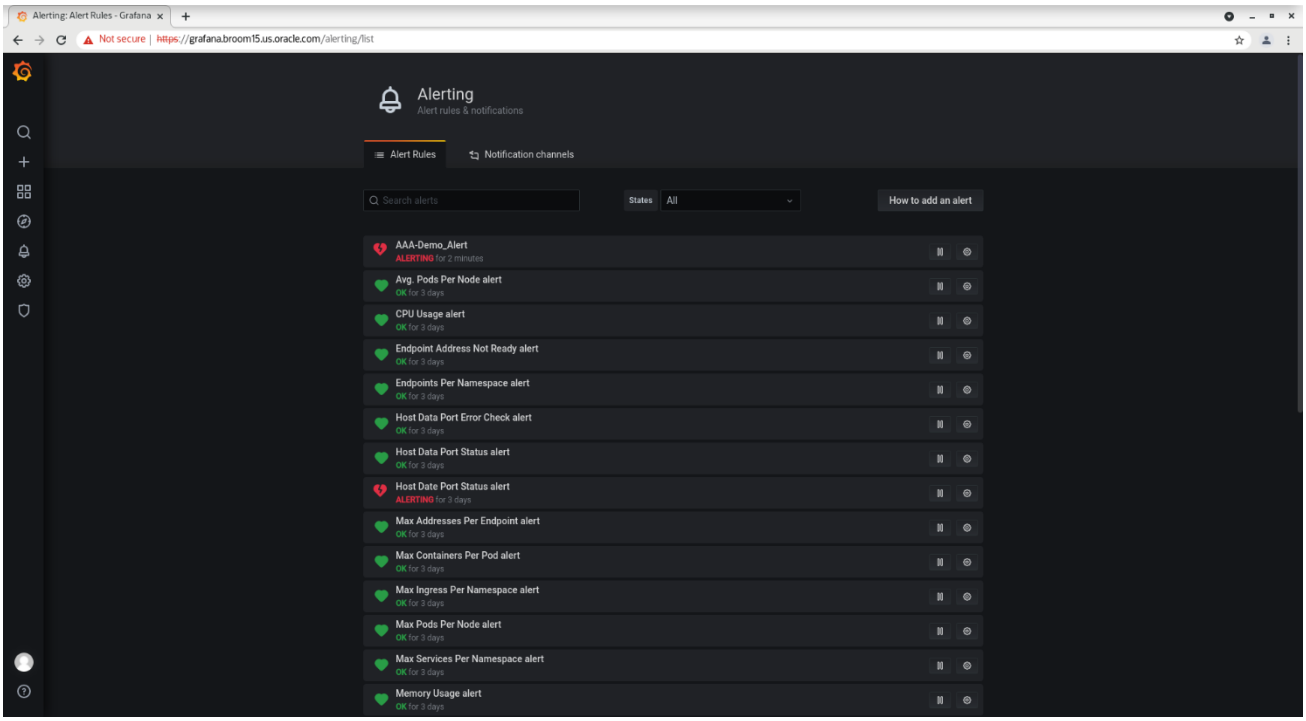
Then, open the Alerting screen (Alert Icon -> Alerting).



Grafana Alerts – Check Alert Status

The new alert can be seen, initially in a 'Pending' state and the Alert Rule is being processed.

Once processed, the Alerting Rule state will change. In this example, the threshold was set to such a level that an alert would be automatically generated.



Grafana Alerts – Triggered Alerting Rule

The Alert State has changed from 'Pending' to 'Alerting' and the designated Notification Channel(s) will be receiving a Grafana Alert message.

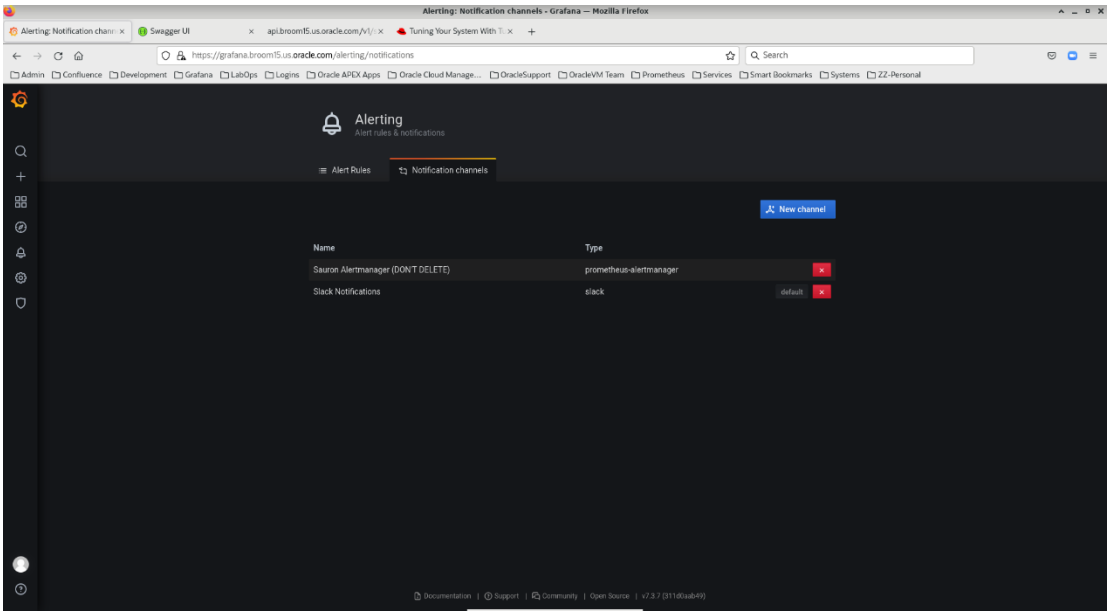
Please refer to the Grafana documentation for more detailed information.

Notification Channels

Two default Notification Channels are defined within the default configuration of a Private Cloud Appliance.

- Sauron Alertmanager—an internal management framework in the Private Cloud Appliance.
- Slack Notifications—configured to address and internal Slack instance.

This is illustrated below.



Grafana Notification Channels – Defaults

Neither of these Notification Channels will alert externally.

Additional Notification Channels can be defined but requires configuration changes to the default Grafana configuration. The process to accomplish this is outlined in the next section.

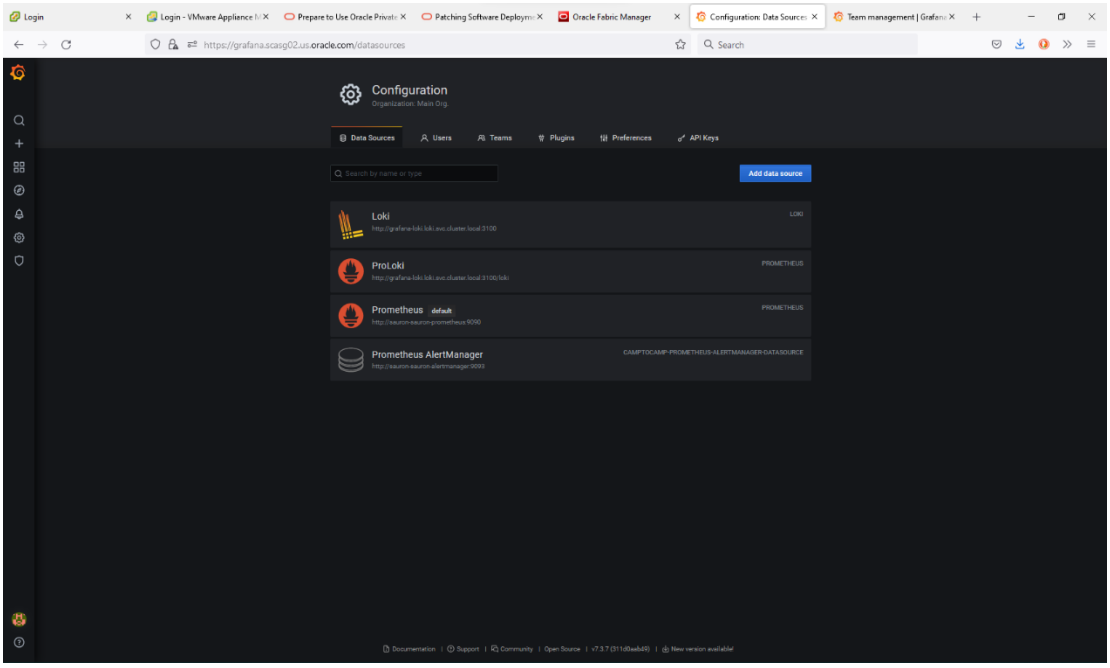
Data source administration - Updated

The default data sources provide access to the various metrics, logs, and alerts being collected and collated in the Private Cloud Appliance.

The initial installation provides a single data source for each of the following:

- Private Cloud Appliance internal Prometheus service
- Private Cloud Appliance Prometheus Alertmanager service
- Private Cloud Appliance Prometheus ProLoki service
- Private Cloud Appliance Grafana Loki service

This is illustrated in the image below.



Grafana Data Source Administration - Updated

Note: Additional data sources could be defined but this capability is unavailable with the current Private Cloud Appliance system software release.

Significant customization of the Private Cloud Appliance internal Grafana environment is discouraged. These services have been designed to accommodate the anticipated workload from a single Private Cloud Appliance only and not to provide Grafana services for external systems.

Any such customizations would not be expected to survive a Private Cloud Appliance systems software upgrade.

ACCESSING EXTERNAL SERVICES

Integration into external customer data center services for the centralized administration and management of several core components is technically possible for the Grafana implementation in a Private Cloud Appliance. The following sections cover what integration points are available with the current Private Cloud Appliance systems software release.

Identity Management

Grafana has capabilities to integrate with several user authentication services. This is documented on the Grafana website.

The Open Source Software (OSS) version of Grafana is used in the Private Cloud Appliance. Please use the Support & Role Mapping columns to determine what is technically possible.

Note: Integration between the Private Cloud Appliance Grafana implementation and ANY external Identity Management service is currently unavailable.

Alerting notification channels

Grafana provides several supported notifiers that Grafana generated alerts may be directed. This list includes

- DingDing
- Discord
- Email
- Google Hangouts Chat
- HipChat
- Kafka REST Proxy
- Line
- Microsoft Teams
- OpsGenie
- PagerDuty
- Prometheus Alertmanager
- Pushover
- Sensu
- Slack
- Telegram
- Threema Gateway
- VictorOps
- Webhook

For further details on each of the above options, please see the specific Grafana documentation

The Private Cloud Appliance, in its base configuration does not have external access to connect to any of the above supported notifiers.

However, by setting the HTTP-PROXY and HTTPS-PROXY values for Grafana, external access to Slack and Webhook services has been tested and proven to work.

The steps required for this are contained in the Private Cloud Appliance Administration Guide.

Specifically, the following steps need to be completed:

1. Log onto the Private Cloud Appliance management that “owns” the management virtual IP address.
2. Issue the following command:

```
$ sudo curl -u <admin_user_name> \

-XPUT 'https://api.<mypca>.example.com/v1/grafana/proxy/config?http-
proxy=<proxy_fqdn>:<proxy_port>&https-proxy=<proxy_fqdn>:<proxy_port>'
```

3. The following responses will be received:

```
Enter host password for user '<admin_user_name>':

Grafana proxy config successfully updated!
```

4. As a result of the above command, the Grafana services will restart.
5. Check on their status by issuing the following command:

```
$ sudo kubectl get pods -n sauron
```

6. The following responses will be received:

```
NAME                                          READY   STATUS              RESTARTS   AGE
sauron-sauron-alertmanager-0                  2/2     Running             0          41h
sauron-sauron-alertmanager-1                  2/2     Running             0          41h
sauron-sauron-alertmanager-2                  2/2     Running             0          41h
sauron-sauron-api-bf864d997-c9t2l             1/1     Running             0          41h
sauron-sauron-auth-7d489c7676-gbnhr           1/1     Running             0          2d6h
sauron-sauron-grafana-6d687fdc55-9vcc9        0/3     ContainerCreating   0          5s
sauron-sauron-mandos-867948689b-cl6ws         1/1     Running             0          2d5h
sauron-sauron-prometheus-0-7dd6f48bcc-mt5g9   3/3     Running             0          41h
sauron-sauron-prometheus-gw-5cdf4858bb-d69w5  1/1     Running             0          14h
sauron-sauron-prometheus-gw-cj-1642361400-dw4q2  0/1  Completed           0          14h
sauron-sauron-sauron-exporter-6488577bc5-9lp89   1/1  Running             0          2d5h
sub-sauron-operator-sauron-57cbbc49b-j9cf2    1/1     Running             0          2d5h
```

7. Repeat until the ‘sauron-sauron-grafana’ services is in a ’Running’ state.

Each Notification Channel specific configuration is heavily dependent on the type of Notification Channel being created.

Because of the complexity of this, it will be addressed in a separate document.

Grafana data sources

As noted above, the integration of the Private Cloud Appliance Grafana services to use additional external data sources is not permitted.

REFERENCE MATERIALS - UPDATED

Now that you have an overview of the monitoring and alerting framework in the Private Cloud Appliance system, further information can be obtained from the following URL links:

Oracle Documentation

- Concepts Guide – (https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/3.0/concept-3.0.2/index.html)
- Administration Guide – (https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/3.0/admin-3.0.2/index.html)
- Using Grafana: Viewing and Interpreting Monitoring Data – (https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/3.0-latest/admin/admin-adm-healthmonitor.html#adm-health-monitordata)
- Oracle Learning Library – (https://apexapps.oracle.com/pls/apex/f?p=44785:141:7362546576406:::RP,141:P141_PAGE_ID,P141_SECTION_ID:573,3844)

Grafana Documentation

- Dashboards - (https://grafana.com/docs/grafana/v7.3/dashboards/)
- Alerting - (https://grafana.com/docs/grafana/v7.3/alerting/)
- Best Practices - (https://grafana.com/docs/grafana/v7.3/best-practices/)
- Grafana documentation Library Home - (https://grafana.com/docs/grafana/v7.3/)
- Tutorials – (https://grafana.com/tutorials/grafana-fundamentals/?utm_source=grafana_gettingstarted)
- Loki documentation – (https://grafana.com/docs/loki/v2.2.1/)
- Loki Querying – (https://grafana.com/docs/loki/v2.2.1/logql/)

Prometheus Documentation

- Documentation – (https://prometheus.io/docs/prometheus/2.25/getting_started/)
- Querying - (https://prometheus.io/docs/prometheus/2.25/querying/basics/)
- Alertmanager – (https://prometheus.io/docs/alerting/0.21/overview/)

APPENDICES

The Prometheus client libraries offer four core metric types. These are

- Counter
  - A counter is a cumulative metric whose value can only increase over time, or be reset to zero on restart.
- Gauge
  - A gauge is a metric that represents a single numerical value that can arbitrarily go up or down.
- Histogram
  - A histogram samples observations and counts them into configurable buckets. It also provides a sum of all observations.
- Summary
  - A summary samples observations and provides a total count of observations and a sum of observed values. It also calculates configurable quantiles over a sliding time window.

A fifth metric type of 'untyped', is available for metrics which do not fall into the previous four categories.

The metric type will affect the types of summations, aggregations etc. that can be performed when displaying the base metrics within a Grafana Dashboard.

For example, a line graph of a counter-based metric will just display an ever-increasing line over time. However, applying a rate() calculation to this will show the rate of change over a designated time period.

The following tables show the Prometheus metrics available in the Private Cloud Appliance Grafana services for

- Defined virtual machine instances
- Internal ZFS Storage Appliance
- Compute and management server nodes

This is only a sample of the c. 2,800 individual metrics across some 58 metric types available.

Prometheus VM Instance Metrics

The following table lists the VM instance metrics available from the Private Cloud Appliance Prometheus service for use within the internal Grafana Services:

Prometheus VM instance metrics

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
vm	event	vm_event	vm event	untyped	YES	YES
	stats	vm_stats_cpu_time	VM cpu time in seconds	untyped	YES	YES
		vm_stats_cpu_util	VM cpu utilization	untyped	YES	YES
		vm_stats_current_memory_bytes	VM current memory in bytes	untyped	YES	YES
		vm_stats_disk_read	VM disk read	untyped	YES	YES
		vm_stats_disk_write	VM disk write	untyped	YES	YES
		vm_stats_max_memory_bytes	VM maximum memory in bytes	untyped	YES	YES
		vm_stats_network_receive	VM network receive in bytes	untyped	YES	YES
		vm_stats_network_send	VM network send in bytes	untyped	YES	YES
		vm_stats_online_vcpus	VM number of online vcpus	untyped	YES	YES
		vm_stats_target_memory_bytes	VM target memory in bytes	untyped	YES	YES

Appendix – Prometheus VM Instance Metrics - Updated

Prometheus ZFS Storage Appliance metrics - Updated

The following table lists the ZFS Storage Appliance metrics available from the Private Cloud Appliance Prometheus service for use within the internal Grafana Services:

Prometheus ZFSSA metrics - Updated

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
zfssa	active	zfssa_active_problem_count	ZFSSA active problem count by severity	untyped	YES	YES
	analytics	zfssa_analytics_arc_accesses_hit_miss	Current Value of Dataset arc.accesses[hit/miss]	untyped	NO	YES
		zfssa_analytics_arc_hitratio	Current Value of Dataset arc.hitratio	untyped	NO	YES
		zfssa_analytics_arc_size	Current Value of Dataset arc.size	untyped	NO	YES
		zfssa_analytics_arc_size_component	Current Value of Dataset arc.size[component]	untyped	NO	YES
		zfssa_analytics_cap_bytesused_pool	Current Value of Dataset cap.bytesused[pool]	untyped	YES	YES
		zfssa_analytics_cap_percentused_pool	Current Value of Dataset cap.percentused[pool]	untyped	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		zfssa_analytics_cpu_utilization	Current Value of Dataset cpu.utilization	untyped	YES	YES
		zfssa_analytics_dnlc_accesses_hit_miss	Current Value of Dataset dnlc.accesses[hit/miss]	untyped	NO	YES
		zfssa_analytics_ftp_kilobytes	Current Value of Dataset ftp.kilobytes	untyped	NO	YES
		zfssa_analytics_http_reqs	Current Value of Dataset http.reqs	untyped	NO	YES
		zfssa_analytics_io_bytes	Current Value of Dataset io.bytes	untyped	NO	YES
		zfssa_analytics_io_bytes_op	Current Value of Dataset io.bytes[op]	untyped	NO	YES
		zfssa_analytics_io_ops	Current Value of Dataset io.ops	untyped	YES	YES
		zfssa_analytics_io_ops_disk	Current Value of Dataset io.ops[disk]	untyped	NO	YES
		zfssa_analytics_io_ops_op	Current Value of Dataset io.ops[op]	untyped	NO	YES
		zfssa_analytics_iscsi_bytes	Current Value of Dataset iscsi.bytes	untyped	YES	YES
		zfssa_analytics_iscsi_ops	Current Value of Dataset iscsi.ops	untyped	YES	YES
		zfssa_analytics_net_kilobytes_interface	Current Value of Dataset net.kilobytes[interface]	untyped	YES	YES
		zfssa_analytics_nfs3_bytes	Current Value of Dataset nfs3.bytes	untyped	YES	YES
		zfssa_analytics_nfs3_ops	Current Value of Dataset nfs3.ops	untyped	YES	YES
		zfssa_analytics_nfs4_1_bytes	Current Value of Dataset nfs4-1.bytes	untyped	YES	YES
		zfssa_analytics_nfs4_1_ops	Current Value of Dataset nfs4-1.ops	untyped	YES	YES
		zfssa_analytics_nfs4_bytes	Current Value of Dataset nfs4.bytes	untyped	YES	YES
		zfssa_analytics_nfs4_ops	Current Value of Dataset nfs4.ops	untyped	YES	YES
		zfssa_analytics_nfs4_ops_op	Current Value of Dataset nfs4.ops[op]	untyped	NO	YES
		zfssa_analytics_nic_kilobytes	Current Value of Dataset nic.kilobytes	untyped	NO	YES
		zfssa_analytics_nic_kilobytes_device	Current Value of Dataset nic.kilobytes[device]	untyped	NO	YES
		zfssa_analytics_nic_kilobytes_direction	Current Value of Dataset nic.kilobytes[direction]	untyped	NO	YES
		zfssa_analytics_sftp_kilobytes	Current Value of Dataset sftp.kilobytes	untyped	NO	YES
		zfssa_analytics_smb_ops	Current Value of Dataset smb.ops	untyped	NO	YES
		zfssa_analytics_smb2_ops	Current Value of Dataset smb2.ops	untyped	NO	YES
		zfssa_analytics_smb3_ops	Current Value of Dataset smb3.ops	untyped	NO	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
	cluster	zfssa_cluster_state	ZFSSA Cluster State (0 - not responsive, 1 - clustered, 2 - owner, -1 - stripped, -2 - other)	untyped	YES	YES
	filesystem	zfssa_filesystem_exported	ZFSSA Filesystem Exported (0 - not exported, 1 - exported)	untyped	YES	YES
		zfssa_filesystem_reservation	ZFSSA Filesystem Reservation	untyped	YES	YES
		zfssa_filesystem_usage_available	ZFSSA Filesystem Usage Available	untyped	YES	YES
		zfssa_filesystem_usage_data	ZFSSA Filesystem Usage from Data	untyped	YES	YES
		zfssa_filesystem_usage_quota	ZFSSA Filesystem Usage Quota)	untyped	YES	YES
		zfssa_filesystem_usage_snapshots	ZFSSA Filesystem Snapshot Usage	untyped	YES	YES
		zfssa_filesystem_usage_total	ZFSSA Filesystem Usage Total)	untyped	YES	YES
	lun	zfssa_lun_exported	ZFSSA Lun Exported (0 - not exported, 1 - exported)	untyped	YES	YES
		zfssa_lun_usage_available	ZFSSA Lun Usage Available	untyped	YES	YES
		zfssa_lun_usage_data	ZFSSA Lun Usage from Data (note that LUN usage is allocated bytes, applications may interpret differently)	untyped	YES	YES
		zfssa_lun_usage_snapshots	ZFSSA Lun Snapshot Usage (outside of LUN volsize)	untyped	YES	YES
		zfssa_lun_usage_total	ZFSSA LUN Usage Total (volsize plus additional storage like snapshots)	untyped	YES	YES
		zfssa_lun_volsize	ZFSSA Volume Size	untyped	YES	YES
	pool	zfssa_pool_free	ZFSSA Pool Free	untyped	YES	YES
		zfssa_pool_status	ZFSSA Pool Status (0 - exported, 1 - degraded, 2 - online,-1 - offline, -2 - faulted, -3 - unavail, -4 - removed)	untyped	YES	YES
		zfssa_pool_total	ZFSSA Pool Total	untyped	YES	YES
		zfssa_pool_usage_child_reservation	ZFSSA Pool Reservation from Children	untyped	YES	YES
		zfssa_pool_usage_data	ZFSSA Pool Usage from Data	untyped	YES	YES
		zfssa_pool_usage_replication	ZFSSA Pool Replication Usage	untyped	YES	YES
		zfssa_pool_usage_reservation	ZFSSA Pool Reservation	untyped	YES	YES
		zfssa_pool_usage_snapshots	ZFSSA Pool Snapshot Usage	untyped	YES	YES
		zfssa_pool_usage_total	ZFSSA Pool Usage Total	untyped	YES	YES
		zfssa_pool_used	ZFSSA Pool Used	untyped	YES	YES

Prometheus Server Node Metrics - Updated

The following table lists the server node metrics available from the Private Cloud Appliance Prometheus service for use within the internal Grafana Services:

Prometheus server node metrics – Updated

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
node	arp	node_arp_entries	ARP entries by device	gauge	YES	YES
	bonding	node_bonding_active	Number of active slaves per bonding interface.	gauge	YES	YES
		node_bonding_slaves	Number of configured slaves per bonding interface.	gauge	YES	YES
	boot	node_boot_time_seconds	Node boot time, in unixtime.	gauge	YES	YES
	context	node_context_switches_total	Total number of context switches.	counter	YES	YES
	cooling	node_cooling_device_cur_state	Current throttle state of the cooling device	gauge	YES	YES
		node_cooling_device_max_state	Maximum throttle state of the cooling device	gauge	YES	YES
	cpu	node_cpu_core_throttles_total	Number of times this cpu core has been throttled.	counter	YES	YES
		node_cpu_frequency_max_hertz	Maximum cpu thread frequency in hertz.	gauge	YES	YES
		node_cpu_frequency_min_hertz	Minimum cpu thread frequency in hertz.	gauge	YES	YES
		node_cpu_guest_seconds_total	Seconds the cpus spent in guests (VMs) for each mode.	counter	YES	YES
		node_cpu_package_throttles_total	Number of times this cpu package has been throttled.	counter	YES	YES
		node_cpu_scaling_frequency_hertz	Current scaled cpu thread frequency in hertz.	gauge	YES	YES
		node_cpu_scaling_frequency_max_hertz	Maximum scaled cpu thread frequency in hertz.	gauge	YES	YES
		node_cpu_scaling_frequency_min_hertz	Minimum scaled cpu thread frequency in hertz.	gauge	YES	YES
		node_cpu_seconds_total	Seconds the cpus spent in each mode.	counter	YES	YES
	disk	node_disk_discard_time_seconds_total	This is the total number of seconds spent by all discards.	counter	YES	YES
		node_disk_discarded_sectors_total	The total number of sectors discarded successfully.	counter	YES	YES
		node_disk_discards_completed_total	The total number of discards completed successfully.	counter	YES	YES
		node_disk_discards_merged_total	The total number of discards merged.	counter	YES	YES
		node_disk_io_now	The number of I/Os currently in progress.	gauge	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_disk_io_time_seconds_total	Total seconds spent doing I/Os.	counter	YES	YES
		node_disk_io_time_weighted_seconds_total	The weighted # of seconds spent doing I/Os.	counter	YES	YES
		node_disk_read_bytes_total	The total number of bytes read successfully.	counter	YES	YES
		node_disk_read_time_seconds_total	The total number of seconds spent by all reads.	counter	YES	YES
		node_disk_reads_completed_total	The total number of reads completed successfully.	counter	YES	YES
		node_disk_reads_merged_total	The total number of reads merged.	counter	YES	YES
		node_disk_write_time_seconds_total	This is the total number of seconds spent by all writes.	counter	YES	YES
		node_disk_writes_completed_total	The total number of writes completed successfully.	counter	YES	YES
		node_disk_writes_merged_total	The number of writes merged.	counter	YES	YES
		node_disk_written_bytes_total	The total number of bytes written successfully.	counter	YES	YES
	edac	node_edac_correctable_errors_total	Total correctable memory errors.	counter	YES	YES
		node_edac_csrow_correctable_errors_total	Total correctable memory errors for this csrow.	counter	YES	YES
		node_edac_csrow_uncorrectable_errors_total	Total uncorrectable memory errors for this csrow.	counter	YES	YES
		node_edac_uncorrectable_errors_total	Total uncorrectable memory errors.	counter	YES	YES
	entropy	node_entropy_available_bits	Bits of available entropy.	gauge	YES	YES
	exporter	node_exporter_build_info	A metric with a constant '1' value labeled by version, revision, branch, and goversion from which node_exporter was built.	gauge	YES	YES
	filefd	node_filefd_allocated	File descriptor statistics: allocated.	gauge	YES	YES
		node_filefd_maximum	File descriptor statistics: maximum.	gauge	YES	YES
	filesystem	node_filesystem_avail_bytes	Filesystem space available to non-root users in bytes.	gauge	YES	YES
		node_filesystem_device_error	Whether an error occurred while getting statistics for the given device.	gauge	YES	YES
		node_filesystem_files	Filesystem total file nodes.	gauge	YES	YES
		node_filesystem_files_free	Filesystem total free file nodes.	gauge	YES	YES
		node_filesystem_free_bytes	Filesystem free space in bytes.	gauge	YES	YES
		node_filesystem_readonly	Filesystem read-only status.	gauge	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_filesystem_size_bytes	Filesystem size in bytes.	gauge	YES	YES
	forks	node_forks_total	Total number of forks.	counter	YES	YES
	hwmon	node_hwmon_chip_names	Annotation metric for human-readable chip names	gauge	YES	YES
		node_hwmon_sensor_label	Label for given chip and sensor	gauge	YES	YES
		node_hwmon_temp_celsius	Hardware monitor for temperature (input)	gauge	YES	YES
		node_hwmon_temp_crit_alarm_celsius	Hardware monitor for temperature (crit_alarm)	gauge	YES	YES
		node_hwmon_temp_crit_celsius	Hardware monitor for temperature (crit)	gauge	YES	YES
		node_hwmon_temp_max_celsius	Hardware monitor for temperature (max)	gauge	YES	YES
	infiniband	node_infiniband_info	Non-numeric data from /sys/class/infiniband/<device>, value is always 1.	gauge	YES	YES
		node_infiniband_link_downed_total	Number of times the link failed to recover from an error state and went down	counter	YES	YES
		node_infiniband_link_error_recovery_total	Number of times the link successfully recovered from an error state	counter	YES	YES
		node_infiniband_multicast_packets_received_total	Number of multicast packets received (including errors)	counter	YES	YES
		node_infiniband_multicast_packets_transmitted_total	Number of multicast packets transmitted (including errors)	counter	YES	YES
		node_infiniband_physical_state_id	Physical state of the InfiniBand port (0: no change, 1: sleep, 2: polling, 3: disable, 4: shift, 5: link up, 6: link error recover, 7: phytest)	gauge	YES	YES
		node_infiniband_port_constraint_errors_received_total	Number of packets received on the switch physical port that are discarded	counter	YES	YES
		node_infiniband_port_constraint_errors_transmitted_total	Number of packets not transmitted from the switch physical port	counter	YES	YES
		node_infiniband_port_data_received_bytes_total	Number of data octets received on all links	counter	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_infiniband_port_data_transmitted_bytes_total	Number of data octets transmitted on all links	counter	YES	YES
		node_infiniband_port_discards_transmitted_total	Number of outbound packets discarded by the port because the port is down or congested	counter	YES	YES
		node_infiniband_port_errors_received_total	Number of packets containing an error that were received on this port	counter	YES	YES
		node_infiniband_port_packets_received_total	Number of packets received on all VLs by this port (including errors)	counter	YES	YES
		node_infiniband_port_packets_transmitted_total	Number of packets transmitted on all VLs from this port (including errors)	counter	YES	YES
		node_infiniband_port_transmit_wait_total	Number of ticks during which the port had data to transmit but no data was sent during the entire tick	counter	YES	YES
		node_infiniband_rate_bytes_per_second	Maximum signal transfer rate	gauge	YES	YES
		node_infiniband_state_id	State of the InfiniBand port (0: no change, 1: down, 2: init, 3: armed, 4: active, 5: act defer)	gauge	YES	YES
		node_infiniband_unicast_packets_received_total	Number of unicast packets received (including errors)	counter	YES	YES
		node_infiniband_unicast_packets_transmitted_total	Number of unicast packets transmitted (including errors)	counter	YES	YES
	interrupts	node_interrupts_total	Interrupt details.	counter	YES	YES
	intr	node_intr_total	Total number of interrupts serviced.	counter	YES	YES
	ipvs	node_ipvs_connections_total	The total number of connections made.	counter	YES	YES
		node_ipvs_incoming_bytes_total	The total amount of incoming data.	counter	YES	YES
		node_ipvs_incoming_packets_total	The total number of incoming packets.	counter	YES	YES
		node_ipvs_outgoing_bytes_total	The total amount of outgoing data.	counter	YES	YES
		node_ipvs_outgoing_packets_total	The total number of outgoing packets.	counter	YES	YES
	load	node_load1	1m load average.	gauge	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_load15	15m load average.	gauge	YES	YES
		node_load5	5m load average.	gauge	YES	YES
	md	node_md_blocks	Total number of blocks on device.	gauge	NO	YES
		node_md_blocks_synced	Number of blocks synced on device.	gauge	NO	YES
		node_md_disks	Number of active/failed/spare disks of device.	gauge	NO	YES
		node_md_disks_required	Total number of disks of device.	gauge	NO	YES
		node_md_state	Indicates the state of md-device.	gauge	NO	YES
	memory	node_memory_Active_anon_bytes	Memory information field Active_anon_bytes.	gauge	YES	YES
		node_memory_Active_bytes	Memory information field Active_bytes.	gauge	YES	YES
		node_memory_Active_file_bytes	Memory information field Active_file_bytes.	gauge	YES	YES
		node_memory_AnonHugePages_bytes	Memory information field AnonHugePages_bytes.	gauge	YES	YES
		node_memory_AnonPages_bytes	Memory information field AnonPages_bytes.	gauge	YES	YES
		node_memory_Bounce_bytes	Memory information field Bounce_bytes.	gauge	YES	YES
		node_memory_Buffers_bytes	Memory information field Buffers_bytes.	gauge	YES	YES
		node_memory_Cached_bytes	Memory information field Cached_bytes.	gauge	YES	YES
		node_memory_CmaFree_bytes	Memory information field CmaFree_bytes.	gauge	YES	YES
		node_memory_CmaTotal_bytes	Memory information field CmaTotal_bytes.	gauge	YES	YES
		node_memory_CommitLimit_bytes	Memory information field CommitLimit_bytes.	gauge	YES	YES
		node_memory_Committed_AS_bytes	Memory information field Committed_AS_bytes.	gauge	YES	YES
		node_memory_DirectMap1G_bytes	Memory information field DirectMap1G_bytes.	gauge	YES	YES
		node_memory_DirectMap2M_bytes	Memory information field DirectMap2M_bytes.	gauge	YES	YES
		node_memory_DirectMap4k_bytes	Memory information field DirectMap4k_bytes.	gauge	YES	YES
		node_memory_Dirty_bytes	Memory information field Dirty_bytes.	gauge	YES	YES
		node_memory_FileHugePages_bytes	Memory information field FileHugePages_bytes.	gauge	YES	YES
		node_memory_FilePmdMapped_bytes	Memory information field FilePmdMapped_bytes.	gauge	YES	YES
		node_memory_HardwareCorrupted_bytes	Memory information field HardwareCorrupted_bytes.	gauge	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_memory_HugePages_Free	Memory information field HugePages_Free.	gauge	YES	YES
		node_memory_HugePages_Rsvd	Memory information field HugePages_Rsvd.	gauge	YES	YES
		node_memory_HugePages_Surp	Memory information field HugePages_Surp.	gauge	YES	YES
		node_memory_HugePages_Total	Memory information field HugePages_Total.	gauge	YES	YES
		node_memory_Hugepagesize_bytes	Memory information field Hugepagesize_bytes.	gauge	YES	YES
		node_memory_Hugetlb_bytes	Memory information field Hugetlb_bytes.	gauge	YES	YES
		node_memory_Inactive_anon_bytes	Memory information field Inactive_anon_bytes.	gauge	YES	YES
		node_memory_Inactive_bytes	Memory information field Inactive_bytes.	gauge	YES	YES
		node_memory_Inactive_file_bytes	Memory information field Inactive_file_bytes.	gauge	YES	YES
		node_memory_KernelStack_bytes	Memory information field KernelStack_bytes.	gauge	YES	YES
		node_memory_KReclaimable_bytes	Memory information field KReclaimable_bytes.	gauge	YES	YES
		node_memory_Mapped_bytes	Memory information field Mapped_bytes.	gauge	YES	YES
		node_memory_MemAvailable_bytes	Memory information field MemAvailable_bytes.	gauge	YES	YES
		node_memory_MemFree_bytes	Memory information field MemFree_bytes.	gauge	YES	YES
		node_memory_MemTotal_bytes	Memory information field MemTotal_bytes.	gauge	YES	YES
		node_memory_Mlocked_bytes	Memory information field Mlocked_bytes.	gauge	YES	YES
		node_memory_NFS_Unstable_bytes	Memory information field NFS_Unstable_bytes.	gauge	YES	YES
		node_memory_PageTables_bytes	Memory information field PageTables_bytes.	gauge	YES	YES
		node_memory_Percpu_bytes	Memory information field Percpu_bytes.	gauge	YES	YES
		node_memory_Shmem_bytes	Memory information field Shmem_bytes.	gauge	YES	YES
		node_memory_ShmemHugePages_bytes	Memory information field ShmemHugePages_bytes.	gauge	YES	YES
		node_memory_ShmemPmdMapped_bytes	Memory information field ShmemPmdMapped_bytes.	gauge	YES	YES
		node_memory_Slab_bytes	Memory information field Slab_bytes.	gauge	YES	YES
		node_memory_SReclaimable_bytes	Memory information field SReclaimable_bytes.	gauge	YES	YES
		node_memory_SUnreclaim_bytes	Memory information field SUnreclaim_bytes.	gauge	YES	YES
		node_memory_SwapCached_bytes	Memory information field SwapCached_bytes.	gauge	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_memory_SwapFree_bytes	Memory information field SwapFree_bytes.	gauge	YES	YES
		node_memory_SwapTotal_bytes	Memory information field SwapTotal_bytes.	gauge	YES	YES
		node_memory_Unevictable_bytes	Memory information field Unevictable_bytes.	gauge	YES	YES
		node_memory_VmallocChunk_bytes	Memory information field VmallocChunk_bytes.	gauge	YES	YES
		node_memory_VmallocTotal_bytes	Memory information field VmallocTotal_bytes.	gauge	YES	YES
		node_memory_VmallocUsed_bytes	Memory information field VmallocUsed_bytes.	gauge	YES	YES
		node_memory_Writeback_bytes	Memory information field Writeback_bytes.	gauge	YES	YES
		node_memory_WritebackTmp_bytes	Memory information field WritebackTmp_bytes.	gauge	YES	YES
	netstat	node_netstat_Icmp_InErrors	Statistic IcmpInErrors.	untyped	YES	YES
		node_netstat_Icmp_InMsgs	Statistic IcmpInMsgs.	untyped	YES	YES
		node_netstat_Icmp_OutMsgs	Statistic IcmpOutMsgs.	untyped	YES	YES
		node_netstat_Icmp6_InErrors	Statistic Icmp6InErrors.	untyped	YES	YES
		node_netstat_Icmp6_InMsgs	Statistic Icmp6InMsgs.	untyped	YES	YES
		node_netstat_Icmp6_OutMsgs	Statistic Icmp6OutMsgs.	untyped	YES	YES
		node_netstat_Ip_Forwarding	Statistic IpForwarding.	untyped	YES	YES
		node_netstat_Ip6_InOctets	Statistic Ip6InOctets.	untyped	YES	YES
		node_netstat_Ip6_OutOctets	Statistic Ip6OutOctets.	untyped	YES	YES
		node_netstat_IpExt_InOctets	Statistic IpExtInOctets.	untyped	YES	YES
		node_netstat_IpExt_OutOctets	Statistic IpExtOutOctets.	untyped	YES	YES
		node_netstat_Tcp_ActiveOpens	Statistic TcpActiveOpens.	untyped	YES	YES
		node_netstat_Tcp_CurrEstab	Statistic TcpCurrEstab.	untyped	YES	YES
		node_netstat_Tcp_InErrs	Statistic TcpInErrs.	untyped	YES	YES
		node_netstat_Tcp_InSegs	Statistic TcpInSegs.	untyped	YES	YES
		node_netstat_Tcp_OutSegs	Statistic TcpOutSegs.	untyped	YES	YES
		node_netstat_Tcp_PassiveOpens	Statistic TcpPassiveOpens.	untyped	YES	YES
		node_netstat_Tcp_RetransSegs	Statistic TcpRetransSegs.	untyped	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_netstat_TcpExt_ListenDrops	Statistic TcpExtListenDrops.	untyped	YES	YES
		node_netstat_TcpExt_ListenOverflows	Statistic TcpExtListenOverflows.	untyped	YES	YES
		node_netstat_TcpExt_SyncookiesFailed	Statistic TcpExtSyncookiesFailed.	untyped	YES	YES
		node_netstat_TcpExt_SyncookiesRecv	Statistic TcpExtSyncookiesRecv.	untyped	YES	YES
		node_netstat_TcpExt_SyncookiesSent	Statistic TcpExtSyncookiesSent.	untyped	YES	YES
		node_netstat_TcpExt_TCPSynRetrans	Statistic TcpExtTCPSynRetrans.	untyped	YES	YES
		node_netstat_Udp_InDatagrams	Statistic UdpInDatagrams.	untyped	YES	YES
		node_netstat_Udp_InErrors	Statistic UdpInErrors.	untyped	YES	YES
		node_netstat_Udp_NoPorts	Statistic UdpNoPorts.	untyped	YES	YES
		node_netstat_Udp_OutDatagrams	Statistic UdpOutDatagrams.	untyped	YES	YES
		node_netstat_Udp_RcvbufErrors	Statistic UdpRcvbufErrors.	untyped	YES	YES
		node_netstat_Udp_SndbufErrors	Statistic UdpSndbufErrors.	untyped	YES	YES
		node_netstat_Udp6_InDatagrams	Statistic Udp6InDatagrams.	untyped	YES	YES
		node_netstat_Udp6_InErrors	Statistic Udp6InErrors.	untyped	YES	YES
		node_netstat_Udp6_NoPorts	Statistic Udp6NoPorts.	untyped	YES	YES
		node_netstat_Udp6_OutDatagrams	Statistic Udp6OutDatagrams.	untyped	YES	YES
		node_netstat_Udp6_RcvbufErrors	Statistic Udp6RcvbufErrors.	untyped	YES	YES
		node_netstat_Udp6_SndbufErrors	Statistic Udp6SndbufErrors.	untyped	YES	YES
		node_netstat_UdpLite_InErrors	Statistic UdpLiteInErrors.	untyped	YES	YES
		node_netstat_UdpLite6_InErrors	Statistic UdpLite6InErrors.	untyped	YES	YES
	network	node_network_address_assign_type	address_assign_type value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_carrier	carrier value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_carrier_changes_total	carrier_changes_total value of /sys/class/net/<iface>.	counter	YES	YES
		node_network_carrier_down_changes_total	carrier_down_changes_total value of /sys/class/net/<iface>.	counter	YES	YES
		node_network_carrier_up_changes_total	carrier_up_changes_total value of /sys/class/net/<iface>.	counter	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_network_device_id	device_id value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_dormant	dormant value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_flags	flags value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_iface_id	iface_id value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_iface_link	iface_link value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_iface_link_mode	iface_link_mode value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_info	Non-numeric data from /sys/class/net/<iface>, value is always 1.	gauge	YES	YES
		node_network_mtu_bytes	mtu_bytes value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_name_assign_type	name_assign_type value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_net_dev_group	net_dev_group value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_protocol_type	protocol_type value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_receive_bytes_total	Network device statistic receive_bytes.	counter	YES	YES
		node_network_receive_compressed_total	Network device statistic receive_compressed.	counter	YES	YES
		node_network_receive_drop_total	Network device statistic receive_drop.	counter	YES	YES
		node_network_receive_errs_total	Network device statistic receive_errs.	counter	YES	YES
		node_network_receive_fifo_total	Network device statistic receive_fifo.	counter	YES	YES
		node_network_receive_frame_total	Network device statistic receive_frame.	counter	YES	YES
		node_network_receive_multicast_total	Network device statistic receive_multicast.	counter	YES	YES
		node_network_receive_packets_total	Network device statistic receive_packets.	counter	YES	YES
		node_network_speed_bytes	speed_bytes value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_transmit_bytes_total	Network device statistic transmit_bytes.	counter	YES	YES
		node_network_transmit_carrier_total	Network device statistic transmit_carrier.	counter	YES	YES
		node_network_transmit_colls_total	Network device statistic transmit_colls.	counter	YES	YES
		node_network_transmit_compressed_total	Network device statistic transmit_compressed.	counter	YES	YES
		node_network_transmit_drop_total	Network device statistic transmit_drop.	counter	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_network_transmit_errs_total	Network device statistic transmit_errs.	counter	YES	YES
		node_network_transmit_fifo_total	Network device statistic transmit_fifo.	counter	YES	YES
		node_network_transmit_packets_total	Network device statistic transmit_packets.	counter	YES	YES
		node_network_transmit_queue_length	transmit_queue_length value of /sys/class/net/<iface>.	gauge	YES	YES
		node_network_up	Value is 1 if operstate is 'up', 0 otherwise.	gauge	YES	YES
	nf	node_nf_conntrack_entries	Number of currently allocated flow entries for connection tracking.	gauge	YES	YES
		node_nf_conntrack_entries_limit	Maximum size of connection tracking table.	gauge	YES	YES
	nfs	node_nfs_connections_total	Total number of NFSd TCP connections.	counter	YES	YES
		node_nfs_packets_total	Total NFSd network packets (sent+received) by protocol type.	counter	YES	YES
		node_nfs_requests_total	Number of NFS procedures invoked.	counter	YES	YES
		node_nfs_rpc_authentication_refreshes_total	Number of RPC authentication refreshes performed.	counter	YES	YES
		node_nfs_rpc_retransmissions_total	Number of RPC transmissions performed.	counter	YES	YES
		node_nfs_rpcs_total	Total number of RPCs performed.	counter	YES	YES
	processes	node_processes_max_processes	Number of max PIDs limit	gauge	YES	YES
		node_processes_max_threads	Limit of threads in the system	gauge	YES	YES
		node_processes_pids	Number of PIDs	gauge	YES	YES
		node_processes_state	Number of processes in each state.	gauge	YES	YES
		node_processes_threads	Allocated threads in system	gauge	YES	YES
	procs	node_procs_blocked	Number of processes blocked waiting for I/O to complete.	gauge	YES	YES
		node_procs_running	Number of processes in runnable state.	gauge	YES	YES
	schedstat	node_schedstat_running_seconds_total	Number of seconds CPU spent running a process.	counter	YES	YES
		node_schedstat_timeslices_total	Number of timeslices executed by CPU.	counter	YES	YES
		node_schedstat_waiting_seconds_total	Number of seconds spent by processing waiting for this CPU.	counter	YES	YES
	scrape	node_scrape_collector_duration_seconds	node_exporter: Duration of a collector scrape.	gauge	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_scrape_collector_success	node_exporter: Whether a collector succeeded.	gauge	YES	YES
	sockstat	node_sockstat_FRAG_inuse	Number of FRAG sockets in state inuse.	gauge	YES	YES
		node_sockstat_FRAG_memory	Number of FRAG sockets in state memory.	gauge	YES	YES
		node_sockstat_FRAG6_inuse	Number of FRAG6 sockets in state inuse.	gauge	YES	YES
		node_sockstat_FRAG6_memory	Number of FRAG6 sockets in state memory.	gauge	YES	YES
		node_sockstat_RAW_inuse	Number of RAW sockets in state inuse.	gauge	YES	YES
		node_sockstat_RAW6_inuse	Number of RAW6 sockets in state inuse.	gauge	YES	YES
		node_sockstat_sockets_used	Number of IPv4 sockets in use.	gauge	YES	YES
		node_sockstat_TCP_alloc	Number of TCP sockets in state alloc.	gauge	YES	YES
		node_sockstat_TCP_inuse	Number of TCP sockets in state inuse.	gauge	YES	YES
		node_sockstat_TCP_mem	Number of TCP sockets in state mem.	gauge	YES	YES
		node_sockstat_TCP_mem_bytes	Number of TCP sockets in state mem_bytes.	gauge	YES	YES
		node_sockstat_TCP_orphan	Number of TCP sockets in state orphan.	gauge	YES	YES
		node_sockstat_TCP_tw	Number of TCP sockets in state tw.	gauge	YES	YES
		node_sockstat_TCP6_inuse	Number of TCP6 sockets in state inuse.	gauge	YES	YES
		node_sockstat_UDP_inuse	Number of UDP sockets in state inuse.	gauge	YES	YES
		node_sockstat_UDP_mem	Number of UDP sockets in state mem.	gauge	YES	YES
		node_sockstat_UDP_mem_bytes	Number of UDP sockets in state mem_bytes.	gauge	YES	YES
		node_sockstat_UDP6_inuse	Number of UDP6 sockets in state inuse.	gauge	YES	YES
		node_sockstat_UDPLITE_inuse	Number of UDPLITE sockets in state inuse.	gauge	YES	YES
		node_sockstat_UDPLITE6_inuse	Number of UDPLITE6 sockets in state inuse.	gauge	YES	YES
	softnet	node_softnet_dropped_total	Number of dropped packets	counter	YES	YES
		node_softnet_processed_total	Number of processed packets	counter	YES	YES
		node_softnet_times_squeezed_total	Number of times processing packets ran out of quota	counter	YES	YES
	systemd	node_systemd_socket_accepted_connections_total	Total number of accepted socket connections	counter	NO	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_systemd_socket_current_connections	Current number of socket connections	gauge	NO	YES
		node_systemd_system_running	Whether the system is operational (see 'systemctl is-system-running')	gauge	NO	YES
		node_systemd_timer_last_trigger_seconds	Seconds since epoch of last trigger.	gauge	NO	YES
		node_systemd_unit_state	Systemd unit	gauge	NO	YES
		node_systemd_units	Summary of systemd unit states	gauge	NO	YES
		node_systemd_version	Detected systemd version	gauge	NO	YES
	textfile	node_textfile_scrape_error	1 if there was an error opening or reading a file, 0 otherwise	gauge	YES	YES
	thermal	node_thermal_zone_temp	Zone temperature in Celsius	gauge	YES	YES
	time	node_time_seconds	System time in seconds since epoch (1970).	gauge	YES	YES
	timex	node_timex_estimated_error_seconds	Estimated error in seconds.	gauge	YES	YES
		node_timex_frequency_adjustment_ratio	Local clock frequency adjustment.	gauge	YES	YES
		node_timex_loop_time_constant	Phase-locked loop time constant.	gauge	YES	YES
		node_timex_maxerror_seconds	Maximum error in seconds.	gauge	YES	YES
		node_timex_offset_seconds	Time offset in between local system and reference clock.	gauge	YES	YES
		node_timex_pps_calibration_total	Pulse per second count of calibration intervals.	counter	YES	YES
		node_timex_pps_error_total	Pulse per second count of calibration errors.	counter	YES	YES
		node_timex_pps_frequency_hertz	Pulse per second frequency.	gauge	YES	YES
		node_timex_pps_jitter_seconds	Pulse per second jitter.	gauge	YES	YES
		node_timex_pps_jitter_total	Pulse per second count of jitter limit exceeded events.	counter	YES	YES
		node_timex_pps_shift_seconds	Pulse per second interval duration.	gauge	YES	YES
		node_timex_pps_stability_exceeded_total	Pulse per second count of stability limit exceeded events.	counter	YES	YES
		node_timex_pps_stability_hertz	Pulse per second stability, average of recent frequency changes.	gauge	YES	YES
		node_timex_status	Value of the status array bits.	gauge	YES	YES
		node_timex_sync_status	Is clock synchronized to a reliable server (1 = yes, 0 = no).	gauge	YES	YES
		node_timex_tai_offset_seconds	International Atomic Time (TAI) offset.	gauge	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_timex_tick_seconds	Seconds between clock ticks.	gauge	YES	YES
	udp	node_udp_queues	Number of allocated memory in the kernel for UDP datagrams in bytes.	gauge	YES	YES
	uname	node_uname_info	Labeled system information as provided by the uname system call.	gauge	YES	YES
	vmstat	node_vmstat_oom_kill	/proc/vmstat information field oom_kill.	untyped	YES	YES
		node_vmstat_pgfault	/proc/vmstat information field pgfault.	untyped	YES	YES
		node_vmstat_pgmajfault	/proc/vmstat information field pgmajfault.	untyped	YES	YES
		node_vmstat_pgpgin	/proc/vmstat information field pgpgin.	untyped	YES	YES
		node_vmstat_pgpgout	/proc/vmstat information field pgpgout.	untyped	YES	YES
		node_vmstat_pswpin	/proc/vmstat information field pswpin.	untyped	YES	YES
		node_vmstat_pswpout	/proc/vmstat information field pswpout.	untyped	YES	YES
	xfs	node_xfs_allocation_btree_compares_total	Number of allocation B-tree compares for a filesystem.	counter	YES	YES
		node_xfs_allocation_btree_lookups_total	Number of allocation B-tree lookups for a filesystem.	counter	YES	YES
		node_xfs_allocation_btree_records_deleted_total	Number of allocation B-tree records deleted for a filesystem.	counter	YES	YES
		node_xfs_allocation_btree_records_inserted_total	Number of allocation B-tree records inserted for a filesystem.	counter	YES	YES
		node_xfs_block_map_btree_compares_total	Number of block map B-tree compares for a filesystem.	counter	YES	YES
		node_xfs_block_map_btree_lookups_total	Number of block map B-tree lookups for a filesystem.	counter	YES	YES
		node_xfs_block_map_btree_records_deleted_total	Number of block map B-tree records deleted for a filesystem.	counter	YES	YES
		node_xfs_block_map_btree_records_inserted_total	Number of block map B-tree records inserted for a filesystem.	counter	YES	YES
		node_xfs_block_mapping_extent_list_compares_total	Number of extent list compares for a filesystem.	counter	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_xfs_block_mapping_extent_list_deletions_total	Number of extent list deletions for a filesystem.	counter	YES	YES
		node_xfs_block_mapping_extent_list_insertions_total	Number of extent list insertions for a filesystem.	counter	YES	YES
		node_xfs_block_mapping_extent_list_lookups_total	Number of extent list lookups for a filesystem.	counter	YES	YES
		node_xfs_block_mapping_reads_total	Number of block map for read operations for a filesystem.	counter	YES	YES
		node_xfs_block_mapping_unmaps_total	Number of block unmaps (deletes) for a filesystem.	counter	YES	YES
		node_xfs_block_mapping_writes_total	Number of block map for write operations for a filesystem.	counter	YES	YES
		node_xfs_directory_operation_create_total	Number of times a new directory entry was created for a filesystem.	counter	YES	YES
		node_xfs_directory_operation_getdents_total	Number of times the directory getdents operation was performed for a filesystem.	counter	YES	YES
		node_xfs_directory_operation_lookup_total	Number of file name directory lookups which miss the operating systems directory name lookup cache.	counter	YES	YES
		node_xfs_directory_operation_remove_total	Number of times an existing directory entry was created for a filesystem.	counter	YES	YES
		node_xfs_extent_allocation_blocks_allocated_total	Number of blocks allocated for a filesystem.	counter	YES	YES
		node_xfs_extent_allocation_blocks_freed_total	Number of blocks freed for a filesystem.	counter	YES	YES
		node_xfs_extent_allocation_extents_allocated_total	Number of extents allocated for a filesystem.	counter	YES	YES
		node_xfs_extent_allocation_extents_freed_total	Number of extents freed for a filesystem.	counter	YES	YES
		node_xfs_read_calls_total	Number of read(2) system calls made to files in a filesystem.	counter	YES	YES
		node_xfs_vnode_active_total	Number of vnodes not on free lists for a filesystem.	counter	YES	YES
		node_xfs_vnode_allocate_total	Number of times vn_alloc called for a filesystem.	counter	YES	YES

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type	r3.0.1	r3.0.2
		node_xfs_vnode_get_total	Number of times vn_get called for a filesystem.	counter	YES	YES
		node_xfs_vnode_hold_total	Number of times vn_hold called for a filesystem.	counter	YES	YES
		node_xfs_vnode_reclaim_total	Number of times vn_reclaim called for a filesystem.	counter	YES	YES
		node_xfs_vnode_release_total	Number of times vn_rele called for a filesystem.	counter	YES	YES
		node_xfs_vnode_remove_total	Number of times vn_remove called for a filesystem.	counter	YES	YES
		node_xfs_write_calls_total	Number of write(2) system calls made to files in a filesystem.	counter	YES	YES

Appendix – Prometheus Server Node Metrics - Updated

CONNECT WITH US

Call +1.800.ORACLE1 or visit oracle.com.
Outside North America, find your local office at oracle.com/contact.

blogs.oracle.com facebook.com/oracle twitter.com/oracle

Monitoring & Alerting Capabilities in an Oracle Private Cloud Appliance X9-2
March 2323
Author: Stephen Dennis