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Observability, Monitoring and Alerting Across Multiple Oracle Private Cloud Appliance X9-2 System–Part 2

A step-by-step guide to creating variable-driven Grafana dashboards within an external Grafana Server service for multiple Oracle Private Cloud Appliance X9-2 systems

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Purpose statement

This document outlines how to extend the capabilities of an external Grafana Server service, providing a single, central, and common monitoring and alerting framework for multiple Oracle Private Cloud Appliance X9-2 systems, by creating variable-driven Grafana dashboards.

It is intended solely to help you assess the business benefits of using such an approach and to plan your information technology projects accordingly.

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Introduction

Oracle Private Cloud Appliance (PCA) is an Oracle Cloud Infrastructure (OCI)-compatible Engineered System, providing a fast and efficient infrastructure for modern software and business applications. Oracle Private Cloud Appliance has the same infrastructure constructs with APIs and SDKs compatible with OCI. This enables customers to adopt a “develop once, deploy anywhere” approach to rapidly design and develop high-performance applications and middleware.

Advantages of Oracle Private Cloud Appliance

Oracle Private Cloud Appliance (PCA) is an Oracle Engineered System designed for implementing the application and middleware tiers. PCA is an integrated hardware and software system that reduces infrastructure complexity and deployment time for virtualized workloads in private clouds. It is a complete platform for a wide range of application types and workloads, with built-in management, compute, storage, and networking resources. PCA provides excellent performance and other system properties for hosting a broad range of applications.

Oracle Private Cloud Appliance X9-2 is the latest member of the Oracle Private Cloud Appliance product family. PCA provides cloud and administrative services for a supporting range of workloads including cloud native applications. It makes use of a modern microservices architecture, Kubernetes, and related technologies, for a future-proofed software stack.

A key new feature of Oracle Private Cloud Appliance X9-2, compared to previous versions, is that it delivers private cloud infrastructure and architecture consistent with Oracle Cloud Infrastructure (OCI). Oracle Private Cloud Appliance brings APIs and SDKs compatible with Oracle Cloud Infrastructure (OCI) to an on-premises implementation at rack scale, making workloads, user experience, tool sets and skills portable between private and public clouds. Oracle Private Cloud Appliance can be paired with Oracle Exadata to create an ideal infrastructure for scalable, multitier applications. Customers preferring or requiring an on-premises solution can realize the operational benefits of public cloud deployments using Oracle Private Cloud Appliance X9-2.

Scope and content

This document builds upon the “Observability, Monitoring and Alerting Across Multiple Oracle Private Cloud Appliance X9-2 Systems—Part 1” technical brief document . It is recommended that you have read the contents of this document prior to reading this second technical brief.

This document provides a step-by-step guide on the construction of an example variable-driven Grafana Dashboard delivering observability, monitoring, and alerting capabilities for multiple Oracle Private Cloud Appliance X9-2 systems within a single dashboard.

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Monitoring and Alerting on Oracle Private Cloud Appliance X9-2

Oracle Private Cloud Appliance X9-2 provides monitoring and alerting capabilities through an integrated Grafana service. For customers with multiple Oracle Private Cloud Appliance X9-2 racks, the technical brief document noted above outlined how this capability can be further expanded through a single, centralized, external Grafana instance that can monitor multiple systems.

Creating a single, common, Grafana Dashboard, using variables to select specific Oracle Private Cloud Appliance X9-2 systems, can provide observability for a single "Service Type" across all available systems.

This document will outline an example Grafana dashboard capable of providing such a feature.

Prerequisites & Assumptions

The following prerequisites and assumptions are required to follow the step-by-step guide within this document.

Prerequisites

The availability of an existing external Grafana Server service, running Grafana v9, or above, is a mandatory requirement to follow the steps outlined within this document.

If this service is not available, please refer to the "Observability, Monitoring and Alerting Across Multiple Oracle Private Cloud Appliance X9-2 Systems—Part 1" technical brief document for details on how to provide such a capability.

Assumptions

It is assumed that the external Grafana Server service has been already configured with a minimum of ONE Oracle Private Cloud Appliance X9-2 system as a Prometheus data source.

For the purposes of this document, it is assumed that two Oracle Private Cloud Appliance X9-2 Prometheus data sources are available, labelled as:

- PCA01
- PCA02

As before, if this service is not available, please refer to the "Observability, Monitoring and Alerting Across Multiple Oracle Private Cloud Appliance X9-2 Systems—Part 1" technical brief document for details on how to provide such a capability.

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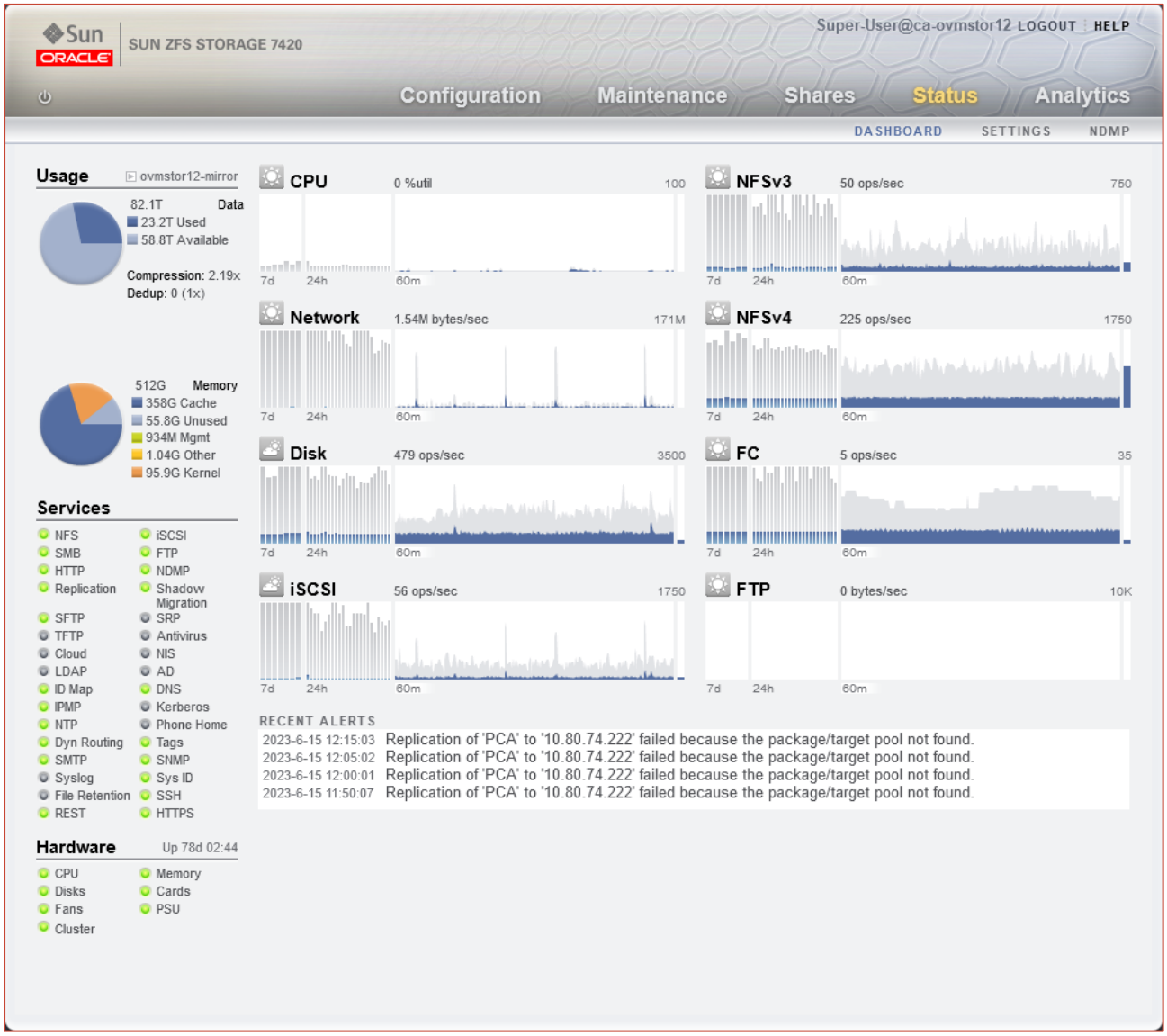
Background

With a working external Grafana Server service and several Oracle Private Cloud Appliance X9-2 Dashboards imported for each system being monitored, it is time to look at creating new dashboards which can provide views into multiple PCA X9-2 systems by changing the dashboard data source from a dashboard variable drop down menu.

Target Grafana Dashboard

For this example, a new Grafana Dashboard will be created to emulate the standard Oracle ZFS Storage Appliance (ZFSSA) Status page.

Many storage administrators are familiar with the ZFSSA Status page within the ZFSSA BUI interface:



Background – ZFS Storage Appliance Status screen

This provides, in a single screen, key information concerning the status and performance of an Oracle ZFS Storage Appliance.

Within the PCA X9-2, a Grafana Dashboard is available for displaying information concerning the internal ZFS Storage Appliance ZS9-2, but the scope and level of detail is somewhat limited:

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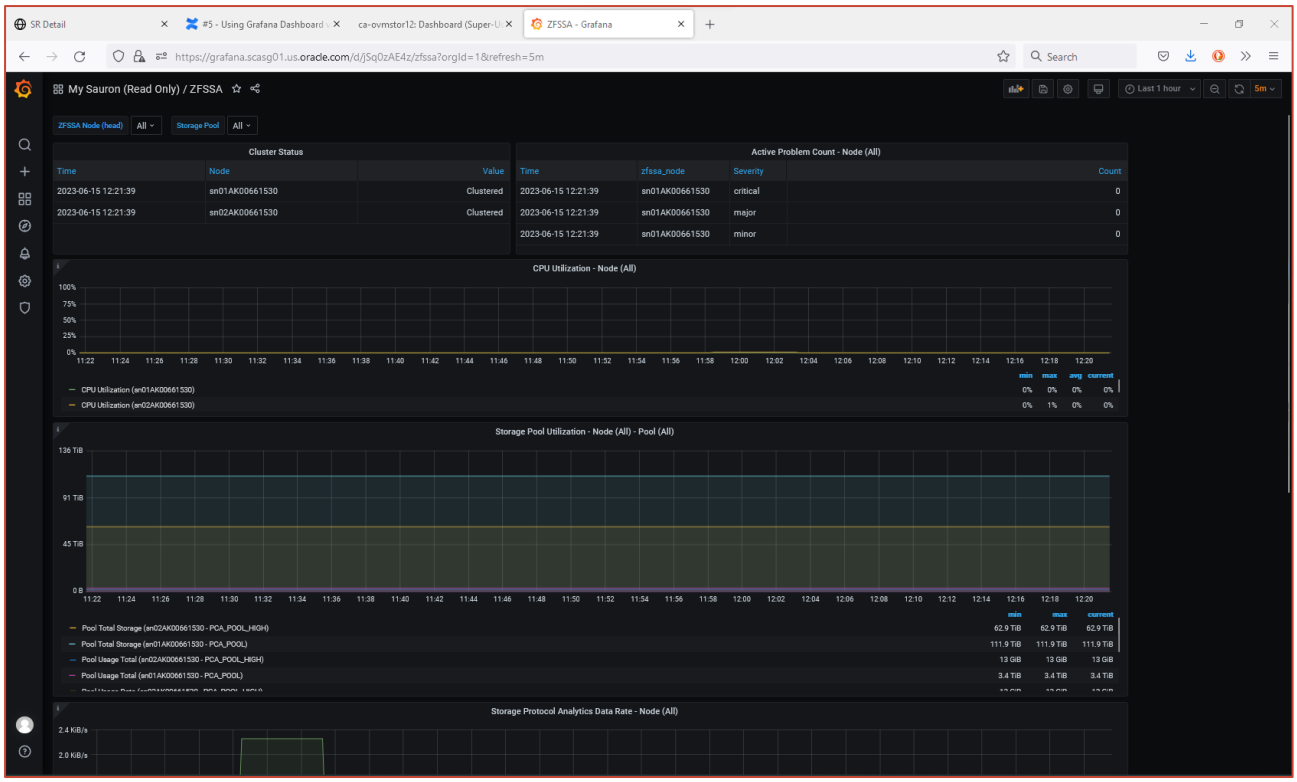

Background – PCA X9-2 ZFSSA Grafana Dashboard

By using Grafana Dashboard variables, an emulation of this more familiar ZFS Storage Appliance Status screen will be attempted.

Available ZFS Storage Appliance Metrics

The PCA X9-2's internal Prometheus service collects a subset of the standard ZFS Analytics Metrics. The table below shows the current metrics being collected:

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

Metric Series	Metric Category	Metric Name	Metric Description	Metric Type
zfssa	active	zfssa_active_problem_count	ZFSSA active problem count by severity	untyped
	analytics	zfssa_analytics_arc_accesses_hit_miss	Current Value of Dataset arc.accesses[hit/miss]	untyped
		zfssa_analytics_arc_hitratio	Current Value of Dataset arc.hitratio	untyped
		zfssa_analytics_arc_size	Current Value of Dataset arc.size	untyped
		zfssa_analytics_arc_size_component	Current Value of Dataset arc.size[component]	untyped
		zfssa_analytics_cap_bytesused_pool	Current Value of Dataset cap.bytesused[pool]	untyped
		zfssa_analytics_cap_percentused_pool	Current Value of Dataset cap.percentused[pool]	untyped
		zfssa_analytics_cpu_utilization	Current Value of Dataset cpu.utilization	untyped
		zfssa_analytics_dnlc_accesses_hit_miss	Current Value of Dataset dnlc.accesses[hit/miss]	untyped
		zfssa_analytics_ftp_kilobytes	Current Value of Dataset ftp.kilobytes	untyped
		zfssa_analytics_http_reqs	Current Value of Dataset http.reqs	untyped
		zfssa_analytics_io_bytes	Current Value of Dataset io.bytes	untyped
		zfssa_analytics_io_bytes_op	Current Value of Dataset io.bytes[op]	untyped
		zfssa_analytics_io_ops	Current Value of Dataset io.ops	untyped

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Metric Series	Metric Category	Metric Name	Metric Description	Metric Type
		zfssa_analytics_io_ops_disk	Current Value of Dataset io.ops[disk]	untyped
		zfssa_analytics_io_ops_op	Current Value of Dataset io.ops[op]	untyped
		zfssa_analytics_iscsi_bytes	Current Value of Dataset iscsi.bytes	untyped
		zfssa_analytics_iscsi_ops	Current Value of Dataset iscsi.ops	untyped
		zfssa_analytics_net_kilobytes_interface	Current Value of Dataset net.kilobytes[interface]	untyped
		zfssa_analytics_nfs3_bytes	Current Value of Dataset nfs3.bytes	untyped
		zfssa_analytics_nfs3_ops	Current Value of Dataset nfs3.ops	untyped
		zfssa_analytics_nfs4_1_bytes	Current Value of Dataset nfs4-1.bytes	untyped
		zfssa_analytics_nfs4_1_ops	Current Value of Dataset nfs4-1.ops	untyped
		zfssa_analytics_nfs4_bytes	Current Value of Dataset nfs4.bytes	untyped
		zfssa_analytics_nfs4_ops	Current Value of Dataset nfs4.ops	untyped
		zfssa_analytics_nfs4_ops_op	Current Value of Dataset nfs4.ops[op]	untyped
		zfssa_analytics_nic_kilobytes	Current Value of Dataset nic.kilobytes	untyped
		zfssa_analytics_nic_kilobytes_device	Current Value of Dataset nic.kilobytes[device]	untyped
		zfssa_analytics_nic_kilobytes_direction	Current Value of Dataset nic.kilobytes[direction]	untyped
		zfssa_analytics_sftp_kilobytes	Current Value of Dataset sftp.kilobytes	untyped
		zfssa_analytics_smb_ops	Current Value of Dataset smb.ops	untyped
		zfssa_analytics_smb2_ops	Current Value of Dataset smb2.ops	untyped
		zfssa_analytics_smb3_ops	Current Value of Dataset smb3.ops	untyped
	cluster	zfssa_cluster_state	ZFSSA Cluster State (0 – not responsive, 1 – clustered, 2 – owner, -1 – stripped, -2 – other)	untyped
	filesystem	zfssa_filesystem_exported	ZFSSA Filesystem Exported (0 – not exported, 1 – exported)	untyped
		zfssa_filesystem_reservation	ZFSSA Filesystem Reservation	untyped
		zfssa_filesystem_usage_available	ZFSSA Filesystem Usage Available	untyped
		zfssa_filesystem_usage_data	ZFSSA Filesystem Usage from Data	untyped
		zfssa_filesystem_usage_quota	ZFSSA Filesystem Usage Quota)	untyped
		zfssa_filesystem_usage_snapshots	ZFSSA Filesystem Snapshot Usage	untyped
		zfssa_filesystem_usage_total	ZFSSA Filesystem Usage Total)	untyped
	lun	zfssa_lun_exported	ZFSSA Lun Exported (0 – not exported, 1 – exported)	untyped
		zfssa_lun_usage_available	ZFSSA Lun Usage Available	untyped
		zfssa_lun_usage_data	ZFSSA Lun Usage from Data (note that LUN usage is allocated bytes, applications may interpret differently)	untyped
		zfssa_lun_usage_snapshots	ZFSSA Lun Snapshot Usage (outside of LUN volsize)	untyped
		zfssa_lun_usage_total	ZFSSA LUN Usage Total (volsize plus additional storage like snapshots)	untyped
		zfssa_lun_volsize	ZFSSA Volume Size	untyped
	pool	zfssa_pool_free	ZFSSA Pool Free	untyped

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Metric Series	Metric Category	Metric Name	Metric Description	Metric Type
		zfssa_pool_status	ZFSSA Pool Status (0 – exported, 1 – degraded, 2 – online,-1 – offline, -2 – faulted, -3 – unavail, -4 – removed)	untyped
		zfssa_pool_total	ZFSSA Pool Total	untyped
		zfssa_pool_usage_child_reservation	ZFSSA Pool Reservation from Children	untyped
		zfssa_pool_usage_data	ZFSSA Pool Usage from Data	untyped
		zfssa_pool_usage_replication	ZFSSA Pool Replication Usage	untyped
		zfssa_pool_usage_reservation	ZFSSA Pool Reservation	untyped
		zfssa_pool_usage_snapshots	ZFSSA Pool Snapshot Usage	untyped
		zfssa_pool_usage_total	ZFSSA Pool Usage Total	untyped
		zfssa_pool_used	ZFSSA Pool Used	untyped

Background – Prometheus ZFS Storage Appliance Metrics

These represent the metrics available from which to construct the new ZFS Storage Appliance Status Screen.

Several of the required metrics are not present. The following metric types are currently uncollected:

- ZFS Storage Appliance Controller Memory Utilization
- ZFS Storage Appliance Service Status
- ZFS Storage Appliance Hardware Status

Where possible, alternative sources for these metric series will be utilized.

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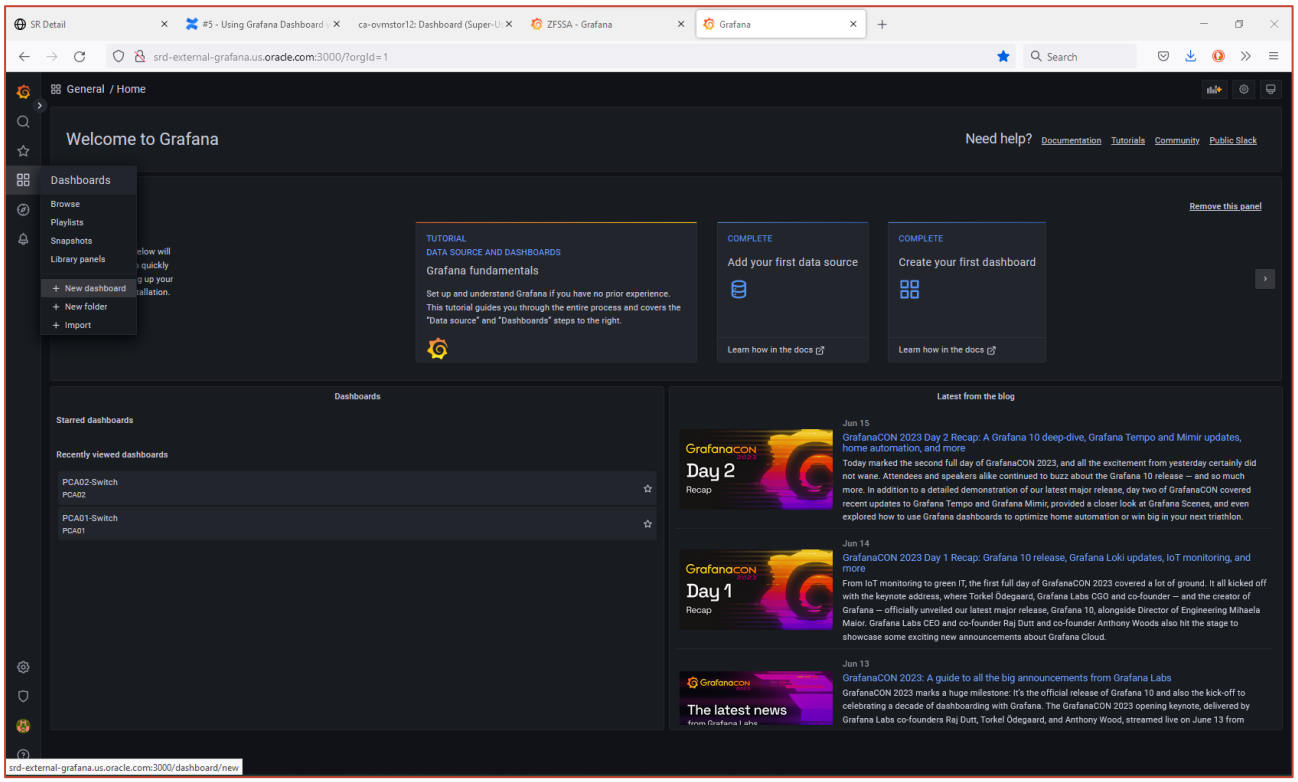
Dashboard Construction

The following sections will outline the steps required to produce this new variable-driven Grafana Dashboard.

The definitive source for information on the use of Grafana and Prometheus as the data source, remains with the Documentation Libraries provided by each vendor. URL links to the relevant documentation will be provided at the end of this section.

Base Dashboard

From the Grafana Server home page, create a new Dashboard within the General Folder:



Dashboard Construction – Create New Dashboard

This will display the New Dashboard screen ready for the first panel to be added:

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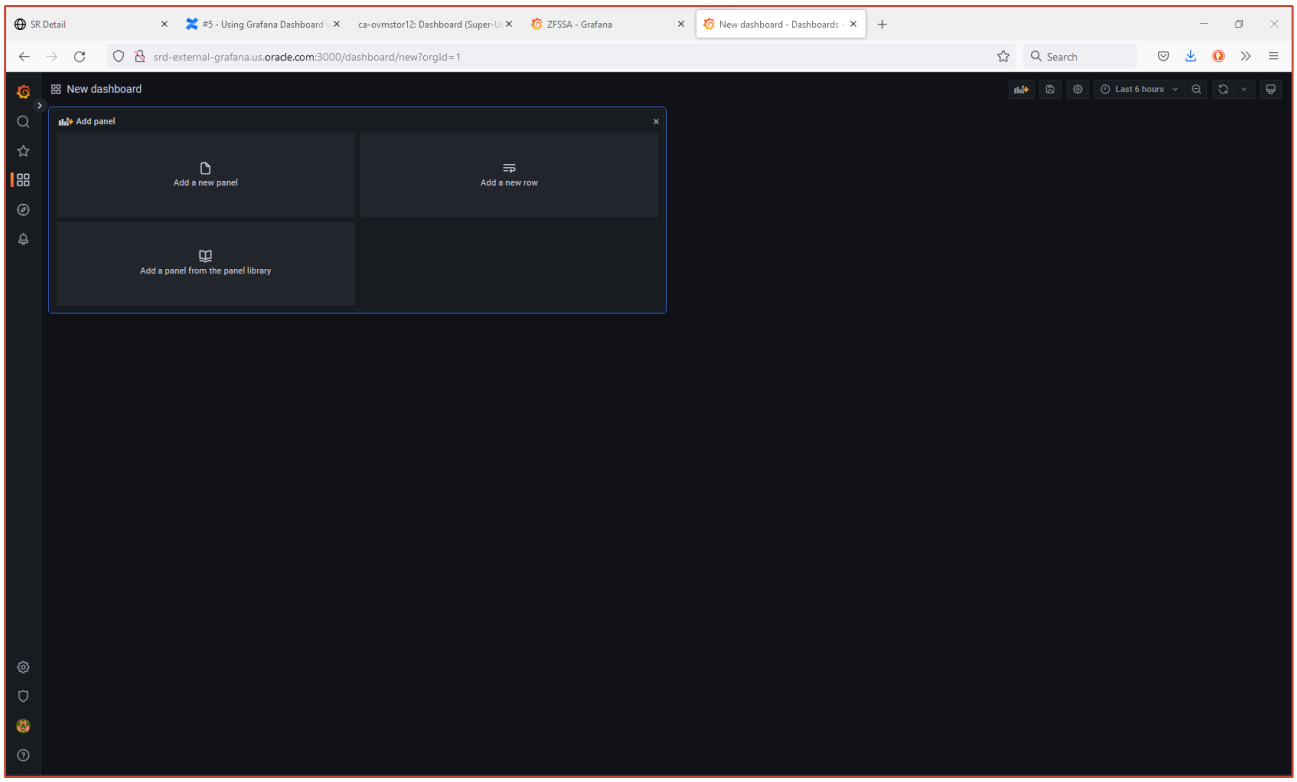
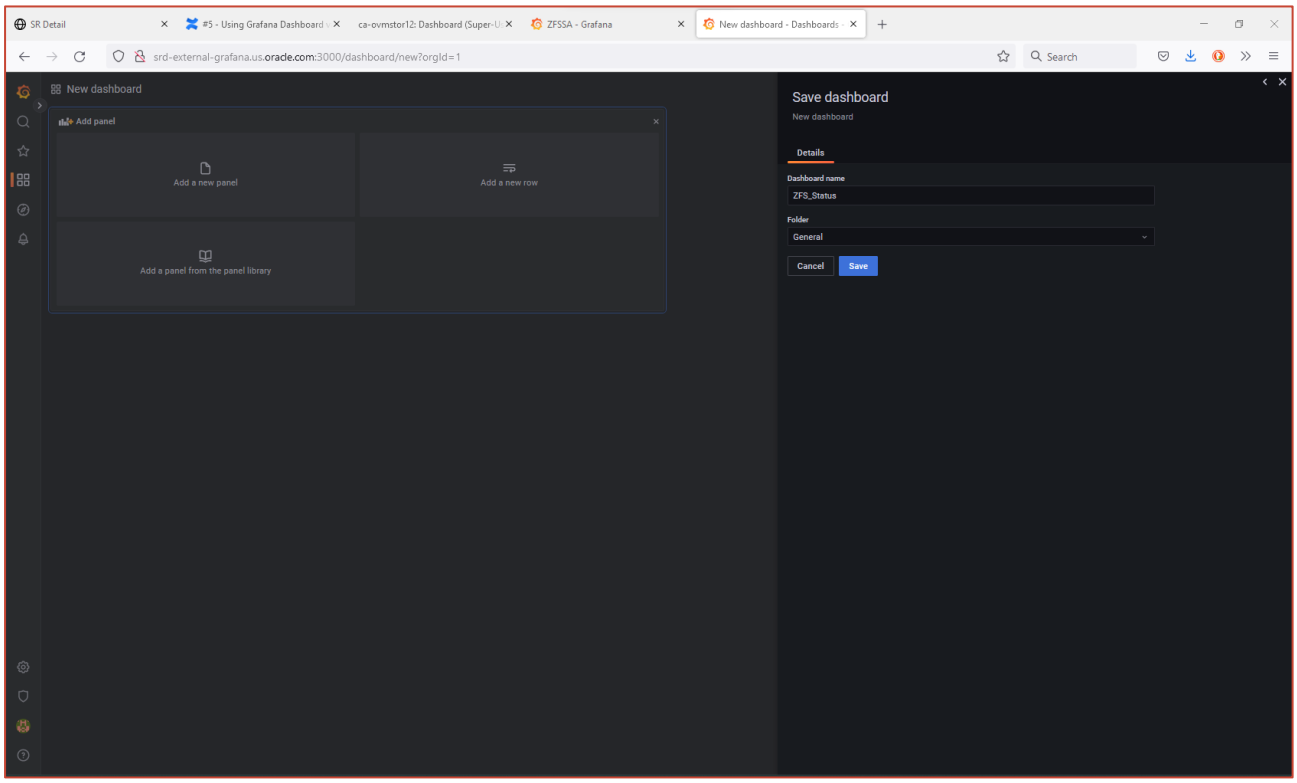


Dashboard Construction – Empty Dashboard

Before creating any content, save the New Dashboard. In this case, the new dashboard is being saved with the name 'ZFS_Status' and into the General folder:



Dashboard Construction – Saved Base Dashboard

The base Grafana Dashboard to be used within this step-by-step guide is now ready for the creation of dashboard-specific variables.

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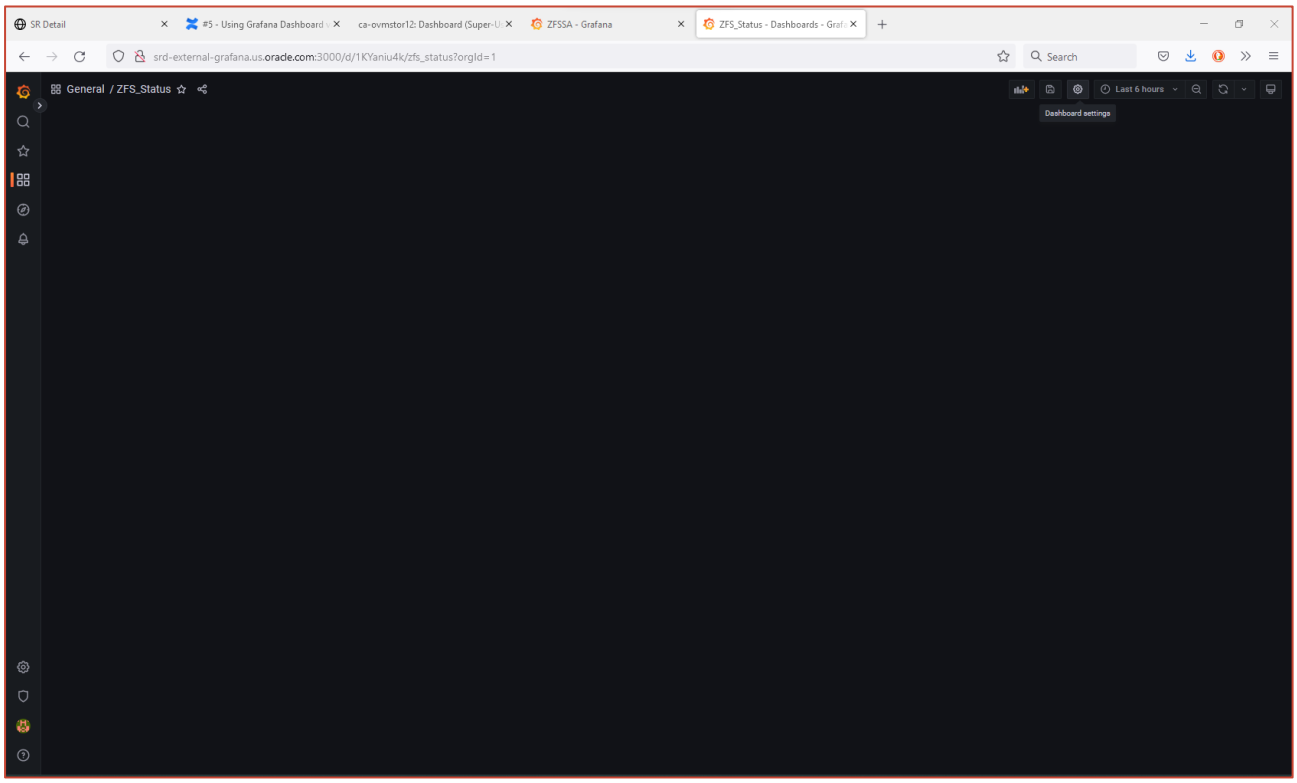
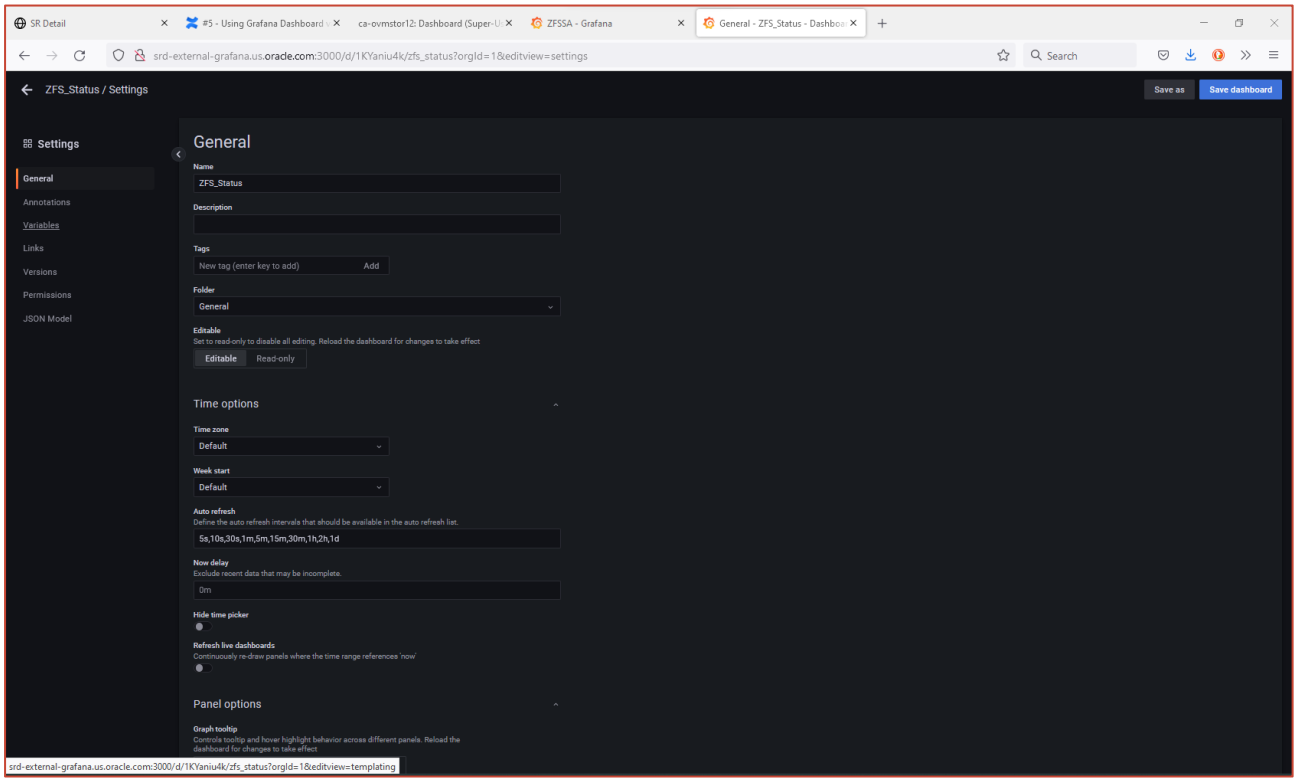
Variable Creation

To create dashboard variables, go to the Dashboard Settings:



Dashboard Construction – Dashboard Settings

The General Setting screen is shown:



Dashboard Construction – General Settings

Select the Variables option from the list on the left-hand side, and an option to create a new variable is shown:

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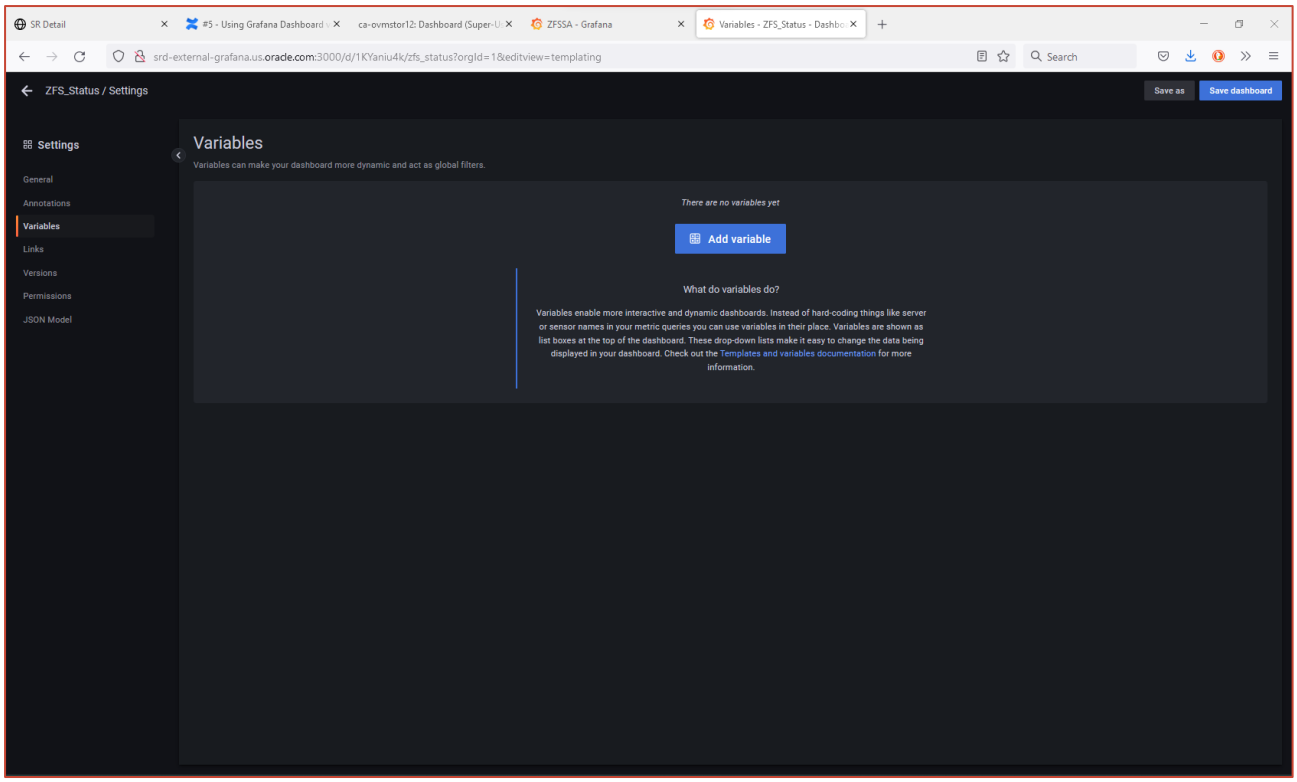
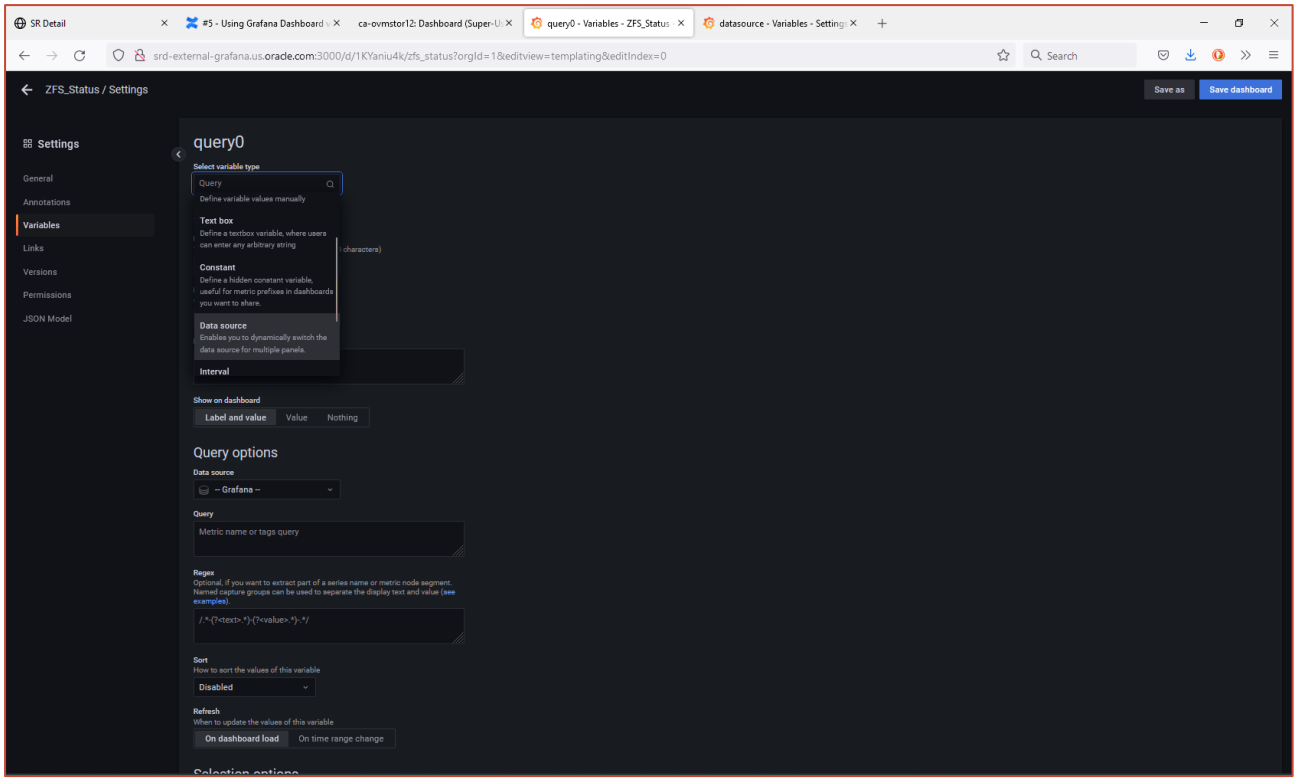


Dashboard Construction – Add Variable

A new variable of type 'Data source' is required:



Dashboard Construction – Add Data Source Variable

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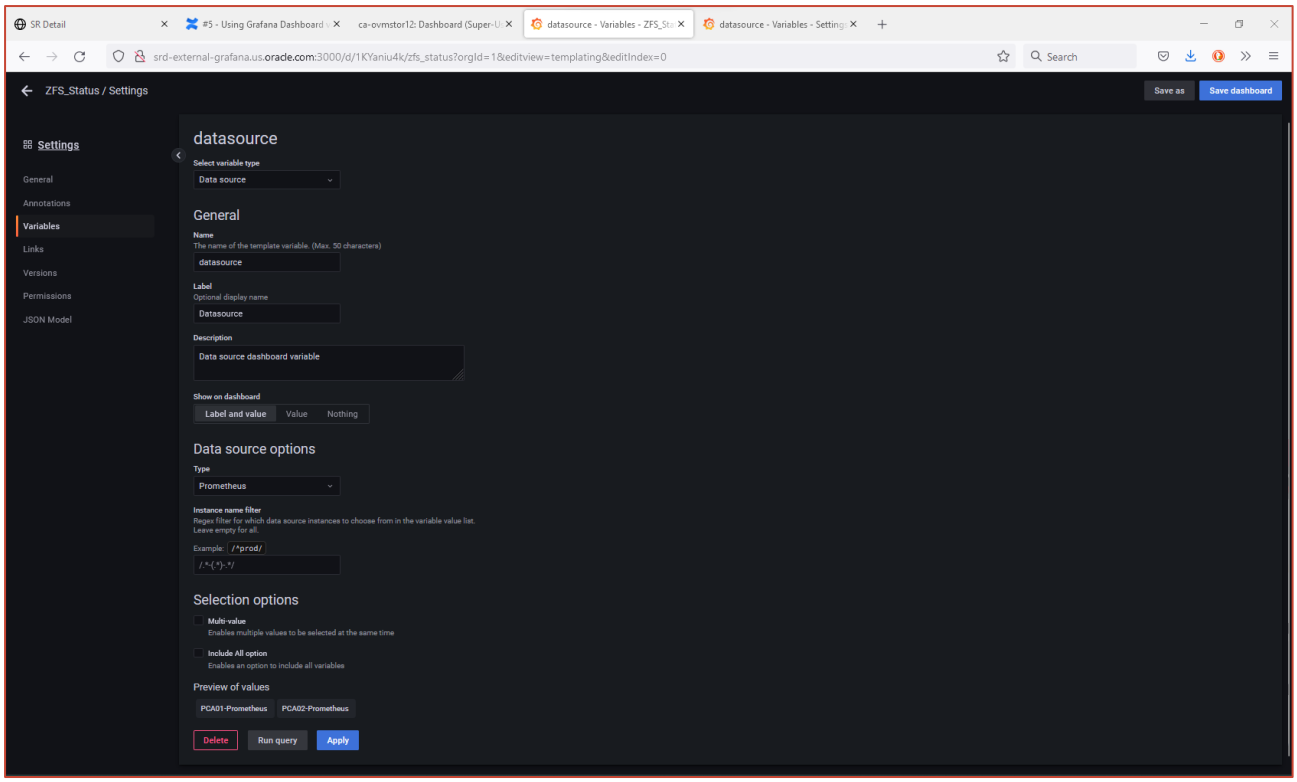

Dashboard Construction – Populated Data Source Variable

Note some of the values used:

- Variable Type: Data sources
- Name: datasource
- Label: Datasource
- Data source type: Prometheus

The preview of the values this variable can use are previewed. Now apply to save this variable:

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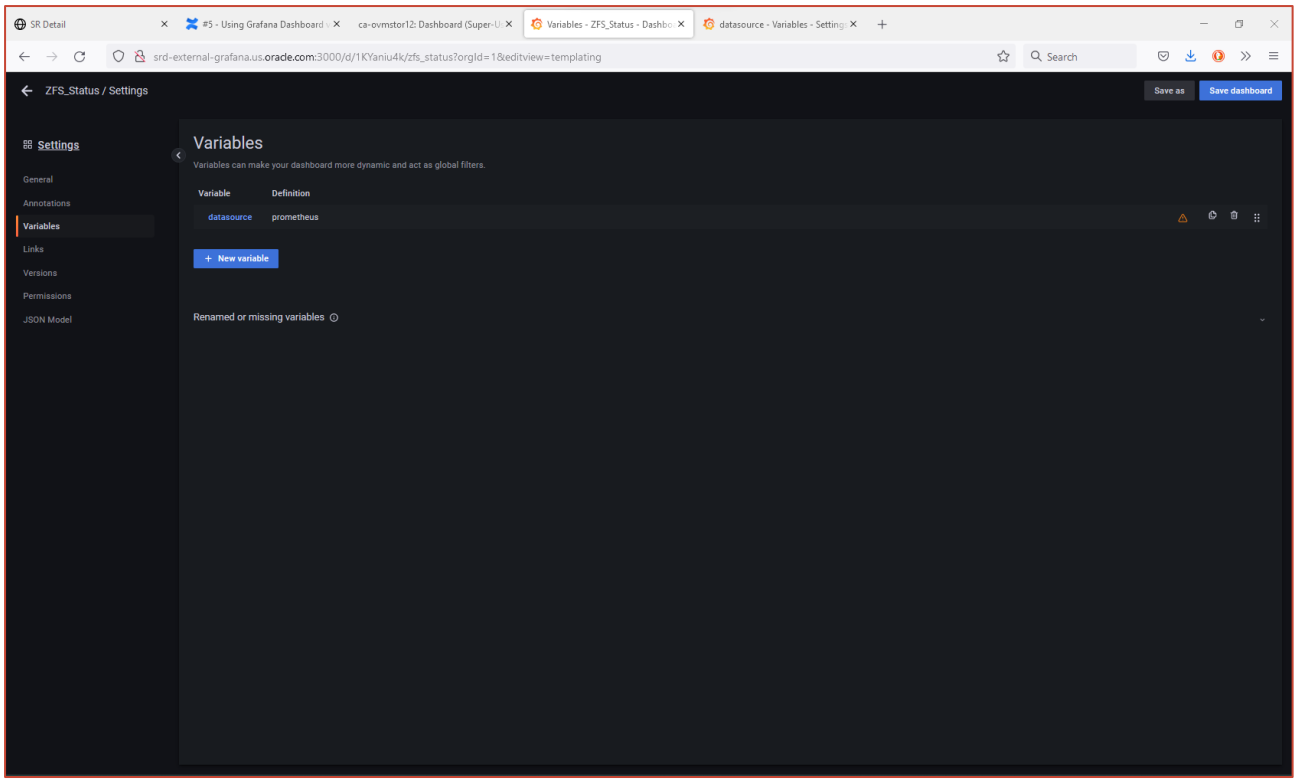
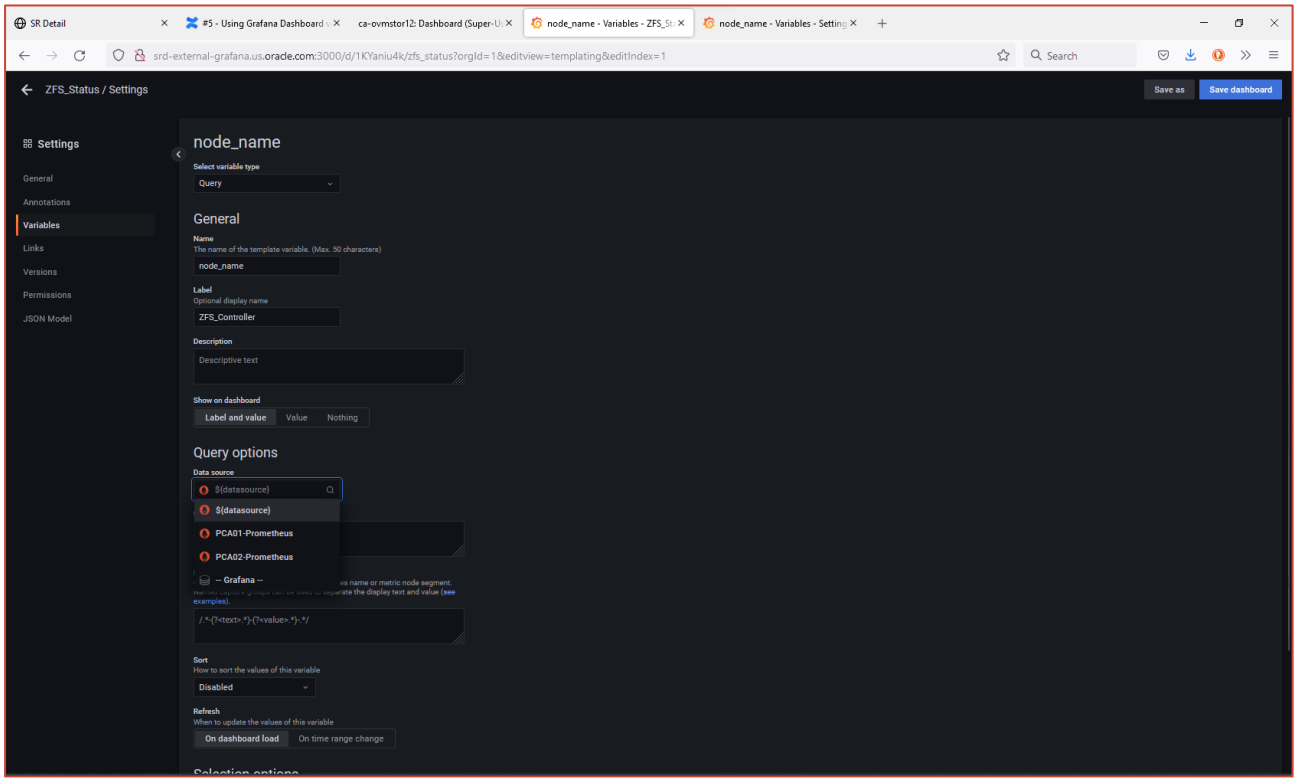


Dashboard Construction – Saved Data Source variable

There is now a working variable called 'datasource' available for use within this Grafana Dashboard.

A second variable is now required:



Dashboard Construction – Data source drop-down

This time, the variable is a query called 'node_name'. Notice how there is now a THIRD data source option available, '${datasource}'. This is from the first variable created.

The following screenshot shows the remaining values used to create the 'node_name' variable:

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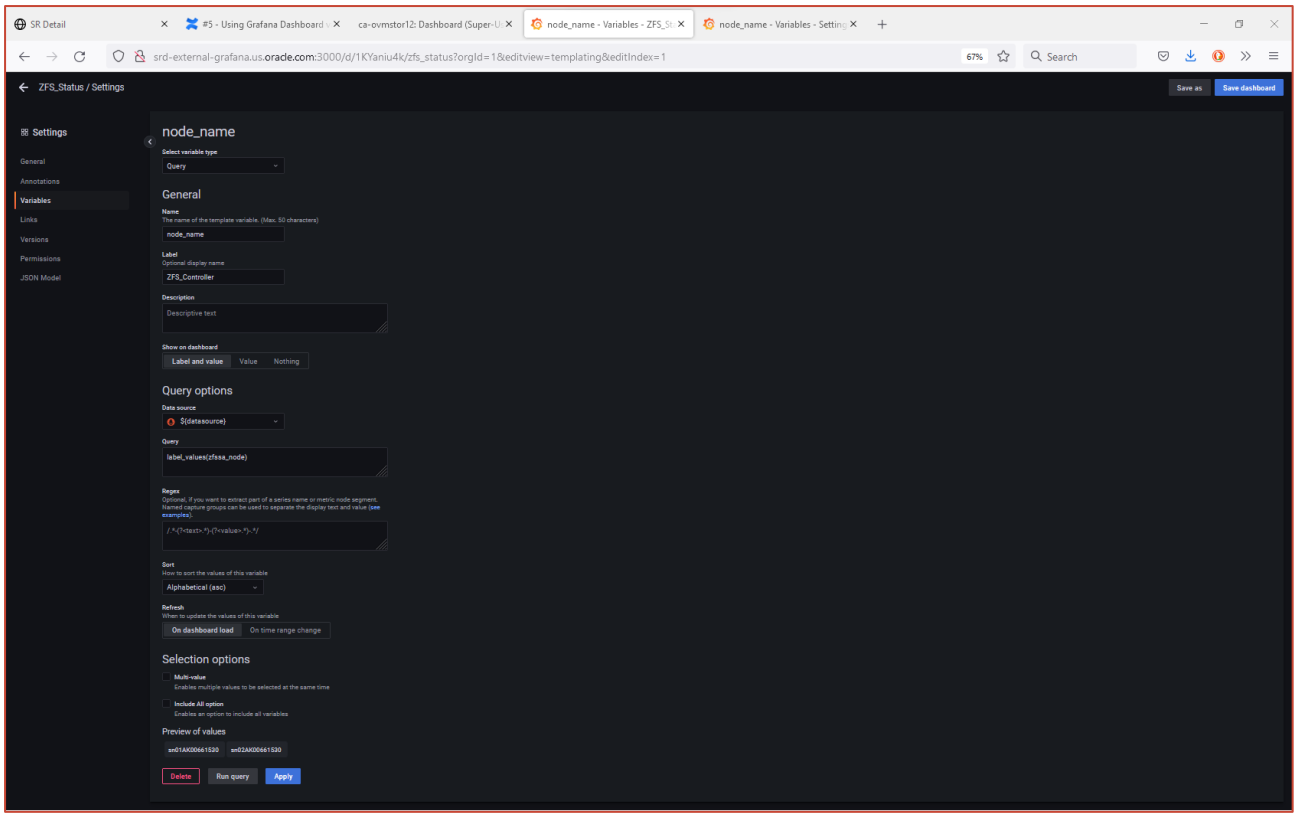
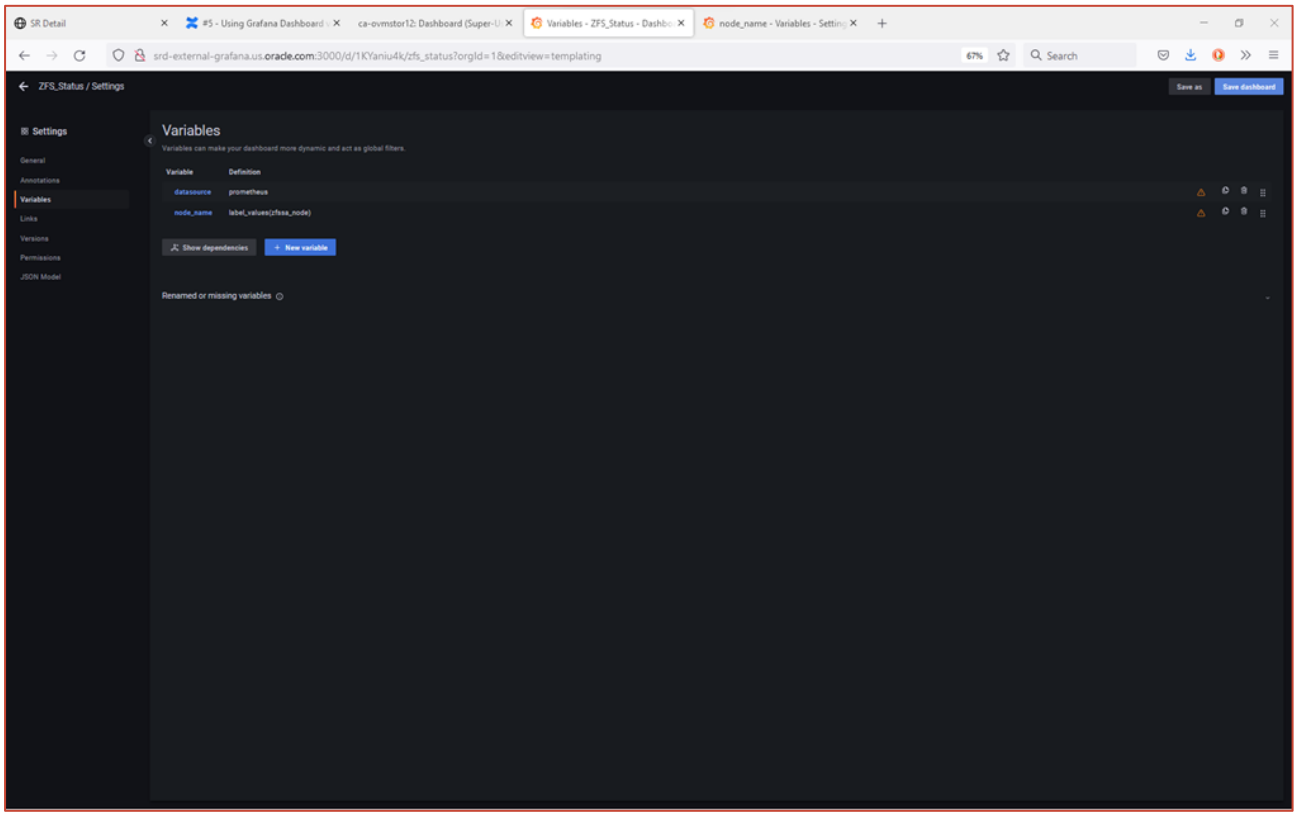


Dashboard Construction – Node Name Variable

Take note of the Prometheus query 'label_values(zfssa_node)' used to find the unique ZFS Controller names for any given Prometheus data source, in this case, PCA01.

After applying the variable definitions and saving, we now see both variables available within this dashboard.



Dashboard Construction – Two Variables

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Having completed these initial preparation activities, it now time to save the changes and start populating the dashboard with working panels.

This completes this section of the step-by-step guide.

Section References

The following URL's provide links to additional documentation:

- Oracle Private Cloud Appliance X9-2 -Status & Health Monitoring – https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/3.0-latest/admin/admin-adm-healthmonitor.html#adm-health-grafana
- Grafana Documentation Library – https://grafana.com/docs/grafana/latest/
- Grafana Data Source documentation – https://grafana.com/docs/grafana/latest/datasources/
- Grafana Dashboard Documentation – https://grafana.com/docs/grafana/latest/dashboards/
- Grafana Panels and Visualizations – https://grafana.com/docs/grafana/latest/panels-visualizations/
- Grafana Variables – https://grafana.com/docs/grafana/latest/dashboards/variables/
- Prometheus Querying – https://prometheus.io/docs/prometheus/latest/querying/basics/
- Prometheus PromQL 'Cheat Sheet' – https://promlabs.com/promql-cheat-sheet/

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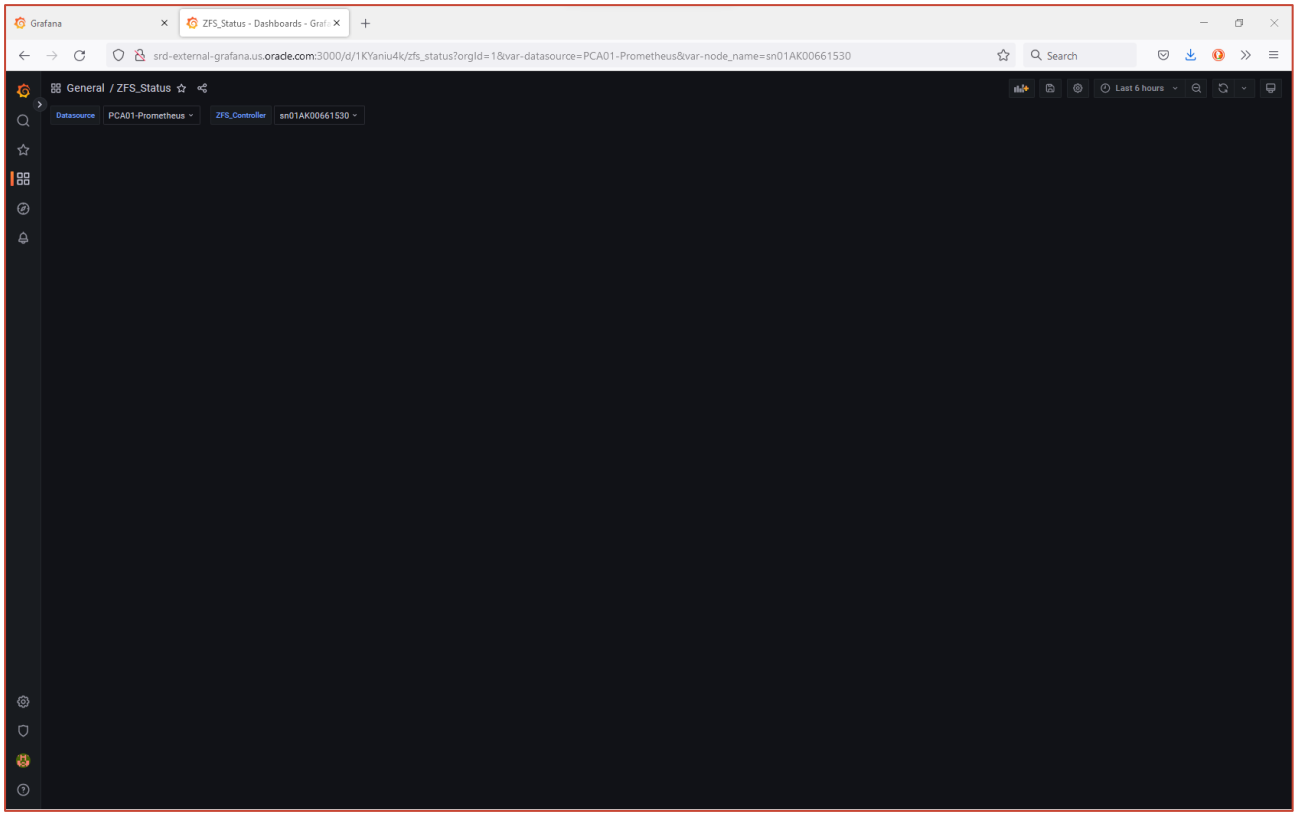
Dashboard Basic Layout

Having created an empty, variable-driven Grafana Dashboard, it is now time to start to populate this dashboard with Rows, to separate the displayed data and Panels, displaying any required metrics, from the Oracle Private Cloud Appliance X9-2 systems available as datasources.

The screen shot below shows the previously empty ZFS_Status dashboard now having two drop-down lists available for the variables created above:



Dashboard Basic Layout – Available Variables

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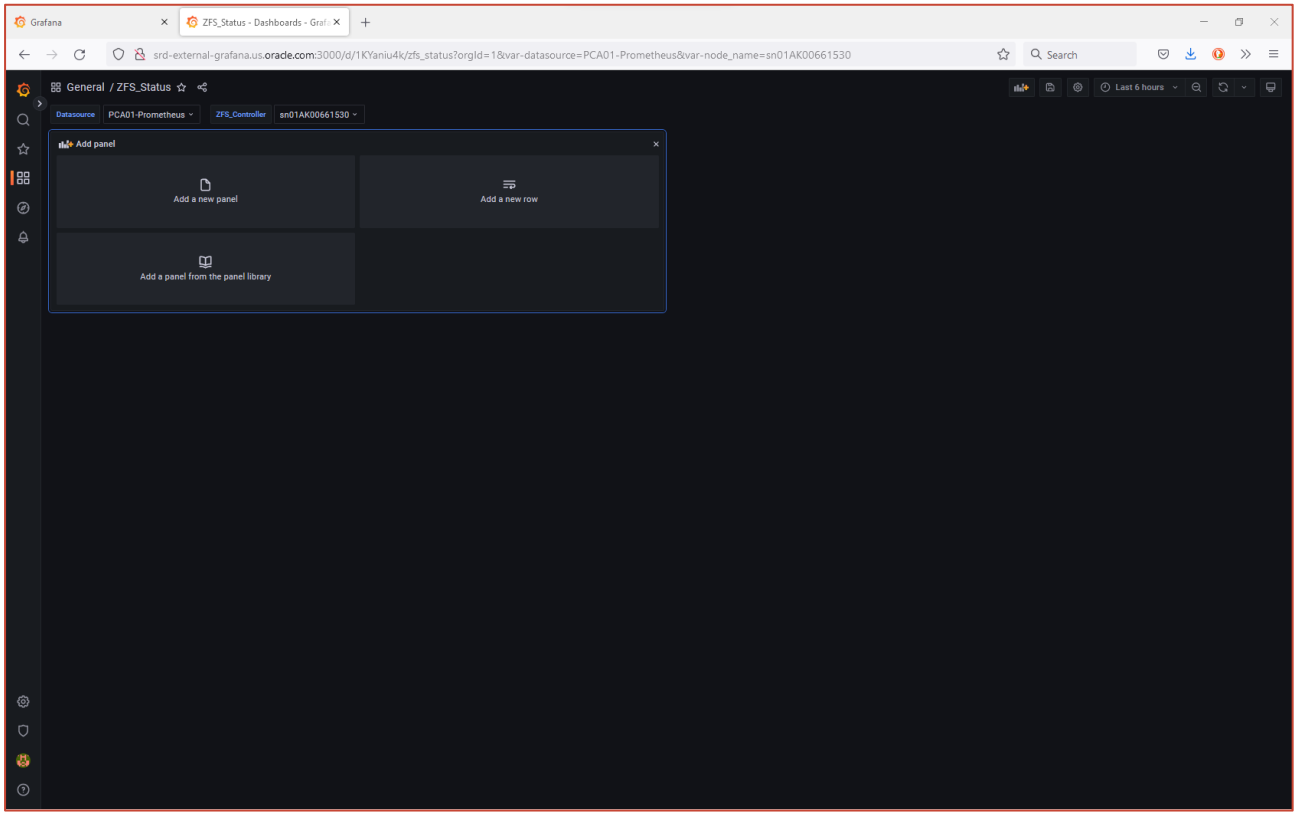
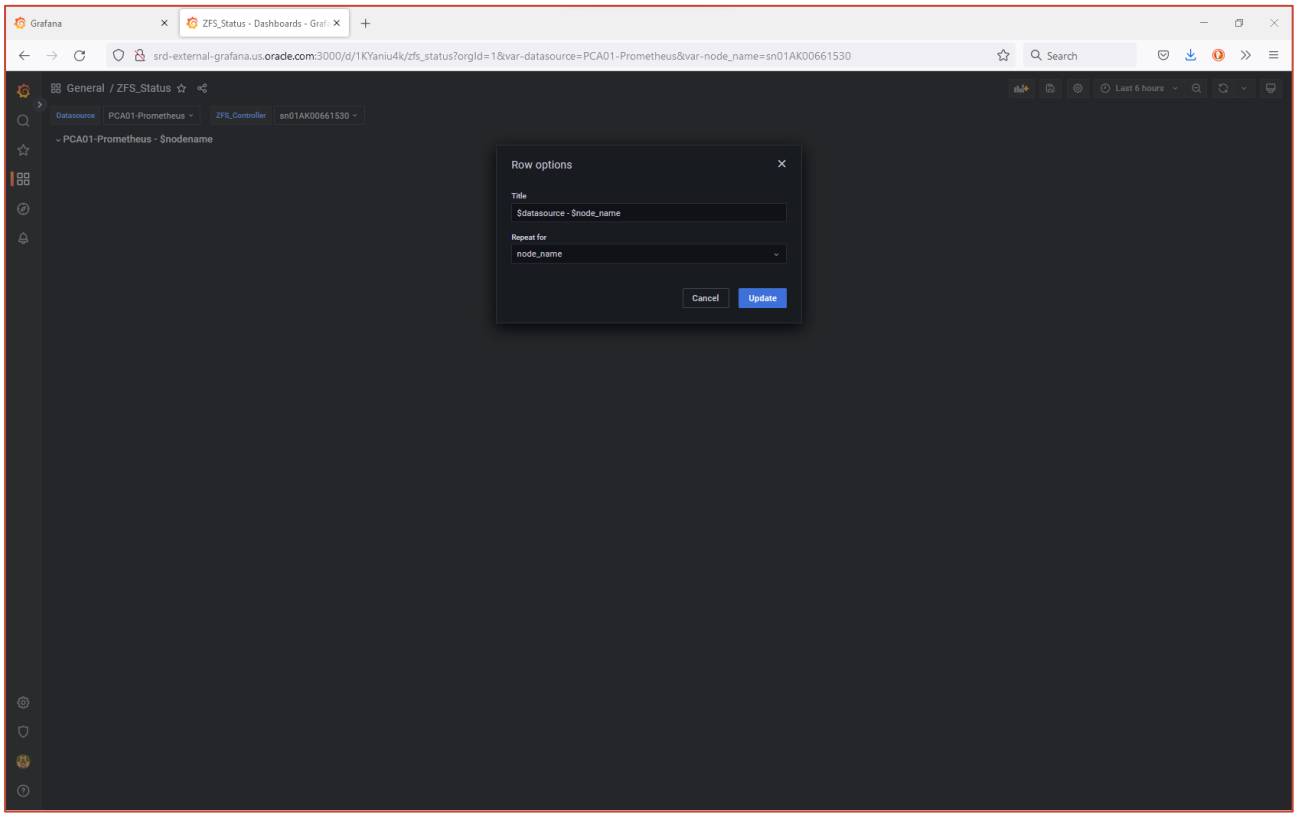
First, add a new Row. This is a special type of Dashboard component that separates panels into groups within each row boundary:



Dashboard Basic Layout – Add Row

Immediately edit the Row and provide the Title and Repeat for options as shown below:



Dashboard Basic Layout – Edit Row

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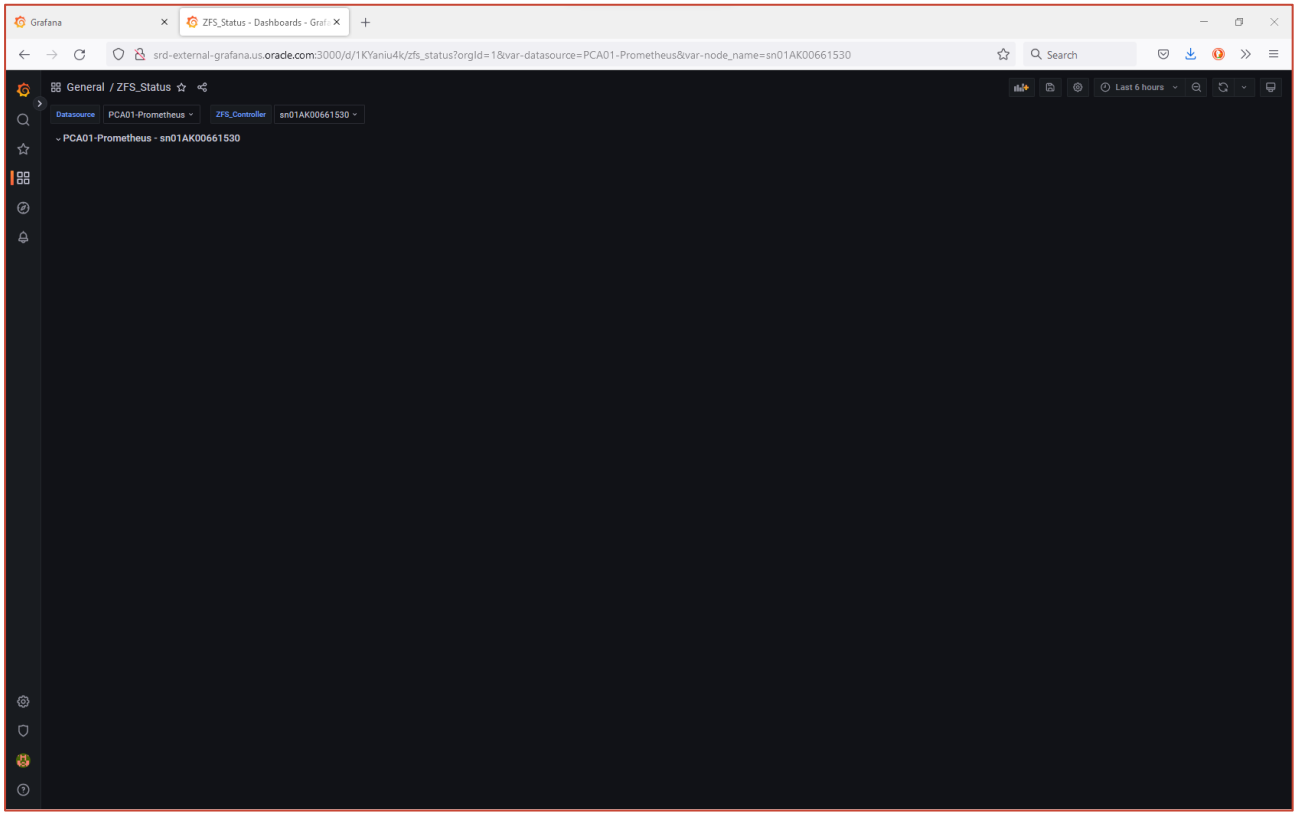
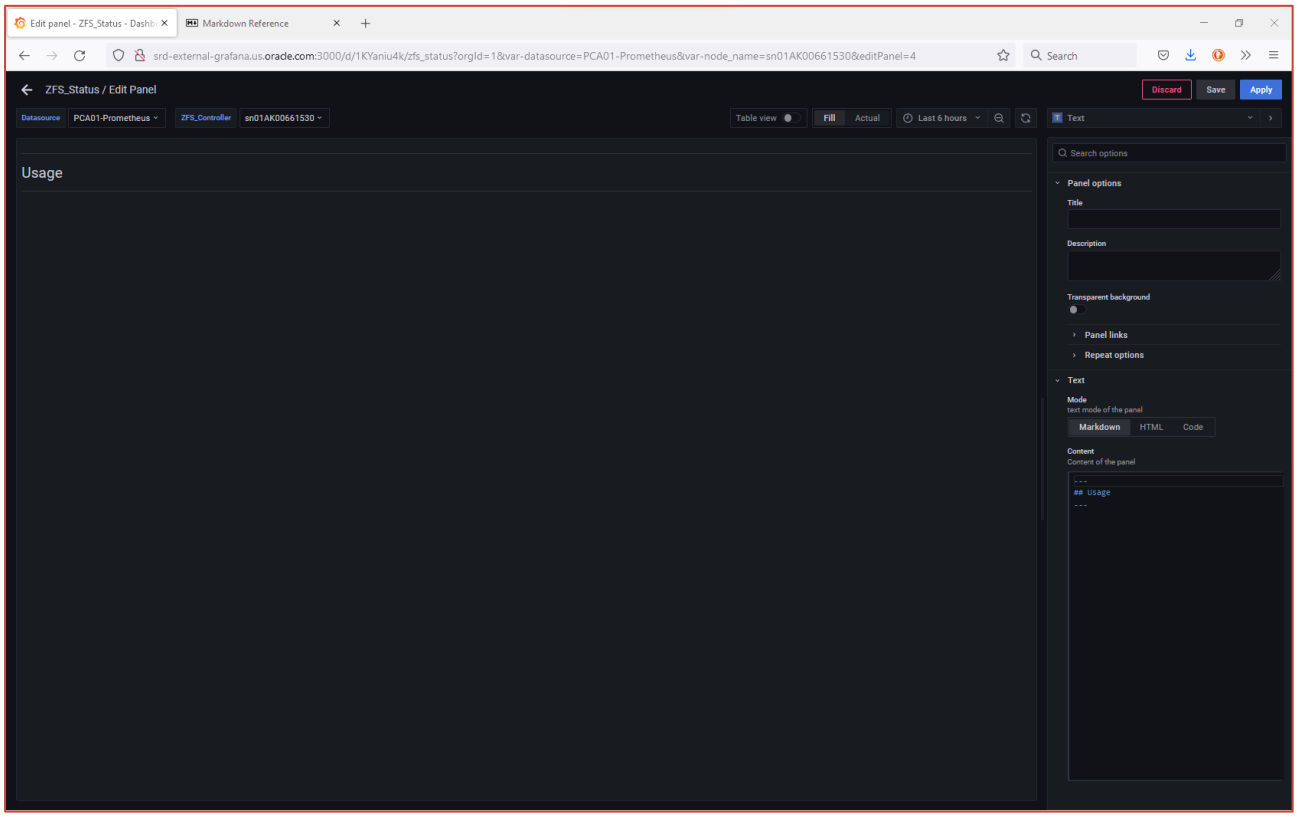
The Row Name is now specific to the selected Datasource and ZFS _Controller values selected from the variable drop down lists:



Dashboard Basic Layout – Row label using variables

Now to create the first Dashboard Panel:



Dashboard Basic Layout – Add Text Panel

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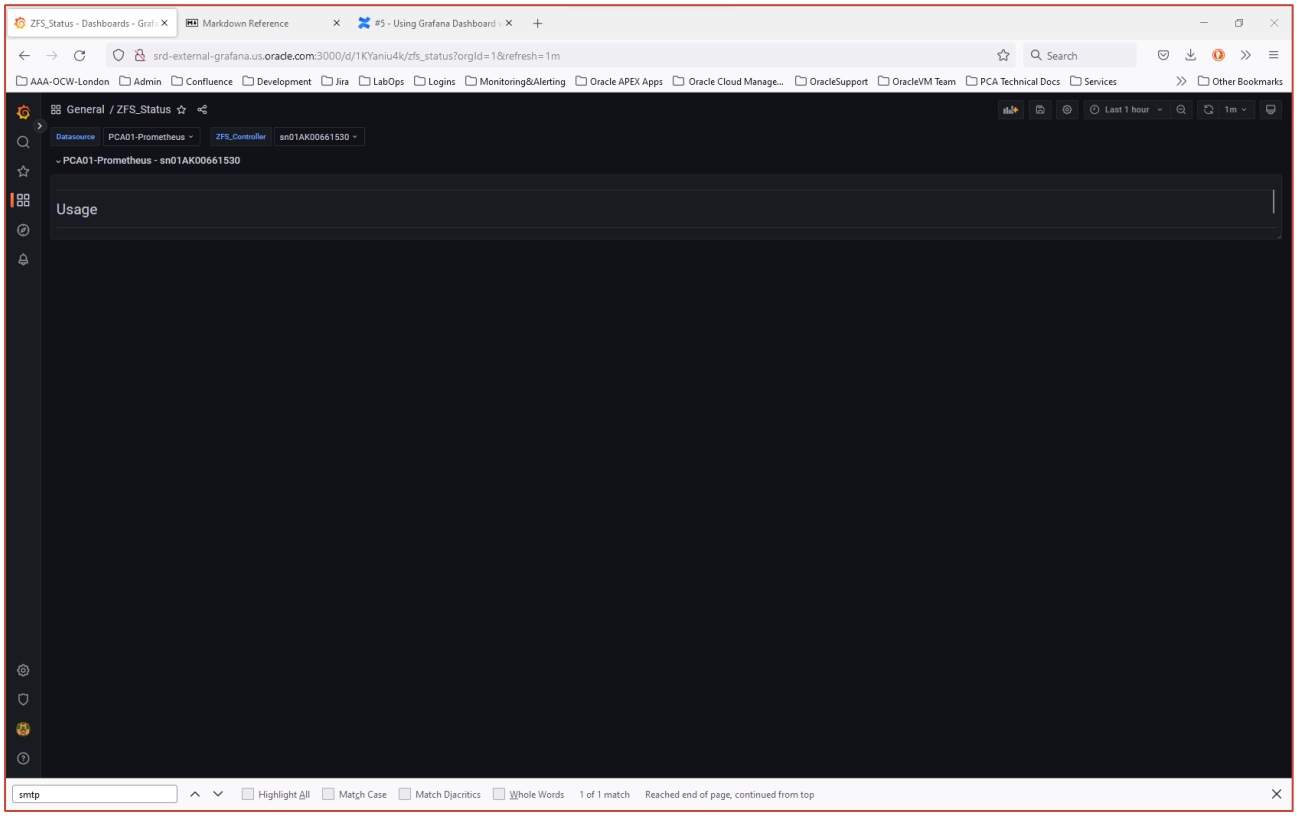
This needs to be positioned *BELOW* the Row Header and have the following characteristics:

Visualization Type: Text

- Title: NULL
- Content: '---<CR>## Usage<CR>---'
- Now Apply the changes.

The following screen will be displayed:



Dashboard Basic Layout – First Text Panel

There is now a Text based panel below the Row Header to act as a separator between the multiple panels to be created later.

Before the next steps, there is an edit to be made to 'node_name,' the variable created previously. Access the variable (Dashboard Settings → Variables → variable) and check the 'Include All' option. See below for a screen shot of this setting:

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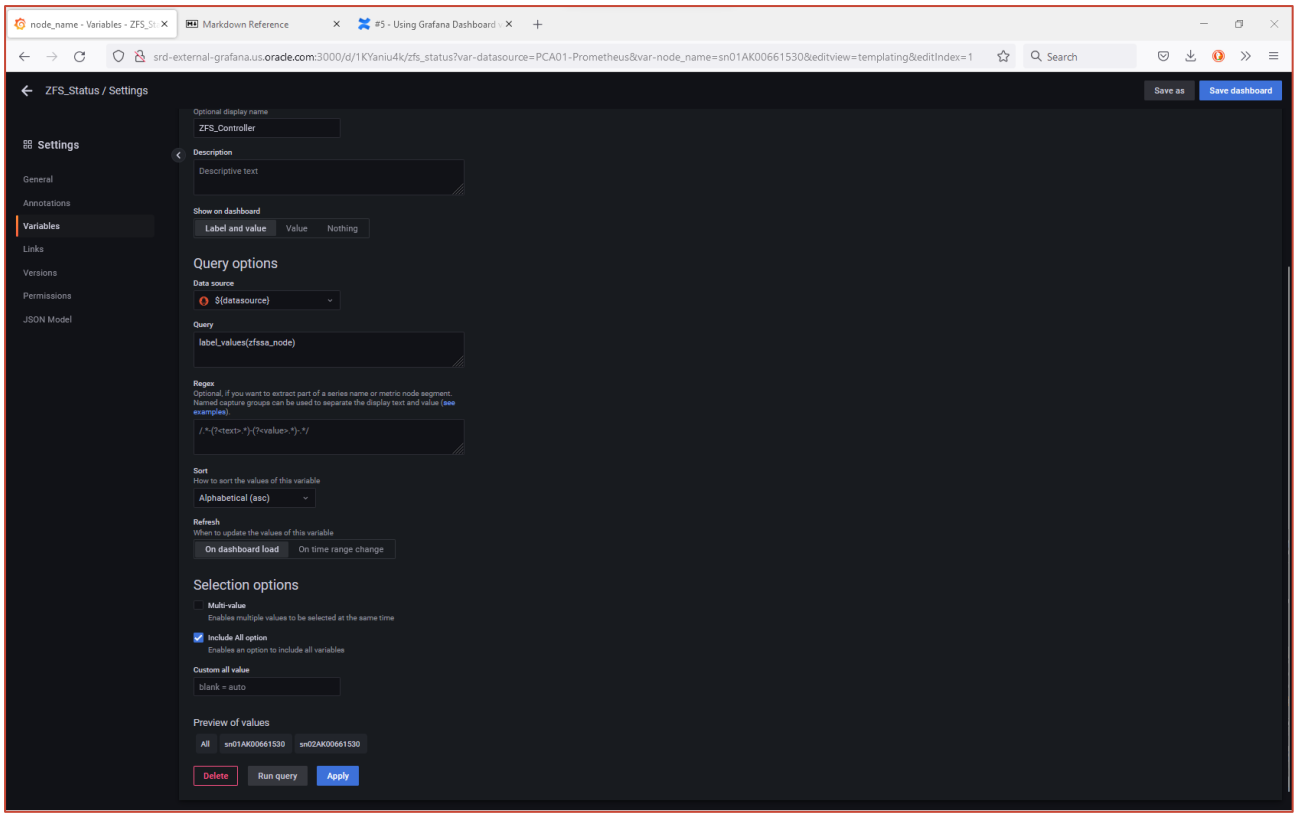
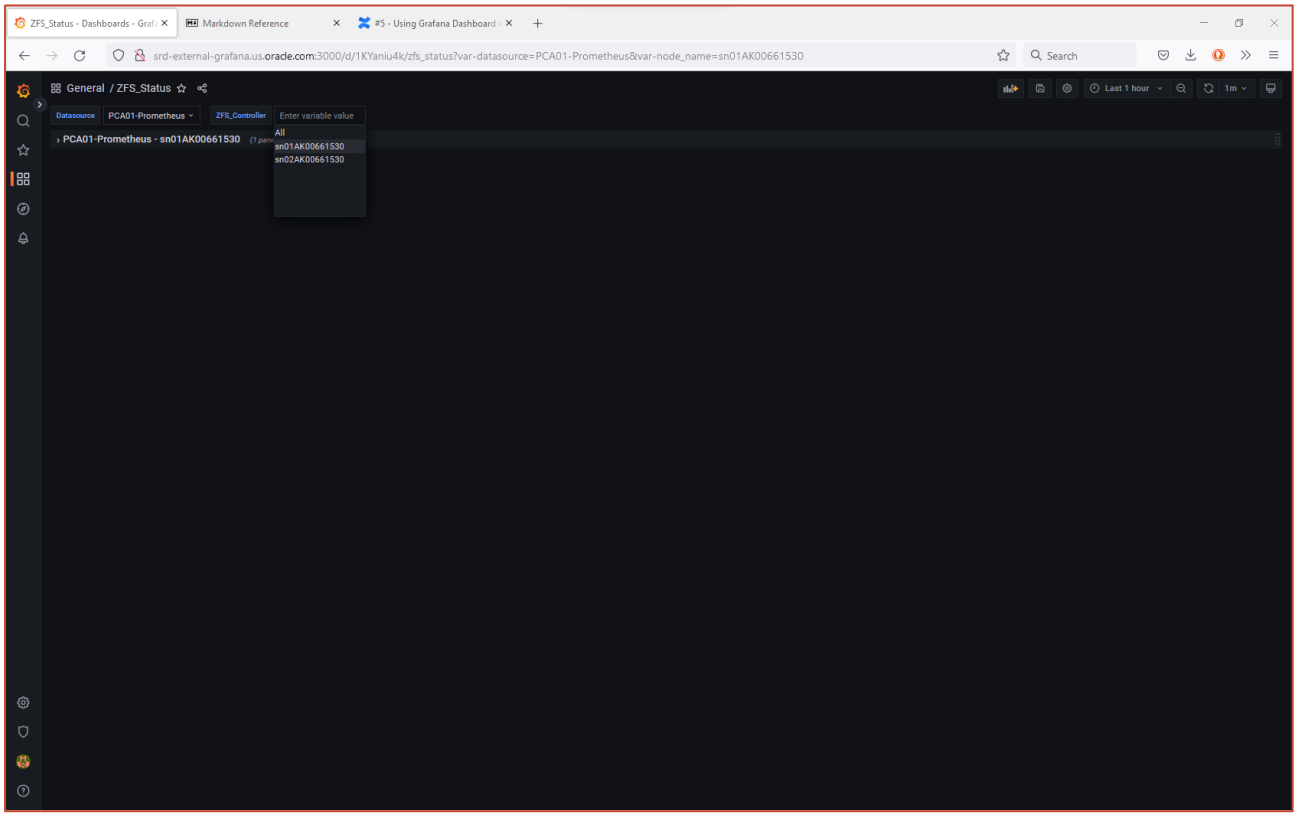


Dashboard Basic Layout – Add 'ALL' option to Node Name variable

Click Apply, Save the Dashboard, and return to the Dashboard page. Nothing immediately obvious appears to have changed. But when selecting the ZFS_Controller variable, there is now an option to use 'All' values:



Dashboard Basic Layout – Selecting 'All' Node Names

Now select 'All' for the ZFS_Controller and the Dashboard will now display two Row Headings each with its own Text Box:

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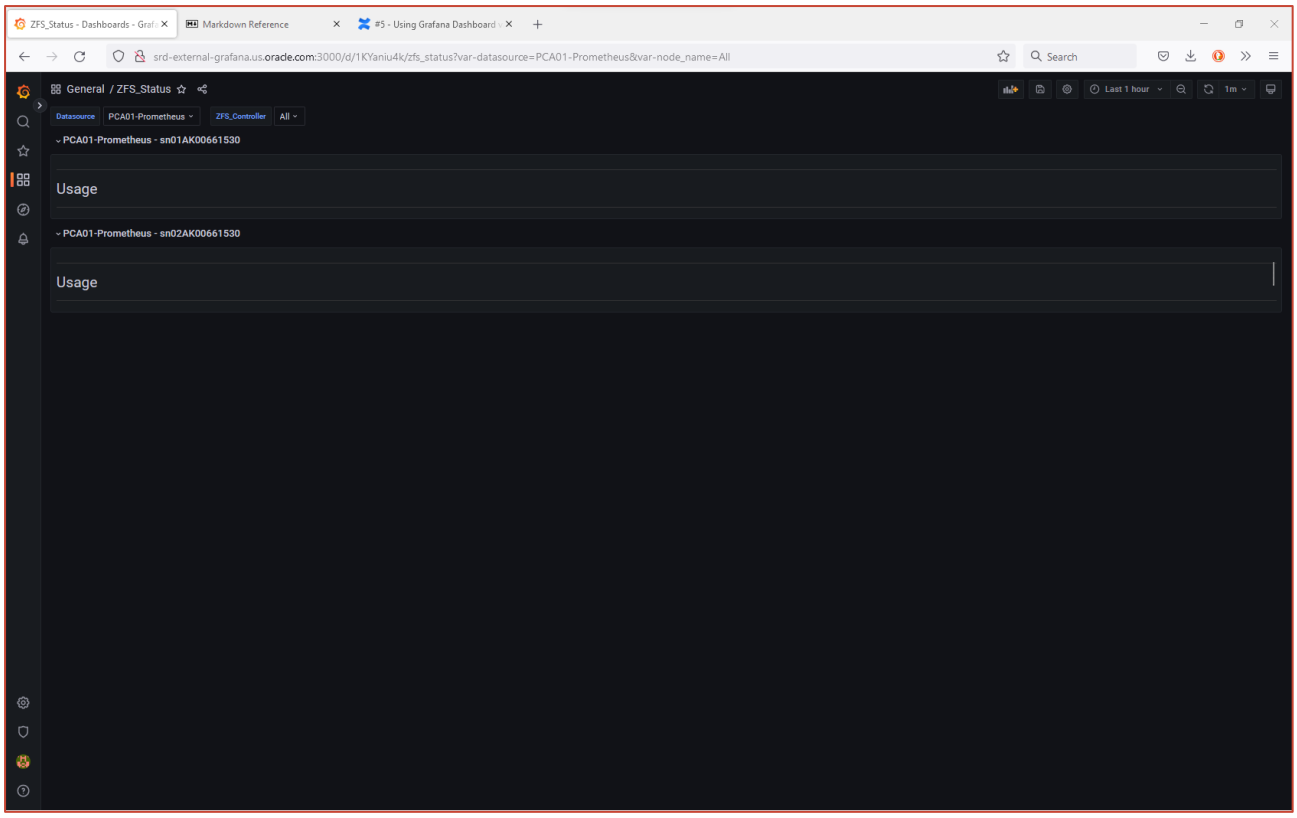
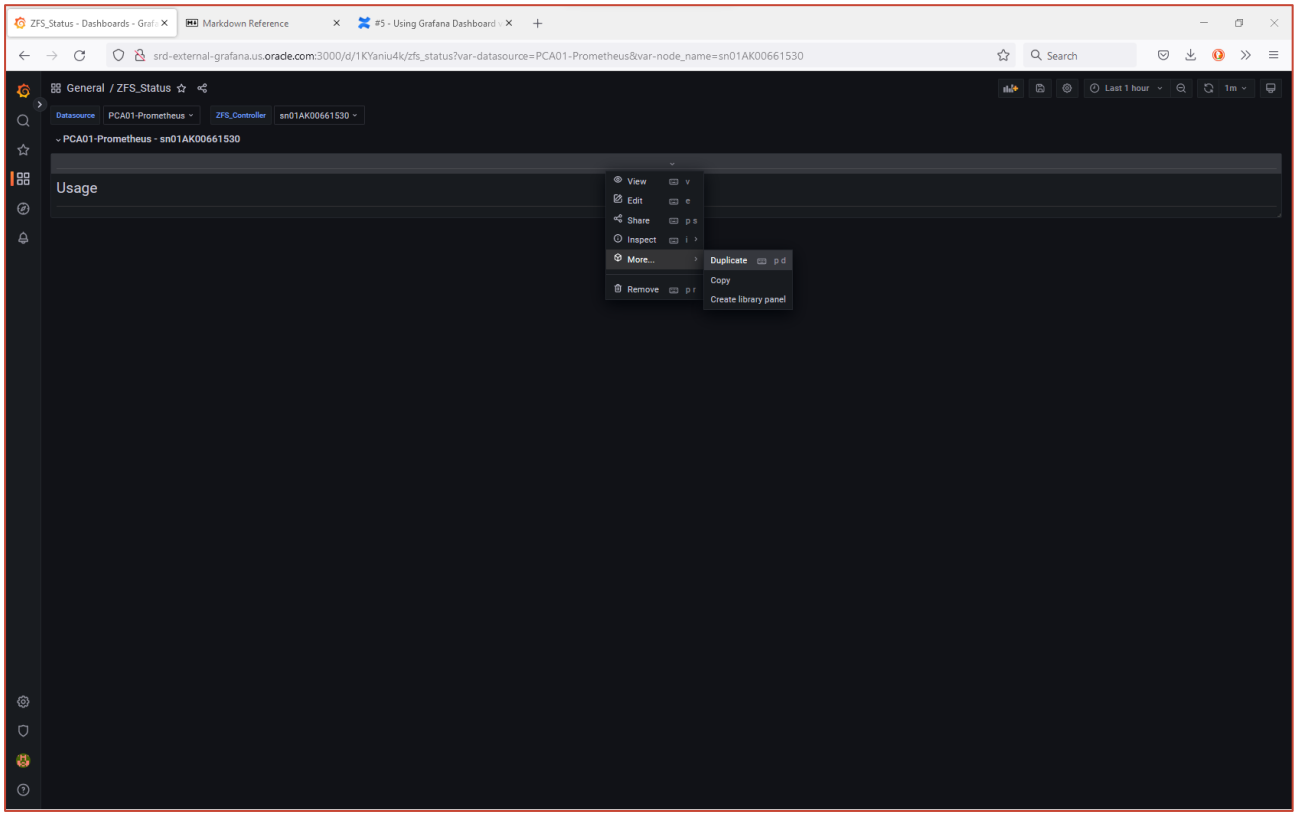


Dashboard Basic Layout – Displaying 'All' Node Names

The standard ZFS Storage Appliance Status page has data presented in three columns. This will be a little too cluttered within Grafana (unless you possess a super-wide screen (☺ !), so for the purposes of this example, a maximum two columns will be used.

Access the 'Usage' Text Panel and Duplicate this panel a further two times.



Dashboard Basic Layout – Duplicate Text Panel

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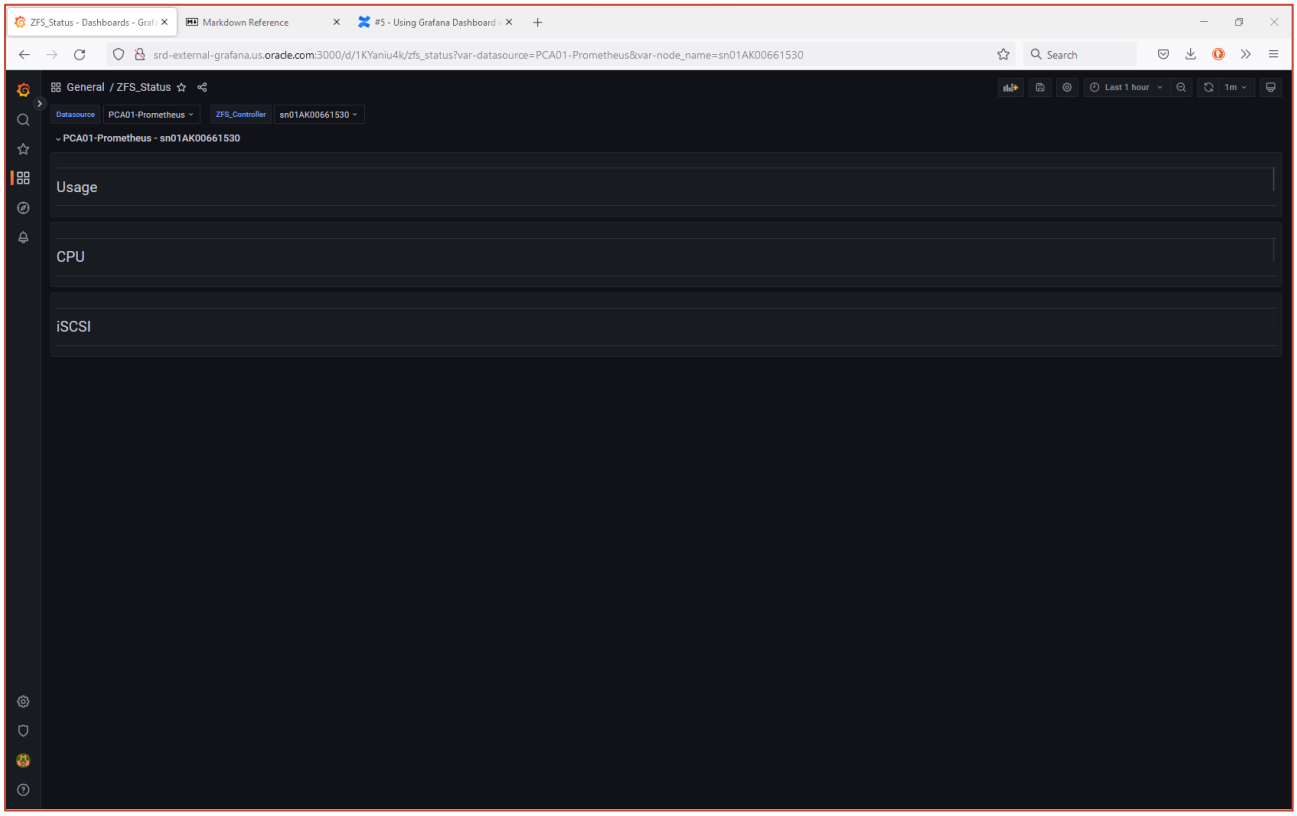
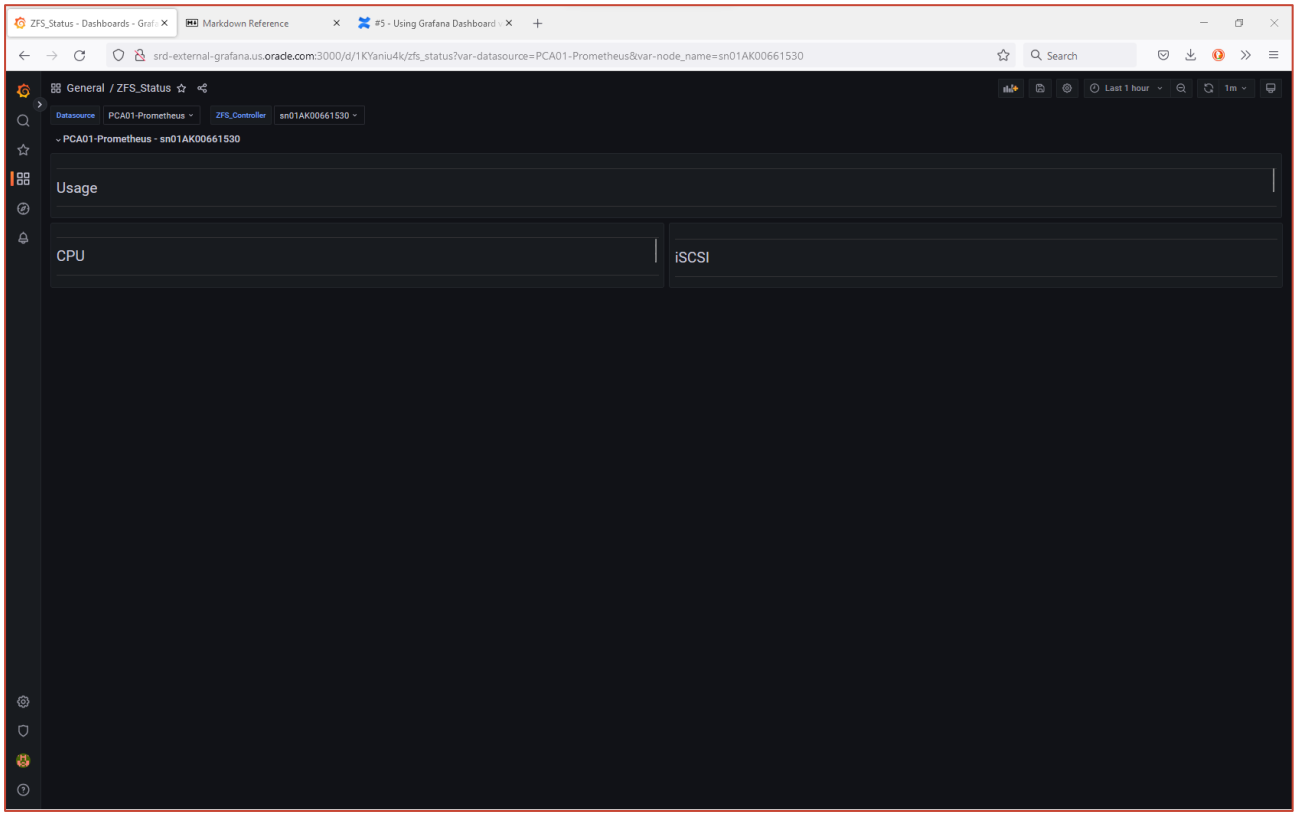
Edit the Text Panel contents on the first copy to read CPU and the Text Panel contents on the second copy to read 'iSCSI', as shown below:



Dashboard Basic Layout – Multiple Text Panels

Now, by clicking and dragging on the bottom right corner of the 'CPU' and 'iSCSI' Text panels, resize each so they fit alongside each other on a single row:



Dashboard Basic Layout – Completed Dashboard Screen Layout

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Having completed the basic screen layout, now it is time to start populating each block with specific panels displaying useful information.

This completes this section of the step-by-step guide.

Section References

The following URL's provide links to additional documentation:

- Grafana Documentation Library – https://grafana.com/docs/grafana/latest/
- Grafana Panels and Visualizations – https://grafana.com/docs/grafana/latest/panels-visualizations/
- Grafana Library Panels – https://grafana.com/docs/grafana/latest/dashboards/build-dashboards/manage-library-panels/

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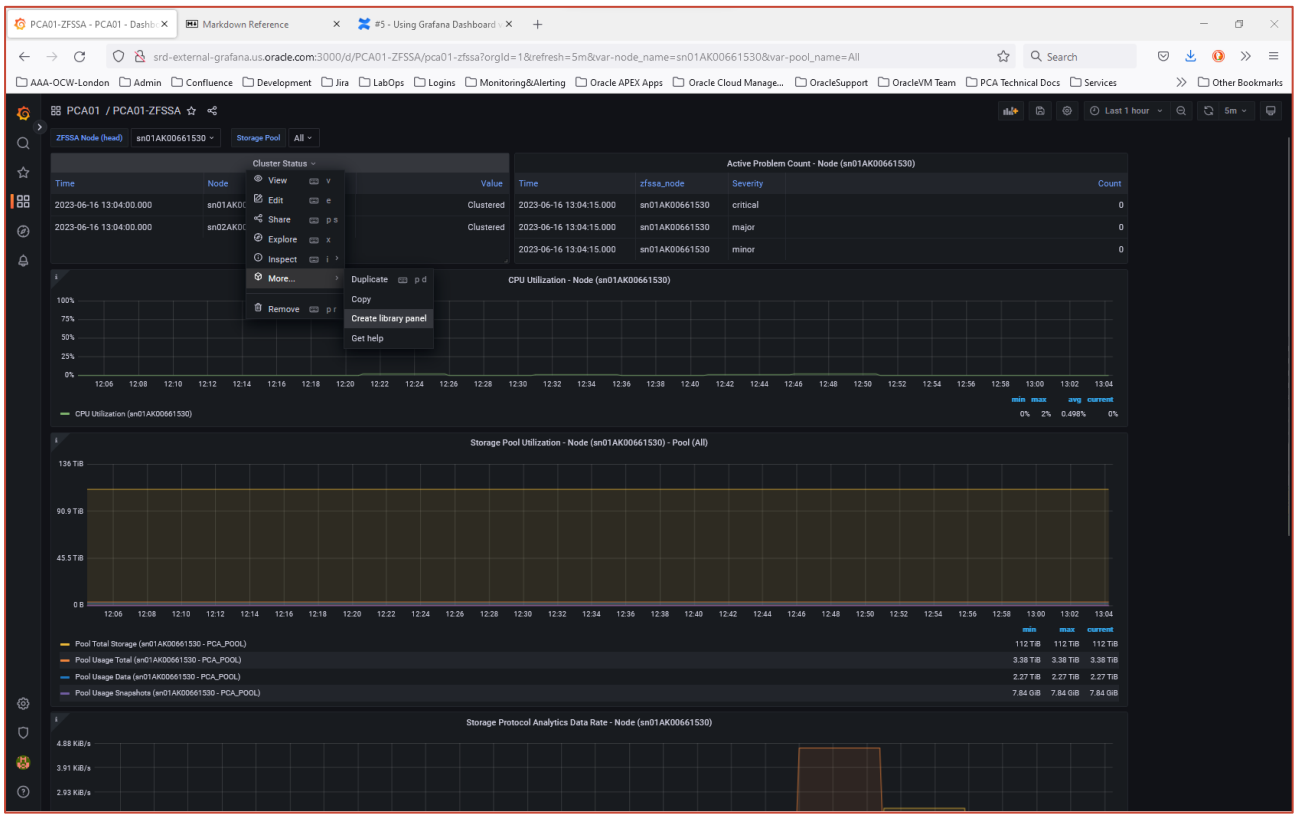
Dashboard Library Panels

As an initial starting point, it is possible to 'borrow' panels from the Private Cloud Appliance X9-2 ZFS Storage Appliance Grafana Dashboard. This has been previously imported into the external Grafana Server service.

Create Library Panels

It is possible to create Library Panel 'copies' of any dashboard panels of interest. In the example below, a library copy of the Cluster Status panel is created:



Dashboard Library Panels – PCA X9-2 ZFSSA Dashboard

The Create Library Panel option then opens a further window:

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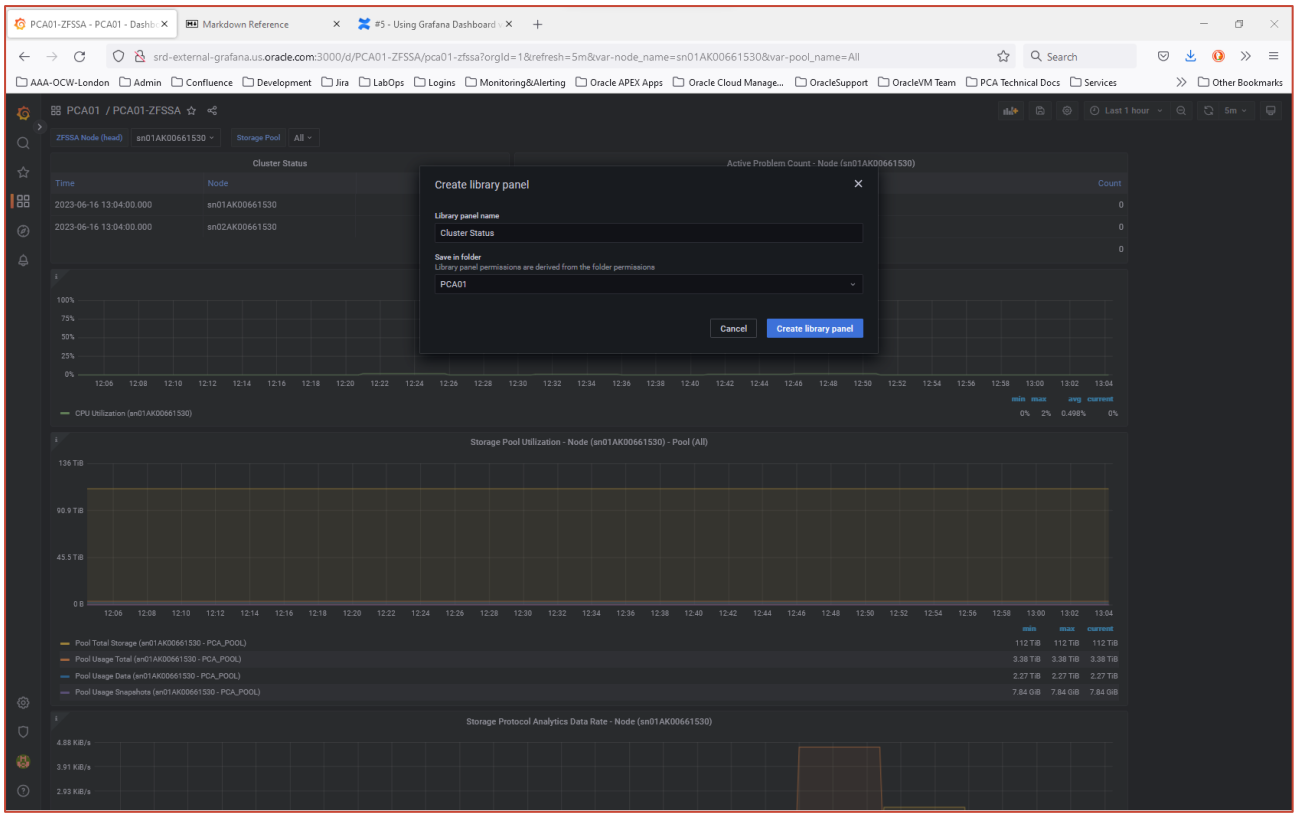
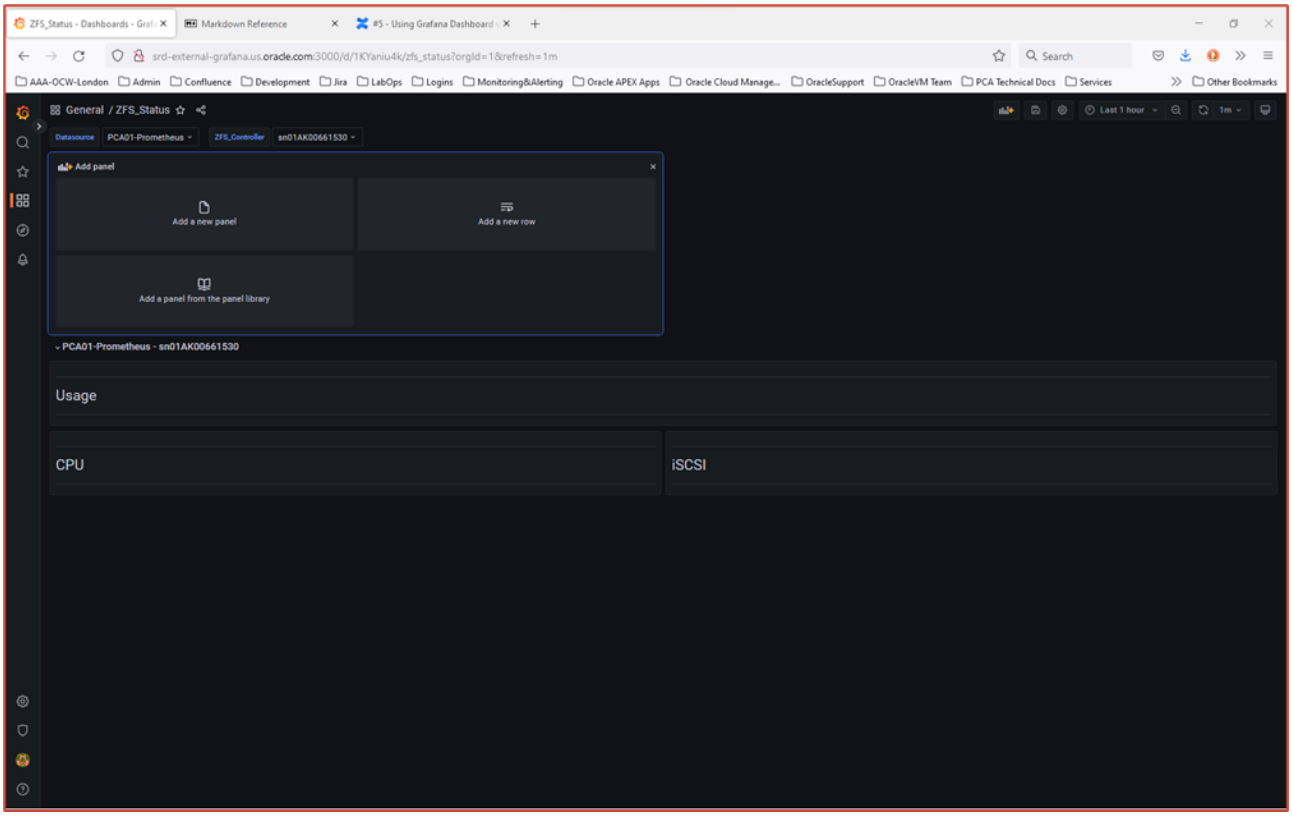


Dashboard Library Panels – Save Panel to Library

This process was also repeated for the Active Problem Count panel.

Using Library Panels

To use any Library panels, open the ZFS_Status Grafana Dashboard under construction and select the 'Add a panel from the panel library' option:



Dashboard Library Panels – Add Library Panel

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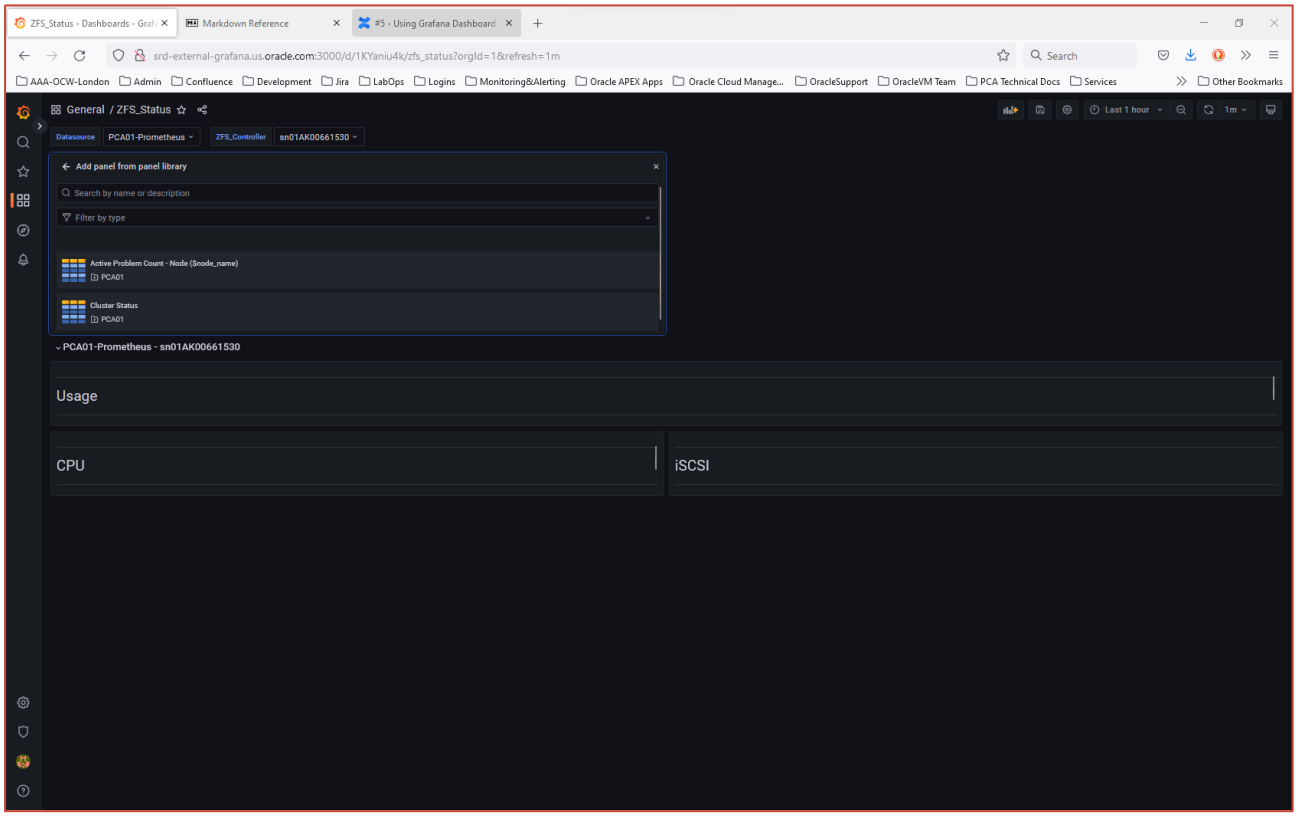
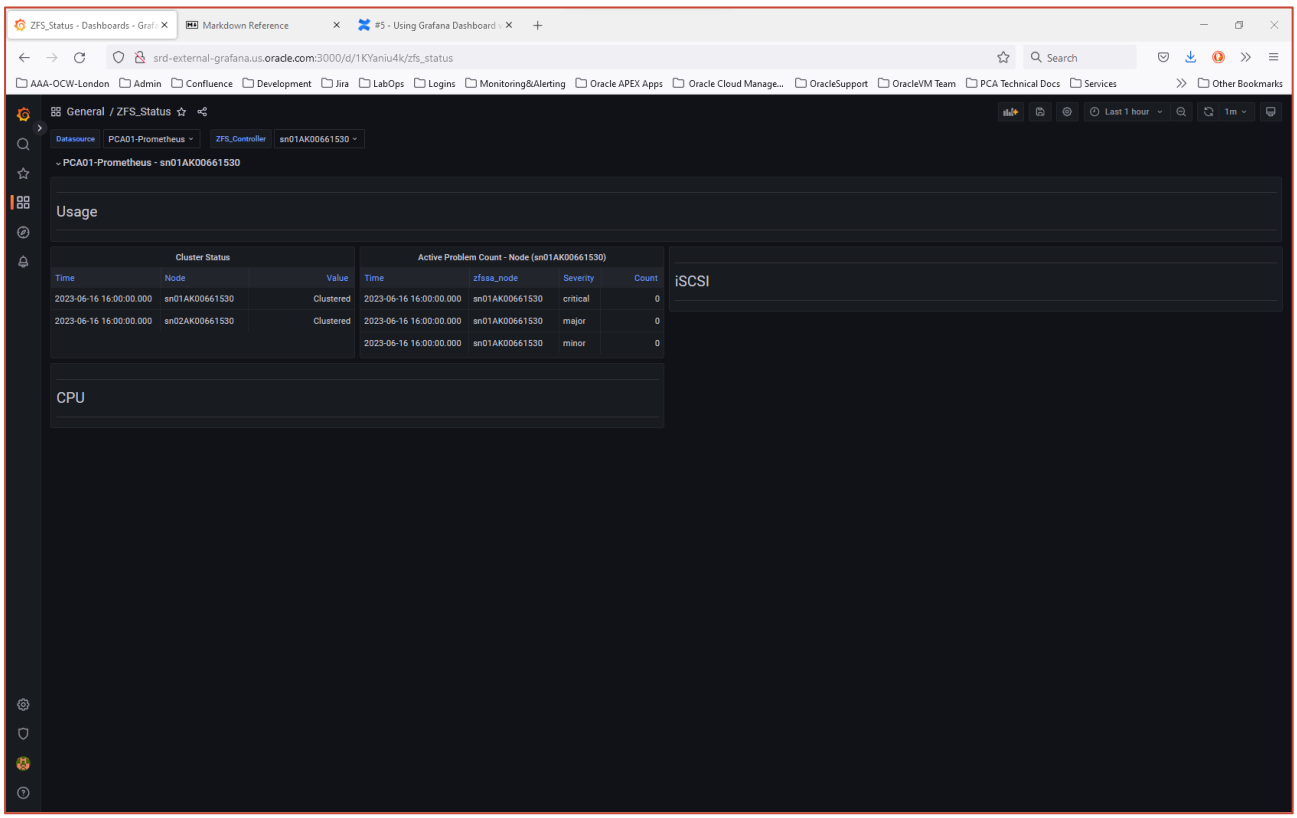
This then displays the available panels within the Grafana Server panel library:



Dashboard Library Panels – Select Library Panel

In this working example, one of each library panel type will be added and positioned under the 'Usage' Text panel:



Dashboard Library Panels – Added Panels from Library

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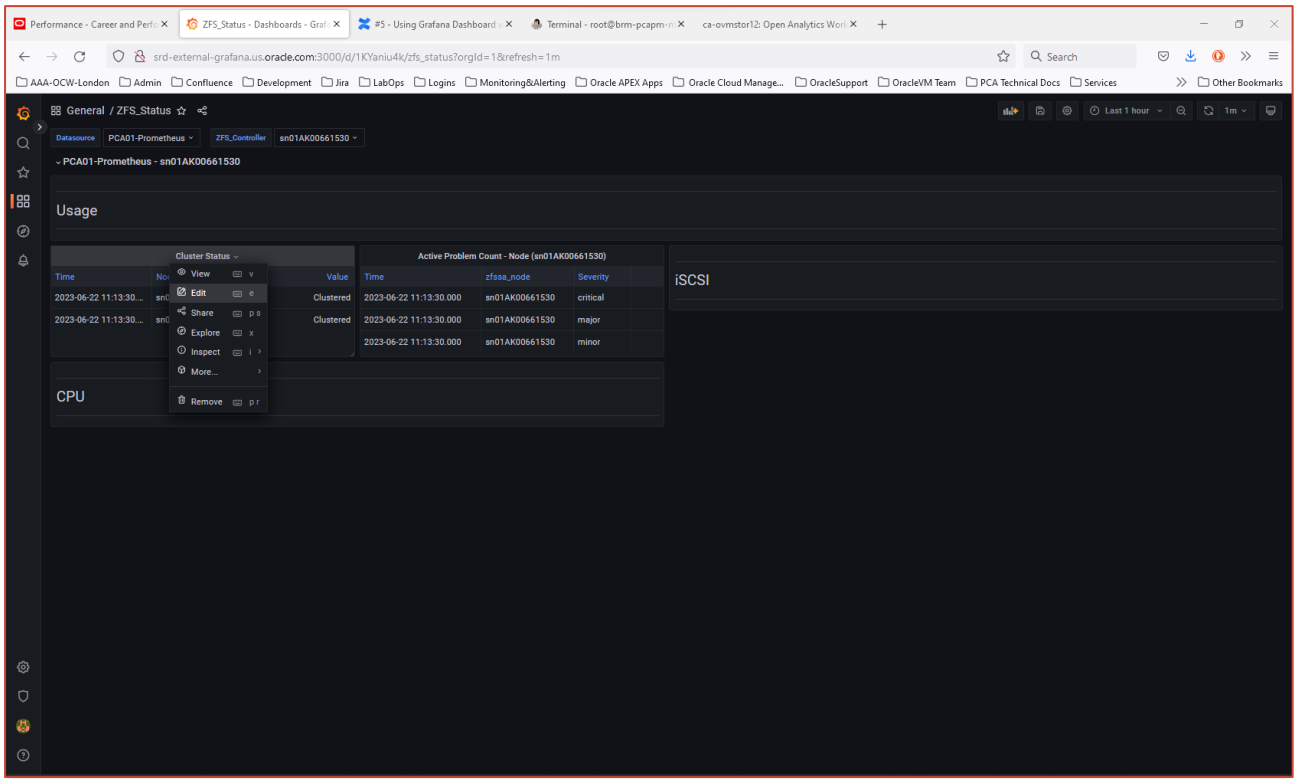
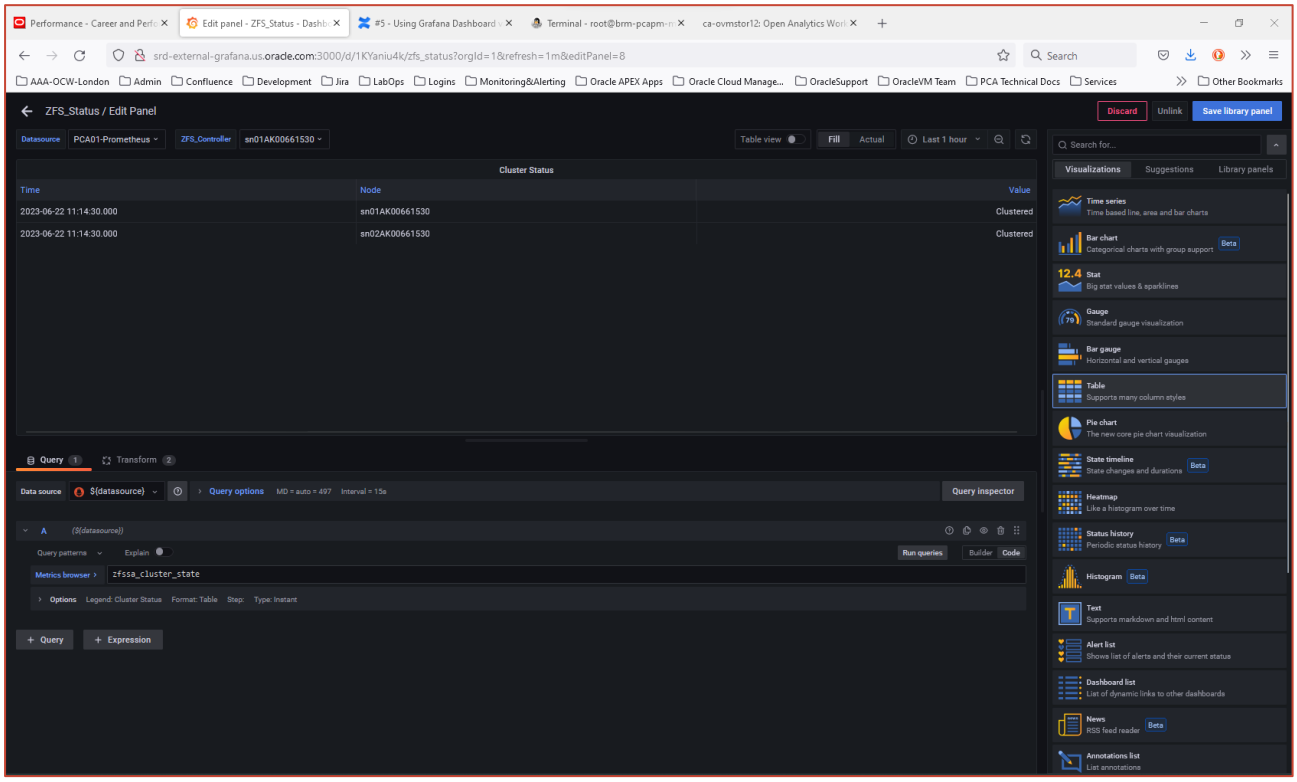
The Cluster Status Panel is showing the status' for both ZFS Controllers, but we have a ZFS Controller-specific Dashboard 'row' for each.

This panel can be edited to display the current status in a more prominent manner. Edit the Cluster Status Panel:



Dashboard Library Panels – Edit Panel from Library

Change the Visualization type from 'Table' to 'Stat':



Dashboard Library Panels – Save Changes to Library Panel

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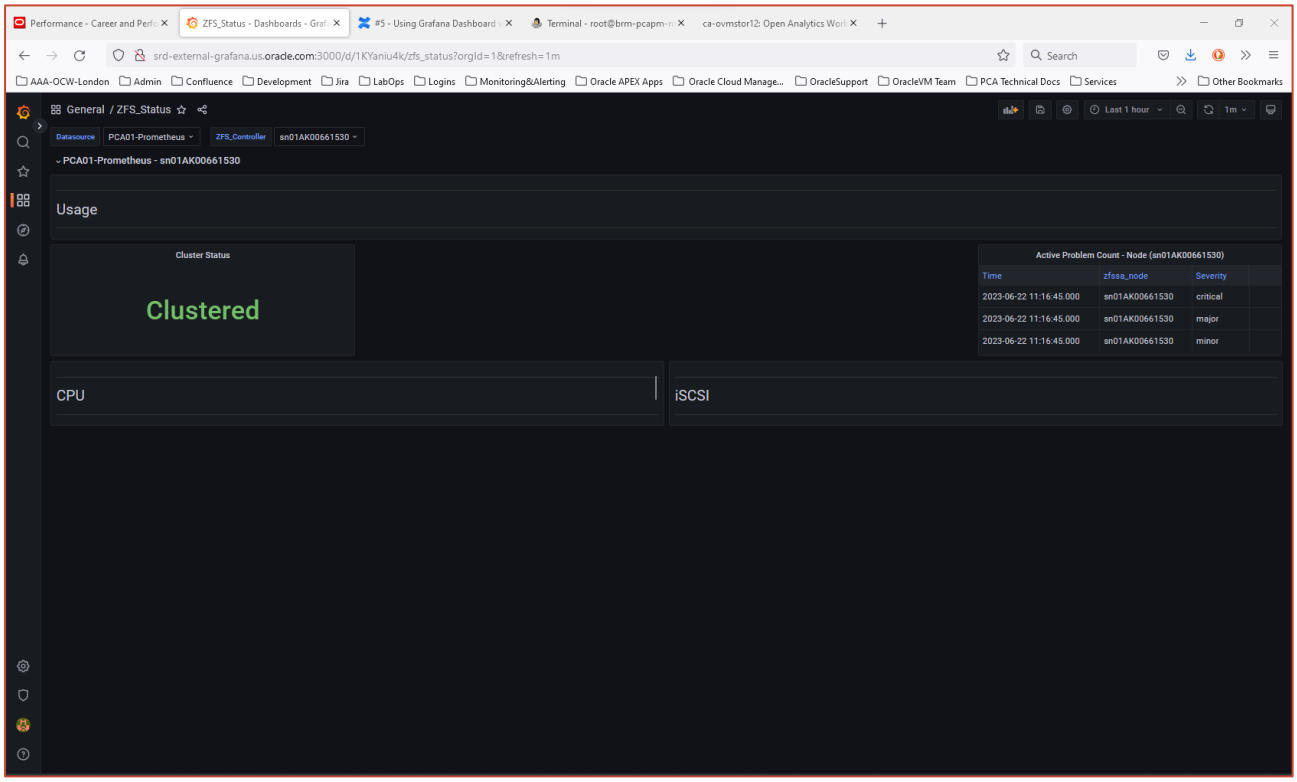
Apply the change and save the Dashboard:



Dashboard Library Panels – Modified Panel

The Cluster Status is now displayed as a more prominent 'Cluster State'. At the same time, the Active Problem Count Panel was right justified.

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Creating New Panels

So far, we have 'borrowed' existing Grafana Dashboard panels from dashboards imported from the Oracle Private Cloud Appliance X9-2 systems. Now it is time to create new Panel objects.

Repeated Panel Creation

Further Dashboard Panels can now be added to show:

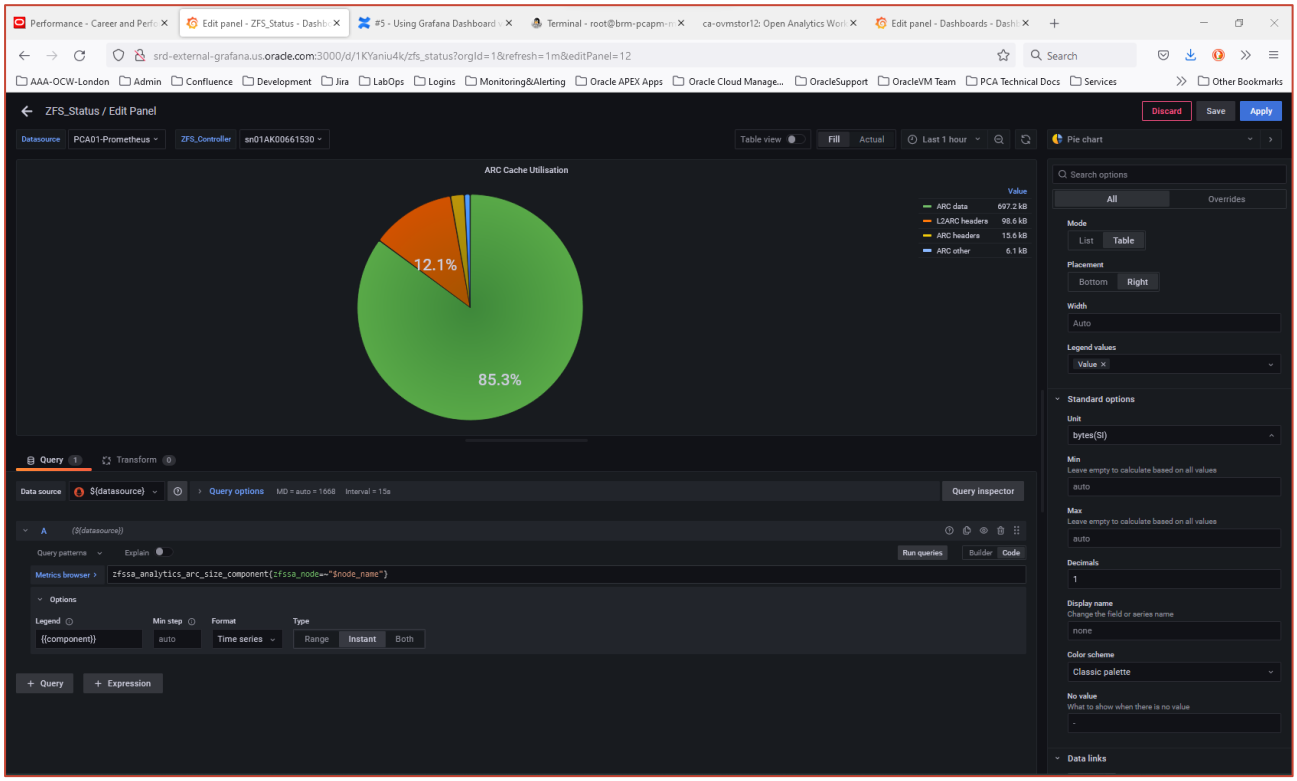
- Disk Pool Utilization (Used / Free)
- Disk Pool Used details (Data / Snapshots / Replication / Reservation)
- ARC Utilization (Data / Headers / Other / L2ARC Headers)
- ARC Cache Hit Ratio

Within this document, two new panels will be created.

The first will display the ARC Utilization. The panel characteristics will be:

- Visualization Type: Pie Chart
- Title: ARC Cache Utilization
- Value Options: Calculate (Last*); Numeric Fields
- Pie Chart: Labels (percent)
- Legend: Visible; Table; Right justified
- Unit: Bytes(IEC)
- Query #A:
  - Datasource='${Datasource}';
  - Query=zfssa_analytics_arc_size_component{zfssa_node=~"$node_name"}; Legend='{{component}}'

The following screen shot shows this first panel being created:



Creating New Panels – Creating ARC Cache Pie Chart

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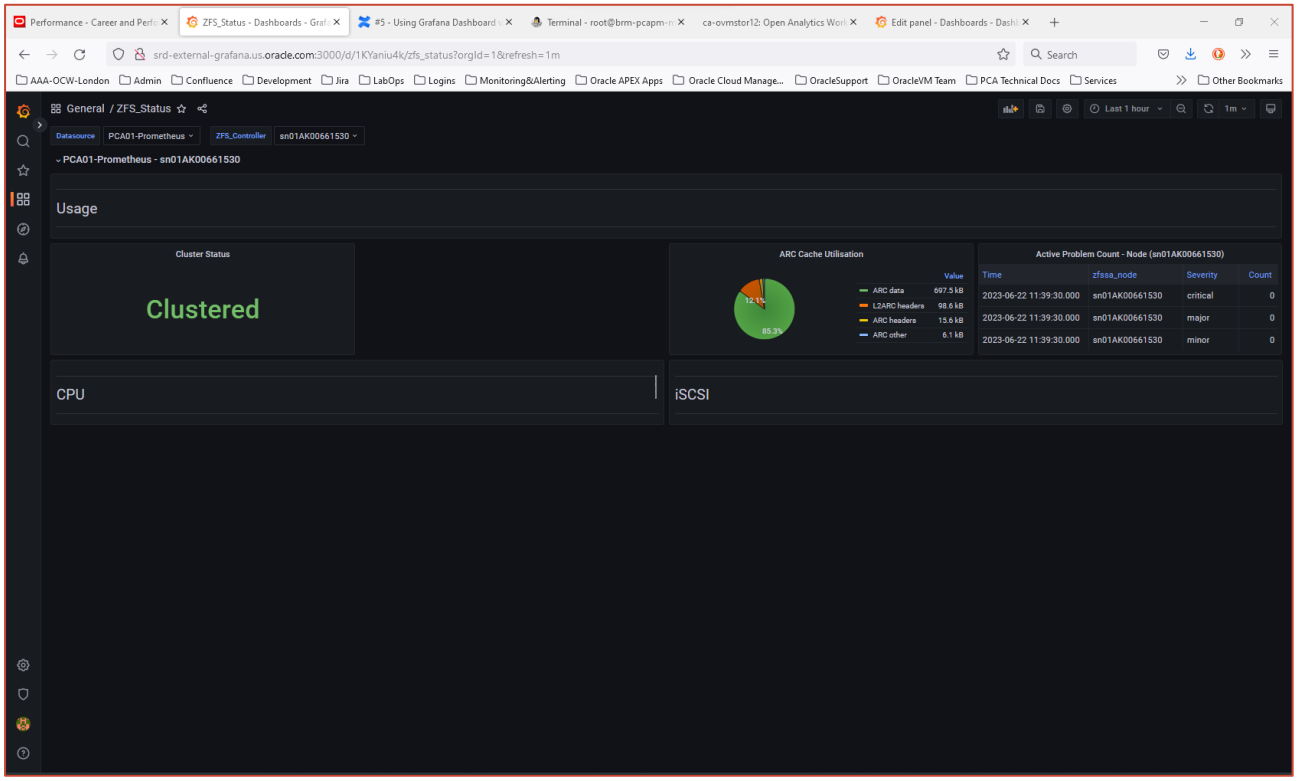
Now Apply and Save the Dashboard Panel and re-arrange within the ZFS_Status Dashboard to align with the rest of the ZFS Cluster metrics:



Creating New Panels – Saved ARC Cache Pie Chart

This panel has been resized and aligned to the right.

The second new panel will display the Disk Pool Utilization. The panel characteristics will be:

- Visualization Type: Pie Chart
- Title: Disk Storage Pool Utilization
- Value Options: Calculate (Last*); Numeric Fields
- Pie Chart: Labels (percent)
- Legend: Visible; Table; Right justified
- Unit: Bytes(IEC)
- Query #A:
  - Datasource='${Datasource}';
  - Query='zfssa_pool_used{zfssa_node=~"$node_name"}'; Legend='{{pool}}-Used'
- Query #B:
  - Datasource='${Datasource}';
  - Query='zfssa_pool_free{zfssa_node=~"$node_name"}'; Legend='{{pool}}-Free'

The following screen shot shows this second panel being created:

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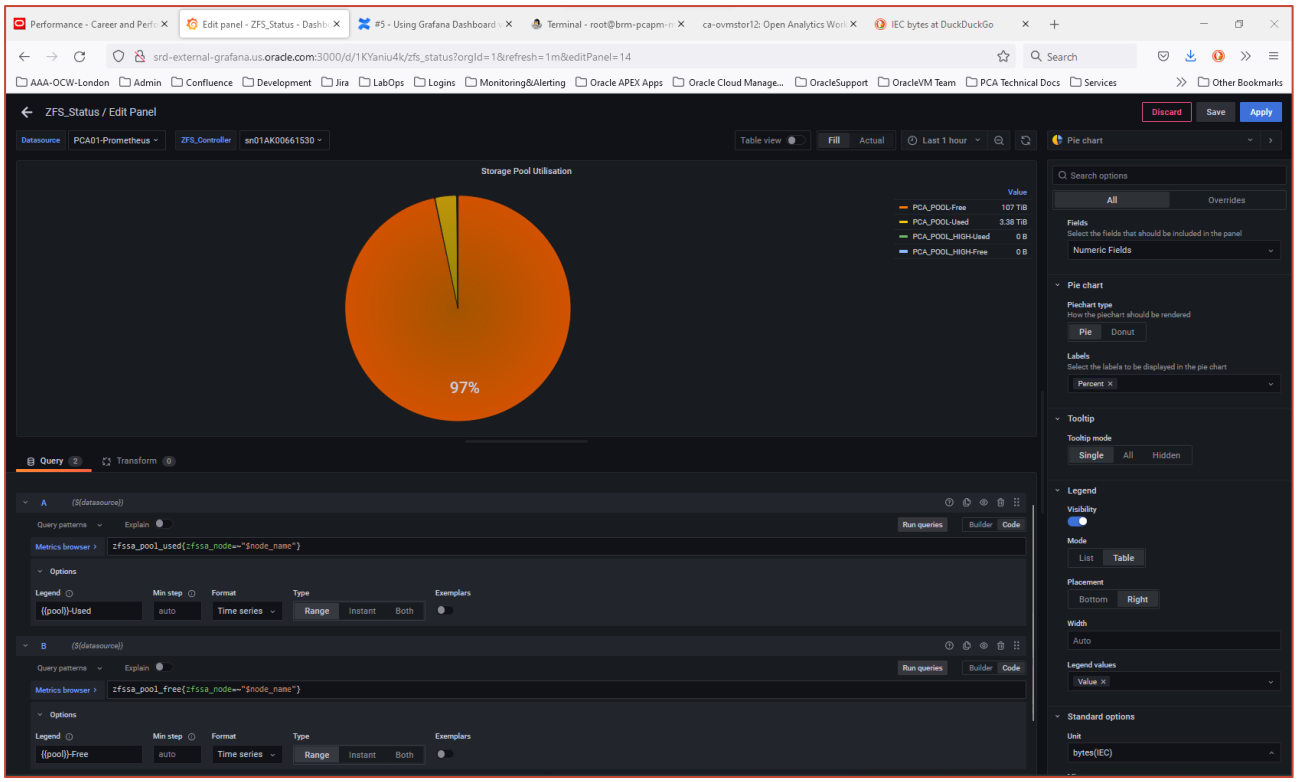
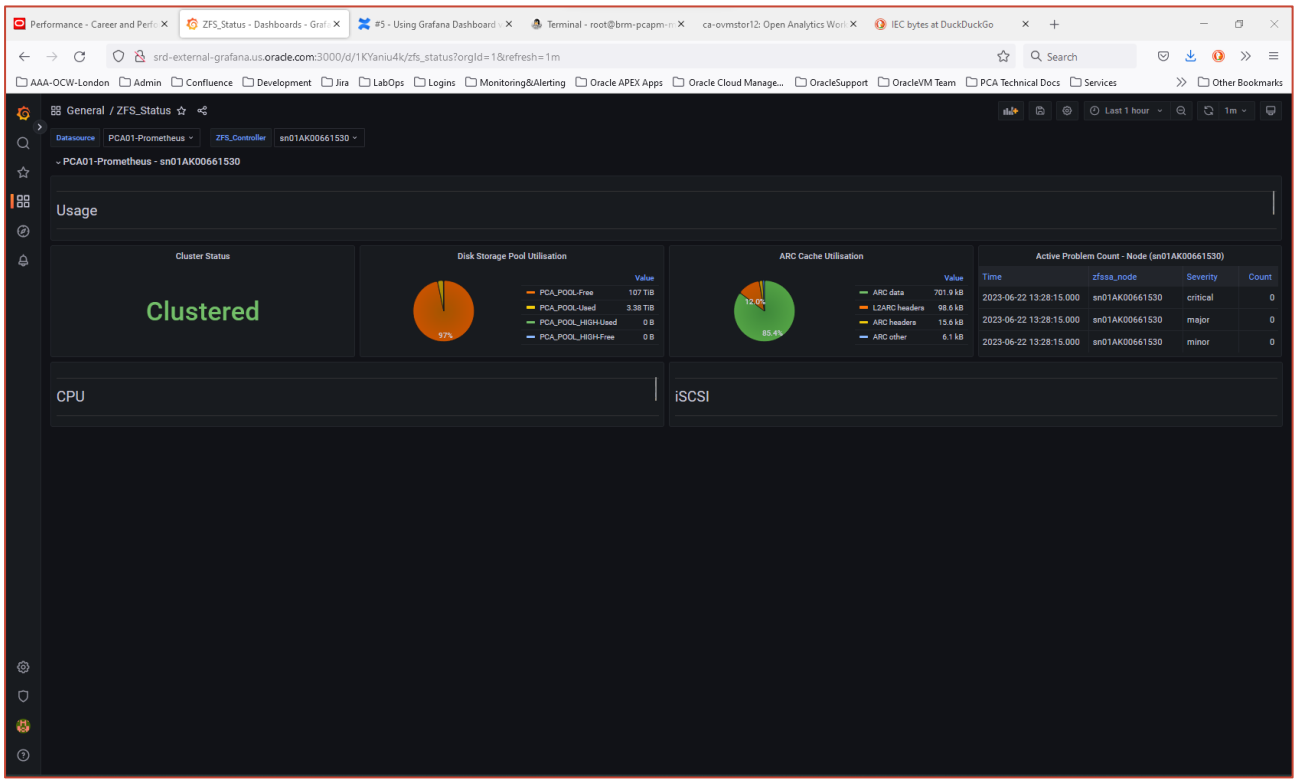


Creating New Panels – Creating Disk Pool Utilisation Pie Chart

Now Apply and Save this second Dashboard Panel and rearrange within the ZFS_Status Dashboard to align with the rest of the ZFS Cluster metrics:



Creating New Panels – Four Panel ZFS Controller Usage – One Controller

There are now four operational Grafana Dashboard Panels available. More can be added as required.

See what this looks like when selecting first 'All ZFS Controllers' for PCA01:

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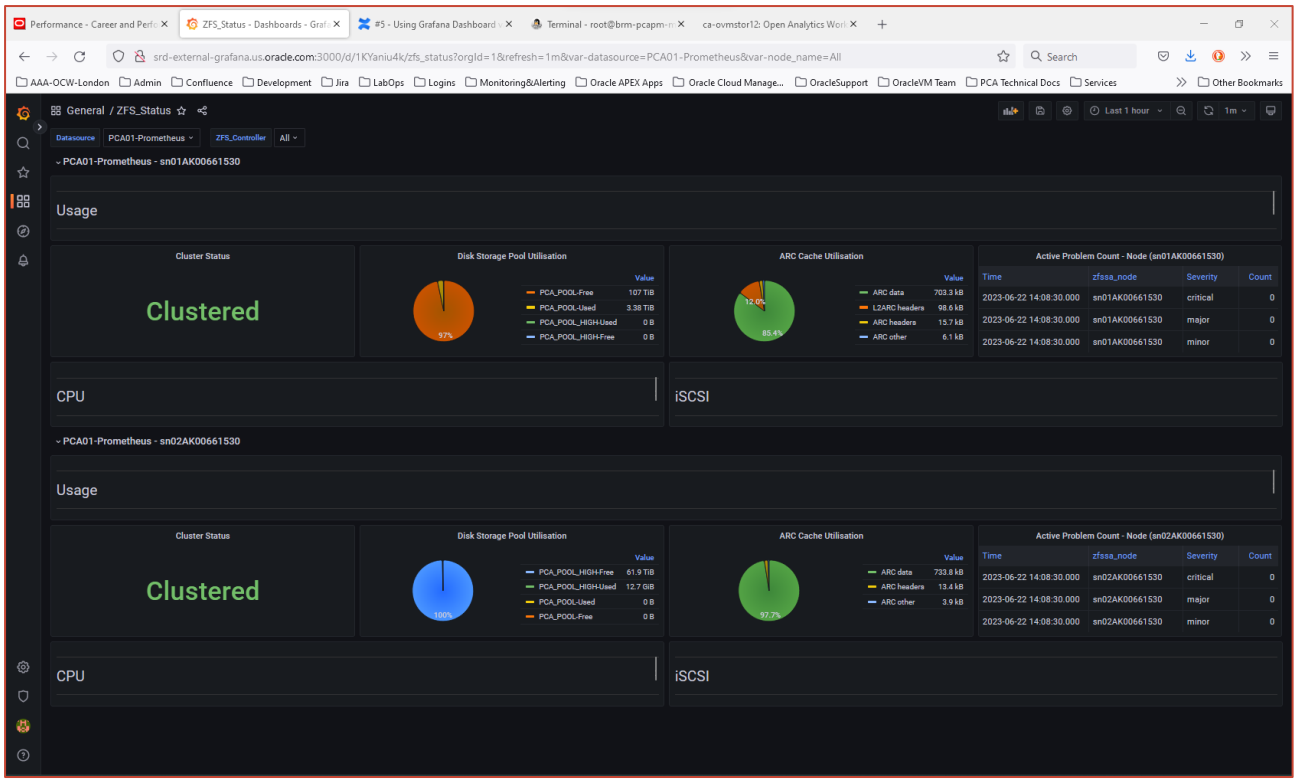
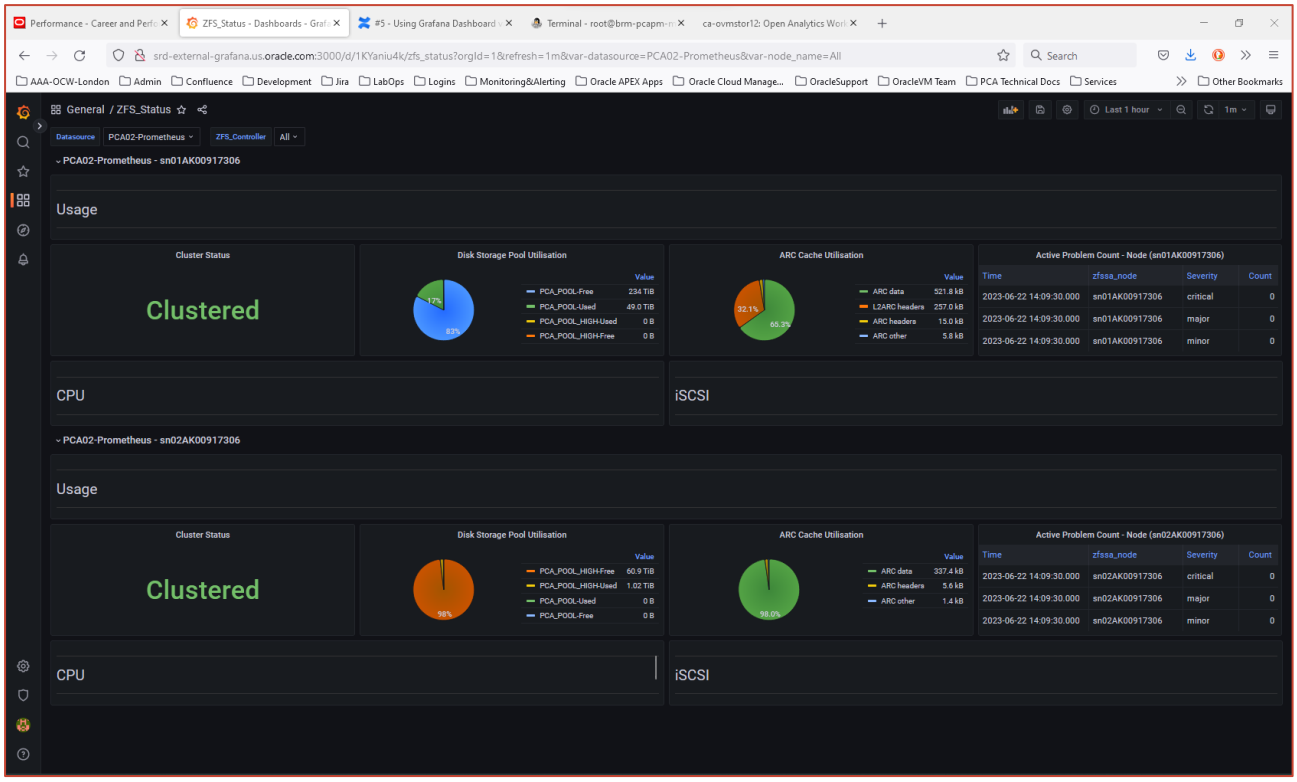


Creating New Panels – Four Panel ZFS Controller Usage – Both Controllers – PCA01

And then, 'All ZFS Controllers' for PCA02:



Creating New Panels – Four Panel ZFS Controller Usage – Both Controllers – PCA02

This illustrates how one Grafana Dashboard can provide a common Visualization reference for multiple PCA X9-2 systems.

Now to extend the displayed data further.

Two additional areas need to be covered. These are:

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- ZFS Controller Utilization
  - Controller CPU Utilization
  - Back-End Disk Loop IOPS
  - Network Interface Traffic
- Disk Pool Storage Services
  - iSCSI disk services
  - NFS storage services
  - SMB storage services
  - S/FTP storage services
  - HTTP storage services

All the above are displayed on the default ZFS Storage Appliance Status page showing:

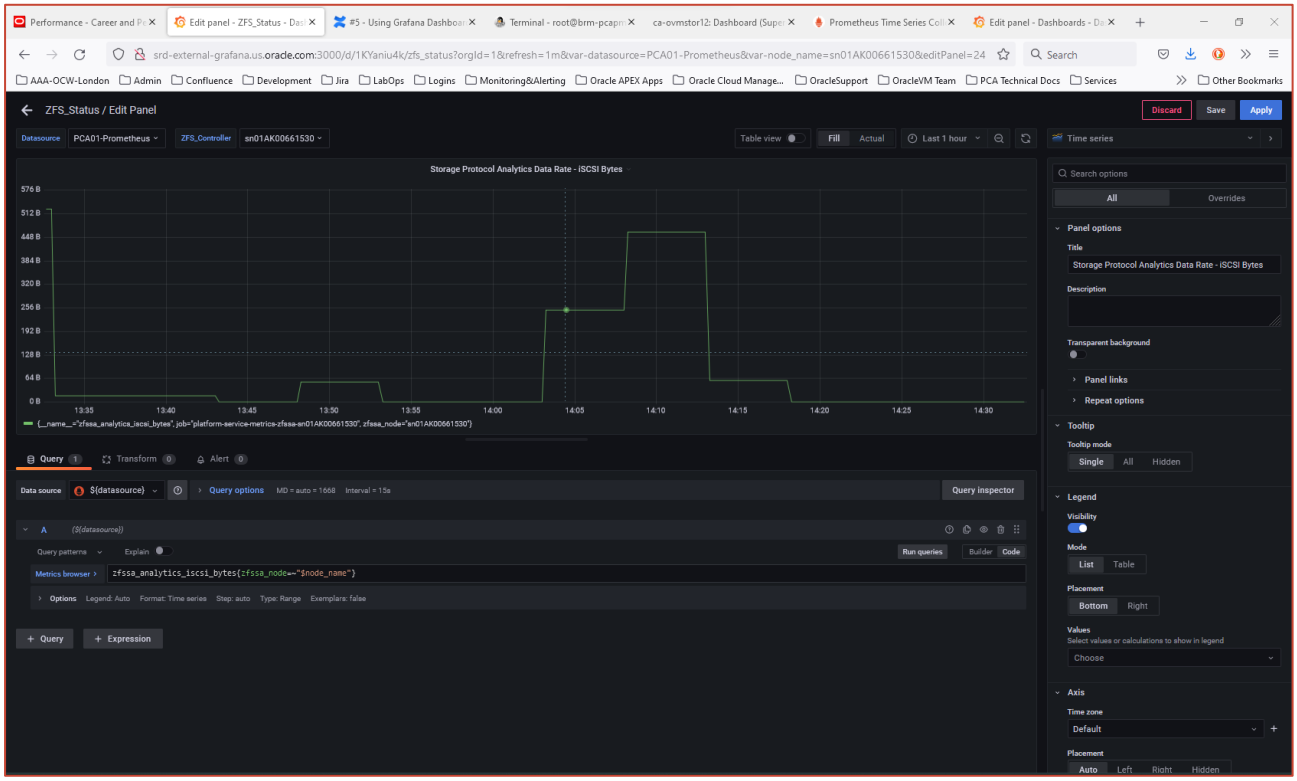
- Last 7 days
- Last 24 hours
- Last hour
- Now

By creating, rather than reusing a Library Panel, each can now be added to this ZFS_Status Dashboard.

The same process will be used for each of the mentioned data metric sets.

The iSCSI disk services will be used as the working example.

Once more, create a new panel:



Creating New Panels – New iSCSI Disk Panel

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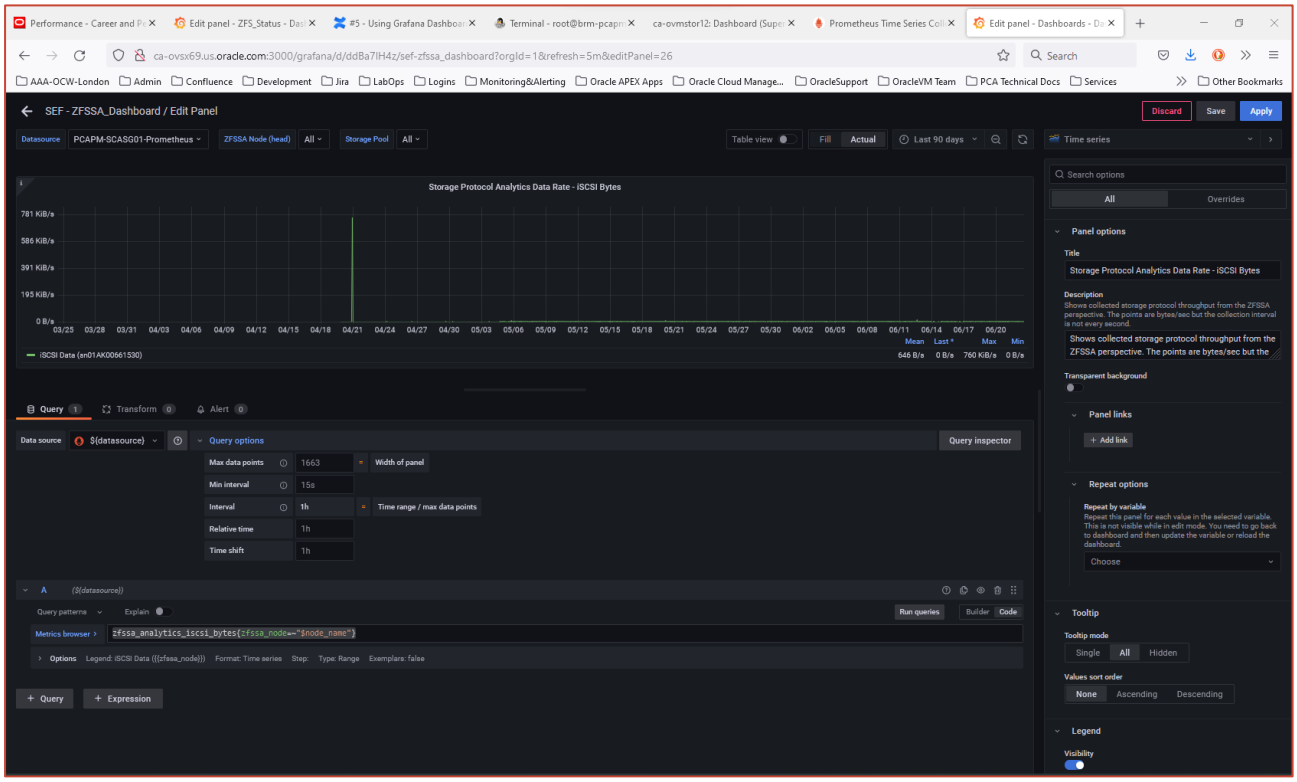
Edit its properties as needed to be consistent with the required visualization:



Creating New Panels – Modified iSCSI Disk Panel

The panel characteristics will be:

- Visualization Type: Bar Chart
- Title: Storage Protocol Analytics Data Rate – iSCSI Bytes
- Legend: Visible; Table; Right justified
- Unit: Bytes(IEC)
- Query #A:
  - Datasource='${Datasource}'
  - Query Options: Relative Time=1hr
  - Query= ‘zfssa_analytics_iscsi_bytes{zfssa_node=~"$node_name"}’; Legend ‘iSCSI Bytes

Apply and Save. The following new Dashboard Panel will be seen:

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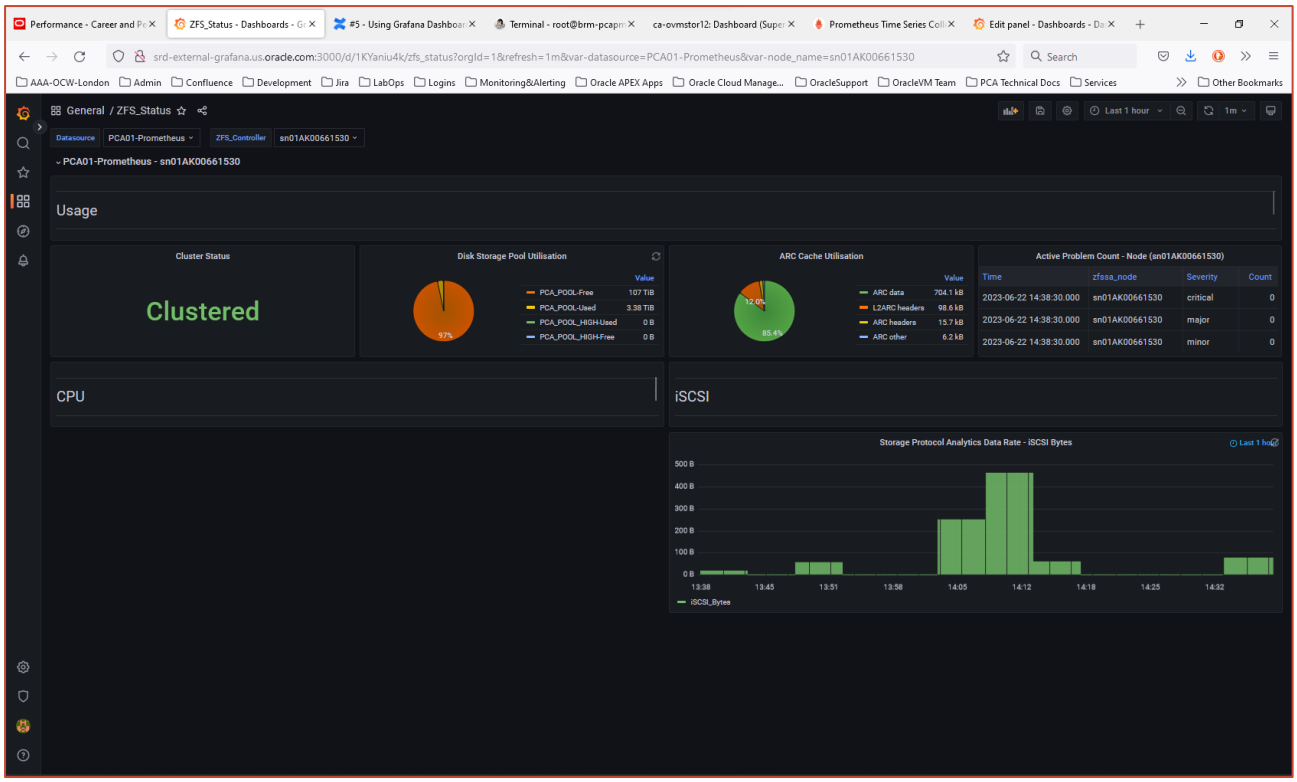
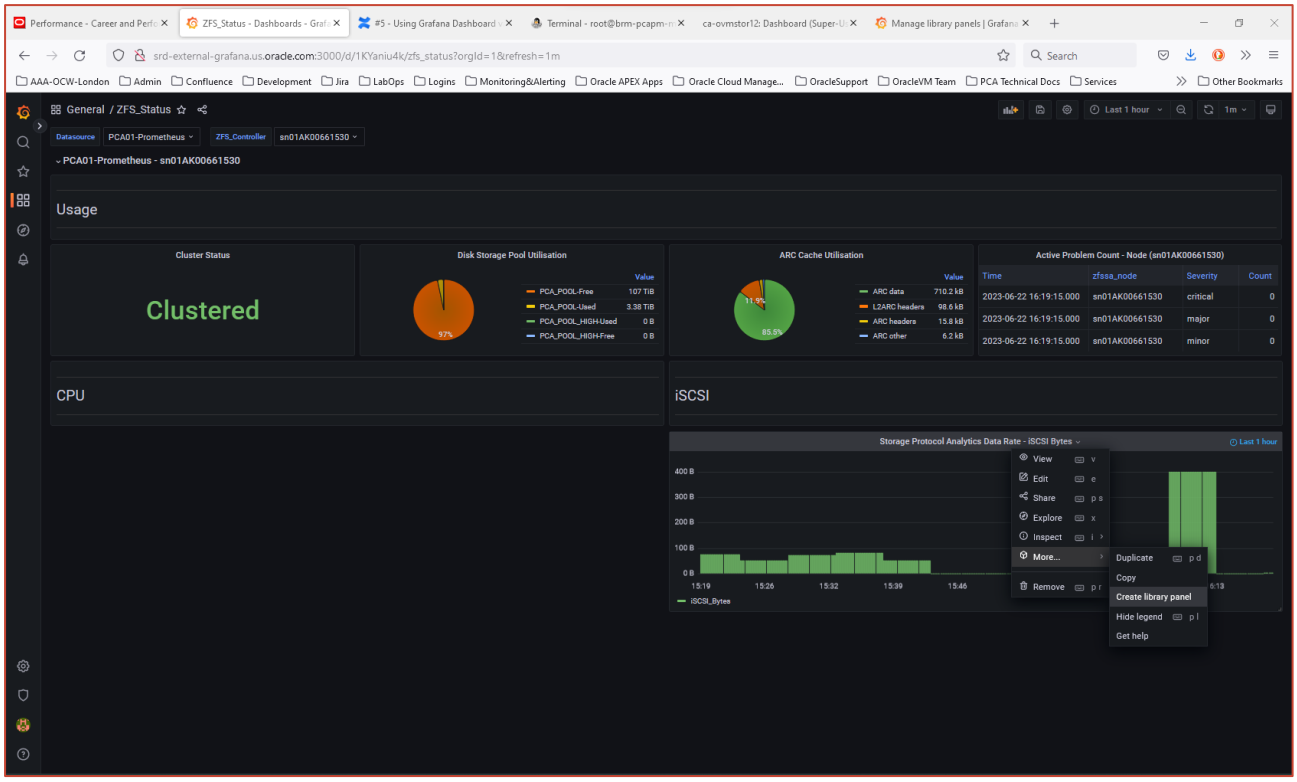


Creating New Panels – Added iSCSI Disk Panel

Then, save to the Panel Library:



Creating New Panels – New iSCSI Disk Panel – Save to Library

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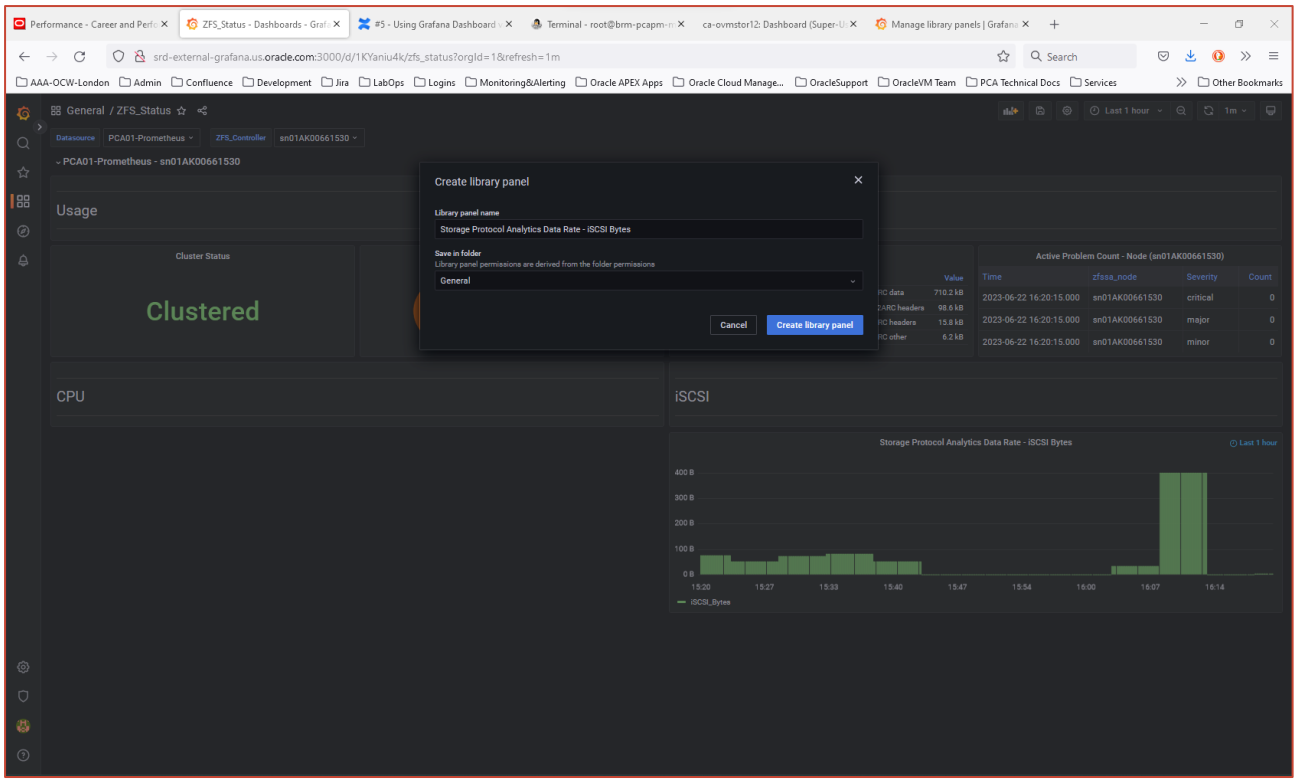
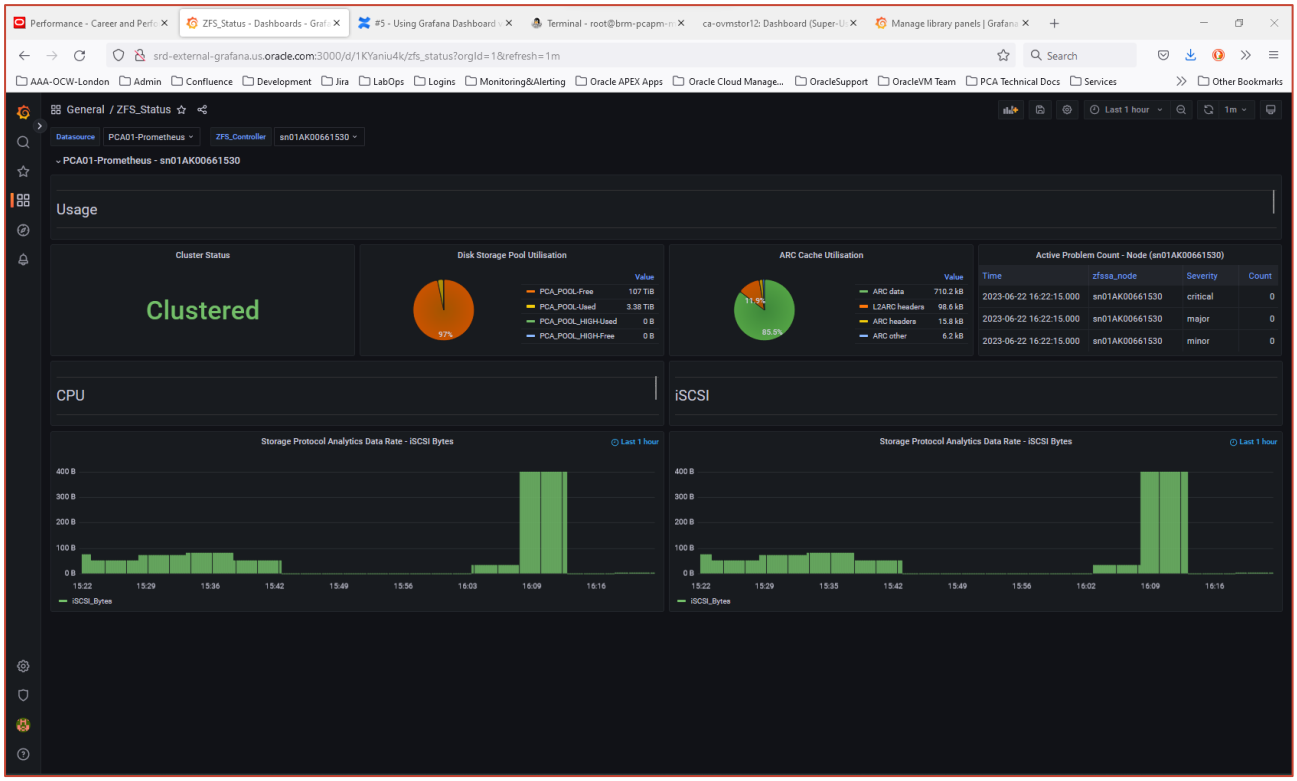


Creating New Panels – New iSCSI Disk Panel – Added to Library

Then, create a second panel from this Library Panel:



Creating New Panels – Library Copy of iSCSI Disk Panel

There are now two copies of the same panel. Before making changes to either panel, they must be unlinked from the library panel to provide a 'stand-alone' version which can be edited.

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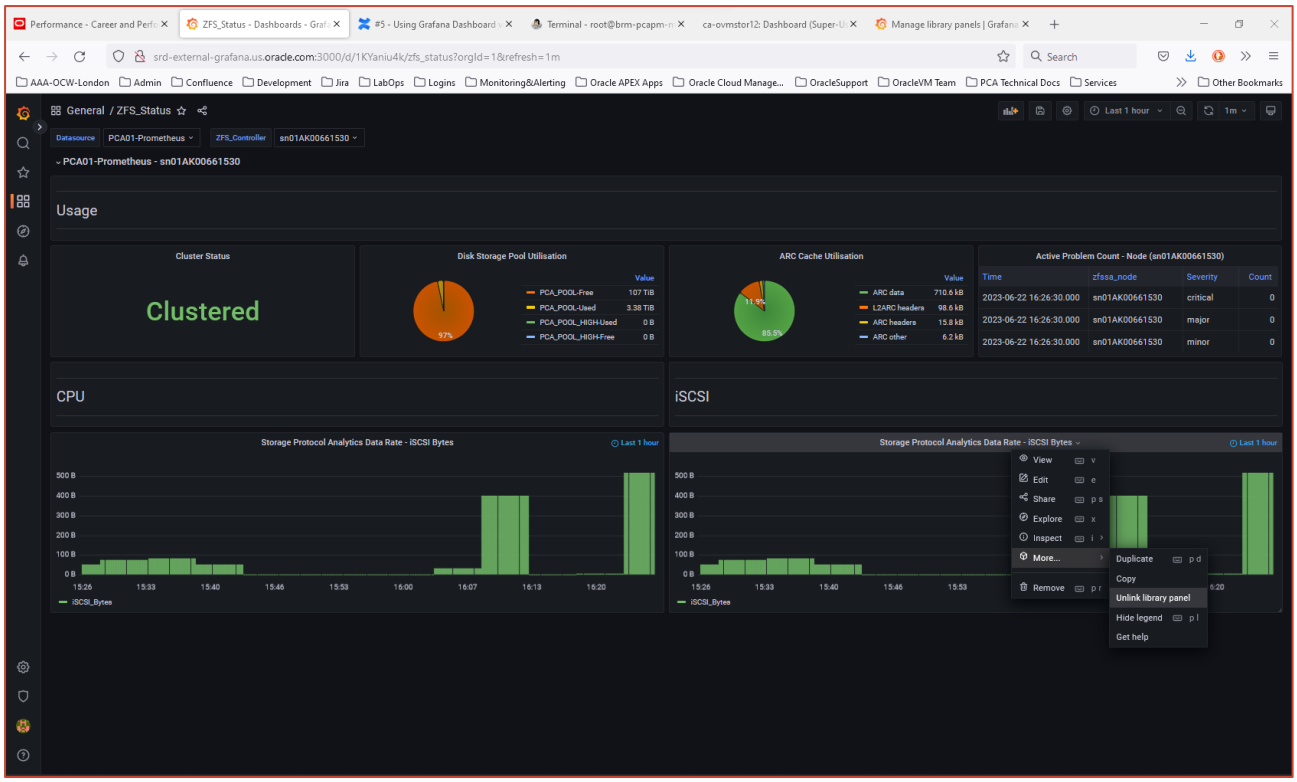
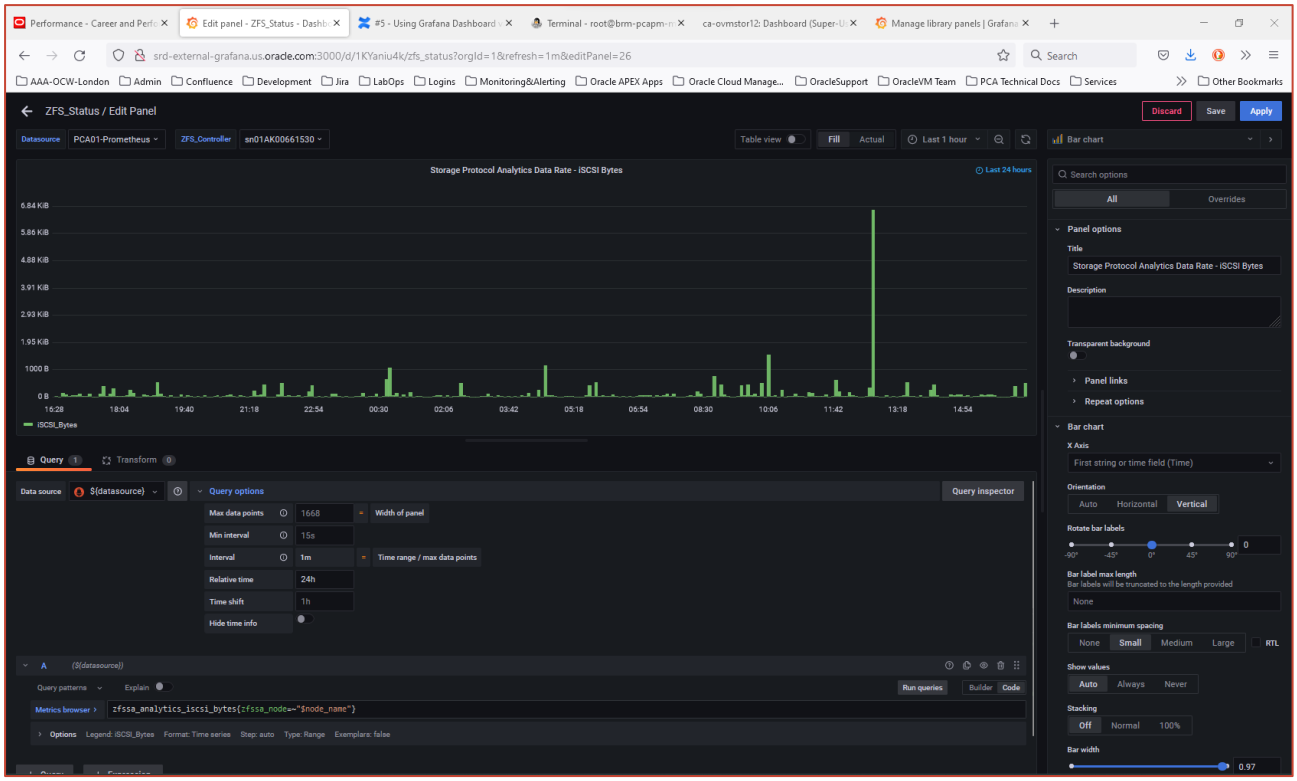


Creating New Panels – Unlinking the panel from the Library

Apply the changes and Save the Dashboard.



Creating New Panels – Amending the Query Options: Relative Time value

Each of the iSCSI panels will be identical with minor panel configuration change(s) required for each:

- 1 week panel – Query Options: Relative Time=1w
- 1 day panel - Query Options: Relative Time=1d

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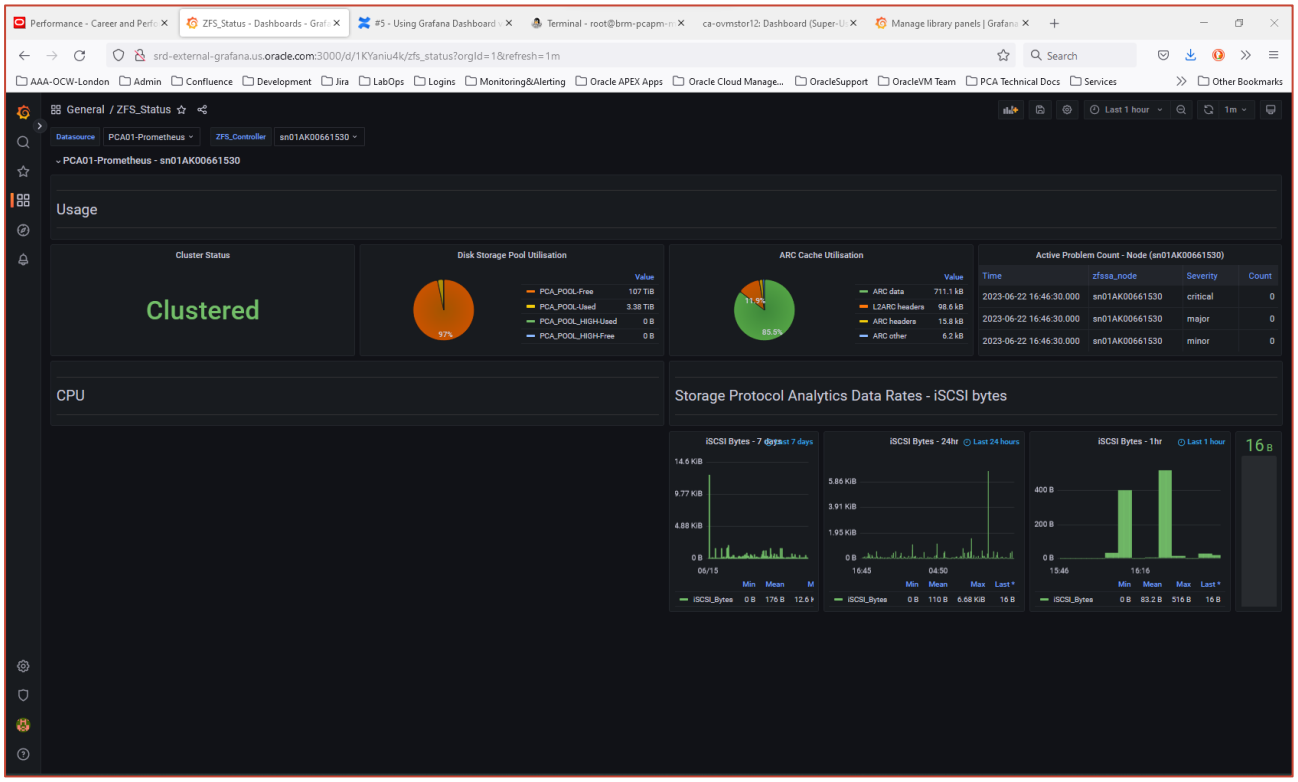
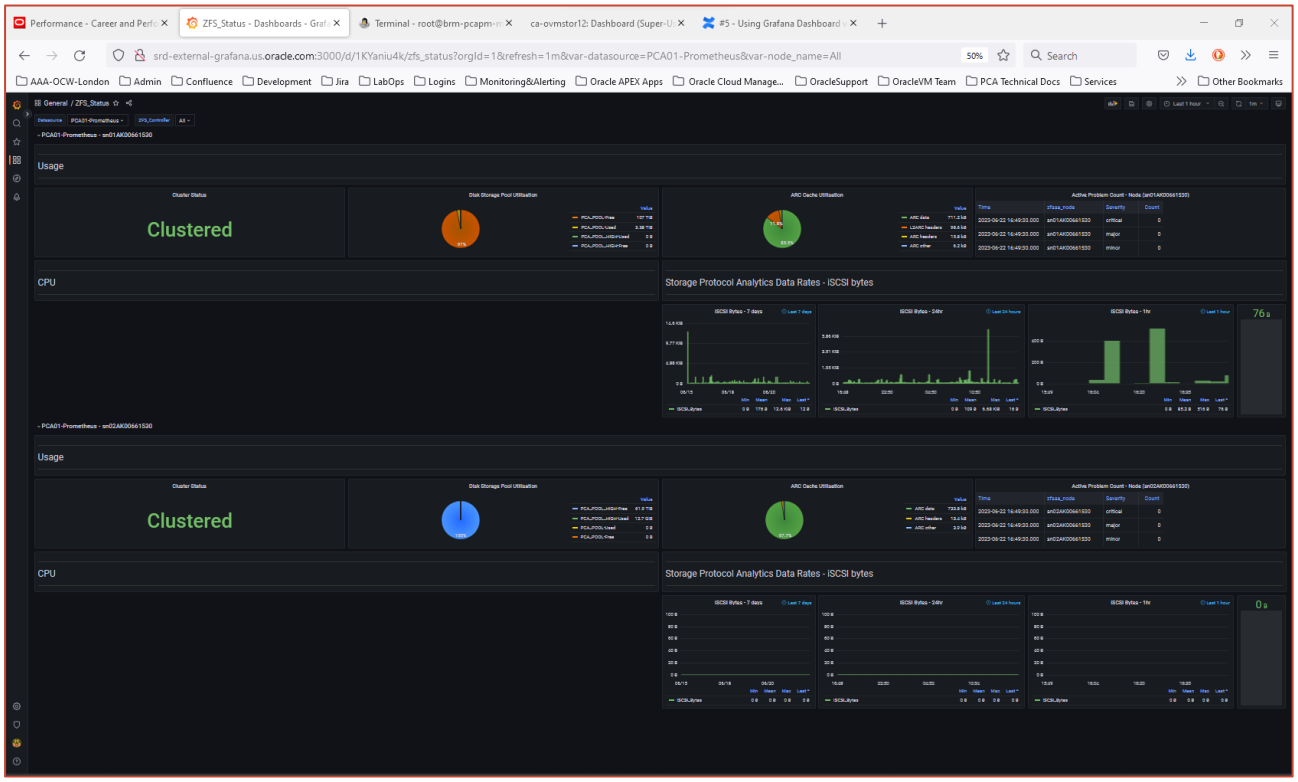
- 1 hour panel - Query Options: Relative Time=1hr
- ‘Now’ panel – Query Options: Relative Time=NULL & Options Type: Instant

Repeat to create the remaining panels required for the ‘full set’. After some resizing and relabelling of the Titles and Text Panel, the following result should be seen:



Creating New Panels – Completed iSCSI metrics panels – PCA01 – ZFS Controller 1

Let’s look at this when both ZFS Controllers are selected:



Creating New Panels – Completed iSCSI metrics panels – PCA01 – ‘All’ ZFS Controllers

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The same principles used to create a common panel for any given metric can then be applied for the remaining panel types and data sets, namely:

- ZFS Controller Utilization
  - Controller CPU Utilization
  - Back-End Disk Loop IOPS
  - Network Interface Traffic
- Disk Pool Storage Services
  - iSCSI disk services
  - NFS storage services
  - SMB storage services
  - S/FTP storage services
  - HTTP storage services

This completes this step-by-step example for the creation of a variable-driven, multiple Oracle Private Cloud Appliance source Grafana Dashboard.

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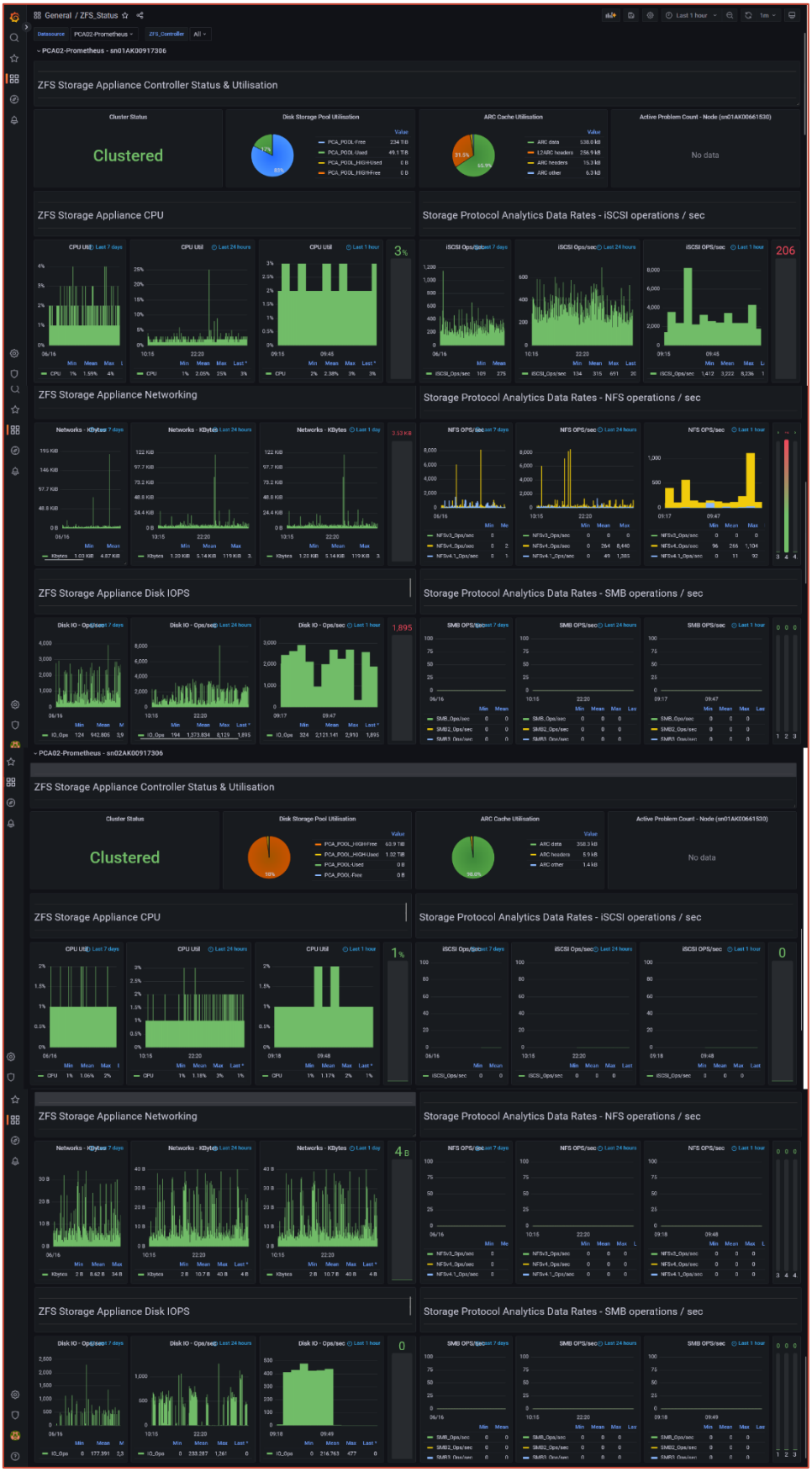
The Completed Dashboard

The following aggregate screen shot shows the completed dashboard with all available metrics and measures being presented in a single, common Grafana Dashboard:



Creating New Panels – The Completed Dashboard

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Section References

For the definitive source for information and instruction for configuring Grafana Server, review the Grafana documentation:

- Grafana Document Library – https://grafana.com/docs/grafana/latest/
- Grafana Dashboard Documentation – https://grafana.com/docs/grafana/latest/dashboards/
- Grafana Panels and Visualizations – https://grafana.com/docs/grafana/latest/panels-visualizations/
- Grafana Library Panels – https://grafana.com/docs/grafana/latest/dashboards/build-dashboards/manage-library-panels/

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Reference Materials

The following reference URLs provide a consolidated summary of the various section references provided elsewhere within this document:

Oracle References

- Oracle Private Cloud Appliance X9-2 -Status and Health Monitoring – https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/3.0-latest/admin/admin-adm-healthmonitor.html#adm-health-grafana

Grafana References

- Grafana Documentation Library – https://grafana.com/docs/grafana/latest/
- Grafana Panels and Visualizations – https://grafana.com/docs/grafana/latest/panels-visualizations/
- Grafana Variables – https://grafana.com/docs/grafana/latest/dashboards/variables/
- Grafana Library Panels – https://grafana.com/docs/grafana/latest/dashboards/build-dashboards/manage-library-panels/
- Grafana Data Source documentation – https://grafana.com/docs/grafana/latest/datasources/
- Grafana Dashboard Documentation – https://grafana.com/docs/grafana/latest/dashboards/

Prometheus References

- Prometheus Querying – https://prometheus.io/docs/prometheus/latest/querying/basics/
- Prometheus PromQL 'Cheat Sheet' – https://promlabs.com/promql-cheat-sheet/

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