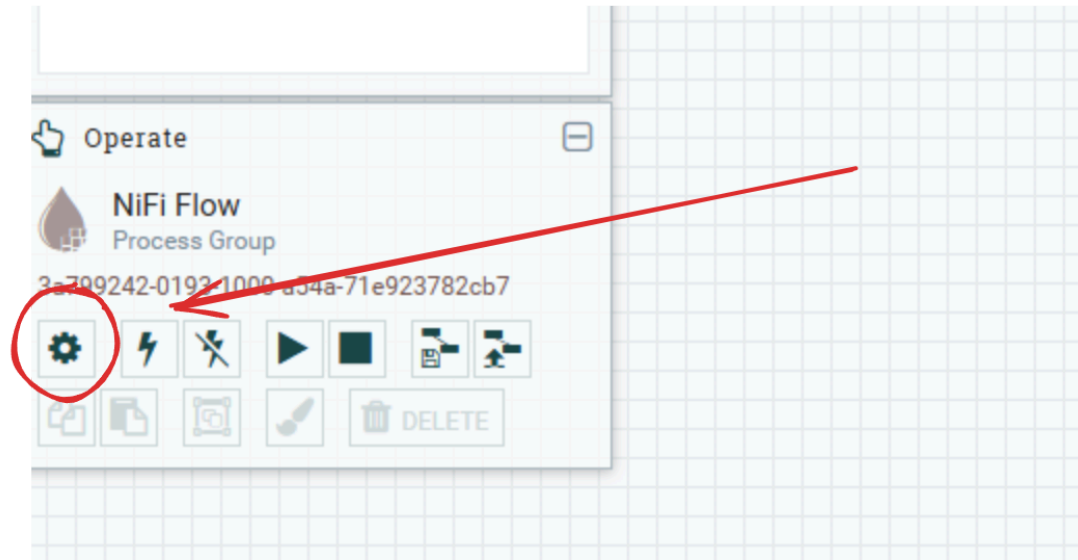


Part 2 - Configuration

Configuring NiFi Services

After NiFi has been deployed, we can start configuring it to consume events from Kafka and send them to OpenSearch. Once NiFi is ready, you should be able to access it by going to <http://localhost:32002/nifi>.

Before we begin, we need to define the services our processors will need. To do this, find the Settings button underneath the "NiFi Flow" text on the middle-left side of the screen. Selecting this should pop up the NiFi Flow Configuration screen. Then, select the "Controller Services" tab.



Configuring NiFi Services (2)

After that, press the "+" symbol near the top-right side of the table to add a service. We will need to add the following services:

- `JsonTreeReader`
- `JsonRecordSetWriter`
- `StandardRestrictedSSLContextService`
- `ElasticSearchClientServiceImpl`

The `JsonTreeReader` and `JsonRecordSetWriter` can both be enabled immediately by clicking on the lightning bolts to the right of their respective rows and selecting "Enable" in the window that pops up.

Note: once "Enable" has been clicked, the button will change to a "Cancel" button, so clicking again will cause the enable to be cancelled.

Configuring NiFi Services (3)

StandardRestrictedSSLContextService needs to be configured by clicking the Settings button on its row, then going to the Properties tab. Fill in the following properties:

- Keystore Filename: `keytool/keystore.p12`
- Keystore Password: `keystore`
- Key Password: (leave blank)
- Keystore Type: `PCKS12`
- Truststore Filename: `keytool/truststore.p12`
- Truststore Password: `truststore`
- Truststore Type: `PCKS12`

Then select apply.

Configuring NiFi Services (4)

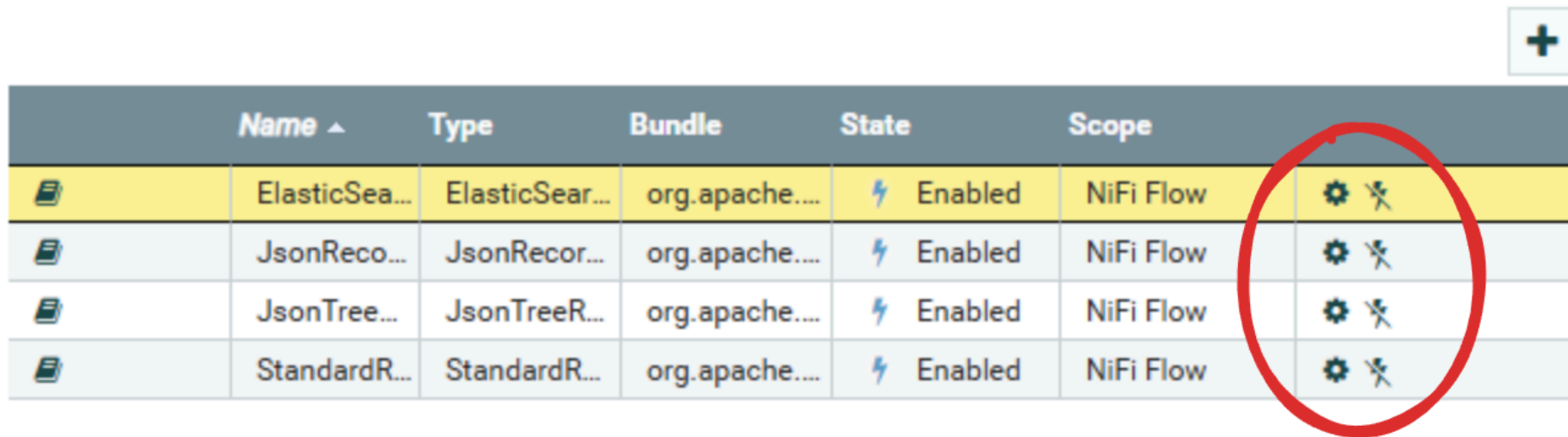
Next, we need to configure ElasticSearchClientServiceImpl. Click on the settings button to the right, and navigate to Properties. Enter the following settings:

















- HTTP Hosts: `https://opensearch-cluster-master:9200`
- Username: `admin`
- Password: `admin`
- SSL Context Service: `StandardRestrictedSSLContextService`

Click apply, then enable both the StandardRestrictedSSLContextService and the ElasticSearchClientServiceImpl.

Configuring NiFi Processors

Double check to ensure that all your services are properly enabled. Every service should have a crossed-out lightning bolt symbol as shown below:



	Name ▲	Type	Bundle	State	Scope	
	ElasticSea...	ElasticSear...	org.apache....	 Enabled	NiFi Flow	 
	JsonReco...	JsonRecor...	org.apache....	 Enabled	NiFi Flow	 
	JsonTree...	JsonTreeR...	org.apache....	 Enabled	NiFi Flow	 
	StandardR...	StandardR...	org.apache....	 Enabled	NiFi Flow	 

Once checked, exit out of the NiFi Flow Configuration screen. Now that all the services we need are enabled, we can add the processors. In the top left of the screen, find the Processors icon. Click and drag the icon to create a new processor. Find the "ConsumeKafkaRecord_2_6" processor and add it.

Configuring NiFi Processors (2)

Double click on the processor to open its settings, then set the following properties:

- Kafka Brokers: `kafka:9092`
- Topic Name(s): `filebeat`
- Value Record Reader: `JsonTreeReader`
- Record Value Writer: `JsonRecordSetWriter`
- Group ID: `nifi`
- Security Protocol: `SASL_PLAINTEXT`
- SASL Mechanism: `PLAIN`
- Username: `user1`
- Password: `kafka`

Note: The username and password fields do not appear until SASL Mechanism is set to `plain`.

Configuring NiFi Processors (3)

Create a PutElasticsearchRecord processor, and configure the following settings:

- Index: `filebeat`
- Client Service: `ElasticSearchClientServiceImpl`
- Record Reader: `JsonTreeReader`

Click apply.

Configuring NiFi Relationships

NiFi processors are connected with each other using relationships. All relationships need to be configured in order for a NiFi processor to be runnable. To view a processor's relationships, double click the processor to open its settings, then navigate to the "Relationships" tab to view its relationships.

For example, the "ConsumeKafkaRecord_2_6" processor has two relationships:

`success` , and `parse.failure` .

Configuring NiFi Relationships (2)

Below each relationship is a brief explanation. For example, in our case, if the event cannot be parsed by `JsonTreeReader`, the event will be sent to the `parse.failure` relationship. Every relationship has both a "terminate" and "retry" option.

SETTINGS	SCHEDULING	PROPERTIES	RELATIONSHIPS
----------	------------	------------	---------------

Automatically Terminate / Retry Relationships ?

parse.failure

☒ terminate ☐ retry

If a message from Kafka cannot be parsed using the configured Record Reader, the contents of the message will be routed to this Relationship as its own individual FlowFile.

success

☐ terminate ☐ retry

FlowFiles received from Kafka. Depending on demarcation strategy it is a flow file per message or a bundle of messages grouped by topic and partition.

Configuring NiFi Relationships (3)

Enabling the "retry" option will cause the event to be re-processed by the processor a set number of times in a configurable manner. The "terminate" option causes the event to be dropped. Both "retry" and "terminate" options can be enabled, which causes the event to be dropped after all retries have been exhausted.

Any relationship that does not have the "terminate" option enabled must be connected to another processor, even if "retry" is enabled on that relationship. In our case, we will be connecting our ConsumeKafkaRecord_2_6 processor's `success` relationship to our PutElasticsearchRecord processor.

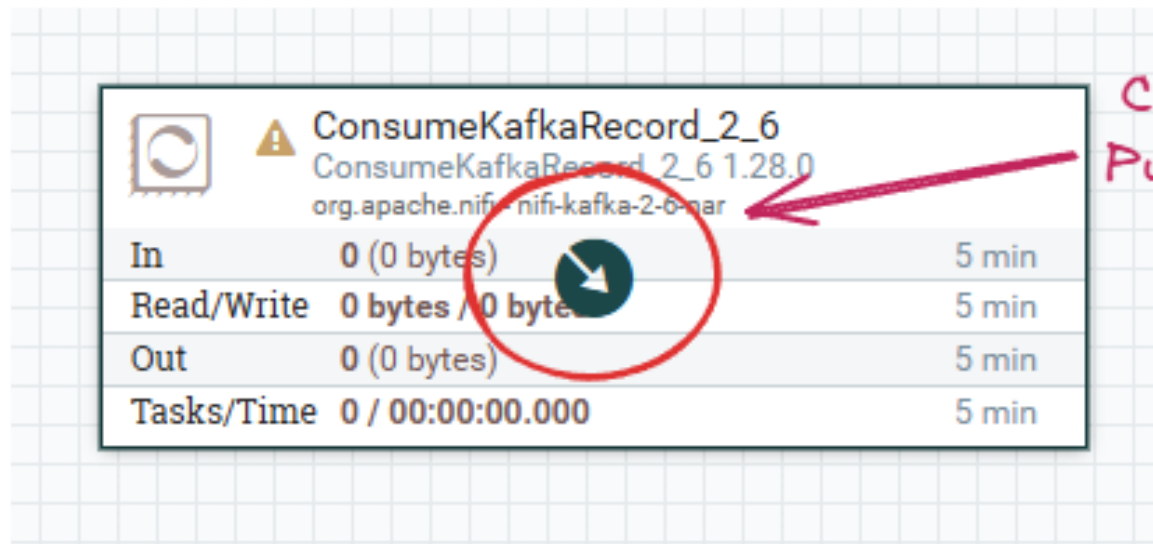
Configuring NiFi Relationships (4)

First, we need to terminate all the relationships we don't need. Open the ConsumeKafkaRecord_2_6 settings again. Go to the "Relationships" tab, and select "terminate" under `parse.failure`, and apply.

Then, open the PutElasticsearchRecord processor settings, go to the "Relationships" tab, and select "terminate" for all relationships. We will be handling errors later. Exit out of the processor's settings.

Configuring NiFi Relationships (5)

Now, hover over the ConsumeKafkaRecord_2_6 processor until an arrow appears in the middle of it. Drag the arrow to the PutElasticsearchRecord processor. Select the `success` relationship, and apply. This creates a connection for the `success` relationship between the ConsumeKafkaRecord_2_6 and the PutElasticsearchRecord processors.



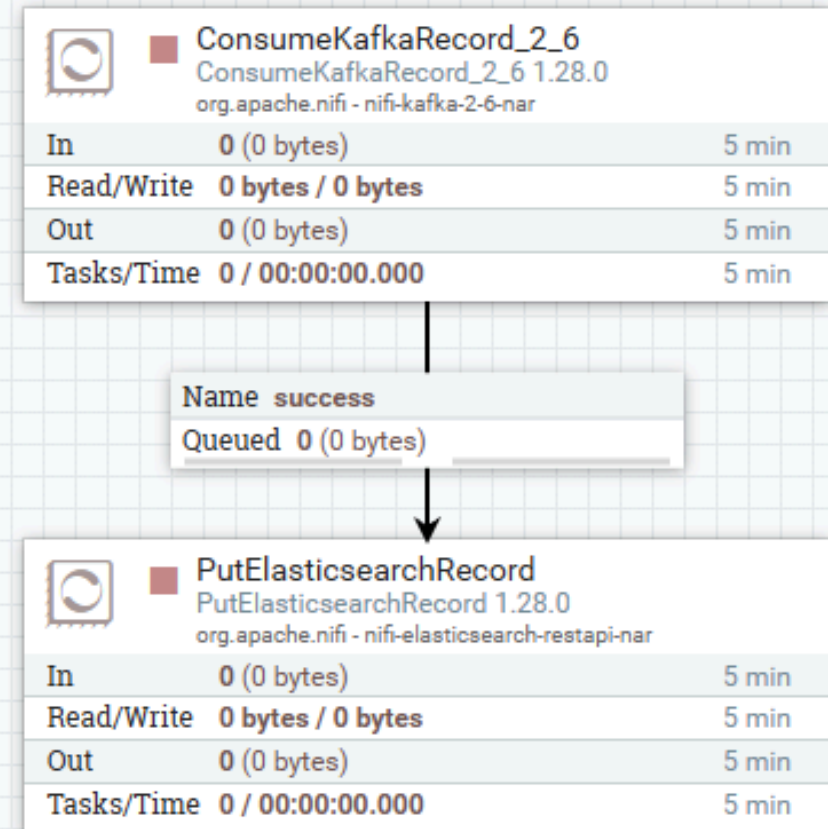
Click and drag this arrow to the PutElasticsearchRecord processor

Running NiFi processors

The screen should now look like this:

Now, for each processor, click on it once, and in the "Operate" panel on the left, select the "Play" button to run the processor.

Note: if your processors are still displaying a yellow triangle instead of a "Stop" symbol, it has not been configured correctly. You can hover over the triangle to see the error. Please ask for help if you are stuck and the yellow triangle doesn't go away.

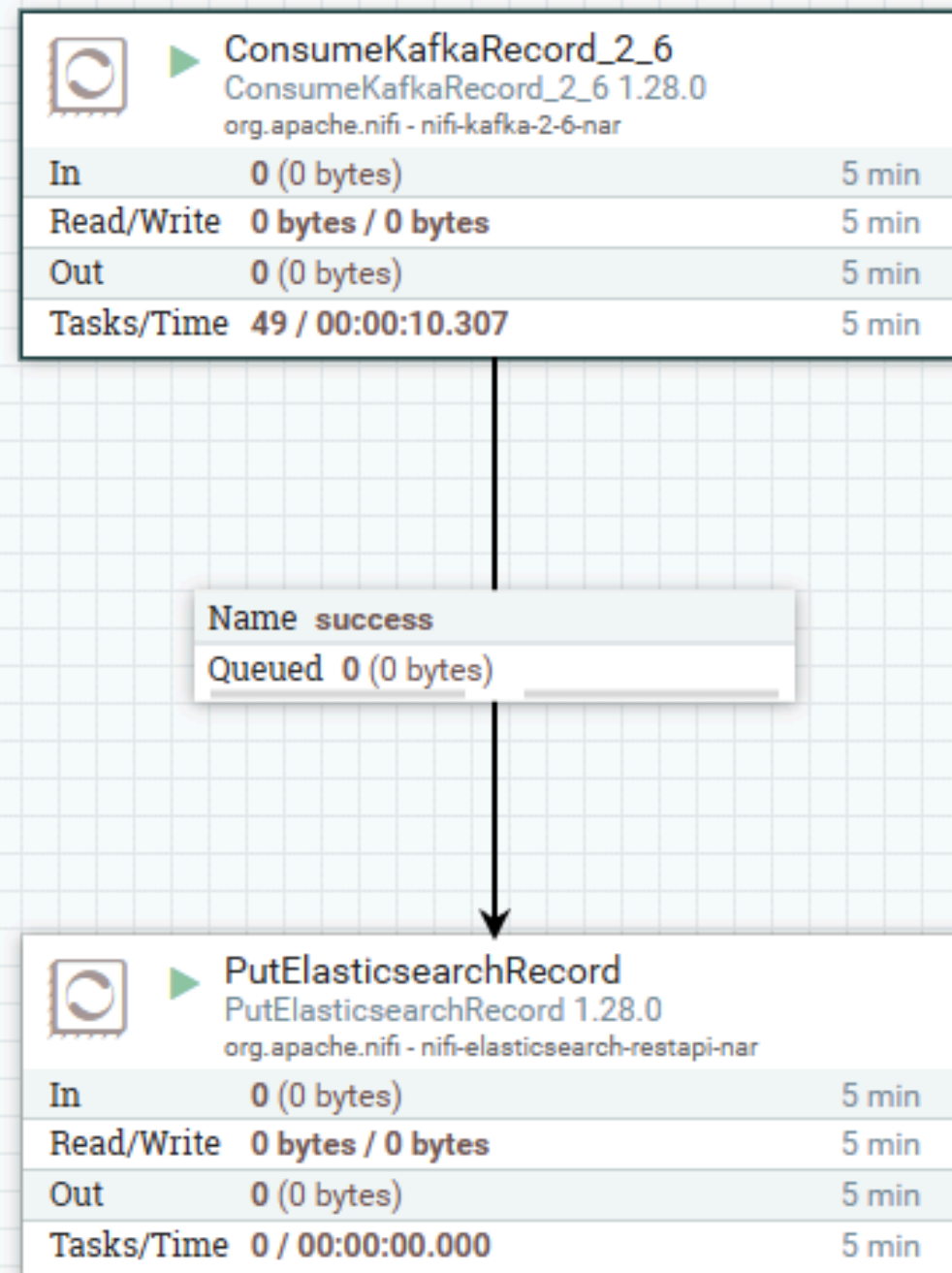


Running NiFi processors (2)

The screen should now look like this:

You can stop the processor again by clicking on it once, then selecting the "Stop" button in the "Operate" panel on the left.

Note: once a processor is running, its properties can no longer be edited. To edit the properties, stop the processor first. Once the processor is stopped, its properties can be edited again.



Configuring Other Processors

Duplicating processors: To duplicate a processor, right click on it and select "Copy". Then right click on any blank space and select "Paste" to paste a copy of the processor with identical configuration.

Hint: You can select multiple processors by holding down "Shift".

Mini-Exercise

Configure the processors for the *metricbeat*, *packetbeat*, and *prometheus* topics.

Ensure that both the Topic Name in the ConsumeKafkaRecord_2_6 processor and the Index in the PutElasticsearchRecord processor are set to the same value for consistency.

Inspecting FlowFiles

NiFi lets you inspect queued FlowFiles pretty easily. To do this, **you must first stop the PutElasticsearchRecord processor**. Then, right click the queue (i.e., the box labeled "success"). Then select "List queue". This shows a list of all FlowFiles in the queue.

You can select the "eye" icon to view its content. **(If you get an error, ensure you stopped the PutElasticsearchRecord processor that was downstream from the queue)**

In the "View as" selection box, select "formatted" to see the formatted JSON.

Common Issues

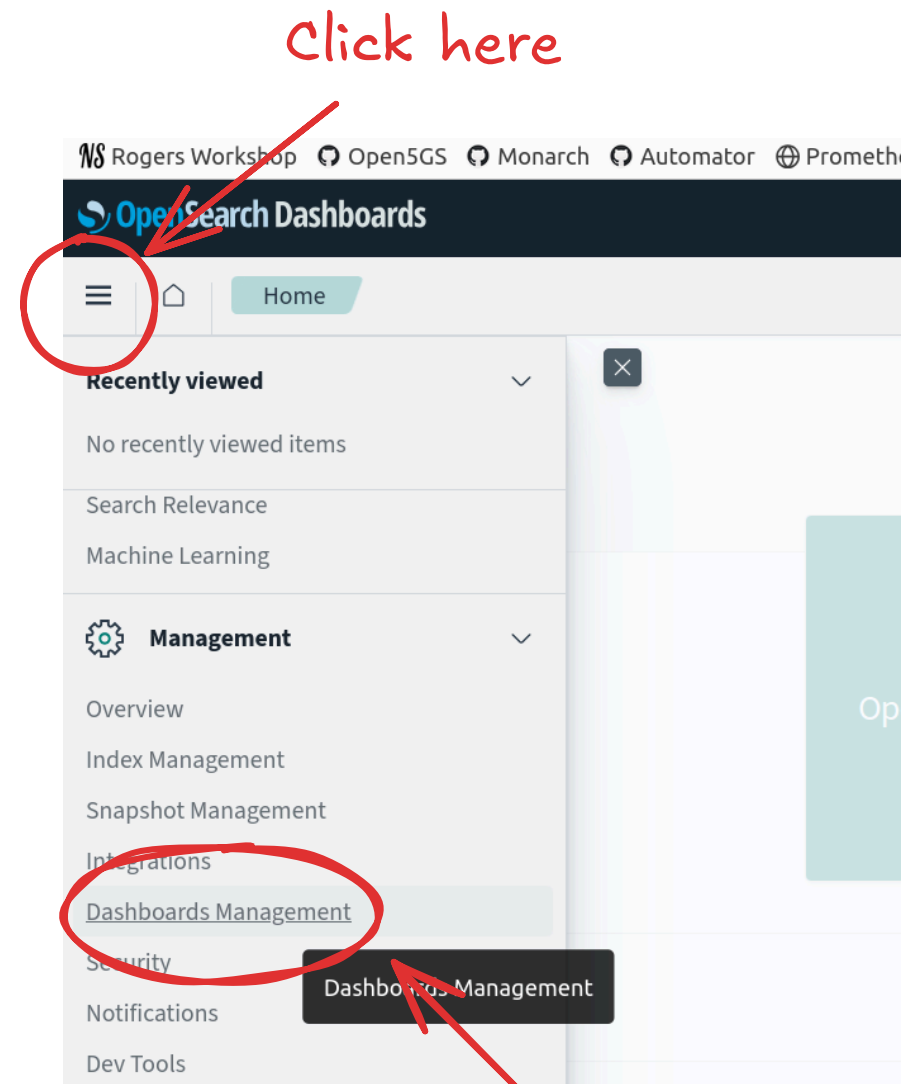
If no events are arriving at your ConsumeKafkaRecord_2_6 processors after a while, ensure that the settings are correct by double clicking it and verifying the processor's properties. Common mistakes include:

- Leaving the Kafka Brokers value as `localhost:9092` instead of setting it to `kafka:9092`
- Typos being present in the Topic Name(s) field

Configure OpenSearch

Now that everything is deployed, we can visualize it in OpenSearch. Go to <http://localhost:32001>. Log in using username `admin` and password `admin`, if prompted.

Select "Explore on my own". Close the dialog box about the new theme. Then, select the menu button on the top left, scroll down and select "Dashboards Management".



Then, scroll down until you see this option near the bottom

Configure OpenSearch (2)

Create index patterns with the names `filebeat`, `packetbeat`, `metricbeat`, `prometheus`, and `*beat,prometheus`. Set the "Time field" to the value `@timestamp` for all of them.

Hint: Click on "Index patterns" on the left to go back to the screen with the "Create index pattern" button.

The screenshot shows the OpenSearch Dashboards interface. The top navigation bar includes the 'OpenSearch Dashboards' logo and a 'Index patterns' tab. A red arrow points to a '+ Create index pattern' button in the top right corner, with the annotation '1. Create an index pattern by clicking here'. Below this, the 'Index patterns' configuration page is shown. The 'Index pattern name' field is highlighted with an orange circle and contains the text 'filebeat'. An orange arrow points to this field with the annotation '2. Fill in your index pattern name (should be either filebeat, metricbeat, packetbeat, prometheus, or *beat,prometheus)'. Below the name field, the 'Time field' dropdown menu is open, and '@timestamp' is selected and highlighted with an orange circle. An orange arrow points to this selection with the annotation '3. Select @timestamp as the time field'. A 'Next step >' button is visible to the right of the name field.

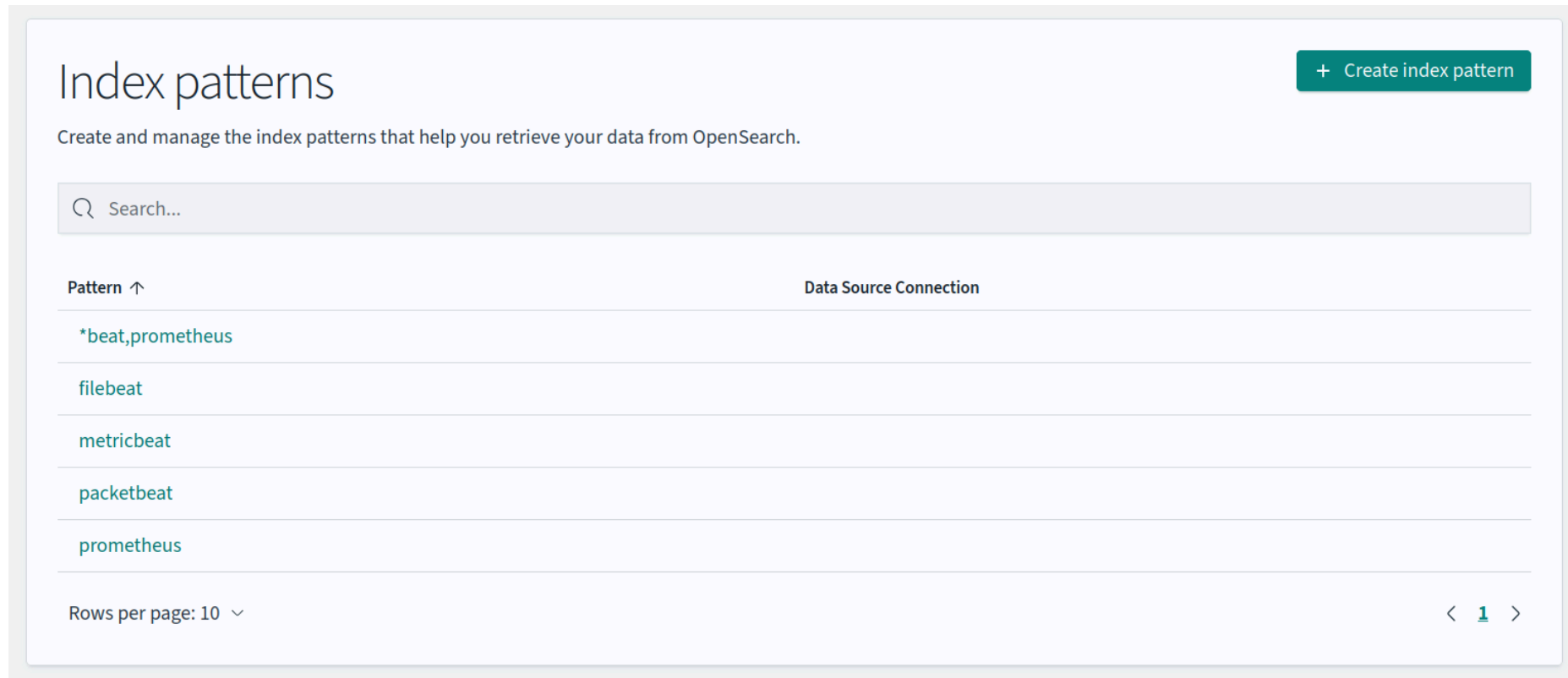
Configure OpenSearch (3)

What are index patterns?

Index patterns allow you to search one or more indices in OpenSearch at the same time. We created index patterns for each type of data so we could search them individually, but also defined a `*beat,prometheus` pattern that matches all four of our indices.

Check OpenSearch Configuration

Once you have created all your patterns, you should see the following:



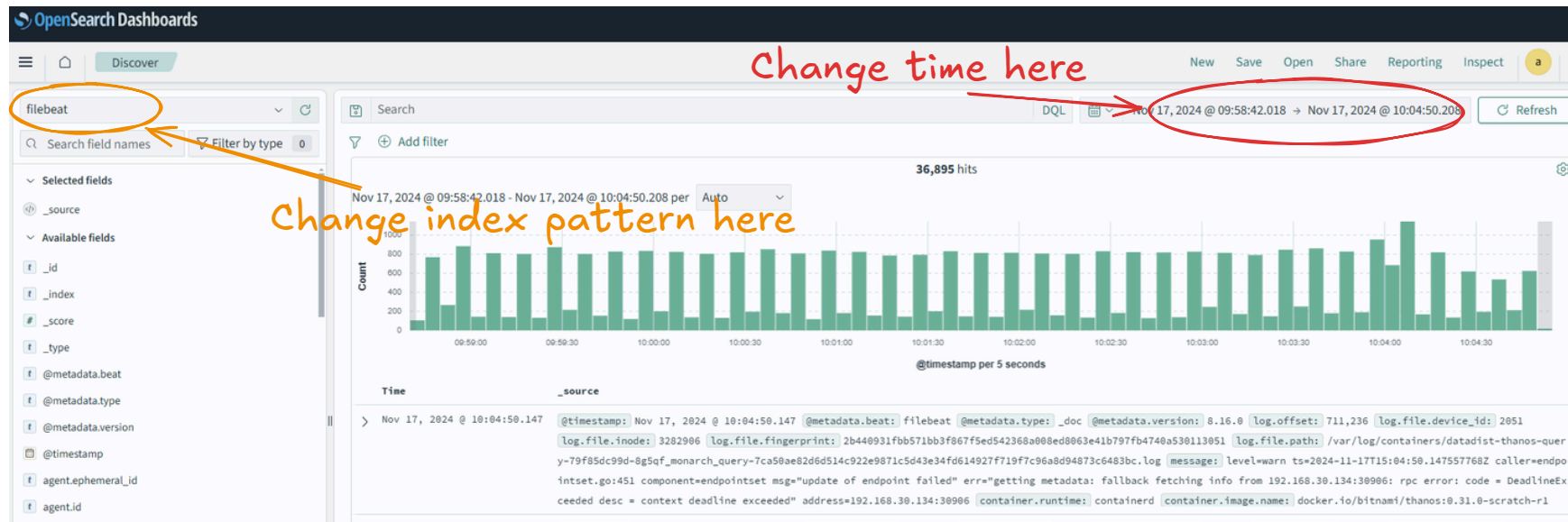
The screenshot shows the 'Index patterns' page in OpenSearch. At the top, there's a title 'Index patterns' and a '+ Create index pattern' button. Below the title is a subtitle: 'Create and manage the index patterns that help you retrieve your data from OpenSearch.' A search bar is present. The main content is a table with two columns: 'Pattern' and 'Data Source Connection'. The table lists five patterns: '*beat,prometheus', 'filebeat', 'metricbeat', 'packetbeat', and 'prometheus'. At the bottom, there's a 'Rows per page: 10' dropdown and a pagination control showing page 1 of 1.

Pattern	Data Source Connection
*beat,prometheus	
filebeat	
metricbeat	
packetbeat	
prometheus	

If some patterns were added but don't show up, try refreshing the page.

Searching Data

Open the menu, and select "Discover". Discover should look like this:



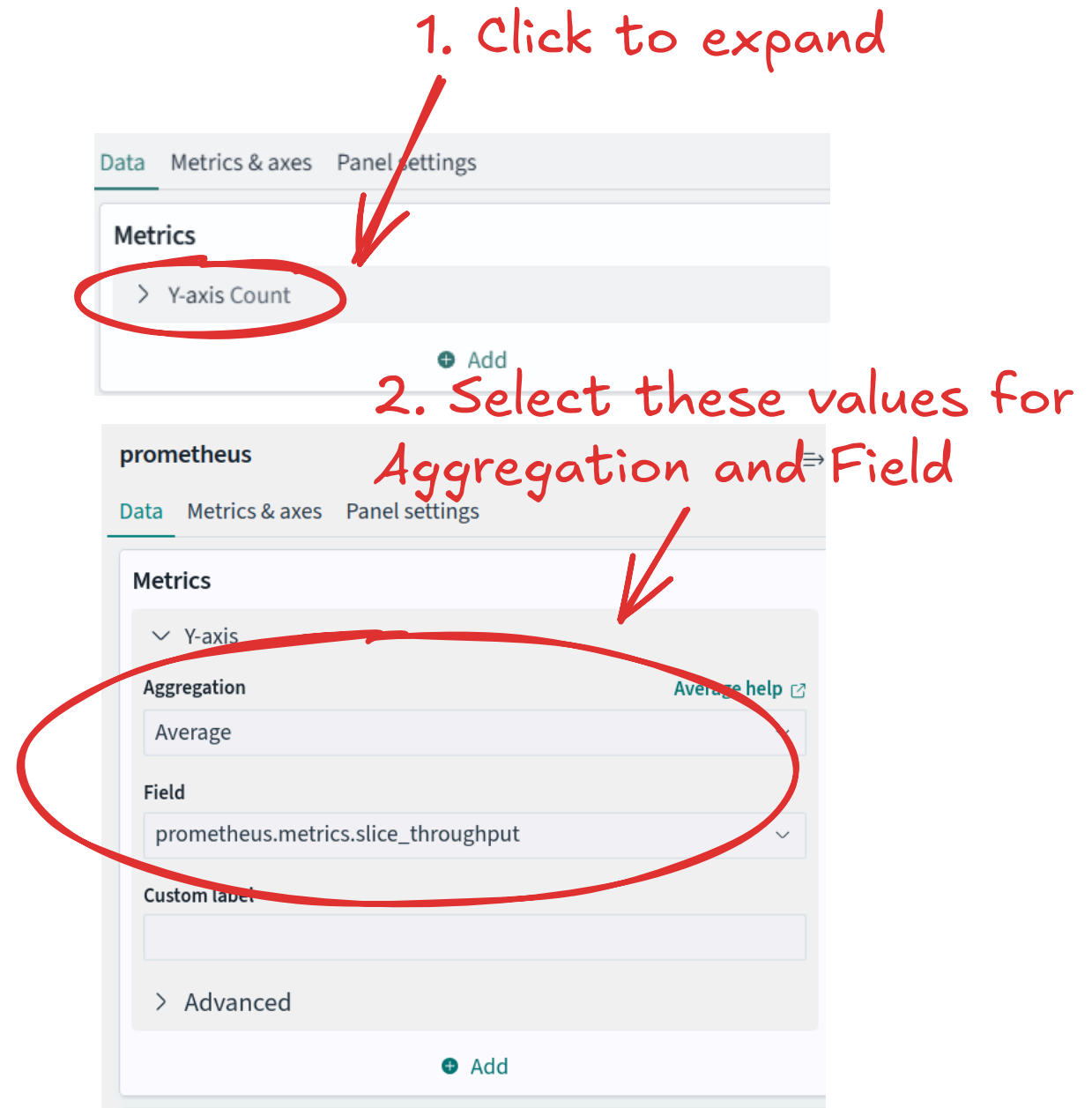
If you do not see any data, you can change the search time frame on the top right input to the left of the "Refresh" button. A relative time of "Past 1 hour" should yield some results. You can also change the index pattern using the field on the left side of the screen, to the left of the search box.

Creating Visualizations

Create a visualization to view data. To do this, select the menu button, and navigate to Visualize.

Create a new "Line" visualization, and choose the `prometheus` index pattern.

Click on the Y-axis to expand the aggregation. Select the `average` aggregation. For the field, select `prometheus.metric.slice_throughput` metric.



Creating Visualizations (2)

Add an X-axis by selecting "Add" below the "Bucket" panel in the bottom right side of the screen. Add a date histogram to the X-axis using the `@timestamp` field. Press the Update button in the bottom right to apply changes. Save the visualization by pressing Save on the top right. Give the visualization a title and optionally a description.

The screenshot shows the configuration interface for a visualization. It includes a 'Custom label' field, an 'ADD BUCKET' button, and a 'Buckets' panel. The 'Buckets' panel has a dropdown for 'X-axis', an 'Aggregation' section with a 'Date Histogram' option, a 'Field' section with '@timestamp' selected, and a 'Minimum interval' section with 'Auto' selected. There are also checkboxes for 'Drop partial buckets' and a 'Custom label' field. At the bottom, there are 'Discard' and 'Update' buttons.

2. Select X-axis

1. Add a bucket

3. Set the values "Date Histogram" for Aggregation and "@timestamp" for Field

4. Click the Update button to apply changes

Checking Visualization Configuration

If done correctly, your visualization settings should match the image on the right.

The image shows a Prometheus visualization configuration interface. At the top, the title 'prometheus' is displayed with a menu icon. Below the title, there are three tabs: 'Data' (selected), 'Metrics & axes', and 'Panel settings'. The main content area is divided into two sections: 'Metrics' and 'Buckets'.

Metrics Section:

- Y-axis:** A dropdown menu showing 'Average'. To the right of the dropdown is a link 'Average help' with an external link icon.
- Field:** A dropdown menu showing 'prometheus.metrics.slice_throughput'.
- Custom label:** An empty text input field.
- Advanced:** A link with a right-pointing chevron.
- Add:** A green button with a plus icon and the text 'Add'.

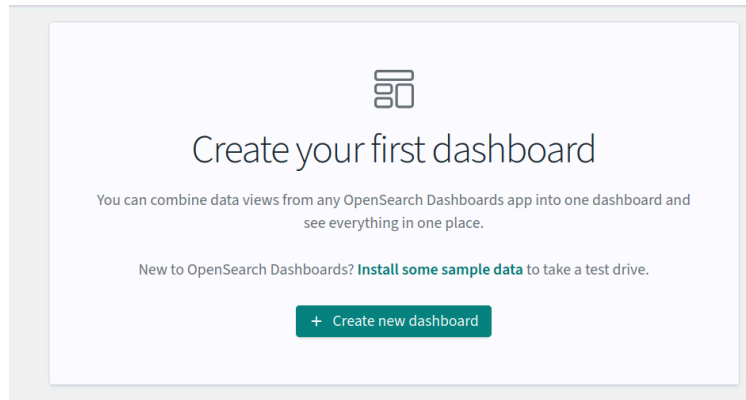
Buckets Section:

- X-axis:** A dropdown menu showing 'Date Histogram'. To the right of the dropdown are icons for visibility (an eye) and a close button (an 'X').
- Aggregation:** A dropdown menu showing 'Date Histogram'. To the right of the dropdown is a link 'Date Histogram help' with an external link icon.
- Field:** A dropdown menu showing '@timestamp'.
- Minimum interval:** A dropdown menu showing 'Auto'. To the right of the dropdown is a link with an external link icon.
- Examples:** Below the dropdown, text reads: 'Select an option or create a custom value. Examples: 30s, 20m, 24h, 2d, 1w, 1M'.
- Drop partial buckets:** A toggle switch that is currently turned off.
- Custom label:** An empty text input field.
- Advanced:** A link with a right-pointing chevron.
- Add:** A green button with a plus icon and the text 'Add'.

Creating Dashboards

Create a dashboard to view a collection of visualizations. Select the menu button, and navigate to Dashboards under `OpenSearch Dashboards` .

Note: Be careful not to select the Observability dashboards. You should see a screen like the image below.



Select "Create new dashboard", then select "Add an existing", and add the visualization you just created. Press save on the top right and give it a title and optionally a description.

NiFi Enrichment

If time permits, the NiFi enrichment slides can be found [here](#).

NiFi Error Handling

If time permits, the NiFi error handling slides can be found [here](#).

Next Steps

Congratulations!

You have successfully completed the following:

- Deployed a highly available data pipeline
- Configured agents to collect statistics from custom Prometheus exporters
- Learned about how to transform, enrich, and handle errors in data using NiFi
- Explored the data being sent by the agents using OpenSearch Dashboards

What's Next?

In the afternoon session, we will dive into [5G slice modeling and dynamic resource scaling](#).