

Apache NiFi User Guide

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Introduction

Apache NiFi is a dataflow system based on the concepts of flow-based programming. It supports powerful and scalable directed graphs of data routing, transformation, and system mediation logic. NiFi has a web-based user interface for design, control, feedback, and monitoring of dataflows. It is highly configurable along several dimensions of quality of service, such as loss-tolerant versus guaranteed delivery, low latency versus high throughput, and priority-based queuing. NiFi provides fine-grained data provenance for all data received, forked, joined cloned, modified, sent, and ultimately dropped upon reaching its configured end-state.

See the [System Administrator's Guide](#) for information about system requirements, installation, and configuration. Once NiFi is installed, use a supported web browser to view the UI.

Browser Support

Browser	Version
Chrome	Current and Current - 1
FireFox	Current and Current - 1
Edge	Current and Current - 1
Safari	Current and Current - 1

Current and Current - 1 indicates that the UI is supported in the current stable release of that browser and the preceding one. For instance, if the current stable release is 45.X then the officially supported versions will be 45.X and 44.X.

For Safari, which releases major versions much less frequently, Current and Current - 1 simply represent the two latest releases.

The supported browser versions are driven by the capabilities the UI employs and the dependencies it uses. UI features will be developed and tested against the supported browsers. Any problem using a supported browser should be reported to Apache NiFi.

Unsupported Browsers

While the UI may run successfully in unsupported browsers, it is not actively tested against them. Additionally, the UI is designed as a desktop experience and is not currently supported in mobile browsers.

Viewing the UI in Variably Sized Browsers

In most environments, all of the UI is visible in your browser. However, the UI has a responsive design that allows you to scroll through screens as needed, in smaller sized browsers or tablet environments.

In environments where your browser width is less than 800 pixels and the height less than 600 pixels, portions of the UI may become unavailable.

Terminology

NiFi Clustering is unique and has its own terminology. It's important to understand the following terms before setting up a cluster:

NiFi Cluster Coordinator: A NiFi Cluster Coordinator is the node in a NiFi cluster that is responsible for carrying out tasks to manage which nodes are allowed in the cluster and providing the most up-to-date flow to newly joining nodes. When a DataFlow Manager manages a dataflow in a cluster, they are able to do so through the User Interface of any node in the cluster. Any change made is then replicated to all nodes in the cluster.

Nodes: Each cluster is made up of one or more nodes. The nodes do the actual data processing.

Primary Node: Every cluster has one Primary Node. On this node, it is possible to run "Isolated Processors" (see below). ZooKeeper is used to automatically elect a Primary Node. If that node disconnects from the cluster for any reason, a new Primary Node will automatically be elected. Users can determine which node is currently elected as the Primary Node by looking at the Cluster Management page of the User Interface.

The screenshot shows the 'NiFi Cluster' management page. It has tabs for 'NODES', 'SYSTEM', 'JVM', 'FLOWFILE STORAGE', and 'CONT'. The 'NODES' tab is selected. Below the tabs, it says 'Displaying 2 of 2'. There is a 'Filter' input field and a dropdown menu set to 'by address'. Below this is a table with the following data:

	Node Address	Active Thread Count	Queue / Size	Status
	localhost:9443	0	10 / 0 bytes	CONNECT
	localhost:9444	0	10 / 0 bytes	CONNECT

At the bottom left, there is a refresh icon and the text 'Last updated: 15:06:27 EDT'. The footer of the interface says 'NiFi Flow'.

Isolated Processors: In a NiFi cluster, the same dataflow runs on all the nodes. As a result, every component in the flow runs on every node. However, there may be cases when the DFM would not want every processor to run on every node. The most common case is when using a processor that communicates with an external service using a protocol that does not scale well. For example, the GetSFTP processor pulls from a remote directory. If the GetSFTP

Processor runs on every node in the cluster and tries simultaneously to pull from the same remote directory, there could be race conditions. Therefore, the DFM could configure the GetSFTP on the Primary Node to run in isolation, meaning that it only runs on that node. With the proper dataflow configuration, it could pull in data and load-balance it across the rest of the nodes in the cluster. Note that while this feature exists, it is also very common to simply use a standalone NiFi instance to pull data and feed it to the cluster. It just depends on the resources available and how the Administrator decides to configure the cluster.

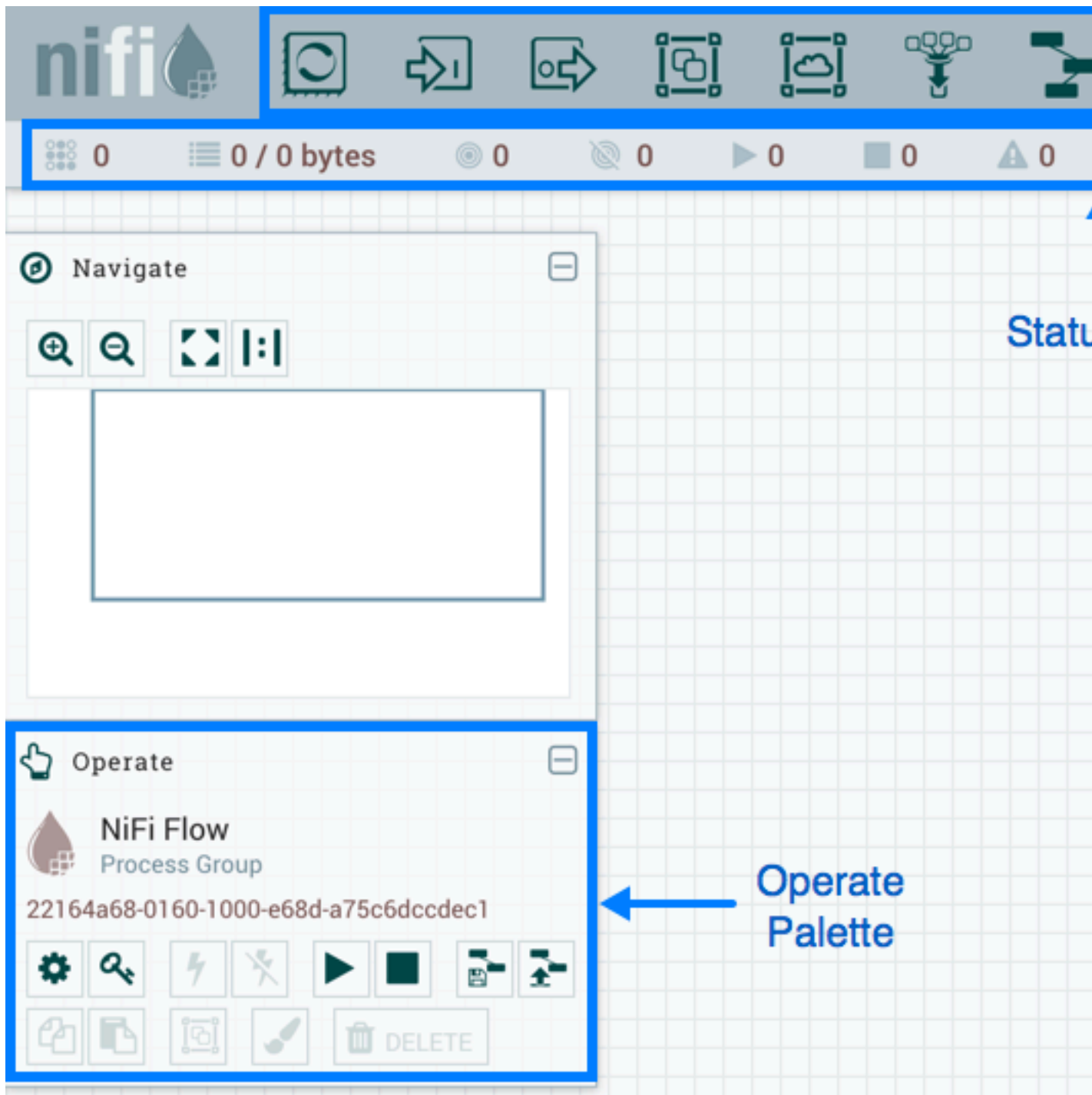
Heartbeats: The nodes communicate their health and status to the currently elected Cluster Coordinator via "heartbeats", which let the Coordinator know they are still connected to the cluster and working properly. By default, the nodes emit heartbeats every 5 seconds, and if the Cluster Coordinator does not receive a heartbeat from a node within 40 seconds, it disconnects the node due to "lack of heartbeat". The 5-second setting is configurable in the `nifi.properties` file. The reason that the Cluster Coordinator disconnects the node is because the Coordinator needs to ensure that every node in the cluster is in sync, and if a node is not heard from regularly, the Coordinator cannot be sure it is still in sync with the rest of the cluster. If, after 40 seconds, the node does send a new heartbeat, the Coordinator will automatically request that the node re-join the cluster, to include the re-validation of the node's flow. Both the disconnection due to lack of heartbeat and the reconnection once a heartbeat is received are reported to the DFM in the User Interface.

NiFi User Interface

The NiFi UI provides mechanisms for creating automated dataflows, as well as visualizing, editing, monitoring, and administering those dataflows. The UI can be broken down into several segments, each responsible for different functionality of the application. This section provides screenshots of the application and highlights the different segments of the UI. Each segment is discussed in further detail later in the document.

When the application is started, the user is able to navigate to the UI by going to the default address of `http://<host name>:8080/nifi` in a web browser. There are no permissions configured by default, so anyone is able to view and modify the dataflow. For information on securing the system, see the [System Administrator's Guide](#).

When a DFM navigates to the UI for the first time, a blank canvas is provided on which a dataflow can be built:

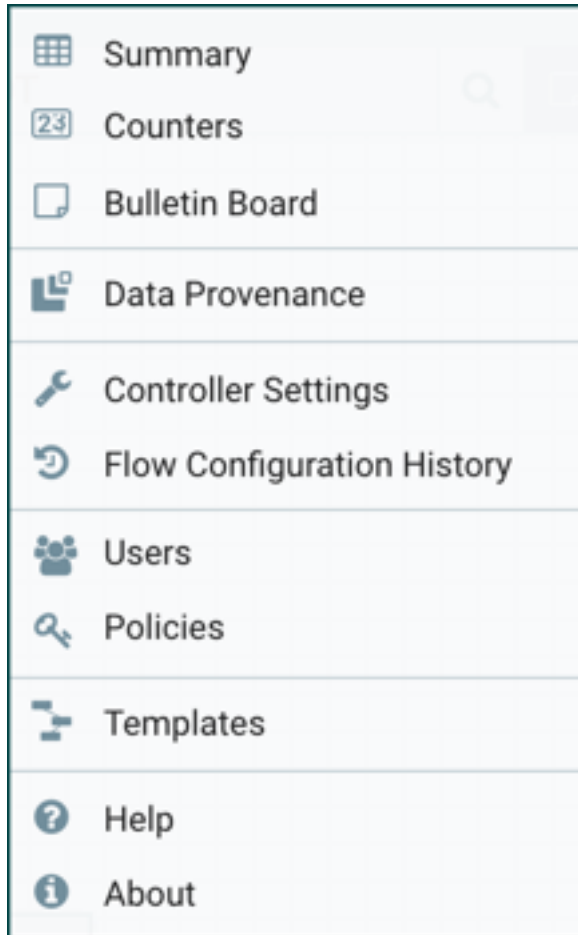


The Components Toolbar runs across the top left portion of your screen. It consists of the components you can drag onto the canvas to build your dataflow. Each component is described in more detail in [Building a DataFlow](#).

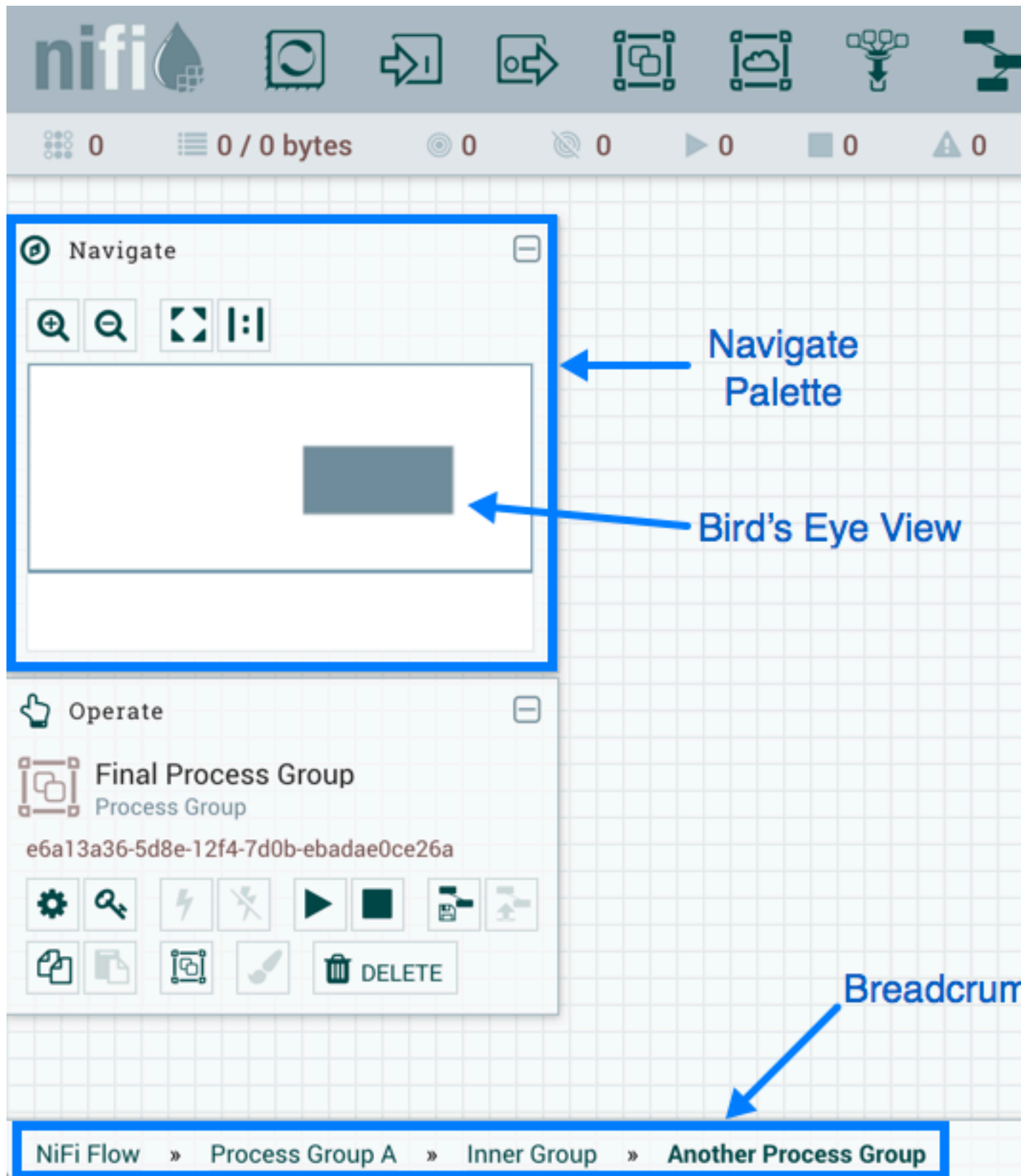
The Status Bar is under the Components Toolbar. The Status bar provides information about the number of threads that are currently active in the flow, the amount of data that currently exists in the flow, how many Remote Process Groups exist on the canvas in each state (Transmitting, Not Transmitting), how many Processors exist on the canvas in each state (Stopped, Running, Invalid, Disabled), how many versioned Process Groups exist on the canvas in each state (Up to date, Locally modified, Stale, Locally modified and stale, Sync failure) and the timestamp at which all of this information was last refreshed. Additionally, if the instance of NiFi is clustered, the Status bar shows how many nodes are in the cluster and how many are currently connected.

The Operate Palette sits to the left-hand side of the screen. It consists of buttons that are used by DFMs to manage the flow, as well as by administrators who manage user access and configure system properties, such as how many system resources should be provided to the application.

On the right side of the canvas is Search, and the Global Menu. You can use Search to easily find components on the canvas and to search by component name, type, identifier, configuration properties, and their values. The Global Menu contains options that allow you to manipulate existing components on the canvas:



Additionally, the UI has some features that allow you to easily navigate around the canvas. You can use the Navigate Palette to pan around the canvas, and to zoom in and out. The "Birds Eye View" of the dataflow provides a high-level view of the dataflow and allows you to pan across large portions of the dataflow. You can also find breadcrumbs along the bottom of the screen. As you navigate into and out of Process Groups, the breadcrumbs show the depth in the flow, and each Process Group that you entered to reach this depth. Each of the Process Groups listed in the breadcrumbs is a link that will take you back up to that level in the flow.



Accessing the UI with Multi-Tenant Authorization

Multi-tenant authorization enables multiple groups of users (tenants) to command, control, and observe different parts of the dataflow, with varying levels of authorization. When an authenticated user attempts to view or modify a NiFi resource, the system checks whether the user has privileges to perform that action. These privileges are defined by policies that you can apply system wide or to individual components. What this means from a Dataflow Manager perspective is that once you have access to the NiFi canvas, a range of functionality is visible and available to you, depending on the privileges assigned to you.

The available global access policies are:

Policy	Privilege
view the UI	Allows users to view the UI
access the controller	Allows users to view and modify the controller including reporting tasks, Controller Services, and nodes in the cluster
query provenance	Allows users to submit a provenance search and request even lineage
access restricted components	Allows users to create/modify restricted components assuming other permissions are sufficient. The restricted components may indicate which specific permissions are required. Permissions can be granted for specific restrictions or be granted regardless of restrictions. If permission is granted regardless of restrictions, the user can create/modify all restricted components.
access all policies	Allows users to view and modify the policies for all components
access users/groups	Allows users to view and modify the users and user groups
retrieve site-to-site details	Allows other NiFi instances to retrieve Site-To-Site details
view system diagnostics	Allows users to view System Diagnostics
proxy user requests	Allows proxy machines to send requests on the behalf of others
access counters	Allows users to view and modify counters

The available component-level access policies are:

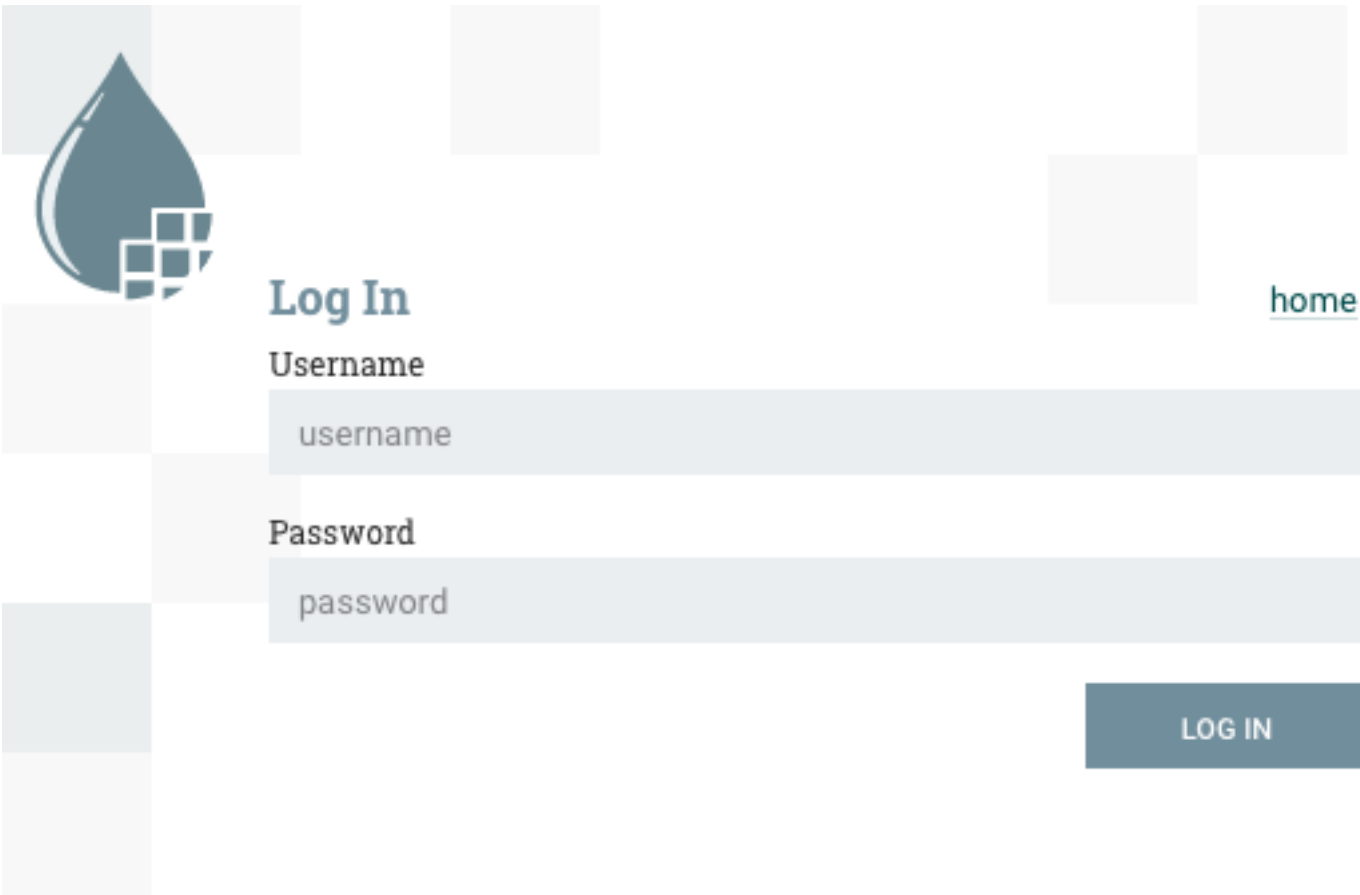
Policy	Privilege
view the component	Allows users to view component configuration details
modify the component	Allows users to modify component configuration details
view provenance	Allows users to view provenance events generated by this component
view the data	Allows users to view metadata and content for this component in flowfile queues in outbound connections and through provenance events
modify the data	Allows users to empty flowfile queues in outbound connections and submit replays through provenance events
view the policies	Allows users to view the list of users who can view and modify a component
modify the policies	Allows users to modify the list of users who can view and modify a component
retrieve data via site-to-site	Allows a port to receive data from NiFi instances
send data via site-to-site	Allows a port to send data from NiFi instances

If you are unable to view or modify a NiFi resource, contact your System Administrator or see [Configuring Users and Access Policies](#) in the [System Administrator's Guide](#) for more information.

Logging In

If NiFi is configured to run securely, users will be able to request access to the DataFlow. For information on configuring NiFi to run securely, see the [System Administrator's Guide](#). If NiFi supports anonymous access, users will be given access accordingly and given an option to log in.

Clicking the 'login' link will open the log in page. If the user is logging in with their username/password they will be presented with a form to do so. If NiFi is not configured to support anonymous access and the user is logging in with their username/password, they will be immediately sent to the login form bypassing the canvas.

The image shows a login form for NiFi. On the left is the NiFi logo, a blue water drop with a white grid pattern. To the right of the logo is the text "Log In" in a bold, dark blue font. Below "Log In" are two input fields: "Username" and "Password". The "Username" field contains the text "username" and the "Password" field contains the text "password". To the right of the "Log In" text is a link labeled "home" in a dark blue font. At the bottom right of the form is a dark blue button with the text "LOG IN" in white capital letters.

Building a DataFlow

A DFM is able to build an automated dataflow using the NiFi UI. Simply drag components from the toolbar to the canvas, configure the components to meet specific needs, and connect the components together.

Adding Components to the Canvas

The User Interface section above outlined the different segments of the UI and pointed out a Components Toolbar. This section looks at each of the Components in that toolbar:



Processor: The Processor is the most commonly used component, as it is responsible for data ingress, egress, routing, and manipulating. There are many different types of Processors. In fact, this is a very common Extension Point in NiFi, meaning that many vendors may implement their own Processors to perform whatever functions are necessary for their use case. When a Processor is dragged onto the canvas, the user is presented with a dialog to choose which type of Processor to use:

Add Processor

Source

Displaying 219 of 219

all groups ▼	Type ▲	Version	Tags
amazon attributes	AttributeRollingWindow	1.2.0	rolling, da
avro aws consume	AttributesToJSON	1.2.0	flowfile, js
csv database fetch	Base64EncodeContent	1.2.0	encode, b
files get hadoop	CaptureChangeMySQL	1.2.0	cdc, jdbc,
ingest input insert	CompareFuzzyHash	1.2.0	fuzzy-has
json listen logs	CompressContent	1.2.0	lzma, dec
message put	ConnectWebSocket	1.2.0	subscribe
remote restricted	ConsumeAMQP	1.2.0	receive, a
source sql text	ConsumeEWS	1.2.0	EWS, Excl
update	ConsumeIMAP	1.2.0	Imap, Em
	ConsumeJMS	1.2.0	jms, recei
	ConsumeKafka	1.2.0	PubSub, C

AttributeRollingWindow 1.2.0 org.apache.nifi -

Track a Rolling Window based on evaluating an Expression and add that value to the processor's state. Each FlowFile's FlowFiles and total aggregate value of values processed

In the top-right corner, the user is able to filter the list based on the Processor Type or the Tags associated with a Processor. Processor developers have the ability to add Tags to their Processors. These tags are used in this dialog for filtering and are displayed on the left-hand side in a Tag Cloud. The more Processors that exist with a particular

Tag, the larger the Tag appears in the Tag Cloud. Clicking a Tag in the Cloud will filter the available Processors to only those that contain that Tag. If multiple Tags are selected, only those Processors that contain all of those Tags are shown. For example, if we want to show only those Processors that allow us to ingest files, we can select both the files Tag and the ingest Tag:

Add Processor

Source

Displaying 11 of 219


all groups ▼


amazon attributes
 avro aws consume
 csv database fetch
 files get hadoop
 ingest input insert
 json listen logs
 message put remote
 restricted source sql
 text update

Type ▲	Version	T
FetchFTP	1.2.0	
FetchFile	1.2.0	
FetchSFTP	1.2.0	
GetFTP	1.2.0	
GetFile	1.2.0	
GetHDFS	1.2.0	
GetSFTP	1.2.0	
ListFTP	1.2.0	
ListFile	1.2.0	
ListHDFS	1.2.0	
ListSFTP	1.2.0	

FetchFTP 1.2.0 org.apache.nifi - nifi-standards

Fetches the content of a file from a remote SFTP server and returns the content of the remote file.

Restricted components will be marked with a  icon next to their name. These are components that can be used to execute arbitrary unsanitized code provided by the operator through the NiFi REST API/UI or can be used to obtain or alter data on the NiFi host system using the NiFi OS credentials. These components could be used by an otherwise authorized NiFi user to go beyond the intended use of the application, escalate privilege, or could expose data about the internals of the NiFi process or the host system. All of these capabilities should be considered privileged, and admins should be aware of these capabilities and explicitly enable them for a subset of trusted users. Before a user is allowed to create and modify restricted components they must be granted access. Hovering over

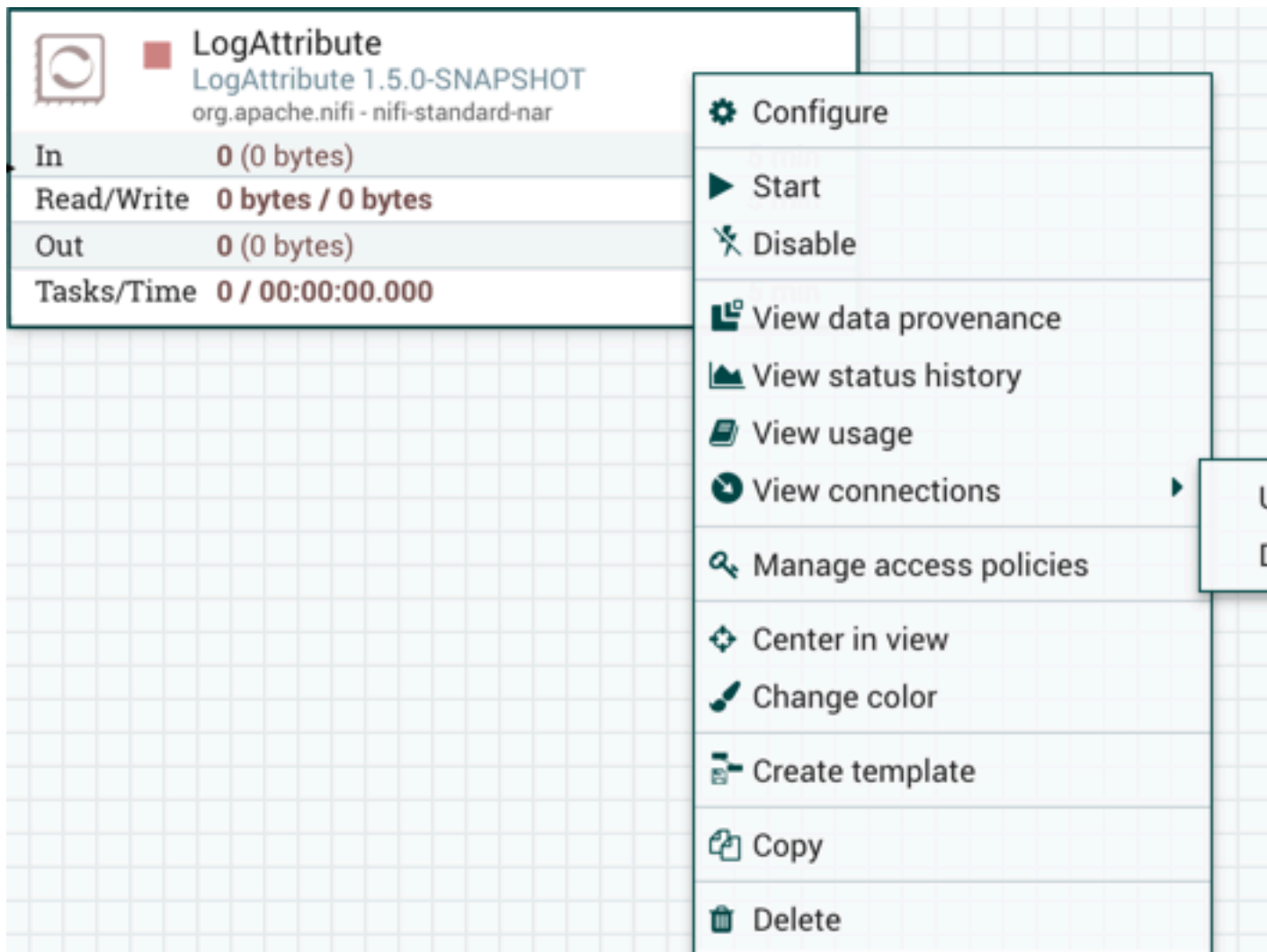
the  icon will display the specific permissions a restricted component requires. Permissions can be assigned regardless of restrictions. In this case, the user will have access to all restricted components. Alternatively, users can be assigned access to specific restrictions. If the user has been granted access to all restrictions a component requires, they will have access to that component assuming otherwise sufficient permissions. For more information refer to [Accessing the UI with Multi-Tenant Authorization](#) and [Restricted Components in Versioned Flows](#).

Clicking the "Add" button or double-clicking on a Processor Type will add the selected Processor to the canvas at the location that it was dropped.



Note: For any component added to the canvas, it is possible to select it with the mouse and move it anywhere on the canvas. Also, it is possible to select multiple items at once by either holding down the Shift key and selecting each item or by holding down the Shift key and dragging a selection box around the desired components.

Once you have dragged a Processor onto the canvas, you can interact with it by right-clicking on the Processor and selecting an option from the context menu. The options available to you from the context menu vary, depending on the privileges assigned to you.



While the options available from the context menu vary, the following options are typically available when you have full privileges to work with a Processor:

- **Configure:** This option allows the user to establish or change the configuration of the Processor (see [Configuring a Processor](#)).



Note: For Processors, Ports, Remote Process Groups, Connections and Labels, it is possible to open the configuration dialog by double-clicking on the desired component.

- **Start or Stop:** This option allows the user to start or stop a Processor; the option will be either Start or Stop, depending on the current state of the Processor.
- **Enable or Disable:** This option allows the user to enable or disable a Processor; the option will be either Enable or Disable, depending on the current state of the Processor.
- **View data provenance:** This option displays the NiFi Data Provenance table, with information about data provenance events for the FlowFiles routed through that Processor (see [Data Provenance](#)).
- **View status history:** This option opens a graphical representation of the Processor's statistical information over time.
- **View usage:** This option takes the user to the Processor's usage documentation.
- **View connections#Upstream:** This option allows the user to see and "jump to" upstream connections that are coming into the Processor. This is particularly useful when processors connect into and out of other Process Groups.

- View connections#Downstream: This option allows the user to see and "jump to" downstream connections that are going out of the Processor. This is particularly useful when processors connect into and out of other Process Groups.
- Center in view: This option centers the view of the canvas on the given Processor.
- Change color: This option allows the user to change the color of the Processor, which can make the visual management of large flows easier.
- Create template: This option allows the user to create a template from the selected Processor.
- Copy: This option places a copy of the selected Processor on the clipboard, so that it may be pasted elsewhere on the canvas by right-clicking on the canvas and selecting Paste. The Copy/Paste actions also may be done using the keystrokes Ctrl-C (Command-C) and Ctrl-V (Command-V).
- Delete: This option allows the DFM to delete a Processor from the canvas.



Input Port: Input Ports provide a mechanism for transferring data into a Process Group. When an Input Port is dragged onto the canvas, the DFM is prompted to name the Port. All Ports within a Process Group must have unique names.

All components exist only within a Process Group. When a user initially navigates to the NiFi page, the user is placed in the Root Process Group. If the Input Port is dragged onto the Root Process Group, the Input Port provides a mechanism to receive data from remote instances of NiFi via [Site-to-Site](#). In this case, the Input Port can be configured to restrict access to appropriate users, if NiFi is configured to run securely. For information on configuring NiFi to run securely, see the [System Administrator's Guide](#).



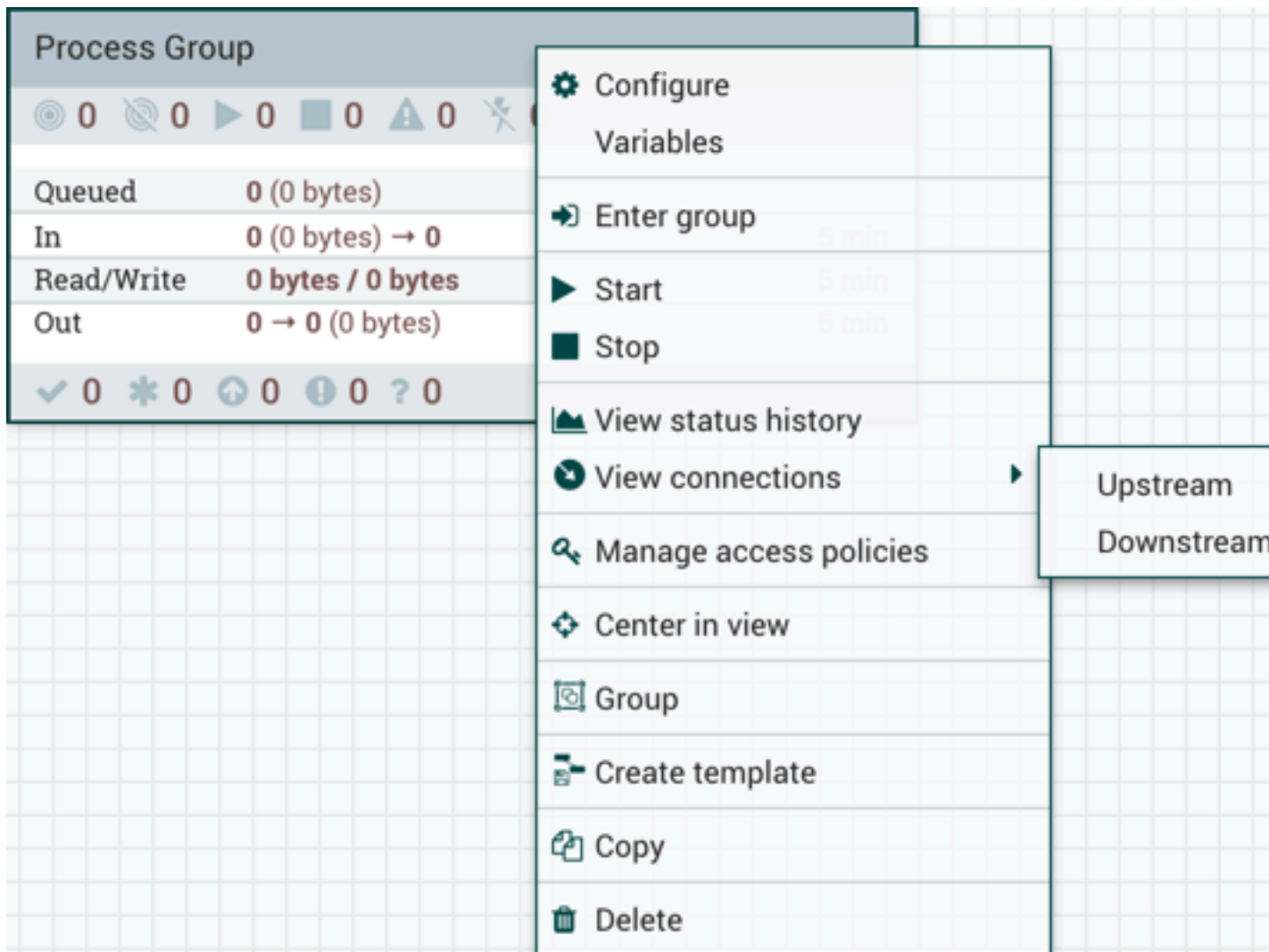
Output Port: Output Ports provide a mechanism for transferring data from a Process Group to destinations outside of the Process Group. When an Output Port is dragged onto the canvas, the DFM is prompted to name the Port. All Ports within a Process Group must have unique names.

If the Output Port is dragged onto the Root Process Group, the Output Port provides a mechanism for sending data to remote instances of NiFi via [Site-to-Site](#). In this case, the Port acts as a queue. As remote instances of NiFi pull data from the port, that data is removed from the queues of the incoming Connections. If NiFi is configured to run securely, the Output Port can be configured to restrict access to appropriate users. For information on configuring NiFi to run securely, see the [System Administrator's Guide](#).



Process Group: Process Groups can be used to logically group a set of components so that the dataflow is easier to understand and maintain. When a Process Group is dragged onto the canvas, the DFM is prompted to name the Process Group. All Process Groups within the same parent group must have unique names. The Process Group will then be nested within that parent group.

Once you have dragged a Process Group onto the canvas, you can interact with it by right-clicking on the Process Group and selecting an option from the context menu. The options available to you from the context menu vary, depending on the privileges assigned to you.



While the options available from the context menu vary, the following options are typically available when you have full privileges to work with the Process Group:

- **Configure:** This option allows the user to establish or change the configuration of the Process Group.
- **Variables:** This option allows the user to create or configure variables within the NiFi UI.
- **Enter group:** This option allows the user to enter the Process Group.



Note: It is also possible to double-click on the Process Group to enter it.

- **Start:** This option allows the user to start a Process Group.
- **Stop:** This option allows the user to stop a Process Group.
- **View status history:** This option opens a graphical representation of the Process Group's statistical information over time.
- **View connections#Upstream:** This option allows the user to see and "jump to" upstream connections that are coming into the Process Group.
- **View connections#Downstream:** This option allows the user to see and "jump to" downstream connections that are going out of the Process Group.
- **Center in view:** This option centers the view of the canvas on the given Process Group.
- **Group:** This option allows the user to create a new Process Group that contains the selected Process Group and any other components selected on the canvas.
- **Create template:** This option allows the user to create a template from the selected Process Group.

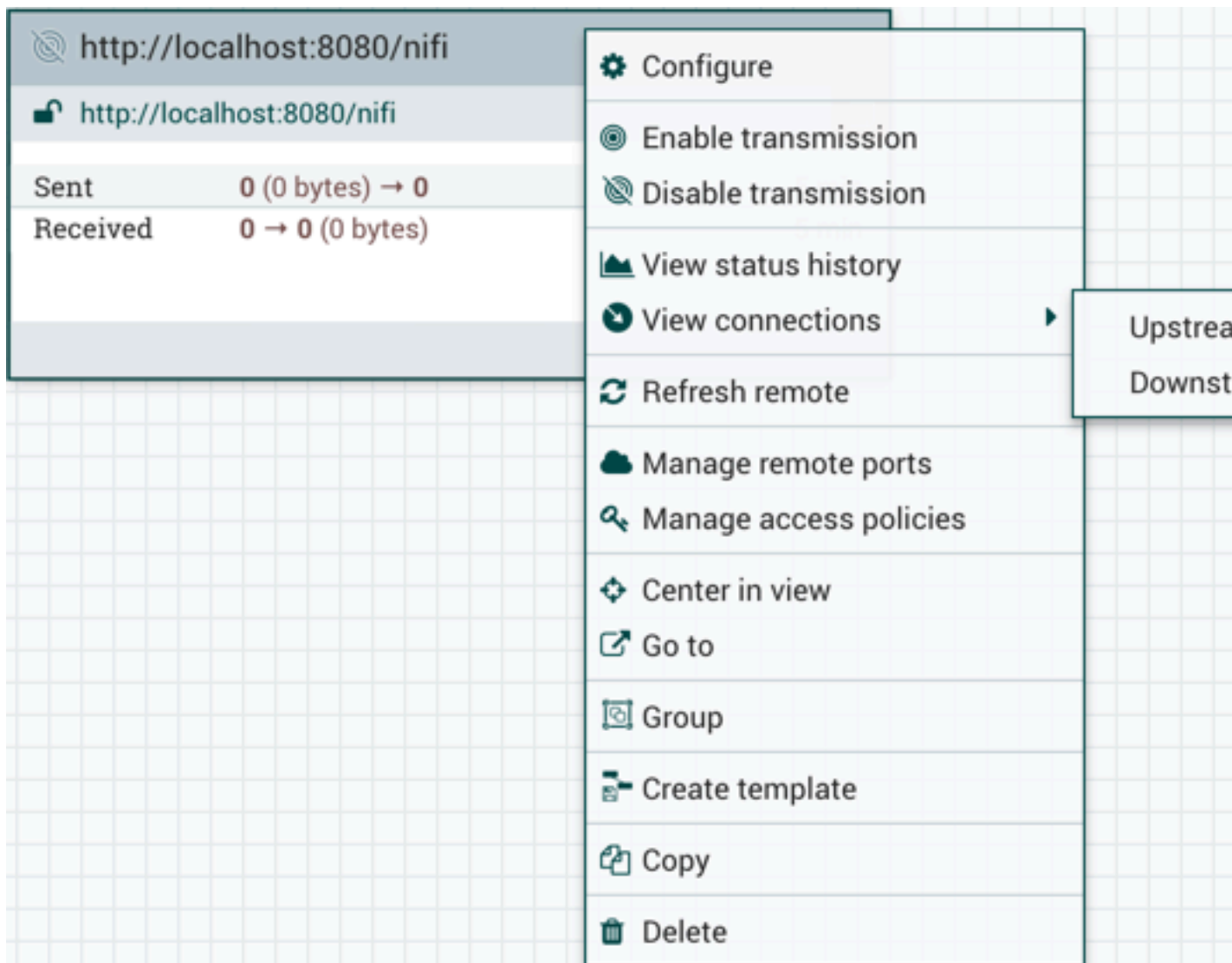
- **Copy:** This option places a copy of the selected Process Group on the clipboard, so that it may be pasted elsewhere on the canvas by right-clicking on the canvas and selecting Paste. The Copy/Paste actions also may be done using the keystrokes Ctrl-C (Command-C) and Ctrl-V (Command-V).
- **Delete:** This option allows the DFM to delete a Process Group.



Remote Process Group: Remote Process Groups appear and behave similar to Process Groups. However, the Remote Process Group (RPG) references a remote instance of NiFi. When an RPG is dragged onto the canvas, rather than being prompted for a name, the DFM is prompted for the URL of the remote NiFi instance. If the remote NiFi is a clustered instance, adding two or more cluster node URLs is recommended so that an initial connection can be made even if one of the nodes is unavailable. Multiple URLs can be specified in a comma-separated format.

When data is transferred to a clustered instance of NiFi via an RPG, the RPG will first connect to the remote instance whose URL is configured to determine which nodes are in the cluster and how busy each node is. This information is then used to load balance the data that is pushed to each node. The remote instances are then interrogated periodically to determine information about any nodes that are dropped from or added to the cluster and to recalculate the load balancing based on each node's load. For more information, see the section on [Site-to-Site](#).

Once you have dragged a Remote Process Group onto the canvas, you can interact with it by right-clicking on the Remote Process Group and selecting an option from the context menu. The options available to you from the menu vary, depending on the privileges assigned to you.



The following options are typically available when you have full privileges to work with the Remote Process Group:

- **Configure:** This option allows the user to establish or change the configuration of the Remote Process Group.
- **Enable transmission:** Makes the transmission of data between NiFi instances active (see [Remote Process Group Transmission](#)).
- **Disable transmission:** Disables the transmission of data between NiFi instances.
- **View status history:** This option opens a graphical representation of the Remote Process Group's statistical information over time.
- **View connections#Upstream:** This option allows the user to see and "jump to" upstream connections that are coming into the Remote Process Group.
- **View connections#Downstream:** This option allows the user to see and "jump to" downstream connections that are going out of the Remote Process Group.
- **Refresh remote:** This option refreshes the view of the status of the remote NiFi instance.
- **Manage remote ports:** This option allows the user to see input ports and/or output ports that exist on the remote instance of NiFi that the Remote Process Group is connected to. Note that if the Site-to-Site configuration is secure, only the ports that the connecting NiFi has been given access to will be visible.
- **Center in view:** This option centers the view of the canvas on the given Remote Process Group.
- **Go to:** This option opens a view of the remote NiFi instance in a new tab of the browser. Note that if the Site-to-Site configuration is secure, the user must have access to the remote NiFi instance in order to view it.

- **Group:** This option allows the user to create a new Process Group that contains the selected Remote Process Group and any other components selected on the canvas.
- **Create template:** This option allows the user to create a template from the selected Remote Process Group.
- **Copy:** This option places a copy of the selected Process Group on the clipboard, so that it may be pasted elsewhere on the canvas by right-clicking on the canvas and selecting Paste. The Copy/Paste actions also may be done using the keystrokes Ctrl-C (Command-C) and Ctrl-V (Command-V).
- **Delete:** This option allows the DFM to delete a Remote Process Group from the canvas.



Funnel: Funnels are used to combine the data from many Connections into a single Connection. This has two advantages. First, if many Connections are created with the same destination, the canvas can become cluttered if those Connections have to span a large space. By funneling these Connections into a single Connection, that single Connection can then be drawn to span that large space instead. Secondly, Connections can be configured with FlowFile Prioritizers. Data from several Connections can be funneled into a single Connection, providing the ability to Prioritize all of the data on that one Connection, rather than prioritizing the data on each Connection independently.



Template: Templates can be created by DFMs from sections of the flow, or they can be imported from other dataflows. These Templates provide larger building blocks for creating a complex flow quickly. When the Template is dragged onto the canvas, the DFM is provided a dialog to choose which Template to add to the canvas:

Add Template

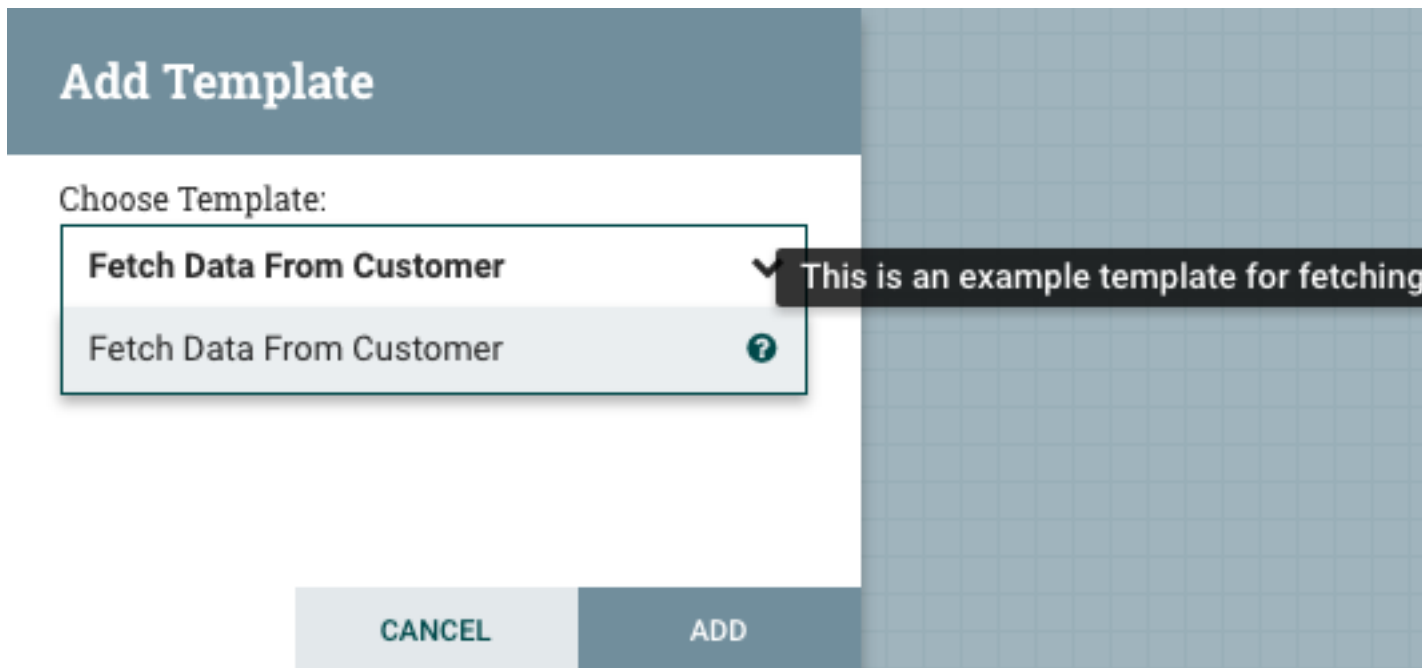
Choose Template:

Fetch Data From Customer
▼

CANCEL

ADD

Clicking the drop-down box shows all available Templates. Any Template that was created with a description will show a question mark icon, indicating that there is more information. Hovering over the icon with the mouse will show this description:



Label: Labels are used to provide documentation to parts of a dataflow. When a Label is dropped onto the canvas, it is created with a default size. The Label can then be resized by dragging the handle in the bottom-right corner. The Label has no text when initially created. The text of the Label can be added by right-clicking on the Label and choosing Configure.

Component Versions

You have access to information about the version of your Processors, Controller Services, and Reporting Tasks. This is especially useful when you are working within a clustered environment with multiple NiFi instances running different versions of a component or if you have upgraded to a newer version of a processor. The Add Processor, Add Controller Service, and Add Reporting Task dialogs include a column identifying the component version, as well as the name of the component, the organization or group that created the component, and the NAR bundle that contains the component.

Add Processor

Source

Displaying 2 of 221

all groups ▼

amazon attributes
avro aws
consume csv
database fetch
files get hadoop
ingest input
insert json listen
logs message
put remote
restricted source
sql text update

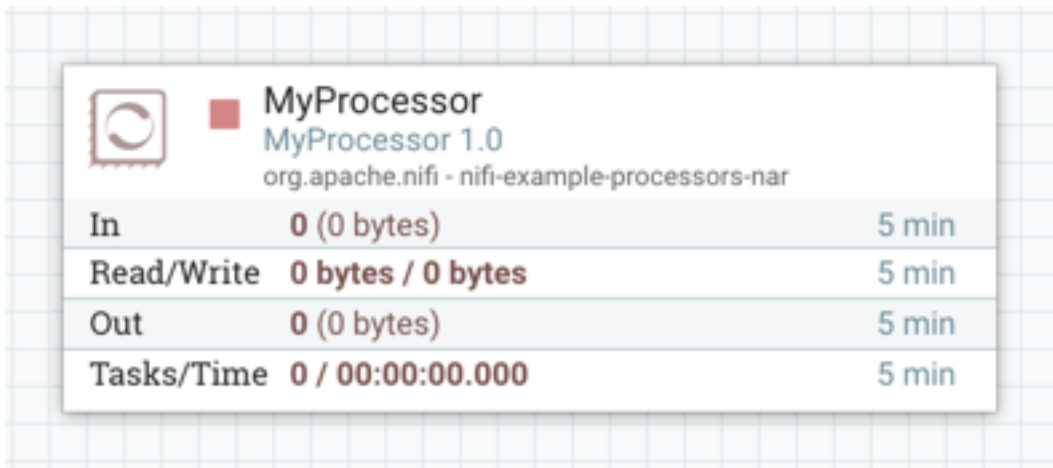
Type	Version ▲	Tags
MyProcessor	1.0	example
MyProcessor	2.0	example



Name
↓
MyProcessor 1.0
Provide a description

Group
↓
org.apache.nifi - nifi-example-pro

Bundle
↓

Each component displayed on the canvas also contains this information.



		MyProcessor MyProcessor 1.0 org.apache.nifi - nifi-example-processors-nar
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

Sorting and Filtering Components

When you are adding a component, you can sort on version number or filter based on originating source.

To sort based on version, click the version column to display in ascending or descending version order.

To filter based on source group, click the source drop-down in the upper left of your Add Component dialog, and select the group you want to view.

Add Processor

Source

all groups ▼

amazon attributes
avro aws
consume csv
database fetch
files get hadoop
ingest input
insert json listen
logs message
put remote
restricted source
sql text update

Displaying 2 of 221

Type	Version ▲	Tags
MyProcessor	1.0	example
MyProcessor	2.0	example

MyProcessor 1.0 org.apache.nifi - nifi-example-pro

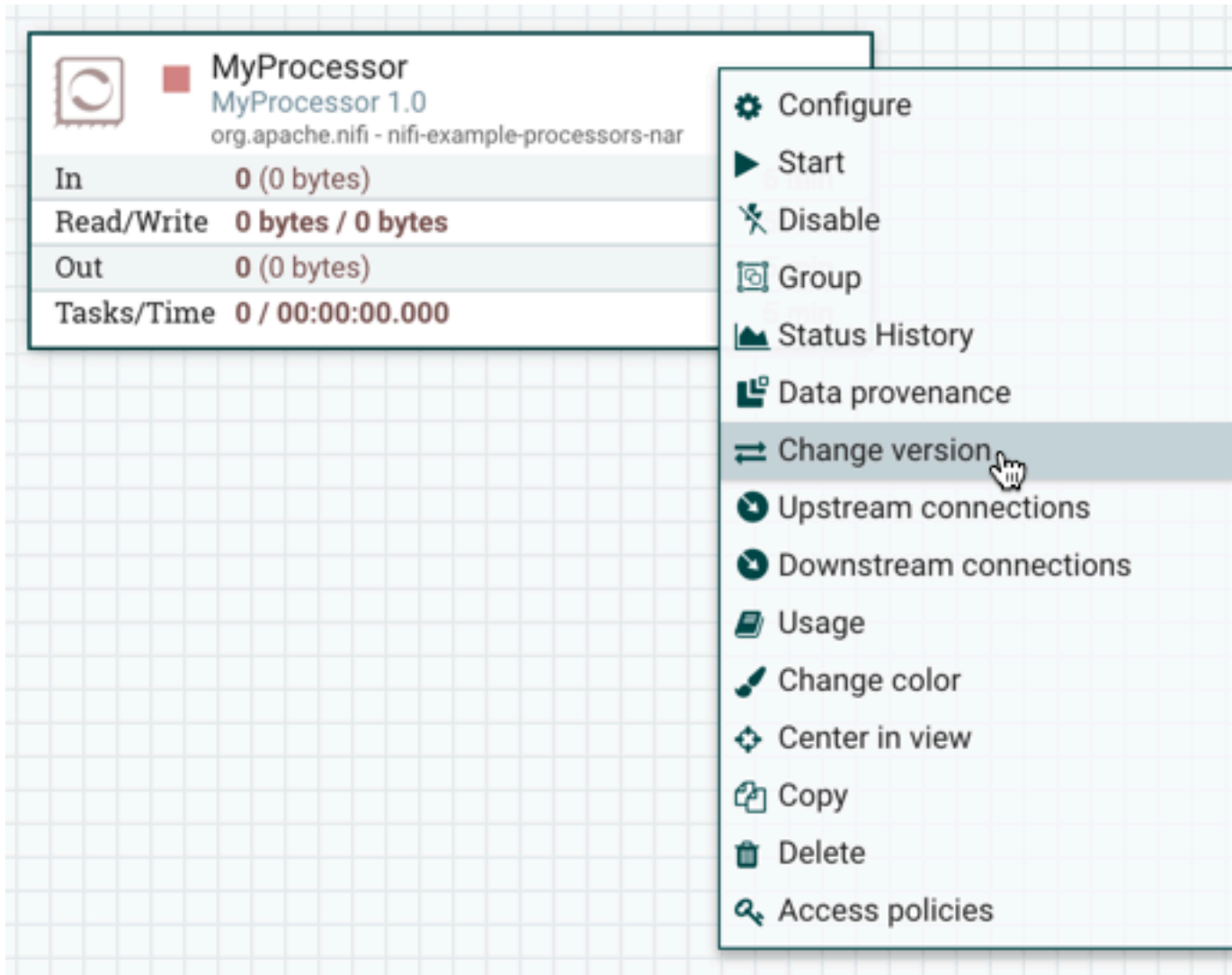
Provide a description

Changing Component Versions

To change a component version, perform the following steps.

1. Right-click the component on the canvas to display configuration options.

2. Select Change version.



3. In the Component Version dialog, select the version you want to run from the Version drop-down menu.

Component Version

Name
MyProcessor

Bundle
org.apache.nifi - nifi-example-processors-nar

Version

1.0	✓
2.0	?
1.0	?

Restriction
No restriction

Description
Provide a description

CANCEL **APPLY**

Understanding Version Dependencies

When you are configuring a component, you can also view information about version dependencies.

1. Right-click your component and select Configure to display the Configure dialog for your component.
2. Click the Properties tab.
3. Click the information icon to view any version dependency information.

Configure Processor

SETTINGS

SCHEDULING

PROPERTIES

COMMENTS

Required field

Property		Value
My Property	?	No value set
My Service	?	No value set

Example Controller Service Property

Supports expression language: false

Requires Controller Service: MyService 1.0 from org.apache.nifi - nifi-example-service-api-nar

In the following example, MyProcessor version 1.0 is configured properly with the controller service StandardMyService version 1.0:

Configure Processor

SETTINGS

SCHEDULING

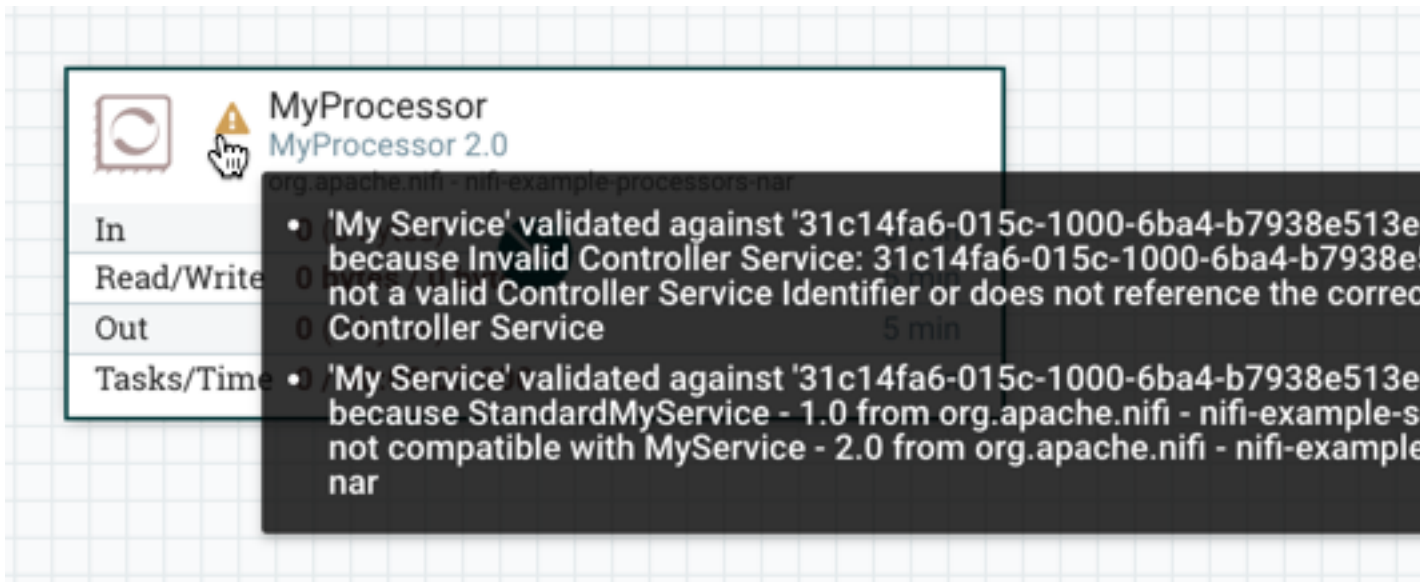
PROPERTIES

COMMENTS

Required field

Property		Value
My Property	?	test
My Service	?	StandardMyService 1.0

If the version of MyProcessor is changed to an incompatible version (MyProcessor 2.0), validation errors will be displayed on the processor:



and an error message will be displayed in the processor's controller service configuration since the service is no longer valid:

Configure Processor

SETTINGS SCHEDULING **PROPERTIES** COMMENTS

Required field

Property		Value
My Property	?	Property1
My Service	?	Incompatible Controller Service C

Configuring a Processor

To configure a processor, right-click on the Processor and select the Configure option from the context menu. Alternatively, just double-click on the Processor. The configuration dialog is opened with four different tabs, each of which is discussed below. Once you have finished configuring the Processor, you can apply the changes by clicking "Apply" or cancel all changes by clicking "Cancel".

Note that after a Processor has been started, the context menu shown for the Processor no longer has a Configure option but rather has a View Configuration option. Processor configuration cannot be changed while the Processor is running. You must first stop the Processor and wait for all of its active tasks to complete before configuring the Processor again.

Note that entering certain control characters are not supported and will be automatically filtered out when entered. The following characters and any unpaired Unicode surrogate codepoints will not be retained in any configuration:

```
[#x0], [#x1], [#x2], [#x3], [#x4], [#x5], [#x6], [#x7], [#x8], [#xB], [#xC],  
[#xE], [#xF], [#x10], [#x11], [#x12], [#x13], [#x14], [#x15], [#x16], [#x17],  
[#x18], [#x19], [#x1A], [#x1B], [#x1C], [#x1D], [#x1E], [#x1F], [#xFFFE],  
[#xFFFF]
```

Settings Tab

The first tab in the Processor Configuration dialog is the Settings tab:

Configure Processor

SETTINGS

SCHEDULING

PROPERTIES

COMMENTS

Name

RouteOnAttribute

Id

313ab384-015c-1000-46ec-0ead80a5eb1e

Type

RouteOnAttribute 1.2.0

Bundle

org.apache.nifi - nifi-standard-nar

Penalty Duration ?

30 sec

Yield Duration ?

1 sec

Bulletin Level ?

WARN
▼

Automatically Terminate

☐ unmatched

FlowFiles that do not
will be routed here

This tab contains several different configuration items. First, it allows the DFM to change the name of the Processor. The name of a Processor by default is the same as the Processor type. Next to the Processor Name is a checkbox, indicating whether the Processor is Enabled. When a Processor is added to the canvas, it is enabled. If the Processor is disabled, it cannot be started. The disabled state is used to indicate that when a group of Processors is started, such as when a DFM starts an entire Process Group, this (disabled) Processor should be excluded.

Below the Name configuration, the Processor's unique identifier is displayed along with the Processor's type and NAR bundle. These values cannot be modified.

Next are two dialogues for configuring 'Penalty Duration' and 'Yield Duration'. During the normal course of processing a piece of data (a FlowFile), an event may occur that indicates that the data cannot be processed at this time but the data may be processable at a later time. When this occurs, the Processor may choose to Penalize the FlowFile. This will prevent the FlowFile from being Processed for some period of time. For example, if the Processor is to push the data to a remote service, but the remote service already has a file with the same name as the filename that the Processor is specifying, the Processor may penalize the FlowFile. The 'Penalty Duration' allows the DFM to specify how long the FlowFile should be penalized. The default value is 30 seconds.

Similarly, the Processor may determine that some situation exists such that the Processor can no longer make any progress, regardless of the data that it is processing. For example, if a Processor is to push data to a remote service and that service is not responding, the Processor cannot make any progress. As a result, the Processor should 'yield', which will prevent the Processor from being scheduled to run for some period of time. That period of time is specified by setting the 'Yield Duration'. The default value is 1 second.

The last configurable option on the left-hand side of the Settings tab is the Bulletin level. Whenever the Processor writes to its log, the Processor also will generate a Bulletin. This setting indicates the lowest level of Bulletin that should be shown in the User Interface. By default, the Bulletin level is set to WARN, which means it will display all warning and error-level bulletins.

The right-hand side of the Settings tab contains an 'Automatically Terminate Relationships' section. Each of the Relationships that is defined by the Processor is listed here, along with its description. In order for a Processor to be considered valid and able to run, each Relationship defined by the Processor must be either connected to a downstream component or auto-terminated. If a Relationship is auto-terminated, any FlowFile that is routed to that Relationship will be removed from the flow and its processing considered complete. Any Relationship that is already connected to a downstream component cannot be auto-terminated. The Relationship must first be removed from any Connection that uses it. Additionally, for any Relationship that is selected to be auto-terminated, the auto-termination status will be cleared (turned off) if the Relationship is added to a Connection.

Scheduling Tab

The second tab in the Processor Configuration dialog is the Scheduling Tab:

Configure Processor

SETTINGS

SCHEDULING

PROPERTIES

COMMENTS

Scheduling Strategy ?

Timer driven
▼

Run Duration ?

0ms 25ms 50ms 1

Lower latency

Concurrent Tasks ?

1

Run Schedule ?

0 sec

Execution ?

All nodes
▼

Scheduling Strategy

The first configuration option is the Scheduling Strategy. There are three possible options for scheduling components:

Timer driven: This is the default mode. The Processor will be scheduled to run on a regular interval. The interval at which the Processor is run is defined by the 'Run Schedule' option (see below).

Event driven: When this mode is selected, the Processor will be triggered to run by an event, and that event occurs when FlowFiles enter Connections feeding this Processor. This mode is currently considered experimental and is

not supported by all Processors. When this mode is selected, the 'Run Schedule' option is not configurable, as the Processor is not triggered to run periodically but as the result of an event. Additionally, this is the only mode for which the 'Concurrent Tasks' option can be set to 0. In this case, the number of threads is limited only by the size of the Event-Driven Thread Pool that the administrator has configured.



Note: Experimental

This implementation is marked [experimental](#) as of Apache NiFi 1.10.0 (October 2019). The API, configuration, and internal behavior may change without warning, and such changes may occur during a minor release. Use at your own risk.

CRON driven: When using the CRON driven scheduling mode, the Processor is scheduled to run periodically, similar to the Timer driven scheduling mode. However, the CRON driven mode provides significantly more flexibility at the expense of increasing the complexity of the configuration. The CRON driven scheduling value is a string of six required fields and one optional field, each separated by a space. These fields are:

Field	Valid values
Seconds	0-59
Minutes	0-59
Hours	0-23
Day of Month	1-31
Month	1-12 or JAN-DEC
Day of Week	1-7 or SUN-SAT
Year (optional)	empty, 1970-2099

You typically specify values one of the following ways:

- **Number:** Specify one or more valid value. You can enter more than one value using a comma-separated list.
- **Range:** Specify a range using the <number>-<number> syntax.
- **Increment:** Specify an increment using <start value>/<increment> syntax. For example, in the Minutes field, 0/15 indicates the minutes 0, 15, 30, and 45.

You should also be aware of several valid special characters:

- ***** - Indicates that all values are valid for that field.
- **?** - Indicates that no specific value is specified. This special character is valid in the Days of Month and Days of Week field.
- **L** - You can append L to one of the Day of Week values, to specify the last occurrence of this day in the month. For example, 1L indicates the last Sunday of the month.

For example:

- The string 0 0 13 * * ? indicates that you want to schedule the processor to run at 1:00 PM every day.
- The string 0 20 14 ? * MON-FRI indicates that you want to schedule the processor to run at 2:20 PM every Monday through Friday.
- The string 0 15 10 ? * 6L 2011-2017 indicates that you want to schedule the processor to run at 10:15 AM, on the last Friday of every month, between 2011 and 2017.

For additional information and examples, see the [cron triggers tutorial](#) in the [Quartz Documentation](#).

Concurrent Tasks

Next, the Scheduling tab provides a configuration option named 'Concurrent Tasks'. This controls how many threads the Processor will use. Said a different way, this controls how many FlowFiles should be processed by this Processor at the same time. Increasing this value will typically allow the Processor to handle more data in the same amount of time. However, it does this by using system resources that then are not usable by other Processors. This essentially

provides a relative weighting of Processors - it controls how much of the system's resources should be allocated to this Processor instead of other Processors. This field is available for most Processors. There are, however, some types of Processors that can only be scheduled with a single Concurrent task.

Run Schedule

The 'Run Schedule' dictates how often the Processor should be scheduled to run. The valid values for this field depend on the selected Scheduling Strategy (see above). If using the Event driven Scheduling Strategy, this field is not available. When using the Timer driven Scheduling Strategy, this value is a time duration specified by a number followed by a time unit. For example, 1 second or 5 mins. The default value of 0 sec means that the Processor should run as often as possible as long as it has data to process. This is true for any time duration of 0, regardless of the time unit (i.e., 0 sec, 0 mins, 0 days). For an explanation of values that are applicable for the CRON driven Scheduling Strategy, see the description of the CRON driven Scheduling Strategy itself.

Execution

The Execution setting is used to determine on which node(s) the Processor will be scheduled to execute. Selecting 'All Nodes' will result in this Processor being scheduled on every node in the cluster. Selecting 'Primary Node' will result in this Processor being scheduled on the Primary Node only. Processors that have been configured for 'Primary Node' execution are identified by a "P" next to the processor icon:

The screenshot displays the Apache NiFi web interface. At the top, the NiFi logo and a toolbar with various icons are visible. Below the toolbar, a status bar shows metrics: 2/2, 0, 0 (0 bytes), 0, 0, 0, 8, and 3. The main workspace is a grid where a process group is being configured. Two panels are open: 'Navigate' and 'Operate'. The 'Operate' panel shows the 'NiFi Flow' process group with ID 2975f925-0161-1000-3347-52474a6a030d. It includes a toolbar with icons for settings, search, lightning bolt, slash, play, stop, and other actions. A tooltip for the 'insert, update, delete' action is visible, showing 'Queued 0 (0 bytes)'. Another tooltip for the 'P' icon is visible, showing 'In', 'Read/Write', 'Out', and 'Tasks/Tim'. The bottom of the screen shows a table with columns for 'Name', 'Version', and 'Status'. The first row is 'eJsonPath 1.5.0' with status '5 min'. The second row is 'NiFi Flow' with status '5 min'.

Navigate

Operate

NiFi Flow
Process Group
2975f925-0161-1000-3347-52474a6a030d

Name insert, update, delete
Queued 0 (0 bytes)

Name eJsonPath 1.5.0
Version 1.5.0
Status 5 min

Name NiFi Flow
Version 1.5.0
Status 5 min

To quickly identify 'Primary Node' processors, the "P" icon is also shown in the Processors tab on the Summary page:

NiFi Summary

PROCESSORS

INPUT PORTS

OUTPUT PORTS

REMOTE PROCESS GROUPS

Displaying 22 of 22

Filter

by name



	Name ▲	Type	Process Group	Run Status
	CaptureChangeMySQL	CaptureChangeMy...	NiFi Flow	Stopp
	CaptureChangeMySQL	CaptureChangeMy...	PG1	Invali
	EnforceOrder	EnforceOrder	NiFi Flow	Stopp
	EnforceOrder	EnforceOrder	PG1	Stopp
	Get Table Name	EvaluateJsonPath	PG1	Stopp
	Get Table Name	EvaluateJsonPath	NiFi Flow	Stopp
	JoltTransformJSON	JoltTransformJSON	PG1	Stopp
	JoltTransformJSON	JoltTransformJSON	NiFi Flow	Stopp
	LogAttribute	LogAttribute	PG1	Invali
	LogAttribute	LogAttribute	NiFi Flow	Invali
	LogAttribute	LogAttribute	NiFi Flow	Invali
	LogAttribute	LogAttribute	PG1	Invali
	PutDatabaseRecord	PutDatabaseRecord	PG1	Invali
	PutDatabaseRecord	PutDatabaseRecord	NiFi Flow	Invali
	RouteOnAttribute	RouteOnAttribute	NiFi Flow	Stopp
	RouteOnAttribute	RouteOnAttribute	PG1	Stopp



Last updated: 16:16:06 EST

Run Duration

The right-hand side of the Scheduling tab contains a slider for choosing the 'Run Duration'. This controls how long the Processor should be scheduled to run each time that it is triggered. On the left-hand side of the slider, it is marked 'Lower latency' while the right-hand side is marked 'Higher throughput'. When a Processor finishes running, it must update the repository in order to transfer the FlowFiles to the next Connection. Updating the repository is expensive, so the more work that can be done at once before updating the repository, the more work the Processor can handle (Higher throughput). However, this means that the next Processor cannot start processing those FlowFiles until the previous Process updates this repository. As a result, the latency will be longer (the time required to process the FlowFile from beginning to end will be longer). As a result, the slider provides a spectrum from which the DFM can choose to favor Lower Latency or Higher Throughput.

Properties Tab

The Properties tab provides a mechanism to configure Processor-specific behavior. There are no default properties. Each type of Processor must define which Properties make sense for its use case. Below, we see the Properties tab for a RouteOnAttribute Processor:

Configure Processor

SETTINGS

SCHEDULING


PROPERTIES

COMMENTS

Required field

Property		Value
Routing Strategy		Route to Property name

This Processor, by default, has only a single property: 'Routing Strategy'. The default value is 'Route to Property

name'. Next to the name of this property is a small question mark symbol (). This help symbol is seen in other places throughout the User Interface, and it indicates that more information is available. Hovering over this symbol with the mouse will provide additional details about the property and the default value, as well as historical values that have been set for the Property.

Clicking on the value for the property will allow a DFM to change the value. Depending on the values that are allowed for the property, the user is either provided a drop-down from which to choose a value or is given a text area to type a value:

Configure Processor

SETTINGS SCHEDULING **PROPERTIES** COMMENTS

Required field

Property
Routing Strategy

- Route to Property name
- Route to Property name
- Route to 'matched' if all match
- Route to 'matched' if any match


In the top-right corner of the tab is a button for adding a New Property. Clicking this button will provide the DFM with a dialog to enter the name and value of a new property. Not all Processors allow User-Defined properties. In processors that do not allow them, the Processor becomes invalid when User-Defined properties are applied. RouteOnAttribute, however, does allow User-Defined properties. In fact, this Processor will not be valid until the user has added a property.

Configure Processor

SETTINGS
SCHEDULING
PROPERTIES
COMMENTS

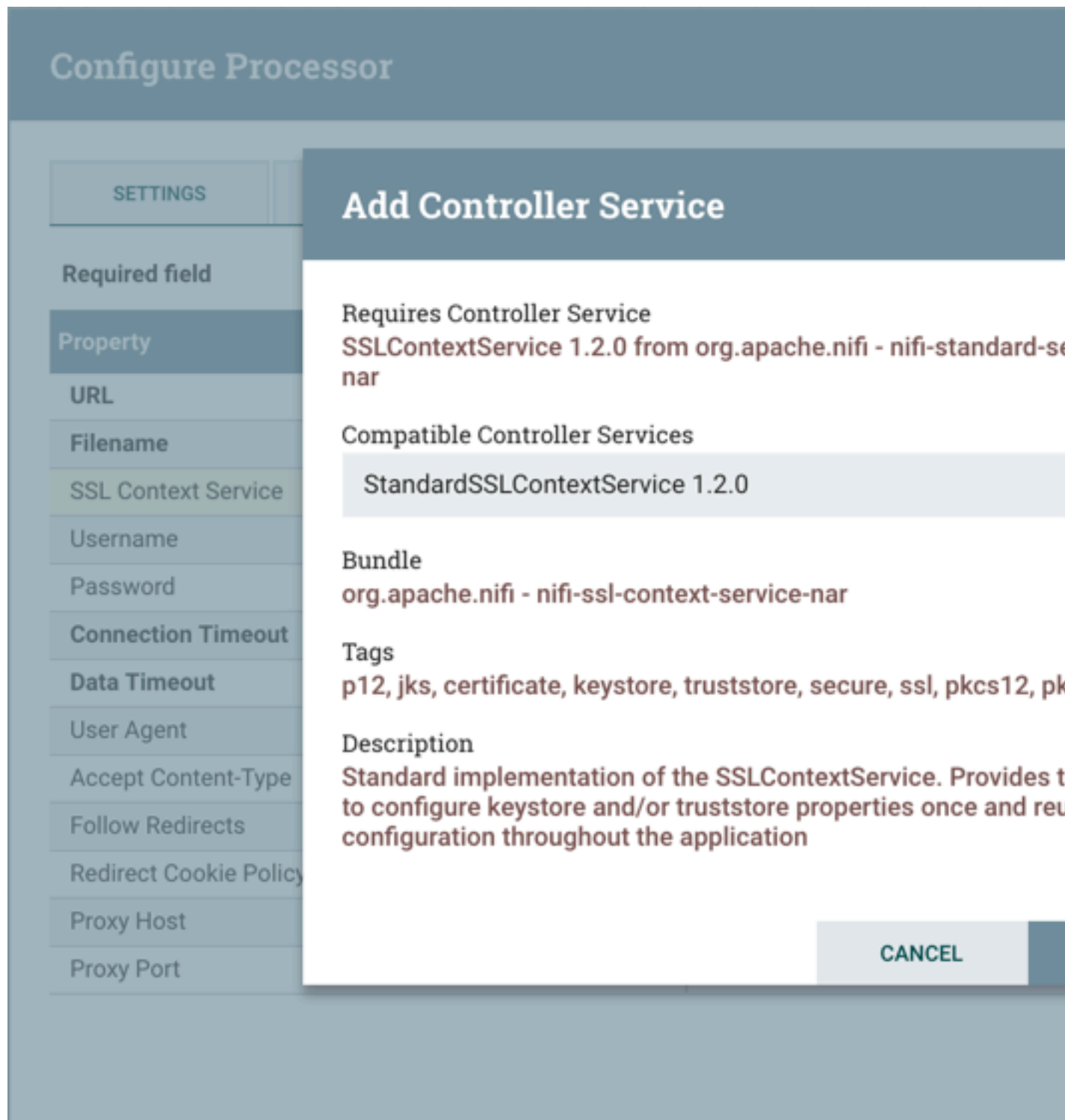
Required field

Property	Value
Routing Strategy	
route 1	<div style="border: 1px solid #ccc; padding: 5px; margin-top: 5px;"> <div style="display: flex; align-items: center;"> <div style="border-right: 1px solid #ccc; padding-right: 5px; text-align: center; width: 30px;">1</div> <div style="padding-left: 5px;">Some Value</div> </div> <div style="margin-top: 10px;"> <input type="checkbox"/> Set empty string </div> </div> <div style="text-align: right; margin-top: 10px;"> CANCEL </div>

Note that after a User-Defined property has been added, an icon will appear on the right-hand side of that row (). Clicking it will remove the User-Defined property from the Processor.

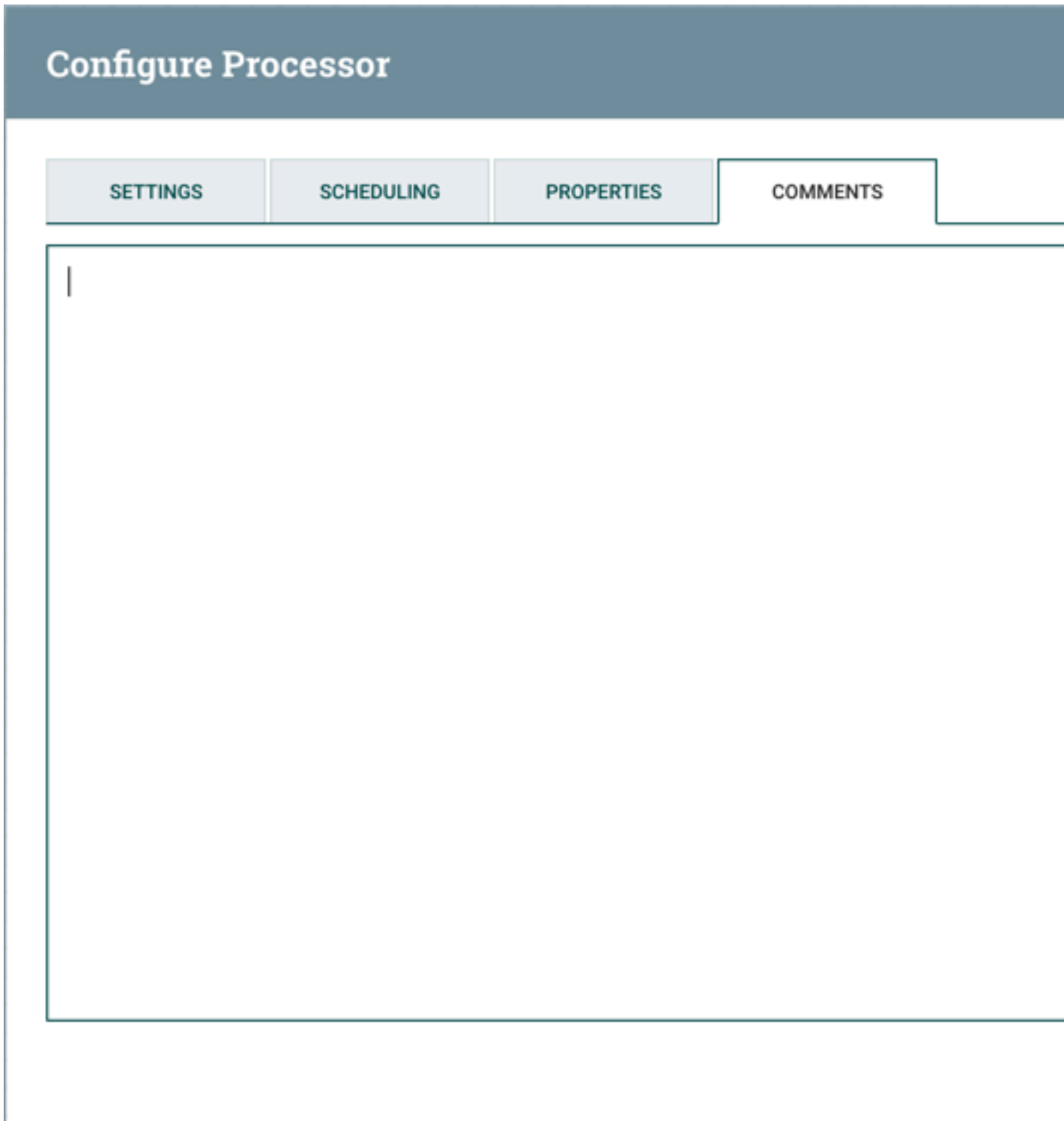
Some processors also have an Advanced User Interface (UI) built into them. For example, the UpdateAttribute processor has an Advanced UI. To access the Advanced UI, click the "Advanced" button that appears at the bottom of the Configure Processor window. Only processors that have an Advanced UI will have this button.

Some processors have properties that refer to other components, such as Controller Services, which also need to be configured. For example, the GetHTTP processor has an `SSLContextService` property, which refers to the `StandardSSLContextService` controller service. When DFMs want to configure this property but have not yet created and configured the controller service, they have the option to create the service on the spot, as depicted in the image below. For more information about configuring Controller Services, see the [Controller Services](#) section.



Comments Tab

The last tab in the Processor configuration dialog is the Comments tab. This tab simply provides an area for users to include whatever comments are appropriate for this component. Use of the Comments tab is optional:



The screenshot shows a window titled "Configure Processor". At the top, there is a dark blue header bar with the title in white. Below the header, there are four tabs: "SETTINGS", "SCHEDULING", "PROPERTIES", and "COMMENTS". The "COMMENTS" tab is currently selected and highlighted. The main area of the dialog is a large, empty text box with a light blue background and a thin blue border, intended for entering comments.

Additional Help

You can access additional documentation about each Processor's usage by right-clicking on the Processor and selecting 'Usage' from the context menu. Alternatively, select Help from the Global Menu in the top-right corner of

the UI to display a Help page with all of the documentation, including usage documentation for all the Processors that are available. Click on the desired Processor to view usage documentation.

Parameters

The values of properties in the flow, including sensitive properties, can be parameterized using Parameters. Parameters are created and configured within the NiFi UI. Any property can be configured to reference a Parameter with the following conditions:

- A sensitive property can only reference a Sensitive Parameter
- A non-sensitive property can only reference a Non-Sensitive Parameter
- Properties that reference Controller Services can not use Parameters
- Parameters cannot be referenced in Reporting Tasks or in controller-level Controller Services

The UI indicates whether a Parameter can be used for a property value.

Configure Processor

Invalid

- ✓ **Expression Language (EL) supported**
After beginning with the start delimiter `${` use `property` to see a list of available functions.
- ✓ **Parameters (PARAM) supported**
After beginning with the start delimiter `#{$` use `parameter` to see a list of available parameters.

Required for

Property

Kafka Brokers
Security Protocol
Kerberos Service Name
Kerberos Credentials Service
Kerberos Principal
Kerberos Keytab
SSL Context Service
Topic Name
Delivery Guarantee
Kafka Key
Key Attribute Encoding
Message Demarcator

1 `#{$kafka.brokers}`

☐ Set empty string

Delivery Guarantee	?	Best Effort
Kafka Key	?	No value set
Key Attribute Encoding	?	UTF-8 Encode
Message Demarcator	?	No value set

Tasks/Time 0 / 00:00

NiFi Flow » Kafka Flow



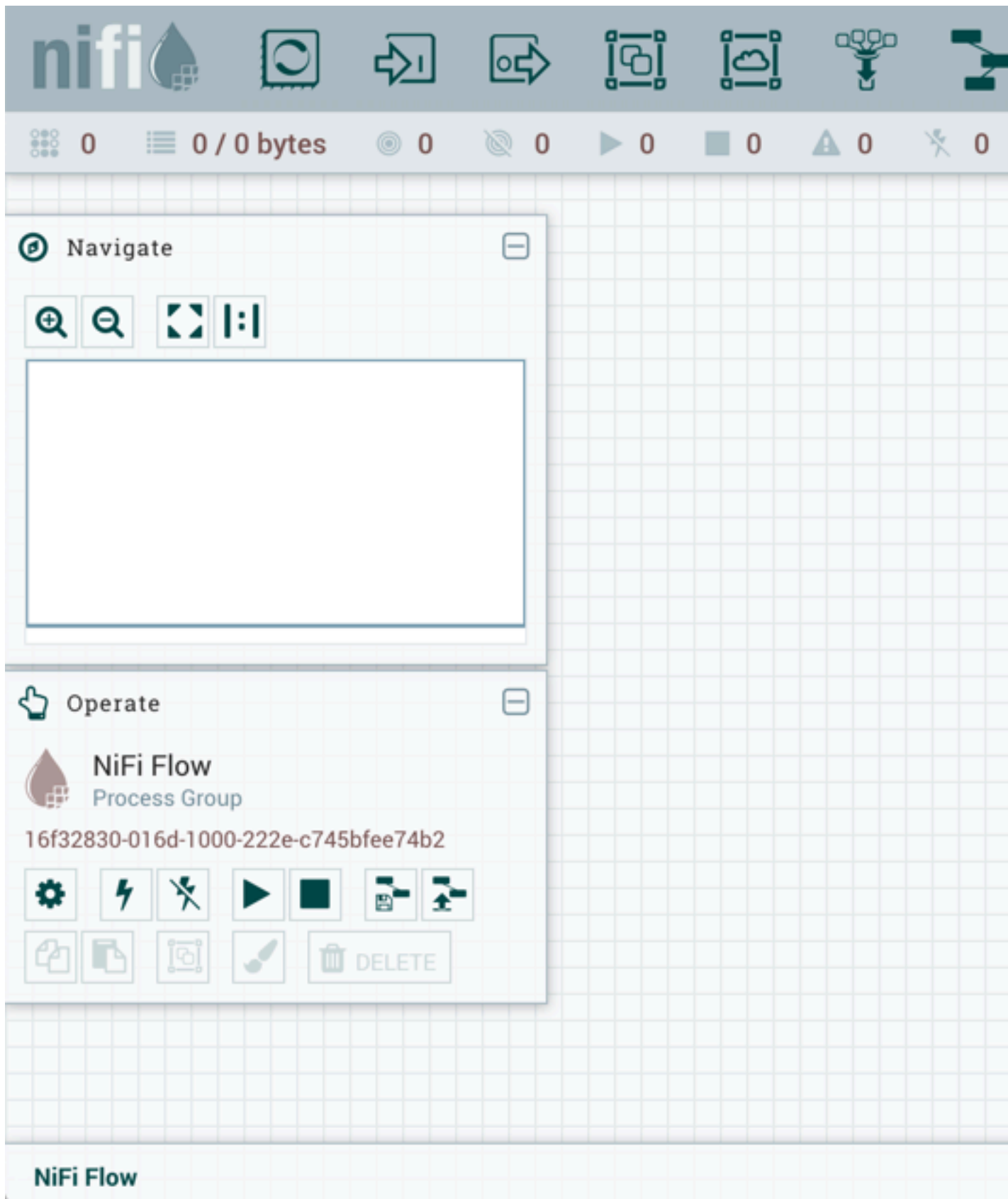
Note: Parameters have numerous advantages over Variables. In addition to sensitive value support, Parameters offer more granular control over access policies. Additionally, properties that reference Parameters are validated against the substituted value, unlike most properties that reference Variables using Expression Language.

Parameter Contexts

Parameters are created within Parameter Contexts. Parameter Contexts are globally defined/accessible to the NiFi instance. Access policies can be applied to Parameter Contexts to determine which users can create them. Once created, policies to read and write to a specific Parameter Context can also be applied (see [Accessing Parameters](#) for more information).

Creating a Parameter Context

To create a Parameter Context, select Parameter Contexts from the Global Menu:



In the Parameter Contexts window, click the + button in the upper-right corner and the Add Parameter Context window opens. The window has two tabs: Settings and Parameters.

Add Parameter Context

SETTINGS **PARAMETERS**

Name

my_parameter_context

Description

Last updated

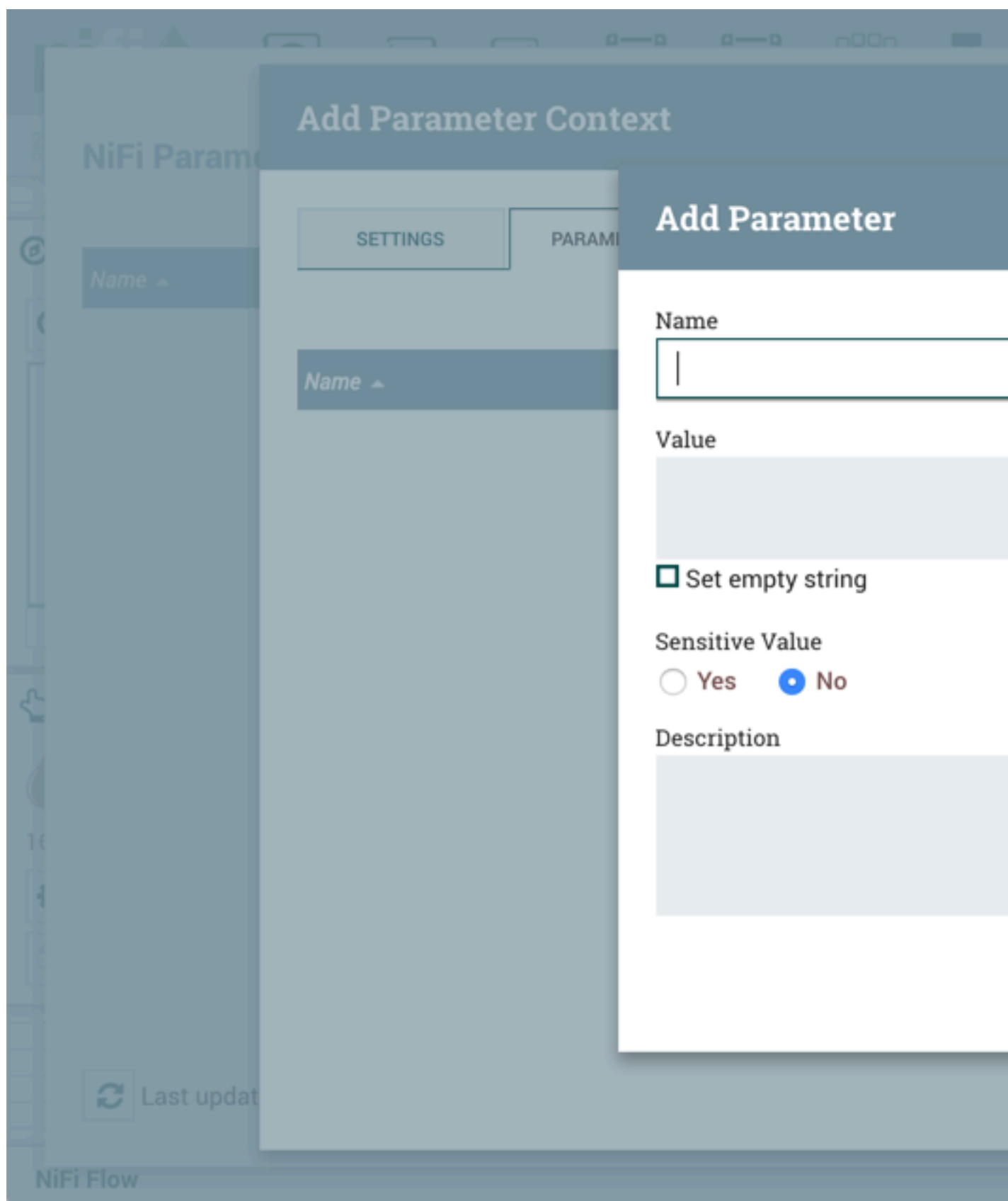
NiFi Flow

On the "Settings" tab, add a name for the Parameter Context and a description if desired. Select "Apply" to save the Parameter Context or select the "Parameters" tab to add parameters to the context.

Adding a Parameter to a Parameter Context

Parameters can be added during Parameter Context creation or added to existing Parameter Contexts.

During Parameter Context creation, select the "Parameters" tab. Click the + button to open the Add Parameter window.



To add parameters to an existing Parameter Context, open the Parameter Context window and click the Edit button



() in the row of the desired Parameter Context.

NiFi Parameter Contexts

Name ▲	De
parameter_context_1	
parameter_context_2	
parameter_context_3	

Last updated: 13:04:55 EDT

NiFi Flow

On the "Parameters" tab, click the + button to open the Add Parameter window.

The Add Parameter window has the following settings:

- Name - A name that is used to denote the Parameter. Only alpha-numeric characters (a-z, A-Z, 0-9), hyphens (-), underscores (_), periods (.), and spaces are allowed.
- Value - The value that will be used when the Parameter is referenced. Parameter values do not support Expression Language or embedded parameter references.
- Set empty string - Check to explicitly set the value of the Parameter to an empty string. Unchecked by default. (Note: If checked but a value is set, the checkbox is ignored.)
- Sensitive Value - Set to "Yes" if the Parameter's Value should be considered sensitive. If sensitive, the value of the Parameter will not be shown in the UI once applied. The default setting is "No". Sensitive Parameters can only be referenced by sensitive properties and Non-Sensitive Parameters by non-sensitive properties. Once a Parameter is created, its sensitivity flag cannot be changed.
- Description - A description that explains what the Parameter is, how it is to be used, etc. This field is optional.

Once these settings are configured, select "Apply". The Referencing Components lists the components referenced by the currently selected parameter. Add additional Parameters or edit any existing Parameters.

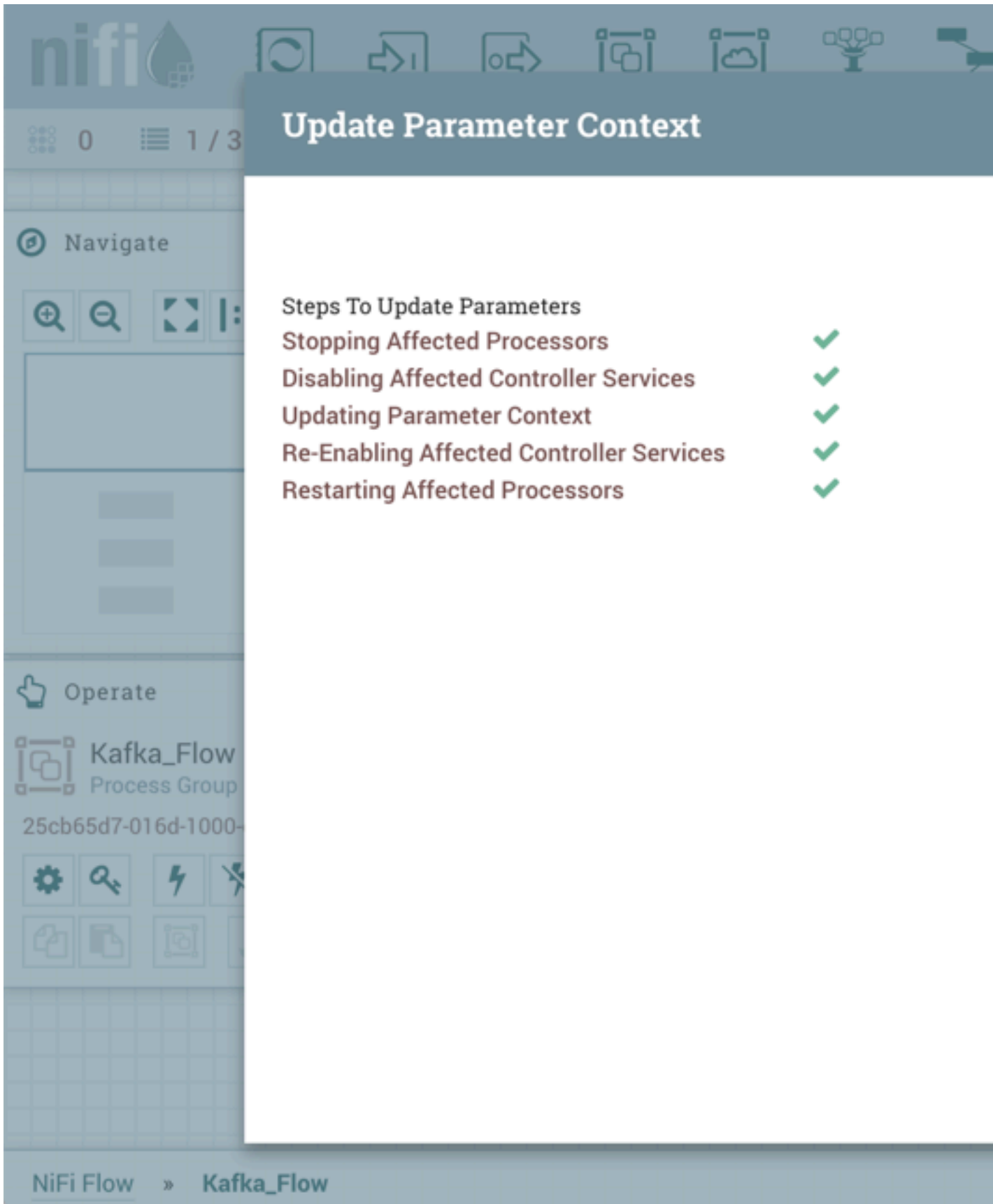
Update Parameter Context

SETTINGS PARAMETERS

Name ▲	Value
Database Connection URL	jdbc:mysql://127.0.0.1:3306
Database Driver Class Name	com.mysql.jdbc.Driver
db.password	Sensitive value set
db.user	admin
kafka.broker	localhost:9093
kafka.topic	Movies

NiFi Flow » Kafka_Flow

To complete the process, select "Apply" from the Parameter Context window. The following operations are performed to validate all components that reference the added or modified parameters: Stopping/Restarting affected Processors, Disabling/Re-enabling affected Controller Services, Updating Parameter Context.



Update Parameter Context

Steps To Update Parameters

- Stopping Affected Processors ✓
- Disabling Affected Controller Services ✓
- Updating Parameter Context ✓
- Re-Enabling Affected Controller Services ✓
- Restarting Affected Processors ✓

NiFi Flow » Kafka_Flow

The Referencing Components section now lists an aggregation of all the components referenced by the set of parameters added/edited/deleted, organized by process group.

Assigning a Parameter Context to a Process Group

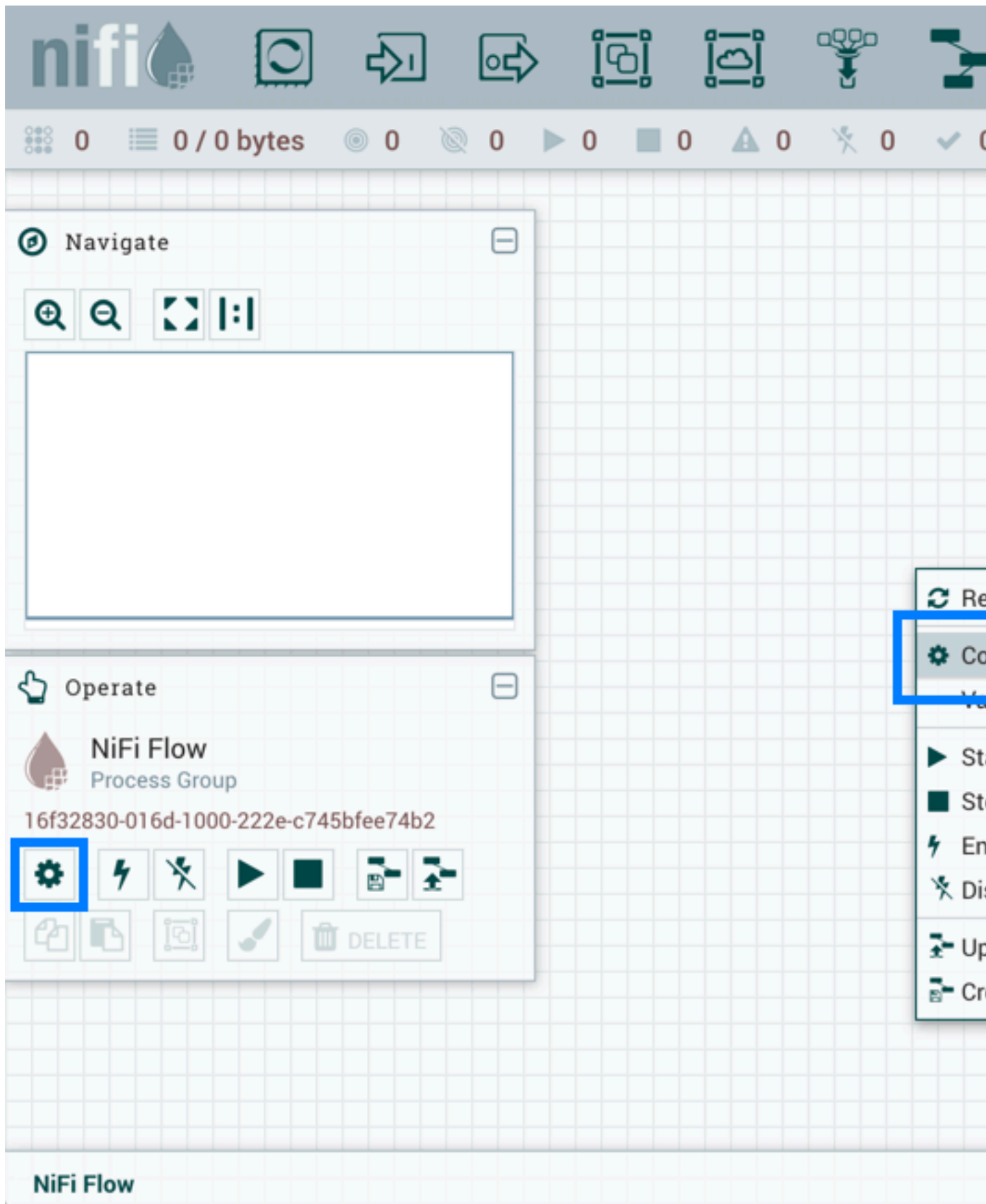
For a component to reference a Parameter, its Process Group must first be assigned a Parameter Context. Once assigned, processors and controller services within that Process Group may only reference Parameters within that Parameter Context.

A Process Group can only be assigned one Parameter Context, while a given Parameter Context can be assigned to multiple Process Groups.

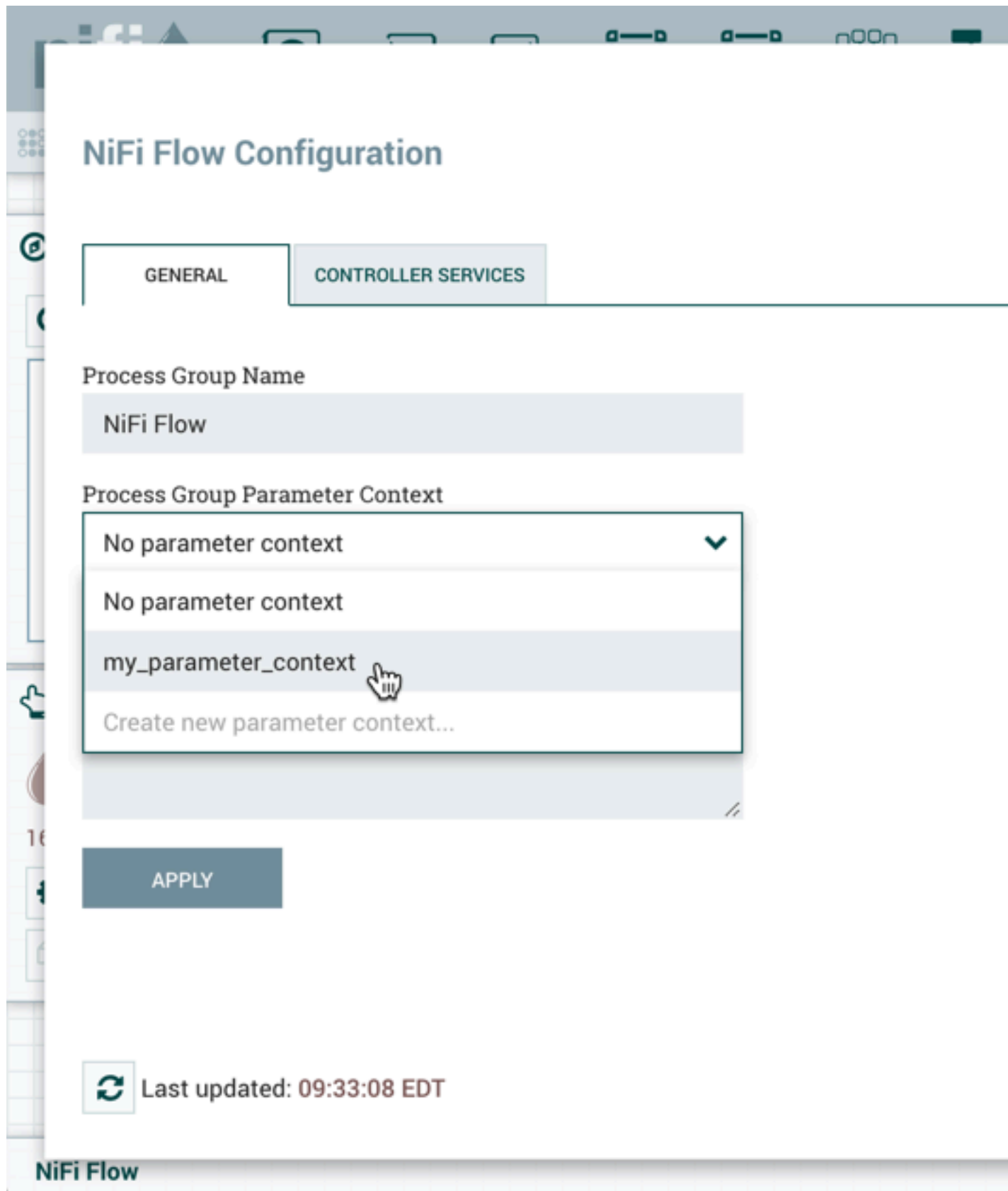


Note: A user can only set the Parameter Context of a Process Group to one of the Parameter Contexts that the user has the view policy for. Additionally, in order to set the Parameter Context, the user must have the modify policy for the Process Group. See [Accessing Parameters](#) for more information.

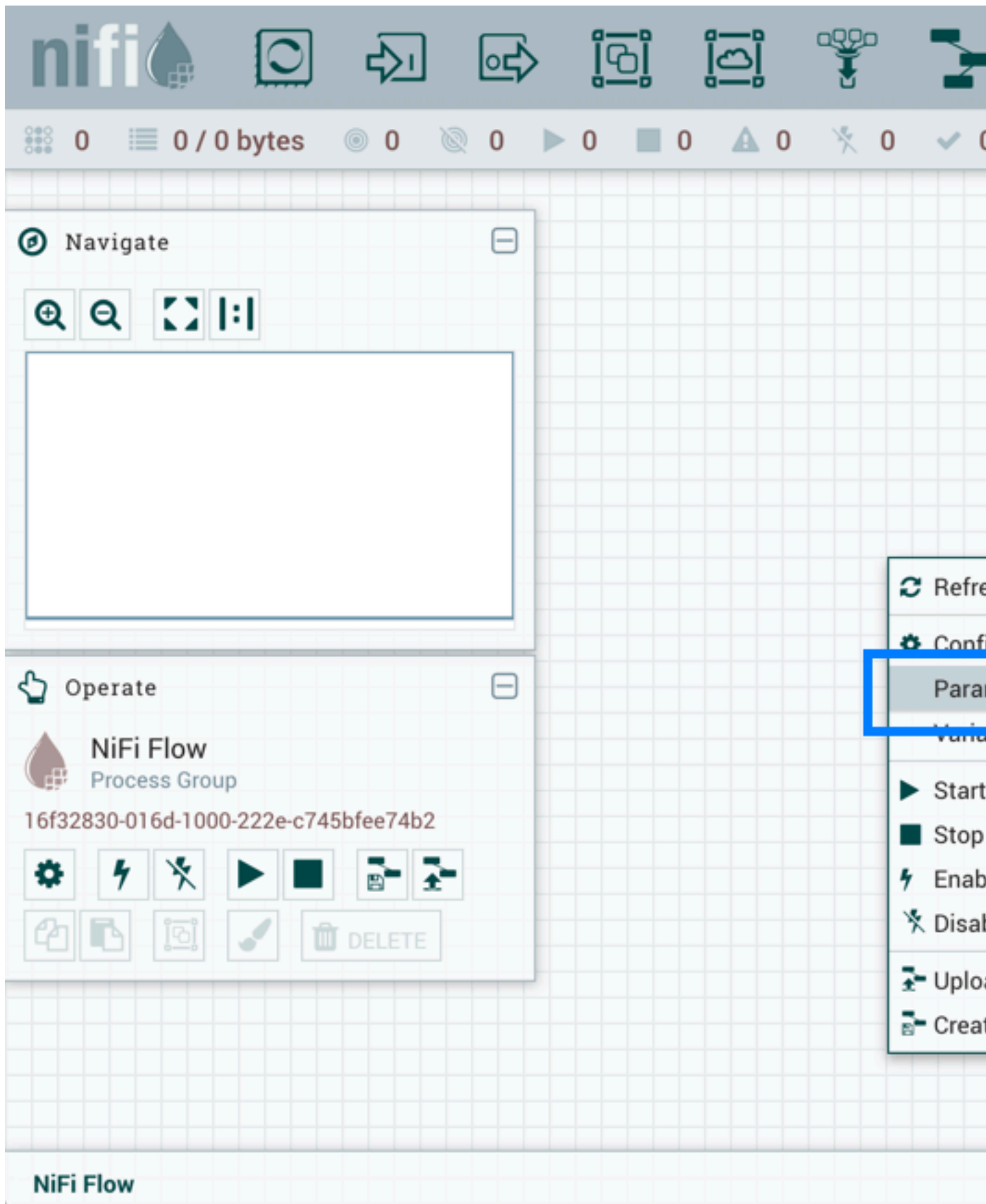
To assign a Parameter Context to a Process Group, click Configure, either from the Operate Palette or from the Process Group context menu.



In the Flow Configuration window, select the "General" tab. From the Process Group Parameter Context drop-down menu, select an existing Parameter Context or create a new one.



Select "Apply" to save the configuration changes. The Process Group context menu now includes a "Parameters" option which allows quick access to the Update Parameter Context window for the assigned Parameter Context.



If the Parameter Context for a Process Group is changed, all components that reference any Parameters in that Process Group will be stopped, validated, and restarted assuming the components were previously running and are still valid.



Note: If a Parameter Context is unset from a Process Group, it does NOT inherit the Parameter Context from the parent Process Group. Instead, no Parameters can be referenced. Any component that does already reference a Parameter will become invalid.

Referencing Parameters

Parameter Reference Syntax

To configure an eligible property to reference a Parameter, use the # symbol as the start, with the Parameter's name enclosed in curly braces:

```
#{Parameter.Name}
```

This can be escaped using an additional # character at the beginning. To illustrate this, assume that the Parameter abc has a value of xxx and Parameter def has a value of yyy. Then, the following user-defined property values will evaluate to these effective values:

User-Entered Literal Property Value	Effective Property Value	Explanation
#{abc}	xxx	Simple substitution
#{abc}/data	xxx/data	Simple substitution with additional literal data
#{abc}/#{def}	xxx/yyy	Multiple substitution with additional literal data
#{abc	#{abc	No { } for parameter replacement
#abc	#abc	No { } for parameter replacement
##{abc}	#{abc}	Escaped # for literal interpretation
###{abc}	#xxx	Escaped # for literal interpretation, followed by simple substitution
####{abc}	##{abc}	Escaped # for literal interpretation, twice
#####{abc}	##xxx	Escaped # for literal interpretation, twice, followed by simple substitution
#{abc/data}	Exception thrown on property set operation	/ not a valid parameter name character

When referencing a Parameter from within [Expression Language](#), the Parameter reference is evaluated first. As an example, to replace xxx with zzz for the abc Parameter:

```
${ #{abc}:replace('xxx', 'zzz') }
```

Referencing and Creating Parameters During Component Configuration

Parameters can be easily referenced or created as you configure the components in your flow. For example, assume a process group has the Parameter Context "Kafka Settings" assigned to it. "Kafka Settings" contains the parameters kafka.broker and kafka.topic1.

The screenshot shows the 'Update Parameter Context' dialog box in the Apache NiFi interface. The dialog has two tabs: 'SETTINGS' and 'PARAMETERS'. The 'PARAMETERS' tab is active, displaying a table with two rows of parameter data. The left sidebar shows the 'Kafka Flow' process group selected.

Update Parameter Context

SETTINGS **PARAMETERS**

Name ▲	Value
kafka.broker	localhost:9092
kafka.topic1	Songs

NiFi Flow » Kafka Flow

To reference `kafka.broker` as the value for the "Kafka Brokers" property in the PublishKafka processor, clear the default value and begin a new entry with the start delimiter `#{`. Next use the keystroke `control+space` to show the list of available parameters:

Configure Processor

Invalid

SETTINGS | **SCHEDULING** | **PROPERTIES**

Required field

Property	Value
Kafka Brokers	1 # { kafka.b kafka.t
Security Protocol	
Kerberos Service Name	
Kerberos Credentials Service	
Kerberos Principal	
Kerberos Keytab	
SSL Context Service	
Topic Name	
Delivery Guarantee	? Best Effort
Kafka Key	? No value set
Key Attribute Encoding	? UTF-8 Encode
Message Demarcator	? No value set

☐ Set empty string

Tasks/Time 0 / 00:

NiFi Flow » Kafka Flow

Select kafka.broker and complete the entry with a closing curly brace }.

Configure Processor

Invalid

SETTINGS SCHEDULING **PROPERTIES**

Required field

Property		Value
Kafka Brokers	?	#(kafka.broker
Security Protocol	?	PLAINTEXT
Kerberos Service Name	?	No value set
Kerberos Credentials Service	?	No value set
Kerberos Principal	?	No value set
Kerberos Keytab	?	No value set
SSL Context Service	?	No value set
Topic Name	?	No value set
Delivery Guarantee	?	Best Effort
Kafka Key	?	No value set
Key Attribute Encoding	?	UTF-8 Encode
Message Demarcator	?	No value set

Tasks/Time 0 / 00:

NiFi Flow » **Kafka Flow**

Help text describing this process is displayed when hovering over the Expression Language and Parameters eligibility indicators.

Configure Processor

Invalid

- ✓ **Expression Language (EL) supported**
After beginning with the start delimiter `${` use `#{` to see a list of available functions.
- ✓ **Parameters (PARAM) supported**
After beginning with the start delimiter `#{$}` use `#{` to see a list of available parameters.

Property

Kafka Brokers	
Security Protocol	
Kerberos Service Name	
Kerberos Credentials Service	
Kerberos Principal	
Kerberos Keytab	
SSL Context Service	
Topic Name	
Delivery Guarantee	Best Effort
Kafka Key	No value set
Key Attribute Encoding	UTF-8 Encode
Message Demarcator	No value set

1 `#{kafka.br`

☐ Set empty string

Tasks/Time 0 / 00:

NiFi Flow » Kafka Flow

Parameters can also be created on the fly. For example, to create a parameter for the "Topic Name" property, select



the "Convert to Parameter" icon () in that property's row. This icon will only be available if the user has appropriate permissions to modify the Parameter Context (see [Accessing Parameters](#) for more information).

Configure Processor

Invalid

SETTINGS | SCHEDULING | PROPERTIES

Required field

Property	Value
Kafka Brokers	#{kafka.broker}
Security Protocol	PLAINTEXT
Kerberos Service Name	No value set
Kerberos Credentials Service	No value set
Kerberos Principal	No value set
Kerberos Keytab	No value set
SSL Context Service	No value set
Topic Name	No value set
Delivery Guarantee	Best Effort
Kafka Key	No value set
Key Attribute Encoding	UTF-8 Encode
Message Demarcator	No value set

Tasks/Time 0 / 00:

NiFi Flow » Kafka Flow

The Add Parameter dialog will open. Configure the new parameter as desired.

Configure Processor

Invalid

SETTINGS

Required field

Property

Kafka Brokers

Security Protocol

Kerberos Service Name

Kerberos Credentials

Kerberos Principal

Kerberos Keytab

SSL Context Service

Topic Name

Delivery Guarantee

Kafka Key

Key Attribute Encoding

Message Demarcator

...

Add Parameter

Name

kafka.topic2

Value

Movies

☒ Set empty string

Sensitive Value

☐ Yes ☒ No

Description

NiFi Flow » Kafka Flow

Tasks/Time 0 / 00:

Select "Apply". The process group's Parameter Context will be updated and the new parameter will be referenced by the property with the proper syntax applied automatically.

Configure Processor

Invalid

SETTINGS SCHEDULING PROPERTIES

Required field

Property	Value
Kafka Brokers	<code>#{kafka.broker</code>
Security Protocol	PLAINTEXT
Kerberos Service Name	No value set
Kerberos Credentials Service	No value set
Kerberos Principal	No value set
Kerberos Keytab	No value set
SSL Context Service	No value set
Topic Name	<code>#{kafka.topic2</code>
Delivery Guarantee	Best Effort
Kafka Key	No value set
Key Attribute Encoding	UTF-8 Encode
Message Demarcator	No value set

Tasks/Time 0 / 00:

NiFi Flow » Kafka Flow

Properties values that are selectable can also reference parameters. In addition to applying the "Convert to Parameter" method described earlier, the option "Reference parameter.." is available in the value drop-down menu.

Configure Processor

■ **Stopped**

SETTINGS SCHEDULING **PROPERTIES** COMMENTS

Required field

Property	
Log Level	
Log Payload	
Attributes to Log	
Attributes to Log by Regular Expression	?
Attributes to Ignore	?
Attributes to Ignore by Regular Expression	?
Log prefix	?
Character Set	?

info

trace

debug

info

warn

error

Reference parameter...

Selecting "Reference parameter..." will display a drop-down list of available parameters, determined by the parameter context assigned to the component's process group and the user's access policies.

Configure Processor

Stopped

SETTINGS SCHEDULING **PROPERTIES** COMMENTS

Required field

Property	
Log Level	
Log Payload	
Attributes to Log	
Attributes to Log by Regular Expression	
Attributes to Ignore	
Attributes to Ignore by Regular Expression	?
Log prefix	?
Character Set	?

Reference parameter...

level1

level1 **Designates finer-grained**

level2

No value set

No value set

UTF-8

Hovering over the question mark icon (?) displays the parameter's description.

Using Parameters with Sensitive Properties

Sensitive properties may only reference sensitive Parameters. This is important for [versioned flows](#). The value of the sensitive Parameter itself will NOT be sent to the flow registry, only the fact that the property references the sensitive Parameter. For more information see [Parameters in Versioned Flows](#).

The value of a sensitive property must be set to a single Parameter reference. For example, values of `{password}123` and `{password}{suffix}` are not allowed. Sending `{password}123` would lead to exposing part of the sensitive property's value. This is in contrast to a non-sensitive property, where a value such as `{path}/child/file.txt` is valid.

Accessing Parameters

User privileges to Parameters are managed via access policies on the following levels:

- Parameter Context
- Process Group
- Component



Note: For additional information on how to configure access policies, see the [Access Policies](#) section in the System Administrator's Guide.

Parameter Context Access Policies

For a user to see Parameter Contexts, they must be added to either the "access the controller" view policy or the "access parameter contexts" view policy. For a user to modify Parameter Contexts, they must also be added to the corresponding modify policies. These policies are accessed via "Policies" from the Global Menu. See the [Global Access Policies](#) section in the System Administrator's Guide for more information.



Note: The "access parameter contexts" policies are inherited from the "access the controller" policies unless overridden.


View and modify policies can also be set on individual parameter contexts to determine which users can view or add parameters to the context. Select "Parameter Contexts" from the Global Menu. Select the "Access Policies" button



() in the row of the desired parameter context to manage these policies.

NiFi Parameter Contexts

Name ▲	Description
Kafka Settings	
MySQL Settings	

 Last updated: 15:28:49 EDT

NiFi Flow

See the [Component Level Access Policies](#) section in the System Administrator's Guide for more information.

Process Group Access Policies

A user can only set the Parameter Context of a Process Group to one of the Parameter Contexts that the user has the view policy for. Additionally, in order to set the Parameter Context, the user must have the modify policy for the Process Group. The Process Group access policies can be managed by highlighting the Process Group and selecting



the "Access Policies" button () from the Operate Palette.

Component Access Policies

To reference Parameters or convert properties to a Parameter in a component, a user needs to have the view and modify policies for the component. These policies are inherited if the user has view and modify policies to the component's process group, but these policies can be overridden on the component level.

In order to modify a Parameter, a user must have view and modify policies for any and all components that reference that Parameter. This is needed because changing the Parameter requires that the components be stopped/started and also because by taking that action, the user is modifying the behavior of the component.

See the [Component Level Access Policies](#) section in the System Administrator's Guide for more information.

Using Custom Properties with Expression Language

You can use NiFi Expression Language to reference FlowFile attributes, compare them to other values, and manipulate their values when you are creating and configuring dataflows. For more information on Expression Language, see the [Expression Language Guide](#).

In addition to using FlowFile attributes, system properties, and environment properties within Expression Language, you can also define custom properties for Expression Language use. Defining custom properties gives you more flexibility in handling and processing dataflows. You can also create custom properties for connection, server, and service properties, for easier dataflow configuration.

NiFi properties have resolution precedence of which you should be aware when creating custom properties:

- Processor-specific attributes
- FlowFile properties
- FlowFile attributes
- From Variable Registry:
 - User defined properties (custom properties)
 - System properties
 - Operating System environment variables

When you are creating custom properties, ensure that each custom property contains a distinct property value, so that it is not overridden by existing environment properties, system properties, or FlowFile attributes.

There are two ways to use and manage custom properties with Expression Language:

- **Variables:** Variables are created and configured within the NiFi UI. They can be used in any field that supports Expression Language. Variables cannot be used for sensitive properties. NiFi automatically picks up new or modified variables. Variables are defined at the Process Group level, as a result, the access policies for viewing and changing variables are derived from the access policies of the Process Group. See [Variables](#) for more information.
- **Custom Properties File:** Key/value pairs are defined in a custom properties file that is referenced via the `nifi.variable.registry.properties` in `nifi.properties`. NiFi must be restarted for updates to be picked up. See [Referencing Custom Properties via nifi.properties](#) for more information.



Note: Custom properties via Variables and the `nifi.properties` file are still supported for compatibility purposes but do not have the same power as Parameters such as support for sensitive properties and more granular control over who can create, modify or use them. Variables and the `nifi.variable.registry.properties` property will be removed in a future release. As a result, it is highly recommended to switch to Parameters.

Expression Language support for a property is indicated in the UI.

Configure Processor

Stopped

SETTINGS **SCHEDULE**

Required field

Property

- Input Directory**
- File Filter**
- Path Filter**
- Batch Size**
- Keep Source File**
- Recurse Subdirectories**
- Polling Interval**
- Ignore Hidden Files**
- Minimum File Age**
- Maximum File Age**
- Minimum File Size**
- Maximum File Size**

Expression Language (EL)
After beginning with the `EL` prefix, you can use the following syntax to see a list of available properties.

Parameters (PARAM)
After beginning with the `PARAM` prefix, you can use the following syntax to see a list of available parameters.

GetFile Processor

2b944ccb-016d-1000-69b1-c3d

NiFi Flow

Variables



Note: Custom properties via Variables and the `nifi.properties` file are still supported for compatibility purposes but do not have the same power as Parameters such as support for sensitive properties and more granular control over who can create, modify or use them. Variables and the `nifi.variable.registry.properties` property will be removed in a future release. As a result, it is highly recommended to switch to Parameters.

Variables are created and configured within the NiFi UI. They can be used in any field that supports Expression Language. Variables cannot be used for sensitive properties. Variables are defined at the Process Group level, as a result, the access policies for viewing and changing variables are derived from the access policies of the Process Group. Variable values cannot reference other variables or make use of Expression Language.

Variables Window

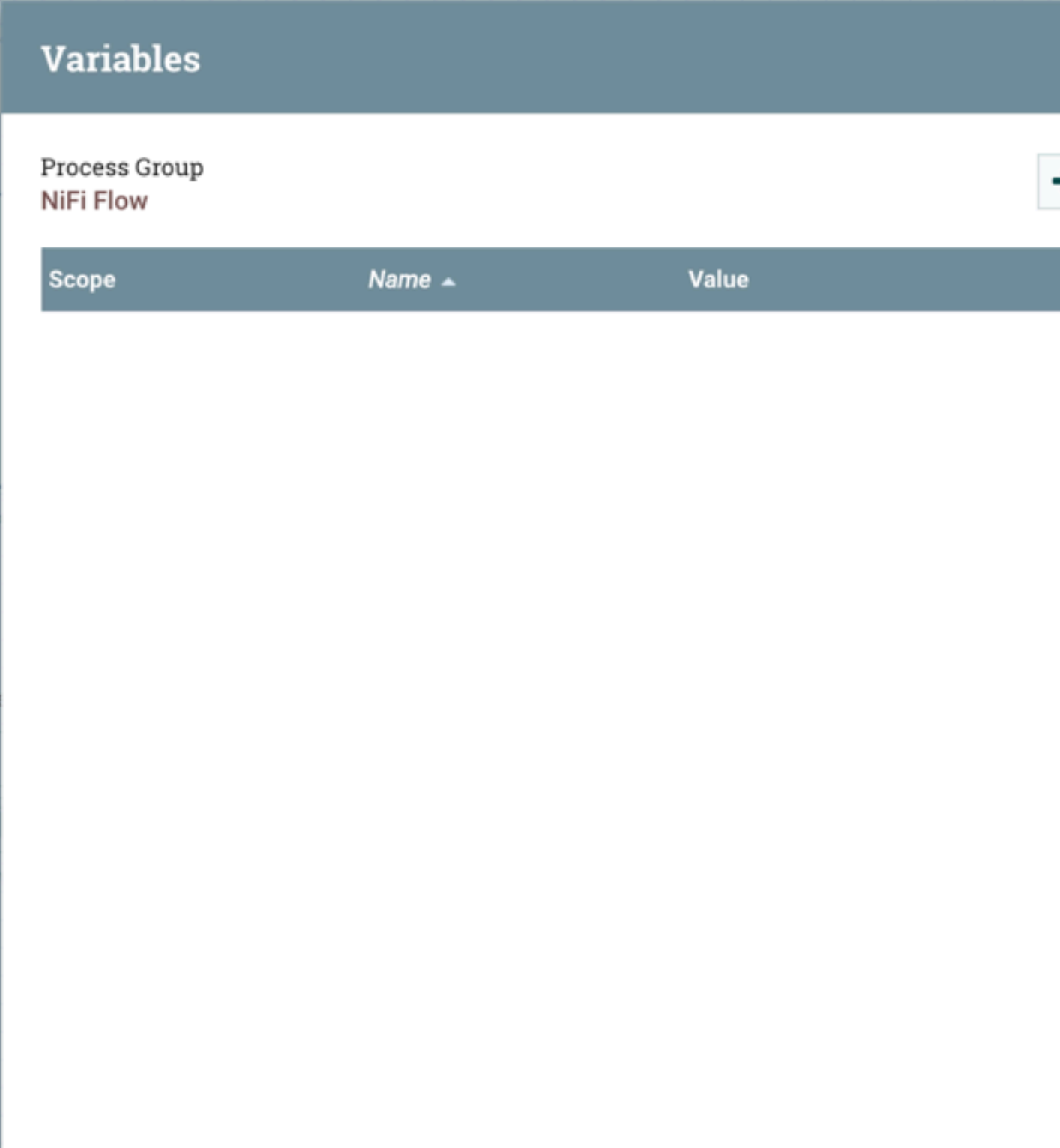
To access the Variables window, right-click on the canvas with nothing selected:

The screenshot displays the Apache NiFi web interface. At the top, there is a toolbar with various icons for navigating and managing the flow. Below the toolbar, a status bar shows metrics: 0, 0 / 0 bytes, 0, 0, and 0. The main workspace is a grid where a process group is visible. The process group is titled "NiFi Flow" and has a unique ID "ed930f02-015e-1000-6ecc-33e1d1e97a2d". It contains a "GenerateFlowFile" node. A context menu is open over the "GenerateFlowFile" node, showing options: Refresh, Configure, Variables (highlighted with a blue box and a mouse cursor), Start, Stop, Upload template, and Create template. The "GenerateFlowFile" node's details are shown in a tooltip:

GenerateFlowFile	
GenerateFlowFile 1.4.0	
org.apache.nifi - nifi-standard-nar	
In	0 (0 bytes)
Read/Write	0 bytes / 0 bytes
Out	0 (0 bytes)
Tasks/Time	0 / 00:00:00.000

At the bottom left, the text "NiFi Flow" is visible.

Select "Variables" from the Context Menu:



The screenshot shows the 'Variables' tab in the Apache NiFi web console. At the top, there is a header bar with the word 'Variables' in white text on a dark blue background. Below this, the 'Process Group' is identified as 'NiFi Flow' in a dark blue font. A table with three columns is displayed: 'Scope', 'Name', and 'Value'. The 'Name' column has a small upward-pointing triangle next to it, indicating it is sorted by name. The table is currently empty of data rows.

Scope	Name ▲	Value
-------	--------	-------

"Variables" is also available in the right-click Context Menu when a process group is selected:

The screenshot displays the Apache NiFi web interface. At the top, the 'nifi' logo is visible alongside a toolbar with icons for various components. Below the toolbar, a status bar shows metrics: 0, 0 / 0 bytes, 0, 0, and 0. The main canvas is a grid where a data flow is being constructed. A 'GenerateFlowFile' processor (represented by a circular arrow icon) is placed on the canvas. To its right, a tooltip provides details: 'GenerateFlowFile 1.4.0', 'org.apache.nifi - nifi-standard-nar', and statistics: 'In 0 (0 bytes)', 'Read/Write 0 bytes / 0 bytes', 'Out 0 (0 bytes)', and 'Tasks/Time 0 / 00:00:00.000'. Below the canvas, a 'Process Group A' sub-flow is visible, identified by the ID 'f211c57e-015e-1000-eb6e-1a0377d090b4'. The 'Process Group A' panel includes a 'Navigate' section with zoom and pan controls, and an 'Operate' section with icons for settings, refresh, delete, play, stop, and other actions, along with a 'DELETE' button.

nifi

0 0 / 0 bytes 0 0 0

Navigate

GenerateFlowFile
GenerateFlowFile 1.4.0
org.apache.nifi - nifi-standard-nar

In	0 (0 bytes)
Read/Write	0 bytes / 0 bytes
Out	0 (0 bytes)
Tasks/Time	0 / 00:00:00.000

Operate

Process Group A
Process Group
f211c57e-015e-1000-eb6e-1a0377d090b4

DELETE

Creating a Variable

In the Variables window, click the + button to create a new variable. Add a name:

The screenshot shows the 'Variables' window in NiFi. At the top, it says 'Variables'. Below that, it shows 'Process Group' and 'NiFi Flow'. There is a table with columns 'Scope', 'Name', and 'Value'. A 'New Variable' dialog is open, showing 'Variable Name' with the text 'putfile_dir' entered. A 'Create' button is visible at the bottom right of the dialog.

Scope	Name	Value
-------	------	-------

New Variable
Variable Name
putfile_dir
Create

and a value:

Variables

Process Group

NiFi Flow

Scope	Name ▲
NiFi Flow	putfile_dir

putfile_dir: /usr/local/root_direct

☐ Set empty string

CANCEL

Select "Apply":

Variables

Process Group

NiFi Flow

Steps To Update Variables

Identifying components affected	✓
Stopping affected Processors	✓
Disabling affected Controller Services	✓
Applying Updates	✓
Re-Enabling affected Controller Services	✓
Restarting affected Processors	✓

Steps to update the variable are performed (Identifying components affected, Stopping affected Processors, etc.). For example, the Referencing Processors section now lists the "PutFile-Root" processor. Selecting the name of the processor in the list will navigate to that processor on the canvas. Looking at the properties of the processor, `${putfile_dir}` is referenced by the Directory property:

Configure Processor

SETTINGS

SCHEDULING

PROPERTIES

COMMENTS

Required field

Property		Value
Directory	?	<code>\${putfile_dir}</code>
Conflict Resolution Strategy	?	fail
Create Missing Directories	?	true
Maximum File Count	?	No value set
Last Modified Time	?	No value set
Permissions	?	No value set
Owner	?	No value set
Group	?	No value set

Variable Scope

Variables are scoped by the Process Group they are defined in and are available to any Processor defined at that level and below (i.e. any descendant Processors).

Variables in a descendant group override the value in a parent group. More specifically, if a variable `x` is declared at the root group and also declared inside a process group, components inside the process group will use the value of `x` defined in the process group.

For example, in addition to the `putfile_dir` variable that exists at the root process group, assume another `putfile_dir` variable was created within Process Group A. If one of the components within Process Group A references `putfile_dir`, both variables will be listed, but the `putfile_dir` from the root group will have a strikethrough indicating that is is being overridden:

Variables

Process Group
Process Group A

Scope	Name ▲	Value	
Process Group A	putfile_dir	/usr/local/pgA_directory	🗑️
NiFi Flow	putfile_dir	/usr/local/root_directory	➔

A variable can only be modified for the process group it was created in, which is listed at the top of the Variables window. To modify a variable defined in a different process group, select the "arrow" icon in that variable's row:

Variables

Process Group
Process Group A ← Current Process Group

Scope	Name ▲	Value	
Process Group A	putfile_dir	/usr/local/pgA_directory	🗑️
NiFi Flow	putfile_dir	/usr/local/root_directory	➔

Root Process Group



Go to Variable Root Proces

which will navigate to the Variables window for that process group:

Variables

Process Group

NiFi Flow

Scope	Name ▲	Value	
NiFi Flow	drivers_dir	file:///drivers/jdbc/mysql-...	
NiFi Flow	putfile_dir	/usr/local/root_directory	

Variable Permissions

Variable permissions are based solely on the privileges configured on the corresponding Process Group.

For example, if a user does not have access to View a process group, the Variables window can not be viewed for that process group:

The screenshot displays the Apache NiFi web interface. At the top, the NiFi logo is visible alongside a toolbar with icons for various actions like refresh, zoom, and navigation. Below the toolbar, a status bar shows metrics: 0 items, 0 / 0 bytes, 0 tasks, and 0 errors. The main workspace is a grid where a process group is being edited. A 'Navigate' panel on the left provides search and zoom controls. The 'Operate' panel on the right shows the process group's details, including its ID (c23788f2-e06e-3089-8d34-88a4...) and a 'DELETE' button. A warning message is overlaid on the right side, indicating an 'Insufficient' error: 'Unable to e06e-3089 system ac'.

Navigate

Operate

Insufficient

Unable to e06e-3089 system ac

NiFi Flow » c23788f2-e06e-3089-8d34-88a499defae2

If a user has access to View a process group but does not have access to Modify the process group, the variables can be viewed but not modified.

For information on how to manage privileges on components, see the [Access Policies](#) section in the System Administrator's Guide.



Referencing Controller Services

In addition to Referencing Processors, the Variables window also displays Referencing Controller Services:

Variables

Process Group

NiFi Flow

Scope	Name ▲	Value	
NiFi Flow	drivers_dir	file:///drivers/jdbc/mysql-connector-java-5.1 ...	
NiFi Flow	property1	./private	
NiFi Flow	putfile_dir	/usr/local/root_directory	

Selecting the name of the controller service will navigate to that controller service in the Configuration window:

NiFi Flow Configuration

GENERAL CONTROLLER SERVICES

	Name	Type	Bundle
	DBCPCConnectionPool	DBCPCConnectionPool 1.4.0	org.apache.nifi -

Last updated: 12:08:48 EDT Liste

NiFi Flow 15e-1000-cc67-c08e5afe2fa1



Unauthorized Referencing Components

When View or Modify privileges are not given to a component that references a variable, the UUID of the component will be displayed in the Variables window:

Variables

Process Group

NiFi Flow

Scope	Name ▲	Value	
NiFi Flow	drivers_dir	file:///drivers/jdbc/mysql-connector-java-5.1 ...	
NiFi Flow	property1	./private	
NiFi Flow	putfile_dir	/usr/local/root_directory	

In the above example, the variable `property1` is referenced by a processor that "user1" is not able to view:

The screenshot displays the Apache NiFi web console interface. At the top, the NiFi logo and a toolbar with various icons are visible. Below the toolbar, a status bar shows metrics: 0 nodes, 0 / 0 bytes of data, 0 processors, 0 connections, and 0 tasks.

The main canvas is a grid where a DataFlow is being built. A 'GenerateFlowFile' processor is highlighted in the 'Operate' panel. The 'Operate' panel shows the processor's ID, name, and a 'DELETE' button. The 'GenerateFlowFile' processor is a standard NiFi processor that generates flow files.

The 'GenerateFlowFile' processor details are shown in a tooltip on the right:

GenerateFlowFile	
GenerateFlowFile 1.4.0	
org.apache.nifi - nifi-standard-na	
In	0 (0 bytes)
Read/Write	0 bytes / 0 bytes
Out	0 (0 bytes)
Tasks/Time	0 / 00:00:00.000

Custom Properties

To configure custom properties for use with NiFi's Expression Language:

- Create the custom property. Ensure that:
 - Each custom property contains a distinct property value, so that it is not overridden by existing environment properties, system properties, or FlowFile attributes.
 - Each node in a clustered environment is configured with the same custom properties.
- Update `nifi.variable.registry.properties` with the location of the custom property file(s):

Property	Description
<code>nifi.variable.registry.properties</code>	This is a comma-separated list of file location paths for one or more custom property files.

- Restart your NiFi instance(s) for the updates to be picked up.

Custom properties can also be configured in the NiFi UI.

Controller Services

Controller Services are shared services that can be used by reporting tasks, processors, and other services to utilize for configuration or task execution.



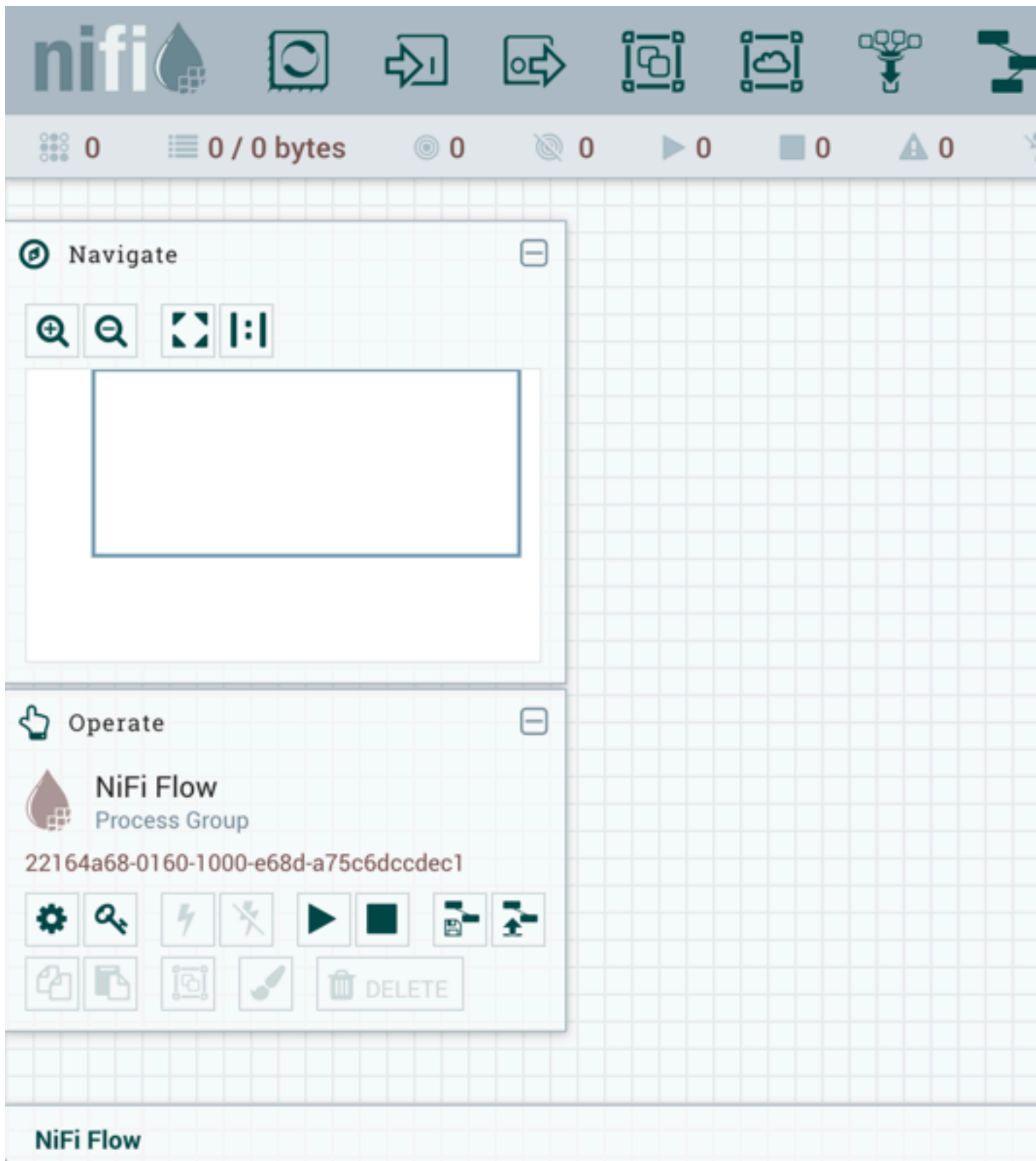
Note: Controller Services defined on the controller level are limited to reporting tasks and other services defined there. Controller Services for use by processors in your dataflow must be defined in the configuration of the root process group or sub-process group(s) where they will be used.



Note: If your NiFi instance is secured, your ability to view and add Controller Services is dependent on the privileges assigned to you. If you do not have access to one or more Controller Services, you are not able to see or access it in the UI. Access privileges can be assigned on a global or Controller Service-specific basis (see [Accessing the UI with Multi-Tenant Authorization](#) for more information).

Adding Controller Services for Reporting Tasks

To add a Controller Service for a reporting task, select Controller Settings from the Global Menu.



This displays the NiFi Settings window. The window has four tabs: General, Reporting Task Controller Services, Reporting Tasks and Registry Clients. The General tab provides settings for the overall maximum thread counts of the instance.

NiFi Settings

GENERAL	REPORTING TASK CONTROLLER SERVICES	REPORTING TASKS	REGISTRY CL
---------	------------------------------------	-----------------	-------------

Maximum Timer Driven Thread Count ?

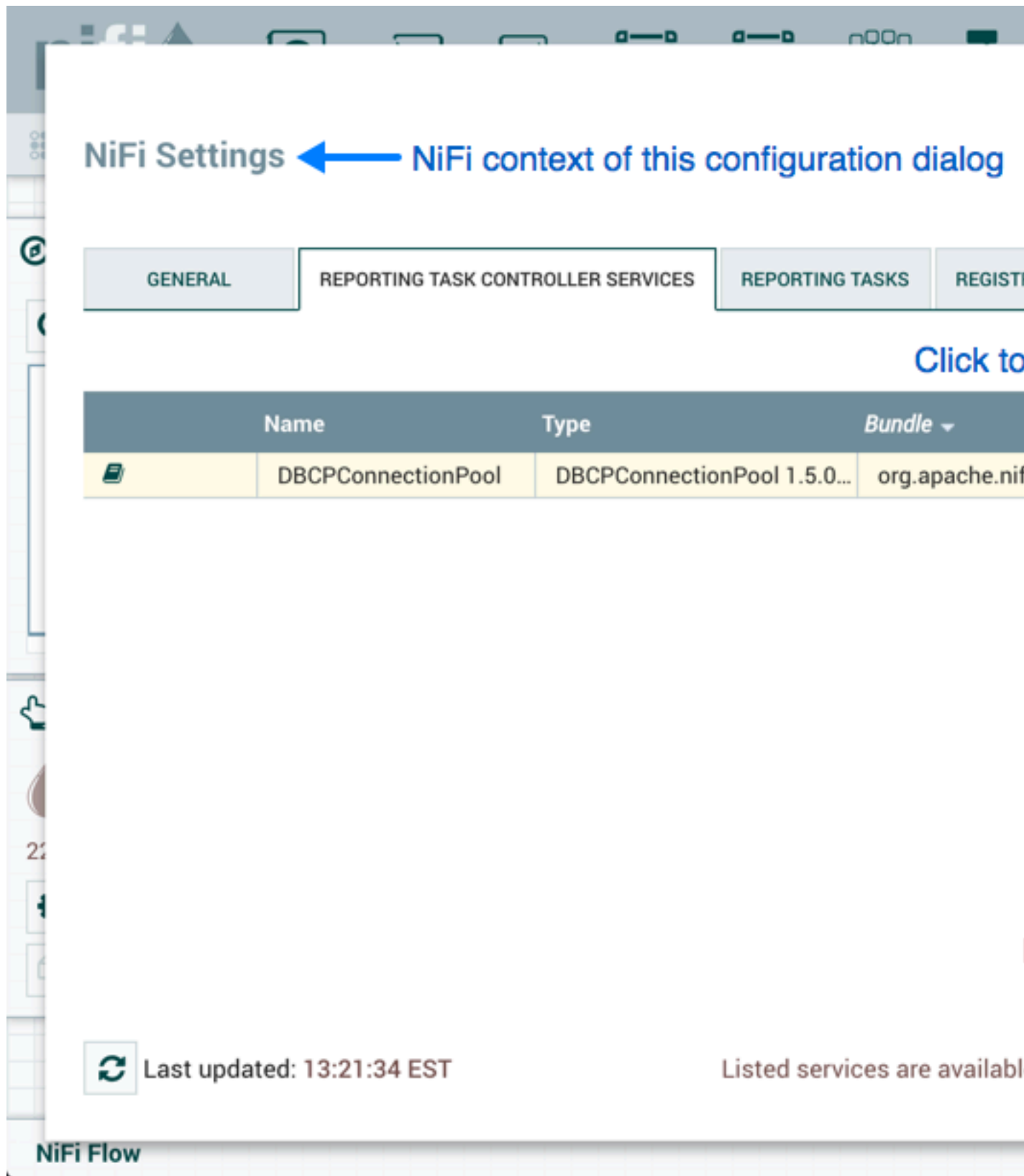
10

Maximum Event Driven Thread Count ?

5

APPLY

To the right of the General tab is the Reporting Task Controller Services tab. From this tab, the DFM may click the + button in the upper-right corner to create a new Controller Service.











The Add Controller Service window opens. This window is similar to the Add Processor window. It provides a list of the available Controller Services on the right and a tag cloud, showing the most common category tags used for Controller Services, on the left. The DFM may click any tag in the tag cloud in order to narrow down the list of Controller Services to those that fit the categories desired. The DFM may also use the Filter field at the top-right of

the window to search for the desired Controller Service or use the Source drop-down at the top-left to filter the list by the group who created them. Upon selecting a Controller Service from the list, the DFM can see a description of the service below. Select the desired controller service and click Add, or simply double-click the name of the service to add it.

Add Controller Service

Source

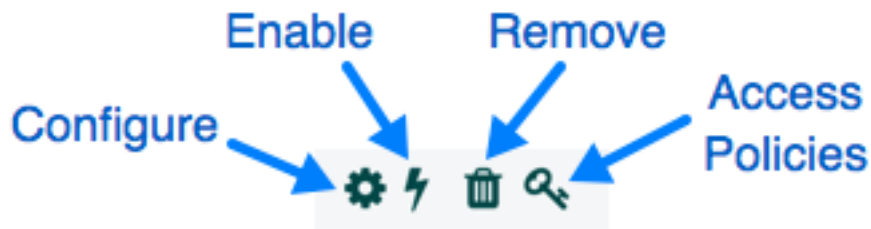
Displaying 10 of 28

all groups ▼	Type	Version ▲
avro cache cluster	AWSCredentialsProviderControllerService	1.2.0 
comma connection	CouchbaseClusterService	1.2.0 
csv database dbcp	DistributedMapCacheClientService	1.2.0 
delimited	DistributedMapCacheServer	1.2.0
distributed jdbc	DistributedSetCacheClientService	1.2.0 
json parse pooling	DistributedSetCacheServer	1.2.0
provider reader	GCPCredentialsControllerService	1.2.0 
record recordset	HBase_1_1_2_ClientService	1.2.0 
result row separated	StandardSSLContextService	1.2.0 
server set store	JettyWebSocketServer	1.2.0 
writer		

StandardSSLContextService 1.2.0 org.apache.n

Standard implementation of the SSLContextService. Provides and/or truststore properties once and reuse that configuration.

Once you have added a Controller Service, you can configure it by clicking the "Configure" button in the far-right column. Other buttons in this column include "Enable", "Remove" and "Access Policies".



You can obtain information about Controller Services by clicking the "Usage" and "Alerts" buttons in the left-hand column.



When the DFM clicks the "Configure" button, a Configure Controller Service window opens. It has three tabs: Settings, Properties, and Comments. This window is similar to the Configure Processor window. The Settings tab provides a place for the DFM to give the Controller Service a unique name (if desired). It also lists the UUID, Type, Bundle and Support information for the service and provides a list of other components (reporting tasks or other controller services) that reference the service.

Configure Controller Service

SETTINGS	PROPERTIES	COMMENTS
Name StandardSSLContextService		Referencing Components ▼ Reporting Tasks (1) ⚠ SiteToSiteProvenance
Id 172438f9-015c-1000-ecd6-ea699f013e59		
Type StandardSSLContextService 1.2.0		
Bundle org.apache.nifi - nifi-ssl-context-service-nar		
Supports Controller Service <ul style="list-style-type: none"> • SSLContextService 1.2.0 from org.apache.nifi - nifi-standard-services-api-nar 		

The Properties tab lists the various properties that apply to the particular controller service. As with configuring processors, the DFM may hover over the question mark icons to see more information about each property.

Configure Controller Service

SETTINGS

PROPERTIES

COMMENTS

Required field

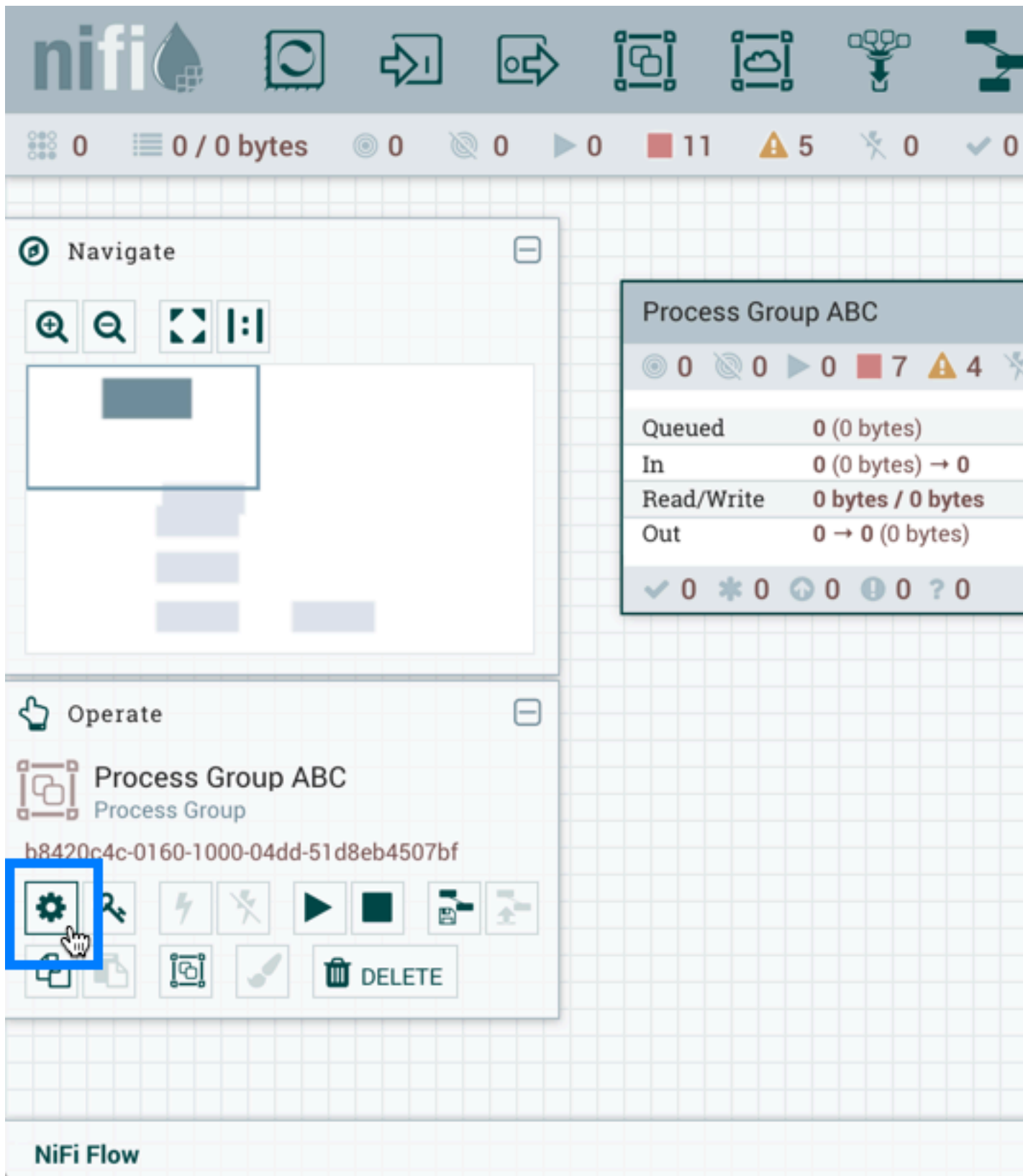
Property		Value
Keystore Filename	?	No value set
Keystore Password	?	Sensitive value set
Key Password	?	Sensitive value set
Keystore Type	?	No value set
Truststore Filename	?	No value set
Truststore Password	?	Sensitive value set
Truststore Type	?	No value set
SSL Protocol	?	TLS

The algorithm to use for this SSL context
 Default value: TLS
 Supports expression language: false

The Comments tab is just an open-text field, where the DFM may include comments about the service. After configuring a Controller Service, click "Apply" to save the configuration and close the window, or click "Cancel" to discard the changes and close the window.

Adding Controller Services for Dataflows

To add a Controller Service for a dataflow, you can either right click a Process Group and select Configure, or click Configure from the Operate Palette.



When you click Configure from the Operate Palette with nothing selected on your canvas, you add a Controller Service for your Root Process Group. That Controller Service is then available to all nested Process Groups in your dataflow. When you select a Process Group on the canvas and then click Configure from either the Operate Palette or

the Process Group context menu, the service will be available to all Processors and Controller Services defined in that Process Group and below.

Process Group ABC Configuration ← Process Group context menu

GENERAL CONTROLLER SERVICES

	Name	Type	Bundle
	AvroSchemaRegistry	AvroSchemaRegistry ...	org.apache.nifi - nifi-
	CSVReader	CSVReader 1.5.0-SNA...	org.apache.nifi - nifi-
	DBCPConnectionPool	DBCPConnectionPool ...	org.apache.nifi - nifi-
	JsonRecordSetWriter	JsonRecordSetWriter ...	org.apache.nifi - nifi-
	MYSQL DBCP	DBCPConnectionPool ...	org.apache.nifi - nifi-
	CDC MapCache	DistributedMapCache...	org.apache.nifi - nifi-
	JsonPathReader	JsonPathReader 1.5.0...	org.apache.nifi - nifi-

Description of availability → Last updated: 14:17:35 EST

Listed services are available

NiFi Flow

Use the following steps to add a Controller Service:

1. Click Configure, either from the Operate Palette, or from the Process Group context menu. This displays the process group Configuration window. The window has two tabs: General and Controller Services. The General tab is for settings that pertain to general information about the process group. For example, if configuring the root process group, the DFM can provide a unique name for the overall dataflow, as well as comments that describe

the flow (Note: this information is visible to any other NiFi instance that connects remotely to this instance (using Remote Process Groups, a.k.a., Site-to-Site)).

The screenshot shows the 'Process Group ABC Configuration' dialog box in the Apache NiFi web console. The dialog has two tabs: 'GENERAL' and 'CONTROLLER SERVICES'. The 'CONTROLLER SERVICES' tab is currently selected. Below the tabs, there are two input fields: 'Process Group Name' with the value 'Process Group ABC' and 'Process Group Comments' which is empty. Below these fields is an 'APPLY' button. At the bottom of the dialog, there is a refresh icon and the text 'Last updated: 14:30:13 EDT'. The background shows a blurred view of the NiFi web console interface, including a sidebar with navigation icons and a top bar with the text 'NiFi Flow » Process Group ABC'.

Process Group ABC Configuration

GENERAL **CONTROLLER SERVICES**

Process Group Name
Process Group ABC


Process Group Comments

APPLY

Last updated: 14:30:13 EDT


NiFi Flow » Process Group ABC


2. From the Process Group Configuration page, select the Controller Services tab.
3. Click the + button to display the Add Controller Service dialog.
4. Select the Controller Service desired, and click Add.
- 5.

Perform any necessary Controller Service configuration tasks by clicking the Configure icon () in the right-hand column.

Enabling/Disabling Controller Services

After a Controller Service has been configured, it must be enabled in order to run. Do this using the "Enable" button

() in the far-right column of the Controller Services tab. In order to modify an existing/running controller service, the DFM needs to stop/disable it (as well as all referencing reporting tasks and controller services). Do this

using the "Disable" button (). Rather than having to hunt down each component that is referenced by that controller service, the DFM has the ability to stop/disable them when disabling the controller service in question. When enabling a controller service, the DFM has the option to either start/enable the controller service and all referencing components or start/enable only the controller service itself.

Enable Controller Service

Service

StandardSSLContextService

Scope

Service only	▼
Service only	?
Service and referencing components	?

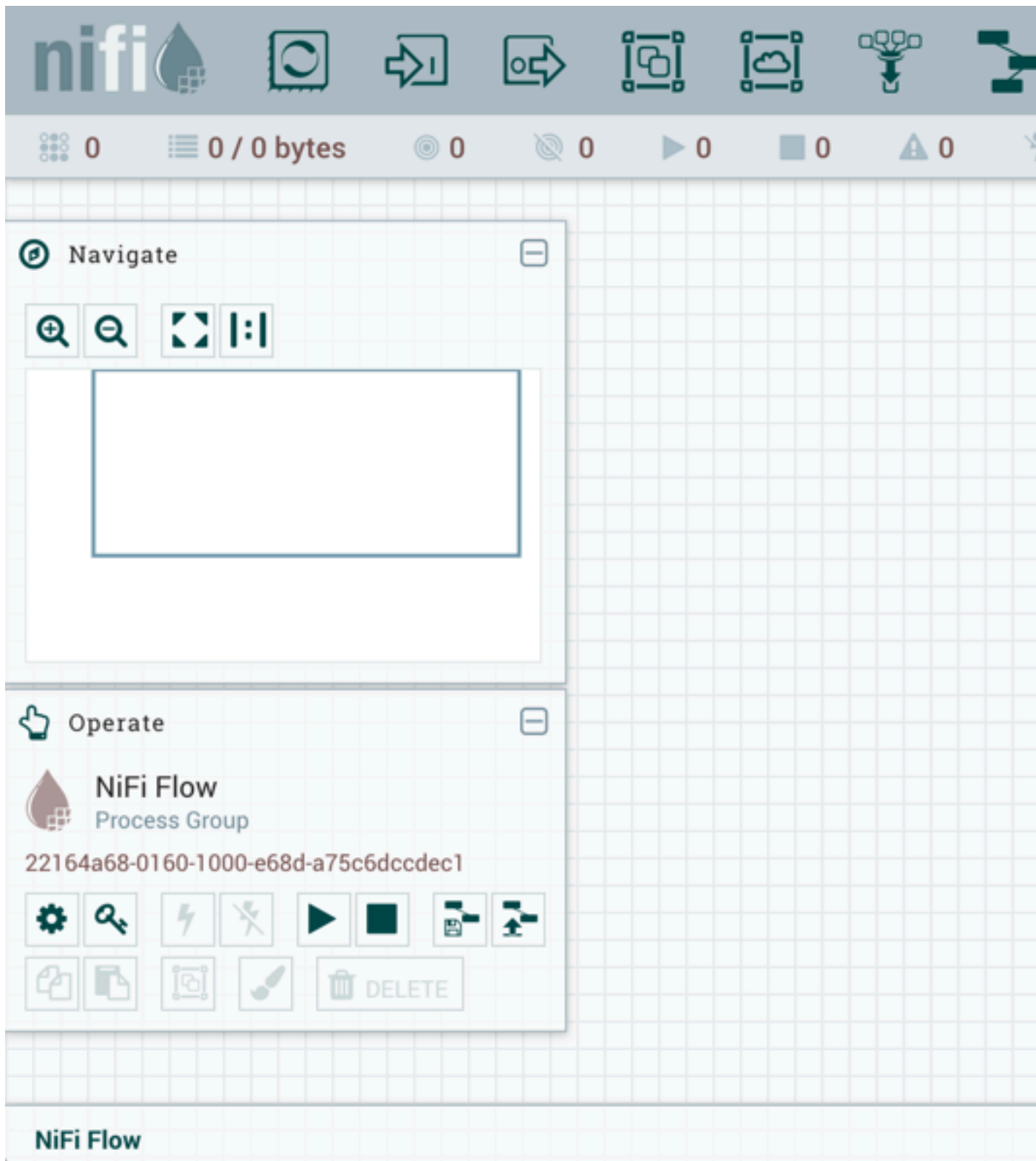
Referencing Components

▼ **Reporting Tasks** (1)

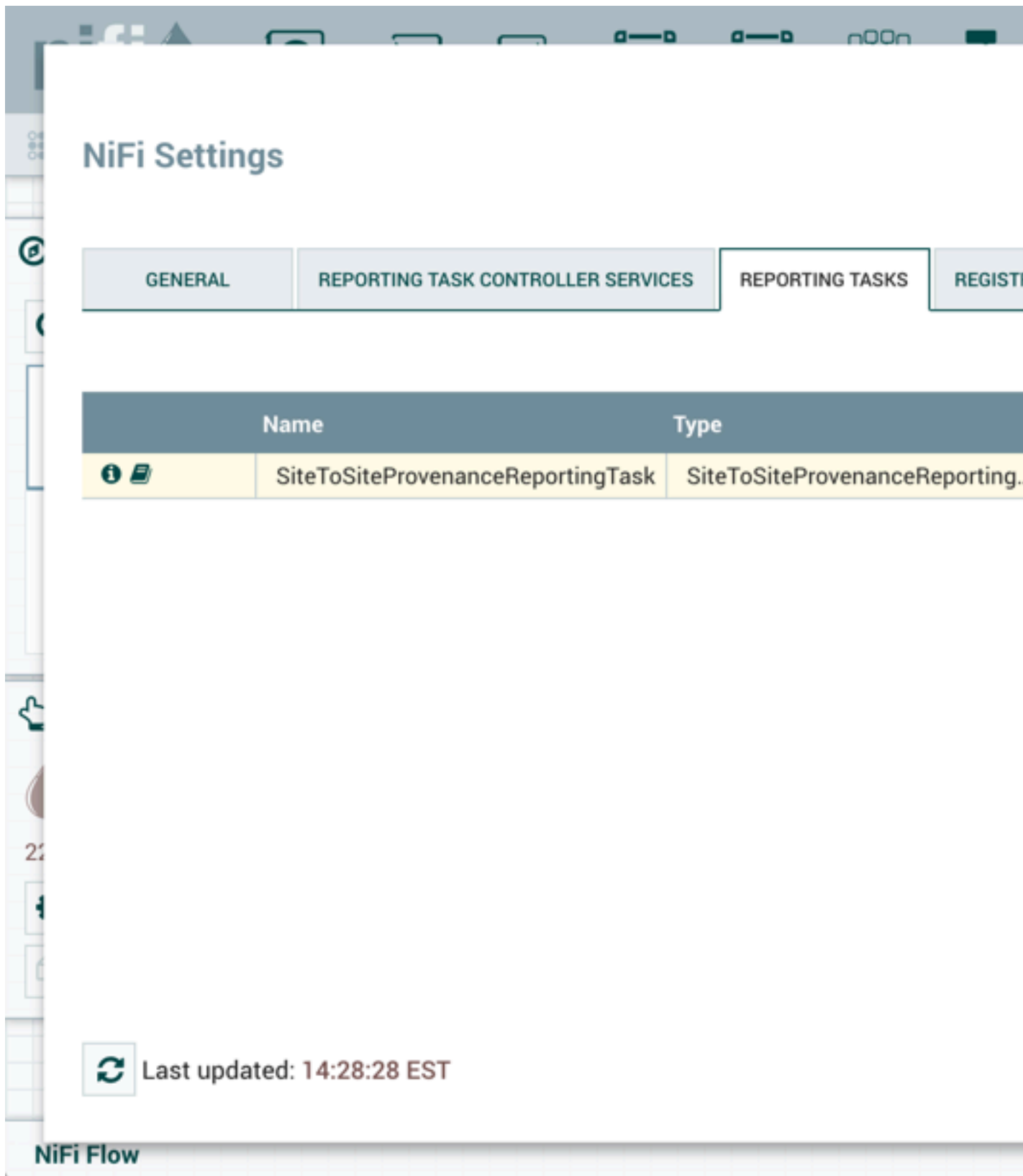
⚠ [SiteToSiteProvenance](#)

Reporting Tasks

Reporting Tasks run in the background to provide statistical reports about what is happening in the NiFi instance. The DFM adds and configures Reporting Tasks similar to the process for Controller Services. To add a Reporting Task, select Controller Settings from the Global Menu.



This displays the NiFi Settings window. Select the Reporting Tasks tab and click the + button in the upper-right corner to create a new Reporting Task.



The Add Reporting Task window opens. This window is similar to the Add Processor window. It provides a list of the available Reporting Tasks on the right and a tag cloud, showing the most common category tags used for Reporting Tasks, on the left. The DFM may click any tag in the tag cloud in order to narrow down the list of Reporting Tasks to those that fit the categories desired. The DFM may also use the Filter field at the top-right of the window to search for

the desired Reporting Task or use the Source drop-down at the top-left to filter the list by the group who created them. Upon selecting a Reporting Task from the list, the DFM can see a description of the task below. Select the desired reporting task and click Add, or simply double-click the name of the service to add it.

Add Reporting Task

Source

Displaying 7 of 10

all groups ▼

ambari execute

garbage collection gc groovy

heap js jvm jython log lua

lua memory **metrics**

monitor monitoring python

reporting

restricted script **site**

site to site stats

storage **warning**

Type ▲	Version
AmbariReportingTask	1.2.0
ControllerStatusReportingTask	1.2.0
DataDogReportingTask	1.2.0
ScriptedReportingTask	1.2.0
SiteToSiteBulletinReportingTask	1.2.0
SiteToSiteProvenanceReportingTask	1.2.0
SiteToSiteStatusReportingTask	1.2.0

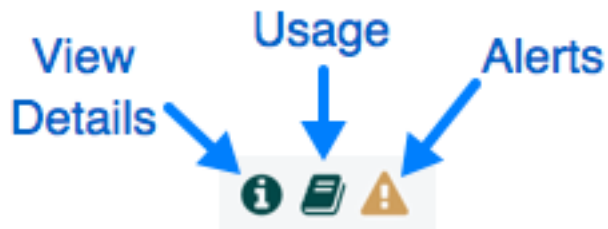
SiteToSiteStatusReportingTask 1.2.0 [org.apache...](#)

Publishes Status events using the Site To Site protocol. The filter is the union of the component filters. Only components matching both regexes are recursively searched for matching components, regardless of the component filters. The component filters matches the component filters.

Once a Reporting Task has been added, the DFM may configure it by clicking the "Edit" button in the far-right column. Other buttons in this column include "Start", "Remove", "State" and "Access Policies".



You can obtain information about Reporting Tasks by clicking the "View Details", "Usage", and "Alerts" buttons in the left-hand column.



When the DFM clicks the "Edit" button, a Configure Reporting Task window opens. It has three tabs: Settings, Properties, and Comments. This window is similar to the Configure Processor window. The Settings tab provides a place for the DFM to give the Reporting Task a unique name (if desired). It also lists the UUID, Type, and Bundle information for the task and provides settings for the task's Scheduling Strategy and Run Schedule (similar to the same settings in a processor). The DFM may hover the mouse over the question mark icons to see more information about each setting.

Configure Reporting Task

SETTINGS	PROPERTIES	COMMENTS
Name	SiteToSiteStatusReportingTask <input checked="" type="checkbox"/> Enabled	Scheduling Strategy ? Timer driven
Id	1d1f5ecd-015c-1000-bff7-40b54c50db99	Run Schedule ? 5 mins
Type	SiteToSiteStatusReportingTask 1.2.0	
Bundle	org.apache.nifi - nifi-site-to-site-reporting-nar	

The Properties tab lists the various properties that may be configured for the task. The DFM may hover the mouse over the question mark icons to see more information about each property.

Configure Reporting Task

SETTINGS

PROPERTIES

COMMENTS

Required field


Property		Value
Destination URL	?	No value set
Input Port Name	?	No value set
SSL Context Service	?	No value set
Instance URL	?	http://\${hostname(true)}:8080/nifi
Compress Events	?	true
Communications Timeout	?	30 secs
Batch Size	?	1000
Platform	?	nifi
Component Type Filter Regex	?	(Processor ProcessGroup RemoteProcess
Component Name Filter Regex	?	.*

A regex specifying which component names to report. Any component name matching this regex will be included.

Default value: .*


Supports expression language: true

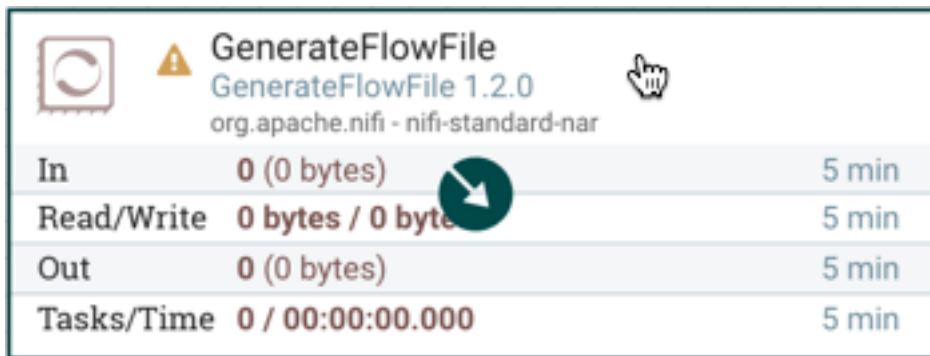
The Comments tab is just an open-text field, where the DFM may include comments about the task. After configuring the Reporting Task, click "Apply" to save the configuration and close the window, or click "Cancel" to discard the changes and close the window.

When you want to run the Reporting Task, click the "Start" button ().

Connecting Components

Once processors and other components have been added to the canvas and configured, the next step is to connect them to one another so that NiFi knows what to do with each FlowFile after it has been processed. This is accomplished by creating a Connection between each component. When the user hovers the mouse over the center of

a component, a new Connection icon () appears:



The user drags the Connection bubble from one component to another until the second component is highlighted. When the user releases the mouse, a 'Create Connection' dialog appears. This dialog consists of two tabs: 'Details' and 'Settings'. They are discussed in detail below. Note that it is possible to draw a connection so that it loops back on the same processor. This can be useful if the DFM wants the processor to try to re-process FlowFiles if they go down a failure Relationship. To create this type of looping connection, simply drag the connection bubble away and then back to the same processor until it is highlighted. Then release the mouse and the same 'Create Connection' dialog appears.

Details Tab

The Details tab of the 'Create Connection' dialog provides information about the source and destination components, including the component name, the component type, and the Process Group in which the component lives:

Create Connection

DETAILS

SETTINGS

From Processor

GenerateFlowFile
GenerateFlowFile

Within Group

NiFi Flow

For Relationships

☒ success

To Processor

LogAttribute
LogAttribute

Within Group

NiFi Flow

Additionally, this tab provides the ability to choose which Relationships should be included in this Connection. At least one Relationship must be selected. If only one Relationship is available, it is automatically selected.



Note: If multiple Connections are added with the same Relationship, any FlowFile that is routed to that Relationship will automatically be 'cloned', and a copy will be sent to each of those Connections.

Settings

The Settings tab provides the ability to configure the Connection's Name, FlowFile Expiration, Back Pressure Thresholds, Load Balance Strategy and Prioritization:

Configure Connection

DETAILS

SETTINGS

Name

Id

208bf461-0166-1000-ffff-ffffefb88d70

FlowFile Expiration ?

0 sec

Back Pressure Object Threshold ?

10000

Size Threshold ?

1 GB

Load Balance Strategy ?

Do not load balance

Available Prioritizers ?

FirstInFirstOutPrioritiz

NewestFlowFileFirstP

OldestFlowFileFirstPr

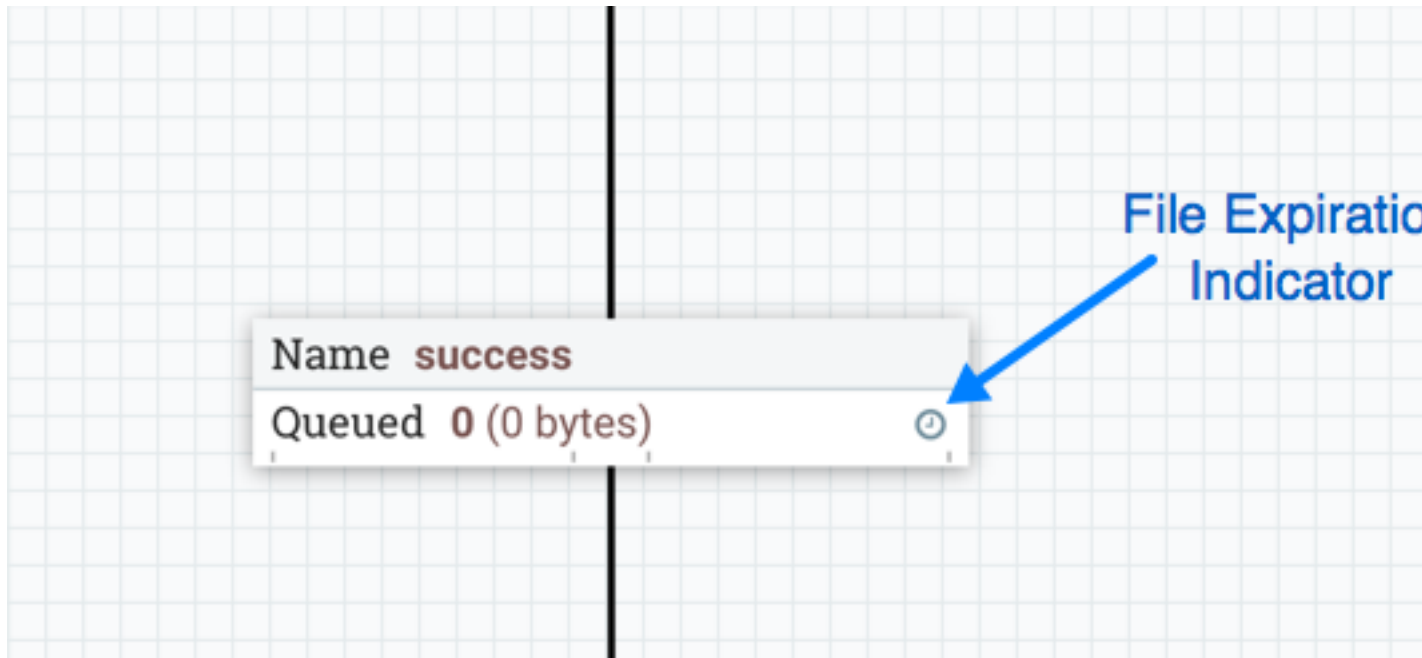
PriorityAttributePriorit

Selected Prioritizers ?

The Connection name is optional. If not specified, the name shown for the Connection will be names of the Relationships that are active for the Connection.

FlowFile Expiration

FlowFile expiration is a concept by which data that cannot be processed in a timely fashion can be automatically removed from the flow. This is useful, for example, when the volume of data is expected to exceed the volume that can be sent to a remote site. In this case, the expiration can be used in conjunction with Prioritizers to ensure that the highest priority data is processed first and then anything that cannot be processed within a certain time period (one hour, for example) can be dropped. The expiration period is based on the time that the data entered the NiFi instance. In other words, if the file expiration on a given connection is set to '1 hour', and a file that has been in the NiFi instance for one hour reaches that connection, it will expire. The default value of 0 sec indicates that the data will never expire. When a file expiration other than '0 sec' is set, a small clock icon appears on the connection label, so the DFM can see it at-a-glance when looking at a flow on the canvas.



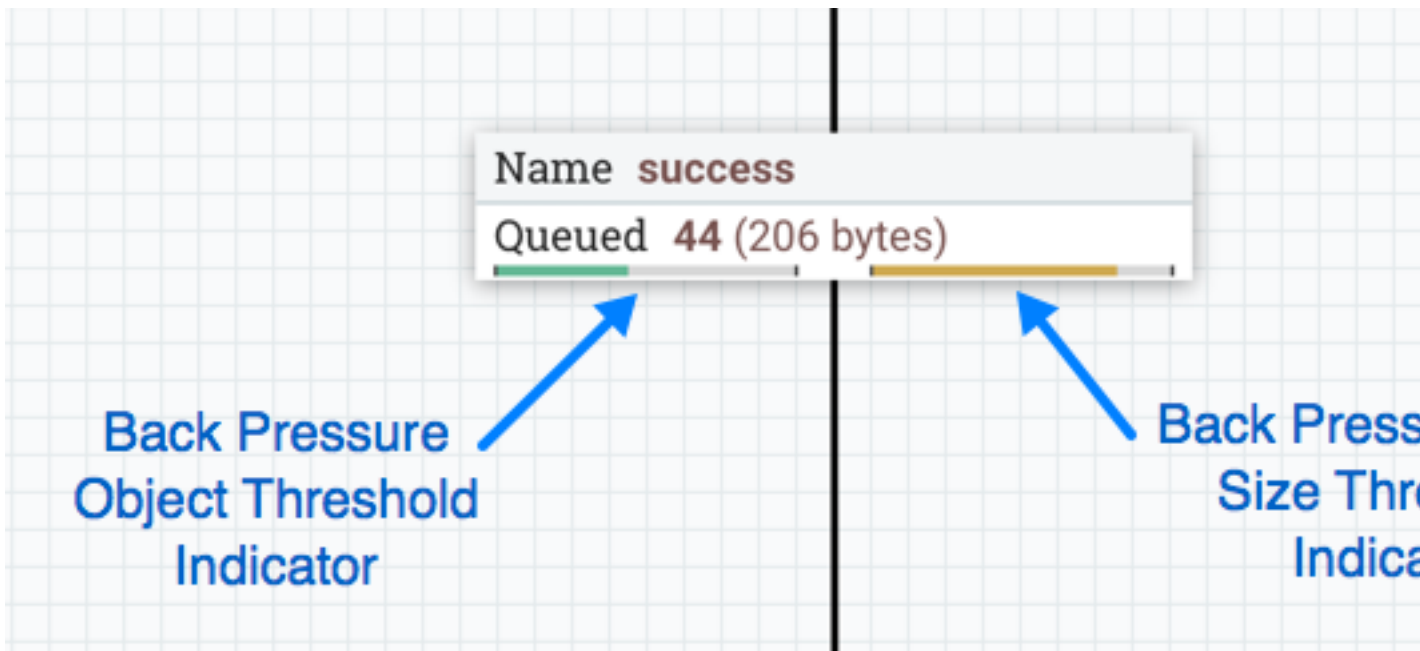
Back Pressure

NiFi provides two configuration elements for Back Pressure. These thresholds indicate how much data should be allowed to exist in the queue before the component that is the source of the Connection is no longer scheduled to run. This allows the system to avoid being overrun with data. The first option provided is the "Back pressure object threshold." This is the number of FlowFiles that can be in the queue before back pressure is applied. The second configuration option is the "Back pressure data size threshold." This specifies the maximum amount of data (in size) that should be queued up before applying back pressure. This value is configured by entering a number followed by a data size (B for bytes, KB for kilobytes, MB for megabytes, GB for gigabytes, or TB for terabytes).

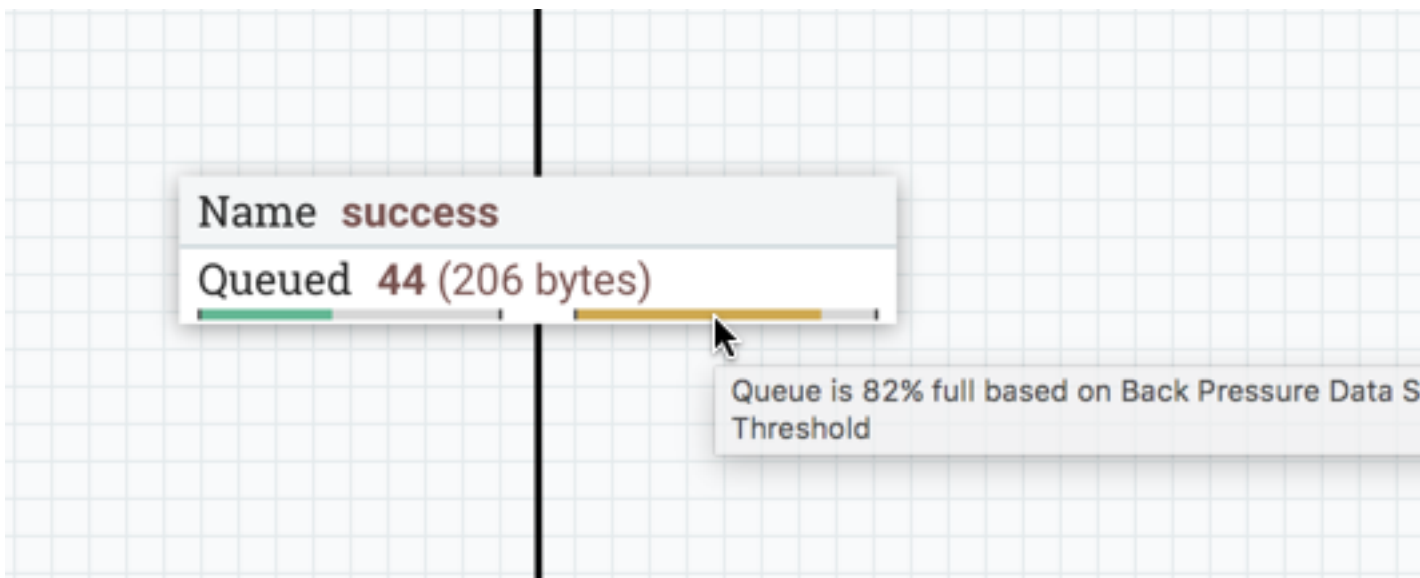


Note: By default each new connection added will have a default Back Pressure Object Threshold of 10,000 objects and Back Pressure Data Size Threshold of 1 GB. These defaults can be changed by modifying the appropriate properties in the `nifi.properties` file.

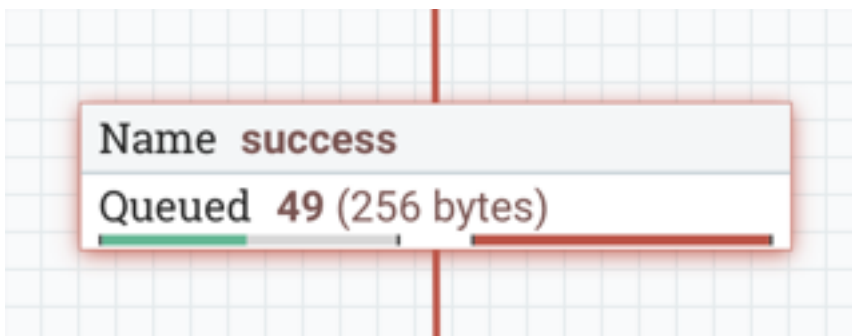
When back pressure is enabled, small progress bars appear on the connection label, so the DFM can see it at-a-glance when looking at a flow on the canvas. The progress bars change color based on the queue percentage: Green (0-60%), Yellow (61-85%) and Red (86-100%).



Hovering your mouse over a bar displays the exact percentage.



When the queue is completely full, the Connection is highlighted in red.



Load Balancing

Load Balance Strategy

To distribute the data in a flow across the nodes in the cluster, NiFi offers the following load balance strategies:

- **Do not load balance:** Do not load balance FlowFiles between nodes in the cluster. This is the default.
- **Partition by attribute:** Determines which node to send a given FlowFile to based on the value of a user-specified FlowFile Attribute. All FlowFiles that have the same value for the Attribute will be sent to the same node in the cluster. If the destination node is disconnected from the cluster or if unable to communicate, the data does not fail over to another node. The data will queue, waiting for the node to be available again. Additionally, if a node joins or leaves the cluster necessitating a rebalance of the data, consistent hashing is applied to avoid having to redistribute all of the data.
- **Round robin:** FlowFiles will be distributed to nodes in the cluster in a round-robin fashion. If a node is disconnected from the cluster or if unable to communicate with a node, the data that is queued for that node will be automatically redistributed to another node(s). If a node is not able to receive the data as fast other nodes in the cluster, the node may also be skipped for one or more iterations in order to maximize throughput of data distribution across the cluster.
- **Single node:** All FlowFiles will be sent to a single node in the cluster. Which node they are sent to is not configurable. If the node is disconnected from the cluster or if unable to communicate with the node, the data that is queued for that node will remain queued until the node is available again.



Note: In addition to the UI settings, there are Cluster Node Properties related to load balancing that must also be configured in `nifi.properties`.



Note: NiFi persists the nodes that are in a cluster across restarts. This prevents the redistribution of data until all of the nodes have connected. If the cluster is shutdown and a node is not intended to be brought back up, the user is responsible for removing the node from the cluster via the "Cluster" dialog in the UI (see [Managing Nodes](#) for more information). [d3bc5bfcae5d4e3815054c4b948c43ef96625c23.xml#load-balance-compression](#) Load Balance Compression. After selecting the load balance strategy, the user can configure whether or not data should be compressed when being transferred between nodes in the cluster.

Configure Connection

DETAILS

SETTINGS

Name

Id
208bf461-0166-1000-ffff-ffffefb88d70

FlowFile Expiration ?

Back Pressure Object Threshold ?

10000

Size Threshold ?

1 GB

Load Balance Strategy ?

Partition by attribute ▼

Attribute Name ?

Load Balance Compression ?

Do not compress ▼

Do not compress ?

Compress attributes only ?

Compress attributes and content ?

Available Prioritizers ?

FirstInFirstOutPrioritizer

NewestFlowFileFirstPrioritize


OldestFlowFileFirstPrioritizer

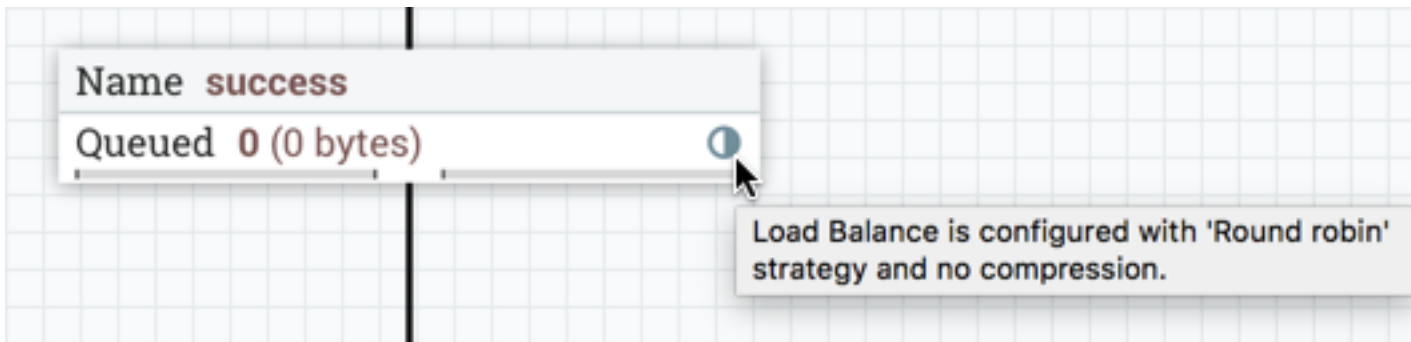
PriorityAttributePrioritizer

Selected Prioritizers ?

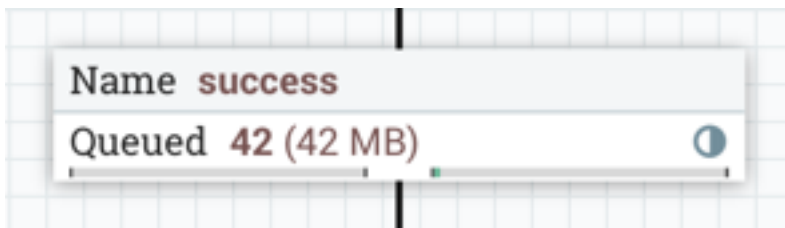
The following compression options are available:

- Do not compress: FlowFiles will not be compressed. This is the default.
- Compress attributes only: FlowFile attributes will be compressed, but FlowFile contents will not.
- Compress attributes and content: FlowFile attributes and contents will be compressed.

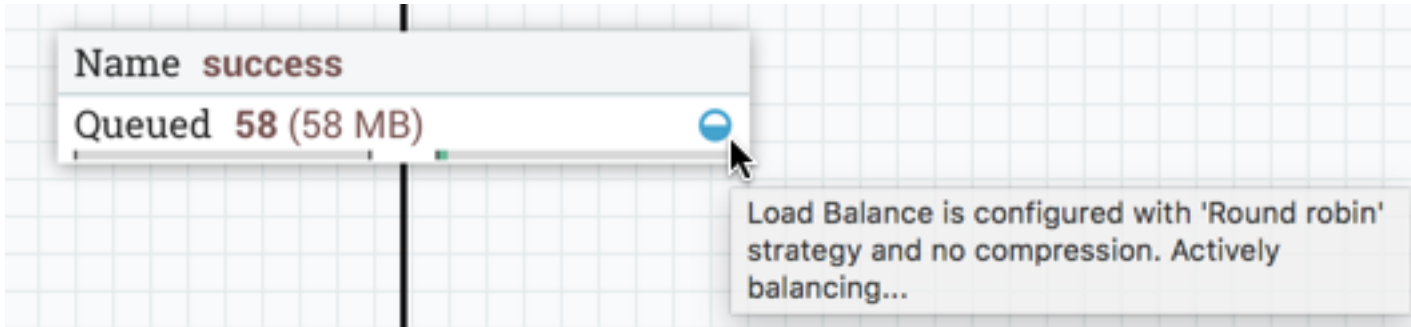
Load Balance Indicator When a load balance strategy has been implemented for a connection, a load balance indicator () will appear on the connection:



Hovering over the icon will display the connection's load balance strategy and compression configuration. The icon in this state also indicates that all data in the connection has been distributed across the cluster.



When data is actively being transferred between the nodes in the cluster, the load balance indicator will change orientation and color:



Cluster Connection Summary To see where data has been distributed among the cluster nodes, select Summary from the Global Menu. Then select the "Connections" tab and the "View Connection Details" icon for a source:

The image shows a 'NiFi Summary' dialog box with a sidebar on the left containing various icons. The main area has four tabs: 'PROCESSORS', 'INPUT PORTS', 'OUTPUT PORTS', and 'REMOTE PROCESS GROUPS'. Below the tabs, it says 'Displaying 1 of 1'. There is a 'Filter' input field and a dropdown menu set to 'by source'. A table displays the following data:

	Source Name ▲	Name	Destination Name	In / Size 5 min	
	GenerateFlow...	success	LogAttribute	0 (0 bytes)	

At the bottom left of the dialog is a refresh icon. At the bottom right, it says 'Last updated: 00:47:57 EDT'. The bottom of the dialog has a 'NiFi Flow' label.

This will open the Cluster Connection Summary dialog, which shows the data on each node in the cluster:

NiFi Summary

Cluster Connection Summary

success
Connection

208bf461-0166-1000-ffff-ffffefb88d70

Node ▲	In / Size 5 min	Queue / Size
localhost:9443	0 (0 bytes)	124 (124 MB)
localhost:9444	0 (0 bytes)	126 (126 MB)

Last updated: 00:55:08 EDT

NiFi Flow

Prioritization

The right-hand side of the tab provides the ability to prioritize the data in the queue so that higher priority data is processed first. Prioritizers can be dragged from the top ('Available prioritizers') to the bottom ('Selected prioritizers'). Multiple prioritizers can be selected. The prioritizer that is at the top of the 'Selected prioritizers' list is the highest priority. If two FlowFiles have the same value according to this prioritizer, the second prioritizer will determine which FlowFile to process first, and so on. If a prioritizer is no longer desired, it can then be dragged from the 'Selected prioritizers' list to the 'Available prioritizers' list.

The following prioritizers are available:

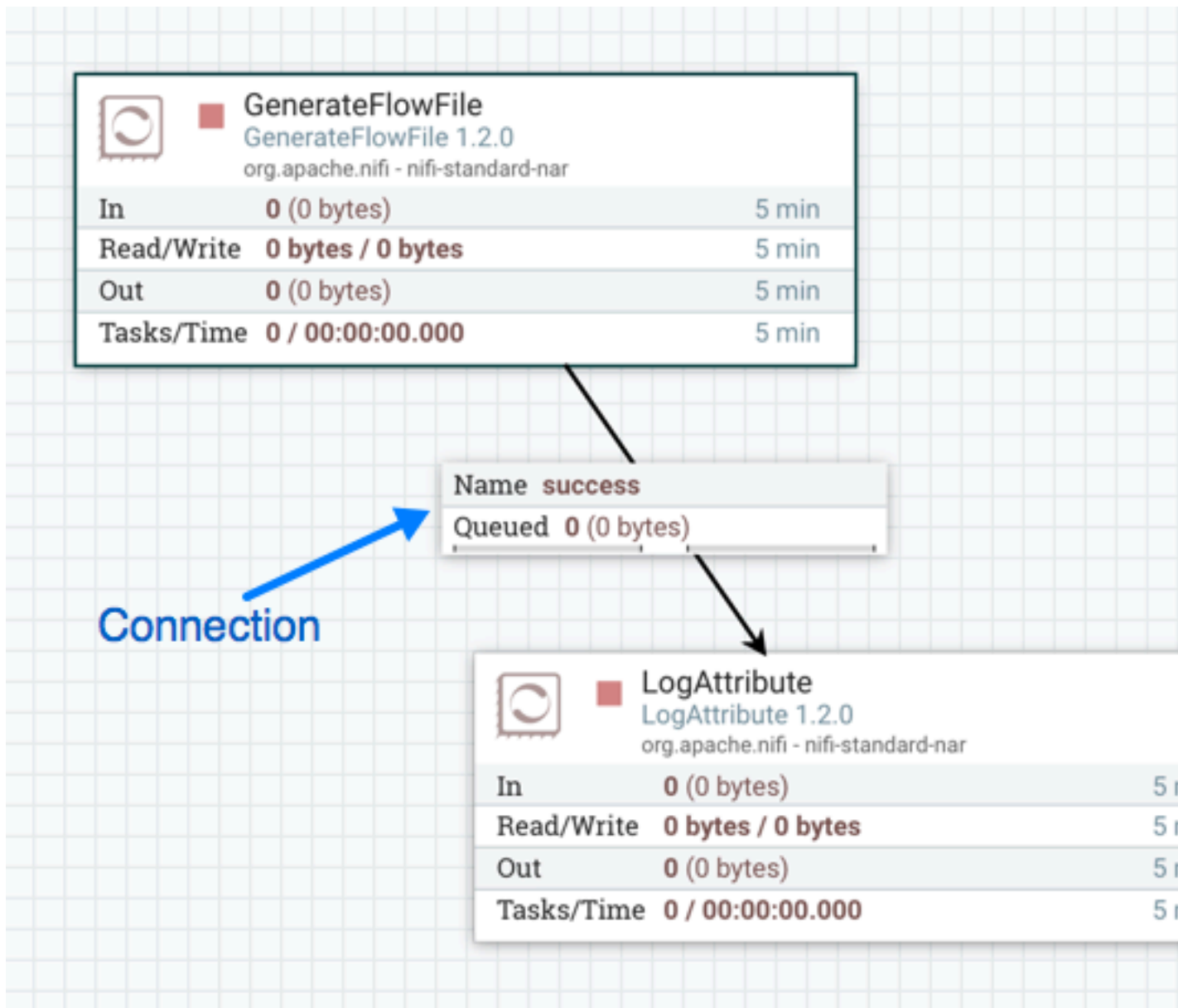
- **FirstInFirstOutPrioritizer:** Given two FlowFiles, the one that reached the connection first will be processed first.
- **NewestFlowFileFirstPrioritizer:** Given two FlowFiles, the one that is newest in the dataflow will be processed first.
- **OldestFlowFileFirstPrioritizer:** Given two FlowFiles, the one that is oldest in the dataflow will be processed first. 'This is the default scheme that is used if no prioritizers are selected'.
- **PriorityAttributePrioritizer:** Given two FlowFiles, an attribute called "priority" will be extracted. The one that has the lowest priority value will be processed first.
 - Note that an UpdateAttribute processor should be used to add the "priority" attribute to the FlowFiles before they reach a connection that has this prioritizer set.
 - If only one has that attribute it will go first.
 - Values for the "priority" attribute can be alphanumeric, where "a" will come before "z" and "1" before "9"
 - If "priority" attribute cannot be parsed as a long, unicode string ordering will be used. For example: "99" and "100" will be ordered so the flowfile with "99" comes first, but "A-99" and "A-100" will sort so the flowfile with "A-100" comes first.



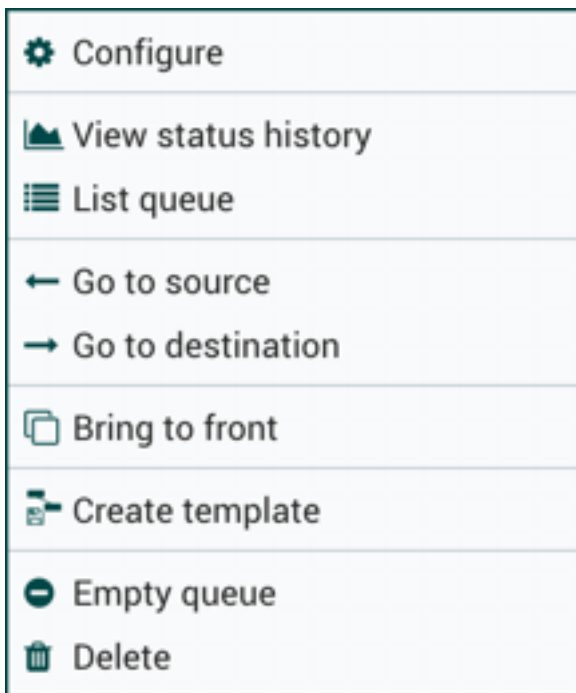
Note: With a Load Balance Strategy configured, the connection has a queue per node in addition to the local queue. The prioritizer will sort the data in each queue independently.

Changing Configuration and Context Menu Options

After a connection has been drawn between two components, the connection's configuration may be changed, and the connection may be moved to a new destination; however, the processors on either side of the connection must be stopped before a configuration or destination change may be made.



To change a connection's configuration or interact with the connection in other ways, right-click on the connection to open the connection context menu.

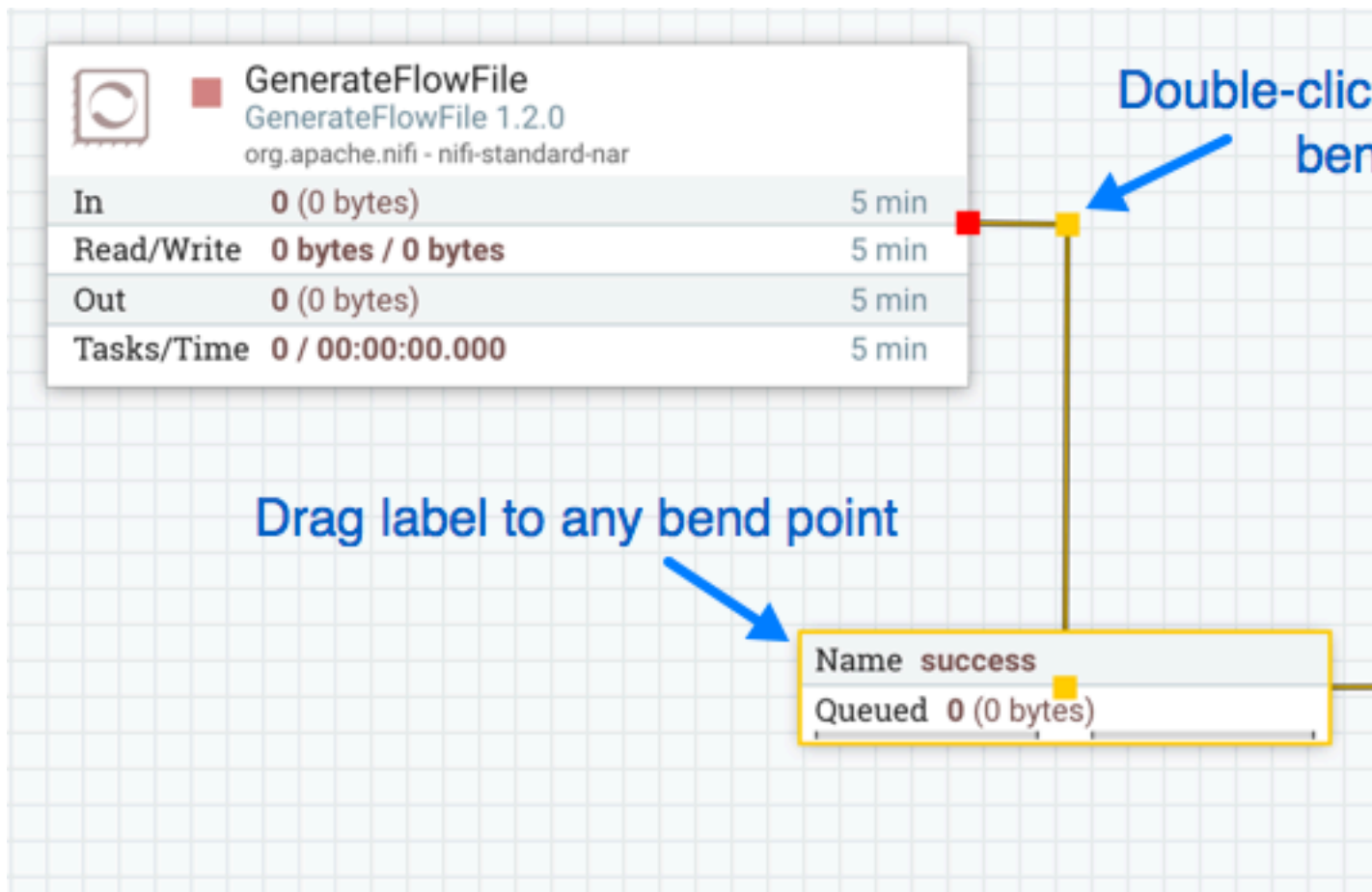


The following options are available:

- **Configure:** This option allows the user to change the configuration of the connection.
- **View status history:** This option opens a graphical representation of the connection's statistical information over time.
- **List queue:** This option lists the queue of FlowFiles that may be waiting to be processed.
- **Go to source:** This option can be useful if there is a long distance between the connection's source and destination components on the canvas. By clicking this option, the view of the canvas will jump to the source of the connection.
- **Go to destination:** Similar to the "Go to source" option, this option changes the view to the destination component on the canvas and can be useful if there is a long distance between two connected components.
- **Bring to front:** This option brings the connection to the front of the canvas if something else (such as another connection) is overlapping it.
- **Empty queue:** This option allows the DFM to clear the queue of FlowFiles that may be waiting to be processed. This option can be especially useful during testing, when the DFM is not concerned about deleting data from the queue. When this option is selected, users must confirm that they want to delete the data in the queue.
- **Delete:** This option allows the DFM to delete a connection between two components. Note that the components on both sides of the connection must be stopped and the connection must be empty before it can be deleted.

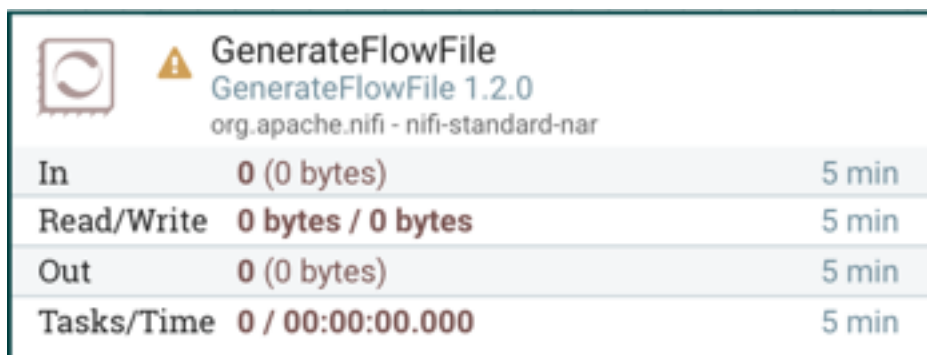
Bending Connections

To add a bend point (or elbow) to an existing connection, simply double-click on the connection in the spot where you want the bend point to be. Then, you can use the mouse to grab the bend point and drag it so that the connection is bent in the desired way. You can add as many bend points as you want. You can also use the mouse to drag and move the label on the connection to any existing bend point. To remove a bend point, simply double-click it again.




Processor Validation

Before trying to start a Processor, it's important to make sure that the Processor's configuration is valid. A status indicator is shown in the top-left of the Processor. If the Processor is invalid, the indicator will show a yellow Warning indicator with an exclamation mark indicating that there is a problem:



In this case, hovering over the indicator icon with the mouse will provide a tooltip showing all of the validation errors for the Processor. Once all of the validation errors have been addressed, the status indicator will change to a Stop icon, indicating that the Processor is valid and ready to be started but currently is not running:

 GenerateFlowFile GenerateFlowFile 1.2.0 org.apache.nifi - nifi-standard-nar		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

Site-to-Site

When sending data from one instance of NiFi to another, there are many different protocols that can be used. The preferred protocol, though, is the NiFi Site-to-Site Protocol. Site-to-Site makes it easy to securely and efficiently transfer data to/from nodes in one NiFi instance or data producing application to nodes in another NiFi instance or other consuming application.

Using Site-to-Site provides the following benefits:

- Easy to configure
 - After entering the URL(s) of the remote NiFi instance/cluster, the available ports (endpoints) are automatically discovered and provided in a drop-down list.
- Secure
 - Site-to-Site optionally makes use of Certificates in order to encrypt data and provide authentication and authorization. Each port can be configured to allow only specific users, and only those users will be able to see that the port even exists. For information on configuring the Certificates, see the [Security Configuration](#) section of the [System Administrator's Guide](#).
- Scalable
 - As nodes in the remote cluster change, those changes are automatically detected and data is scaled out across all nodes in the cluster.
- Efficient
 - Site-to-Site allows batches of FlowFiles to be sent at once in order to avoid the overhead of establishing connections and making multiple round-trip requests between peers.
- Reliable
 - Checksums are automatically produced by both the sender and receiver and compared after the data has been transmitted, in order to ensure that no corruption has occurred. If the checksums don't match, the transaction will simply be canceled and tried again.
- Automatically load balanced
 - As nodes come online or drop out of the remote cluster, or a node's load becomes heavier or lighter, the amount of data that is directed to that node will automatically be adjusted.
- FlowFiles maintain attributes
 - When a FlowFile is transferred over this protocol, all of the FlowFile's attributes are automatically transferred with it. This can be very advantageous in many situations, as all of the context and enrichment that has been determined by one instance of NiFi travels with the data, making for easy routing of the data and allowing users to easily inspect the data.
- Adaptable
 - As new technologies and ideas emerge, the protocol for handling Site-to-Site communications are able to change with them. When a connection is made to a remote NiFi instance, a handshake is performed in order

to negotiate which protocol and which version of the protocol will be used. This allows new capabilities to be added while still maintaining backward compatibility with all older instances. Additionally, if a vulnerability or deficiency is ever discovered in a protocol, it allows a newer version of NiFi to forbid communication over the compromised versions of the protocol.

Site-to-Site is a protocol transferring data between two NiFi instances. Both end can be a standalone NiFi or a NiFi cluster. In this section, the NiFi instance initiates the communications is called Site-to-Site client NiFi instance and the other end as Site-to-Site server NiFi instance to clarify what configuration needed on each NiFi instances.

A NiFi instance can be both client and server for Site-to-Site protocol, however, it can only be a client or server within a specific Site-to-Site communication. For example, if there are three NiFi instances A, B and C. A pushes data to B, and B pulls data from C. A - push # B # pull - C. Then B is not only a server in the communication between A and B, but also a client in B and C.

It is important to understand which NiFi instance will be the client or server in order to design your data flow, and configure each instance accordingly. Here is a summary of what components run on which side based on data flow direction:

- Push: a client sends data to a Remote Process Group, the server receives it with an Input Port
- Pull: a client receives data from a Remote Process Group, the server sends data through an Output Port

Configure Site-to-Site client NiFi instance

Remote Process Group: In order to communicate with a remote NiFi instance via Site-to-Site, simply drag a [Remote Process Group](#) onto the canvas and enter the URL(s) of the remote NiFi instance (for more information on the components of a Remote Process Group, see the [Remote Process Group Transmission](#) section of this guide.) The URL is the same URL you would use to go to that instance's User Interface or in the case of a cluster, the URLs of the cluster nodes. At this point, you can drag a connection to or from the Remote Process Group in the same way you would drag a connection to or from a Processor or a local Process Group. When you drag the connection, you will have a chance to choose which Port to connect to. Note that it may take up to one minute for the Remote Process Group to determine which ports are available.

If the connection is dragged starting from the Remote Process Group, the ports shown will be the Output Ports of the remote group, as this indicates that you will be pulling data from the remote instance. If the connection instead ends on the Remote Process Group, the ports shown will be the Input Ports of the remote group, as this implies that you will be pushing data to the remote instance.



Note: If the remote instance is configured to use secure data transmission, you will see only ports that you are authorized to communicate with. For information on configuring NiFi to run securely, see the [System Administrator's Guide](#).

Transport Protocol: On a Remote Process Group creation or configuration dialog, you can choose Transport Protocol to use for Site-to-Site communication as shown in the following image:

Configure Remote Process Group

Name

`http://localhost:8080/nifi/`

Id

`a43a9b4e-015a-1000-6997-39a4e265a8b8`


URLs

`http://localhost:8080/nifi/`


Transport Protocol 

RAW


Local Network Interface

HTTP Proxy Server Hostname 


HTTP Proxy Server Port

HTTP Proxy User 

HTTP Proxy Password 

Communications Timeout 

30 sec

Yield Duration 

10 sec

By default, it is set to RAW which uses raw socket communication using a dedicated port. HTTP transport protocol is especially useful if the remote NiFi instance is in a restricted network that only allow access through HTTP(S) protocol or only accessible from a specific HTTP Proxy server. For accessing through a HTTP Proxy Server, BASIC and DIGEST authentication are supported.

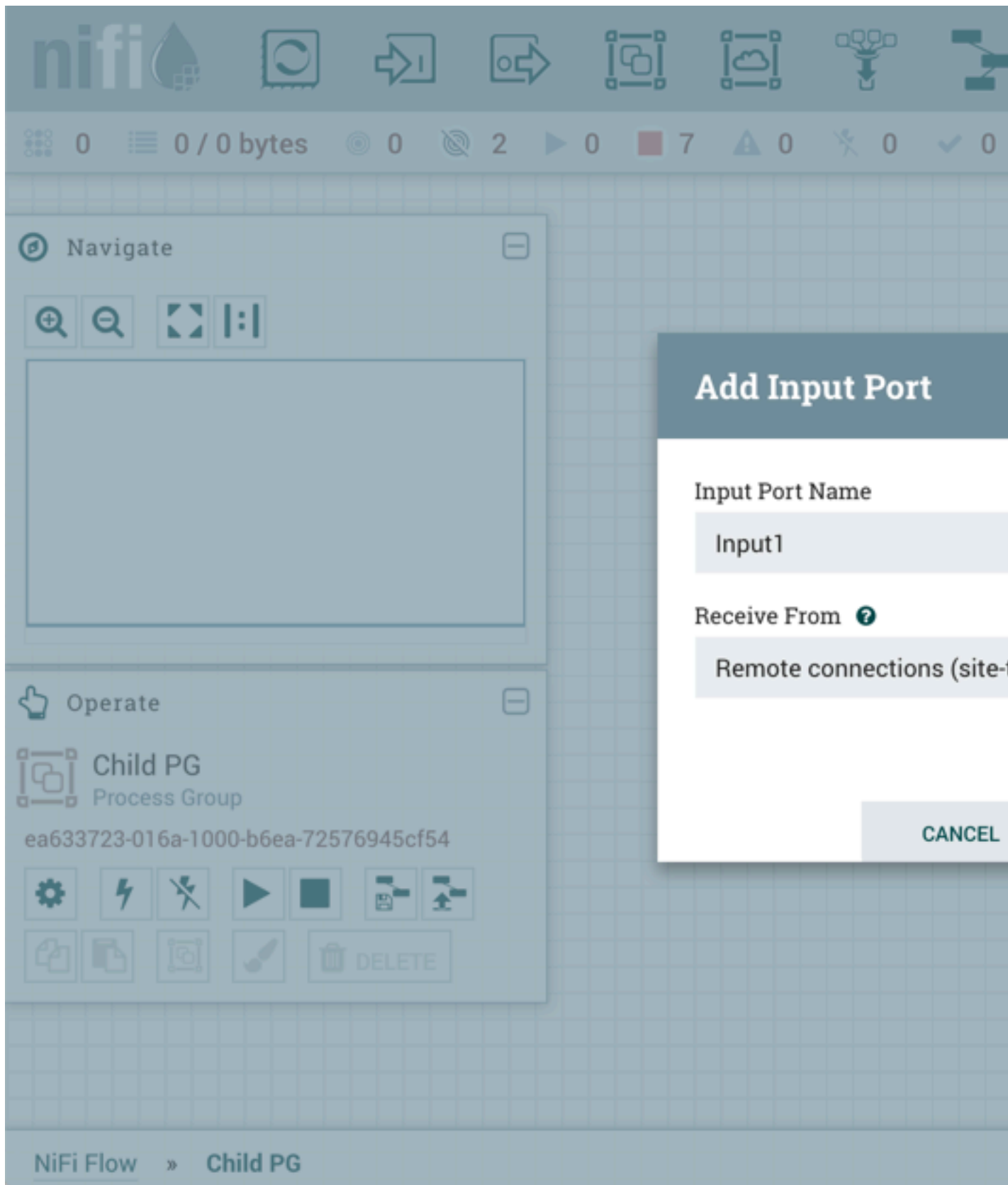
Local Network Interface: In some cases, it may be desirable to prefer one network interface over another. For example, if a wired interface and a wireless interface both exist, the wired interface may be preferred. This can be configured by specifying the name of the network interface to use in this box. If the value entered is not valid, the Remote Process Group will not be valid and will not communicate with other NiFi instances until this is resolved.

Configure Site-to-Site Server NiFi Instance

Retrieve Site-to-Site Details: If your NiFi is running securely, in order for another NiFi instance to retrieve information from your instance, it needs to be added to the Global Access "retrieve site-to-site details" policy. This will allow the other instance to query your instance for details such as name, description, available peers (nodes when clustered), statistics, OS port information and available Input and Output ports. Utilizing Input and Output ports in a secured instance requires additional policy configuration as described below.

Input Port: In order to allow another NiFi instance to push data to your local instance, you can simply drag an [Input Port](#) onto the Root Process Group of your canvas. After entering a name for the port, it will be added to your flow. You can now right-click on the Input Port and choose Configure in order to adjust the name and the number of concurrent tasks that are used for the port.

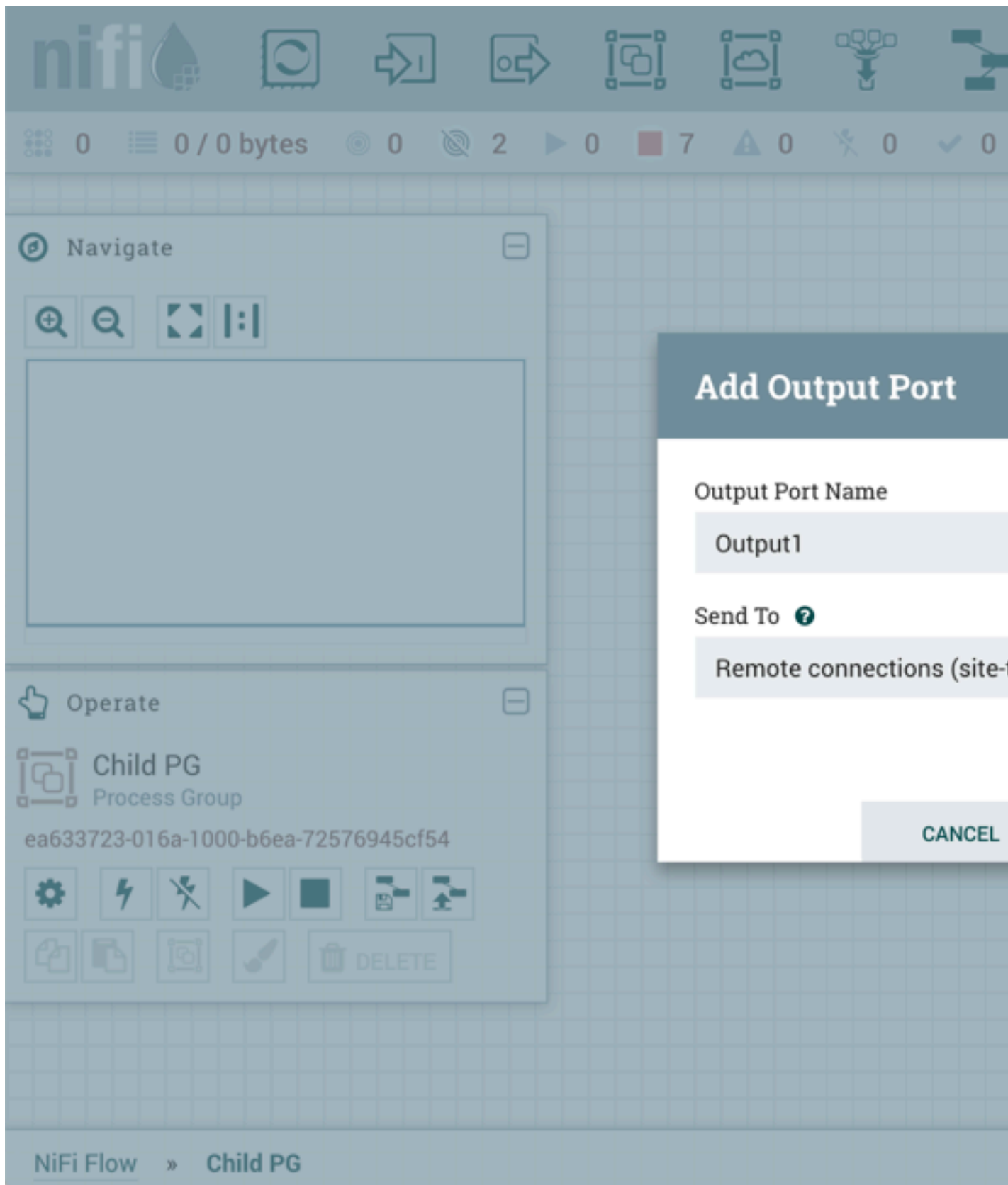
To create an Input Port for Site-to-Site in a child Process Group, enter the name for the port and select "Remote connections (site-to-site)" from the Receive From drop-down menu.



If Site-to-Site is configured to run securely, you will need to manage the input port's "receive data via site-to-site" component access policy. Only those users who have been added to the policy will be able to communicate with the port.

Output Port: Similar to an Input Port, a DataFlow Manager may choose to add an [Output Port](#) to the Root Process Group. The Output Port allows an authorized NiFi instance to remotely connect to your instance and pull data from the Output Port. After dragging an Output Port onto the canvas, right-click and choose Configure to adjust the name and how many concurrent tasks are allowed. Manage the output port's "receive data via site-to-site" component access policy to control which users are authorized to pull data from the instance being configured.

To create an Output Port for Site-to-Site in a child Process Group, enter the name for the port and select "Remote connections (site-to-site)" from the Send To drop-down menu.



In addition to other instances of NiFi, some other applications may use a Site-to-Site client in order to push data to or receive data from a NiFi instance. For example, NiFi provides an Apache Storm spout and an Apache Spark Receiver that are able to pull data from NiFi's Output Ports for Site-to-Site connections.



Note: For information on how to enable and configure Site-to-Site on a NiFi instance, see the [Site-to-Site Properties](#) section of the [System Administrator's Guide](#).



Note: For information on how to configure access policies, see the [Access Policies](#) section of the [System Administrator's Guide](#).

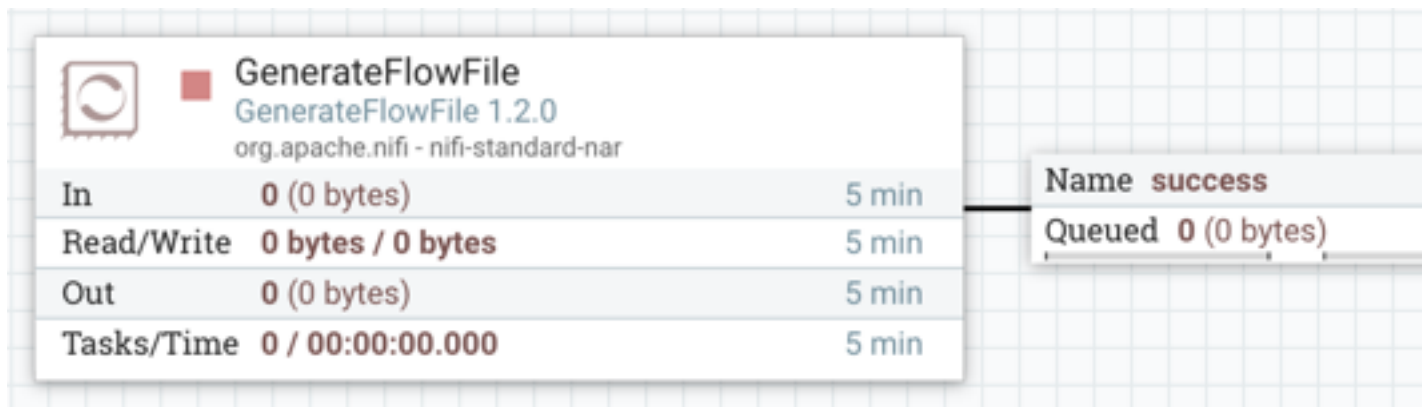
Example Dataflow

This section has described the steps required to build a dataflow. Now, to put it all together. The following example dataflow consists of just two processors: GenerateFlowFile and LogAttribute. These processors are normally used for testing, but they can also be used to build a quick flow for demonstration purposes and see NiFi in action.

After you drag the GenerateFlowFile and LogAttribute processors to the canvas and connect them (using the guidelines provided above), configure them as follows:

- Generate FlowFile
 - On the Scheduling tab, set Run schedule to: 5 sec. Note that the GenerateFlowFile processor can create many FlowFiles very quickly; that's why setting the Run schedule is important so that this flow does not overwhelm the system NiFi is running on.
 - On the Properties tab, set File Size to: 10 KB
- Log Attribute
 - On the Settings tab, under Auto-terminate relationships, select the checkbox next to Success. This will terminate FlowFiles after this processor has successfully processed them.
 - Also on the Settings tab, set the Bulletin level to Info. This way, when the dataflow is running, this processor will display the bulletin icon (see [Anatomy of a Processor](#)), and the user may hover over it with the mouse to see the attributes that the processor is logging.

The dataflow should look like the following:



Now see the following section on how to start and stop the dataflow. When the dataflow is running, be sure to note the statistical information that is displayed on the face of each processor (see [Anatomy of a Processor](#)).

Command and Control of the DataFlow


When a component is added to the NiFi canvas, it is in the Stopped state. In order to cause the component to be triggered, the component must be started. Once started, the component can be stopped at any time. From a Stopped state, the component can be configured, started, or disabled.

Starting a Component


In order to start a component, the following conditions must be met:

- The component's configuration must be valid.
- All defined Relationships for the component must be connected to another component or auto-terminated.
- The component must be stopped.
- The component must be enabled.
- The component must have no active tasks. For more information about active tasks, see the "Anatomy of ..." sections under [Monitoring of DataFlow](#) ([Anatomy of a Processor](#), [Anatomy of a Process Group](#), [Anatomy of a Remote Process Group](#)).



Components can be started by selecting all of the components to start and then clicking the "Start" button () in the Operate Palette or by right-clicking a single component and choosing Start from the context menu.


If starting a Process Group, all components within that Process Group (including child Process Groups) will be started, with the exception of those components that are invalid or disabled.

Once started, the status indicator of a Processor will change to a Play symbol ().

Stopping a Component

A component can be stopped any time that it is running. A component is stopped by right-clicking on the component



and clicking Stop from the context menu, or by selecting the component and clicking the "Stop" button () in the Operate Palette.

If a Process Group is stopped, all of the components within the Process Group (including child Process Groups) will be stopped.

Once stopped, the status indicator of a component will change to the Stop symbol ().


Stopping a component does not interrupt its currently running tasks. Rather, it stops scheduling new tasks to be performed. The number of active tasks is shown in the top-right corner of the Processor.



Enabling/Disabling a Component


When a component is enabled, it is able to be started. Users may choose to disable components when they are part of a dataflow that is still being assembled, for example. Typically, if a component is not intended to be run, the component is disabled, rather than being left in the Stopped state. This helps to distinguish between components that are intentionally not running and those that may have been stopped temporarily (for instance, to change the component's configuration) and inadvertently were never restarted.

When it is desirable to re-enable a component, it can be enabled by selecting the component and clicking the "Enable"



button () in the Operate Palette. This is available only when the selected component or components are disabled. Alternatively, a component can be enabled by checking the checkbox next to the "Enabled" option in the Settings tab of the Processor configuration dialog or the configuration dialog for a Port.



Once enabled, the component's status indicator will change to either Invalid () or Stopped (), depending on whether or not the component is valid.


A component is then disabled by selecting the component and clicking the "Disable" button () in the Operate Palette, or by clearing the checkbox next to the "Enabled" option in the Settings tab of the Processor configuration dialog or the configuration dialog for a Port.

Only Ports and Processors can be enabled and disabled.

Remote Process Group Transmission

Remote Process Groups provide a mechanism for sending data to or retrieving data from a remote instance of NiFi. When a Remote Process Group (RPG) is added to the canvas, it is added with the Transmission Disabled, as indicated

by the icon () in the top-left corner. When Transmission is Disabled, it can be enabled by right-clicking on the RPG and clicking the "Enable transmission" menu item. This will cause all ports for which there is a Connection to begin transmitting data. This will cause the status indicator to then change to the Transmission Enabled icon ().

If there are problems communicating with the Remote Process Group, a Warning indicator () may instead be present in the top-left corner. Hovering over this Warning indicator with the mouse will provide more information about the problem.

Individual Port Transmission

There are times when the DFM may want to either enable or disable transmission for only a specific port within the Remote Process Group. This can be accomplished by right-clicking on the Remote Process Group and choosing the "Manage remote ports" menu item. This provides a configuration dialog from which ports can be configured:

Remote Process Group Ports

Name

NiFi Flow

URLs

http://localhost:8080/r

Input ports



Input1

No description specified.

Concurrent Tasks ?

1

Batch Settings ?

Count

10

Size

10 KB

Compressed

No

Duration

10 sec



Input2

No description specified.

Concurrent Tasks ?

1

Batch Settings ?

Count

No value set

Size

No value set

Compressed

No

Duration

No value set



Output1

No description specified.



Concurrent Tasks ?

1

Batch Settings ?

Count

No value set



Output2

No description specified.

Concurrent Tasks ?

1

Batch Settings ?

Count

No value set






The left-hand side lists all of the Input Ports that the remote instance of NiFi allows data to be sent to. The right-hand side lists all of the Output Ports from which this instance is able to pull data. If the remote instance is using secure communications (the URL of the NiFi instance begins with https://, rather than http://), any ports that the remote instance has not made available to this instance will not be shown.




Note: If a port that is expected to be shown is not shown in this dialog, ensure that the instance has proper permissions and that the Remote Process Group's flow is current. This can be checked by closing the Remote Process Group Ports dialog and looking at the bottom-left corner of the Remote Process Group. The date and time when the flow was last refreshed is displayed. If the flow appears to be outdated, it can be updated by right-clicking on the Remote Process Group and selecting "Refresh remote". (See Anatomy of a Remote Process Group for more information).

Each port is shown with its Name, its Description, configured number of Concurrent Tasks, and whether or not data sent to this port will be Compressed. Additionally, the port's configured Batch Settings (Count, Size and Duration) are displayed. To the left of this information is a toggle switch to turn the port on or off. Ports that have no connections attached to them are grayed out:

Remote Process Group Ports

Name				URLs
NiFi Flow				http://localhost:8080/r
Input ports			Output ports	
	Input1 No description specified.	Currently Transmitting		Output1 No description specified.
	Concurrent Tasks ? 1			Concurrent Tasks ? 1
	Batch Settings ? Count 10			Batch Settings ? Count No value set
	Size 10 KB		Edit	
	Duration 10 sec			
	Input2 No description specified.	Not Connected		Output2 No description specified.
	Concurrent Tasks ? 1			Concurrent Tasks ? 1
	Batch Settings ? Count No value set			Batch Settings ? Count No value set
	Size No value set			
	Duration No value set			

The on/off toggle switch provides a mechanism to enable and disable transmission for each port in the Remote Process Group independently. Those ports that are connected but are not currently transmitting can be configured by

clicking the pencil icon () below the on/off toggle switch. Clicking this icon will allow the DFM to change the number of Concurrent Tasks, whether or not compression should be used when transmitting data to or from this port, and Batch Settings.

For an Input Port, the batch settings control how NiFi sends data to the remote input port in a transaction. NiFi will transfer flow files, as they are queued in incoming relationships, until any of the limits (Count, Size, Duration) is met. If none of the settings are configured, a 500 milliseconds batch duration is used by default.

For an Output Port, the batch settings tells the remote NiFi how NiFi prefers to receive data from the remote output port in a transaction. The remote NiFi will use the specified settings (Count, Size, Duration) to control the transfer of flow files. If none of the settings are configured, a 5 seconds batch duration is used by default.

Navigating within a DataFlow

NiFi provides various mechanisms for getting around a dataflow. The [NiFi User Interface](#) section describes various ways to navigate around the NiFi canvas; however, once a flow exists on the canvas, there are additional ways to get from one component to another. When multiple Process Groups exist in a flow, breadcrumbs appear at the bottom of the screen, providing a way to navigate between them. In addition, to enter a Process Group that is currently visible on the canvas, simply double-click it, thereby "drilling down" into it. Connections also provide a way to jump from one location to another within the flow. Right-click on a connection and select "Go to source" or "Go to destination" in order to jump to one end of the connection or another. This can be very useful in large, complex dataflows, where the connection lines may be long and span large areas of the canvas. Finally, all components provide the ability to jump forward or backward within the flow. Right-click any component (e.g., a processor, process group, port, etc.) and select either "Upstream connections" or "Downstream connections". A dialog window will open, showing the available upstream or downstream connections that the user may jump to. This can be especially useful when trying to follow a dataflow in a backward direction. It is typically easy to follow the path of a dataflow from start to finish, drilling down into nested process groups; however, it can be more difficult to follow the dataflow in the other direction.

Component Linking

A hyperlink can be used to navigate directly to a component on the NiFi canvas. This is especially useful when [Multi-Tenant Authorization](#) is configured. For example, a URL can be given to a user to direct them to the specific process group to which they have privileges.

The default URL for a NiFi instance is `http://<hostname>:8080/nifi` which points to the root process group. When a component is selected on the canvas, the URL is updated with the component's process group id and component id in the form `http://<hostname>:8080/nifi/?processGroupId=<UUID>&componentIds=<UUIDs>`;

In the following screenshot, the GenerateFlowFile processor in the process group PG1 is the selected component:

The screenshot displays the Apache NiFi web interface in a browser window. The address bar shows the URL: `localhost:8080/nifi/?processGroupId=b14d379f-015b-1000-d`. The interface includes a top navigation bar with the NiFi logo and several icons for navigation and actions. Below the navigation bar, there are status indicators for various components, including a "0 / 0 bytes" label.

The main workspace is a grid-based canvas. On the left, there is a "Navigate" panel with search and zoom controls. In the center, there is a "GenerateFlowFile" processor. The processor's details are shown in a panel on the right:

GenerateFlowFile	
GenerateFlowFile 1.2.0-SNAPSHOT	
org.apache.nifi - nifi-standard-n	
In	0 (0 bytes)
Read/Write	0 bytes / 0 bytes
Out	0 (0 bytes)
Tasks/Time	0 / 00:00:00.000

Below the processor details, there is a "Name" field with the value "GenerateFlowFile" and a "Queued" status of "0".

At the bottom of the interface, there is a "NiFi Flow" section with a "PG1" label.



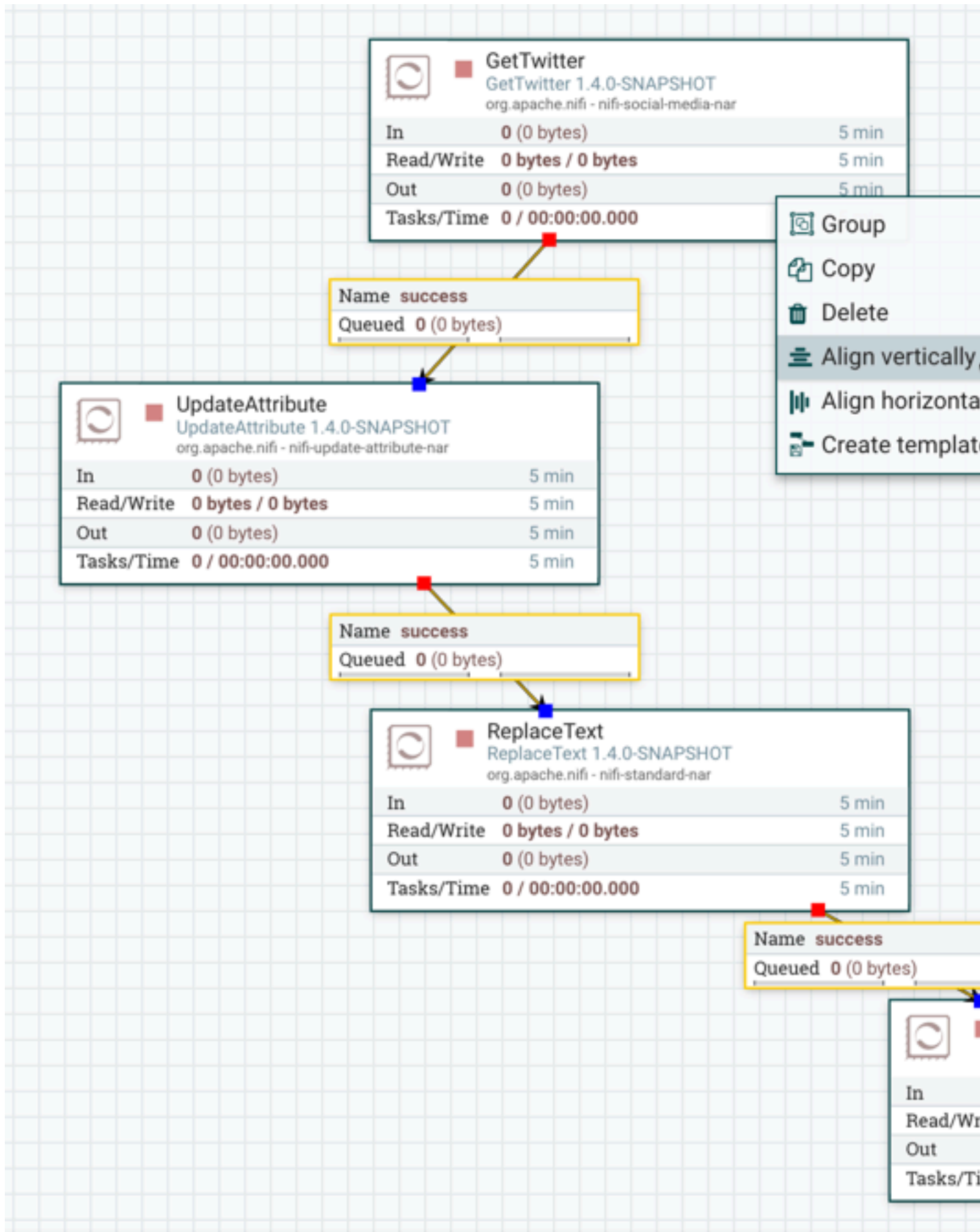
Note: Linking to multiple components on the canvas is supported, with the restriction that the length of the URL cannot exceed a 2000 character limit.

Component Alignment

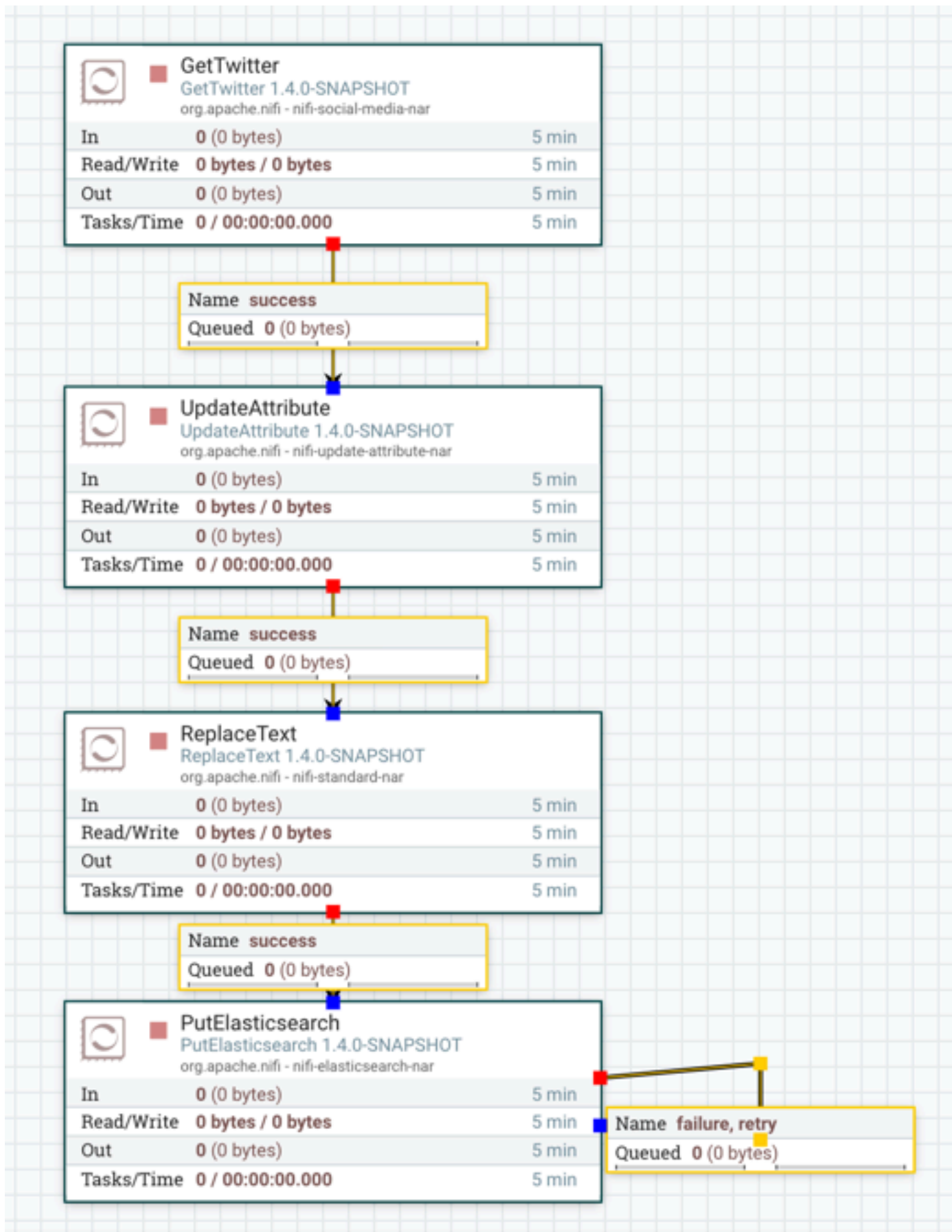
Components on the NiFi canvas can be aligned to more precisely arrange your dataflow. To do this, first select all the components you want to align. Then right-click to see the context menu and select "Align vertically" or "Align horizontally" depending on your desired result.

Align Vertically

Here is an example of aligning components vertically on your canvas. With all components selected/highlighted, right-click:

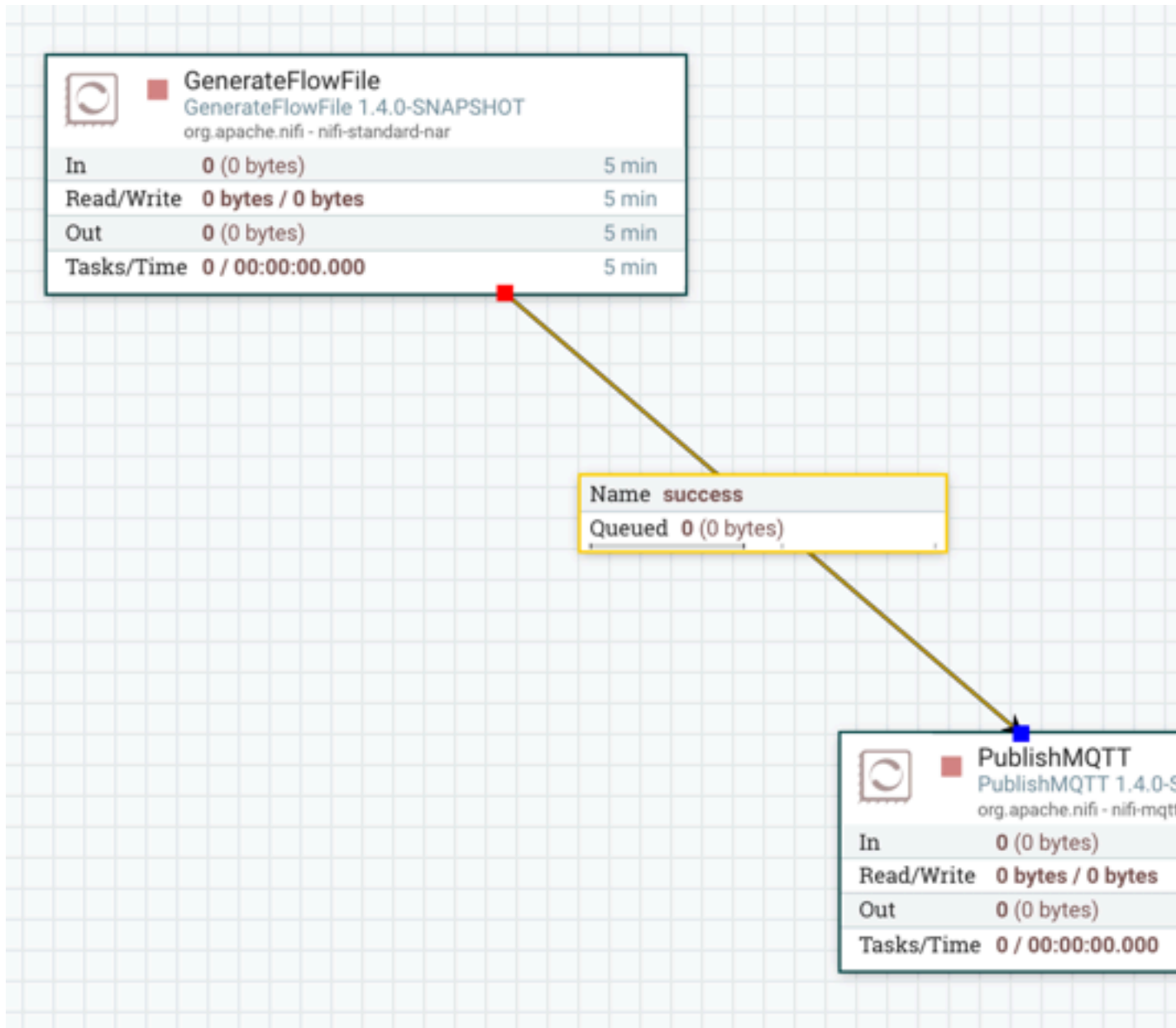


and select "Align vertically" to achieve these results:

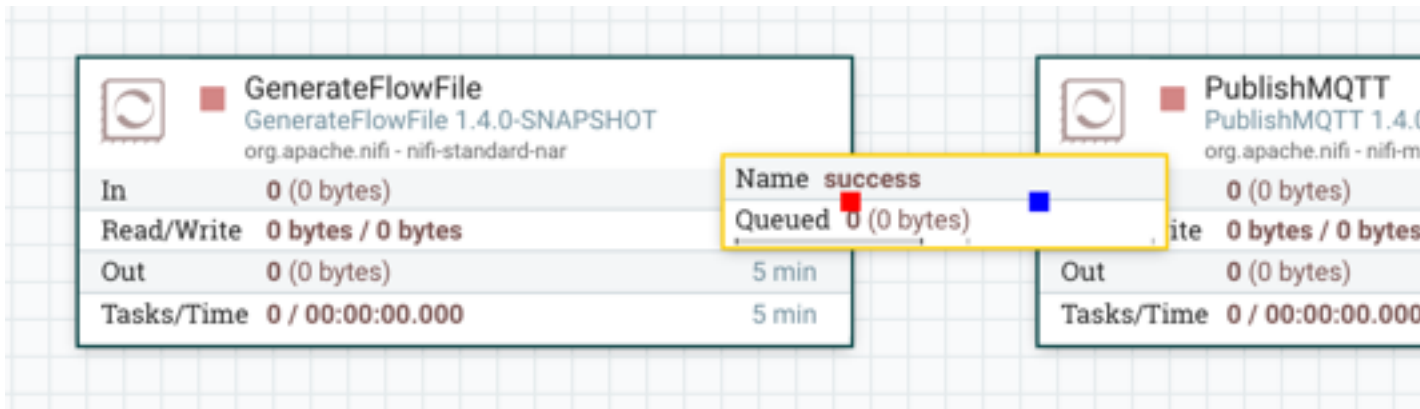


Align Horizontally

Here is an example of aligning components horizontally on your canvas. With all components selected/highlighted, right-click:



and select "Align horizontally" to achieve these results:

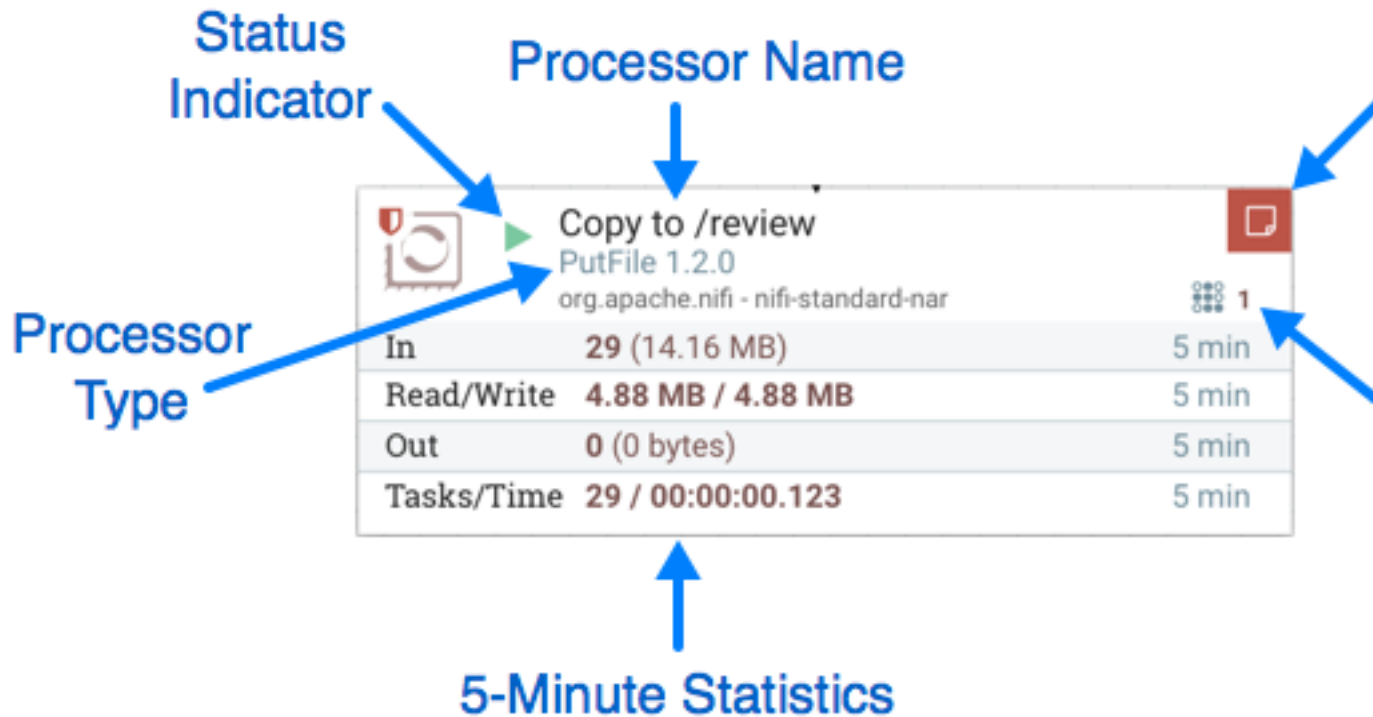


Monitoring of DataFlow

NiFi provides a great deal of information about the DataFlow in order to monitor its health and status. The Status bar provides information about the overall system health (see [NiFi User Interface](#)). Processors, Process Groups, and Remote Process Groups provide fine-grained details about their operations. Connections and Process Groups provide information about the amount of data in their queues. The Summary Page provides information about all of the components on the canvas in a tabular format and also provides System Diagnostics that include disk usage, CPU utilization, and Java Heap and Garbage Collection information. In a clustered environment, this information is available per-node or as aggregates across the entire cluster. We will explore each of these monitoring artifacts below.

Anatomy of a Processor

NiFi provides a significant amount of information about each Processor on the canvas. The following diagram shows the anatomy of a Processor:



The image outlines the following elements:

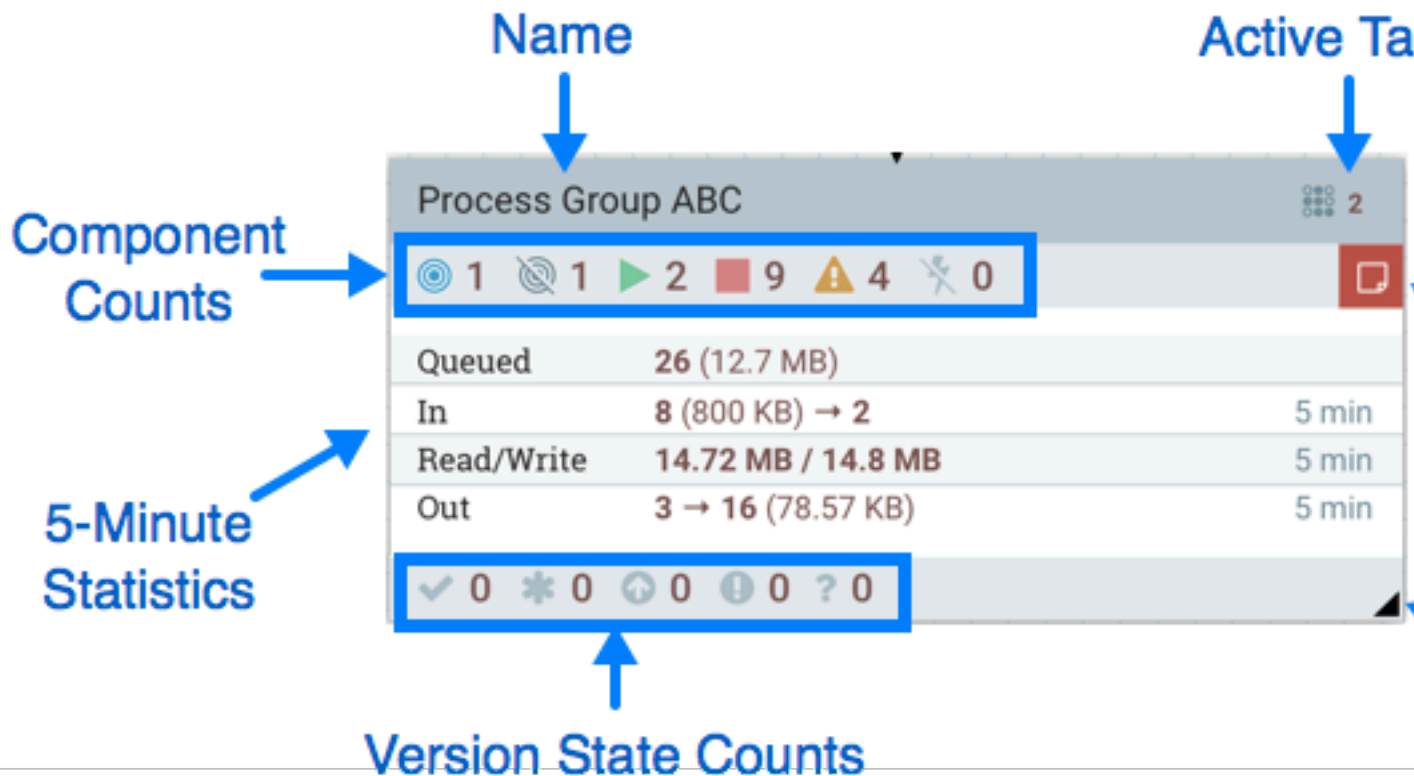
- **Processor Type:** NiFi provides several different types of Processors in order to allow for a wide range of tasks to be performed. Each type of Processor is designed to perform one specific task. The Processor type (PutFile, in this example) describes the task that this Processor performs. In this case, the Processor writes a FlowFile to disk - or "Puts" a FlowFile to a File.
- **Bulletin Indicator:** When a Processor logs that some event has occurred, it generates a Bulletin to notify those who are monitoring NiFi via the User Interface. The DFM is able to configure which bulletins should be displayed in the User Interface by updating the "Bulletin level" field in the "Settings" tab of the Processor configuration dialog. The default value is WARN, which means that only warnings and errors will be displayed in the UI. This icon is not present unless a Bulletin exists for this Processor. When it is present, hovering over the icon with the mouse will provide a tooltip explaining the message provided by the Processor as well as the Bulletin level. If the instance of NiFi is clustered, it will also show the Node that emitted the Bulletin. Bulletins automatically expire after five minutes.
- **Status Indicator:** Shows the current Status of the Processor. The following indicators are possible:
 - **Running:** The Processor is currently running.
 - **Stopped:** The Processor is valid and enabled but is not running.
 - **Invalid:** The Processor is enabled but is not currently valid and cannot be started. Hovering over this icon will provide a tooltip indicating why the Processor is not valid.
 - **Disabled:** The Processor is not running and cannot be started until it has been enabled. This status does not indicate whether or not the Processor is valid.
- **Processor Name:** This is the user-defined name of the Processor. By default, the name of the Processor is the same as the Processor Type. In the example, this value is "Copy to /review".
- **Active Tasks:** The number of tasks that this Processor is currently executing. This number is constrained by the "Concurrent tasks" setting in the "Scheduling" tab of the Processor configuration dialog. Here, we can see that the

Processor is currently performing one task. If the NiFi instance is clustered, this value represents the number of tasks that are currently executing across all nodes in the cluster.

- **5-Minute Statistics:** The Processor shows several different statistics in tabular form. Each of these statistics represents the amount of work that has been performed in the past five minutes. If the NiFi instance is clustered, these values indicate how much work has been done by all of the Nodes combined in the past five minutes. These metrics are:
 - **In:** The amount of data that the Processor has pulled from the queues of its incoming Connections. This value is represented as <count> (<size>) where <count> is the number of FlowFiles that have been pulled from the queues and <size> is the total size of those FlowFiles' content. In this example, the Processor has pulled 29 FlowFiles from the input queues, for a total of 14.16 megabytes (MB).
 - **Read/Write:** The total size of the FlowFile content that the Processor has read from disk and written to disk. This provides valuable information about the I/O performance that this Processor requires. Some Processors may only read the data without writing anything while some will not read the data but will only write data. Others will neither read nor write data, and some Processors will both read and write data. In this example, we see that in the past five minutes, this Processor has read 4.88 MB of the FlowFile content and has written 4.88 MB as well. This is what we would expect, since this Processor simply copies the contents of a FlowFile to disk. Note, however, that this is not the same as the amount of data that it pulled from its input queues. This is because some of the files that it pulled from the input queues already exist in the output directory, and the Processor is configured to route FlowFiles to failure when this occurs. Therefore, for those files which already existed in the output directory, data was neither read nor written to disk.
 - **Out:** The amount of data that the Processor has transferred to its outbound Connections. This does not include FlowFiles that the Processor removes itself, or FlowFiles that are routed to connections that are auto-terminated. Like the "In" metric above, this value is represented as <count> (<size>) where <count> is the number of FlowFiles that have been transferred to outbound Connections and <size> is the total size of those FlowFiles' content. In this example, all of the Relationships are configured to be auto-terminated, so no FlowFiles are reported as having been transferred Out.
 - **Tasks/Time:** The number of times that this Processor has been triggered to run in the past 5 minutes, and the amount of time taken to perform those tasks. The format of the time is <hour>:<minute>:<second>. Note that the amount of time taken can exceed five minutes, because many tasks can be executed in parallel. For instance, if the Processor is scheduled to run with 60 Concurrent tasks, and each of those tasks takes one second to complete, it is possible that all 60 tasks will be completed in a single second. However, in this case we will see the Time metric showing that it took 60 seconds, instead of 1 second. This time can be thought of as "System Time," or said another way, this value is 60 seconds because that's the amount of time it would have taken to perform the action if only a single concurrent task were used.







Anatomy of a Process Group

The Process Group provides a mechanism for grouping components together into a logical construct in order to organize the DataFlow in a way that makes it more understandable from a higher level. The following image highlights the different elements that make up the anatomy of a Process Group:



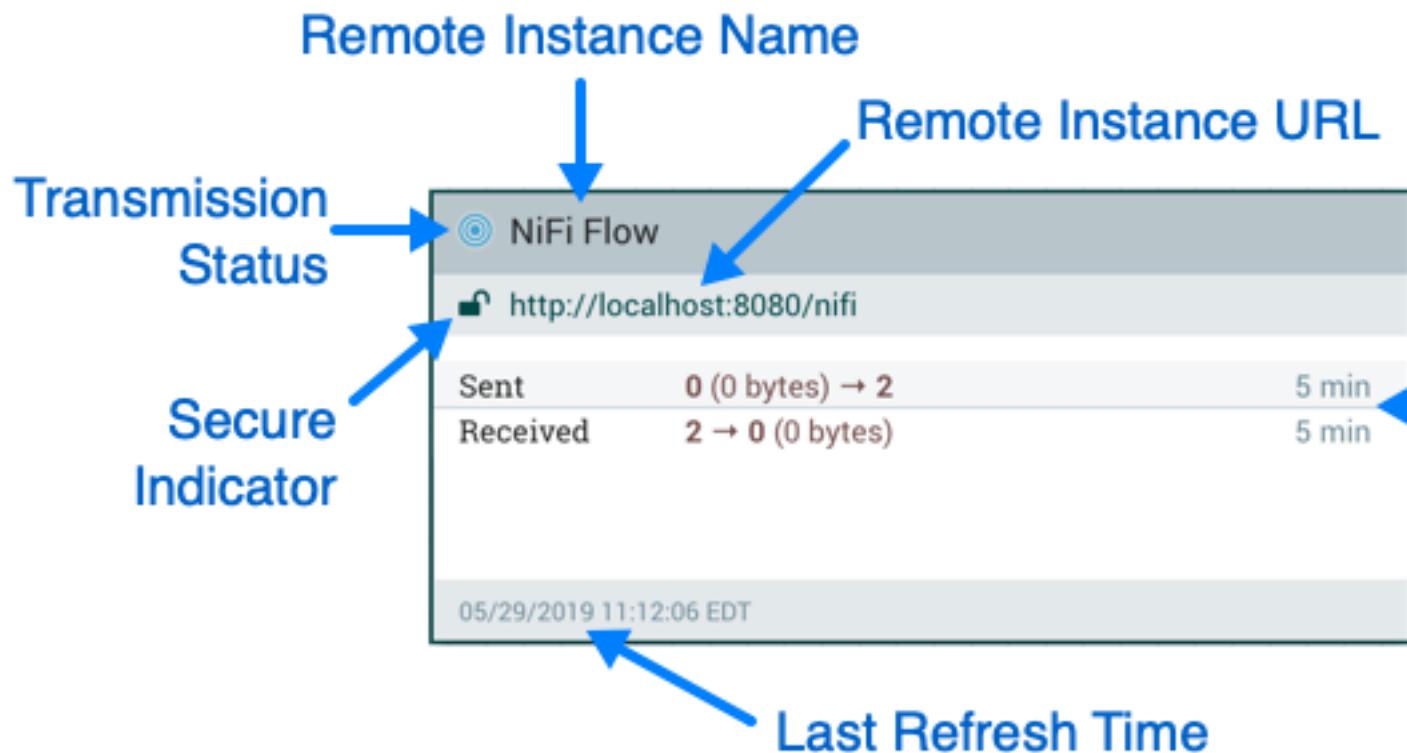
The Process Group consists of the following elements:

- **Name:** This is the user-defined name of the Process Group. This name is set when the Process Group is added to the canvas. The name can later be changed by right-clicking on the Process Group and clicking the "Configure" menu option. In this example, the name of the Process Group is "Process Group ABC."
- **Bulletin Indicator:** When a child component of a Process Group emits a bulletin, that bulletin is propagated to the component's parent Process Group, as well. When any component has an active Bulletin, this indicator will appear, allowing the user to hover over the icon with the mouse to see the Bulletin.
- **Active Tasks:** The number of tasks that are currently executing by the components within this Process Group. Here, we can see that the Process Group is currently performing two tasks. If the NiFi instance is clustered, this value represents the number of tasks that are currently executing across all nodes in the cluster.
- **Statistics:** Process Groups provide statistics about the amount of data that has been processed by the Process Group in the past 5 minutes as well as the amount of data currently enqueued within the Process Group. The following elements comprise the "Statistics" portion of a Process Group:
 - **Queued:** The number of FlowFiles currently enqueued within the Process Group. This field is represented as <count> (<size>) where <count> is the number of FlowFiles that are currently enqueued in the Process Group and <size> is the total size of those FlowFiles' content. In this example, the Process Group currently has 26 FlowFiles enqueued with a total size of 12.7 megabytes (MB).
 - **In:** The number of FlowFiles that have been transferred into the Process Group through all of its Input Ports over the past 5 minutes. This field is represented as <count> / <size> # <ports> where <count> is the number of FlowFiles that have entered the Process Group in the past 5 minutes, <size> is the total size of those FlowFiles' content and <ports> is the number of Input Ports. In this example, 8 FlowFiles have entered the Process Group with a total size of 800 KB and two Input Ports exist.





- **Read/Write:** The total size of the FlowFile content that the components within the Process Group have read from disk and written to disk. This provides valuable information about the I/O performance that this Process Group requires. In this example, we see that in the past five minutes, components within this Process Group have read 14.72 MB of the FlowFile content and have written 14.8 MB.
- **Out:** The number of FlowFiles that have been transferred out of the Process Group through its Output Ports over the past 5 minutes. This field is represented as <ports> # <count> (<size>) where <ports> is the number of Output Ports, <count> is the number of FlowFiles that have exited the Process Group in the past 5 minutes and <size> is the total size of those FlowFiles' content. In this example, there are three Output Ports, 16 FlowFiles have exited the Process Group and their total size is 78.57 KB.
- **Component Counts:** The Component Counts element provides information about how many components of each type exist within the Process Group. The following provides information about each of these icons and their meanings:
 -  **Transmitting Ports:** The number of Remote Process Group Ports that currently are configured to transmit data to remote instances of NiFi or pull data from remote instances of NiFi.
 -  **Non-Transmitting Ports:** The number of Remote Process Group Ports that are currently connected to components within this Process Group but currently have their transmission disabled.
 -  **Running Components:** The number of Processors, Input Ports, and Output Ports that are currently running within this Process Group.
 -  **Stopped Components:** The number of Processors, Input Ports, and Output Ports that are currently not running but are valid and enabled. These components are ready to be started.
 -  **Invalid Components:** The number of Processors, Input Ports, and Output Ports that are enabled but are currently not in a valid state. This may be due to misconfigured properties or missing Relationships.
 -  **Disabled Components:** The number of Processors, Input Ports, and Output Ports that are currently disabled. These components may or may not be valid. If the Process Group is started, these components will not cause any errors but will not be started.
- **Version State Counts:** The Version State Counts element provides information about how many versioned process groups are within the Process Group. See [Version States](#) for more information.
- **Comments:** When the Process Group is added to the canvas, the user is given the option of specifying Comments in order to provide information about the Process Group. The comments can later be changed by right-clicking on the Process Group and clicking the "Configure" menu option.

Anatomy of a Remote Process Group

When creating a DataFlow, it is often necessary to transfer data from one instance of NiFi to another. In this case, the remote instance of NiFi can be thought of as a Process Group. For this reason, NiFi provides the concept of a Remote Process Group. From the User Interface, the Remote Process Group looks similar to the Process Group. However, rather than showing information about the inner workings and state of a Remote Process Group, such as queue sizes, the information rendered about a Remote Process Group is related to the interaction that occurs between this instance of NiFi and the remote instance.




The image above shows the different elements that make up a Remote Process Group. Here, we provide an explanation of the icons and details about the information provided.

- **Transmission Status:** The Transmission Status indicates whether or not data Transmission between this instance of NiFi and the remote instance is currently enabled. The icon shown will be the Transmission Enabled icon () if any of the Input Ports or Output Ports is currently configured to transmit or the Transmission Disabled icon () if all of the Input Ports and Output Ports that are currently connected are stopped.
- **Remote Instance Name:** This is the name of the NiFi instance that was reported by the remote instance. When the Remote Process Group is first created, before this information has been obtained, the URL(s) of the remote instance will be shown here instead.
- **Remote Instance URL:** This is the URL of the remote instance that the Remote Process Group points to. This URL is entered when the Remote Process Group is added to the canvas and it cannot be changed.
- **Secure Indicator:** This icon indicates whether or not communications with the remote NiFi instance are secure. If communications with the remote instance are secure, this will be indicated by the "Locked" icon (). If the communications are not secure, this will be indicated by the "Unlocked" icon (). If the communications are secure, this instance of NiFi will not be able to communicate with the remote instance until an administrator for the remote instance grants access. Whenever the Remote Process Group is added to the canvas, this will automatically initiate a request to have a user for this instance of NiFi created on the remote instance. This instance will be unable to communicate with the remote instance until an administrator on the remote instance adds the user to the system and adds the "NiFi" role to the user. In the event that communications are not secure, the Remote Process Group is able to receive data from anyone, and the data is not encrypted while it is transferred between instances of NiFi.
- **5-Minute Statistics:** Two statistics are shown for Remote Process Groups: Sent and Received. Both of these are in the format <count> (<size>) where <count> is the number of FlowFiles that have been sent or received in the previous five minutes and <size> is the total size of those FlowFiles' content.

- **Last Refresh Time:** The information that is pulled from a remote instance and rendered on the Remote Process Group in the User Interface is periodically refreshed in the background. This element indicates the time at which that refresh last happened, or if the information has not been refreshed for a significant amount of time, the value will change to indicate Remote flow not current. NiFi can be triggered to initiate a refresh of this information by right-clicking on the Remote Process Group and choosing the "Refresh remote" menu item.

Queue Interaction

The FlowFiles enqueued in a Connection can be viewed when necessary. The Queue listing is opened via List queue in a Connection's context menu. The listing will return the top 100 FlowFiles in the active queue according to the configured priority. The listing can be performed even if the source and destination are actively running.

Additionally, details for a Flowfile in the listing can be viewed by clicking the "Details" button () in the left most column. From here, the FlowFile details and attributes are available as well as buttons for downloading or viewing the content. Viewing the content is only available if the `nifi.content.viewer.url` has been configured. If the source or destination of the Connection are actively running, there is a chance that the desired FlowFile will no longer be in the active queue.

The FlowFiles enqueued in a Connection can also be deleted when necessary. The removal of the FlowFiles is initiated via Empty queue in the Connection's context menu. This action can also be performed if the source and destination are actively running.

If the analytics prediction feature is enabled, hovering over the queue will also reveal predicted statistics on when the queue may encounter back pressure, either due to the object count or content size meeting the current threshold settings. Predictions will only be available when NiFi has enough data in its internal repository and if its model is accurate enough to broadcast a prediction. For more information, see the [Analytics Framework](#) section in the System Administrator's Guide.

Summary Page
























While the NiFi canvas is useful for understanding how the configured DataFlow is laid out, this view is not always optimal when trying to discern the status of the system. In order to help the user understand how the DataFlow is functioning at a higher level, NiFi provides a Summary page. This page is available in the Global Menu in the top-right corner of the User Interface. See the [NiFi User Interface](#) section for more information about the location of this toolbar.

The Summary Page is opened by selecting Summary from the Global Menu. This opens the Summary table dialog:

NiFi Summary

PROCESSORS	INPUT PORTS	OUTPUT PORTS	REMOTE PROCESS GROUPS	C
------------	-------------	--------------	-----------------------	---

Displaying 60 of 60

Filter	by name 			
Name ▲	Type	Run Status	In / Size 5 min	
 Base64EncodeCo...	Base64EncodeCo...	 Invalid	0 (0 bytes)	
 Capture Network ...	ExecuteProcess	 Running (5)	0 (0 bytes)	
 Check if Dataset ...	IdentifyMimeType	 Running	0 (0 bytes)	
 Decompress Data...	CompressContent	 Running	0 (0 bytes)	
 Detect Interesting...	RouteOnAttribute	 Running (2)	11,741,700 (13 GB)	
 Empty Contents	ReplaceText	 Running	0 (0 bytes)	
 EvaluateJsonPath	EvaluateJsonPath	 Running	0 (0 bytes)	
 EvaluateJsonPath	EvaluateJsonPath	 Running (4)	11,742,510 (13 GB)	
 Extract File ID	UpdateAttribute	 Running	0 (0 bytes)	
 Extract File ID	UpdateAttribute	 Running	0 (0 bytes)	
 ExtractText	ExtractText	 Running	1,498,914 (244.45 MB)	



























Last updated: **17:45:24 UTC**


This dialog provides a great deal of information about each of the components on the canvas. Below, we have annotated the different elements within the dialog in order to make the discussion of the dialog easier.

NiFi Summary

PROCESSORS	INPUT PORTS	OUTPUT PORTS	REMOTE PROCESS GROUPS
------------	-------------	--------------	-----------------------

Displaying 60 of 60

Filter	by name 			
Name 	Type	Run Status	In / Size 5 min	
 Base64EncodeCo...	Base64EncodeCo...	 Invalid	0 (0 bytes)	
 Capture Network ...	ExecuteProcess	 Running (5)	0 (0 bytes)	
 Check if Dataset ...	IdentifyMimeType	 Running	0 (0 bytes)	
 Decon...	Content	 Running	0 (0 bytes)	
 Detect...	tribute	 Running (2)	11,741,700 (13 0	
 Empty Contents	ReplaceText	 Running	0 (0 bytes)	
 EvaluateJsonPath	EvaluateJsonPath	 Running	0 (0 bytes)	
 EvaluateJsonPath	EvaluateJsonPath	 Running (4)	11,742,510 (13 0	
 Extract File ID	UpdateAttribute	 Running	0 (0 bytes)	
 Extract File ID	UpdateAttribute	 Running	0 (0 bytes)	
 ExtractText	ExtractText	 Running	1,498,914 (244.4	

 Last updated: **17:45:24 UTC**

The Summary page is primarily comprised of a table that provides information about each of the components on the canvas. Above this table is a set of five tabs that can be used to view the different types of components. The information provided in the table is the same information that is provided for each component on the canvas. Each of the columns in the table may be sorted by clicking on the heading of the column. For more on the types of information displayed, see the sections [Anatomy of a Processor](#), [Anatomy of a Process Group](#), and [Anatomy of a Remote Process Group](#) above.

The Summary page also includes the following elements:

- **Bulletin Indicator:** As in other places throughout the User Interface, when this icon is present, hovering over the icon will provide information about the Bulletin that was generated, including the message, the severity level, the

time at which the Bulletin was generated, and (in a clustered environment) the node that generated the Bulletin. Like all the columns in the Summary table, this column where bulletins are shown may be sorted by clicking on the heading so that all the currently existing bulletins are shown at the top of the list.

- **Details:** Clicking the Details icon will provide the user with the details of the component. This dialog is the same as the dialog provided when the user right-clicks on the component and chooses the "View Configuration" menu item.
- **Go To:** Clicking this button will close the Summary page and take the user directly to the component on the NiFi canvas. This may change the Process Group that the user is currently in. This icon is not available if the Summary page has been opened in a new browser tab or window (by clicking the "Pop Out" button, as described below).
- **Status History:** Clicking the Status History icon will open a new dialog that shows a historical view of the statistics that are rendered for this component. See the section [Historical Statistics of a Component](#) for more information.
- **Refresh:** The "Refresh" button allows the user to refresh the information displayed without closing the dialog and opening it again. The time at which the information was last refreshed is shown just to the right of the "Refresh" button. The information on the page is not automatically refreshed.
- **Filter:** The Filter element allows users to filter the contents of the Summary table by typing in all or part of some criteria, such as a Processor Type or Processor Name. The types of filters available differ according to the selected tab. For instance, if viewing the Processor tab, the user is able to filter by name or by type. When viewing the Connections tab, the user is able to filter by source, by name, or by destination name. The filter is automatically applied when the contents of the text box are changed. Below the text box is an indicator of how many entries in the table match the filter and how many entries exist in the table.
- **Pop-Out:** When monitoring a flow, it is helpful to be able to open the Summary table in a separate browser tab or window. The "Pop Out" button, next to the "Close" button, will cause the entire Summary dialog to be opened in a new browser tab or window (depending on the configuration of the browser). Once the page is "popped out", the dialog is closed in the original browser tab/window. In the new tab/window, the "Pop Out" button and the "Go To" button will no longer be available.
- **System Diagnostics:** The System Diagnostics window provides information about how the system is performing with respect to system resource utilization. While this is intended mostly for administrators, it is provided in this view because it does provide a summary of the system. This dialog shows information such as CPU utilization, how full the disks are, and Java-specific metrics, such as memory size and utilization, as well as Garbage Collection information.

Historical Statistics of a Component

While the Summary table and the canvas show numeric statistics pertaining to the performance of a component over the past five minutes, it is often useful to have a view of historical statistics as well. This information is available by right-clicking on a component and choosing the "Status History" menu option or by clicking on the Status History in the Summary page (see [Summary Page](#) for more information).

The amount of historical information that is stored is configurable in the NiFi properties but defaults to 24 hours. For specific configuration information reference the Component Status Repository of the [System Administrator's Guide](#). When the Status History dialog is opened, it provides a graph of historical statistics:

Status History

Status History

Id

b0a3b095-5408-38b8-b0dd-7b31babb2e04

Group Id

50380170-a353-47ad-8b01-14f3ac4b4551

Name

Twitter Garden Host

Type

GetTwitter

Start

07/28/2016 19:13:47.262

End

07/28/2016 22:47:51.162

NiFi

Min / Max / Mean

0.00 bytes / 76.78 MB / 35.89 MB

✓ NiFi

Nodes

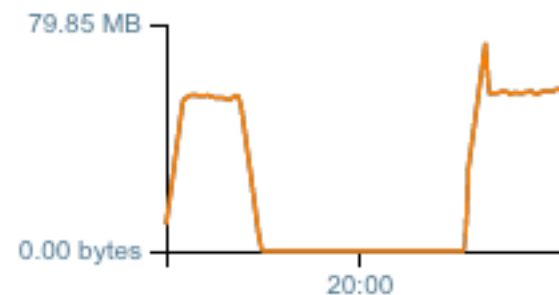
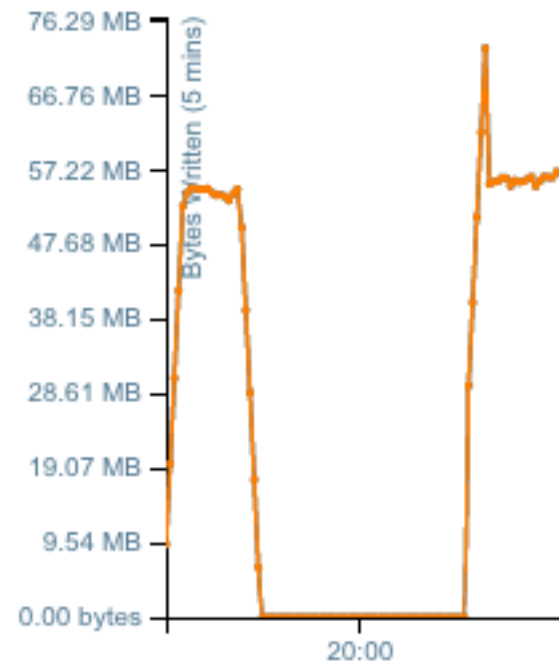
Min / Max / Mean

0.00 bytes / 76.78 MB / 35.89 MB

✓ nifi-04:8080



Last updated: 22:48:13 UTC




The left-hand side of the dialog provides information about the component that the stats are for, as well as a textual representation of the statistics being graphed. The following information is provided on the left-hand side:

- Id: The ID of the component for which the stats are being shown.
- Group Id: The ID of the Process Group in which the component resides.
- Name: The Name of the Component for which the stats are being shown.
- Component-Specific Entries: Information is shown for each different type of component. For example, for a Processor, the type of Processor is displayed. For a Connection, the source and destination names and IDs are shown.

- **Start:** The earliest time shown on the graph.
- **End:** The latest time shown on the graph.
- **Min/Max/Mean:** The minimum, maximum, and mean (arithmetic mean, or average) values are shown. These values are based only on the range of time selected, if any time range is selected. If this instance of NiFi is clustered, these values are shown for the cluster as a whole, as well as each individual node. In a clustered environment, each node is shown in a different color. This also serves as the graph's legend, showing the color of each node that is shown in the graph. Hovering the mouse over the Cluster or one of the nodes in the legend will also make the corresponding node bold in the graph.

The right-hand side of the dialog provides a drop-down list of the different types of metrics to render in the graphs below. The top graph is larger so as to provide an easier-to-read rendering of the information. In the bottom-right

corner of this graph is a small handle () that can be dragged to resize the graph. The blank areas of the dialog can also be dragged around to move the entire dialog.

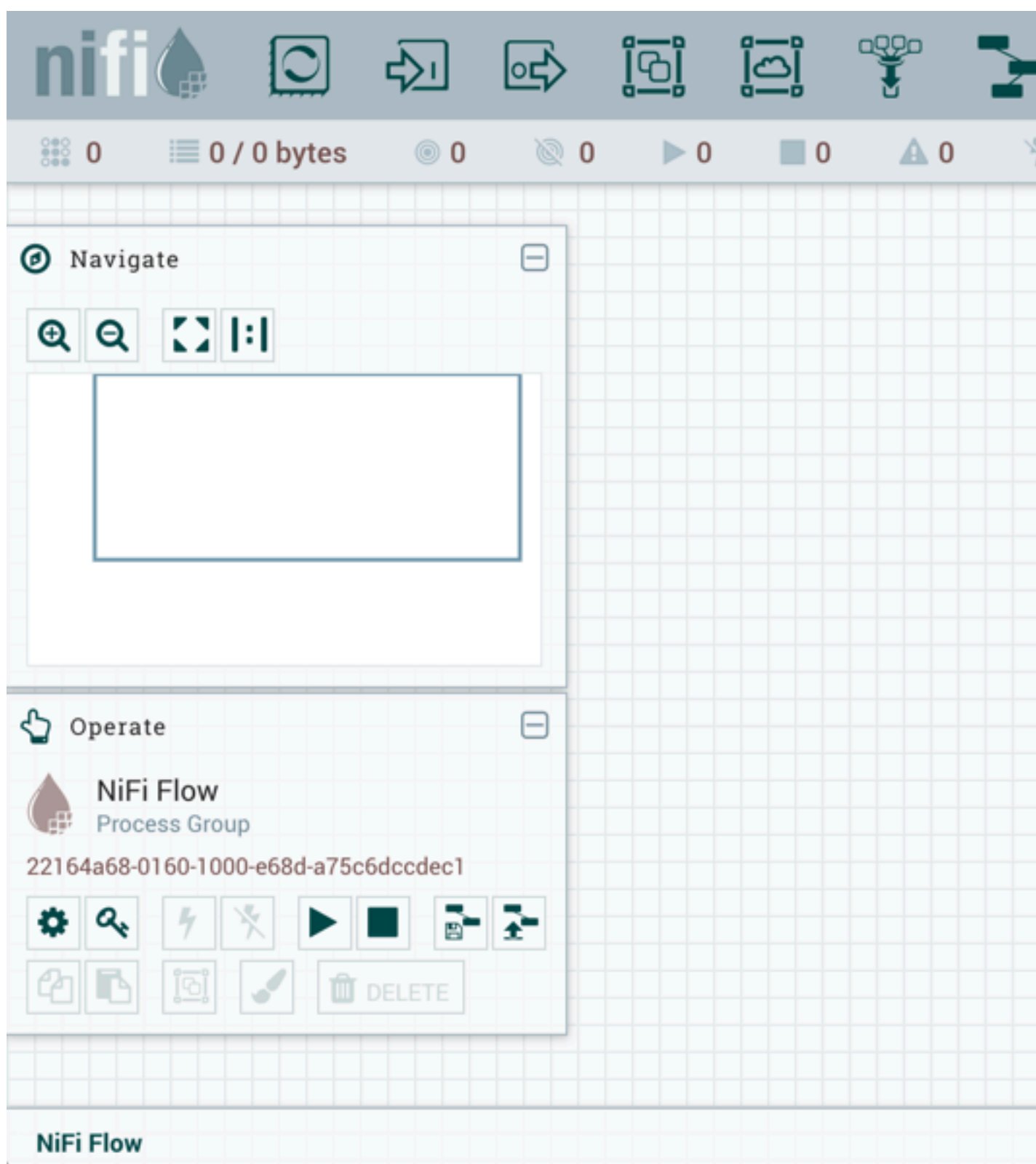
The bottom graph is much shorter and provides the ability to select a time range. Selecting a time range here will cause the top graph to show only the time range selected, but in a more detailed manner. Additionally, this will cause the Min/Max/Mean values on the left-hand side to be recalculated. Once a selection has been created by dragging a rectangle over the graph, double-clicking on the selected portion will cause the selection to fully expand in the vertical direction (i.e., it will select all values in this time range). Clicking on the bottom graph without dragging will remove the selection.

Versioning a DataFlow

When NiFi is connected to a NiFi Registry, dataflows can be version controlled on the process group level. For more information about NiFi Registry usage and configuration, see the documentation at <https://nifi.apache.org/docs/nifi-registry-docs/index.html>.

Connecting to a NiFi Registry

To connect NiFi to a Registry, select Controller Settings from the Global Menu.



This displays the NiFi Settings window. Select the Registry Clients tab and click the + button in the upper-right corner to register a new Registry client.

NiFi Settings

GENERAL

REPORTING TASK CONTROLLER SERVICES

REPORTING TASKS

REGISTRO

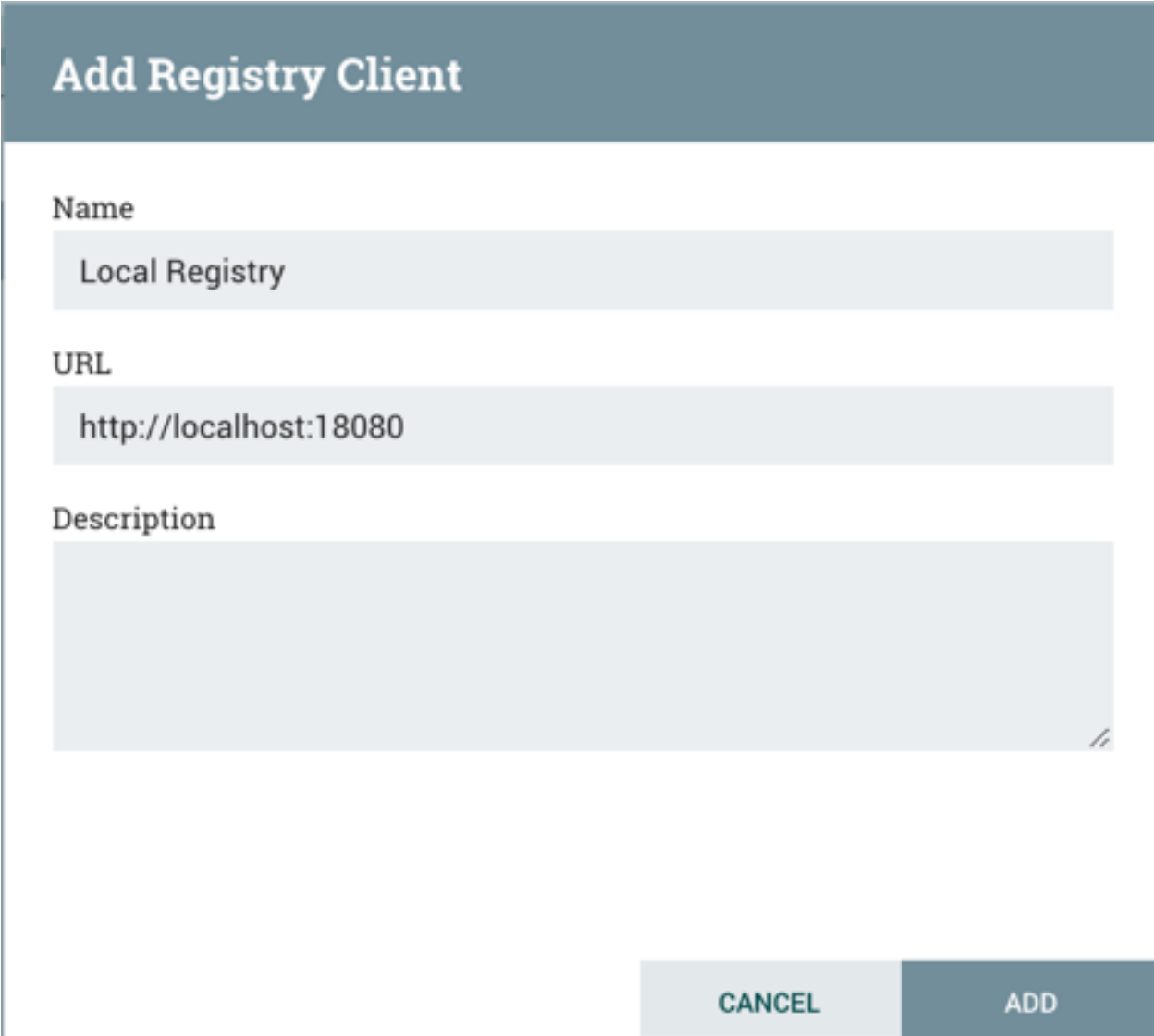
Name ▲

Location

Last updated: 16:18:47 EST

NiFi Flow

In the Add Registry Client window, provide a name and URL.



The image shows a window titled "Add Registry Client". It contains three input fields: "Name" with the text "Local Registry", "URL" with the text "http://localhost:18080", and "Description" which is empty. At the bottom right, there are two buttons: "CANCEL" and "ADD".

Add Registry Client	
Name	Local Registry
URL	http://localhost:18080
Description	
<div>CANCEL ADD</div>	

Click "Add" to complete the registration.

NiFi Settings


GENERAL

REPORTING TASK CONTROLLER SERVICES

REPORTING TASKS

REGISTER

Name ▲	Location
Local Registry	http://localhost:18080

 Last updated: 16:18:47 EST






NiFi Flow



Note: Versioned flows are stored and organized in registry buckets. Bucket Policies and Special Privileges configured by the registry administrator determine which buckets a user can import versioned flows from and which buckets a user can save versioned flows to. Information on Bucket Policies and Special Privileges can be found in the NiFi Registry User Guide (<https://nifi.apache.org/docs/nifi-registry-docs/html/user-guide.html>).

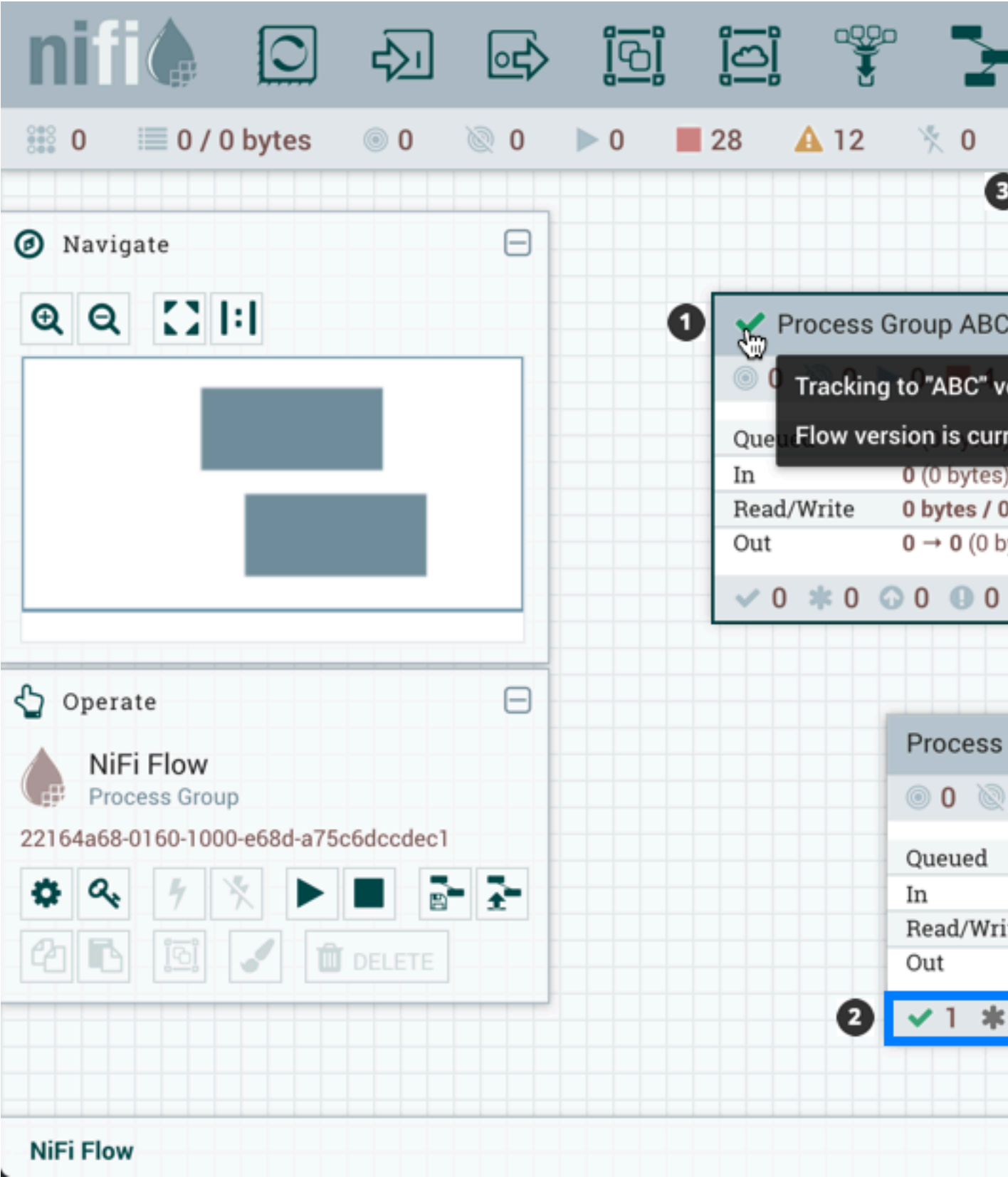
Version States

Versioned process groups exist in the following states:

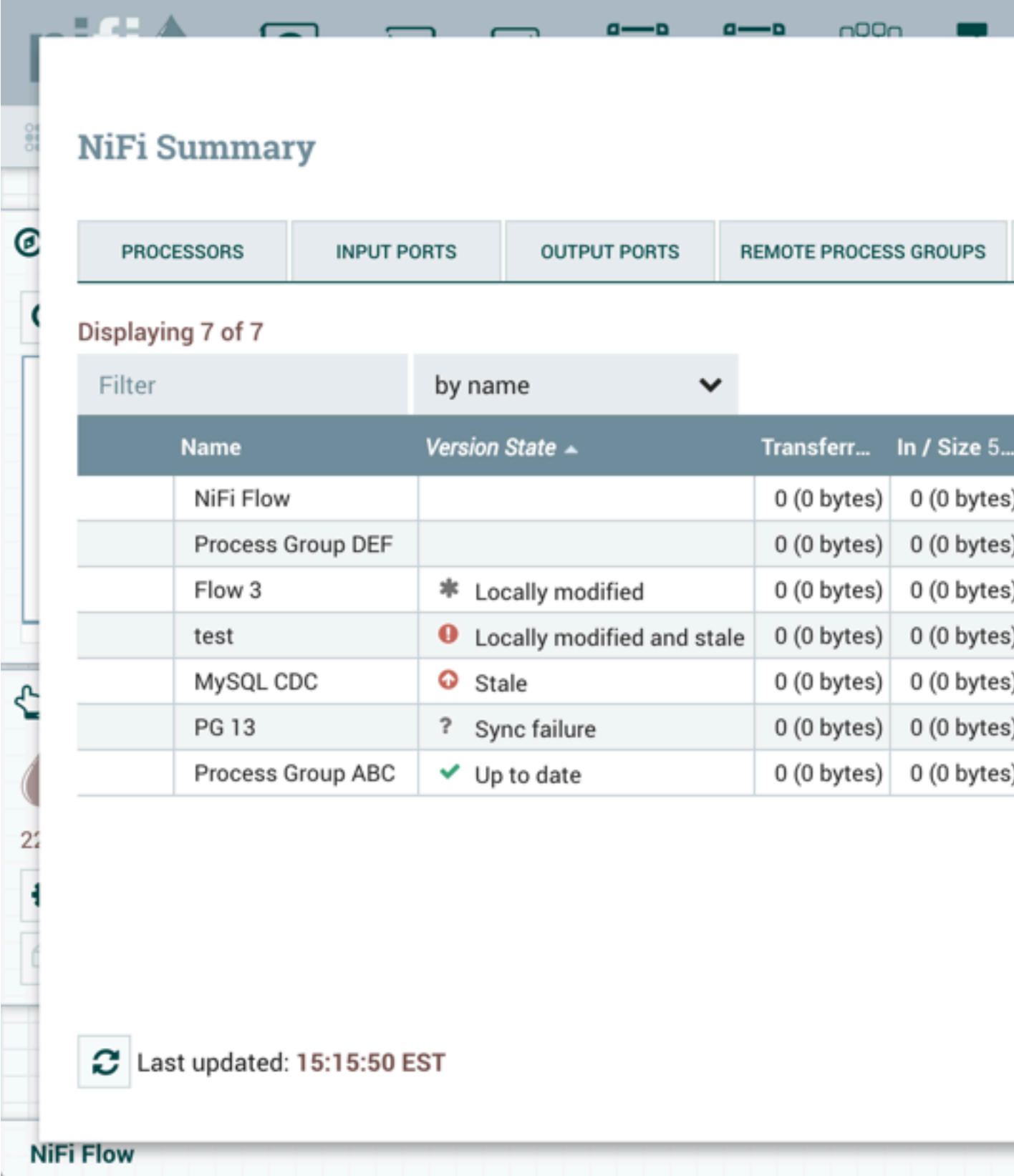
-  Up to date: The flow version is the latest.
-  Locally modified: Local changes have been made.
-  Stale: A newer version of the flow is available.
-  Locally modified and stale: Local changes have been made and a newer version of the flow is available.
-  Sync failure: Unable to synchronize the flow with the registry.

Version state information is displayed:

1. Next to the process group name, for the versioned process group itself. Hovering over the state icon displays additional information about the versioned flow.
2. At the bottom of a process group, for the versioned flows contained in the process group.
3. In the Status Bar at the top of the UI, for the versioned flows contained in the root process group.



Version state information is also shown in the "Process Groups" tab of the Summary Page.




NiFi Summary

PROCESSORS INPUT PORTS OUTPUT PORTS REMOTE PROCESS GROUPS

Displaying 7 of 7

Filter by name ▼

Name	Version State ▲	Transferr...	In / Size 5...
NiFi Flow		0 (0 bytes)	0 (0 bytes)
Process Group DEF		0 (0 bytes)	0 (0 bytes)
Flow 3	* Locally modified	0 (0 bytes)	0 (0 bytes)
test	! Locally modified and stale	0 (0 bytes)	0 (0 bytes)
MySQL CDC	⬆ Stale	0 (0 bytes)	0 (0 bytes)
PG 13	? Sync failure	0 (0 bytes)	0 (0 bytes)
Process Group ABC	✓ Up to date	0 (0 bytes)	0 (0 bytes)

 Last updated: 15:15:50 EST

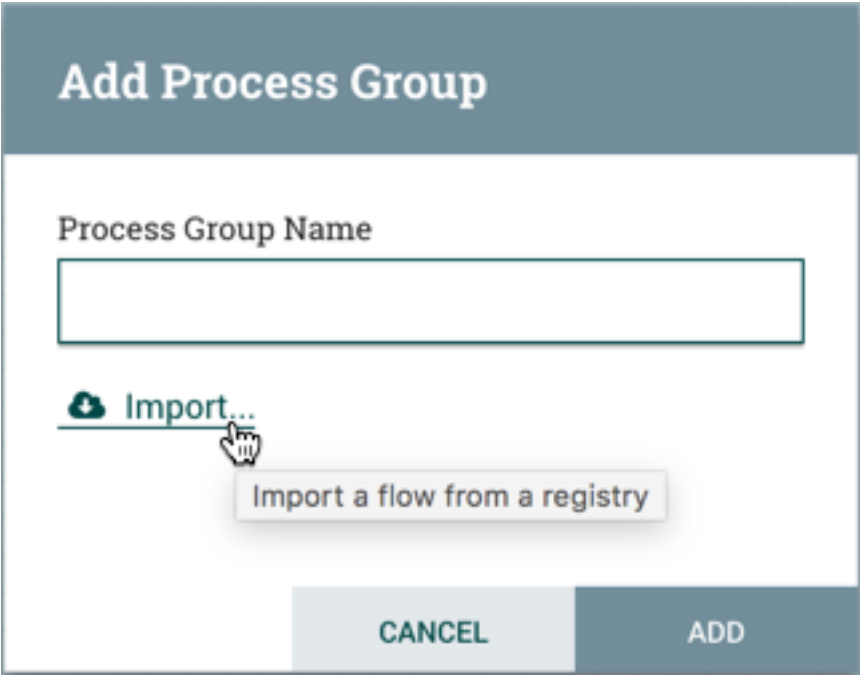
NiFi Flow



Note: To see the most recent version states, it may be necessary to right-click on the NiFi canvas and select 'Refresh' from the context menu.

Import a Versioned Flow

When a NiFi instance is connected to a registry, an "Import" link will appear in the Add Process Group dialog.



The screenshot shows the "Add Process Group" dialog box. It features a title bar at the top. Below the title bar is a text input field labeled "Process Group Name". Underneath the input field is a link labeled "Import..." with a small cloud icon to its left. A mouse cursor is hovering over the "Import..." link, and a tooltip box appears with the text "Import a flow from a registry". At the bottom of the dialog are two buttons: "CANCEL" and "ADD".

Selecting the link will open the Import Version dialog.

Import Version

Registry

Local Registry

Bucket

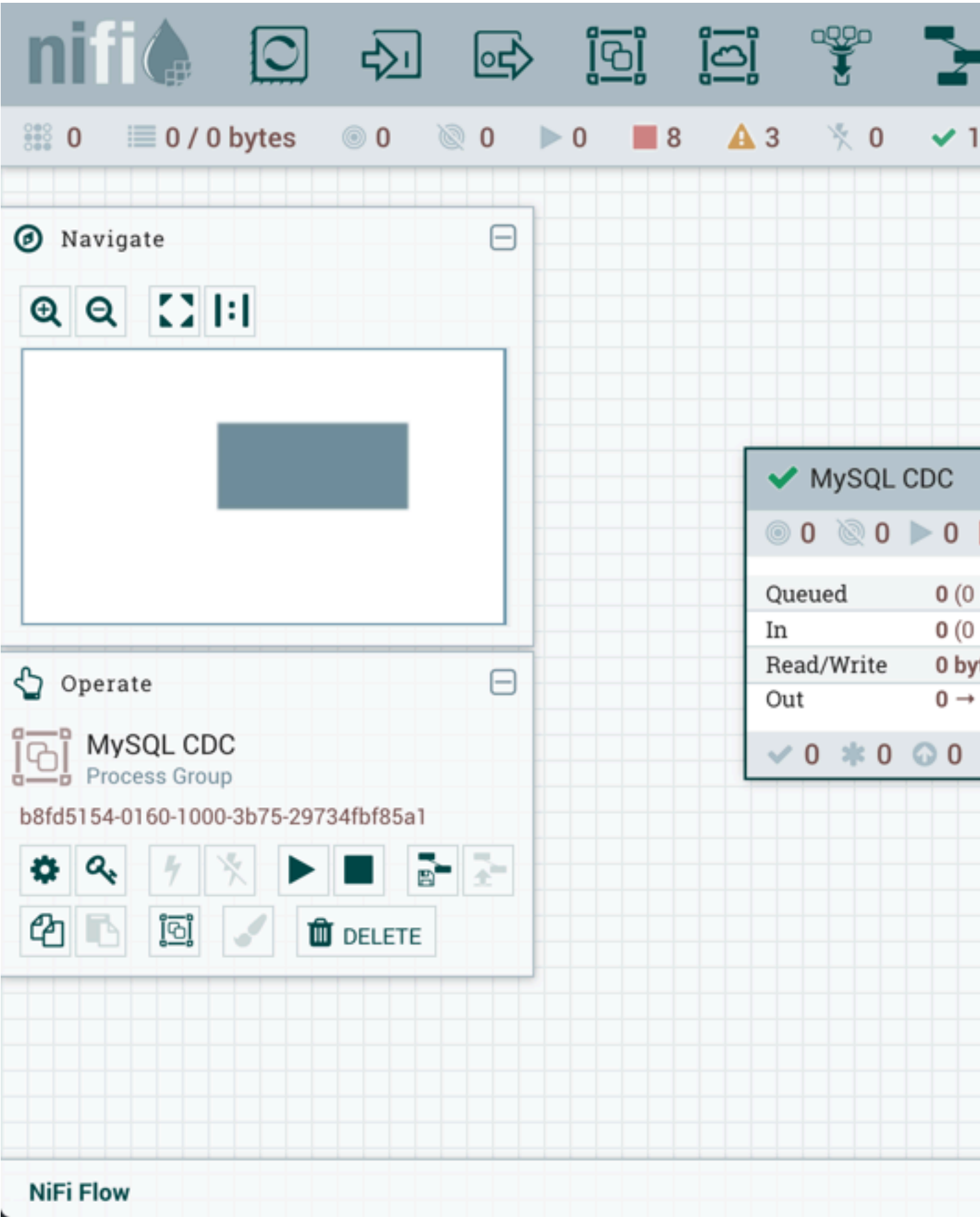
Bucket 1



Name

MySQL CDC

Version ▾	Created	Comments
3	01/02/2018 17:18:44.686	Changed Run Schedule of CDC processor to 30
2	01/02/2018 17:17:38.128	Corrected LogAttribute Processor by auto-term
1	01/02/2018 17:12:17.339	Start from template

Connected registries will appear as options in the Registry drop-down menu. For the chosen Registry, buckets the user has access to will appear as options in the Bucket drop-down menu. The names of the flows in the chosen bucket will appear as options in the Name drop-down menu. Select the desired version of the flow to import and select "Import" for the dataflow to be placed on the canvas.



Since the version imported in this example is the latest version (MySQL CDC, Version 3), the state of the versioned process group is "Up to date" (). If the version imported had been an older version, the state would be "Stale" (.

Start Version Control

To place a process group under version control, right-click on the process group and in the context menu, select "Version#Start version control".

The screenshot shows the Apache NiFi web console interface. At the top, there is a navigation bar with the NiFi logo and several status icons. Below this, the left sidebar contains two main sections: 'Navigate' and 'Operate'. The 'Operate' section is currently active, displaying details for a specific 'Process Group ABC'. The details include the group's ID 'bc90960f-0160-1000-5805-5c2e2cee845d' and a table of metrics.

Process Group ABC	
Queued	0 (0 bytes)
In	0 (0 bytes) → 0
Read/Write	0 bytes / 0 bytes
Out	0 → 0 (0 bytes)

At the bottom of the sidebar, there is a 'DELETE' button. The main area of the console is currently empty, showing a grid pattern.

In the Save Flow Version window, select a Registry and Bucket and enter a Name for the Flow. If desired, add content for the Description and Comment fields.

Save Flow Version

Registry

Local Registry

Bucket

Bucket 2

Name

ABC

Description


Get movie CSV data, convert to JSON and publish to Kafka topic "Movies"

Comments

Initial Save

Select Save and Version 1 of the flow is saved.

The screenshot displays the Apache NiFi web console interface. At the top, there is a navigation bar with the NiFi logo and several icons. Below this, a status bar shows various metrics: 0, 0 / 0 bytes, 0, 0, 0, 5, 0, 0, and 1. The main content area is divided into two panels. The left panel, titled 'Navigate', contains a search bar and a list of process groups. The right panel, titled 'Process Group ABC', shows a summary of the flow's status: 0 Queued, 0 In, 0 Read/Write, and 0 Out. Below this, there is a table with columns for 'Queued', 'In', 'Read/Write', and 'Out'. The bottom panel, titled 'Operate', shows the flow's ID (22164a68-0160-1000-e68d-a75c6dccdec1) and a set of action buttons including 'Settings', 'Search', 'Refresh', 'Stop', 'Start', 'Pause', 'Resume', 'Delete', and 'Clone'.

As the first and latest version of the flow, the state of the versioned process group is "Up to date" (.




Note: The root process group can not be placed under version control.

Managing Local Changes

When changes are made to a versioned process group, the state of the component updates to "Locally



modified" (). The DFM can show, revert or commit the local changes. These options are available for selection in the context menu when right-clicking on the process group:

The screenshot displays the Apache NiFi web interface. At the top, the NiFi logo and a series of icons are visible. The left sidebar contains two main sections: 'Navigate' and 'Operate'. The 'Operate' section is currently active, showing the details for a specific process group named 'Process Group ABC'. This section includes the process group's ID, 'bcb6cc32-0160-1000-4503-16c7bbba2dd9', and a 'DELETE' button. The right sidebar provides a summary of the process group's status, including 'Queued', 'In', 'Read/Write', and 'Out' counts, along with a 'DELETE' button. The main canvas area is currently empty.

or when right-clicking on the canvas inside the process group:

The screenshot displays the Apache NiFi web console interface. At the top, the NiFi logo and a toolbar with various icons are visible. Below the toolbar, a status bar shows metrics: 0 nodes, 0 / 0 bytes, 0 connections, 0 processors, 0 groups, 5 queues, 1 alert, 0 errors, and 0 successes.

On the left, two panels are open:

- Navigate**: Contains search and zoom icons and a map view of the NiFi cluster.
- Operate**: Shows details for **Process Group ABC** (ID: bcb6cc32-0160-1000-4503-16c7bbba2dd9). It includes icons for settings, search, refresh, delete, play, stop, and other actions. A **DELETE** button is also present.

On the right, a data flow is shown with the following processors:

- Get Movie Data** (GetHTTP 1.5.0-SNAPSHOT): In: 0 (0 bytes), Read/Write: 0 bytes / 0 bytes, Out: 0 (0 bytes), Tasks/Time: 0 / 00:00:00.000. Status: Name success, Queued 0 (0 bytes).
- Unzip** (UnpackContent 1.5.0-SNAPSHOT): In: 0 (0 bytes), Read/Write: 0 bytes / 0 bytes, Out: 0 (0 bytes), Tasks/Time: 0 / 00:00:00.000. Status: Name success, Queued 0 (0 bytes).
- RouteOnAttribute** (RouteOnAttribute 1.5.0-SNAPSHOT): In: 0 (0 bytes), Read/Write: 0 bytes / 0 bytes, Out: 0 (0 bytes), Tasks/Time: 0 / 00:00:00.000. Status: Name movies, Queued 0 (0 bytes).
- Add Schema Name Attribute** (UpdateAttribute 1.5.0-SNAPSHOT): In: 0 (0 bytes), Read/Write: 0 bytes / 0 bytes, Out: 0 (0 bytes), Tasks/Time: 0 / 00:00:00.000.

At the bottom, the breadcrumb navigation shows **NiFi Flow » * Process Group ABC**.

The following actions are not considered local changes:

- disabling/enabling processors and controller services
- stopping/starting processors
- modifying sensitive property values
- modifying remote process group URLs
- updating a processor that was referencing a non-existent controller service to reference an externally available controller service
- assigning, creating, modifying or deleting parameter contexts
- creating, modifying or deleting variables



Note: Assigning or creating a parameter context does not trigger a local change because assigning or creating a parameter context on its own has not changed anything about what the flow processes. A component will have to be created or modified that uses a parameter in the parameter context, which will trigger a local change. Modifying a parameter context does not trigger a local change because parameters are intended to be different in each environment. When a versioned flow is imported, it is assumed there is a one-time operation required to set those parameters specific for the given environment. Deleting a parameter context does not trigger a local change because any components that reference parameters in that parameter context will need need to be modified, which will trigger a local change.



Note: Creating a variable does not trigger a local change because creating a variable on its own has not changed anything about what the flow processes. A component will have to be created or modified that uses the new variable, which will trigger a local change. Modifying a variable does not trigger a local change because variable values are intended to be different in each environment. When a versioned flow is imported, it is assumed there is a one-time operation required to set those variables specific for the given environment. Deleting a variable does not trigger a local change because the component that references that variable will need need to be modified, which will trigger a local change.



Note: Variables do not support sensitive values and will be included when versioning a Process Group. Variables are still supported for compatibility purposes but do not have the same power as Parameters such as support for sensitive properties and more granular control over who can create, modify or use them. Variables will be removed in a future release. As a result, it is highly recommended to switch to Parameters.

Show Local Changes

The local changes made to a versioned process group can be viewed in the Show Local Changes dialog by selecting "Version#Show local changes" from the context menu.

Show Local Changes

The following changes have been made to ABC (Version 1).

Displaying 4 of 4

Filter

Component Name ▲	Change Type	Difference
Get Movie Data	Run Schedule Changed	From '10 mins' to '5 mins'
LogAttribute	Component Added	Processor was added
Publish to "Movies" Topic	Property Value Changed	From 'Compression Type=none'
RouteOnAttribute	Bulletin Level Changed	From 'WARN' to 'ERROR'

You can navigate to a component by selecting the "Go To" icon () in its row.



Note: As described in the Managing Local Changes section, there are exceptions to which actions are reviewable local changes. Additionally, multiple changes to the same property will only appear as one change in the list as the changes are determined by diffing the current state of the process group and the saved version of the process group noted in the Show Local Changes dialog.

Revert Local Changes

Revert the local changes made to a versioned process group by selecting "Version#Revert local changes" from the context menu. The Revert Local Changes dialog displays a list of the local changes for the DFM to review and consider prior to initiating the revert. Select "Revert" to remove all changes.

Revert Local Changes

The following changes have been made to ABC (Version 1). Revert will remove all changes.

Displaying 4 of 4

Filter

Component Name ▲	Change Type	Difference
Get Movie Data	Run Schedule Changed	From '10 mins' to '5 mins'
LogAttribute	Component Added	Processor was added
Publish to "Movies" Topic	Property Value Changed	From 'Compression Type=non
RouteOnAttribute	Bulletin Level Changed	From 'WARN' to 'ERROR'

You can navigate to a component by selecting the "Go To" icon () in its row.



Note: As described in the Managing Local Changes section, there are exceptions to which actions are revertible local changes. Additionally, multiple changes to the same property will only appear as one change in the list as the changes are determined by diffing the current state of the process group and the saved version of the process group noted in the Revert Local Changes dialog.

Commit Local Changes

To commit and save a flow version, select "Version#Commit local changes" from the context menu. In the Save Flow Version dialog, add comments if desired and select "Save".

Save Flow Version

Registry

Local Registry

Bucket

Bucket 2

Name

ABC

Description

Get movie CSV data, convert to JSON and publish to Kafka topic "Movies"

Comments


Lowered Run Schedule on GetHttp

Added Gzip compression

Increased bulletin level from Warn to Error

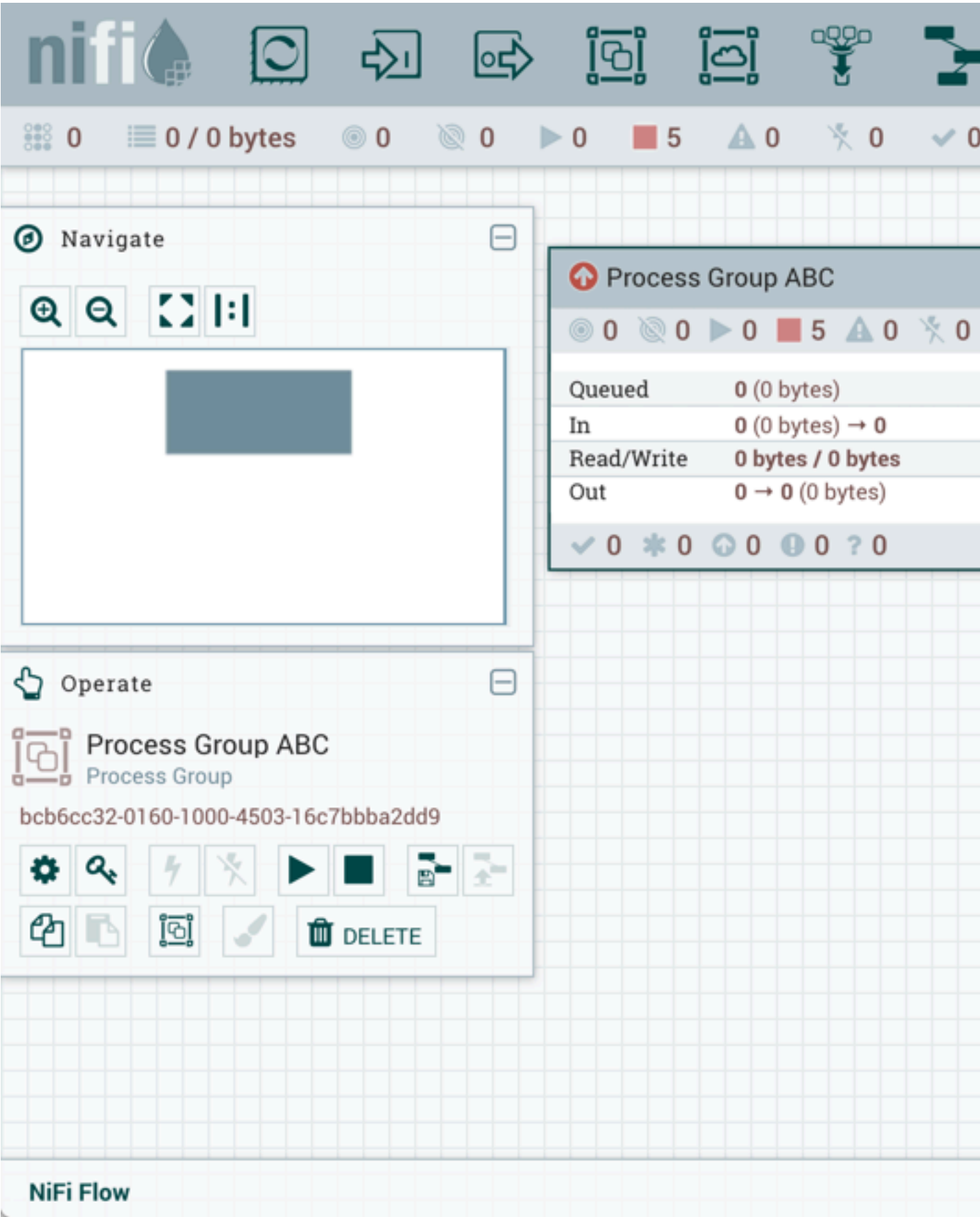
Added new LogAttribute processor

Local changes can not be committed if the version that has been modified is not the latest version. In this scenario, the

version state is "Locally modified and stale" ()

Change Version

To change the version of a flow, right-click on the versioned process group and select "Version#Change version".



In the Change Version dialog, select the desired version and select "Change":

Change Version

Registry

Local Registry

Bucket

Bucket 2

Name

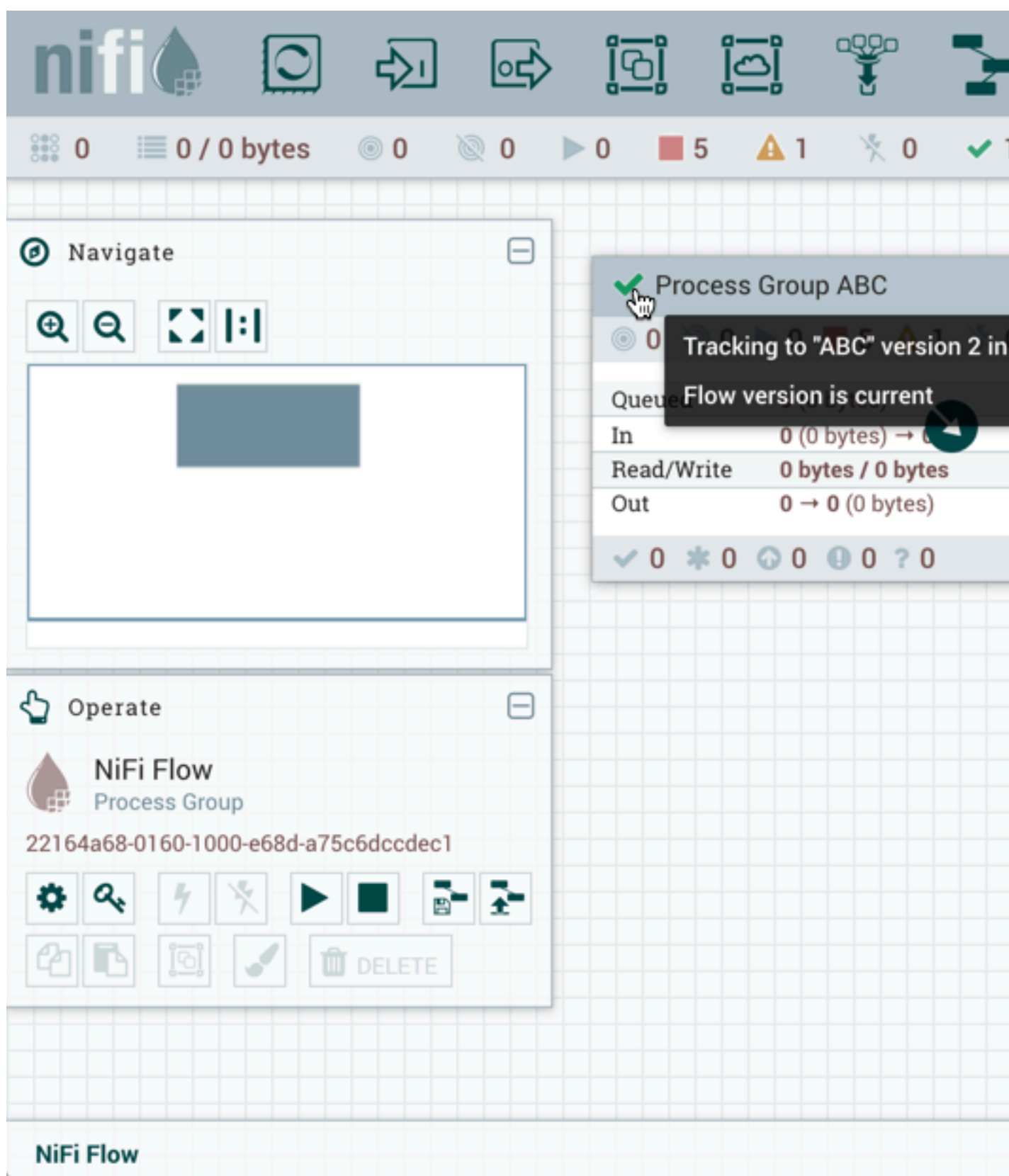
ABC

Current Version

1

Version ▾	Created	Comments
2	01/04/2018 11:23:10.564	Lowered Run Schedule on GetHttp Added Gzip
1	01/03/2018 10:39:36.520	Initial Save

The version of the flow is changed:



In the example shown, the versioned flow is upgraded from an older to the newer latest version. However, a versioned flow can also be rolled back to an older version.

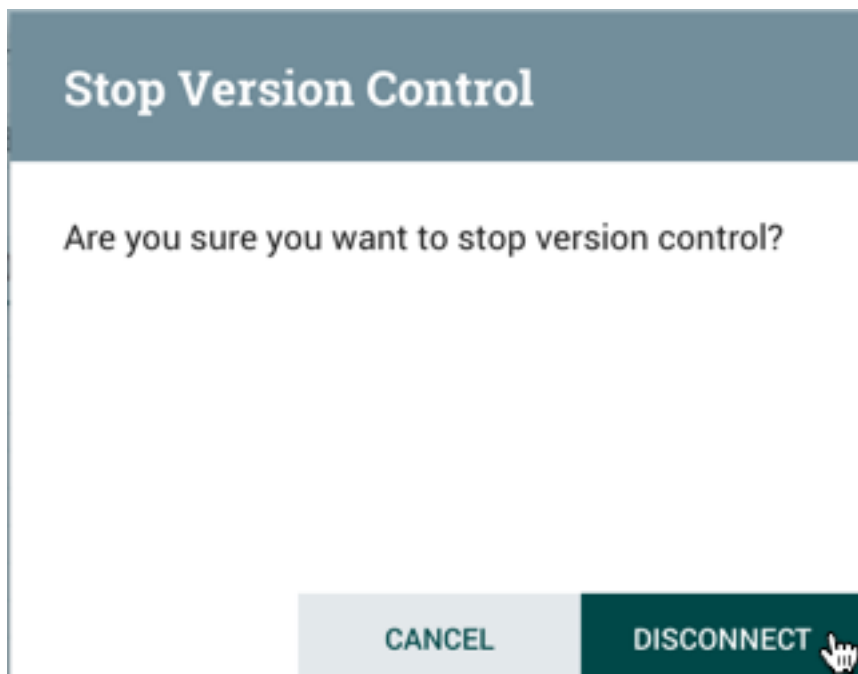


Note: For "Change version" to be an available selection, local changes to the process group need to be reverted.

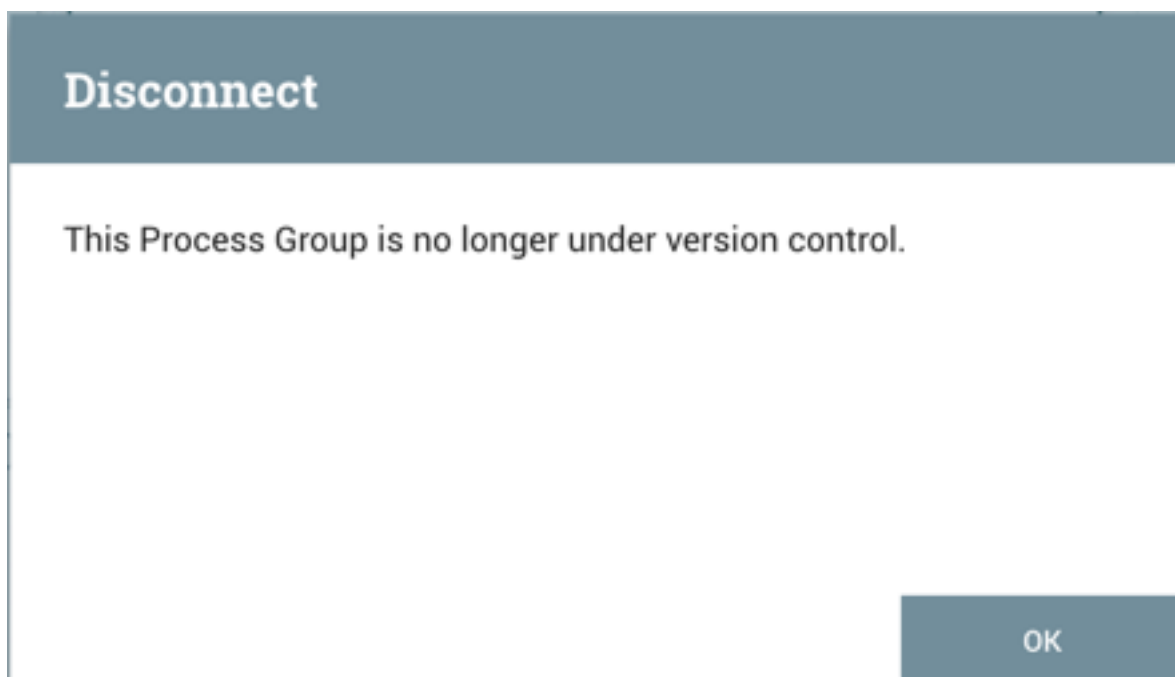
Stop Version Control

To stop version control on a flow, right-click on the versioned process group and select "Version#Stop version control":

In the Stop Version Control dialog, select "Disconnect".



The removal of the process group from version control is confirmed.



Nested Versioned Flows

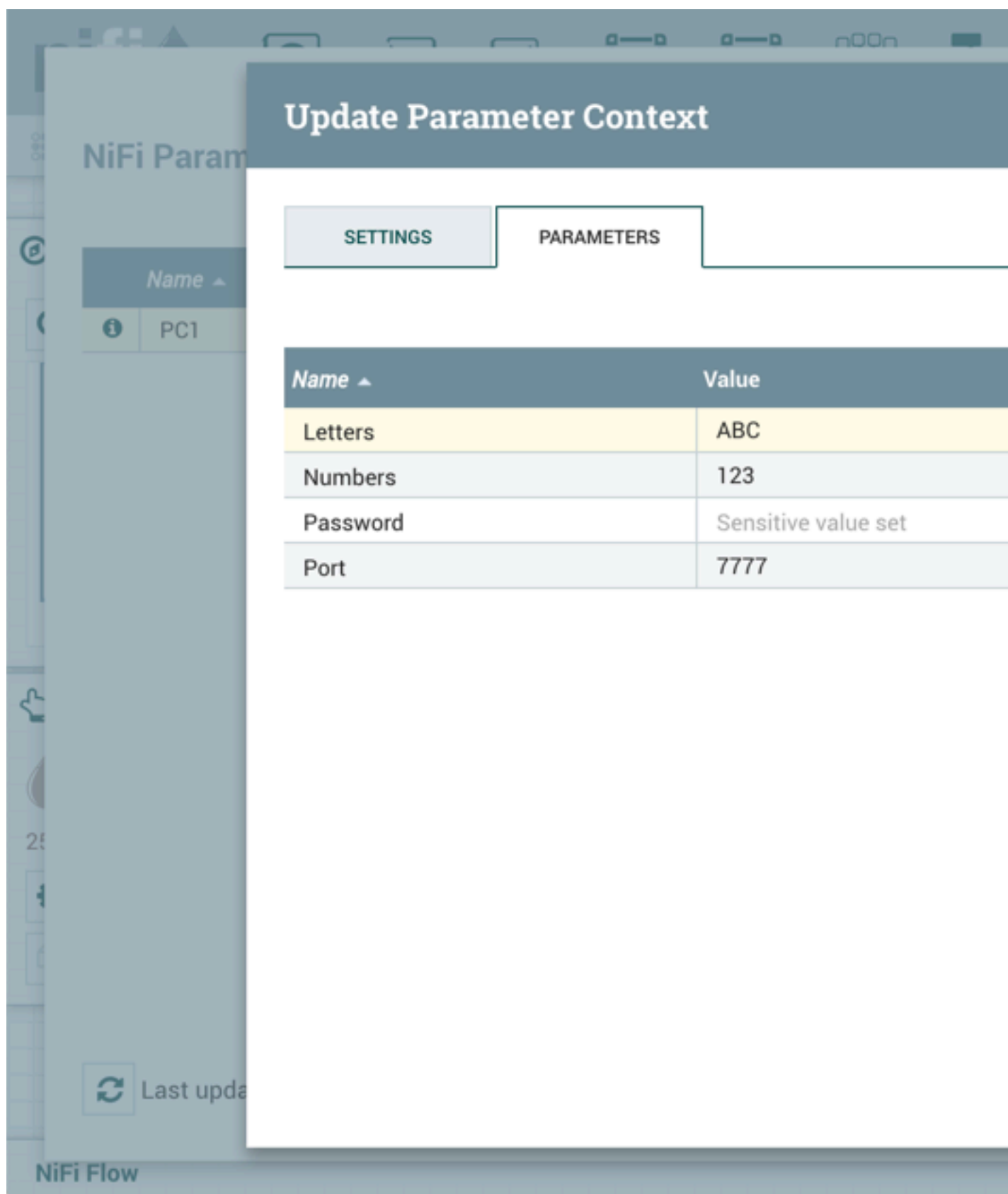
A versioned process group can contain other versioned process groups. However, local changes to a parent process group cannot be reverted or saved if it contains a child process group that also has local changes. The child process group must first be reverted or have its changes committed for those actions to be performed on the parent process group.

Parameters in Versioned Flows

When exporting a versioned flow to a Flow Registry, the name of the Parameter Context is sent for each process group that is stored. The Parameters (names, descriptions, values, whether or not sensitive) are also stored with the flow. However, Sensitive Parameter values are not stored.

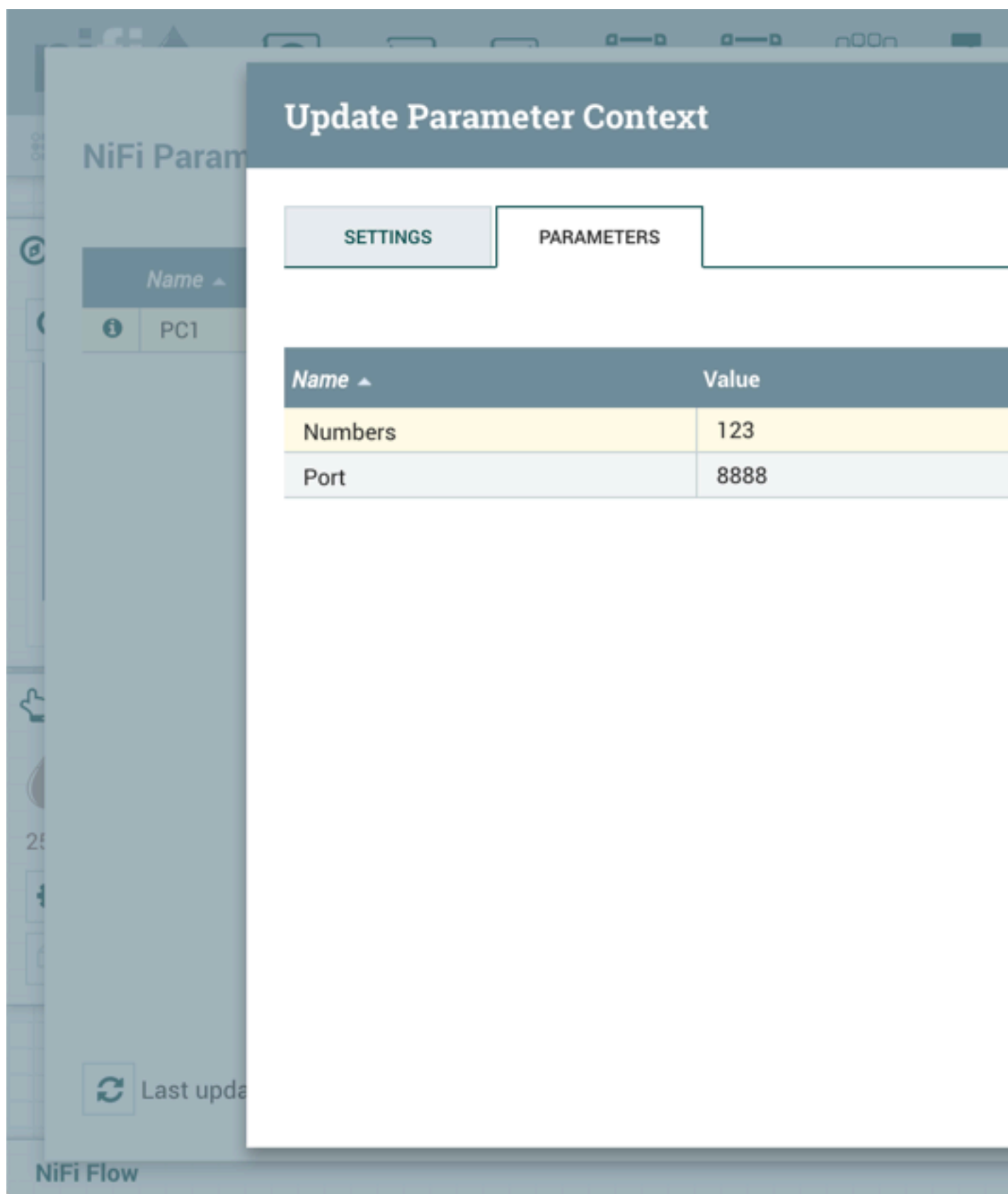
When a versioned flow is imported, a Parameter Context will be created for each one that doesn't already exist in the NiFi instance. When importing a versioned flow from Flow Registry, if NiFi has a Parameter Context with the same name, the values are merged, as described in the following example:

A flow has a Parameter Context "PC1" with the following parameters:



The flow is exported and saved to the Flow Registry.

A NiFi instance has a Parameter Context also named "PC1" with the following parameters:



The versioned flow is imported into the NiFi instance. The Parameter Context "PC1" now has the following parameters:

Update Parameter Context

SETTINGS **PARAMETERS**

Name ▲	Value
Letters	ABC
Numbers	123
Password	No value set
Port	8888

⌂ Last update

NiFi Flow

The "Letters" parameter did not exist in the NiFi instance and was added. The "Numbers" parameter existed in both the versioned flow and NiFi instance with identical values, so no changes were made. "Password" is a sensitive

Parameter missing from the NiFi instance, so it was added but with no value. "Port" existed in the NiFi instance with a different value than the versioned flow, so its value remained unchanged.

Parameter Contexts are handled similarly when a flow version is changed. Consider the following two examples:

If the versioned flow referenced earlier is changed to another version (Version 2) and Version 2's Parameter Context "PC1" has a "Colors" Parameter, "Colors" will be added to "PC1" in the NiFi instance.

Version 1 of a flow does not have a Parameter Context associated with it. A new version (Version 2) does. When the flow is changed from Version 1 to Version 2, one of the following occurs:


- A new Parameter Context is created if it does not already exist
- An existing Parameter Context is assigned (by name) to the Process Group and the values of the Parameter Contexts are merged

Variables in Versioned Flows

Variables are included when a process group is placed under version control. If a versioned flow is imported that references a variable not defined in the versioned process group, the reference is maintained if the variable exists. If the referenced variable does not exist, a copy of the variable will be defined in the process group. To illustrate, assume the variable "RPG_Var" is defined in the root process group:

Variables

Process Group
NiFi Flow

Scope	Name ▲	Value	
NiFi Flow	RPG_Var	/Users/tmp	

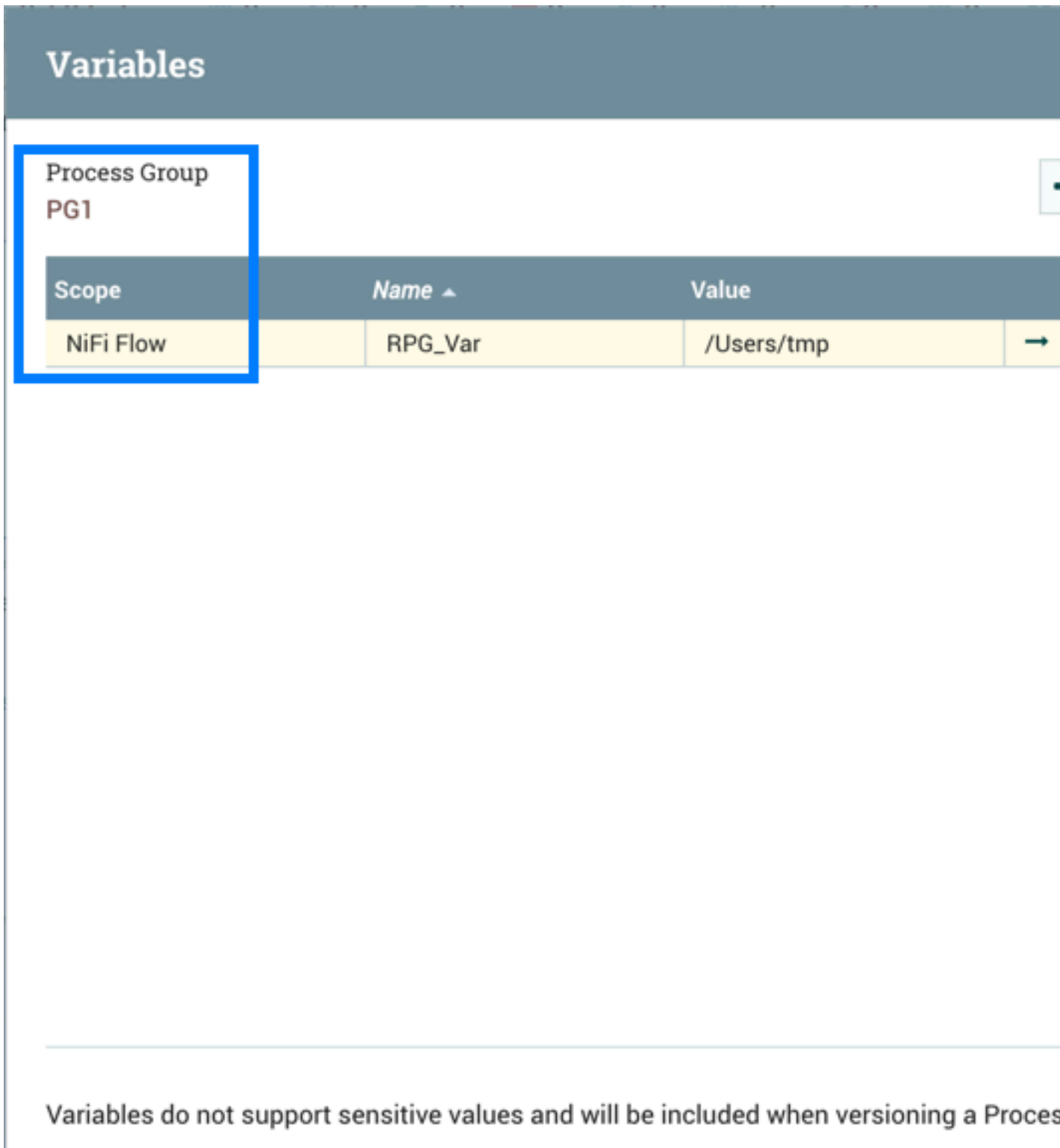
Variables do not support sensitive values and will be included when versioning a Process

A process group PG1 is created:

The screenshot displays the Apache NiFi web interface. At the top, a toolbar contains various icons for navigation and actions. Below the toolbar, a status bar shows counts for different components: 0, 0 / 0 bytes, 0, 0, 0, 2, 0, 0, 0. The main area is divided into two panels. The left panel, titled 'Navigate', contains a search bar and a list of items. The right panel, titled 'Operate', shows the 'PG1' Process Group. It includes a 'DELETE' button and a table of metrics for the 'Get' and 'Log' processors. The 'Get' processor metrics are: In: 0, Read/Write: 0, Out: 0, Tasks/Time: 0. The 'Log' processor metrics are: In: 0, Read/Write: 0, Out: 0, Tasks/Time: 0.

Processor	In	Read/Write	Out	Tasks/Time
Get	0	0	0	0
Log	0	0	0	0

The GetFile processor in PG1 references the variable "RPG_Var":

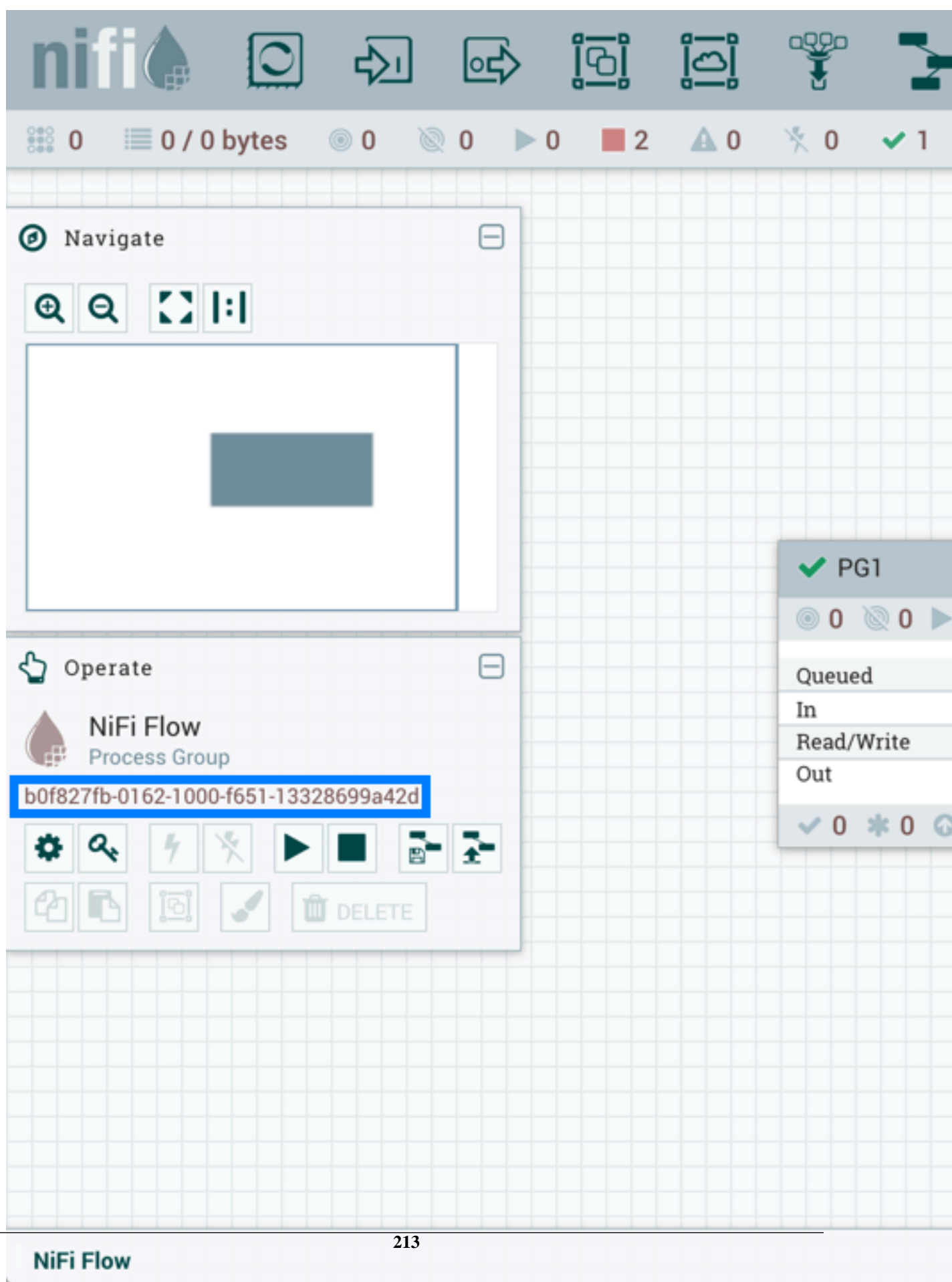


The screenshot displays the 'Variables' management interface in Apache NiFi. A blue box highlights the 'Process Group PG1' section. Within this section, a table lists variables. The first row shows a variable named 'RPG_Var' with the value '/Users/tmp' under the 'NiFi Flow' scope. The table has columns for 'Scope', 'Name', and 'Value'. A green arrow icon is visible at the end of the row.

Scope	Name	Value
NiFi Flow	RPG_Var	/Users/tmp

Variables do not support sensitive values and will be included when versioning a Process Group

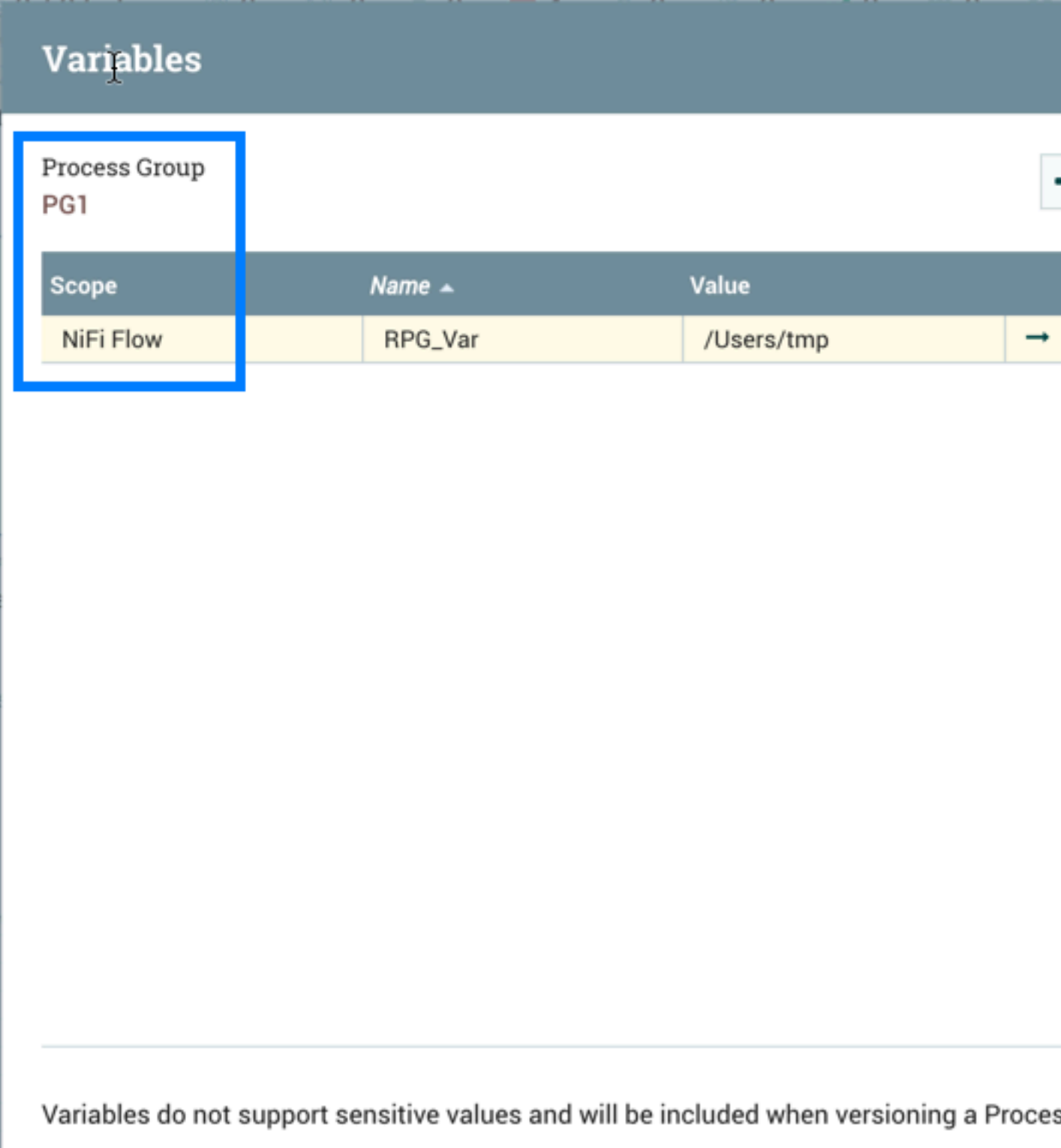
PG1 is saved as a versioned flow:



If PG1 versioned flow is imported into this same NiFi instance:

The screenshot shows the NiFi Flow console with the 'Operate' tab selected. The process group 'b0f827fb-0162-1000-f651-13328699a42d' is highlighted. The console displays metrics for PG1, including Queued (0), In (0), Read/Write (0 bytes / 0), and Out (0 → 0). The 'DELETE' button is visible in the bottom right corner of the console.

the added GetFile processor will also reference the "RPG_Var" variable that exists in the root process group:



The screenshot shows the 'Variables' page in Apache NiFi. A blue box highlights the 'Process Group PG1' section. Below it, a table lists variables. The table has three columns: 'Scope', 'Name', and 'Value'. The first row shows a variable named 'RPG_Var' in the 'NiFi Flow' scope with the value '/Users/tmp'.

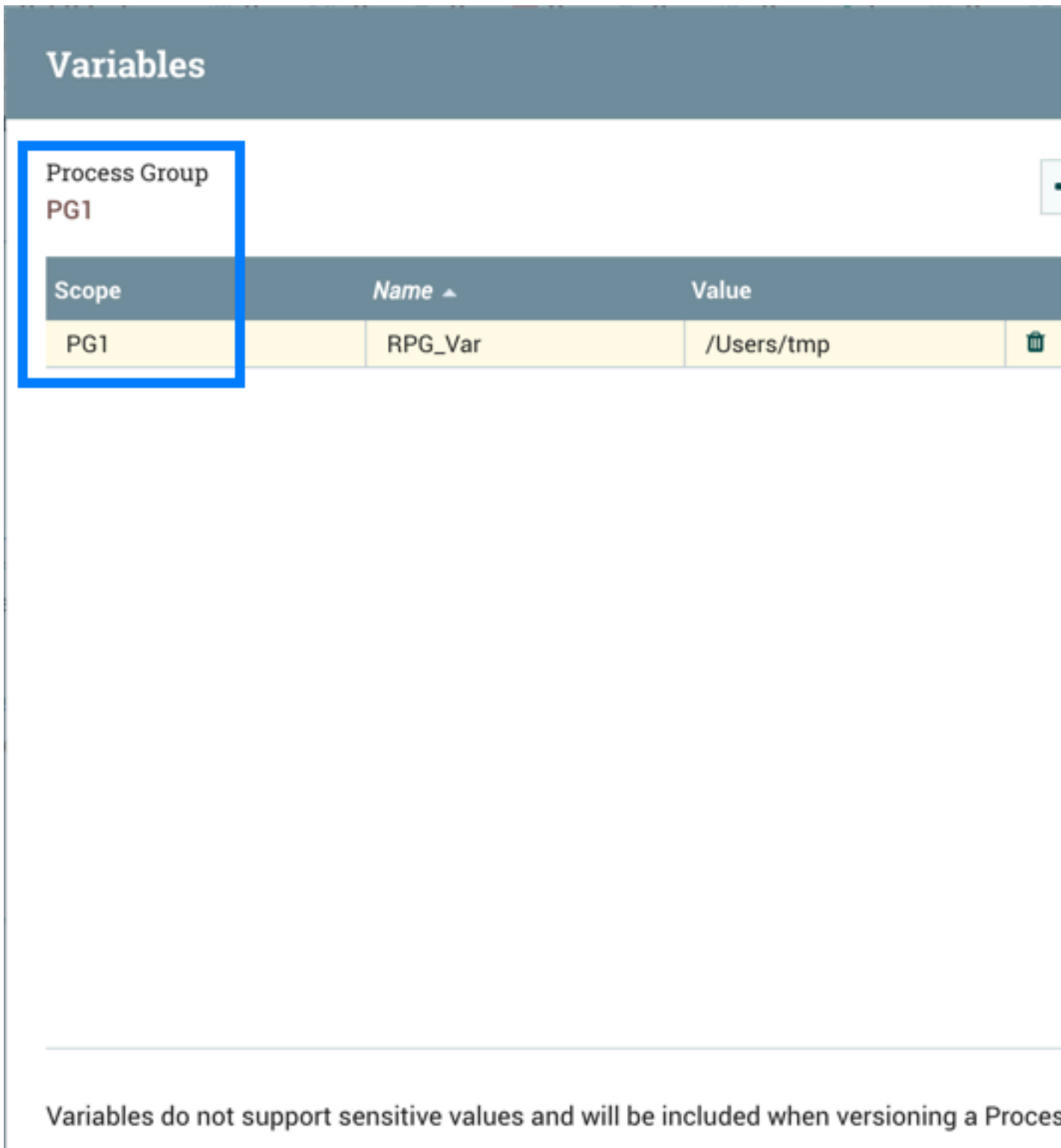
Scope	Name	Value
NiFi Flow	RPG_Var	/Users/tmp

Variables do not support sensitive values and will be included when versioning a Process

If PG1 versioned flow is imported into a different NiFi instance where "RPG_Var" does not exist:

The screenshot shows the NiFi Flow console interface. At the top, there's a status bar with various icons and metrics: 0, 0 / 0 bytes, 0, 0, 0, 2, 0, 0, 1. Below this, the 'Operate' panel is active, displaying the NiFi Flow logo, the text 'NiFi Flow Process Group', and a highlighted ID '0c75d8df-0162-1000-ef72-2ecd332243b6'. The panel also includes a row of icons for settings, search, refresh, stop, play, and delete, and a 'DELETE' button. On the right, a summary for 'PG1' is shown with metrics: Queued 0 (0 B), In 0 (0 B), Read/Write 0 bytes, and Out 0 → 0. The bottom status bar shows 'NiFi Flow' and the page number '217'.

A "RPG_Var" variable is created in the PG1 process group:



The screenshot shows a web interface titled "Variables". On the left, a sidebar displays "Process Group PG1" with a blue selection box. The main area contains a table with columns "Scope", "Name", and "Value". A single row is visible with "PG1" in the Scope column, "RPG_Var" in the Name column, and "/Users/tmp" in the Value column. A trash icon is present at the end of the row.

Scope	Name	Value
PG1	RPG_Var	/Users/tmp

Variables do not support sensitive values and will be included when versioning a Process

Restricted Components in Versioned Flows

To import a versioned flow or revert local changes in a versioned flow, a user must have access to all the components in the versioned flow. As such, it is recommended that restricted components are created at the root process group

level if they are to be utilized in versioned flows. Let's walk through some examples to illustrate the benefits of this configuration. Assume the following:

- There are two users, "sys_admin" and "test_user" who have access to both view and modify the root process group.

- "sys_admin" has access to all restricted components.

The screenshot shows the 'Access Policies' dialog box in the NiFi Flow interface. The dialog has a title bar and a main content area. At the top, there are two tabs: 'access restricted components' (selected) and 'regardless of restrictions'. Below the tabs, there is a 'User' section with a dropdown arrow and the text 'CN=sys_admin, OU=NIFI'. At the bottom left, there is a refresh icon and the text 'Last updated: 09:52:40 EDT'. The bottom of the dialog shows the 'NiFi Flow' logo.

Access Policies

access restricted components ▼ regardless of restrictions

User ▲

CN=sys_admin, OU=NIFI

↻ Last updated: 09:52:40 EDT

NiFi Flow

- "test_user" has access to restricted components requiring 'read filesystem' and 'write filesystem'.

Access Policies

access restricted components ▼ requiring 'read filesystem'

User ▲

CN=test_user, OU=NIFI

96

⌂ Last updated: 12:51:25 EDT Only listing restriction specific

NiFi Flow » * ABC


Restricted Controller Service Created in Root Process Group


In this first example, `sys_admin` creates a `KeytabCredentialsService` controller service at the root process group level.

NiFi Flow Configuration

GENERAL

CONTROLLER SERVICES

	Name	Type	Bundled
	KeytabCredentialsService RPG	KeytabCredentialsService 1.6.0	org.apache.nifi

 Last updated: 10:29:24 EDT

NiFi Flow

KeytabCredentialService controller service is a restricted component that requires 'access keytab' permissions:

Add Controller Service

Source: all groups

Displaying 48 of 48

Type
JettyWebSocketServer
JsonPathReader
JsonRecordSetWriter
JsonTreeReader
KeytabCredentialsService
MongoDBLookupService
PropertiesFileLookupService
RedisConnectionPoolService
RedisDistributedMapCache

KeytabCredentialsService

Requires the following properties:

- 'access keytab' - Allowed to be used by other components

AWSCredentialsProvider

Defines credentials for Amazon S3 configuration. Default credentials are provided by environment variables, etc. A named profile, and assumed role file, named profile, and assumed role file.

GENERAL

Na

Last updated:

NiFi Flow

Sys_admin creates a process group ABC containing a flow with GetFile and PutHDFS processors:

The screenshot displays the Apache NiFi web interface. At the top, the 'nifi' logo is followed by a series of icons representing different components: a square with a circle, a square with an arrow, a square with a circle and arrow, a square with a cloud, a square with a lightning bolt, and a square with a lightning bolt and arrow. Below these icons, a status bar shows various metrics: 0, 0 / 0 bytes, 0, 0, 0, 2, 0, and 0. The main workspace is a grid. On the left, there are two panels: 'Navigate' and 'Operate'. The 'Operate' panel is highlighted with a blue border and contains a list of components. The first component is 'ABC', a 'Process Group', with a unique ID '962749c1-0162-1000-36b5-b45bcf45c3de'. Below the component list are several icons for actions: a gear, a magnifying glass, a lightning bolt, a lightning bolt with a slash, a play button, a square, a document with a lightning bolt, a document with a lightning bolt and arrow, a document with a lightning bolt and arrow, a document with a lightning bolt and arrow, a document with a lightning bolt and arrow, and a 'DELETE' button. On the right side of the workspace, there are two context menus. The top one shows 'In', 'Read/Write', 'Out', and 'Tasks/Time'. The bottom one shows 'In', 'Read/Write', 'Out', and 'Tasks/Time'. At the bottom of the interface, the breadcrumb 'NiFi Flow » ABC' is visible.

Navigate

Operate

ABC
Process Group
962749c1-0162-1000-36b5-b45bcf45c3de

NiFi Flow » ABC

GetFile processor is a restricted component that requires 'write filesystem' and 'read filesystem' permissions:

Add Processor

Source: all groups

Displaying 258 of 258

Type

- GeoEnrichIP
- GetAzureEventHub
- GetCouchbaseKey
- GetDynamoDB
- GetFTP
- GetFile**
 - Requires the following permissions:
 - 'write filesystem' - Process group has access to.
 - 'read filesystem' - Process group has access to.
- GetHDFSSequenceFile
- GetHTMLElement
- GetHTTP

AttributeRollingWindow

Track a Rolling Window based on a FlowFile and add that value to the total of FlowFiles and total aggregated

PutHDFS is a restricted component that requires 'write filesystem' permissions:

The screenshot shows the NiFi 'Add Processor' dialog. The background is a blurred view of the NiFi interface, including the 'nifi' logo, a 'Navigate' sidebar, and a 'Process Group' named 'ABC' with ID '962749c1-0162-1000-36b...'. The dialog itself has a title bar 'Add Processor' and a 'Source' dropdown set to 'all groups'. A list of 258 processors is displayed, with 'PutHDFS' highlighted. A tooltip for 'PutHDFS' is visible, stating 'Requires the following properties: • 'write filesystem' - Provides access to in HDFS or...'. Below the list, the version 'PutHDFS 1.6.0' and the organization 'org.apache' are shown, along with a description 'Write FlowFile data to Hadoop...'.

Add Processor

Source: all groups

Displaying 258 of 258

Type
PutGCSObject
PutHBaseCell
PutHBaseJSON
PutHBaseRecord
PutHDFS
PutHiveStreaming
PutIgniteCache
PutInfluxDB
PutJMS
PutKafka

PutHDFS 1.6.0 org.apache

Write FlowFile data to Hadoop...

amazon attributes
avro aws consume
csv delete fetch
get hadoop
ingest ingress
insert json kafka
listen logs
message pubsub
put record
restricted send
source update

NiFi Flow » ABC

The PutHDFS processor is configured to use the root process group level KeytabCredentialsService controller service:

Configure Processor

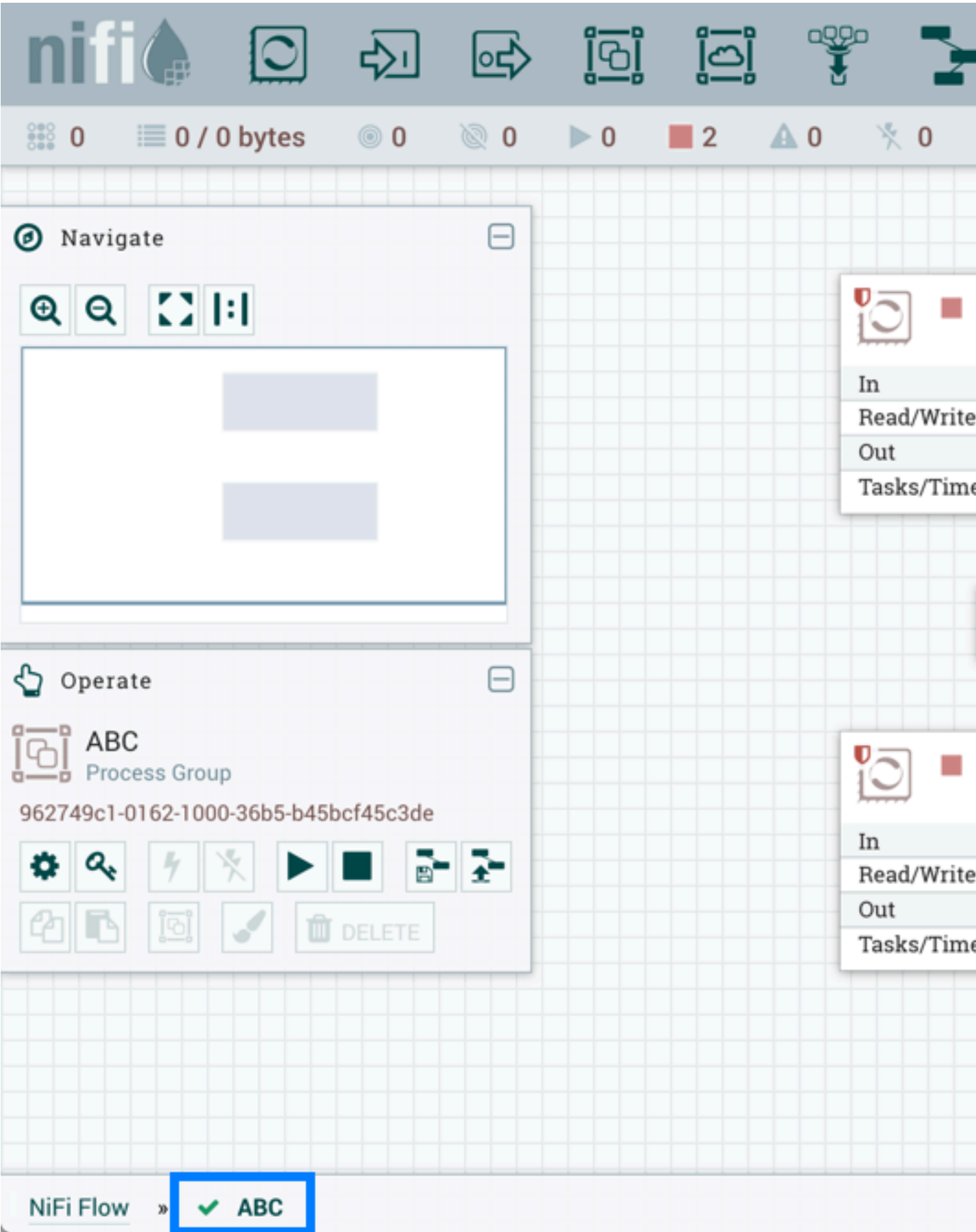
SETTINGS SCHEDULING **KERBEROS** PROPERTIES

Required field

Property	Value
Hadoop Configuration Resources	?
Kerberos Credentials Service	?
Kerberos Principal	?
Kerberos Keytab	?
Kerberos Relogin Period	?
Additional Classpath Resources	?
Directory	?
Conflict Resolution Strategy	?
Block Size	?
IO Buffer Size	?
Replication	?
Permissions umask	?
Remote Owner	?
Remote Group	?

NiFi Flow » ABC

Sys_admin saves the process group as a versioned flow:



Test_user changes the flow by removing the KeytabCredentialsService controller service:

Configure Processor

SETTINGS SCHEDULING **PROPERTIES**

Required field

Property	Value
Hadoop Configuration Resources	?
Kerberos Credentials Service	?
Kerberos Principal	?
Kerberos Keytab	?
Kerberos Relogin Period	?
Additional Classpath Resources	?
Directory	?
Conflict Resolution Strategy	?
Block Size	?
IO Buffer Size	?
Replication	?
Permissions umask	?
Remote Owner	?
Remote Group	?

If test_user chooses to revert this change:

The screenshot shows the NiFi web interface. On the left, the 'Navigate' sidebar is visible with search and zoom controls. The main canvas shows a process group named 'ABC' with ID '962749c1-0162-1000-36b5-b4'. A modal dialog titled 'Revert Local Changes' is open on the right. It states: 'The following changes have been made to ABC_Flow (Vers...)' and 'Displaying 1 of 1'. Below this is a table with two columns: 'Component Name' and 'Change Type'. The table contains one entry: 'PutHDFS' with the change type 'Property Removed'.

Revert Local Changes

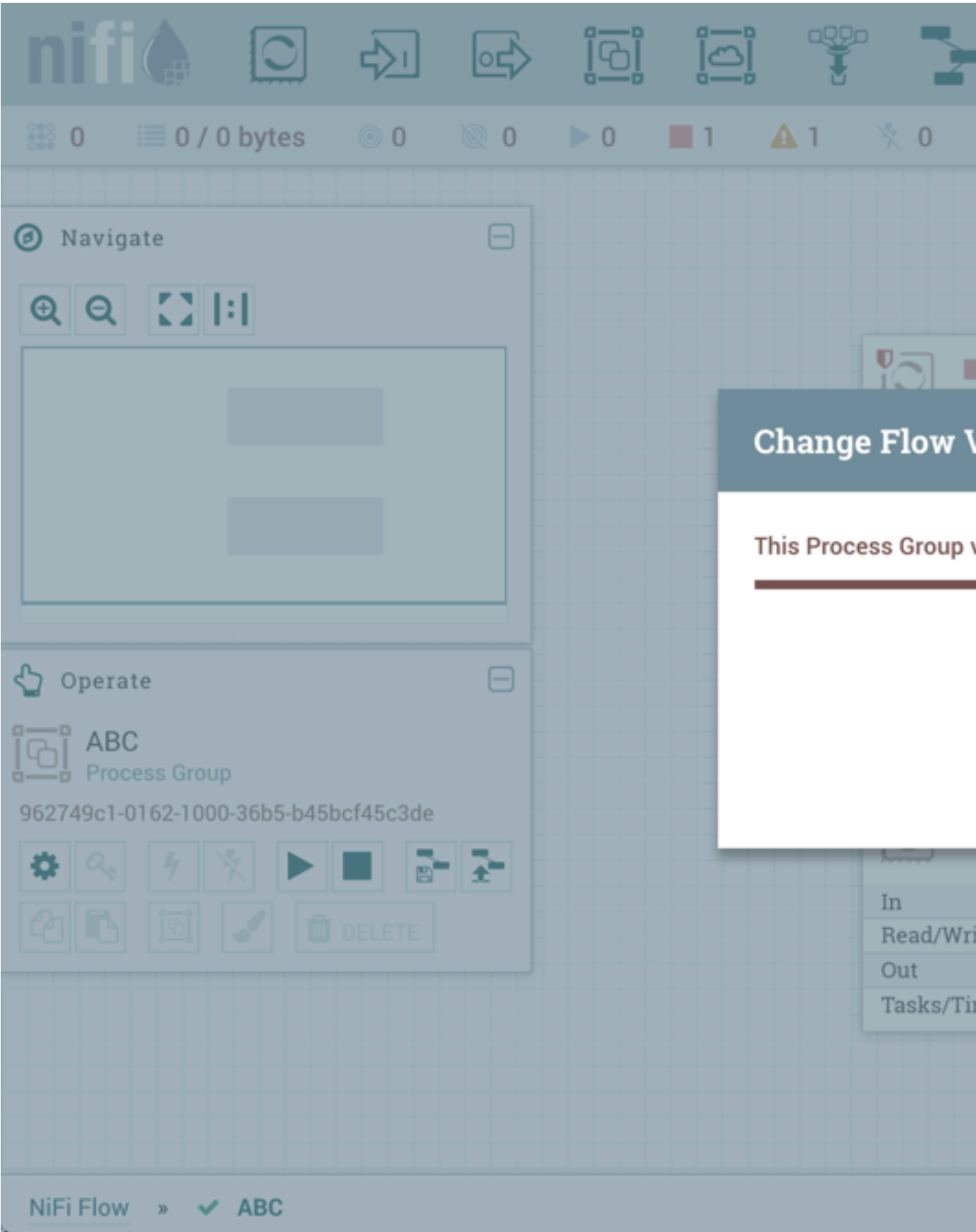
The following changes have been made to ABC_Flow (Vers...

Displaying 1 of 1

Filter

Component Name	Change Type
PutHDFS	Property Removed

the revert is successful:



Additionally, if `test_user` chooses to import the ABC versioned flow:

Import Version

Registry

Local Secured Registry

Bucket

Bucket_ABC

Name

ABC_Flow

Version ▾	Created	Comments
1	04/05/2018 13:00:37.510	Initial Save

NiFi Flow

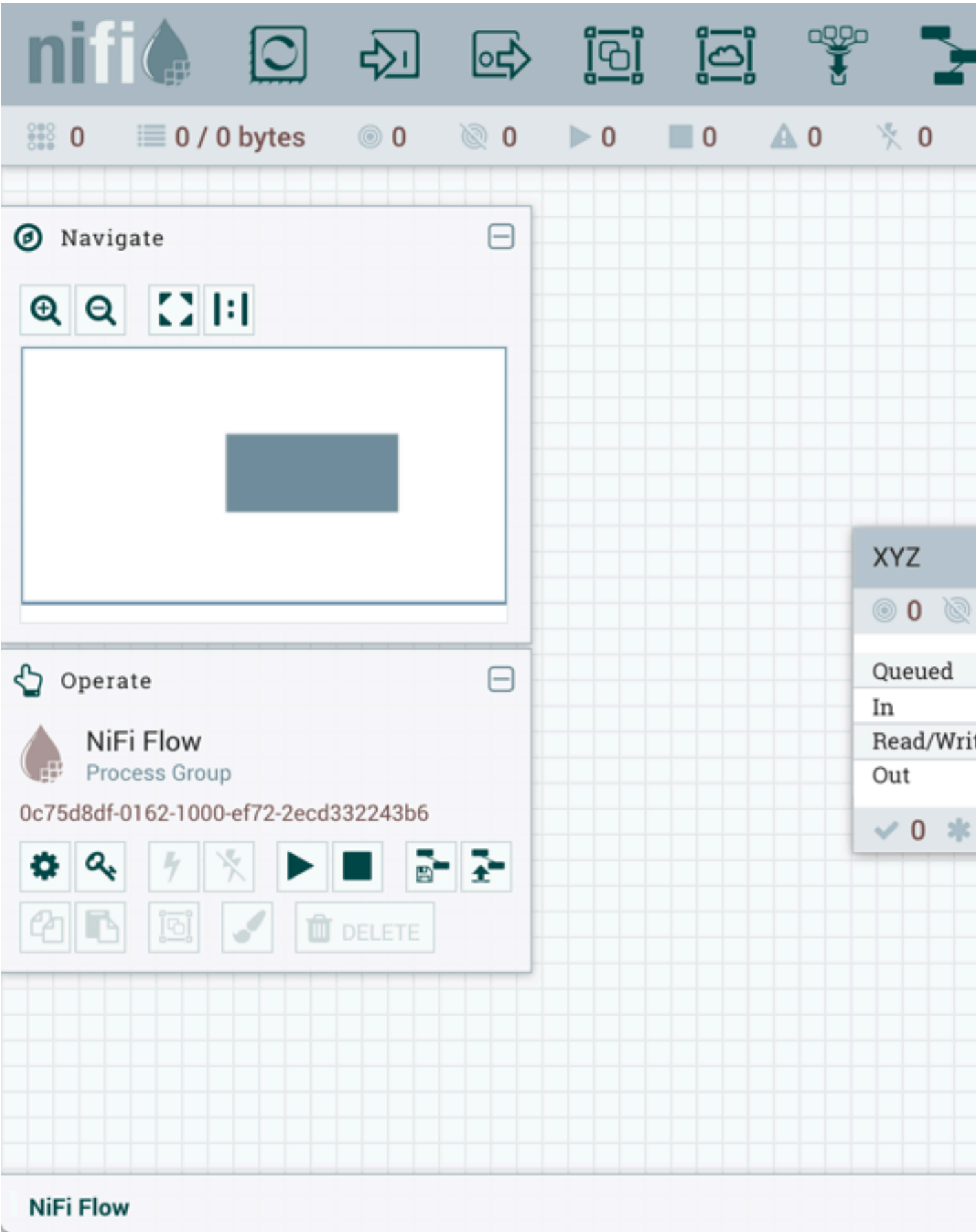
The import is successful:

The screenshot displays the Apache NiFi web interface. At the top, a navigation bar contains the 'nifi' logo and several icons for navigation and actions. Below this, a status bar shows various metrics: 0, 0 / 0 bytes, 0, 0, 0, 2, 0, and 0. The main workspace is a grid. On the left, a 'Navigate' panel is open, showing a search bar and a list of process groups. The 'NiFi Flow' process group is selected, and its details are shown in the 'Operate' panel. The 'NiFi Flow' process group is a 'Process Group' with the ID '0c75d8df-0162-1000-ef72-2ecd332243b6'. The 'Operate' panel contains several icons for actions like 'Edit', 'Run', 'Stop', 'Refresh', 'Delete', and 'Download'. On the right, a 'Summary' panel is visible, showing a green checkmark and the text 'ABC'. Below this, a table displays metrics: 'Queued' (0), 'In' (0), 'Read/Write' (0), and 'Out' (0). At the bottom, a 'NiFi Flow' label is present.

Restricted Controller Service Created in Process Group

Now, consider a second scenario where the controller service is created on the process group level.

Sys_admin creates a process group XYZ:





Sys_admin creates a KeytabCredentialsService controller service at the process group level:

XYZ Configuration

GENERAL

CONTROLLER SERVICES

	Name	Type	Bundled
	KeytabCredentialsService PG	KeytabCredentialsService 1.6.0	org.apache.nifi...



Last updated: 15:49:36 EDT

List

NiFi Flow

The same GetFile and PutHDFS flow is created in the process group:

The screenshot displays the Apache NiFi web interface. At the top, the 'nifi' logo is visible alongside a toolbar with various icons for flow management. Below the toolbar, a status bar shows metrics: 0 flows, 0 / 0 bytes, 0 targets, 0 disabled, 0 running, 2 failed, 0 alerts, and 0 deleted. The main workspace is a grid where a 'Process Group' named 'XYZ' is highlighted. The 'XYZ' Process Group is identified by the ID '96db60fc-0162-1000-1ac8-dc96718ec37a'. A context menu is open for the 'XYZ' Process Group, showing options: 'In', 'Read/Write', 'Out', and 'Tasks...'. The 'XYZ' Process Group is currently selected, and its details are shown in the 'Operate' panel. The 'Operate' panel includes a 'XYZ Process Group' icon, the ID '96db60fc-0162-1000-1ac8-dc96718ec37a', and a set of icons for actions: 'Settings', 'Search', 'Refresh', 'Delete', 'Run', 'Stop', 'Download', 'Upload', 'Duplicate', 'Copy', 'Paste', and 'DELETE'. The bottom of the interface shows the breadcrumb 'NiFi Flow » XYZ'.

Navigate

Operate

XYZ
Process Group
96db60fc-0162-1000-1ac8-dc96718ec37a

NiFi Flow » XYZ

However, PutHDFS now references the process group level controller service:

Configure Processor

SETTINGS SCHEDULING PROPERTIES

Required field

Property	Value
Hadoop Configuration Resources	?
Kerberos Credentials Service	?
Kerberos Principal	?
Kerberos Keytab	?
Kerberos Relogin Period	?
Additional Classpath Resources	?
Directory	?
Conflict Resolution Strategy	?
Block Size	?
IO Buffer Size	?
Replication	?
Permissions umask	?
Remote Owner	?
Remote Group	?

NiFi Flow » XYZ

Sys_admin saves the process group as a versioned flow.

Test_user changes the flow by removing the KeytabCredentialsService controller service. However, with this configuration, if test_user attempts to revert this change:

Revert Local Changes

The following changes have been made to XYZ_Flow (Vers 1)

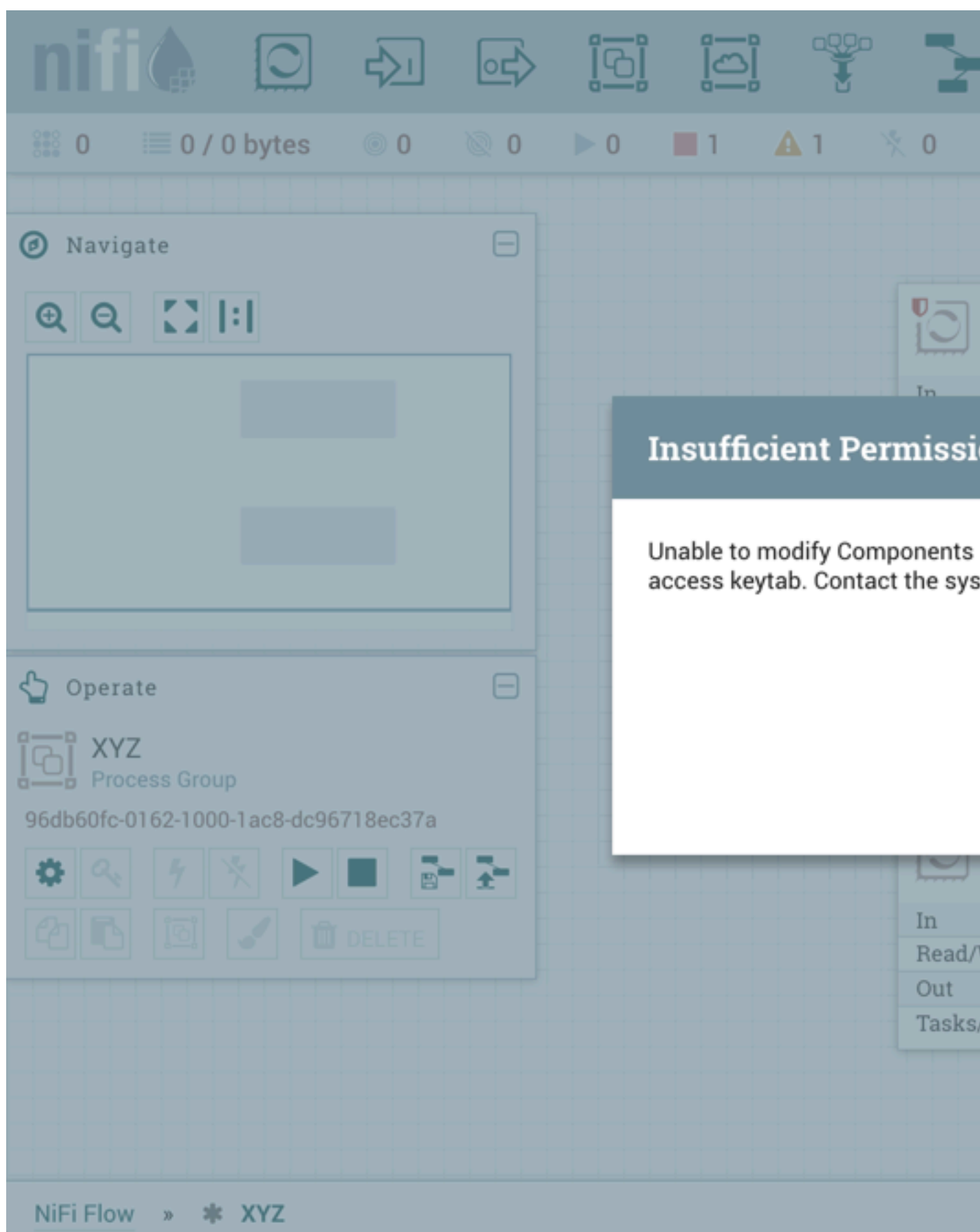
Displaying 1 of 1

Filter

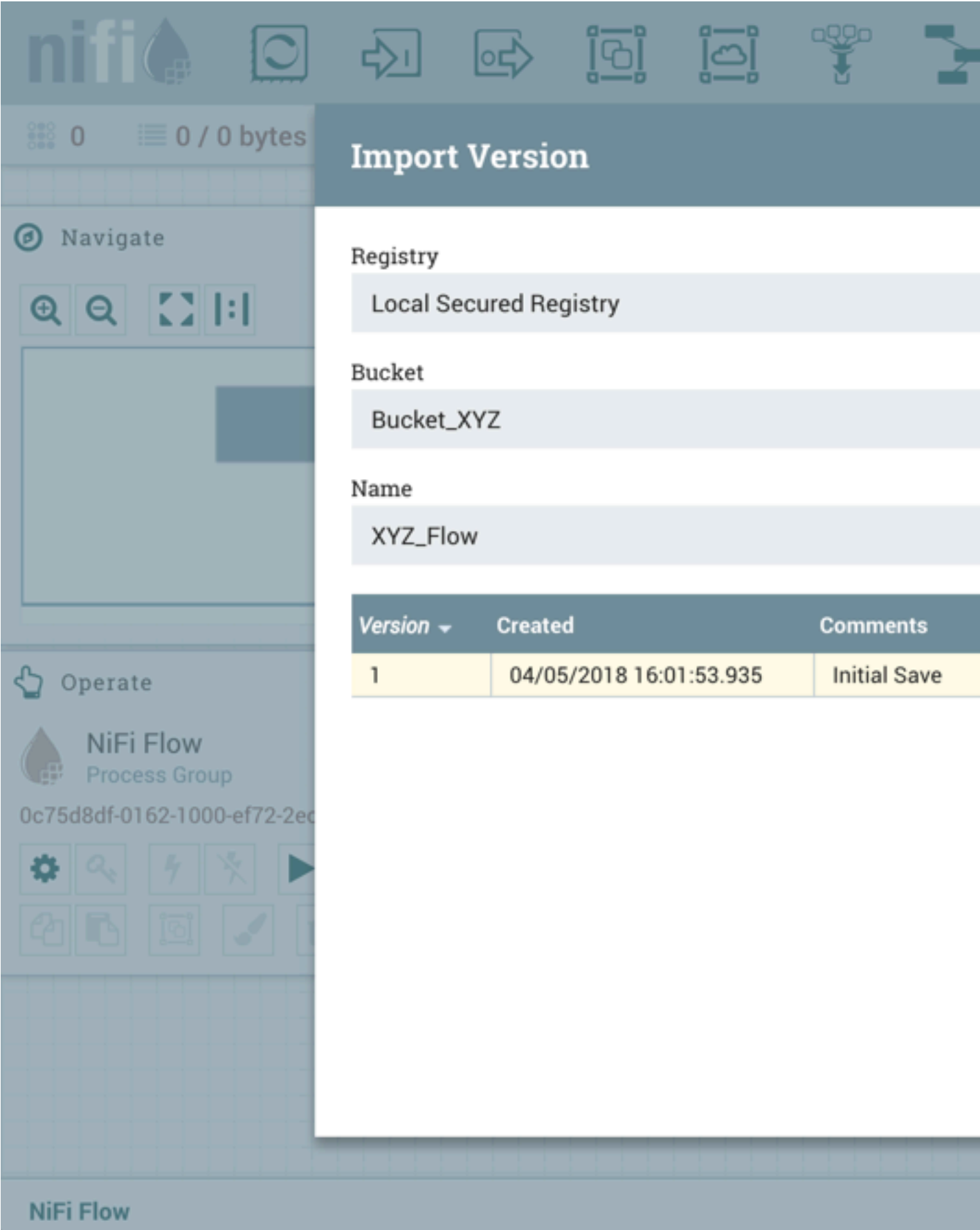
Component Name	Change Type
PutHDFS	Property Removed

NiFi Flow » * XYZ

the revert is unsuccessful because test_user does not have the 'access keytab' permissions required by the KeytabCredentialService controller service:



Similarly, if `test_user` tries to import the XYZ versioned flow:

A screenshot of the Apache NiFi web interface. The top navigation bar contains the NiFi logo and several icons for navigation and actions. Below the navigation bar, there's a status bar showing '0' and '0 / 0 bytes'. The left sidebar has a 'Navigate' section with search and zoom icons, and an 'Operate' section with a 'NiFi Flow' process group. The main content area is titled 'Import Version' and contains a form with fields for 'Registry' (Local Secured Registry), 'Bucket' (Bucket_XYZ), and 'Name' (XYZ_Flow). Below the form is a table with columns 'Version', 'Created', and 'Comments', containing one row with version 1, created on 04/05/2018 at 16:01:53.935, with the comment 'Initial Save'.

Import Version

Registry

Local Secured Registry

Bucket

Bucket_XYZ

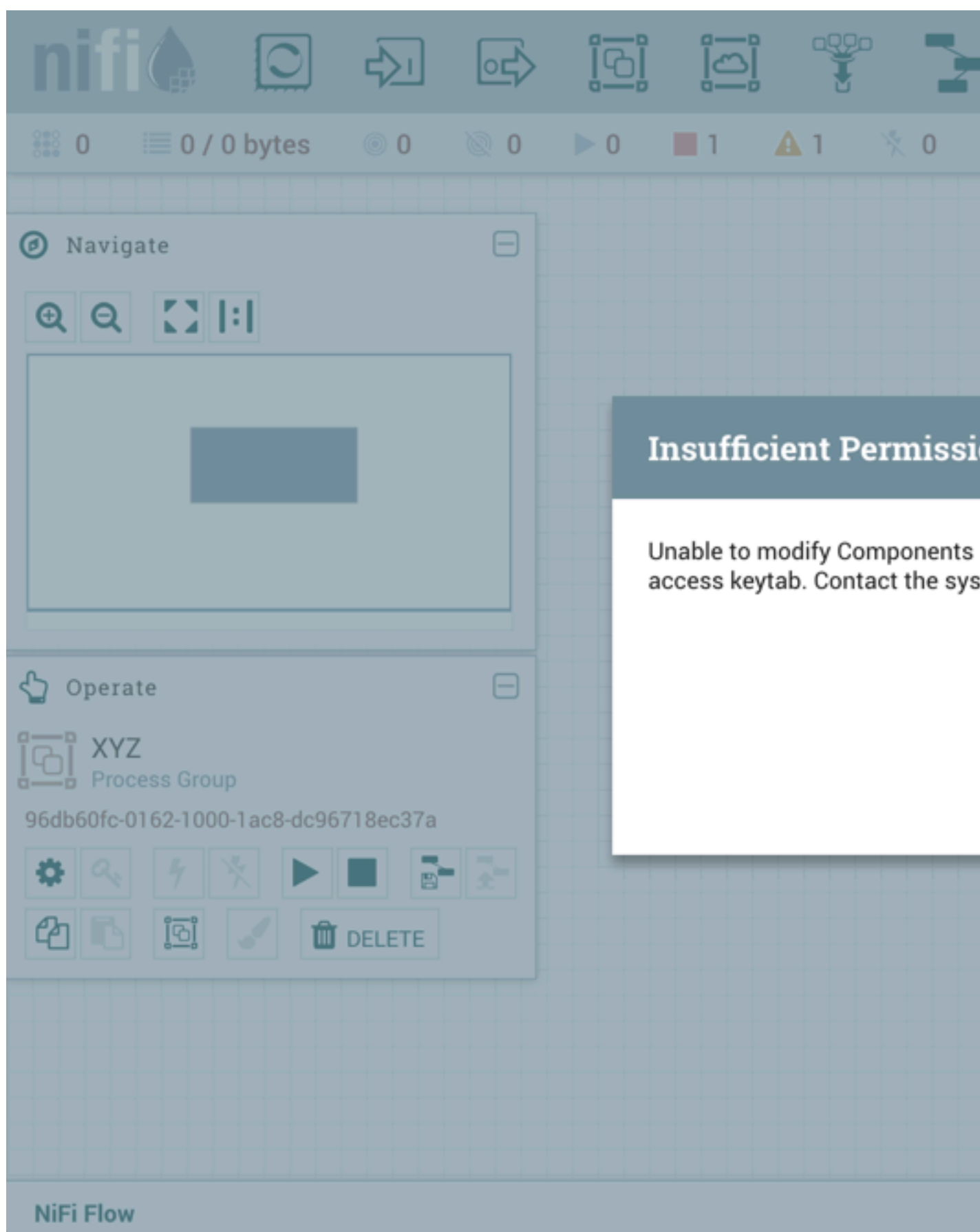
Name

XYZ_Flow

Version ▾	Created	Comments
1	04/05/2018 16:01:53.935	Initial Save

NiFi Flow

The import fails:



Templates

DFMs have the ability to build very large and complex DataFlows using NiFi. This is achieved by using the basic components: Processor, Funnel, Input/Output Port, Process Group, and Remote Process Group. These can be thought of as the most basic building blocks for constructing a DataFlow. At times, though, using these small building blocks can become tedious if the same logic needs to be repeated several times.

To solve this issue, NiFi provides the concept of a Template. A Template is a way of combining these basic building blocks into larger building blocks. Once a DataFlow has been created, parts of it can be formed into a Template. This Template can then be dragged onto the canvas, or can be exported as an XML file and shared with others. Templates received from others can then be imported into an instance of NiFi and dragged onto the canvas.

Creating a Template

To create a Template, select the components that are to be a part of the template, and then click the "Create



Template" () button in the Operate Palette (See [NiFi User Interface](#) for more information on the Operate Palette).

Clicking this button without selecting anything will create a Template that contains all of the contents of the current Process Group. This means that creating a Template with nothing selected while on the Root Process Group will create a single Template that contains the entire flow.

After clicking this button, the user is prompted to provide a name and an optional description for the template. Each template must have a unique name. After entering the name and optional description, clicking the "Create" button will generate the template and notify the user that the template was successfully created, or provide an appropriate error message if unable to create the template for some reason.



Note: It is important to note that if any Processor that is Templated has a sensitive property (such as a password), the value of that sensitive property is not included in the Template. As a result, when dragging the Template onto the canvas, newly created Processors may not be valid if they are missing values for their sensitive properties. Additionally, any Connection that was selected when making the Template is not included in the Template if either the source or the destination of the Connection is not also included in the Template.

Importing a Template

After receiving a Template that has been exported from another NiFi, the first step needed to use the template is to import the template into this instance of NiFi. You may import templates into any Process Group where you have the appropriate authorization.



From the Operate Palette, click the "Upload Template" () button (see [NiFi User Interface](#) for more information on the Operate Palette). This will display the Upload Template dialog. Click the find icon and use the File Selection dialog to choose which template file to upload. Select the file and click Open. Clicking the "Upload" button will attempt to import the Template into this instance of NiFi. The Upload Template dialog will update to show "Success" or an error message if there was a problem importing the template.

Instantiating a Template

Once a Template has been created (see [Creating a Template](#)) or imported (see [Importing a Template](#)), it is ready to be instantiated, or added to the canvas. This is accomplished by dragging the Template icon (



) from the Components Toolbar (see [NiFi User Interface](#)) onto the canvas.

This will present a dialog to choose which Template to add to the canvas. After choosing the Template to add, simply click the "Add" button. The Template will be added to the canvas with the upper-left-hand side of the Template being placed wherever the user dropped the Template icon.

This leaves the contents of the newly instantiated Template selected. If there was a mistake, and this Template is no longer wanted, it may be deleted.

Managing Templates

One of the most powerful features of NiFi Templates is the ability to easily export a Template to an XML file and to import a Template that has already been exported. This provides a very simple mechanism for sharing parts of a DataFlow with others. You can select Templates from the Global Menu (see [NiFi User Interface](#)) to open a dialog that displays all of the Templates that are currently available, filter the templates to see only those of interest, export, and delete Templates.

Exporting a Template

Once a Template has been created, it can be shared with others in the Template Management page. To export a Template, locate the Template in the table. The Filter in the top-right corner can be used to help find the appropriate



Template if several are available. Then click the "Download" button (). This will download the template as an XML file to your computer. This XML file can then be sent to others and imported into other instances of NiFi (see [Importing a Template](#)).

Removing a Template

Once it is decided that a Template is no longer needed, it can be easily removed from the Template Management page. To delete a Template, locate it in the table (the Filter in the top-right corner may be used to find the appropriate



Template if several are available) and click the "Delete" button (). This will prompt for confirmation. After confirming the deletion, the Template will be removed from this table and will no longer be available to add to the canvas.

Data Provenance

While monitoring a dataflow, users often need a way to determine what happened to a particular data object (FlowFile). NiFi's Data Provenance page provides that information. Because NiFi records and indexes data provenance details as objects flow through the system, users may perform searches, conduct troubleshooting and evaluate things like dataflow compliance and optimization in real time. By default, NiFi updates this information every five minutes, but that is configurable.

To access the Data Provenance page, select "Data Provenance" from the Global Menu. This opens a dialog window that allows the user to see the most recent Data Provenance information available, search the information for specific items, and filter the search results. It is also possible to open additional dialog windows to see event details, replay

data at any point within the dataflow, and see a graphical representation of the data's lineage, or path through the flow. (These features are described in depth below.)

When authorization is enabled, accessing Data Provenance information requires the 'query provenance' Global Policy as well as the 'view provenance' Component Policy for the component which generated the event. In addition, access to event details which include FlowFile attributes and content require the 'view the data' Component Policy for the component which generated the event.

NiFi Data Provenance

Displaying 1,000 of 1,000
Oldest event available: 07/14/2016 20:56:52 UTC

Filter

	Date/Time ▾	Type	FlowFile Uuid	Size
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	91ae19fa-5797-45...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	bcc29546-bbd0-43...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	9f4c3b69-6cef-40a...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	38bb2021-1f07-4e...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	f31d3aa0-40b7-46...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	7d12c959-6952-41...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	93f31b5c-be89-49e...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	a1e5a6a4-b44e-4e...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	cf2095c8-052a-47...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	c0db8381-6c13-42...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	9da3e06d-9715-46...	1.11 KB
	07/29/2016 00:14:...	ATTRIBUTES_MODI...	18247e64-41b3-4f...	1.11 KB

Last updated: 00:14:35 UTC

Provenance Events

The different event types for provenance reporting are:

Provenance Event	Description
ADDINFO	Indicates a provenance event for adding additional information such as new linkage to a new URI or UUID
ATTRIBUTES_MODIFIED	Indicates that a FlowFile's attributes were modified in some way. This event is not needed when another event is reported at the same time, as the other event will already contain all FlowFile attributes
CLONE	Indicates that a FlowFile is an exact duplicate of its parent FlowFile
CONTENT_MODIFIED	Indicates that a FlowFile's content was modified in some way. When using this Event Type, it is advisable to provide details about how the content is modified
CREATE	Indicates that a FlowFile was generated from data that was not received from a remote system or external process
DOWNLOAD	Indicates that the contents of a FlowFile were downloaded by a user or external entity
DROP	Indicates a provenance event for the conclusion of an object's life for some reason other than object expiration
EXPIRE	Indicates a provenance event for the conclusion of an object's life due to the object not being processed in a timely manner
FETCH	Indicates that the contents of a FlowFile were overwritten using the contents of some external resource. This is similar to the RECEIVE event but varies in that RECEIVE events are intended to be used as the event that introduces the FlowFile into the system, whereas FETCH is used to indicate that the contents of an existing FlowFile were overwritten
FORK	Indicates that one or more FlowFiles were derived from a parent FlowFile
JOIN	Indicates that a single FlowFile is derived from joining together multiple parent FlowFiles
RECEIVE	Indicates a provenance event for receiving data from an external process. This Event Type is expected to be the first event for a FlowFile. As such, a Processor that receives data from an external source and uses that data to replace the content of an existing FlowFile should use the FETCH event type, rather than the RECEIVE event type
REPLAY	Indicates a provenance event for replaying a FlowFile. The UUID of the event indicates the UUID of the original FlowFile that is being replayed. The event contains one Parent UUID that is also the UUID of the FlowFile that is being replayed and one Child UUID that is the UUID of the a newly created FlowFile that will be re-queued for processing
ROUTE	Indicates that a FlowFile was routed to a specified relationship and provides information about why the FlowFile was routed to this relationship
SEND	Indicates a provenance event for sending data to an external process
UNKNOWN	Indicates that the type of provenance event is unknown because the user who is attempting to access the event is not authorized to know the type

Searching for Events

One of the most common tasks performed in the Data Provenance page is a search for a given FlowFile to determine what happened to it. To do this, click the "Search" button in the upper-right corner of the Data Provenance page. This opens a dialog window with parameters that the user can define for the search. The parameters include the processing event of interest, distinguishing characteristics about the FlowFile or the component that produced the event, the timeframe within which to search, and the size of the FlowFile.

Search Events

Fields

Event Type

FlowFile UUID

Filename

Component ID

Relationship

twitter.msg

language

Start date ?

07/28/2016

Start time (UTC)

00:00:00

End date ?

07/28/2016

End time (UTC)

23:59:59

Minimum file size ?

Maximum file size

Search location

cluster

For example, to determine if a particular FlowFile was received, search for an Event Type of "RECEIVE" and include an identifier for the FlowFile, such as its uuid or filename. The asterisk (*) may be used as a wildcard for any number of characters. So, to determine whether a FlowFile with "ABC" anywhere in its filename was received at any time on Jan. 6, 2015, the search shown in the following image could be performed:

Search Events

Fields

Event Type

RECEIVE

FlowFile UUID

Filename

ABC




Component ID

Relationship

twitter.msg

language

Start date 

07/28/2016

Start time (UTC)


00:00:00

End date 

07/28/2016

End time (UTC)

23:59:59


Minimum file size 

Maximum file size

Search location

cluster

Details of an Event

In the far-left column of the Data Provenance page, there is a "View Details" icon for each event (). Clicking this button opens a dialog window with three tabs: Details, Attributes, and Content.

Provenance Event

DETAILS

ATTRIBUTES

CONTENT

Time

07/29/2016 00:58:44.829 UTC

Parent FlowFiles (0)

No parents

Event Duration

No value set

Child FlowFiles (0)

No children

Lineage Duration

00:00:00.203

Type

ATTRIBUTES_MODIFIED

FlowFile Uuid

62d2161f-0b2a-4b2a-a552-ab617bef3811

File Size

1.1 KB

Component Id

7bba4f68-2861-3a12-aac6-60f12e11e215

Component Name

EvaluateJsonPath

Component Type

The Details tab shows various details about the event, such as when it occurred, what type of event it was, and the component that produced the event. The information that is displayed will vary according to the event type. This

tab also shows information about the FlowFile that was processed. In addition to the FlowFile's UUID, which is displayed on the left side of the Details tab, the UUIDs of any parent or children FlowFiles that are related to that FlowFile are displayed on the right side of the Details tab.

The Attributes tab shows the attributes that exist on the FlowFile as of that point in the flow. In order to see only the attributes that were modified as a result of the processing event, the user may select the checkbox next to "Only show modified" in the upper-right corner of the Attributes tab.

Provenance Event

DETAILS

ATTRIBUTES

CONTENT

Attribute Values

eventType

ATTRIBUTES_MODIFIED

No value previously set

filename

6320498487869637

newSize

1119

No value previously set

oldSize

1119

No value previously set

path

./

reporting.task.transaction.id

fc9fad99-89f0-4978-a3aa-571bb8b8851b



uuid

62d2161f-0b2a-4b2a-a552-ab617bef3811


Replaying a FlowFile

A DFM may need to inspect a FlowFile's content at some point in the dataflow to ensure that it is being processed as expected. And if it is not being processed properly, the DFM may need to make adjustments to the dataflow and replay the FlowFile again. The Content tab of the View Details dialog window is where the DFM can do these things. The Content tab shows information about the FlowFile's content, such as its location in the Content Repository and its size. In addition, it is here that the user may click the "Download" button to download a copy of the FlowFile's content as it existed at this point in the flow. The user may also click the "Submit" button to replay the FlowFile at this point in the flow. Upon clicking "Submit", the FlowFile is sent to the connection feeding the component that produced this processing event.


Provenance Event

DETAILS	ATTRIBUTES	CONTENT
Input Claim Container default Section 918 Identifier 1469753924663-275350 Offset 108834 Size 1.1 KB <div>  DOWNLOAD  VIEW </div>		Output Claim Container default Section 918 Identifier 1469753924663-275350 Offset 108834 Size 1.1 KB <div>  DOWNLOAD </div>
Replay Connection Id 88970033-a406-33a2-b679-711d04de4a35		

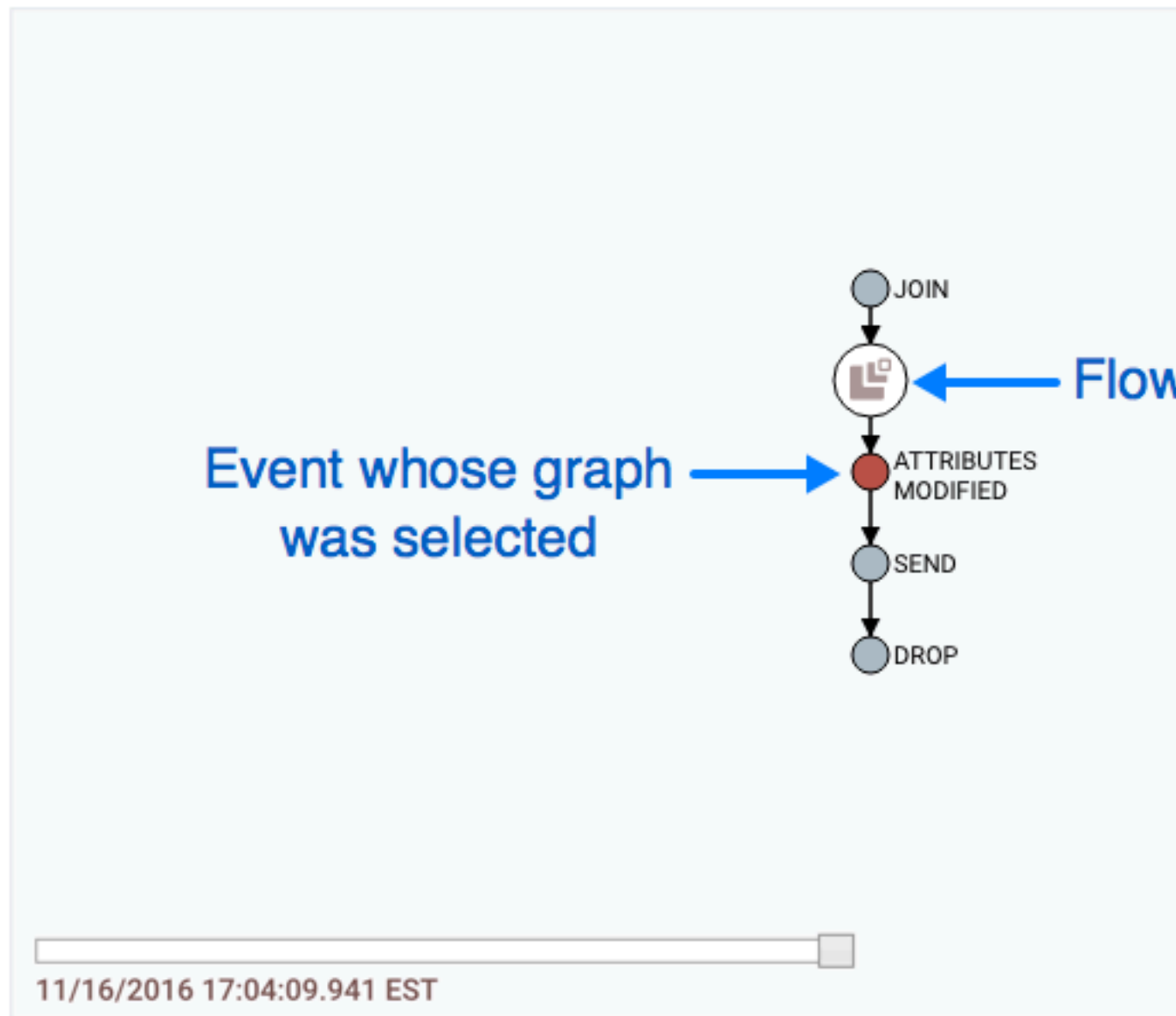
Viewing FlowFile Lineage

It is often useful to see a graphical representation of the lineage or path a FlowFile took within the dataflow. To see a FlowFile's lineage, click on the "Show Lineage" icon () in the far-right column of the Data Provenance table.



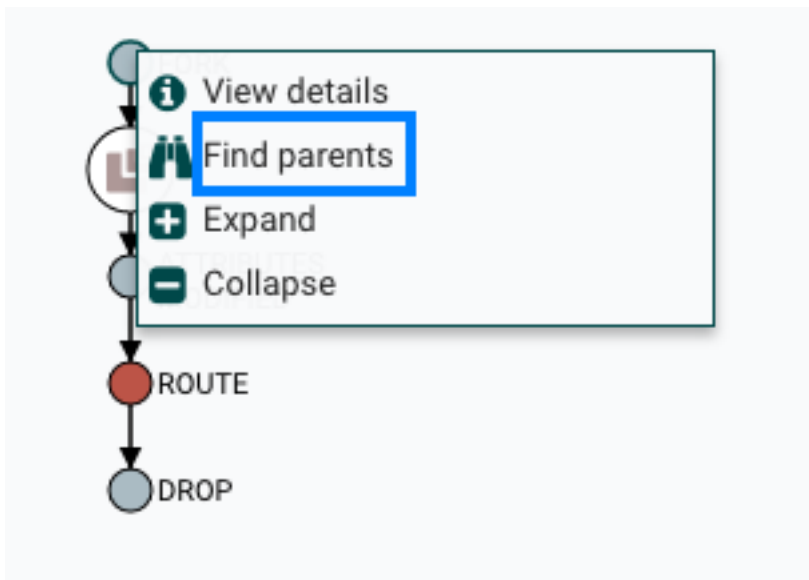
This opens a graph displaying the FlowFile () and the various processing events that have occurred. The selected event will be highlighted in red. It is possible to right-click or double-click on any event to see that event's details (see [Details of an Event](#)). To see how the lineage evolved over time, click the slider at the bottom-left of the window and move it to the left to see the state of the lineage at earlier stages in the dataflow.

NiFi Data Provenance

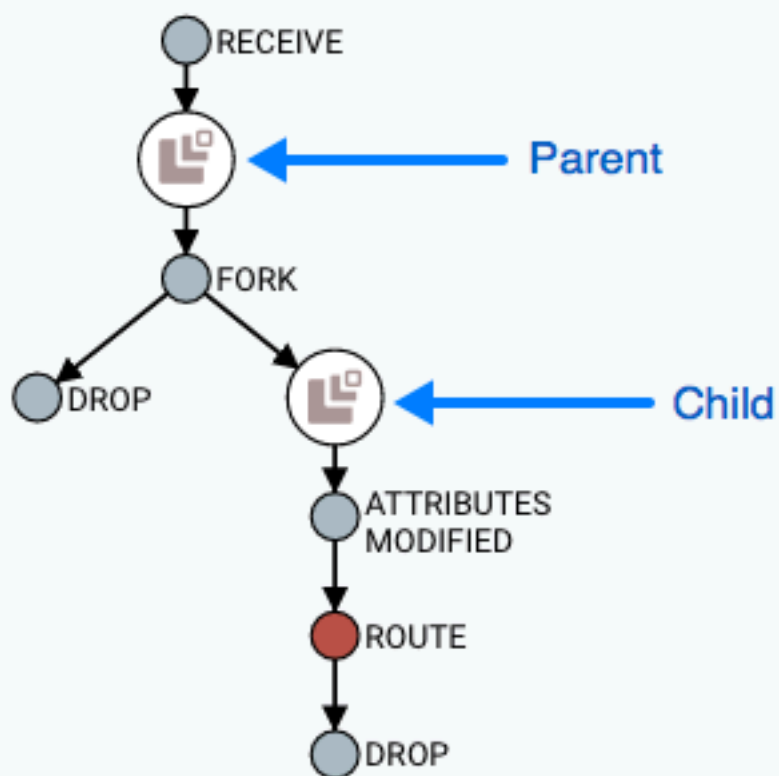


Find Parents

Sometimes, a user may need to track down the original FlowFile that another FlowFile was spawned from. For example, when a FORK or CLONE event occurs, NiFi keeps track of the parent FlowFile that produced other FlowFiles, and it is possible to find that parent FlowFile in the Lineage. Right-click on the event in the lineage graph and select "Find parents" from the context menu.

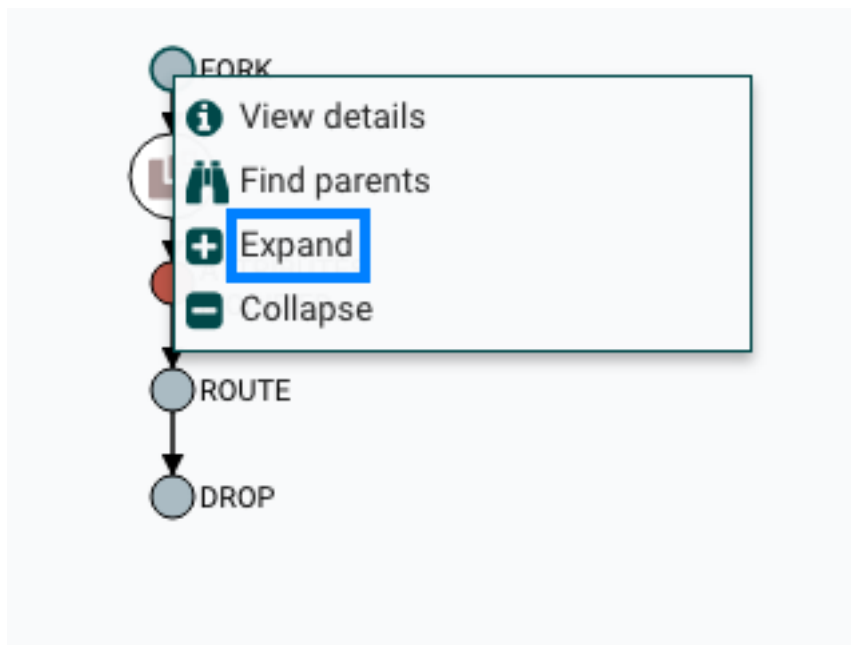


Once "Find parents" is selected, the graph is re-drawn to show the parent FlowFile and its lineage as well as the child and its lineage.

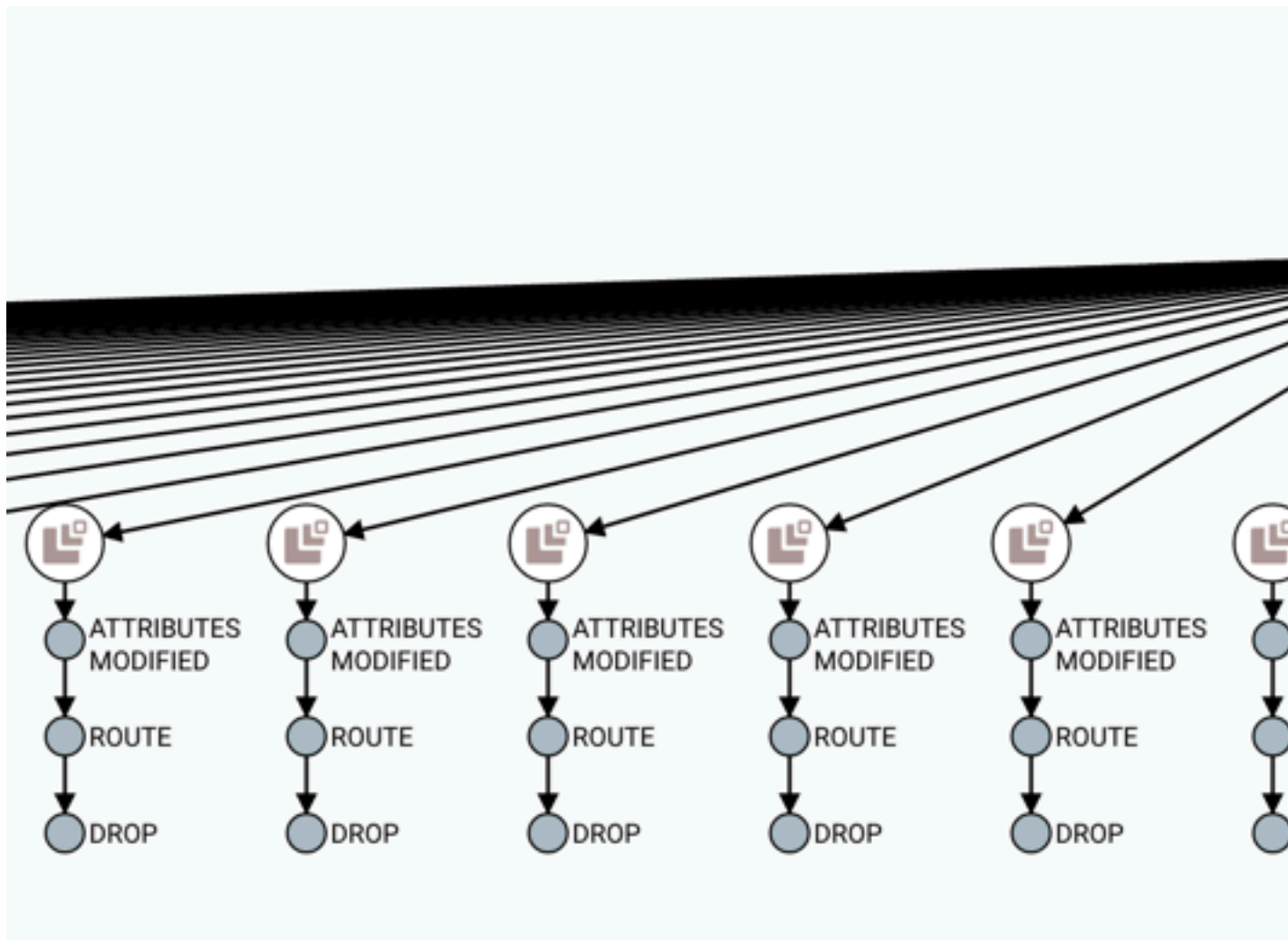


Expanding an Event

In the same way that it is useful to find a parent FlowFile, the user may also want to determine what children were spawned from a given FlowFile. To do this, right-click on the event in the lineage graph and select "Expand" from the context menu.



Once "Expand" is selected, the graph is re-drawn to show the children and their lineage.



Write Ahead Provenance Repository

By default, the Provenance Repository is implemented in a Persistent Provenance configuration. In Apache NiFi 1.2.0, the Write Ahead configuration was introduced to provide the same capabilities as Persistent Provenance, but with far better performance. Migrating to the Write Ahead configuration is easy to accomplish. Simply change the setting for the `nifi.provenance.repository.implementation` system property in the `nifi.properties` file from the default value of `org.apache.nifi.provenance.PersistentProvenanceRepository` to `org.apache.nifi.provenance.WriteAheadProvenanceRepository` and restart NiFi.

However, to increase the chances of a successful migration consider the following factors and recommended actions.

Backwards Compatibility

The `WriteAheadProvenanceRepository` can use the Provenance data stored by the `PersistentProvenanceRepository`. However, the `PersistentProvenanceRepository` may not be able to read the data written by the `WriteAheadProvenanceRepository`. Therefore, once the Provenance Repository is changed to use the `WriteAheadProvenanceRepository`, it cannot be changed back to the `PersistentProvenanceRepository` without first deleting the data in the Provenance Repository. It is therefore recommended that before changing the implementation to Write Ahead, ensure your version of NiFi is stable, in case an issue arises that requires the need to roll back to a previous version of NiFi that did not support the `WriteAheadProvenanceRepository`.

Older Existing NiFi Version

If you are upgrading from an older version of NiFi to 1.2.0 or later, it is recommended that you do not change the provenance configuration to Write Ahead until you confirm your flows and environment are stable in 1.2.0 first. This reduces the number of variables in your upgrade and can simplify the debugging process if any issues arise.

Bootstrap.conf

While better performance is achieved with the G1 garbage collector, Java 8 bugs may surface more frequently in the Write Ahead configuration. It is recommended that the following line is commented out in the `bootstrap.conf` file in the `conf` directory:

```
java.arg.13=-XX:+UseG1GC
```

System Properties

Many of the same system properties are supported by both the Persistent and Write Ahead configurations, however the default values have been chosen for a Persistent Provenance configuration. The following exceptions and recommendations should be noted when changing to a Write Ahead configuration:

- `nifi.provenance.repository.journal.count` is not relevant to a Write Ahead configuration
- `nifi.provenance.repository.concurrent.merge.threads` and `nifi.provenance.repository.warm.cache.frequency` are new properties. The default values of 2 for threads and blank for frequency (i.e. disabled) should remain for most installations.
- Change the settings for `nifi.provenance.repository.max.storage.time` (default value of 24 hours) and `nifi.provenance.repository.max.storage.size` (default value of 1 GB) to values more suitable for your production environment
- Change `nifi.provenance.repository.index.shard.size` from the default value of 500 MB to 4 GB
- Change `nifi.provenance.repository.index.threads` from the default value of 2 to either 4 or 8 as the Write Ahead repository enables this to scale better
- If processing a high volume of events, change `nifi.provenance.repository.rollover.time` from a default of 30 secs to 1 min and `nifi.provenance.repository.rollover.size` from the default of 100 MB to 1 GB

Once these property changes have been made, restart NiFi.

Note: Detailed descriptions for each of these properties can be found in [System Properties](#).

Encrypted Provenance Considerations

The above migration recommendations for `WriteAheadProvenanceRepository` also apply to the encrypted version of the configuration, `EncryptedWriteAheadProvenanceRepository`.

The next section has more information about implementing an Encrypted Provenance Repository.

Encrypted Provenance Repository

While OS-level access control can offer some security over the provenance data written to the disk in a repository, there are scenarios where the data may be sensitive, compliance and regulatory requirements exist, or NiFi is running on hardware not under the direct control of the organization (cloud, etc.). In this case, the provenance repository allows for all data to be encrypted before being persisted to the disk.



Note: Experimental

This implementation is marked [experimental](#) as of Apache NiFi 1.10.0 (October 2019). The API, configuration, and internal behavior may change without warning, and such changes may occur during a minor release. Use at your own risk.



Note: Performance

The current implementation of the encrypted provenance repository intercepts the record writer and reader of `WriteAheadProvenanceRepository`, which offers significant performance improvements over the legacy `PersistentProvenanceRepository` and uses the AES/GCM algorithm, which is fairly performant on commodity hardware. In most scenarios, the added cost will not be significant (unnoticeable on a flow with hundreds of provenance events per second, moderately noticeable on a flow with thousands - tens of thousands of events per second). However, administrators should perform their own risk assessment and performance analysis and decide how to move forward. Switching back and forth between encrypted/unencrypted implementations is not recommended at this time.

What is it?

The `EncryptedWriteAheadProvenanceRepository` is a new implementation of the provenance repository which encrypts all event record information before it is written to the repository. This allows for storage on systems where OS-level access controls are not sufficient to protect the data while still allowing querying and access to the data through the NiFi UI/API.

How does it work?

The `WriteAheadProvenanceRepository` was introduced in NiFi 1.2.0 and provided a refactored and much faster provenance repository implementation than the previous `PersistentProvenanceRepository`. The encrypted version wraps that implementation with a record writer and reader which encrypt and decrypt the serialized bytes respectively.

The fully qualified class `org.apache.nifi.provenance.EncryptedWriteAheadProvenanceRepository` is specified as the provenance repository implementation in `nifi.properties` as the value of `nifi.provenance.repository.implementation`. In addition, [new properties](#) must be populated to allow successful initialization.

StaticKeyProvider

The `StaticKeyProvider` implementation defines keys directly in `nifi.properties`. Individual keys are provided in hexadecimal encoding. The keys can also be encrypted like any other sensitive property in `nifi.properties` using the `./encrypt-config.sh` tool in the NiFi Toolkit.

The following configuration section would result in a key provider with two available keys, "Key1" (active) and "AnotherKey".

```
nifi.provenance.repository.encryption.key.provider.implementation=org.apache.nifi.security.kms.StaticKeyProvider
```

```
nifi.provenance.repository.encryption.key.id=Key1
nifi.provenance.repository.encryption.key=0123456789ABCDEFFEDCBA987654321
00123456789ABCDEFFEDCBA9876543210
nifi.provenance.repository.encryption.key.id.AnotherKey=0101010101010101
0101010101010101010101010101010101010101010101010101010101010101
```

FileBasedKeyProvider

The FileBasedKeyProvider implementation reads from an encrypted definition file of the format:

```
key1=NGCpDpxBZNN0DBodz0p1SdbTjC2FG5kp1pCmdUKJlxxtcMSo6GC4fMlTyy1mPeKOxzLut3D
RX+51j6PC05SznA==
key2=GYxPbMMDbnraXs09eGJudAM5jTvVYp05XtImkAg4JY4rIbmHOiVUUI6OeOf7ZW+hH42jt
PgNW9pSkkQ9HWY/vQ==
key3=SFellxuz7J89Y/IQ7YbJPOL0/YKZRFL/VUxJgEHxxlXpd/8ELA7wwN59K1KTr3BURCcFP5Y
GmwrSKfr4OE4Vlg==
key4=kZprfcTSTH69UuOU3jMkZfrtiVR/eqWmmbdku3bQcUJ/+UToecNB51zOVEMBChyEXppyX
XC35Wa6GEXFK6PMKw==
key5=c6FzfnKm7UR7xqI2NFpZ+fEKBfSU7+1NvRw+XWQ9U39MONWqk5gvoyOCdFR1kUgeg46jrN5
dGXk13sRqE0GETQ==
```

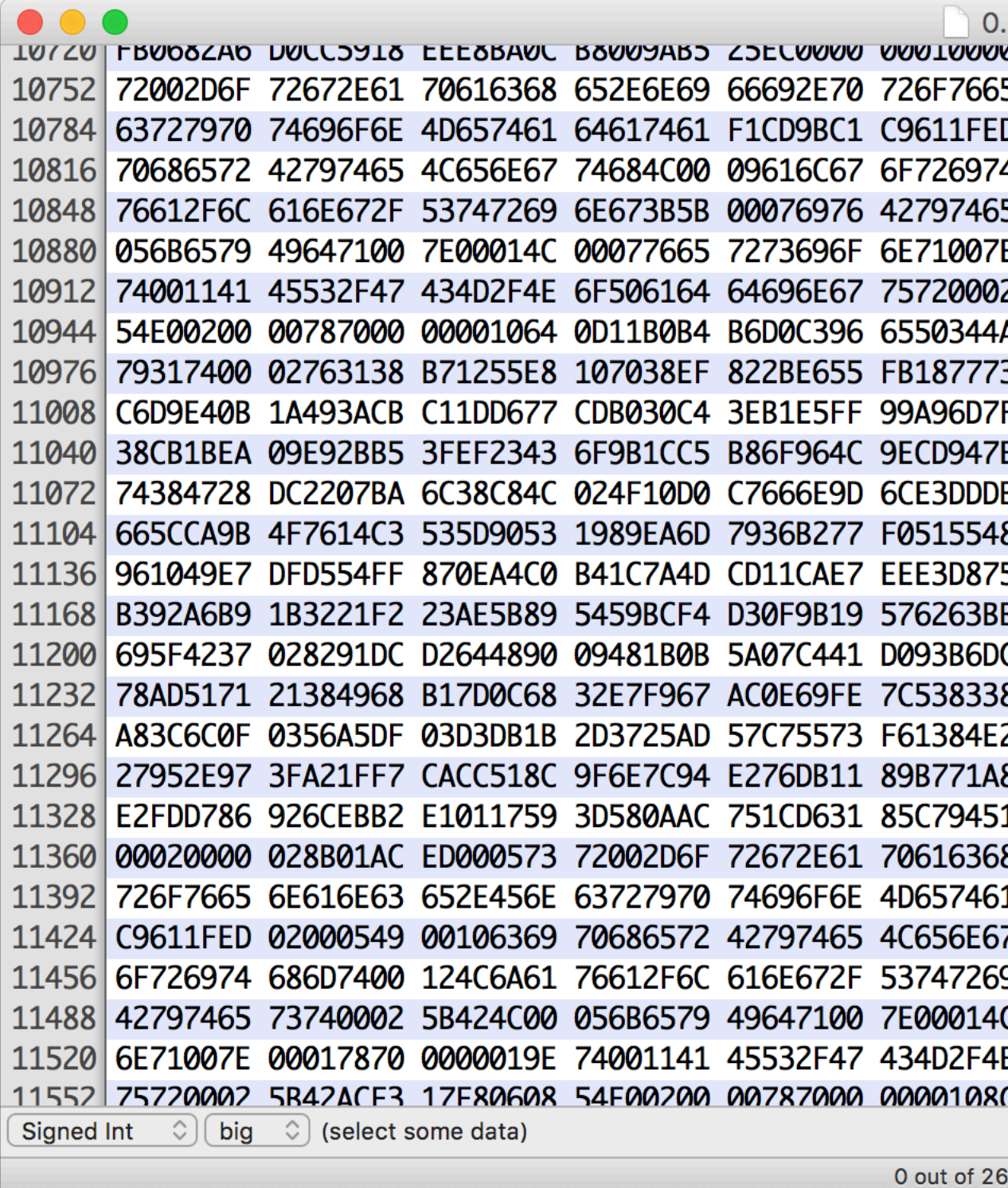
Each line defines a key ID and then the Base64-encoded cipher text of a 16 byte IV and wrapped AES-128, AES-192, or AES-256 key depending on the JCE policies available. The individual keys are wrapped by AES/GCM encryption using the master key defined by `nifi.bootstrap.sensitive.key` in `conf/bootstrap.conf`.

Key Rotation

Simply update `nifi.properties` to reference a new key ID in `nifi.provenance.repository.encryption.key.id`. Previously-encrypted events can still be decrypted as long as that key is still available in the key definition file or `nifi.provenance.repository.encryption.key.id.<OldKeyID>` as the key ID is serialized alongside the encrypted record.

Writing and Reading Event Records

Once the repository is initialized, all provenance event record write operations are serialized according to the configured schema writer (`EventIdFirstSchemaRecordWriter` by default for `WriteAheadProvenanceRepository`) to a `byte[]`. Those bytes are then encrypted using an implementation of `ProvenanceEventEncryptor` (the only current implementation is `AES/GCM/NoPadding`) and the encryption metadata (`keyId`, `algorithm`, `version`, `IV`) is serialized and prepended. The complete `byte[]` is then written to the repository on disk as normal.



10720	FB0682A6	D0CC5918	EEE8BA0C	B8009AB5	25EC0000	00010000	00010000
10752	72002D6F	72672E61	70616368	652E6E69	66692E70	726F7665	726F7665
10784	63727970	74696F6E	4D657461	64617461	F1CD9BC1	C9611FED	C9611FED
10816	70686572	42797465	4C656E67	74684C00	09616C67	6F726974	6F726974
10848	76612F6C	616E672F	53747269	6E673B5B	00076976	42797465	42797465
10880	056B6579	49647100	7E00014C	00077665	7273696F	6E71007E	6E71007E
10912	74001141	45532F47	434D2F4E	6F506164	64696E67	75720002	75720002
10944	54E00200	00787000	00001064	0D11B0B4	B6D0C396	6550344A	6550344A
10976	79317400	02763138	B71255E8	107038EF	822BE655	FB187773	FB187773
11008	C6D9E40B	1A493ACB	C11DD677	CDB030C4	3EB1E5FF	99A96D7F	99A96D7F
11040	38CB1BEA	09E92BB5	3FEF2343	6F9B1CC5	B86F964C	9ECD947E	9ECD947E
11072	74384728	DC2207BA	6C38C84C	024F10D0	C7666E9D	6CE3DDDE	6CE3DDDE
11104	665CCA9B	4F7614C3	535D9053	1989EA6D	7936B277	F0515548	F0515548
11136	961049E7	DFD554FF	870EA4C0	B41C7A4D	CD11CAE7	EEE3D875	EEE3D875
11168	B392A6B9	1B3221F2	23AE5B89	5459BCF4	D30F9B19	576263BE	576263BE
11200	695F4237	028291DC	D2644890	09481B0B	5A07C441	D093B6D0	D093B6D0
11232	78AD5171	21384968	B17D0C68	32E7F967	AC0E69FE	7C538338	7C538338
11264	A83C6C0F	0356A5DF	03D3DB1B	2D3725AD	57C75573	F61384E2	F61384E2
11296	27952E97	3FA21FF7	CACC518C	9F6E7C94	E276DB11	89B771A8	89B771A8
11328	E2FDD786	926CEBB2	E1011759	3D580AAC	751CD631	85C79451	85C79451
11360	00020000	028B01AC	ED000573	72002D6F	72672E61	70616368	70616368
11392	726F7665	6E616E63	652E456E	63727970	74696F6E	4D657461	4D657461
11424	C9611FED	02000549	00106369	70686572	42797465	4C656E67	4C656E67
11456	6F726974	686D7400	124C6A61	76612F6C	616E672F	53747269	53747269
11488	42797465	73740002	5B424C00	056B6579	49647100	7E00014C	7E00014C
11520	6E71007E	00017870	0000019E	74001141	45532F47	434D2F4E	434D2F4E
11552	75720002	5B42ACE3	17F80608	54F00200	00787000	00001080	00001080

Signed Int big (select some data)

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On record read, the process is reversed. The encryption metadata is parsed and used to decrypt the serialized bytes, which are then deserialized into a `ProvenanceEventRecord` object. The delegation to the normal schema record writer/reader allows for "random-access" (i.e. immediate seek without decryption of unnecessary records).

Within the NiFi UI/API, there is no detectable difference between an encrypted and unencrypted provenance repository. The Provenance Query operations work as expected with no change to the process.

Potential Issues



Note: Switching Implementations

When switching between implementation "families" (i.e. `VolatileProvenanceRepository` or `PersistentProvenanceRepository` to `EncryptedWriteAheadProvenanceRepository`), the existing repository must be cleared from the file system before starting NiFi. A terminal command like `localhost:$NIFI_HOME $ rm -rf provenance_repository/` is sufficient.

- Switching between unencrypted and encrypted repositories
 - If a user has an existing repository (`WriteAheadProvenanceRepository` only - not `PersistentProvenanceRepository`) that is not encrypted and switches their configuration to use an encrypted repository, the application writes an error to the log but starts up. However, previous events are not accessible through the provenance query interface and new events will overwrite the existing events. The same behavior occurs if a user switches from an encrypted repository to an unencrypted repository. Automatic roll-over is a future effort ([NIFI-3722](#)) but NiFi is not intended for long-term storage of provenance events so the impact should be minimal. There are two scenarios for roll-over:
 - Encrypted # unencrypted - if the previous repository implementation was encrypted, these events should be handled seamlessly as long as the key provider available still has the keys used to encrypt the events (see [Key Rotation](#))
 - Unencrypted # encrypted - if the previous repository implementation was unencrypted, these events should be handled seamlessly as the previously recorded events simply need to be read with a plaintext schema record reader and then written back with the encrypted record writer
 - There is also a future effort to provide a standalone tool in NiFi Toolkit to encrypt/decrypt an existing provenance repository to make the transition easier. The translation process could take a long time depending on the size of the existing repository, and being able to perform this task outside of application startup would be valuable ([NIFI-3723](#)).
- Multiple repositories - No additional effort or testing has been applied to multiple repositories at this time. It is possible/likely issues will occur with repositories on different physical devices. There is no option to provide a heterogeneous environment (i.e. one encrypted, one plaintext repository).
- Corruption - when a disk is filled or corrupted, there have been reported issues with the repository becoming corrupted and recovery steps are necessary. This is likely to continue to be an issue with the encrypted repository, although still limited in scope to individual records (i.e. an entire repository file won't be irrecoverable due to the encryption).

Encrypted Content Repository

While OS-level access control can offer some security over the flowfile content data written to the disk in a repository, there are scenarios where the data may be sensitive, compliance and regulatory requirements exist, or NiFi is running on hardware not under the direct control of the organization (cloud, etc.). In this case, the content repository allows for all data to be encrypted before being persisted to the disk. For more information on the internal workings of the content repository, see [NiFi In-Depth - Content Repository..](#)

What is it?

The `EncryptedFileSystemRepository` is a new implementation of the content repository which encrypts all content data before it is written to the repository. This allows for storage on systems where OS-level access controls are not sufficient to protect the data while still allowing querying and access to the data through the NiFi UI/API.

How does it work?

The `FileSystemRepository` was introduced in NiFi 0.2.1 and provided the only persistent content repository implementation. The encrypted version wraps that implementation with functionality to return to the Session (usually `StandardProcessSession`) a special `OutputStream/InputStream` which encrypt and decrypt the serialized bytes respectively. This allows all components to continue interacting with the content repository interface in the same way as before and continue operating on content data in a streaming manner, without requiring any changes to handle the data protection.

The fully qualified class `org.apache.nifi.content.EncryptedFileSystemRepository` is specified as the content repository implementation in `nifi.properties` as the value of `nifi.content.repository.implementation`. In addition, [new properties](#) must be populated to allow successful initialization.

StaticKeyProvider

The `StaticKeyProvider` implementation defines keys directly in `nifi.properties`. Individual keys are provided in hexadecimal encoding. The keys can also be encrypted like any other sensitive property in `nifi.properties` using the `./encrypt-config.sh` tool in the NiFi Toolkit.

The following configuration section would result in a key provider with two available keys, "Key1" (active) and "AnotherKey".

```
nifi.content.repository.encryption.key.provider.implementation=org.apache.ni
fi.security.kms.StaticKeyProvider
nifi.content.repository.encryption.key.id=Key1
nifi.content.repository.encryption.key=0123456789ABCDEFEDCBA98765432100123
456789ABCDEFEDCBA9876543210
nifi.content.repository.encryption.key.id.AnotherKey=01010101010101010101
01010101010101010101010101010101
```

FileBasedKeyProvider

The `FileBasedKeyProvider` implementation reads from an encrypted definition file of the format:

```
key1=NGCpDpXBZNN0DBodz0p1SdbTjC2FG5kp1pCmdUKJlxxtcMSo6GC4fMlTyy1mPeKOxzLut3D
RX+51j6PCO5SznA==
key2=GYxPbMMDbnraXs09eGJudAM5jTvVYp05XtImkAg4JY4rIbmHOiVUUI6OeOf7ZW+hH42jt
PgNW9pSkkQ9HWY/vQ==
key3=SFellxuz7J89Y/IQ7YbJPOL0/YKZRFL/VUxJgEHxxlXpd/8ELA7wwN59K1KTr3BURCcFP5Y
GmwrSKfr4OE4Vlg==
key4=kZprfcTSTH69UuOU3jMkZfrtiVR/eqWmmbdku3bQcUJ/+UToecNB5lzOVEMBChyEXppyX
XC35Wa6GEXFK6PMKw==
key5=c6FzfnKm7UR7xqI2NFpZ+fEKBfSU7+1NvRw+XWQ9U39MONWqk5gvoyOCdFR1kUgeg46jrN5
dGXk13sRqE0GETQ==
```

Each line defines a key ID and then the Base64-encoded cipher text of a 16 byte IV and wrapped AES-128, AES-192, or AES-256 key depending on the JCE policies available. The individual keys are wrapped by AES/GCM encryption using the master key defined by `nifi.bootstrap.sensitive.key` in `conf/bootstrap.conf`.

Data Protection vs. Key Protection

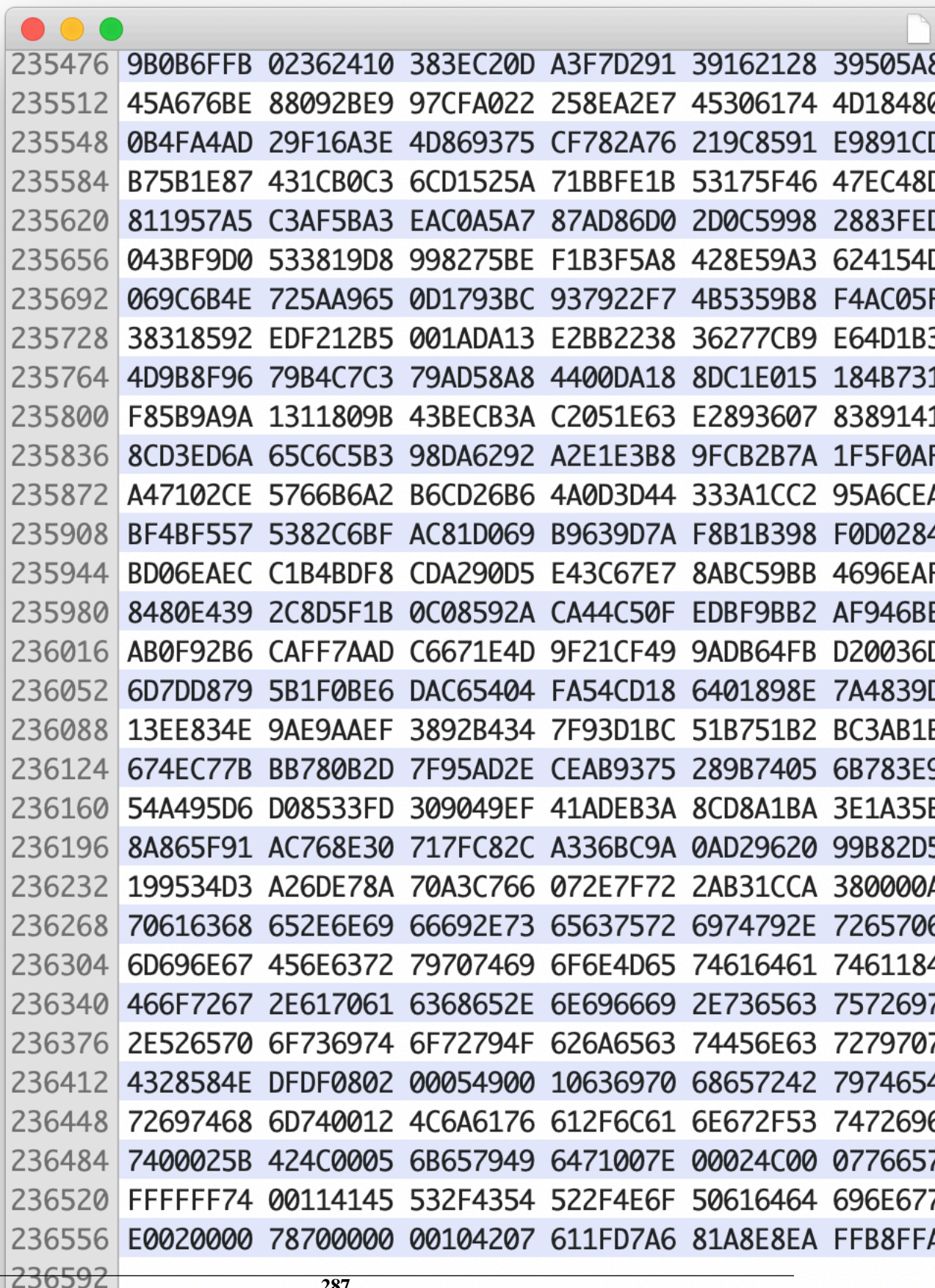
Even though the flowfile content is encrypted using AES/CTR to handle streaming data, if using the Config Encrypt Tool or `FileBasedKeyProvider`, those keys will be protected using AES/GCM to provide authenticated encryption over the key material.

Key Rotation

Simply update `nifi.properties` to reference a new key ID in `nifi.content.repository.encryption.key.id`. Previously-encrypted content claims can still be decrypted as long as that key is still available in the key definition file or `nifi.content.repository.encryption.key.id.<OldKeyID>` as the key ID is serialized alongside the encrypted content.

Writing and Reading Content Claims

Once the repository is initialized, all content claim write operations are serialized using `RepositoryObjectStreamEncryptor` (the only currently existing implementation is `RepositoryObjectAESCTREncryptor`) to an `OutputStream`. The actual implementation is `EncryptedContentRepositoryOutputStream`, which encrypts the data written by the component via `StandardProcessSession` inline and the encryption metadata (`keyId`, `algorithm`, `version`, `IV`) is serialized and prepended. The complete `OutputStream` is then written to the repository on disk as normal.



235476	9B0B6FFB	02362410	383EC20D	A3F7D291	39162128	39505A8
235512	45A676BE	88092BE9	97CFA022	258EA2E7	45306174	4D18480
235548	0B4FA4AD	29F16A3E	4D869375	CF782A76	219C8591	E9891CD
235584	B75B1E87	431CB0C3	6CD1525A	71BBFE1B	53175F46	47EC48D
235620	811957A5	C3AF5BA3	EAC0A5A7	87AD86D0	2D0C5998	2883FED
235656	043BF9D0	533819D8	998275BE	F1B3F5A8	428E59A3	624154D
235692	069C6B4E	725AA965	0D1793BC	937922F7	4B5359B8	F4AC05F
235728	38318592	EDF212B5	001ADA13	E2BB2238	36277CB9	E64D1B3
235764	4D9B8F96	79B4C7C3	79AD58A8	4400DA18	8DC1E015	184B731
235800	F85B9A9A	1311809B	43BECB3A	C2051E63	E2893607	8389141
235836	8CD3ED6A	65C6C5B3	98DA6292	A2E1E3B8	9FCB2B7A	1F5F0AF
235872	A47102CE	5766B6A2	B6CD26B6	4A0D3D44	333A1CC2	95A6CEA
235908	BF4BF557	5382C6BF	AC81D069	B9639D7A	F8B1B398	F0D0284
235944	BD06EAE	C1B4BDF8	CDA290D5	E43C67E7	8ABC59BB	4696EAF
235980	8480E439	2C8D5F1B	0C08592A	CA44C50F	EDBF9BB2	AF946BE
236016	AB0F92B6	CAFF7AAD	C6671E4D	9F21CF49	9ADB64FB	D20036D
236052	6D7DD879	5B1F0BE6	DAC65404	FA54CD18	6401898E	7A4839D
236088	13EE834E	9AE9AAEF	3892B434	7F93D1BC	51B751B2	BC3AB1E
236124	674EC77B	BB780B2D	7F95AD2E	CEAB9375	289B7405	6B783E9
236160	54A495D6	D08533FD	309049EF	41ADEB3A	8CD8A1BA	3E1A35E
236196	8A865F91	AC768E30	717FC82C	A336BC9A	0AD29620	99B82D5
236232	199534D3	A26DE78A	70A3C766	072E7F72	2AB31CCA	380000A
236268	70616368	652E6E69	66692E73	65637572	6974792E	7265706
236304	6D696E67	456E6372	79707469	6F6E4D65	74616461	7461184
236340	466F7267	2E617061	6368652E	6E696669	2E736563	7572697
236376	2E526570	6F736974	6F72794F	626A6563	74456E63	7279707
236412	4328584E	DFDF0802	00054900	10636970	68657242	7974654
236448	72697468	6D740012	4C6A6176	612F6C61	6E672F53	7472696
236484	7400025B	424C0005	6B657949	6471007E	00024C00	0776657
236520	FFFFFF74	00114145	532F4354	522F4E6F	50616464	696E677
236556	E0020000	78700000	00104207	611FD7A6	81A8E8EA	FFB8FFA
236592						

On content claim read, the process is reversed. The encryption metadata (RepositoryObjectEncryptionMetadata) is parsed and used to decrypt the serialized bytes, which are then deserialized into a CipherInputStream object. The delegation to the normal repository file system interaction allows for "random-access" (i.e. immediate seek without decryption of unnecessary content claims).

Within the NiFi UI/API, there is no detectable difference between an encrypted and unencrypted content repository. The Provenance Query operations to view content work as expected with no change to the process.

Potential Issues



Note: Switching Implementations

When switching between implementation "families" (i.e. VolatileContentRepository or FileSystemRepository to EncryptedFileSystemRepository), the existing repository must be cleared from the file system before starting NiFi. A terminal command like `localhost:$NIFI_HOME $ rm -rf content_repository/` is sufficient.

- Switching between unencrypted and encrypted repositories
 - If a user has an existing repository (FileSystemRepository) that is not encrypted and switches their configuration to use an encrypted repository, the application writes an error to the log but starts up. However, previous content claims are not accessible through the provenance query interface and new content claims will overwrite the existing claims. The same behavior occurs if a user switches from an encrypted repository to an unencrypted repository. Automatic roll-over is a future effort (<https://issues.apache.org/jira/browse/NIFI-6783>) but NiFi is not intended for long-term storage of content claims so the impact should be minimal. There are two scenarios for roll-over:
 - Encrypted # unencrypted - if the previous repository implementation was encrypted, these claims should be handled seamlessly as long as the key provider available still has the keys used to encrypt the claims (see [Key Rotation](#)).
 - Unencrypted # encrypted - if the previous repository implementation was unencrypted, these claims should be handled seamlessly as the previously written claims simply need to be read with a plaintext InputStream and then be written back with the EncryptedContentRepositoryOutputStream
 - There is also a future effort to provide a standalone tool in NiFi Toolkit to encrypt/decrypt an existing content repository to make the transition easier. The translation process could take a long time depending on the size of the existing repository, and being able to perform this task outside of application startup would be valuable (<https://issues.apache.org/jira/browse/NIFI-6783>).
- Multiple repositories - No additional effort or testing has been applied to multiple repositories at this time. It is possible/likely issues will occur with repositories on different physical devices. There is no option to provide a heterogeneous environment (i.e. one encrypted, one plaintext repository).
- Corruption - when a disk is filled or corrupted, there have been reported issues with the repository becoming corrupted and recovery steps are necessary. This is likely to continue to be an issue with the encrypted repository, although still limited in scope to individual claims (i.e. an entire repository file won't be irrecoverable due to the encryption). Some testing has been performed on scenarios where disk space is exhausted. While the flow can no longer write additional content claims to the repository in that case, the NiFi application continues to function properly, and successfully written content claims are still available via the Provenance Query operations. Stopping NiFi and removing the content repository (or moving it to a larger disk) resolves the issue.

Encrypted FlowFile Repository

While OS-level access control can offer some security over the flowfile attribute and content claim data written to the disk in a repository, there are scenarios where the data may be sensitive, compliance and regulatory requirements exist, or NiFi is running on hardware not under the direct control of the organization (cloud, etc.). In this case, the flowfile repository allows for all data to be encrypted before being persisted to the disk.

What is it?

The `EncryptedSequentialAccessWriteAheadLog` is a new implementation of the flowfile write-ahead log which encrypts all flowfile attribute data before it is written to the repository. This allows for storage on systems where OS-level access controls are not sufficient to protect the data while still allowing querying and access to the data through the NiFi UI/API.

How does it work?

The SequentialAccessWriteAheadLog was introduced in NiFi 1.6.0 and provided a faster flowfile repository implementation. The encrypted version wraps that implementation with functionality to transparently encrypt and decrypt the serialized RepositoryRecord objects during file system interaction. During all writes to disk (swapping, snapshotting, journaling, and checkpointing), the flowfile containers are serialized to bytes based on a schema, and this serialized form is encrypted before writing. This allows the snapshot handler to continue interacting with the flowfile repository interface in the same way as before and continue operating on flowfile data in a random access manner, without requiring any changes to handle the data protection.

The fully qualified class `org.apache.nifi.wali.EncryptedSequentialAccessWriteAheadLog` is specified as the flowfile repository write-ahead log implementation in `nifi.properties` as the value of `nifi.flowfile.repository.wal.implementation`. In addition, [new properties](#) must be populated to allow successful initialization.

StaticKeyProvider

The StaticKeyProvider implementation defines keys directly in nifi.properties. Individual keys are provided in hexadecimal encoding. The keys can also be encrypted like any other sensitive property in nifi.properties using the `./encrypt-config.sh` tool in the NiFi Toolkit.

The following configuration section would result in a key provider with two available keys, "Key1" (active) and "AnotherKey".

```
nifi.flowfile.repository.encryption.key.provider.implementation=org.apache.nifi.security.kms.StaticKeyProvider
nifi.flowfile.repository.encryption.key.id=Key1
nifi.flowfile.repository.encryption.key=0123456789ABCDEFFEDCBA98765432100123456789ABCDEFFEDCBA9876543210
nifi.flowfile.repository.encryption.key.id.AnotherKey=0101010101010101010101010101010101010101010101010101010101010101
```

FileBasedKeyProvider

The FileBasedKeyProvider implementation reads from an encrypted definition file of the format:

```
key1=NGCpDpxBZNN0DBodz0p1SDbTjC2FG5kplpCmdUKJlxxtcMSo6GC4fMlTyy1mPeKOxzLut3D
RX+51j6PCO5SznA==
key2=GYxPbMMDbnraXs09eGJudAM5jTvVYp05XtImkAg4JY4rIbmHOiVUUI6OeOf7ZW+hH42jt
PgNW9pSkkQ9HWY/vQ==
key3=SFellxuz7J89Y/IQ7YbJPOL0/YKZRFL/VUxJgEHxxlXpd/8ELA7wwN59KlKTr3BURCcFP5Y
GmwrSKfr4OE4Vlg==
key4=kZprfcTSTH69UuOU3jMkZftrtIVR/eqWmmbdku3bQcUJ/+UToecNB5lzOVEMBChyEXppyX
XC35Wa6GEXFK6PMKw==
key5=c6FzfnKm7UR7xqI2NFpZ+fEKBfSU7+1NvRw+XWQ9U39MONWqk5gvoyOCdFR1kUgeg46jrN5
dGXk13sRqE0GETO==
```

Each line defines a key ID and then the Base64-encoded cipher text of a 16 byte IV and wrapped AES-128, AES-192, or AES-256 key depending on the JCE policies available. The individual keys are wrapped by AES/GCM encryption using the master key defined by `nifi.bootstrap.sensitive.key` in `conf/bootstrap.conf`.

Key Rotation

Simply update `nifi.properties` to reference a new key ID in `nifi.flowfile.repository.encryption.key.id`. Previously-encrypted flowfile records can still be decrypted as long as that key is still available in the key definition file or `nifi.flowfile.repository.encryption.key.id.<OldKeyID>` as the key ID is serialized alongside the encrypted record.

Writing and Reading FlowFiles

Once the repository is initialized, all flowfile record write operations are serialized using `RepositoryObjectBlockEncryptor` (the only currently existing implementation is `RepositoryObjectAESGCMEncryptor`) to the provided `DataOutputStream`. The original stream is swapped with a temporary wrapped stream, which encrypts the data written by the wrapped serializer/deserializer via `EncryptedSchemaRepositoryRecordSerde` inline and the encryption metadata (`keyId`, `algorithm`, `version`, `IV`, `cipherByteLength`) is serialized and prepended. The complete length and encrypted bytes are then written to the original `DataOutputStream` on disk as normal.

11748	0A695616	FDACCB9A	BB1242F5	258EBAA0	207B1D86	2A620000
11792	2E6E6966	692E7365	63757269	74792E72	65706F73	69746F72
11836	696F6E4D	65746164	61746136	C69C49D5	97A81F02	00007872
11880	63757269	74792E72	65706F73	69746F72	792E5265	706F7369
11924	4D657461	64617461	9F432858	4EDFDF08	02000549	00106369
11968	6F726974	686D7400	124C6A61	76612F6C	616E672F	53747269
12012	056B6579	49647100	7E00024C	00077665	7273696F	6E71007E
12056	6F506164	64696E67	75720002	5B42ACF3	17F80608	54E00200
12100	992A7F74	00024B31	74000276	3141E990	4557ECC2	58154479
12144	6BA62EAB	7D1179F5	A39DEF5A	B9BCF174	4379AE7D	32E7F183
12188	CF84BF19	0EAFA3C5	14B6BF83	CF067577	885C34C2	02090697
12232	9766E76C	A4A0D0A7	0D2808A1	B6A11DE9	D426D8C3	001112A3
12276	1999C031	D13125B2	57A16737	24318CA6	A547FA98	12CB79E2
12320	A4DD0000	0224ACED	00057372	00416F72	672E6170	61636865
12364	69746F72	792E626C	6F636B2E	426C6F63	6B456E63	72797074
12408	00007872	00466F72	672E6170	61636865	2E6E6966	692E7365
12452	706F7369	746F7279	4F626A65	6374456E	63727970	74696F6E
12496	00106369	70686572	42797465	4C656E67	74684C00	09616C67
12540	53747269	6E673B5B	00076976	42797465	73740002	5B424C00
12584	6E71007E	00027870	000000D1	74001141	45532F47	434D2F4E
12628	54E00200	00787000	000010C6	8ADF06C7	E564EF65	1E451B2E
12672	24A497A1	FB67CF78	36DA4CF7	9CC2E4EB	2A7438C2	50F415AE
12716	B120656D	388407BD	CCA28585	B66F26BA	370A3FED	5488EB94
12760	36A9219C	62835DCA	AE5DD2EA	79069A62	2222D571	B86DD755
12804	049D7B3B	A5C0214A	F6E5098A	703B4022	0F8BFBE1	BCC9C35E
12848	4B0EE409	9B926647	1D8723F0	3744A280	6824FE32	05AA2630

Signed Int le, hex 0xEDAC

On flowfile record read, the process is reversed. The encryption metadata (`RepositoryObjectEncryptionMetadata`) is parsed and used to decrypt the serialized bytes, which are then deserialized into a `DataInputStream` object.

During swaps and recoveries, the flowfile records are deserialized and reserialized, so if the active key has been changed, the flowfile records will be re-encrypted with the new active key.

Within the NiFi UI/API, there is no detectable difference between an encrypted and unencrypted flowfile repository. All framework interactions with flowfiles work as expected with no change to the process.

Potential Issues



Note: Switching Implementations

It is not recommended to switch between any implementation other than `SequentialAccessWriteAheadLog` and the `EncryptedSequentialAccessWriteAheadLog`. To migrate from a different provider, first migrate to the plaintext sequential log, allow NiFi to automatically recover the flowfiles, then stop NiFi and change the configuration to enable encryption. NiFi will automatically recover the plaintext flowfiles from the repository, and begin encrypting them on subsequent writes.

- Switching between unencrypted and encrypted repositories
 - If a user has an existing write-ahead repository (`WriteAheadFlowFileRepository`) that is not encrypted (uses the `SequentialAccessWriteAheadLog`) and switches their configuration to use an encrypted repository, the application handles this and all flowfile records will be recovered on startup. Future writes (including re-serialization of these same flowfiles) will be encrypted. If a user switches from an encrypted repository to an unencrypted repository, the flowfiles cannot be recovered, and it is recommended to delete the existing flowfile repository before switching in this direction. Automatic roll-over is a future effort (<https://issues.apache.org/jira/browse/NIFI-6994>) but NiFi is not intended for long-term storage of flowfile records so the impact should be minimal. There are two scenarios for roll-over:
 - Encrypted # unencrypted - if the previous repository implementation was encrypted, these records should be handled seamlessly as long as the key provider available still has the keys used to encrypt the claims (see [Key Rotation](#))
 - Unencrypted # encrypted - currently handled seamlessly for `SequentialAccessWriteAheadLog` but there are other initial implementations which could be handled
 - There is also a future effort to provide a standalone tool in NiFi Toolkit to encrypt/decrypt an existing flowfile repository to make the transition easier. The translation process could take a long time depending on the size of the existing repository, and being able to perform this task outside of application startup would be valuable (<https://issues.apache.org/jira/browse/NIFI-6994>).
 - Multiple repositories - No additional effort or testing has been applied to multiple repositories at this time. Current implementations of the flowfile repository allow only for one repository, though it can reside across multiple volumes and partitions. It is possible/likely issues will occur with repositories on different physical devices. There is no option to provide a heterogeneous environment (i.e. one encrypted, one plaintext partition/directory).
 - Corruption - when a disk is filled or corrupted, there have been reported issues with the repository becoming corrupted and recovery steps are necessary. This is likely to continue to be an issue with the encrypted repository, although still limited in scope to individual records (i.e. an entire repository file won't be irrecoverable due to the encryption). It is important for the continued operation of NiFi to ensure that the disk storing the flowfile repository does not run out of available space.

Experimental Warning

While all Apache licensed code is provided "on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied" (see <https://www.apache.org/licenses/LICENSE-2.0>), some features of Apache NiFi may be marked experimental. Experimental features may:

- have undergone less extensive testing than is normal for standard NiFi features
- interact with unstable external dependencies
- be subject to change (any exposed APIs should not be considered covered under the minor release backward compatibility guidelines of <https://semver.org>)
- potentially cause data loss
- not be directly supported by the community in the event issues arise

Every attempt is made to provide more detailed and specific information around the nature of the experimental warning on a per-feature basis. Questions around specific experimental features should be directed to the [Apache NiFi Developer Mailing List](#).

Other Management Features

In addition to the Summary Page, Data Provenance Page, Template Management Page, and Bulletin Board Page, there are other tools in the Global Menu (see [NiFi User Interface](#)) that are useful to the DFM. Select Flow Configuration History to view all the changes that have been made to the dataflow. The history can aid in troubleshooting, such as if a recent change to the dataflow has caused a problem and needs to be fixed. The DFM can see what changes have been made and adjust the flow as needed to fix the problem. While NiFi does not have an "undo" feature, the DFM can make new changes to the dataflow that will fix the problem.

Select Node Status History to view instance specific metrics from the last 24 hours or if the instance runs for less time, then since it has been started. The status history can help the DFM in troubleshooting performance issues and provides a general view on the health of the node. The status history includes information about the memory usage and disk usage among other things.

Two other tools in the Global Menu are Controller Settings and Users. The Controller Settings page provides the ability to change the name of the NiFi instance, add comments describing the NiFi instance, and set the maximum number of threads that are available to the application. It also provides tabs where DFMs may add and configure [Controller Services](#) and [Reporting Tasks](#). The Users page is used to manage user access, which is described in the [System Administrator's Guide](#).