NIFI-GUIDE

Objectives

- Core NiFi Terminologies
- More on FlowFiles of NiFi
- Processors and Connections
- Processor Category
- Types of Processors Available in NiFi - List of processors shared to be covered
- Connection configuration
- Processor Configuration Settings
- Processor Configuration Scheduling
- Processor Configuration Property
- Processor Relationship in NiFi
- Connection Queue & Back Pressure in NiFi

Introduction to Apache NiFi

- An Open Source Data Distribution
- Framework for managing complex dataflows
- Provides a way to move data from one place/system to another place / system
- Making transformations and routing decisions as necessary in real time streaming
- Scalable directed graphs of data routing, transformation, and system mediation logic
- Automate the flow of data between systems
- E.g.: JSON -> Database, FTP-> Hadoop, Kafka -> ElasticSearch, etc...
- Data could be anything like log files, HTTP request, XML, CSV, Audio, Video, Telemetry data
- Drag and drop interface
- Focus on configuration of processors (i.e. what matters only to the user)
- Scalable across a cluster of machines
- Guaranteed Delivery / No Data Loss
- Data Buffering / Back Pressure / Prioritization Queuing / Latency vs Throughput
- Templates for rapid development and deployment

Apache NiFi use cases:

What Apache NiFi is good at:

- Reliable and secure transfer of data between systems
- Delivery of data from sources to analytic platforms
- Enrichment and preparation of data:
  1. Conversion between formats
  2. Parsing
  3. Routing decisions

What Apache NiFi shouldn't be used for:

1. Distributed Computation
2. Complex Event processing
3. Joins, rolling windows, aggregates operations

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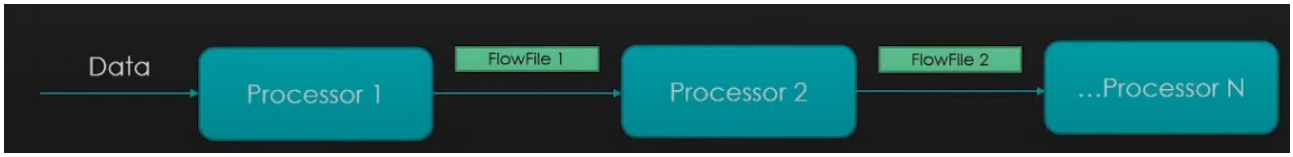
Core NiFi Terminologies: Flow File

- It's basically the data
- Comprised of two elements:
  - Content: the data itself
  - Attributes: Key value pairs associated with the data (creation date, filename, UUID etc....)
- Gets persisted to disk after creation
- A FlowFile represents each object moving through the system and for each one, NiFi keeps track of a map of key/value pair attribute strings and its associated content of zero or more bytes.

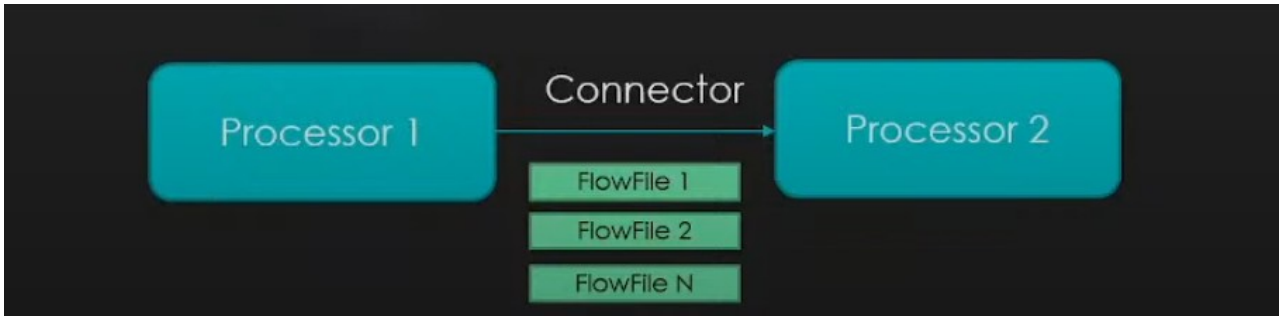
Core NiFi Terminologies: Processor

- Applies a set of transformations and rules to FlowFiles, to generate new FlowFiles
- Any processor can process any FlowFile
- Processors are passing FlowFile references to each other to advance the data processing
- They are all running in parallel (different threads)



Core NiFi Terminologies: Connector

- It's basically a queue of all the FlowFiles that are yet to be processed by Processor
- Defines rules about how FlowFiles are prioritized (which ones first, which ones not at all)
- Can define backpressure to avoid overflow in the system



All Connected: Flowfile, Processors, Connnectors

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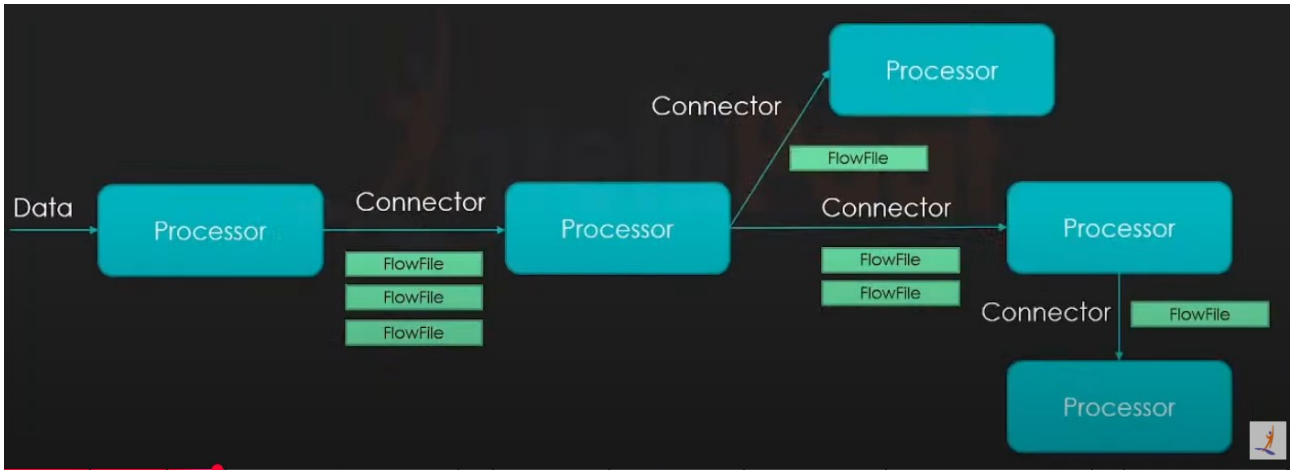

NiFi: Categorization of processors

- **Over 286 bundled processors (as of 1.11.4 version)**

  - **Data Transformation:** ReplaceText, JoltTransformJSON
  - **Routing and Mediation:** RouteOnAttribute, RouteOnContent, ControlRate...
  - **Database Access:** ExecuteSQL, ConvertJSONTOSQL, PutSQL...
  - **Attribute Extraction:** Evaluate JsonPath, ExtractText, UpdateAttribute...
  - **System Interaction:** ExecuteProcess
  - **Data Ingestion:** GetFile, GetFTP, GetHTTP, GetHDFS, ListenUDP, GetKafka...
  - **Sending Data:** PutFile, PutFTP, PutKafka, PutEmail...
  - **Splitting and Aggregation:** SplitText, Split.Json, SplitXml, MergeContent...
  - **HTTP:** GetHTTP, ListenHTTP, PostHTTP...
  - **AWS:** FetchS3Object, PutS3Object, PutSNS, GetSQS

NIFI: Connection Configuration

Connecting Components

- Connecting two components and acts like a buffer /queue.
- **Settings**
  1 Flowfile Expiration -Data not processed in timely fashion will be removed from the system. Zero Secs that is the default value, indicates data will never expire.
  2 Expiration can be done effectively with prioritizes.

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Right click on processor and select option configuration then you will see window like below

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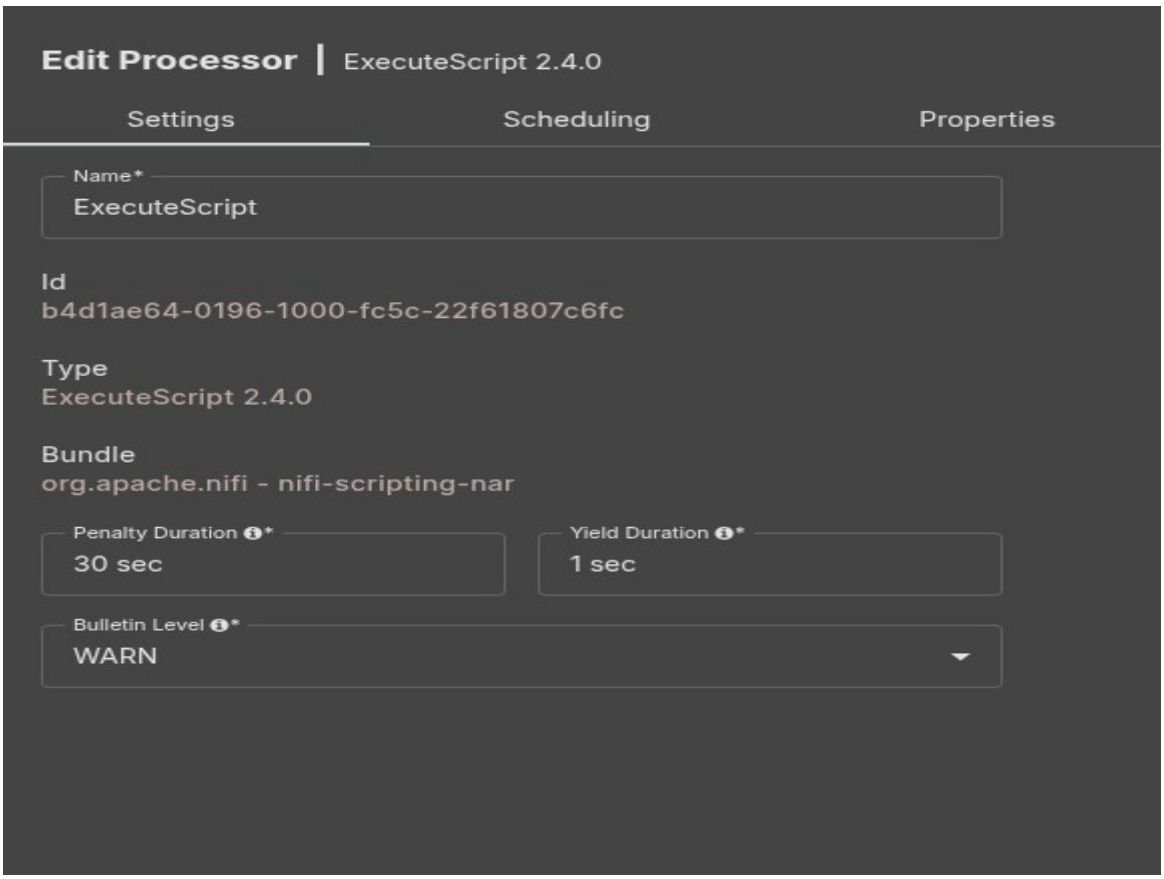

Settings Tab Fields Explained:

1. Name

- **What it is:** The name of the processor.
- **Purpose:** Helps you identify it on the canvas.
- **Tip:** Use a meaningful name like `ChunkingScript` or `JSONFormatter`.

2. Id

- **What it is:** A unique UUID automatically assigned to the processor.
- **Purpose:** Used internally by NiFi to track this processor.
- **Note:** You cannot change it.

3. Type

- **What it is:** The processor type — in this case, `ExecuteScript`.
- **Version:** 2.4.0
- **Purpose:** Tells NiFi which processor logic to use.

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4. Bundle

- **What it is:** Identifies the NiFi component group that contains the processor.
- **Example:**
  `org.apache.nifi - nifi-scripting-nar`
- **Purpose:** Shows which NAR (NiFi Archive) this processor belongs to.

5. Penalty Duration

- **Default:** `30 sec`
- **What it is:** Time to wait before the same flow file is retried if it fails (e.g., exception in script).
- **Purpose:** Prevents retrying too fast and overloading the system.
- **Example:** If a script fails, the flow file is penalized for 30 seconds.

6. Yield Duration

- **Default:** `1 sec`
- **What it is:** If the processor encounters a general error, it will stop processing for this time.
- **Purpose:** Prevents continuous failure loops.
- **Example:** If the script has no input, it will wait 1 second before trying again.

7. Bulletin Level

- **Default:** `WARN`
- **What it is:** The minimum log level at which messages will be shown in the NiFi UI.
- **Options:** `DEBUG`, `INFO`, `WARN`, `ERROR`
- **Purpose:** Controls how verbose the NiFi UI bulletins will be for this processor.
- **Tip:** Set to `DEBUG` temporarily if you're troubleshooting a script.

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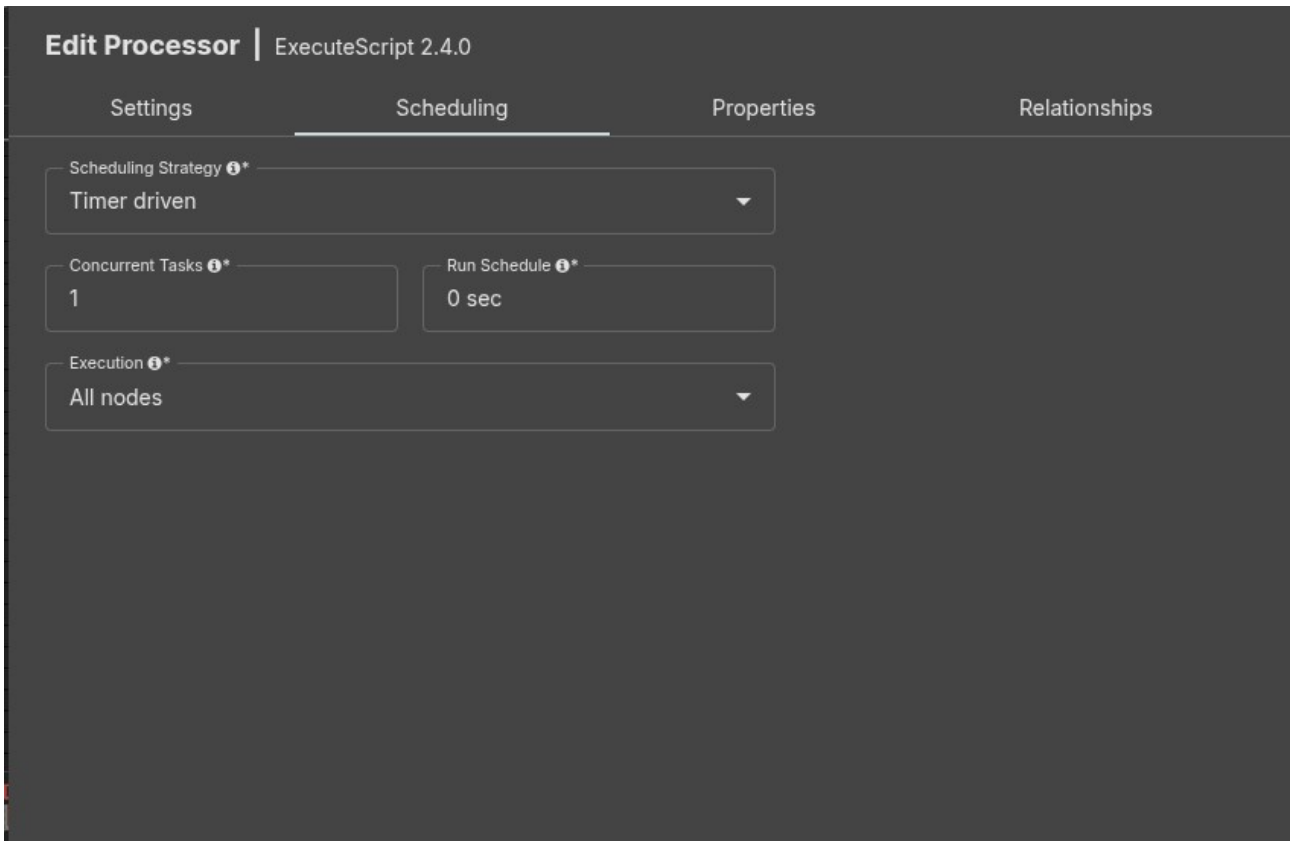
Scheduling Tab Fields Explained:



1. **Sheduling Strategy**

- **Value shown:** `Timer driven`
- **What it is:** Defines how the processor is triggered.
- **Options:**
    - `Timer driven`: Runs periodically based on the `Run Schedule` (default and most common).
    - `Event driven`: Runs when triggered by system events (rarely used).
    - `CRON driven`: Runs based on a CRON expression (e.g., `"0 0 * * *"` for hourly).
- **Use:** `Timer driven` is suitable when you want the processor to run at fixed intervals.

2. Concurrent Tasks

- **Value shown:** `1`

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- **What it is:** Number of threads NiFi can use to run this processor in parallel.
- **Use:**
    - Increase it (e.g., 2, 4, 8...) if your processor can handle parallelism (e.g., multiple flow files).
    - Keep it `1` for sequential processing or when using shared resources like files.

3. Run Schedule

- **Value shown:** `0 sec`
- **What it is:** Delay between each run of the processor.
- **Use:**
    - `0 sec` = run as fast as possible (immediate after each run).
    - `5 sec` = wait 5 seconds between each run.
- **Tip:** Add delay if the processor is resource-intensive or hits an external API.

4. Execution

- **Value shown:** `All nodes`
- **What it is:** Determines on which cluster node(s) the processor will run.
- **Options:**
    - `All nodes`: Run on every node in a NiFi cluster.
    - `Primary node`: Run only on the designated primary node.
- **Use:**
    - Use `All nodes` if the processor handles independent data.
    - Use `Primary node` when writing to shared destinations like databases or filesystems to avoid conflicts.

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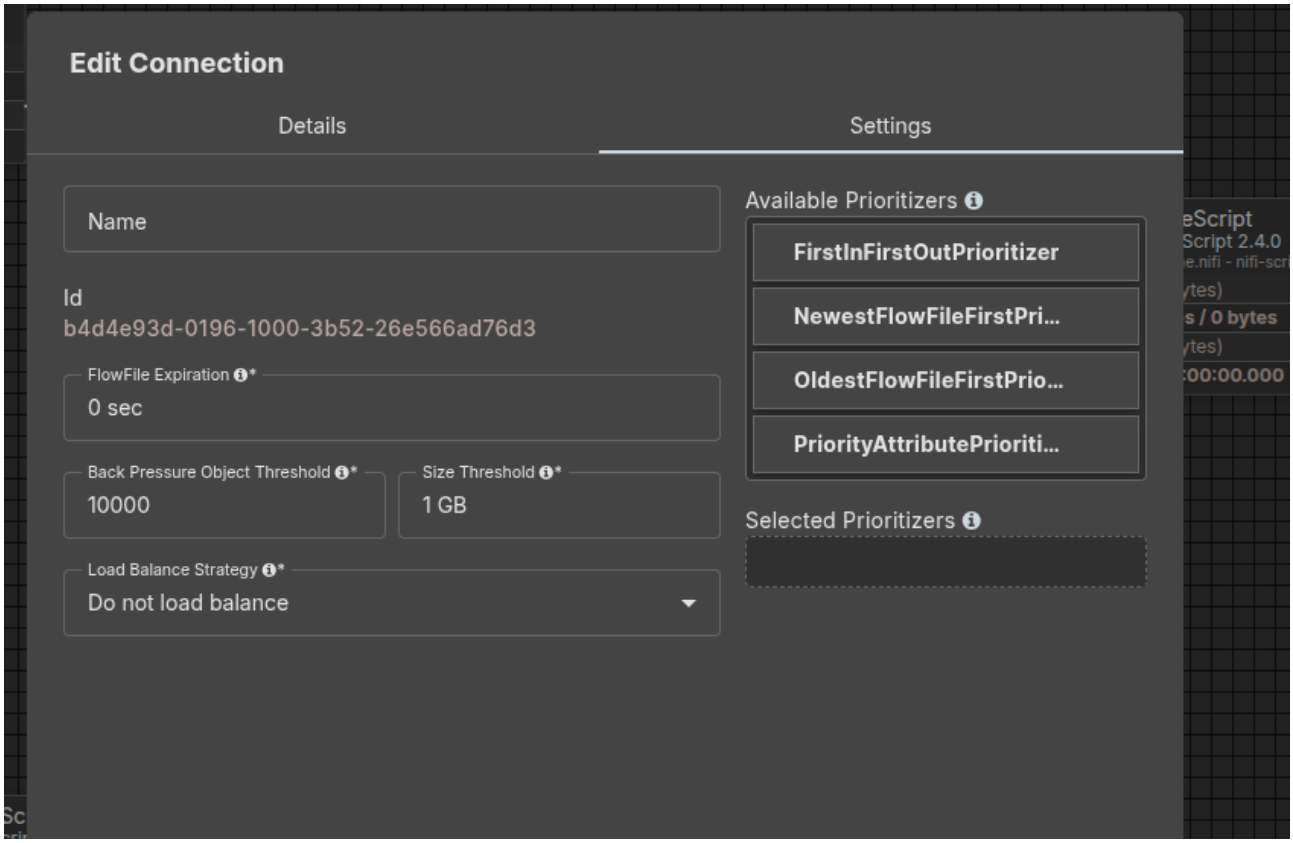

Edit Connection – Settings Tab Explained:

1. Name

- Optional field to give your connection a custom name.
- Helpful for identifying connections between processors in complex flows.

2. Id

- A unique identifier automatically assigned to the connection.
- Used internally by NiFi; typically not editable.

3. FlowFile Expiration

- **Value shown:** `0 sec`
- Determines how long a FlowFile can remain in this connection queue.
- **`0 sec`** means it will never expire.
- Set a time limit (e.g., `5 min`) if you want to drop stale files.

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4. Back Pressure Object Threshold

- **Value shown:** `10000`
- Max number of FlowFiles allowed in this connection queue before **back pressure** is applied.
- Once the limit is reached, upstream processors will stop pushing new FlowFiles.

5. Size Threshold

- **Value shown:** `1 GB`
- Maximum total size of FlowFiles allowed in the queue before back pressure is triggered.
- Helps avoid memory/disk overload.

6. Load Balance Strategy

- **Value shown:** `Do not load balance`
- Controls how FlowFiles are distributed across nodes in a NiFi cluster.
- **Options:**
  - `Do not load balance`: Default, no balancing.
  - `Round Robin`: Distributes FlowFiles evenly across nodes.
  - `Single Node`: Sends all FlowFiles to one node.
  - `Partition by Attribute`: Uses a FlowFile attribute to group files per node.

7. Available Prioritizers

Controls the **order** in which FlowFiles are retrieved from the queue. You can select one or more to customize behavior.

Options:

- **FirstInFirstOutPrioritizer**: Oldest files processed first (default).
- **NewestFlowFileFirstPrioritizer**: Most recent files processed first.
- **OldestFlowFileFirstPrioritizer**: Explicitly enforces old-first logic.
- **PriorityAttributePrioritizer**: Prioritize based on a custom FlowFile attribute (e.g., `"priority=high”)`

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Working with Attributes in flow file ..

An Example

- A file that is picked up from a local file system, the FlowFile would have an attribute called filename that reflected the name of the file on the file system. Additionally, the FlowFile will have a path attribute that reflects the directory on the file system that this file lived in. Th FlowFile will also have an attribute named uuid, which is a unique identifier for this FlowFile.

Other Core Attributes

- Absolute Path (absolute.path): The FlowFile's absolute path indicates the absolute directory to which a FlowFile belongs and does not contain the filename.
- Priority (priority): A numeric value Indicating the FlowFile priority.
- MIME Type (mime.type): The MIME Type of this FlowFile.
- Discard Reason (discard.reason): Specifies the reason that a FlowFile is being discarded.
- Alternate Identifier (alternate.Identifier): Indicates an identifier other than the FlowFile's UUID that is known to refer to this FlowFile.

Working with Attributes in flow file – Hands-On

- GetFile Processor
- RoutingOnAttribute Processor
- PutFile Processor JSON (Route JSON Files)
- PutFile Processor CSV(Route CSV Files)**see https://www.youtube.com/watchv=himL2kRQA4c&t=25s&ab_channel=Intellipaat from timestamp 1:19:40 to timestamp 1:34:00**

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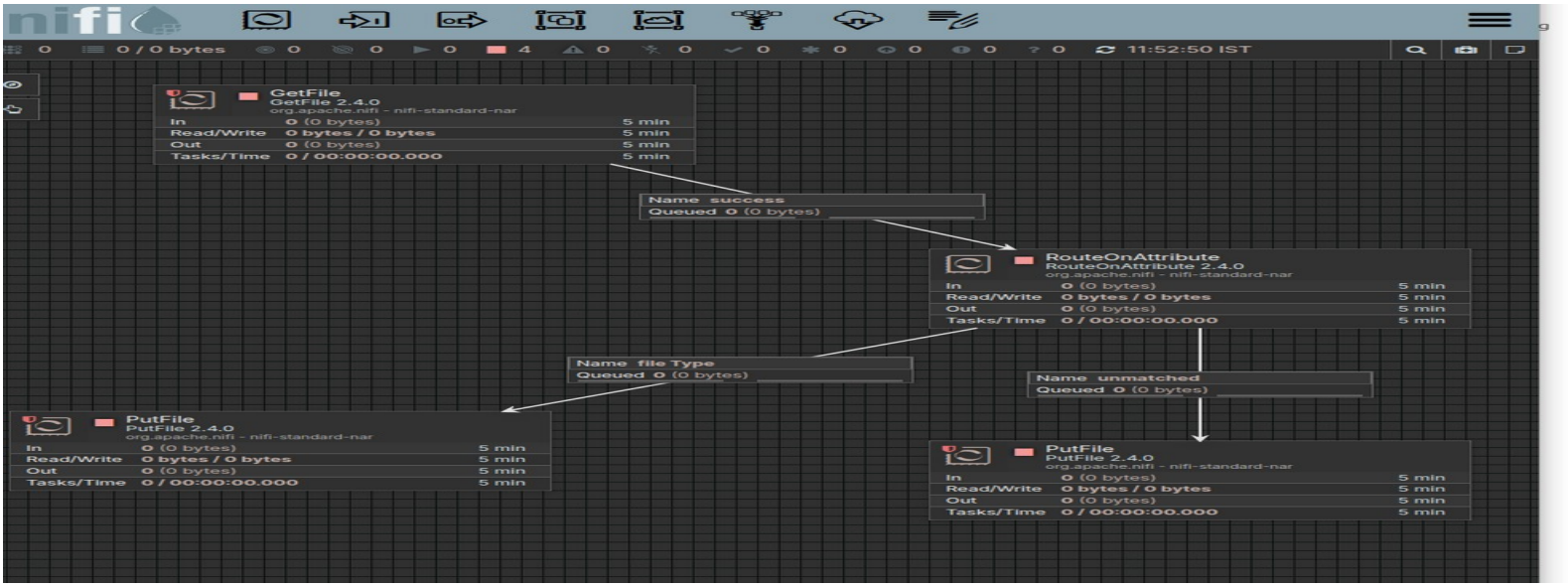

Log Configuration and Monitoring Logs

- There is one configuration file in NiFi that manages all the logging operations performed by NiFi: this file is in the configuration directory (NIFI_HOME/conf) and is named logback.
- It is good to know that this file can be modified "on-the-fly" and it won't be required to restart NiFi for the modifications to be taken into account.
- **Logging helps in debugging and monitoring NiFi.**

How to See Logs

click on top right bar(three liner symbol) then click bulletin Board.There you can see logs.

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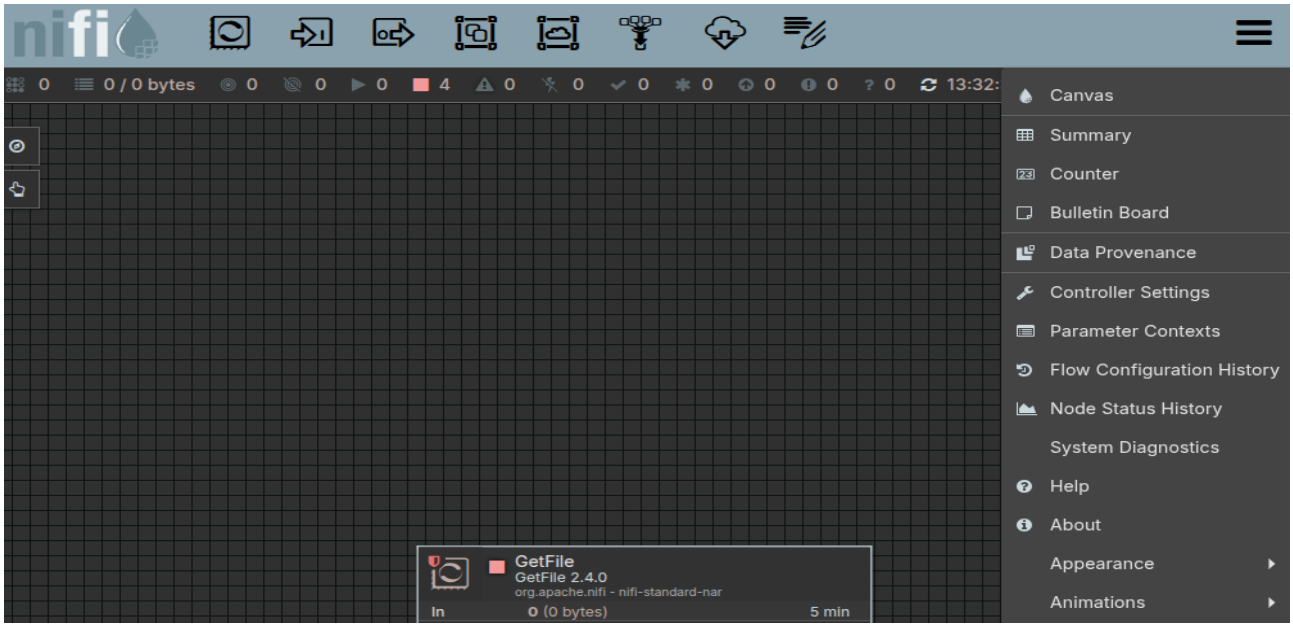

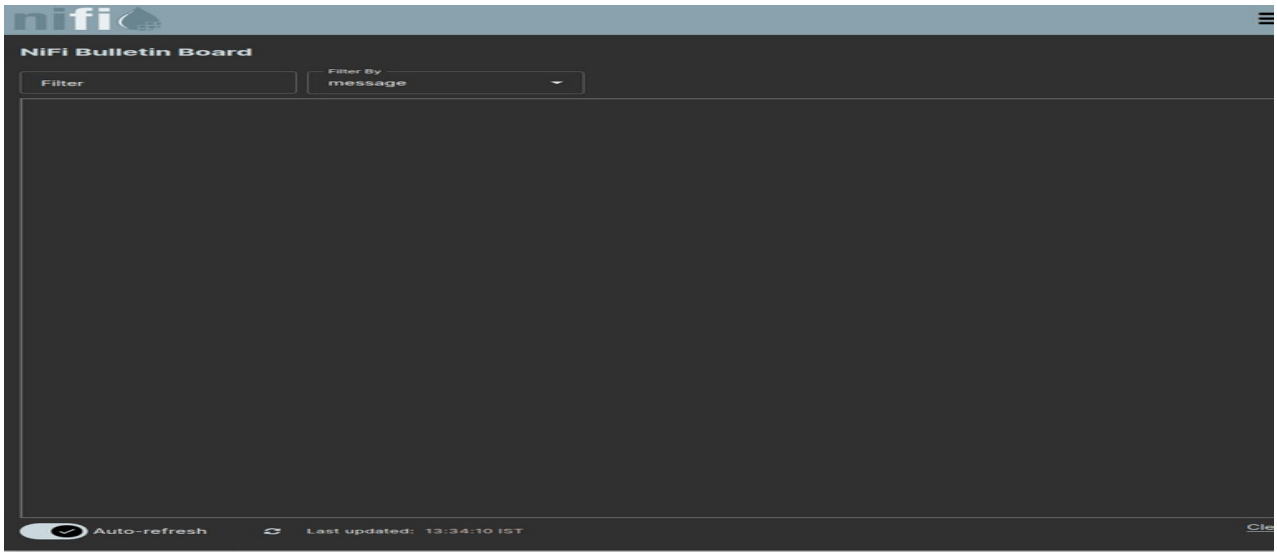

->other way

you can follow path shown in below image (initial directory location depends on your downloaded location)

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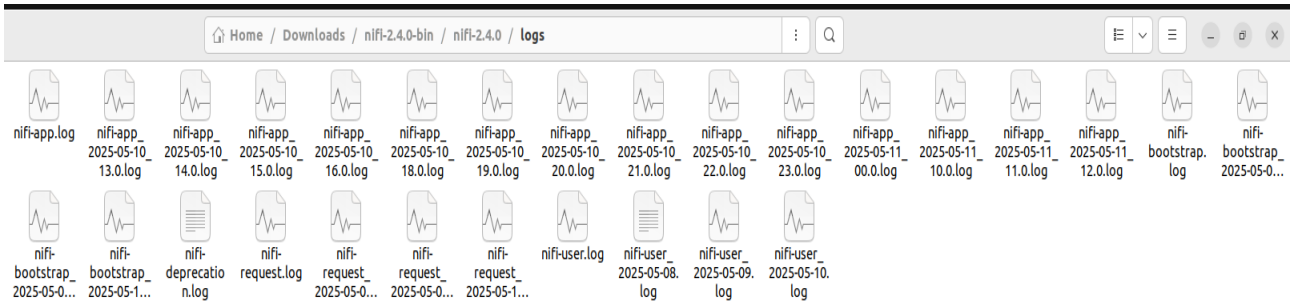


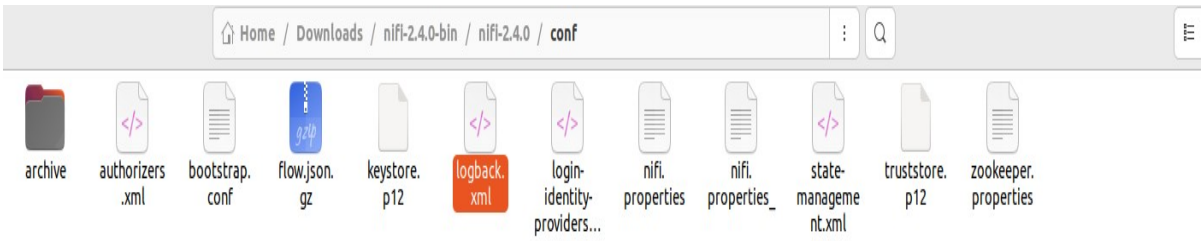
here you can see your application logs click on nifi-app.log file

Log Configuration and Monitoring Hands-on

- Improvise on previous data flow. Add additional attribute (key and value pair) to flowfile if the file type is not JSON type. Please use **LogAttribute processor** as the destination and write logs to a different file for monitoring purpose.
- You need to put appropriate configuration in **logback.xml** file for the same.
- **https://www.youtube.com/watchv=himL2kRQA4c&t=25s&ab_channel=Intellipaat from timestamp 2:01:03 to timestamp 2:21:00**

logback.xml

- `logback.xml` is the configuration file used by Logback, a powerful and flexible logging framework for Java applications. It's the successor to Log4j and is often used in projects like Apache NiFi, Spring Boot, and others for managing logging behavior.
- you can follow path shown in below image (initial directory location depends on your downloaded location)



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```
    <appender name="APP_FILE" class="ch.qos.logback.core.rolling.RollingFileAppender">
        <file>${org.apache.nifi.bootstrap.config.log.dir}/nifi-app.log</file>
        <rollingPolicy class="ch.qos.logback.core.rolling.SizeAndTimeBasedRollingPolicy">
            <!--
              For daily rollover, use 'app_%d.log'.
              For hourly rollover, use 'app_%d{yyyy-MM-dd_HH}.log'.
              To GZIP rolled files, replace '.log' with '.log.gz'.
              To ZIP rolled files, replace '.log' with '.log.zip'.
            -->
            <fileNamePattern>${org.apache.nifi.bootstrap.config.log.dir}/nifi-app_%d{yyyy-MM-dd_HH}.
i.log</fileNamePattern>
            <!-- Control the maximum size of each log file before rolling over -->
            <maxFileSize>100MB</maxFileSize>
            <!-- Control the maximum number of log archive files kept and asynchronously delete olde
iles -->
            <maxHistory>30</maxHistory>
            <!-- Control the total size of all log archive files for this appender -->
            <totalSizeCap>3GB</totalSizeCap>
            <!-- Log files exceeding maximum settings will be rolled on startup -->
            <cleanHistoryOnStart>true</cleanHistoryOnStart>
        </rollingPolicy>
        <immediateFlush>true</immediateFlush>
        <encoder class="ch.qos.logback.classic.encoder.PatternLayoutEncoder">
            <pattern>%date %level [%thread] %logger{40} %msg%n</pattern>
        </encoder>
    </appender>
```

This `logback.xml` snippet configures a rolling file appender for logging in Apache NiFi. Below is a breakdown of the configuration:

Appender Definition:

```
<appender name="APP_FILE"
class="ch.qos.logback.core.rolling.RollingFileAppender">
```

- `name="APP_FILE"`: Identifier for this appender.
- `RollingFileAppender`: Writes logs to a file and rolls them over based on size or time.

Log File Location:

```
<file>${org.apache.nifi.bootstrap.config.log.dir}/nifi-app.log</file>
```

- Writes logs to the file `nifi-app.log` inside the directory specified by `org.apache.nifi.bootstrap.config.log.dir`.
- This property is typically defined in `nifi.properties` and resolves to a directory like `/opt/nifi/logs`.

Rolling Policy:

```
<rollingPolicy
class="ch.qos.logback.core.rolling.SizeAndTimeBasedRollingPolicy">
```

This policy combines both time-based and size-based rollover. Logs will roll over either when a time period ends or when the file size exceeds a defined limit.

Filename Pattern for Rolled Logs:

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```
<fileNamePattern>${org.apache.nifi.bootstrap.config.log.dir}/nifi-app_%d{yyyy-MM-dd_HH}.log</fileNamePattern>
```

- Log files will be rolled over with names like: `/path/to/logs/nifi-app_2025-05-11_10.log`

File Size and Retention Settings:

```
<maxFileSize>100MB</maxFileSize>
<maxHistory>30</maxHistory>
<totalSizeCap>3GB</totalSizeCap>
```

- `maxFileSize`: Rolls over when file exceeds 100 MB.
- `maxHistory`: Keeps up to 30 archived log files.
- `totalSizeCap`: Deletes oldest logs if total size of all log files exceeds 3 GB.

Cleanup Behavior:

```
<cleanHistoryOnStart>true</cleanHistoryOnStart>
```

- Deletes old logs at startup if they exceed `maxHistory` or `totalSizeCap`.

Flush Behavior:

```
<immediateFlush>true</immediateFlush>
```

- Ensures that log entries are written to disk immediately without buffering.

Log Format (Encoder):

```
<encoder class="ch.qos.logback.classic.encoder.PatternLayoutEncoder">
    <pattern>%date %level [%thread] %logger{40} %msg%n</pattern>
</encoder>
```

- Formats log entries with date, log level, thread name, logger name, and the actual message.
- Example log line:
  `2025-05-11 10:45:00 INFO [main] o.a.n.c.StandardProcessScheduler Starting processor...`

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Navigate to bottom of logback.xml file

```
288
289     <root level="INFO">
290         <appender-ref ref="APP_FILE" />
291     </root>
292
```

- level="INFO": Sets the minimum log level for all logs. Levels below INFO (e.g., DEBUG) will not be logged.
- : Binds the root logger to the `APP_FILE` appender, meaning all logs will be written to the `nifi-app.log` file.

Summary:
This configuration logs messages to `nifi-app.log`, rolls over logs hourly or when file size exceeds 100 MB, retains up to 30 log files or 3 GB total, and formats each log entry with relevant metadata.

Source: Follow below link after timestamp 2:21:00 for further Exploration of Some More Proeccesors

https://www.youtube.com/watchv=himL2kRQA4c&t=25s&ab_channel=Intellipaat