

Cisco Crosswork Workflow Manager 2.1 Administrator Guide

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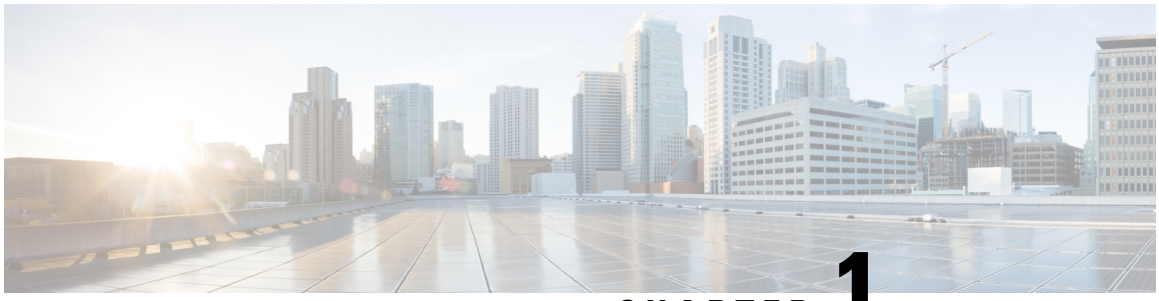
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CHAPTER 1

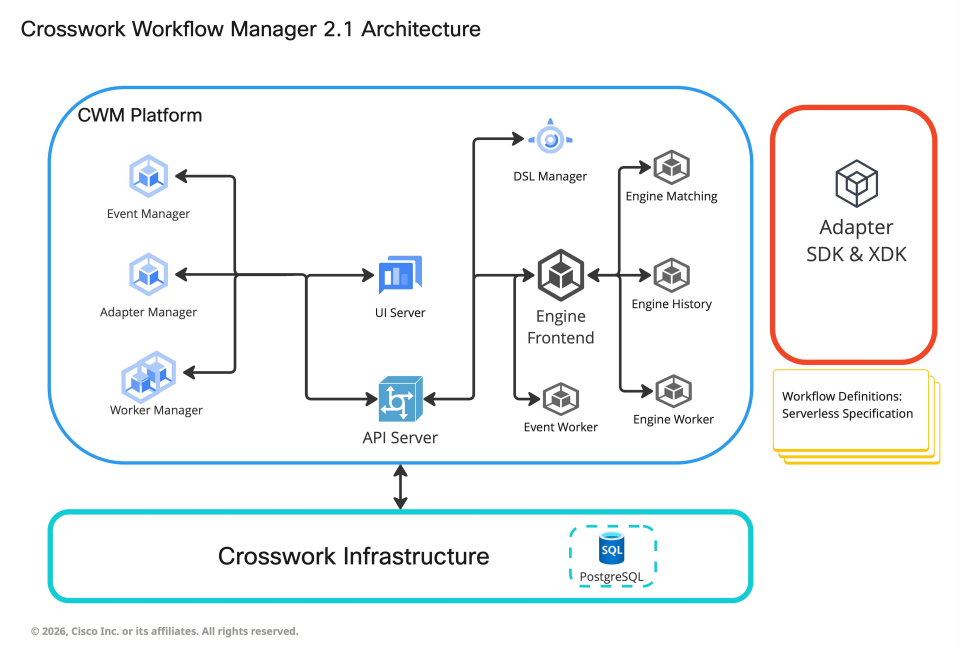
System

This section covers the following topics:

- Architecture overview, on page 1
- GEO High Availability, on page 2

Architecture overview

Cisco Crosswork Workflow Manager architecture is a microservice-based solution that operates on top of the Crosswork Infrastructure. This section shows a diagram presenting its core architectural components along with short descriptions of each.



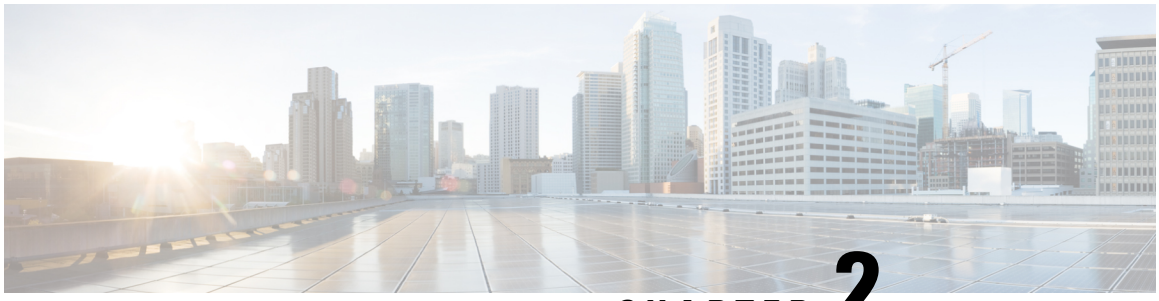
- **UI Server**: Allows operators to add and instantiate workflows, enter workflow data, list running workflows, monitor job progress. The **Administration** section of the CNC UI enables users to add workers, manage worker processes and assign activities from adapters to workers.

- **REST API**: Includes all interaction with the CWM application: deploying adapters, publishing and instantiating workflows, managing workers, resources and secrets.
- **API Server**: Dispatches API requests to relevant microservices.
- **Engine**: The core component that conducts how workflows are handled. It interprets and manages the execution of workflow definitions.
- **Engine Worker (Workflow Worker)**: Executes the workflow tasks. It receives the workflow tasks from the **Engine**, executes them in the correct order, and sends the results back to the **Engine**.
- **Worker Manager**: Manages the Workflow Workers. It ensures that the correct number of workers are running and that they are properly configured.
- **Adapter Manager**: Manages the adapters used by the system. It installs, configures, and updates adapters ("plugins") and ensures that they are compatible with the system.
- **Event Manager**: Manages incoming and outgoing events, dispatching them to correct event queues. Events are signals coming from external sources with which the workflows can interact.
- **Adapter SDK & XDK**: Helps developers create new adapters to integrate with external systems. The XDK application extends the capabilities of the Adapter SDK to enable developers to automatically build interfaces and message logic for custom adapters.
- **Workflow Definitions**: Workflow code written in the JSON format based on the Serverless Workflow specification.
- **Crosswork Infrastructure**: Runtime platform for the CWM application. It is a collection of services that provide the necessary infrastructure to support the deployment and management of the application within a Cluster deployment.
- **PostgreSQL**: The database that the system uses to store and manage its data.
- **DSL Engine**: Executes the Domain-Specific Language (DSL) used to define the workflows. It parses the DSL, generates the appropriate workflow code, and compiles it for execution.
- **Engine Matching**: Matches incoming events with the appropriate workflow. It determines which workflow should execute based on the event data and the defined workflow constraints.
- **Engine History** Tracks the history of executed workflows. It stores the metadata and execution details of all completed, running, and failed workflows.

GEO High Availability

Crosswork Workflow Manager 2.1 supports GEO High Availability (GEO HA) through the underlying Cisco Crosswork infrastructure. To enable and configure GEO HA, refer to the **GEO HA Overview and Enablement instructions** in the CNC documentation: GEO HA Overview.

CWM inherits the HA configuration from CNC; no additional CWM-specific enablement steps are required.



CHAPTER 2

API

This section covers the following topics:

- CWM API Overview, on page 3
- Use the CNC Workflow Automation Postman collection, on page 3

CWM API Overview

Cisco developed the Cisco Crosswork Workflow Manager API based on Representational State Transfer (REST) design principles. You can access the API using HTTP and data files formatted using JSON. The API indicates the success or failure of a given request using relevant HTTP response codes. Data retrieval methods require a GET request, while methods for adding, changing, or deleting data require POST, PUT, PATCH, or DELETE methods, as appropriate. The API returns errors if you send requests using the wrong request type.

You can use the CWM API using a **CWM 2.1 Postman collection** in Postman.

For a full API reference, see the dedicated DevNet space: https://devnetapps.cisco.com/docs/crosswork/workflow-manager/introduction/.

Use the CNC Workflow Automation Postman collection

Follow these steps to import the collection to the Postman application and set the development environmentn.

Before you begin

Be sure that you have access to a Postman web application account or have installed the Postman desktop app. For details, see https://www.postman.com/downloads/.

You must also download the CNC Workflow Automation Postman collection in JSON format by clicking this link and then unzip the archive to an accessible storage resource.

Procedure

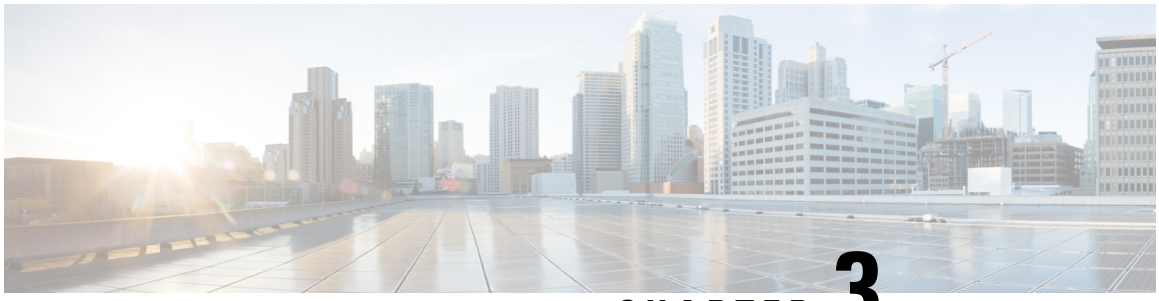
Step 1 Launch Postman and go to **Collections**.

Step 2 Click **Import**, select **folders** from the **Drop anywhere to import** screen, and point to the folder that you unzipped from the CNC Workflow Automation Postman collection archive.

Step 3 Go to **Environments** and select the newly imported **test** environment.

Step 4 Provide current values for the **baseUrl** and **endPoint** variables to match the IP address and port of your CNC Workflow Automation instance. Save save the changes.

To get access to the CNC Workflow Automation API, use the *baseurl*`/crosswork/cnc/v71/`, where *baseurl* is the IP address and port number of your Crosswork Network Controller (CNC) instance with CNC Workflow Automation installed. For example: `https://172.22.141.178:30603`



CHAPTER 3

Events

This section covers the following topics:

- Event handling overview, on page 5
- Define a Kafka event, on page 14

Event handling overview

The event handling mechanism enables CWM to interact with external brokers for handling outbound and inbound events. Workflows can act as either consumers or producers of events which can be used to initiate a new workflow, or signal an existing workflow. For each event type that you define, you can add correlation attributes for filtering events and routing them to the workflow waiting for the event containing specific attribute values.

Event messages need to be defined according to Cloud Events specification. See Event message format, on page 12 for more details.

Brokers and protocols

CWM supports the Kafka broker and the AMQP, MQTT, and HTTP protocols for handling events. Events can be either **consumed** by a workflow running inside CWM (incoming events forwarded by a broker) or **produced** by a running workflow and forwarded to an external system (outgoing events received by a broker).

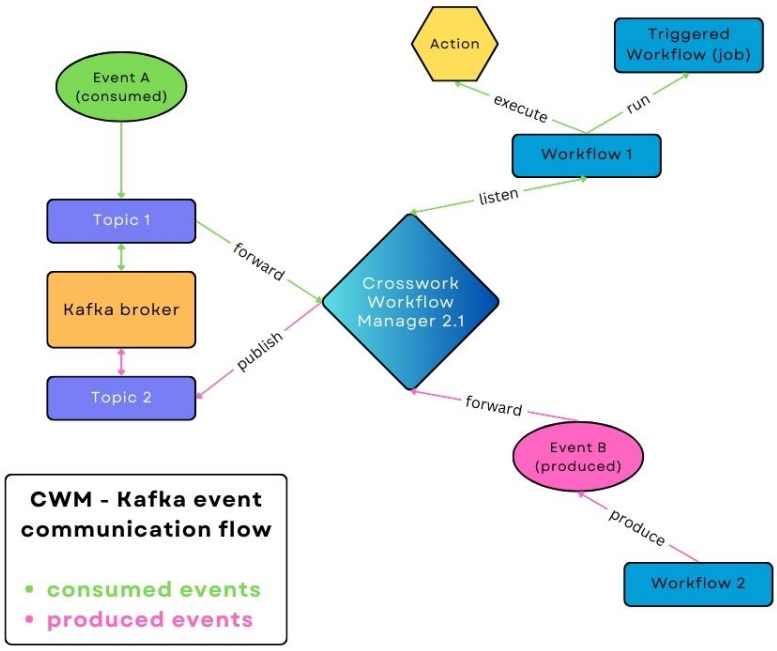


Note It is important to remember that CWM doesn't act as an event broker itself. It provides a means to connect to external brokers to forward messages and events.

Kafka broker

For the **consume** event type, CWM connects to a Kafka broker and listens for a specific event type on a topic. Once an event of the specific type registers to the right topic, CWM retrieves the event data and forwards it to the running workflow. The workflow then executes actions defined inside the Event State and/or runs another workflow execution (if selected).

For the **produce** event type, a running workflow produces a single event or a set of events which CWM then forwards to the broker and they get published in the right topic.



The Kafka broker will accept every event message format supported by the language-specific SDK as long as a valid content-type is sent. See this Github link for lists of supported formats: https://github.com/cloudevents/spec?tab=readme-ov-file.

AMQP protocol (such as the RabbitMQ broker)

For the **consume** event type, CWM connects to an AMQP broker and listens for a specific event type on a queue. Similarly to the Kafka broker, when an event of the specific type registers to the right queue, CWM retrieves the event data and forwards it to the running workflow. The workflow then executes actions defined inside the Event State and/or runs another workflow execution (if selected).

For the **produce** event type, a running workflow produces a single event or a set of events which CWM then forwards to the broker and they get published in the right queue.

AMQP brokers will accept every event message format supported by the specific SDK as long as a valid content-type is sent. The lists of supported event formats are available here: https://github.com/cloudevents/spec?tab=readme-ov-file.

MQTT protocol

For the **consume** event kind, CWM connects to an MQTT broker and subscribes to a specific topic. When a matching event is received on that topic, CWM forwards the data to the workflow engine, which then executes the Event State logic and, if configured, starts another workflow execution. For the **produce** event kind, an executing workflow can generate one or multiple events that CWM delivers to the broker for publishing on the designated topic.

CWM supports both CloudEvents and non-CloudEvents messages via MQTT. Non-CloudEvents messages are automatically wrapped into CloudEvents, with metadata injected using the `ce-` header prefix. The

CloudEvents specification describes the supported event message formats here: https://github.com/cloudevents/spec?tab=readme-ov-file.

HTTP protocol

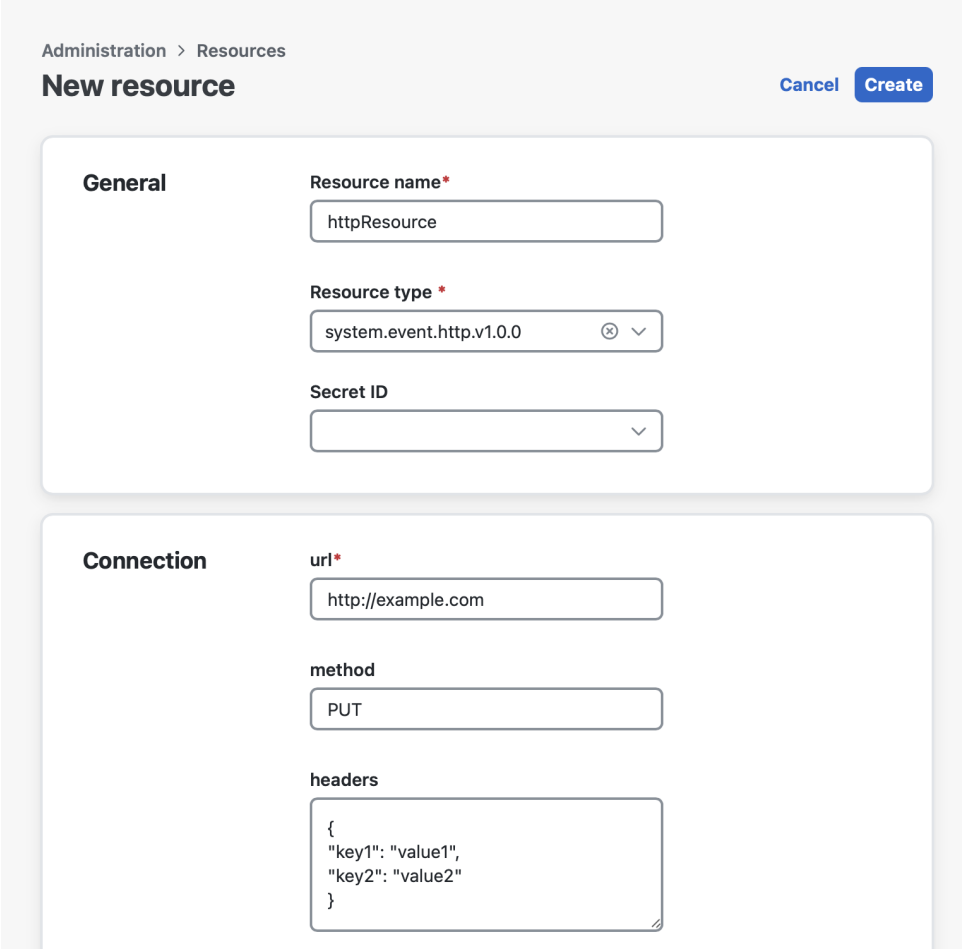
For the **consume** event type, CWM exposes an HTTP endpoint that listens for any incoming events. If an event of a specific type comes, it is forwarded to the running workflow that waits for this event type.

Note When events are consumed, CWM functions as the destination HTTP server. Therefore, the URL of the CWM server is what you effectively provide as the resource for the given HTTP event type.

Event messages need to be HTTP *POST* requests, and the message body needs to be in JSON format representing a Cloud Event:

```
 { "specversion": "1.0",
"id": "2763482-4-324-32-4",
"type": "com.github.pull_request.opened",
"source": "/sensors/tn-1234567/alerts",
"datacontenttype": "text/xml",
"data": "<test=\"xml\"/>",
"contextAttrName": "contextAttrValue" }
```

For **produce** events, a workflow produces an event in the Cloud Event format and CWM forwards it as an HTTP `POST` request to an HTTP endpoint exposed by an external system. The HTTP endpoint address is a concatenation of the host **URL** defined in the Resource configuration in CWM and the **End point** field of the Event definition inside the workflow definition. Inside the resource configuration, you can change the request method to `PUT` or other, and add key and value pairs as header (in JSON format):



Event system configuration

The following topics cover the details of event configuration.

Event system configuration: secrets

In event configuration, secrets store credentials needed to enable connection to a broker or endpoint exposed by a third-party service that sends or receives events. This includes basic authentication: username and password. The Secret ID that you provide when creating a secret will be referenced when creating a resource, so you need to add a secret beforehand. For details, see Step 1: Create a Kafka secret, on page 14.

Event system configuration: resources

The resource is where you provide all the connection details (including the secret) needed to reach an event broker or endpoint exposed by a third party service. Depending on the broker/protocol you want to use, you can choose among three default event resource types

- `system.event.amqp.v1.0.0`

- `system.event.kafka.v1.0.0`
- `system.event.mqtt.v1.0.0`
- `system.event.http.v1.0.0`

Notice that there is a different set of configuration fields for each of them

- For AMQP, provide the **ServerDSN** in the following format `amqp //localhost 5723`.
- For Kafka:
  - **KafkaVersion**: Enter your Kafka version. The standard way to check the Kafka version is to run `bin/kafka topics.sh version` in a terminal.
  - **Brokers**: Enter your Kafka broker addresses in the following format `["localhost 9092", "192.168.10.9 9092"]`.
  - **OtherSettings**: An editable list with default Kafka setting values. You can modify the values as needed. For details, see the "Kafka Other Settings" table below.
- For MQTT:
  - **qos**: set message delivery quality of service level. Accepts `0`, `1`, or `2` (default: `0`). For detailed definitions, see the OASIS MQTT 5.0 Specification.
  - **tls**: enable Transport Layer Security (TLS) for the connection (`true` or `false`, default: `false`). The broker must be configured to support TLS if this option is enabled.
  - **server**: provide broker address in the format [host]:[port] (e.g, `localhost:1234`, `10.1.0.1:1234`).
  - **clientID**: provide unique ID of the client.
- For HTTP:
  - **Produce** event types: Fill in the **URL** field and optionally, **Method** and **Headers** (for example, Client ID header name and value as a JSON object).

Note The **URL** needs to be the address of the destination HTTP server, but without the URL path. You will enter the URL path as the **End point** when configuring the event type.

  - **Consume** event types: Fill in the **URL** field with the server URL of your CWM instance, for example, `192.168.10.9 9092`.

Note Remember to provide the URL of your CWM instance without the URL path (`/event/http`). You will enter the URL path as the **End point** when configuring the event type.

Table 1: Kafka Other Settings

Field	Description
ClientID	The identifier used by Kafka brokers to track the source of requests
KafkaVersion	Specifies the version of Kafka the client is compatible with (e.g., "2.0.0")
MetadataFull	When True, fetches metadata for all topics, not just those needed
AdminRetryMax	Maximum number of retries for admin requests (e.g., creating/deleting topics)
NetSASLVersion	Version of the SASL (Simple Authentication and Security Layer) protocol
AdminTimeoutSecs	Timeout in seconds for admin requests (e.g., topic creation)
ConsumerFetchMin	Minimum amount of data in bytes the broker should return to the consumer
MetadataRetryMax	Maximum number of retries to fetch metadata (e.g., topic and partition info)
NetSASLHandshake	When True, enables the SASL handshake mechanism
NetDialTimeoutSecs	Timeout in seconds for establishing a connection to Kafka
NetReadTimeoutSecs	Timeout in seconds for reading data from Kafka
NetWriteTimeoutSecs	Timeout in seconds for writing data to Kafka
ProducerTimeoutSecs	Timeout in seconds for producing messages to Kafka
ConsumerFetchDefault	Default size in bytes for the consumer fetch request (e.g., 1MB)
ProducerRequiredAcks	Specifies the required number of acknowledgments from brokers for a message to be considered successful (e.g., "WaitForLocal")
ProducerReturnErrors	When True, enables error reporting for failed produce requests
ConsumerIsolationLevel	Specifies whether the consumer reads uncommitted or committed messages ("ReadUncommitted" allows reading in-progress transactions)
ConsumerOffsetsInitial	Initial offset when there is no committed offset (-1 for the latest)

Field	Description
NetMaxOpenRequestsSecs	Maximum time for open requests over the network

Event type

To create a new event type, you need to have a resource and secret added to CWM.

The following fields are available when adding an event type:

- **Event type name**: the name of your event type. It's later referred to inside the workflow definition.
- **Resource**: a list of resources previously added to CWM.
  - **Event source**: a fully user-defined entry that will be referenced in the workflow definition. Required for `produce` event kind.
  - **End point**: the name of Kafka topic (event stream), AMQP endpoint (terminus), or HTTP URL (Host) path.



Note For the HTTP **consume** event type, provide `/event/http` as your **End point**.

- **Select kind**: a list consisting of two options: `consume` or `produce` event kind.



Note The `both` option is not yet supported for CWM.

- **Start listener** (only for `consume` kind): check it to start listening for the defined event type.
- **Run job** (only for `consume` kind): tick this checkbox if you want to trigger a workflow upon receiving the event. Then select the desired workflow from the list.

Correlation attributes

Optionally, you can set context attributes for your event. They apply only to the `consume` event kind and are used to trigger workflows selectively. You can view them as a kind of custom filters that refine the inbound event data and route them to the right workflows that listen on event types with specific values of correlation attributes.

To add an attribute to your event type, click **Add attribute**, and provide an attribute name.



Note Correlation attributes are fully user-defined. They need to match the JSON key and value pair stated inside the Cloud event message that is to be routed to a given workflow.

Event message format

Event messages must follow the Cloud Events specification format. A minimum viable event message following the specification will contain the following parameters:

```
{
  "specversion": "1.0",
  "id": "00001",
  "type": "com.github.pull_request.opened",
  "source": "/sensors/tn-1234567/alerts"
}
```

The message can carry additional parameters, such as `"datacontenttype"`, `"data"`, and a correlation context attribute name (`contextAttrName` in this example) :

```
  {
  "specversion": "1.0",
  "id": "2763482-4-324-32-4",
  "type": "com.github.pull_request.opened",
  "source": "/sensors/tn-1234567/alerts",
  "datacontenttype": "text/xml",
  "data": "<test data=\"xml\"/>",
  "contextAttrName": "contextAttrValue"
}
```

Workflow event definition and state

In the workflow definition, there are two major syntactical elements that you use to handle the events for which the workflow will be waiting. These are:

- The Event definition: Used to define the event type and its properties. For example:

```
{
   "name": "applicant-info",
   "type": "org.application.info",
   "source": "applicationssource",
   "correlation": [
    {
      "contextAttrName": "applicantId"
    }
   ]
}
```

- The Event state: Used to define actions to be taken when the event occurs. For example:

```
{
"name": "MonitorVitals",
"type": "event",
"onEvents": [
        {
          "actions": [
            {
              "functionRef": {
                "refName": "uppercase",
                "arguments": {
                  "input": {
                    "in": "patient ${ .patient } has high temperature"
                  }
                }
              }
            }
```

```
          ],
          "eventRefs": [
            "HighBodyTemperature"
          ]
        }
      ]
}
```

Support for non-CloudEvents messages

Cisco Crosswork Workflow Manager 2.1 supports receiving **non-CloudEvents format messages** across AMQP, MQTT, Kafka, and HTTP listeners to enable greater flexibility in integrating with event producers that do not natively emit CloudEvents. When such messages are received, they are automatically **wrapped** into a CloudEvent using the `type` and `source` specified in the receiver configuration.

- The header injection patterns used are:
  - **AMQP**: `cloudEvents:` prefix
  - **MQTT**: `ce-` prefix
  - **Kafka**: `ce_` prefix
  - **HTTP**: `ce-` prefix

AMQP, MQTT, and Kafka listeners

Both AMQP, MQTT, and Kafka listeners accept raw (non-CloudEvent) messages. The system will wrap these in the CloudEvents format by adding the required fields.

AMQP header format

For AMQP listeners, CloudEvent metadata is injected using the `cloudEvents:` prefix:

```
cloudEvents:specversion = 1.0
cloudEvents:type        = <configuredType>
cloudEvents:source      = <configuredSource>
cloudEvents:id          = <UUIDv4>
```

MQTT header format

For MQTT listeners, CloudEvent metadata is injected using the `ce-` prefix:

```
ce-specversion = 1.0
ce-type        = <configuredType>
ce-source      = <configuredSource>
ce-id          = <UUIDv4>
```

Kafka header format

For Kafka listeners, CloudEvent metadata is injected using the `ce_` prefix:

```
ce_specversion = 1.0
ce_type        = <configuredType>
ce_source      = <configuredSource>
ce_id          = <UUIDv4>
```

Note If the incoming AMQP or Kafka message already contains `source` or `id`, these values will **not** be overwritten during transformation (wrapping).

HTTP listener

The HTTP listener offers an additional endpoint for handling both CloudEvents and non-CloudEvents payloads.

Endpoints

- `/event/http` — accepts only well-formed CloudEvents.
- `/event/http/:type` — accepts both CloudEvents and non-CloudEvents payloads.

Wrapping HTTP requests

When a non-CloudEvent payload is received via the new endpoint:

1. The payload is wrapped into a CloudEvent.
2. The `type` is derived from the `:type` path parameter.
3. The corresponding `source` is determined from the configuration based on the type definition.
4. A unique ID is generated if one is not present.
5. CloudEvent headers are set using the `ce-` prefix:

```
ce-specversion = 1.0
ce-type        = <type from path>
ce-source      = <source from config>
ce-id          = <UUIDv4>
```

Note If the incoming HTTP request already includes `source` or `id`, these values are **retained** and not overwritten during transformation (wrapping).

Define a Kafka event

In the following topics, we will create a Kafka event and add it to a new workflow. The only pre-requisities are that we must have:

- A fully set-up Kafka service.
- CWM installed.

Step 1: Create a Kafka secret

To enable a secure connection to the Kafka service, you need to create a secret with Kafka credentials and a resource with connection details.

Procedure

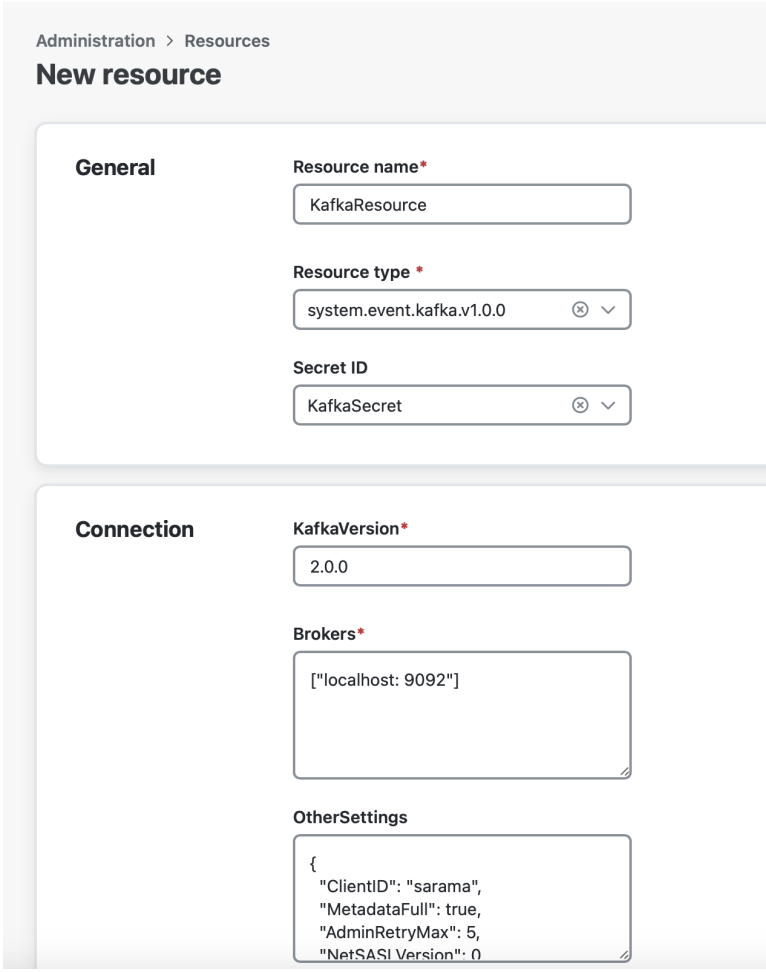
	Command or Action	Purpose
Step 1	In CNC, select **Administration** > **Workflow Administration** > **Secrets**.	
Step 2	Click **Add Secret**.	
Step 3	In the **New secret** view, specify the following:	
Step 4	After selecting the secret type, a set of additional fields is displayed under the **Secret** type details section. Fill in the fields:	
Step 5	Click **Create Secret**.	

Step 2: Create a Kafka resource

You also need to create a resource with connection details.

Procedure

	Command or Action	Purpose
Step 1	In CNC, select **Administration** > **Workflow Administration** > **Resources**.	
Step 2	Click **Add Resource**.	
Step 3	In the **New resource** window, specify the following:	

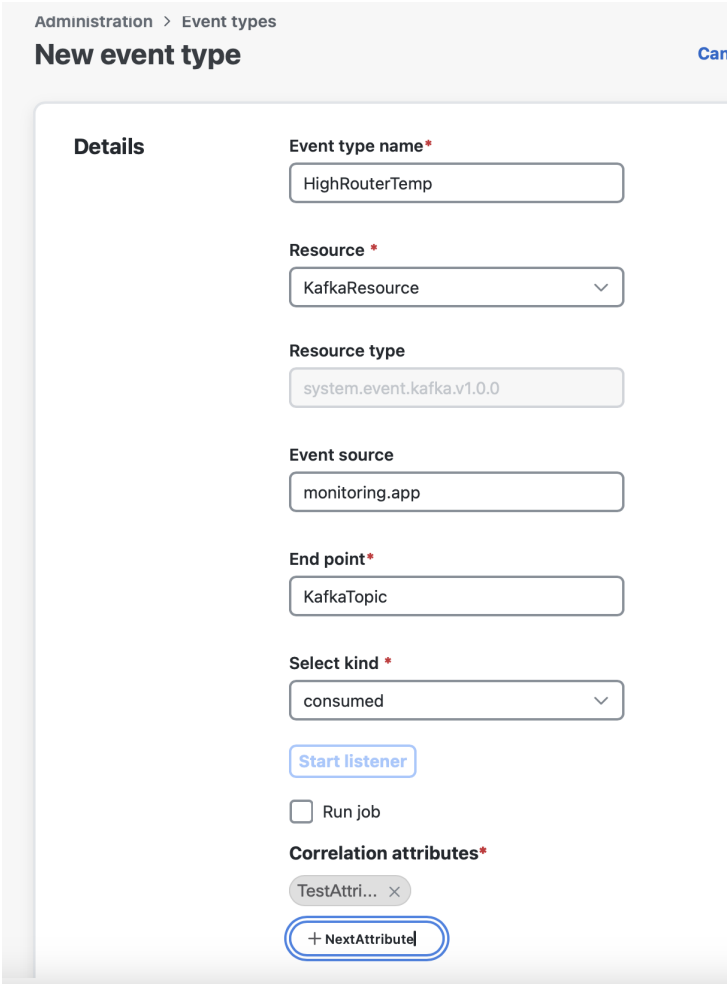
	Command or Action	Purpose
Step 4	Click **Create**.	

Step 3: Add the event type

When you have the secret and resource in place, it's time to specify the type of event that will be consumed or produced.

Procedure

	Command or Action	Purpose
Step 1	In CNC, select **Administration** > **Workflow Administration** > **Event Types**.	
Step 2	Click **Add event type**.	
Step 3	In the **New event type** window, provide the required input:	

	Command or Action	Purpose
Step 4	Click **Create Event type**.	

Step 4: Define the event in a workflow

Now that we have the event type added, we can create a workflow that registers for this event type and executes an action when the event is received by CWM. To do so, we'll need to:

1. Define the event using an Event definition.
2. Specify the Event state
3. Define the actions to be taken when the event occurs.

As an example, let's take a scenario where a router overheating alarm (an inbound event) triggers a single workflow event state and defines two remediation actions to be executed in response to that state.

```
{
    "id": "HighRouterTempWorkflow",
    "name": "Router Overheating Alarm Workflow",
    "start": "RemediateHighTemp",
    "events": [
```

```
        {
            "kind": "consumed",
            "name": "HighRouterTemp",
            "type": "HighRouterTemp",
            "source": "monitoring.app"
        }
    ],
    "states": [
        {
            "end": {
                "terminate": true
            },
            "name": "RemediateHighTemp",
            "type": "event",
            "onEvents": [
                {
                    "actions": [
                        {
                            "functionRef": {
                                "refName": "DispatchTech",
                                "contextAttributes": {
                                    "RouterIP": "${ .RouterIP }"
                                },
                                "resultEventTimeout": "PT30M"
                            }
                        }
                    ],
                    "eventRefs": [
                        "HighRouterTemp"
                    ]
                },
                {
                    "actions": [
                        {
                            "functionRef": {
                                "refName": "MoveTraffic",
                                "contextAttributes": {
                                    "RouterIP": "${ .RouterIP }"
                                },
                                "resultEventTimeout": "PT30M"
                            }
                        }
                    ],
                    "timeouts": {
                        "actionExecTimeout": "PT60M"
                    }
                }
            ]
        }
    ],
    "version": "1.0.0",
    "description": "Remediate router overheating",
    "specVersion": "0.8"
}
```

Note This example is not a complete workflow. It is an example of how to define an event inside a workflow, set a simple state, and then define actions to take in response to that single state. A realistic workflow can define many more states and actions to take in response to each of those states.