



Cisco WAE Coordinated Maintenance 1.2 User and Administration Guide

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Prerequisites

The Cisco WAE (WAN Automation Engine) Coordinated Maintenance application has the following prerequisites.

- You must have the SDN bundle, the WAE platform must be installed, and all system requirements must be met.
- The WAE Design Archive application must be installed and running.
- The WAE Coordinated Maintenance application must be installed and have access to one week of historical data.
- The application must have access to a plan file containing a valid model of the network that is generated and stored in an archive on a regular basis. This plan file must include a demand mesh with traffic and therefore, a snapshot¹ is required for the collection.

Take note of the archive path configured for the `archive_init -archive` and `archive_insert -archive` tools, as well as the archive name configured using `archive_config -name`. If you set the time zone for the archive insertions (`archive_insert -time-zone`), take note of this UTC offset as well. You need this information to properly configure Coordinated Maintenance.



Note

The demands are used as historical data for evaluating events. Therefore, the precision of the demand mesh used by Demand Deduction is critical to the accuracy of the evaluations. The quality of the model is directly related to how useful the application is. For instance, if the demand traffic shows one or more circuits are over utilized all the time, then the plan file will never pass an evaluation.

- The application must have access to a plan file containing a current model of the network topology that is stored in an archive as a template and updated frequently. Since there is no visualization of the network in the Coordinated Maintenance application, there is no need to update the network layout. For information on collecting data using WAE Collector and manually inserting this data into an archive, see the *WAE Platform Configuration Guide*.

This template can be created in one of two ways.

- Use the `copy_from_template` tool in the snapshot collection process. For information on the `copy_from_template` tool, access its help (`copy_from_template -help`).
- If using the WAE Live Map, configure the Map Archive on the WAE Live Settings > General Settings page. WAE Live automatically generates the template in this location once configured from here, but you need to take note of the Map archive path and network name. You need this information to properly configure WAE Coordinated Maintenance to use a WAE Live topology for templates. For information, see the *WAE Live Administration Guide*.

**Note**

The topology template must be well maintained on a regular basis such that it accurately represents the “as-built” network. Best practice is to use the WAE Live Map archive.

- You must configure the application to get the traffic (plan file) and topology (template) from their proper locations. For information, see the [Configuring Data Sources](#) chapter.

Related Topics

- *WAE Server Installation Guide* (for installing the platform)
- *WAE System Administration Guide* (for installing WAE Coordinated Maintenance)
- *WAE Live Administration Guide* (for configuring the Map archive from the WAE Live UI)
- *WAE Platform Configuration Guide* (for configuring WAE Collector to collect network data)

**Note**

Content of this guide is subject to change. The latest version of this guide is posted on cisco.com, as is all documentation referenced in this guide.



Overview

Access: Applications > Coordinated Maintenance

The WAE Coordinated Maintenance application simplifies and automates the process of managing controlled network outages by guiding you on when to perform maintenance events at optimal times. This not only reduces uncertainty about the impact of network changes, but also minimizes impact on the network during scheduled outages.

The principle is simple. You submit a maintenance event for evaluation for a given time frame, and the application returns an evaluation report that identifies the impact of temporarily taking down that object. For instance, you might need to take down all nodes in a specific area for an hour to update the software or replace linecards, or you might need to take down circuits due to rerouting of L1 cross-connects in a PoP. By submitting an event for evaluation, you gain insight into whether you can safely schedule the outage in the network.

There are a few terms to understand when using the UI and reading the documentation.

- **Event**—Activity of taking down one or more network objects for maintenance during a specified, fixed time slot.
- **Evaluation**—A set of tests that determines whether an event is permissible during the requested time slot.
- **Blackout**—Time period reserved for having no events. You can override this, if needed.
- **Overlapping event**—An event that has a date and time duration that intersects with the date and time duration of another event.
- **Plan file**—The file format used to store WAE Collector's network model.

Evaluations

Each evaluation consists of one or more groups, and each group contains one or more tests that is either built-in to the application or is created by a user. Each test has its own criteria for success. While running these tests, the evaluation process considers the following to determine the impact the proposed event will have on the traffic utilization throughout the network.

- Simulated traffic conditions for the specified time slot based on peak traffic demand for the most recently matching time period and day.

For example, if an event is proposed for a Tuesday from 8:00 to 9:00 AM, the application searches the database for data on the previous Tuesday from 8:00 AM to 9:00 AM. If no data is available, it searches the Tuesday prior for the same time until it finds data to use in the evaluation process. Usually, the data is from one week prior.

- Most recent topology
- Previously scheduled events
- Blackout windows

Multi-User Considerations

Multiple users can access the same WAE Coordinated Maintenance application, which means they are using the same collected traffic and topology sources. All users have equal privileges. Therefore, it is important to realize the impact your configurations have on others. For instance, if you schedule a blackout window, that same blackout window applies to all users. Likewise, if you change a Settings page, all users have that same default.

Users might simultaneously evaluate events for the same time period. Any evaluations completing after the first one is scheduled returns a message that there are overlapping events. When this overlap occurs, evaluations must be rerun in order to schedule the event. For information see the [Re-Evaluate Using Different Overlapping Events](#) section in the [Viewing Events and Reading Evaluation Reports](#) chapter.

Common UI Options

Task	Description
Enter paths	If entering a path, you can use any variable that is currently set in the environment on which the server is hosting the application. For example, both <code>\$CARIDEN_ROOT</code> and <code>\$WAE_ROOT</code> are acceptable, as well as variables that you set.
Search in tables	All tables have a search field. To find any information in any column, start typing the search string. The table results change automatically as you type. If you type a new entry, the search results are for the entire table (not for what is currently displaying in the table). Note that searches are not case-sensitive.
Refresh data	To refresh data in any table to show the most recent data for all users, click the Refresh icon in the tab.
Delete an event or a test	Delete an event or a test by clicking the trash can icon.

Configurations

Outside of configuring collection as input to the WAE Coordinated Maintenance application, all necessary configurations are accessible from the Settings tabs. There are no configuration files or CLI tools to access.

Troubleshooting

The WAE Coordinated Maintenance log file is `$WAE_ROOT/logs/applications.log`.

Related log files, such as for the web server, are in `$WAE_ROOT/logs`.

Both the application and web server log files are viewable from the Statistics UI, which is available from the web home page.

**Note**

`$WAE_ROOT` and `$CARIDEN_ROOT` are the same environment variables. They both mean the default installation directory, which is `/opt/cariden` by default.

Related Topics

- *WAE Design Integration and Development Guide* (for information on plan files)



Configuring General Settings

Access: WAE Coordinated Maintenance > Settings > General tab

The Database Path and Cache Directory values are application-wide parameters for all users. The Display Time Zone value is unique per user. These are defaults that cannot be overwritten anywhere but this page.

This chapter references `$WAE_ROOT`, which is the installation direction. By default, this is `/opt/cariden`, and by default, `$WAE_ROOT` and `$CARIDEN_ROOT` are the same.



Note

Since there are multiple users who have equal permissions, be considerate and cautious when making changes to any Settings page.

- **Database Path**—Full path to the local database that stores the scheduled events and those that are under evaluation. If the directory you enter does not exist, it is created for you. By default, this is the value of `$WAE_ROOT/data/appmaint`.



Note

Best practice is to not change the Database Path or Cache Directory fields once the application has used them. If you need to change either of them, you must manually move the existing contents to the new location. This practice enables you to keep existing events, and it requires that you keep the same traffic model archive.

- **Cache Directory**—When events are being evaluated, the application assesses numerous factors, including other scheduled events and their impact on the network, as well as the event under evaluation. In so doing, a plan file is generated that models the network being used for the evaluation. The entry in this field identifies where these plan files of modeled networks are stored. If the directory does not exist, it is created for you. By default, this is the value of `$WAE_ROOT/data/simplans`.
- **Display Time Zone**—The UI displays the local time zone by default. You can, however, select any time zone that you would like to use, and each user can set their own time zone. Internally, all dates and times are stored in UTC.



Configuring Data Sources

Access: WAE Coordinated Maintenance > Settings > Data Source tab



Note

Since there are multiple users who have equal permissions, be considerate and cautious when making changes to any Settings page.

WAE Coordinated Maintenance uses collections from two sources as input into the evaluation process: the traffic model and the topology template. Note that these two sources can be on the same or different hosts, but they must use the same network for their collection. [Figure 4-1](#) shows an example configuration using a remote archive for the traffic source and WAE Live for the topology source.

Traffic Model—This repository identifies the location of the plan files containing the demand traffic. This information is used for evaluating traffic during the proposed event period based on traffic during similar times and dates in the past.

Topology Template—The template is the most current view of the network topology. The topology template must be well maintained on a regular basis such that it accurately represents the “as-built” network. Best practice is to use the WAE Live Map archive.

The following fields are applicable to both the traffic model and topology template unless otherwise specified.

- **Local**—Enter the full path of the local directory containing the traffic plan file or topology template.
 - If using WAE Live (for a topology template), the path must match the entry in the Map Archive field on the WAE Live Settings > General Settings page.
 - Otherwise, the path must match the entries used when configuring `archive_init -archive`, `archive_insert -archive`, and `archive_config -path` to create and populate the repository.



Note

Best practice is to not change the traffic model location once the application has used it. If you change the archive location, start with a new database, change the value in the Database Path field (on the Settings > General page), and re-create events.

- **Remote**—This area identifies the source of remote data collections. Options include Remote WAE Live and Remote Archive.



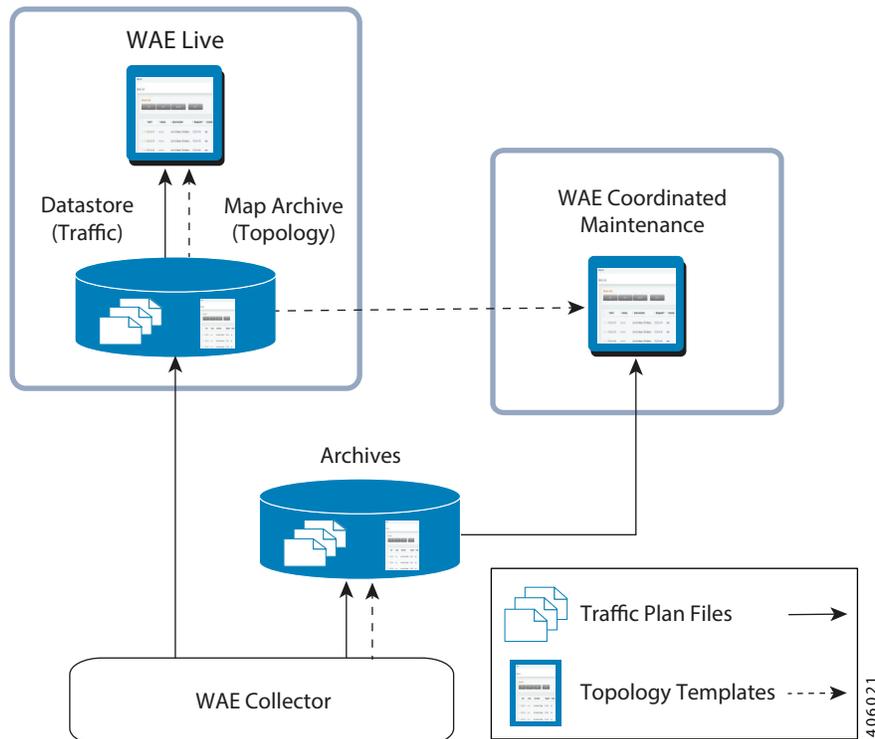
Note

Remote WAE Live is applicable only for the topology template. Remote Archive is applicable to both the traffic model and topology template.

- **Server name, protocol, and port**—Identifies the remote collection source.

- Network Name (Remote WAE Live)—Name of the WAE Live network that identifies the collection on the server. The network name must match the network name for which the Map archive is configured on the WAE Live Settings > General Settings page.
- Archive Name (Remote Archive) —Archive name that uniquely identifies this collection on the server. The archive name must match the archive name used when configuring `archive_config -name`.
- Username and Password—Username and password of the server being accessed.
- (Traffic model only) UTC Offset—The archive's time zone. If `archive_insert -time-zone` was used in the collection process, this UTC offset must be the same UTC value.

Figure 4-1 Example Coordinated Maintenance Configuration



Related Topics

- [Prerequisites](#) chapter
- *WAE Live Administration Guide* (for configuring the Map archive from the WAE Live UI)
- *WAE Platform Configuration Guide* (for configuring WAE Collector to collect network data)



Configuring Evaluations

Access: WAE Coordinated Maintenance > Settings > Evaluations tab



Note

Since there are multiple users who have equal permissions, be considerate and cautious when making changes to any Settings page.

Workflow	See
1. Configure the shortest amount of time (in minutes) that can be scheduled for an event.	Set Minimum Evaluation Interval section
2. Optional: Configure evaluations to run automatically as the event date draws near.	Automatically Re-Evaluate Events section
3. Optional: Create custom tests to use in the evaluation.	Creating User-Defined Tests chapter
4. If you want to modify the default evaluation, which consists of a single congestion test, configure which tests are run in the evaluation and in what sequence. You can also configure which tests must pass for the evaluation to pass, and whether to continue the evaluation if a test fails.	Configure Evaluations and Tests section

Set Minimum Evaluation Interval

The Minimum Evaluation Interval is the amount of time (in minutes) that an evaluation occurs.



Note

The Minimum Evaluation Interval must be no less than the minimum gap between plan files stored in the traffic model repository. For example, if there is a cron job running to execute a snapshot every 30 minutes, then the Minimum Evaluation Interval must be at least 30. Setting this interval smaller is possible, but doing so potentially results in evaluations using the same plan file when the application is searching for available event time slots.

This consistent interval, which cannot be changed elsewhere in the application, ensures that networks can be completely modeled for the evaluation process. If you change this value, the scheduled events that are in progress finish their evaluation. The status of scheduled events remains the same.

This value is also used in last-minute re-evaluations. See the [Last-Minute Re-Evaluations](#) section.

Automatically Re-Evaluate Events

Since network topology and traffic changes, while an event may have passed its initial evaluation, it might prove beneficial to re-evaluate it as close to its scheduled time as possible. The Automatic Re-evaluation option enables you to create automatic re-evaluations for such purposes. If the scheduled event fails the re-evaluation, its state changes to Pending.

To enable or disable, select the Enable Automatic Re-evaluation option. If enabled, the re-evaluations apply in the following order.

- Counting backwards from the start date, the evaluation automatically executes each week prior to the event's start time.
- Once the above time frame completes, the re-evaluation occurs every day until one day before the schedule event time.
- Once the above time frame completes, the re-evaluation occurs every 8 hours up until 2 hours prior to the scheduled event, at which time the final evaluation is scheduled.

Example: For example, if today were April 7 and you scheduled an event to start April 29 at 8:00 PM, automatic re-evaluations would occur weekly on April 8, 15, and 22, daily April 23-28, and again on April 29 at 8:00 AM and 4 PM.

Last-Minute Re-Evaluations

If you are performing automatic evaluations, you can optionally perform last-minute re-evaluations on imminent events. An *imminent event* is an event whose scheduled start time is less than two times the Minimum Evaluation Interval value (in minutes).

Example: If the current time is 7:00 PM, the event start time is 7:30 PM and the Minimum Evaluation Interval is 20 minutes, then the event is imminent since $2 \times 20 > 30$ (difference between 7:00 and 7:30).

Imminent events are re-evaluated using the most recent traffic matrix available. Provided all automatic evaluations have completed and there is still sufficient time to run an evaluation, imminent events are evaluated twice: once at $2 \times M$, where M is the Minimum Evaluation Interval value, and again at M .

Example: If the event start time is 7:30 PM and the Minimum Evaluation Interval is 20 minutes, the imminent event is automatically evaluated at 6:50 PM and again at 7:10 PM.

$2 \times 20 \text{ minutes} = 40 \text{ minutes}$

$7:30 \text{ PM} - 40 \text{ minutes} = 6:50 \text{ PM}$

$7:30 \text{ PM} - 20 \text{ minutes} = 7:10 \text{ PM}$

Configure Evaluations and Tests

Evaluation Structure

The Settings > Evaluations page is where you configure the default evaluation. However, you can modify the evaluation when adding an event.



Note

This information pertains both to this Settings > Evaluations page, as well as when adding an event.

Each evaluation consists of one or more groups, and each group contains one or more tests.

- A test cannot belong to more than one group.
- By default, there are three built-in tests, and each of them resides in a separate group. You cannot delete these built-in tests or the groups in which they reside. Nor can you edit their name or description. For a description of these tests, see the [Built-In Tests](#) section.
- You can create and include custom tests as described throughout this section. You can edit and delete these tests once added. For information on creating custom tests, see the [Creating User-Defined Tests](#) chapter.
- Each group can contain up to three tests maximum. Therefore, the default groups can additionally have two custom tests, while any newly added group can have up to three custom tests.
- All tests within a group run concurrently. The order in which they are listed does not matter.
- Groups of tests are executed in the sequential order in which they appear in the list. You can drag and drop each group to the desired location. As you do, the step number for it automatically changes so you can easily identify the order in which groups of tests are evaluated.

Built-In Tests

WAE Coordinated Maintenance has the following built-in tests.



Note

Built-in tests execute as described here. Changing their operators results in inaccurate evaluations and therefore, is not recommended.

- **Congestion Test**—Returns a list of interfaces that each have a maximum utilization that is greater than the specified value (threshold).
- **Resiliency Test**—Considers unscheduled outages during the proposed event time by executing a worst-case failure analysis, which is a simulation of all single-circuit failures in the network. The test returns a list of interfaces that each have a maximum utilization that is greater than the specified threshold.
- **Dropped Demands Test**—A *demand* represents the source and destination of a potential traffic flow across a network. A route simulation determines the route that this traffic takes from the source to the destination, which is determined by the topology, the routing protocols, and the failure state of the network. This test returns a list of traffic demands that would be unroutable as a result of the event. For instance, including a PE (provider edge) node in an event could render all paths to it as unavailable. The failure condition can be set to greater than, equal to, or less than a specified number of dropped demands.

Test Parameters

All tests have these configurable parameters.

- **Enable**—Enable or disable the test from running, but keep it within the group.
- **Must Pass**—If selected, this test must pass in order for the entire evaluation to pass. Note that if no tests in the evaluation must pass, the evaluation will always pass even if all tests within it fail. Therefore, it is best practice to set at least one test to Must Pass.

- **Stop on Failure**—If selected and the tests fails, this evaluation stops and no further tests in any group are run.

Enable	Must Pass	Stop on Failure
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

- **Failure Condition**—While failure conditions differ depending on the test, you can change the operator and the value used in meeting the criteria. Operators include criteria such as “greater than” and “equal to” the specified value.



Note Do not change the operator of built-in tests.

Failure Condition: Maximum utilization <input type="text" value="greater than"/> <input type="text" value="75"/>
--

UI Tips

To ...	Do This ...
Expand or collapse groups.	Click the arrow icon next to the [Step #].
Execute groups in a preferred sequential order.	Drag and drop the tile to the desired location. You can grab anywhere in the tile or use the four-arrow icon.
Add a group.	Click the plus sign at the bottom of the list of groups.
Add an existing user-defined test to a group.	Expand the group, and then click the plus sign at the bottom of the list of tests.
Delete a group containing only user-defined tests, or to delete a user-defined test within a group.	Click the associated trash can icon.



CHAPTER 6

Creating User-Defined Tests

Access: WAE Coordinated Maintenance > Settings > User-Defined Tests tab

In addition to the built-in tests, you can create customized tests for inclusion in evaluations. The communication between your API and the WAE Coordinated Maintenance application is achieved through the Settings > User-Defined Tests page. When an evaluation is run that contains a user-defined test, the application sends the API a set of parameters on which to conduct the test. In return, the API returns the results to the application for inclusion in the evaluation.

For an example start to finish, including an example API, see the [Example](#) section. The full script used in this example is in

```
$WAE_HOME/mate/current/lib/web/apache-tomcat-6.0.37/webapps/ROOT/services/maintenance/samples. By default, $WAE_HOME is /opt/cariden/software.
```

Workflow	See
1. Create the API that runs the test.	Input and Output sections
2. Configure the Settings > User-Defined Tests page so that the WAE Coordinated Maintenance application and the API can communicate.	Configure User-Defined Tests section
3. Either configure the default evaluation to include the custom test, or add the custom test when adding an event.	Configuring Evaluations chapter

Input

The input is passed to the custom test when the evaluation is run. The API must be able to take the following input in multipart/form-data format that will be passed using the HTTP POST method.

Input Parameter Passed to the API	Format	Description
startTime	yyyy-MM-dd HH:mm:ss	Date and time the event is to start in UTC.
stopTime	yyyy-MM-dd HH:mm:ss	Date and time the event is to stop in UTC.
operand	String for comparison; this can be a double string or an integer string. Examples: 90.00, 10, acme	The criteria value used in the evaluation.

Input Parameter Passed to the API	Format	Description
operator	> < = >= <=	Supported operators used when the operand value is compared to the result. When a comparison is true, the test fails. When a comparison is false, the test passes. Example: If the operand is 75, the result is 80, and operator is >=, then the test fails.
nodes	JSON string that identifies an array of nodes by nodeName	List of nodes used in the evaluation.
circuits	JSON string that identifies an array of circuits by nodeAName, intfA, nodeBName, intfB intf means "interface."	List of circuits used in the evaluation.
ports	JSON string; array of ports by nodeAName, portA, nodeBName, portB	List of ports (LAG members) used in the evaluation.
planFile	File attachment byte stream	Representation of the network during the maintenance event.
origFile	File attachment byte stream	Representation of the network before evaluations are run.

Example Input

In this example, one node, two circuits, and two ports are passed to the custom test. The start time is July 7, 2016 at 10:00 AM (local time), and the duration is three hours. These are entered when adding the event.

The operand is 80, and the operator is > (greater than). These are specified in the UI when adding the custom test to the UI.

```
{
  "planFile": (as a file attachment)
  "origFile": (as a file attachment)
  "nodes": [{"name": "AM_ATL_ER2"}],
  "circuits": [{"nodeAName": "192.168.249.0/24:BgpPsn", "nodeBName": "ASN65300:192.168.30.1",
    "intfA": "TenGigE0/0/0/2", "intfB": "to_EU_AMS_AMSIX"}, {"nodeAName": "192.168.243.0/24:BgpPsn",
    "nodeBName": "ASN65370:192.168.37.1", "intfA": "xe-1/0/1", "intfB": "to_AM_NYC2_EQUINIX"}],
  "ports": [{"nodeAName": "AM_DC_NORTH_BB1", "nodeBName": "AM_DC_NORTH_BB2", "portA": "TenGigE1/0/1",
    "portB": "TenGigE1/0/4"}, {"nodeAName": "AM_DC_NORTH_BB1", "nodeBName": "AM_DC_NORTH_BB2",
    "portA": "TenGigE1/0/2", "portB": "TenGigE0/0/4"}],
  "startTime": "2016-07-07 10:00:00",
  "stopTime": "2016-07-07 13:00:00",
  "operand": "80.00", "operator": ">"
}
```

Output

The custom test's output is passed to the application's evaluation process once the test completes. The API must be able to produce text/plain and application/JSON. The API for the custom test must return these values to the application.

This information appears in the UI in the Summary Report section. The "details" are shown when you click the View Report button next to a failed test.

Output Parameter Passed to the Application	Format	Description
result	String, which must be either "pass" or "fail"	Identifies whether the test passed or failed
score	Real number	Test score
details	CSV	If the test passes (result = pass), this can be left empty. If the test fails (result = fail), this identifies the test report. It must include column headings and one row for each object that failed the test.

Example Output

Pass—The test passed with a score of 47.58. No report is added.

```
{"result": "pass", "score": 47.58, "details": ""}
```

Fail—The test failed with a score of 118.77. The report includes one row of headings and one row of data for the circuit that caused the test to fail.

```
{"result": "fail", "score": 118.77, "details": "[[\"Node\", \"Circuits\", \"Utilization\", \"Traffic Level\", \"Start Time\", \"Stop Time\"], [\"AM_BOS_ER2\", \"TenGigE0/0/1\", \"118.77\", \"Default\", \"2015-04-07 10:00:00\", \"2015-04-07 13:00:00\"]]}
```

Configure User-Defined Tests

Once the API that executes the custom test is created, you must configure the Settings > User-Defined Tests page to set up communication between the API and the application.

General

- **Test Name**—Name of the test. These names appear as a selectable options to add to groups of tests on the Settings > Evaluations page.
- **Description**—(Optional) Summarized explanation of the test, which is particularly useful for communication purposes when there are multiple users.

Resource

This section defines how the application communicates with the API.

- **URI**—Full name of the resource used by the application to reach the API. The URI format is as follows. For scheme, only http and https are supported.

Required format: scheme://[host[:port]][/]path

Example: https://172.12.123.0:8888/opt/acme/tests

Format with optional query and fragment: scheme://[host[:port]][/]path[?query][#fragment]

Example: https://172.12.123.0:8888/opt/acme/tests?event=23#results

- **Authentication**—(Optional) If selected, the URI requires authentication to access it.
 - **Type**—Only Basic authentication is supported.
 - **Username and password**—Username and password that secures the access to the URI.

Test Results

- **Score Label**—Label that appears next to the score in the evaluation report to identify what that score represents.
- **Pass Message**—(Optional) Message that appears next to the word “Pass” in the evaluation report.
- **Fail Message**—(Optional) Message that appears next to the word “Fail” in the evaluation report. This message is particularly useful when other users are generating evaluations with a custom test that they did not develop.

Report

- **Name**—Name of the report included in the evaluation results.
- **Display only if failed**—If selected, display the report only if the test fails.
- **Require original plan**—The application always passes the API a plan file that represents the network during the maintenance event. By selecting this option, you are telling the application to also pass the API the original plan file that represents the network prior to the maintenance event. This original plan can be useful when comparing plan files before and during the event.

Example

This example user-defined test is an over simplified way of demonstrating the most basic components of creating a custom test. The test itself looks for nodes that have the letter “o” in their names. If more than two nodes are found that meet this failure condition, the test fails.

Example API

This section of an API focuses on the handler section of code that takes the application input, loads it into the API framework, and returns results back to the application. This example is using a Tornado python web application package, which must be separately installed. Comments as to what this handler is doing are inline.

```
# Handlers are invoked based on which resource is being accessed in this application.
# There is one handler per resource.

# This handler is for the simple "noOrouters" resource. This resource implements a simple
# test that examines the list of specified nodes and returns a list of any nodes that have
# the letter "o" in their names. It also compares the number of these matching nodes
# against the specified test fault condition (criterion) to return "pass" or "fail,"
# as well as the number of matches.
class NoORoutersHandler(RequestHandler):
    def initialize(self,db) :
        self.db = db
    def post(self,foo='foo') :

        # The test report is returned as an array of arrays. The first contained array
        # is a list of column names for what will be rendered as a table in the UI.
        # There is only 1 column called "Nodes with O," so the array has only 1 element.
        # Note that the details passed must include a column name per column of data.
        matching = [{"Nodes with O"}]

        # Get the list of nodes that were specified in the event. Consider only nodes,
        # and ignore circuits and LAG members.
        nodes = json.loads(self.get_argument('nodes'))

        # Get the threshold value.
        operand = self.get_argument('operand')

        # The value of the threshold is a count of matching nodes, so convert it
        # to an integer.
        try:
            thresh = int(operand)
        except:
            thresh = int(float(operand))

        # Get the comparison operator that was selected.
        oper = self.get_argument('operator')

        # Use the "operator" python module to match this to a usable comparison operator.
        import operator
        ops = {
            '>' : operator.gt,
            '<' : operator.lt,
            '=' : operator.eq
        }
        compare = ops[oper]

        for n in nodes :
            if 'o' in n['name'].lower() : # Check for "o" in the name.
                if n['name'] not in matching : # Check for duplicates.
                    matching.append([n['name']]) # Append it to the list of matching nodes.

        # If any matches were found, the "matching" array will contain 1 entry for the column
        # title and 1 entry for each match. Therefore, the number of matching entries is the
        # length of the "matching" array minus the title row. Note that a score
        # and a result are passed back to the application.
        score = len(matching) - 1
```

Example

```

self.db['response']['score'] = score

# Check how the score compares with the threshold.
if compare(score,thresh) :
    self.db['response']['result'] = 'fail'
else :
    self.db['response']['result'] = 'pass'

# Add the report. Note that details must be passed back to the application. All
# matching nodes are placed in details such that there is one row per matching node.
self.db['response']['details'] = json.dumps(matching)

# Tornado automatically handles setting the content-type of the response.
self.write(self.db['response'])

def make_app():
    return Application([
        url(r"/noOouters/(.*)", NoOoutersHandler,dict(db=db),name='noOouters'),
    ])

```

Example Input

Following is the input passed to the user-defined test as a result of the UI input shown in [Figure 6-1](#) and [Figure 6-2](#).

```

{
  "planFile": "(as a file attachment)"
  "nodes": [{"name": "AM_ATL_ER1"}, {"name": "AP_BEI_ER4"}, {"name": "AP_TOK_BB3"}, {"name": "AM_
  BOS_ER2"}, {"name": "EU_LON_ER4"}]
  "startTime": "2016-04-07 17:00:00",
  "stopTime": "2016-04-07 18:00:00",
  "operand": "2", "operator": ">"
}

```

Figure 6-1 Example UI Input When Adding Event

Nodes for Maintenance

Note: All circuits connected to the selected nodes are included.

Nodes: AM_ATL_ER1 × AP_BEI_ER4 × AP_TOK_BB3 × AM_BOS_ER2 × EU_LON_ER4 ×

* Start: 2016-04-07 17:00

Duration: 1 hours

408202

Figure 6-2 Example UI Input When Adding User-Defined Test

[Step 4] (Please select and add a test)

Enable	Must Pass	Stop on Failure	Info
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Name: 0 Nodes Description: Check for nodes that have the letter "o" in their names Failure Condition: Number of 0 Nodes greater than 2

408201

Example Output

In the above API, the score, result, and details are these lines. [Figure 6-3](#) shows how these results appear in the UI.

```
{ "result": "fail", "score": "3", "details": "[ [ \"Nodes with  
O\" ], [ \"AP_TOK_BB3\" ], [ \"AM_BOS_ER2\" ], [ \"EU_LON_ER4\" ] ]" }
```

Figure 6-3 Example UI Output from User-Defined Test

Summary Report				
(Aggregated test result: Fail)				
Test Name	Start Time	Stop Time	Result	Test Score
	UTC-06:00 Central Standard Time	UTC-06:00 Central Standard Time		
O Nodes	2016-04-07 17:00	2016-04-07 18:00	Fail	3

View Report

Node Names Containing Letter "o"
FAIL - There are nodes whose name includes the letter "o"
Nodes with O
AP_TOK_BB3
AM_BOS_ER2
EU_LON_ER4

406200

Related Topics

- *WAE Design Integration and Development Guide* (for information on plan files)



Adding Events

Access: WAE Coordinated Maintenance > Maintenance > Maintenance Events tab, +Add Event link

An *event* is the activity of taking down one or more network objects for maintenance during a specified, fixed time slot. At the end of the sequence for adding an event, you must run an evaluation. If the evaluation passes, you can schedule or save it as pending for further analysis. If it fails, then you can only save it as pending. Only scheduled events are considered in evaluations for other events.

The UI leads you through the following workflow, though at any time you can click Back to reach a previous page to make modifications.

Configure and Schedule Events

- Step 1** Select the Maintenance > Maintenance Events tab.
- Step 2** Click the +Add Event link (top right).

Name the Event and Evaluation Thresholds

- Step 3** Enter a name to identify the event. It is a best practice to uniquely name the event for easy identification in the Maintenance Events table. If two events have exactly the same time slots, then they must be uniquely named.
- Step 4** Optional: Enter a description. For instance, this description can be used as a reminder of the event's purpose, or you can use this area to communicate with other users.
- Step 5** Select which evaluation tests to run. For information on configuring evaluations or adding user-defined tests to them, see the [Configuring Evaluations](#) chapter and [Creating User-Defined Tests](#) chapter, respectively.
- Step 6** Click Next to specify which objects to include. If you stop here, your changes are not saved.

Select Objects to Take Down

- Step 7** Select which objects you want to take down during the event. Options include nodes, circuits, and LAG members.
If you select nodes, all circuits connected to the nodes are included in the evaluation.
 - Choose Objects—You can choose nodes, circuits, and/or LAG members for inclusion in the event.

If selecting circuits or LAG members, you must first select the source node of the interface.

In the Nodes or Node field, start typing. Just below the field a list of selectable objects appears. Select one. You must re-enter information for each object you want to select.

For circuits, you must select one or more of its interfaces, and for LAG members, you must select one or more of its ports using the same method as described for choosing nodes.

- Search for Objects—You can search for circuits and LAG members. This could be useful for finding circuit IDs in the circuit Description field.
 - In the Search field, type a partial or full string, and then click the magnifying icon.
 - You can search lists of objects by entering the list or by cutting and pasting them into the Search field. These lists must include one object per row with no ending punctuation, such as a comma. A list could be useful, for instance, for finding a set of ports in a particular region of the network.

Example: You could cut and paste the following list in a Circuits or LAG Members Search field.

```
cr1.chi
cr2.chi
er1.chi
```

From the list of available objects, select or deselect objects using the left check boxes. The top check box is for selecting and deselecting all objects in the list.

Step 8 Click Next to schedule the event. If you stop here, your changes are not saved.

Schedule the Event

All events must start on the hour, and all duration periods are in hours. All events are scheduled in the UTC offset and time zone appearing next to the Start and Time Range fields.

Step 9 Select whether to use a specific date and time, or whether to search for time slots. With either option, you must enter the duration period in hours 1-24. If you want an event to occur all day, start it at 00:00 and set the duration to 24.

The date and time format is yyyy-mm-dd-hh:mm.

- Specify Event Time—The event is to start on the exact day and time. Either enter the day and time, or select it from the calendar.
- Search for Time Slots—The application returns the first one to five available time slots in which this event passes an evaluation. Enter From and To dates and times to specify a range of time in which the application searches, or use the calendar to make these selections.

Run Evaluation and Save the Event

Step 10 From the page on which you scheduled the event, you have two alternatives for running the evaluation.

- Click Evaluate. Once the evaluation finishes, you can save as pending or admit it as scheduled.
- Click Evaluate and then select to run the evaluation in the background.

Step 11 If you searched for available time slots (step 9), a list of time slots is returned. Each result shows the highest utilization of any circuit during the event. Select one. If you ran the report in the background, these choices are available in the Maintenance Events tab by clicking the eye icon for the appropriate event.

Step 12 Once the evaluation completes, if it fails, either cancel the event, take action to find a time slot that works, unschedule overlapping events, or save it as pending.

If the evaluation passes, save the event by scheduling it or setting it to pending. If you ran the report in the background, periodically check the Maintenance Events table for the completion of the evaluation so you can then save it in a timely manner.

- **Schedule Event**—This option schedules the event in the calendar. All scheduled events are considered in the evaluation of other events that are evaluated using the same time slot.
- **Save as Pending**—This option saves the event, but it does not schedule it. Pending events are not included in other evaluations, and they require re-evaluations to schedule. Pending events are typically used when you need to further analyze the event at a future date.

**Note**

Unless you are placing events in Pending status for further analysis, it is best practice to schedule events once they pass their evaluations. The reason is because evaluations take time and because the scheduling of new events could affect the validity of the evaluation. Therefore, if running evaluations in the background, it is a good idea to periodically check the Maintenance Events table for their completion.



Adding Blackouts Windows

Access: WAE Coordinated Maintenance > Maintenance > Blackout Windows tab, +Add Blackout Window link

A *blackout window* is a time period reserved for having no events. You may, for instance, want to blackout a time period for when traffic is at its highest or when personnel are on vacation. You can also set recurring blackout windows. One common use case would be to prevent the scheduling of events during mandated network change moratoriums.

When the application looks for available event time slots, it skips the blackout windows.

When scheduling an event, you are warned if there are overlapping blackout windows; however, you have the option to override the warning and schedule the event anyway.

Before saving a blackout window, a list of scheduled events that occur entirely or partially within the blackout window appears. If you save a blackout window when there is an overlapping scheduled event, the event status changes to Pending. Such events require re-evaluation and often require editing their time slot in order to successfully reschedule them.

The workflow for adding a blackout window is as follows. Once a blackout has been created, you can view overlapping events by clicking the eye icon or you can delete the blackout by clicking the trash can icon.

-
- Step 1** Select the Maintenance > Blackout Windows tab.
 - Step 2** Click the +Add Blackout Window link (top right).
 - Step 3** Enter a name to identify the blackout window. It is a best practice to uniquely name blackout windows for easy identification in the table. If two blackout windows have exactly the same time slots, then they must be uniquely named.
 - Step 4** Optional: Enter a description. For instance, this description can be used as a reminder of the blackout window's purpose, or you can use this area to communicate with other users.
 - Step 5** Either enter an exact start day and time, or select it from the calendar. Enter the duration interval in hours 1-24. If you want a blackout to occur all day, start it at 00:00 and set the interval to 24.
 - Step 6** If this is a recurring event, select the Recurring option and then specify the recurrence interval. These intervals are set to occur every 1-10 days, weeks, months, or years.
Example: If you set the start time to Dec 15 at 7:00 AM for a duration of 2 hours, and if you set the blackout to reoccur every 3 months, the first three blackouts would be Dec 15, March 15, and June 15, all starting at 7:00 AM and lasting for 2 hours.
 - Step 7** Click Next.

Step 8 Read the Overlapping Events list to determine if there are scheduled events during the configured blackout window. If there are, either click the Back button to reschedule a different blackout time, or save the blackout window.



Managing Events

Access: WAE Coordinated Maintenance > Maintenance > Maintenance Events tab

The Maintenance Events table gives you a full view of all events, their status, and the status of their evaluations. From here you can add new events, view event details and evaluation results, unschedule events, re-run evaluations, delete events, and stop evaluations that are in progress.

To keep the table updated with your event and evaluation changes, select the Keep Data Current option. However, to refresh the table with data from all users, click the Refresh icon in the tab.

Event Status

The Event Status identifies the event's standing in the process.

- **Active**—This scheduled event is in progress. That is, the start day and time has begun, but the duration interval has not yet ended.
- **Expired**—The event is saved, but the end day and time for the event has passed. If you wish to schedule this event again, you must re-evaluate it with new Start and Duration parameters.
- **New**—The event has not been saved as pending or scheduled. If you attempt to save it as scheduled and if there have been new events saved that overlap this event's time slot since you ran the evaluation, you must re-run the evaluation prior to saving.
- **Pending**—The event is saved, but not scheduled. Pending states occur because you saved an event that way, because a re-evaluation failed, or because a blackout window was scheduled over the event. To schedule a pending event, you must re-evaluate it.

While an event is being re-evaluated, its status temporarily changes to Pending.

- **Scheduled**—This event is scheduled for maintenance and is currently being considered in all event evaluations. If an event is scheduled, you can re-evaluate it by clicking on the check-mark icon, or you can unschedule it by clicking on the eye icon.

Start and Stop Times

These columns identify the start and stop times for the events in the local time zone. If you are running an evaluation in the background and if you selected to have the application return recommended time slots, this column says TBD.

Evaluation Status and Validation

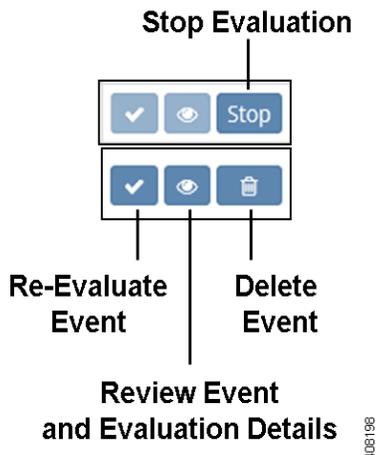
The Evaluation Status identifies the status of the evaluation process.

- Complete—The evaluation has completed.
- Queued—The first test within the evaluation has not yet started, but is queued to start.
- In progress—The evaluation is currently running. If the evaluation is in progress, periodically check back to see if it failed or passed its evaluation so that you know whether and when to schedule it.
- Empty—This is a new event that has not yet been evaluated.

The Validation value identifies whether the evaluation passed or failed. No event can be scheduled until its Validation value shows Pass. If this column is empty, then no evaluation has been run.

Available Tasks

All actions that you can take from the Maintenance Events table are available via icons on the far right.



To...	Click the...
Re-evaluate a pending or scheduled event.	Check-mark icon
Stop an evaluation that is in progress or cancel a new event.	Stop icon
Delete an event.	Trash can icon
View event details, such as which objects are being taken down, and view the results of the evaluation tests. Note that the Event Status and Evaluation Status dictate a number of actions that can be taken from the View page. For information, see the Viewing Events and Reading Evaluation Reports chapter.	Eye icon
Add an event; for more information, see the Adding Events chapter.	+Add Event link
View existing blackout windows or create a blackout window.	Blackout Windows tab



Evaluating Events

Evaluating an event is the last step in the workflow for adding events.

Several factors affect the time it takes to run an evaluation, including the number of objects under evaluation, the duration of the proposed event, and the number of other events that are already scheduled. Therefore, you have the option to schedule evaluations in the background.



Note

Unless you are placing events in Pending status while further analyzing other events, it is best practice to schedule events once they pass their evaluations. The reason is because evaluations take time and because the scheduling of new events could affect the validity of the evaluation. Therefore, if running evaluations in the background, it is a good idea to periodically check the Maintenance Events table for their completion.

Re-Evaluate Events

You can re-evaluate events at any time.

- To re-evaluate a scheduled event, click the check-mark icon in the Maintenance Event table.
- You must re-evaluate pending events before they can be scheduled. From the Maintenance Event table, click the check-mark icon.
- You must re-evaluate events whose evaluations fail before those events can be scheduled. For more information, see the section.
- Scheduled events are automatically re-evaluated if the Enable Automatic Re-evaluation option is selected from the Evaluation Settings page. For more information, see the [Configuring Evaluations](#) chapter.
- From the View page, you can re-evaluate events if there are overlapping events. For information, see the [Re-Evaluate Using Different Overlapping Events](#) section in the [Viewing Events and Reading Evaluation Reports](#) chapter.

Simultaneous Evaluations

If multiple evaluations are running, they will finish at different times. If an evaluation finishes and its event is scheduled before another evaluation finishes, and if that newly scheduled event overlaps the time slot for one that is under evaluation, you must re-evaluate the second event.

Example: Evaluations for events A, B, and C are running. The time slots for B and C overlap. Event C finishes first and you schedule it. When the evaluation for event B finishes, event C will be listed as an overlapping event. You must re-evaluate event B before you can schedule it. Event A is unaffected by events B and C since they use different time slots.

Evaluations of Overlapping Events

One of the admission criteria for a new event is that it not violate the admission criteria of a previously scheduled event. Additionally, all scheduled overlapping events must be accounted for in the proposed event's evaluation. Thus, when a scheduled event is overlapping a newly proposed event, the evaluation process re-evaluates scheduled events for those overlapping windows to ensure their criteria is honored and also conducts evaluations for all possible network states.

Example: Scheduled event A takes down node cr1.fra and is scheduled for November 8 from 3:00 to 5:00 AM. A proposed event B is to take down node cr1.par on November 8 from 4:00 to 6:00 AM. There is one overlapping hour from 4:00 to 5:00 AM. As a result, the following evaluations occur.

- Event A is re-evaluated from 4:00-5:00 AM to verify that by taking down cr1.par in that time frame, the criteria for event A (which is taking down cr1.fra) is not violated. If it is, then event B cannot be scheduled.

If event B is scheduled and automatic re-evaluations are configured, event A is re-evaluated in two segments: once from 3:00-4:00 AM with only cr1.fra taken down and again from 4:00-5:00 with both nodes taken down.

- Event B is evaluated from 4:00-5:00 AM with a network state of both cr1.fra and cr1.par being taken down.
- Event B is evaluated from 5:00-6:00 AM with a network state of only cr1.par being taken down.

The above is a very simple example that is carried through no matter how complex the overlapping scenarios are. Each test segment displays its results in the Summary Report section on the View page.

Handling Evaluation Failures

The simplest method of handling an evaluation failure is to delete the event if you are certain you do not want to schedule it. Otherwise, you can try re-evaluating it.

- Run the re-evaluation using a new time slot.
- Ask the application to search for other time slots. For more information, see the [Search for Time Slots](#) section in the [Viewing Events and Reading Evaluation Reports](#) chapter.
- An evaluation might fail due to an overlapping event. If the overlapping scheduled event has a lower priority than the one you are attempting to schedule, then you can delete the existing event. The safest way to determine if you want to take this action is to use the Overlapping Events feature that enables you to re-evaluate based the inclusion and exclusion of one or more overlapping events. For more information, see the [Re-Evaluate Using Different Overlapping Events](#) section in the [Viewing Events and Reading Evaluation Reports](#) chapter.

Manage Evaluations

To...	Do This...
Evaluate newly added events that have not been saved as pending or scheduled	<p>Click the Evaluate button at the end of the workflow for adding an event.</p> <p>Click the eye icon in the Maintenance Events table.</p>
View completed evaluations	Click the eye icon in the Maintenance Events table.
Re-evaluate scheduled events	Click the check-mark icon in the Maintenance Events table. If needed, change the start time and duration interval. No other changes in evaluation can be made to a scheduled event.
Re-evaluate pending events	<p>Click the check-mark icon in the Maintenance Events table. If needed, change the start time and duration interval. No other changes in evaluation can be made to a pending event.</p> <p>If there are overlapping events, click the eye icon. Change the overlapping evaluations included in the evaluation. For information, see the Re-Evaluate Using Different Overlapping Events section in the Viewing Events and Reading Evaluation Reports chapter.</p>
Stop an evaluation that is in progress	Click the Stop button in the Maintenance Events table (background events) or in the evaluation process window (foreground).
Discard a re-evaluated event	After running a re-evaluation, click the Discard button on the View page for associated event. The results of the previous evaluation remain in tact.



Viewing Events and Reading Evaluation Reports

Access: WAE Coordinated Maintenance > Maintenance > Maintenance Events tab, eye icon

From the View page, you can perform the following tasks.

- [View Events and Read Evaluation Reports](#)
- Available actions
 - [Re-Evaluate Using Different Overlapping Events](#)
 - [Download Files Used in Evaluations](#)
 - The status of the event and evaluation determines other actions you can perform as described in [Table 11-1](#)

View Events and Read Evaluation Reports

To review information about a specific event, including details about the tests run within its evaluation, click its associated eye icon from the Maintenance Events tab. The View page lists the following information.

- General information that identifies the event or proposed event, such as start/stop time, last time the event was evaluated, objects included in (taken down for) the event, and tests run in the evaluation. The test information includes their parameters, such as whether success was required to pass the evaluation, whether the evaluation would stop upon failure, and the criteria used for determining whether a test passed or failed.

For New and Pending events, click the View Detail button to see these parameters.

- Scheduled events that overlap the time slot of the event you are viewing.
- List of nodes, interfaces, and LAG members that the application did not recognize in the evaluation process. The reason an object is not recognized is that an overlapping event contains objects that are no longer available in the current evaluation. This could happen due to an object being removed from the network and thus, being removed from the topology template.
- List of scheduled events that overlap the time slot of the given event. If there are overlapping events, you can select or deselect them, and then click the Re-evaluate button to assess the outcome if one or more overlapping events did not exist.
- Summary Report identifying each test within the evaluation, including the test score and pass/fail result. For more details on a specific report, click the View Report button. For passed tests, this only lists the Pass message. For failed tests, each object that failed to meet the criteria is listed.

The aggregated test result reflects the “Must Pass” status and the criteria, where criteria is based on user-specified operators and operands. If all tests that must pass meet their criteria, the aggregated test result is Pass. If any one of these must-pass tests fail to meet their criteria, the aggregated result is Fail.

Note that the Summary Report shows the results of evaluations that have been segmented due to overlapping events. In this case, the same test for the same event is listed multiple times, with each representing a different time and state of the network. For information, see the [Evaluations of Overlapping Events](#) section in the [Evaluating Events](#) chapter.



Note If no tests within the evaluation are marked “Must Pass,” then the aggregated result is Pass, regardless of whether one or more tests fail to meet their criteria. Similarly, if all tests are disabled, the aggregated result is Pass. Caution should be taken with these test results because you can schedule any event that passes its evaluation.

Available Actions

The status of the event and evaluation determines which actions can be taken from the View page as described in [Table 11-1](#).

Other tasks that are not based on this criteria are the following.

- [Re-Evaluate Using Different Overlapping Events](#)
- [Download Files Used in Evaluations](#)

Note that you can re-evaluate any event with an event status of Pending or Scheduled by clicking the check-mark icon.

Table 11-1 Available Actions on View Page

Event Status	Evaluation Status	Validation	Available Actions on View Page
New	Complete	Pass	Save as Pending Schedule Event If the Start Time and Stop Time are TBD, you first have options to select the time slot.
New	Complete	Fail	Save as Pending Search for Time Slots
New	Stopped		Save as Pending Search for Time Slots
Pending	Complete	Pass	Discard the evaluation. The event remains in a Pending state. Save as Pending Schedule Event
Pending	Complete	Fail	None
Pending	Complete	Pass	None

Table 11-1 Available Actions on View Page

Event Status	Evaluation Status	Validation	Available Actions on View Page
Pending		Fail	None
Scheduled		Pass	Unschedule an event. This keeps the event, but changes its status to Pending.

Re-Evaluate Using Different Overlapping Events

The “Other Events Overlapping Selected Time Window” section lists any scheduled events that overlap the one being viewed. Rerunning an evaluation with one or more of these events not considered in the evaluation might enable you to better prioritize which events are desired based their results or to their criticalness to business. You might, for example, find that re-evaluating without a scheduled event gives you better utilization results.

You might also find that you are unable to schedule an event unless a currently scheduled event is deleted. By re-evaluating without another event considered, you can determine if you need to delete the existing event.

-
- Step 1** Deselect the Overlap option to remove an event from consideration when running the evaluation, or select it to include the results of that scheduled event.
- Step 2** Click the Re-evaluate button.
- Step 3** Repeat the above steps, selecting and deselecting overlapping events until you have the right combination for achieving the desired results.
-

Search for Time Slots

The search feature finds the available time slots in sequential order. For instance, if you want three results, the feature returns the first three available time slots that pass all must-pass tests. After clicking Search for Time Slots, make the following selections.

- Select how many results to return (1-5).
- Enter From and To dates and times to specify a range of time in which the application searches, or use the calendar to make these selections.

The event duration remains the same as the originally specified event and cannot be changed from here.

Any evaluation that was run in the background with the option to find available time slots appears with TBD in the Start and Stop time slots in the Maintenance Events table. The corresponding View page shows options for choosing those time slots.

Save Events

- Schedule Event—This option saves the event to the calendar. All scheduled events are considered in the evaluation of other events that are evaluated thereafter.

- **Save as Pending**—This option saves the event, but it does not schedule it. Pending events are not included in other evaluations, and they require re-evaluations to schedule. Pending events are typically used when you need to further analyze the event at a future date.

Download Files Used in Evaluations

After an evaluation passes, you can download the plan files that were used to produce the test results. This plan file represents the network during the maintenance period. If the test uses a *before* plan that represents the network prior to the event, this plan file is also included. For instance, the Dropped Demands test uses a before plan file.

These plan files are named with timestamps.

Example: 2016-11-08T04_00_00_to_2016-11-08T07_00_00.pln

If the download contains a comparison plan, such as used with the Dropped Demands test, that plan file is labeled with the word *before*.

Example: 2016-11-08T04_00_00_to_2016-11-08T07_00_00_before.pln

With overlapped events, there are multiple plan files, each representing a different event.

-
- Step 1** From the Maintenance Events page, click the eye icon associated with the event of interest.
- Step 2** At the bottom of the View page, click the “Download Simulation Files Used in Evaluation” link.
- Step 3** Open or save the files to a location of your choice.
-

Optionally, if you have WAE Design, you can open the plan file for further assessment. This can be particularly useful for failed evaluations, as well as for comparing the before plan file to the one that represents the network during the event. Following are a few WAE Design examples for reviewing information in these plan files. For more information, see the *WAE Design User Guide*.

- To determine the most utilized interfaces, toggle the Traff Sim column in the Interfaces table.
- If you are analyzing resiliency results, show the Failure Impact view to determine the impact that each failed circuit has on interface utilizations throughout the network. Alternatively, show the Worst-Case view to determine the highest utilization that each interface experiences when all circuits are failed.
- To compare the before and after plan files, open both plan files and select the Reports > Compare Plans menu.