



## Automation Applications

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## Automation Applications

Automation applications rely on having real-time network models to work with. Applications get a copy of the latest network model (primary model) to either run optimization against or manipulate based on what the application's purpose or function is.

You can then view the network model using WAE Design (**File > Open From > WAE Modeling Daemon**).

## Bandwidth on Demand Configuration Workflow

The Bandwidth on Demand application models and predicts the impact of a new service. This application is used when provisioning new services that requires persistent bandwidth and specific IGP or TE metric demands. The application finds a path for the SR policies being delegated in the network. For more information on the Bandwidth on Demand application, see [Bandwidth on Demand Application](#).

This workflow describes the high-level configuration steps to configure Bandwidth on Demand and other components.



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### Note

- Before enabling Bandwidth on Demand, confirm that the Bandwidth Optimization application is not running. You cannot run both applications at the same time.
  - Make sure the sr-traffic-matrix-nimo as part of the aggregator (step 4) is enabled. See [Segment Routing Traffic Matrix Collection](#)
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Steps	For more information, see ...
1. Configure device authgroups and SNMP groups	<a href="#">Configure Device Access Using the Expert Mode.</a>
2. Configure a network access profile	<a href="#">Configure Network Access</a>
3. Configure the XTC agent	<a href="#">Configuring XTC Agents Using the Expert Mode</a>
4. Configure the aggregator	<a href="#">NIMO Collection Consolidation</a> <b>Note</b> Make sure sr-traffic-matrix-nimo is part of the configuration.
5. Configure the WAE Modeling Daemon (WMD)	<a href="#">Configure the WAE Modeling Daemon (WMD)</a>
6. Run topology and additional NIMOs.	<a href="#">Network Interface Modules (NIMOs)</a>
7. Configure the Bandwidth on Demand application and SR policies.	<a href="#">Configure Bandwidth on Demand, on page 2</a>
8. Open the network model.	You can get a visual network model layout using WAE Design. From WAE Design, navigate to <b>File &gt; Open From &gt; WAE Modeling Daemon</b> and select the final network model. <b>Note</b> After initial configuration, you may run NIMOs anytime and the Bandwidth on Demand application will update the network model.

## Configure Bandwidth on Demand

### Before you begin

This procedure describes the configuration options for the Bandwidth on Demand application. For the complete configuration workflow, see [Bandwidth on Demand Configuration Workflow, on page 1](#). For an example of the entire workflow, see [Initial Bandwidth on Demand CLI Configuration Example, on page 3](#)

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- Step 1** From the Expert Mode, in **Configuration editor**, navigate to `/wae:wae/components/bw-on-demand:bw-on-demand` and click the **config** tab.
- Step 2** Enter the following values:
- **xtc-agents**—Select the XTC agents.
  - **enable**—Select true to enable the Bandwidth on Demand application.
  - **keepalive**—Enter the keepalive interval. The Bandwidth on Demand application and XTC exchange keepalive messages to maintain a persistent connection. If the connection fails, the Bandwidth on Demand application shuts down, clears current state, tries to reconnect, and re-delegate the SR policies.
  - **priority**—In case there are multiple Bandwidth on Demand application instances, enter the priority level for this instance. XTC will then delegate instances depending on the priority level.

- **util-threshold**—Enter the congestion constraint (in percentage). When the Bandwidth on Demand application searches a path for the policies being delegated, it will avoid any paths that may exceed the congestion utilization threshold.
- **reopt-interval**—Enter the duration after which the LSPs must be re-optimized.
- **metric-reopt-interval**—Enter the duration after which the LSPs must be re-optimized for metric.
- **priority-mode**—Select true to enable priority mode.

**Note** For **advanced** options, contact your Cisco WAE representative.

**Step 3** Click **Commit** to save the configuration.

**Step 4** Configure a new SR policy with bandwidth and IGP or TE metric type on a device. See the applicable Cisco IOS XR documentation for your specific device configuration (for example, "[Configure SR-TE Policies](#)"). Device configuration example:

```
segment-routing
  traffic-eng
    policy BWOD_2TO3_IGP
      bandwidth 10000
      color 100 end-point ipv4 198.51.100.3
      candidate-paths
        preference 10
        dynamic mpls
          pce
            address ipv4 198.51.100.1
          exit
        metric
          type igp
```

**Step 5** Open the resulting network model using WAE Design (**WAE Design > File > Open From > WAE Modeling Daemon**).

## Initial Bandwidth on Demand CLI Configuration Example

The following is an example of an initial Bandwidth on Demand CLI configuration within a Cisco Virtual Internet Routing Lab (VIRL) test environment. After initial configuration, you may run NIMOs anytime and the Bandwidth on Demand application will update the network model.

Configure device and network discovery.

```
# config
# devices authgroups group vir1_test default-map
# devices authgroups group vir1_test default-map remote-name cisco
# devices authgroups group vir1_test default-map remote-password cisco
# devices authgroups group vir1_test default-map remote-secondary-password cisco
# devices authgroups snmp-group vir1_test default-map
# devices authgroups snmp-group vir1_test default-map community-name cisco
# wae nimos network-access network-access vir1_test default-auth-group vir1_test
# wae nimos network-access network-access vir1_test default-snmp-group vir1_test
# wae nimos network-access network-access vir1_test node-access 198.51.100.1 auth-group
vir1_test
# wae nimos network-access network-access vir1_test node-access 198.51.100.1 snmp-group
vir1_test
# wae nimos network-access network-access vir1_test node-access 198.51.100.1 ip-manage
192.0.2.131
# wae nimos network-access network-access vir1_test node-access 198.51.100.2 auth-group
vir1_test
# wae nimos network-access network-access vir1_test node-access 198.51.100.2 snmp-group
vir1_test
# wae nimos network-access network-access vir1_test node-access 198.51.100.2 ip-manage
```

```

192.0.2.132
# wae nimos network-access network-access virl_test node-access 198.51.100.3 auth-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.3 snmp-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.3 ip-manage
192.0.2.133
# wae nimos network-access network-access virl_test node-access 198.51.100.4 auth-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.4 snmp-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.4 ip-manage
192.0.2.134
# wae nimos network-access network-access virl_test node-access 198.51.100.5 auth-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.5 snmp-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.5 ip-manage
192.0.2.135
# wae nimos network-access network-access virl_test node-access 198.51.100.6 auth-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.6 snmp-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.6 ip-manage
192.0.2.136
# wae nimos network-access network-access virl_test node-access 198.51.100.7 auth-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.7 snmp-group
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.7 ip-manage
192.0.2.137

```

#### Configure XTC agents.

```
# wae agents xtc xtc virl enabled xtc-host-ip 192.0.2.131
```

#### Configure the BGP network (topo-bgppls-xtc-nimo).

```
# networks network virl_bgpls nimo topo-bgppls-xtc-nimo xtc-host virl igp-protocol isis
extended-topology-discovery true backup-xtc-host virl network-access virl_test advanced
nodes remove-node-suffix virl.info
```

#### Configure the LSP PCEP network (lsp-pcep-xtc-nimo).

```
# networks network virl_pcep_lsp nimo lsp-pcep-xtc-nimo xtc-hosts virl xtc-host virl
# networks network virl_pcep_lsp nimo lsp-pcep-xtc-nimo source-network virl_bgpls advanced
sr-use-signaled-name true
```

#### Set the network that the aggregator will write to.

```
# networks network virl_final_model
```

#### Configure continuous polling (traffic-poll-nimo).

```
# networks network virl_cp nimo traffic-poll-nimo network-access virl_max source-network
virl_dare iface-traffic-poller enabled
# networks network virl_cp nimo traffic-poll-nimo lsp-traffic-poller enabled
# networks network virl_cp nimo traffic-poll-nimo advanced snmp-traffic-population
scheduler-interval 0
```

#### Configure the aggregator to subscribe to source networks.

```
# wae components aggregators aggregator vir1_final_model sources source vir1_bgpls
# wae components aggregators aggregator vir1_final_model sources source vir1_pcep_lsp
```

Configure WMD. In this example, WMD is set up to run demand mesh and demand deduction for all applications using WMD. So, when the continuous poller updates WMD, WMD triggers demand deduction.

```
# wae components wmd config network-name vir1_final_model dare dare-destination
vir1_final_model
# wae components wmd config network-name vir1_final_model demands add-demands true
demand-mesh-config dest-equals-source true
```

Run NIMOs (network collection).

```
networks network vir1_bgpls nimo topo-bgpls-xtc-nimo run-xtc-collection
networks network vir1_pcep_lsp nimo lsp-pcep-xtc-nimo run-collection
```

Configure Bandwidth on Demand.

```
# configure
# wae components bw-on-demand config xtc-host 192.0.2.131 xtc-port 8080 util-threshold 90.0
# wae components bw-on-demand config advanced lsp-traffic max-simulated-requested
primary-objective min-metric private-new-lsps true
# commit
# exit
```

Open base network model using WAE Design (**WAE Design > File > Open From > WAE Modeling Daemon**) to compare the resulting network model (after SR policies have been configured and the Bandwidth on Demand application has been executed).

Configure SR policies on a device.

```
# configure
# segment-routing
# traffic-eng
# policy BWOD_2TO3_IGP
# bandwidth 1000
# color 100 end-point ipv4 192.0.2.132
# candidate-paths
# preference 10
# dynamic mpls
# pce
# address ipv4 192.0.2.130
# exit
# metric
# type igp
# commit
# end
```

After the SR policy configuration is committed, WMD is updated and the Bandwidth on Demand application calculates the best path given the congestion restraint and IGP metric. Open the resulting network model using WAE Design (**WAE Design > File > Open From > WAE Modeling Daemon**) to compare the baseline network model to the new network model.

## Shut Down Bandwidth on Demand

To properly shut down the Bandwidth on Demand application, the following steps must be done in order:

**Step 1** Stop Bandwidth on Demand.

```
# wae components bw-on-demand config enable false
# commit
```

**Step 2** Stop the WAE Modeling Daemon.

```
# wae components wmd config enable false
# commit
```

**Step 3** Stop XTC agents.

```
# wae agents xtc xtc <network_name> disable xtc-host-ip <xtc_ip_address>
# commit
```

## Bandwidth Optimization Application Workflow

*Table 1: Feature History*

Feature	Release Information	Description
Collection of Multiple SR Candidate Paths using SR-PCE	Cisco WAE Release 7.5.0	WAE now processes all candidate paths from an XTC agent. For an <code>lsp-pcep-xtc-nimo</code> , WAE processes all candidate paths during data collection and path addition/deletion during notification.

The Bandwidth Optimization application is designed to react and manage traffic as the state of the network changes. It determines if any changes in the network state will cause congestion. If so, the Bandwidth Optimization application computes the LSPs and sends them to XTC for deployment.

WAE processes all candidate paths from an XTC agent. For an `lsp-pcep-xtc-nimo`, WAE processes all candidate paths during data collection and path addition/deletion during notification.

This workflow describes the high-level configuration steps needed to configure the Bandwidth Optimization application and other components.



**Note**

- Make sure the `sr-traffic-matrix-nimo` as part of the aggregator (step 4) is enabled. See [Segment Routing Traffic Matrix Collection](#)

Steps	For more information, see ...
1. Configure device authgroups and SNMP groups	<a href="#">Configure Device Access Using the Expert Mode.</a>
2. Configure a network access profile	<a href="#">Configure Network Access</a>

Steps	For more information, see ...
3. Configure the XTC agent	<a href="#">Configuring XTC Agents Using the Expert Mode</a>
4. Configure the aggregator	<a href="#">NIMO Collection Consolidation</a> <b>Note</b> Make sure sr-traffic-matrix-nimo is part of the configuration.
5. Configure the WAE Modeling Daemon (WMD)	<a href="#">Configure the WAE Modeling Daemon (WMD)</a>
6. Run topology and additional NIMOs.	<a href="#">Network Interface Modules (NIMOs)</a>
7. Configure the Bandwidth Optimization application	<a href="#">Configure Bandwidth Optimization, on page 7</a>
8. Open the network model	You can get a visual network model layout using WAE Design. From WAE Design, navigate to <b>File &gt; Open From &gt; WAE Modeling Daemon</b> and select the final network model. <b>Note</b> After initial configuration, you may run NIMOs anytime and the Bandwidth on Demand application will update the network model.

## Configure Bandwidth Optimization

This procedure describes the configuration options for the Bandwidth Optimization application. For the complete configuration workflow, see [Bandwidth Optimization Application Workflow, on page 6](#).

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- Step 1** From the Expert Mode, in **Configuration editor**, navigate to `/wae:wae/components/bw-opt` and click the **config** tab.
- Step 2** Enter the following values:
- **xtc-agents**—Select the XTC agents.
  - **enable**—Select true to enable the Bandwidth Optimization application.
  - **util-threshold**—Enter a percentage that must be exceeded if optimization is to occur. The default is 100%.
  - **util-hold-margin**—Enter the margin below the util-threshold interface utilization must be to remove an existing tactical SR policy.
  - **color**—Color representing the SR policy for XTC. For more information, contact your Cisco WAE representative.
  - **del-lsps**—Select true to delete all app created tactical SR policies when the app is disabled.
  - **max-global-reopt-interval**—Enter the time interval to re-optimize the existing tactical SR policies globally.
- Step 3** Click **Commit** to save the configuration.
- Step 4** After the tool runs, you can click **created-lsps** to view the SR LSPs that were created for optimized routing..
- Step 5** Open the resulting network model using WAE Design (**WAE Design > File > Open From > WAE Modeling Daemon**).
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### Example

CLI (in config mode) example:

```
# wae components bw-opt config color 2000 enable false threshold 90 xtc-host 192.0.2.131
xtc-port 8080
```

## WAE SR Policy Limitations

When using the latest IOS-XR SR features associated with the SR Policy, the following WAE limitations exist:

- If an SR LSP is created through WAE, a default color will be set to an SR LSP.
- Multiple LSPs cannot have the same color, source, and destination.

## Shut Down Bandwidth Optimization

To properly shut down the Bandwidth Optimization application, the following steps must be done in order:

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**Step 1** Stop Bandwidth Optimization.

```
# wae components bw-opt config enable false
# commit
```

**Step 2** Stop the WAE Modeling Daemon.

```
# wae components wmd config enable false
# commit
```

**Step 3** Stop XTC agents.

```
# wae agents xtc xtc <network_name> disable xtc-host-ip <xtc_ip_address>
# commit
```

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