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 (master 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.

**Note**

Before enabling Bandwidth on Demand, confirm that the Bandwidth Optimization application is not running. You cannot run both applications at the same time.

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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

Note
The Bandwidth Optimization application cannot run concurrently with the Bandwidth on Demand application. You must disable (enable = false) one of the applications in order to use the other. For information on how to properly shut down the Bandwidth Optimization application, see Shut Down Bandwidth Optimization, on page 8.

Step 1
From the Expert Mode, navigate to /wae/wae/components/bw-on-demand:bw-on-demand and click the config tab.

Step 2
Enter the following values:

- **xtc-host**—Enter the XTC host IP address. This entry determines how to connect to XTC using a REST API. This is a persistent connection that, when enabled, is ready to take delegated PCEP requests.
- **xtc-port**—Enter the XTC port.
• **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.

• **enable**—Select true to enable the Bandwidth on Demand application.

**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:

```plaintext
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.

```plaintext
# config
# devices authgroups group virl_test default-map
# devices authgroups group virl_test default-map remote-name cisco
# devices authgroups group virl_test default-map remote-password cisco
# devices authgroups group virl_test default-map remote-secondary-password cisco
# devices authgroups snmp-group virl_test default-map
# devices authgroups snmp-group virl_test default-map community-name cisco
# wae nimos network-access network-access virl_test default-auth-group virl_test
# wae nimos network-access network-access virl_test default-snmp-group virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.1 auth-group virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.1 snmp-group virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.1 ip-manage 192.0.2.131
# wae nimos network-access network-access virl_test node-access 198.51.100.2 auth-group
```
virl_test
# wae nimos network-access network-access virl_test node-access 198.51.100.2 snmp-group
virl_test
# wae nimos network-access network-access virl_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 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 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 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-bgpls-xtc-nimo).
# networks network virl_bgpls nimo topo-bgpls-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.

```bash
# wae components aggregators aggregator virl_final_model sources source virl_bgpls
# wae components aggregators aggregator virl_final_model sources source virl_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.

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

Configure the XATP module. In this example, the `connection-attempts` parameter is set to 0. This means if WMD connection fails, the application will keep trying to connect to WMD until the connection is successful.

```bash
# wae components xatp config xtc-agent virl dare aggregator-network virl_dare pcep-lsp-xtc-nimo-network virl_pcep_lsp topo-bgpls-xtc-nimo-network virl_bgpls
wae components xatp config wmd connection-attempts 0
```

Enable WMD and XATP.

```bash
# wae components wmd config enable true
# wae components xatp config enable true
# commit
# exit
```

Run NIMOs (network collection).

```bash
networks network virl_bgpls nimo topo-bgpls-xtc-nimo run-xtc-collection
networks network virl_pcep_lsp nimo lsp-pcep-xtc-nimo run-collection
```

Configure Bandwidth on Demand.

```bash
# 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.

```bash
# 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
```
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 XTC Agent to Patch module.

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

**Step 3**
Stop the WAE Modeling Daemon.

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

**Step 4**
Stop XTC agents.

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

**Bandwidth Optimization Application Workflow**

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.

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

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## 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.

### Before you begin

The Bandwidth Optimization application cannot run concurrently with the Bandwidth on Demand application. You must disable `enable = false` one of the applications in order to use the other. For information on how to properly shut down the Bandwidth on Demand application, see Shut Down Bandwidth on Demand, on page 6.

### Step 1

From the Expert Mode, navigate to `/wae:wae/components/bw-opt` and click the `config` tab.

### Step 2

Enter the following values:

- **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%.
- **xtc-host**—Enter the hostname or IP address of the XTC host.
- **xtc-port**—Enter the XTC host port.
- **color**—Color representing the SR policy for XTC. For more information, contact your Cisco WAE representative.

### 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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<td>Configure the WAE Modeling Daemon (WMD)</td>
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<td>9. Open the network model</td>
<td>You can get a visual network model layout using WAE Design. From WAE Design, navigate to <strong>File &gt; Open From &gt; WAE Modeling Daemon</strong> and select the final network model. <strong>Note</strong> After initial configuration, you may run NIMOs anytime and the Bandwidth on Demand application will update the network model.</td>
</tr>
</tbody>
</table>
Example

CLI (in config mode) example:

```bash
# 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 2 paths are given under the `candidate-paths` option, then only the first path will be considered.
- 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:

<table>
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</table>
| Step 1 | Stop Bandwidth Optimization.  
# wae components bw-opt config enable false  
# commit |
| Step 2 | Stop the XTC Agent to Patch module.  
# wae components xatp config enable false  
# commit |
| Step 3 | Stop the WAE Modeling Daemon.  
# wae components wmd config enable false  
# commit |
| Step 4 | Stop XTC agents.  
# wae agents xtc xtc <network_name> disable xtc-host-ip <xtc_ip_address>  
# commit |