



Define and Maintain Intent-Based Bandwidth Requirements



Note Functionality described within this section is only available as part of the Advance RTM license package.

Bandwidth on Demand (BWoD) provides a bandwidth-aware Path Computation Element (PCE) to derive SR policy paths with requested bandwidth when available. Computed paths are deployed to the network through SR-PCE. BWoD continuously monitors link utilization to ensure no congestion occurs along the path. If conditions change in the network which causes link utilization to exceed the congestion threshold set by the user, BWoD automatically reoptimizes the policy path. BWoD supports bandwidth constraints for both PCE-initiated and PCC-initiated SR-TE policies.

BWoD utilizes a near real-time model of the network along with SNMP-based SR policy traffic measurements to ensure BWoD policies meet their bandwidth constraints. Users may fine tune the behavior of BWoD, affecting the path it computes, through the selection of application options including network utilization threshold (definition of congestion) and path optimization intent. BWoD works as a bandwidth-aware PCE for SR policies created through the UI and for SR policies created through CLI configuration on a headend with delegation to the SR-PCE. In the latter case, SR-PCE will subdelegate the SR policy with a bandwidth constraint to BWoD for path computation and relay the computed path returned by BWoD to the headend for instantiation.

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BWoD Important Notes

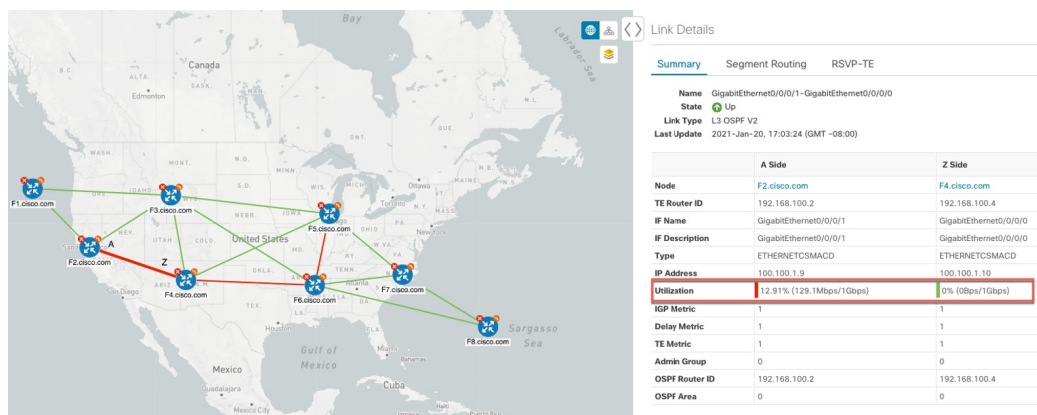
Consider the following information when using BWoD:

- You must have the Advanced RTM license package to use BWoD.
- If BWoD cannot find a path for a policy that guarantees its requested bandwidth, BWoD will attempt to find a *best effort* path if this option is enabled.

- BWoD temporarily pauses operation whenever the Optimization Engine model is unavailable due to an Optimization Engine restart or a rebuild of the topology from Topology Services. Any requests to BWoD during this time are rejected. When the model becomes available and BWoD receives 2 traffic updates from the Optimization Engine, BWoD will resume normal operation.
- If the Policy Violation advanced field is set to either **Strict Policy** or **Strict Network**, then the SR Policy Traffic option should be set to **Max Measured Requested**.


Provision an SR-TE Policy to Maintain Intent-Based Bandwidth Requirements Example

Figure 1: Initial BWoD Topology Example



In this scenario we are using the above topology. The goal is to create a path from F2.cisco.com to F7.cisco.com that can accommodate 920 Mbps of traffic while keeping the utilization at 80%. The above example highlights the utilization on nodes F2.cisco.com and node F4.cisco.com to show that the link is being utilized and has a capacity of 1 Gbps. BWoD will initially try to find a single path that does not include this link since the addition of the requested bandwidth would exceed the utilization threshold. If a single path cannot be found, BWoD may recommend splitting the path.

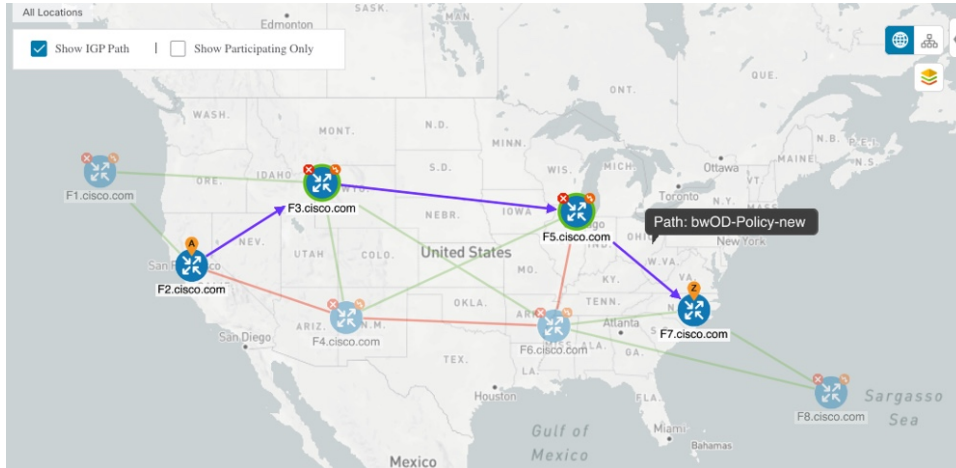
Step 1 Enable and Configure BWoD.

- From the main menu, choose **Traffic Engineering > Bandwidth on Demand > Configuration**.
- Toggle the Enable switch to **True** and enter **80** to set the utilization threshold percentage. To find descriptions of other options, simply hover the mouse over .
- Click **Commit Changes**.

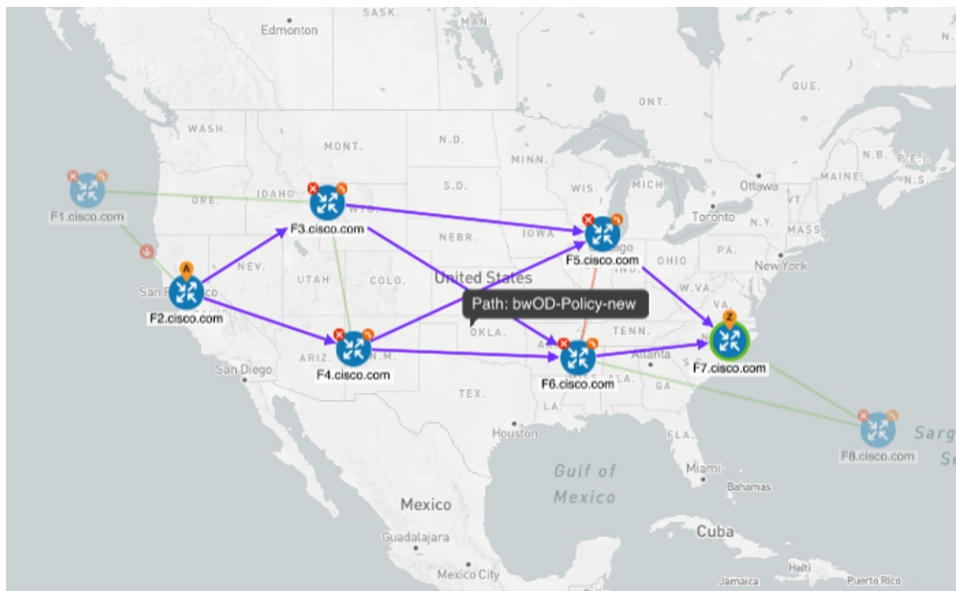
Step 2 Create a PCE-initiated BWoD SR-TE Policy.

- From the main menu, choose **Traffic Engineering > SR-TE** tab and click **+Create**.
- Enter the required SR-TE policy details.
- In the **Policy Path** field, click **Bandwidth on Demand** and enter a unique name for the BWoD path. In this case, **bwOD-Policy-new**.
- From the **Optimization Objective** drop-down list, select **Traffic Engineering (TE) Metric**.
- In the **Bandwidth** field enter the requested bandwidth. In this case, we are requesting **920** Mbps.

f) Click **Preview**.



In the above example, BWoD finds a single path that is under utilized and can still accommodate the requested bandwidth without going above the utilization threshold.



In the above example, BWoD cannot find a single path because of utilization and capacity limitations across several links. In this case, BWoD splits the path to obtain bandwidth and utilization requirements.

g) If you are satisfied with the proposed SR-TE policy deployment, click **Provision**.

Step 3

Verify that the new BWoD SR-TE policy has been created.

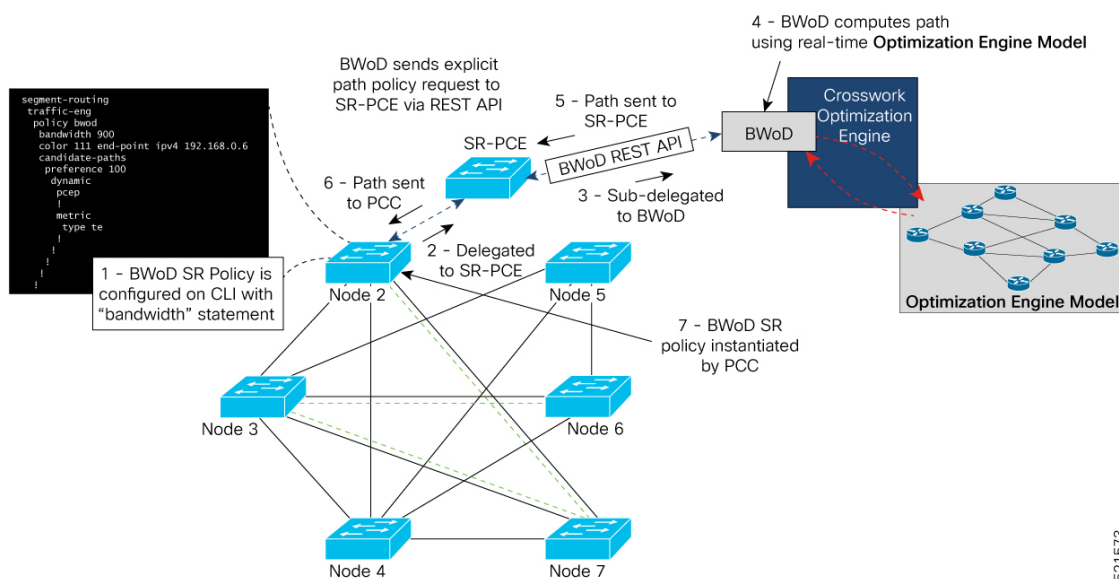
- From the main menu, choose **Traffic Engineering** > **SR-TE**.
- Select the new BWoD SR-TE policy and view the SR policy details (click and choose **View**). Note that the Policy Type is **Bandwidth on Demand**.

PCC-Initiated BWoD SR-TE Policies

When enabled, BWoD automatically connects to all SR-PCE providers configured in Crosswork Optimization Engine. The persistent connection is made to the SR-PCE BWoD Rest API, registering it as a PCE for bandwidth constrained SR-TE policies.

The following figure shows the PCC-initiated workflow for BWoD:

Figure 2: PCC-Initiated BWoD SR-TE Policies



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Callout No.	Description
1	<p>A BWoD policy is configured on a PCC via the CLI. For example:</p> <pre> segment-routing traffic-eng policy bwod bandwidth 900 color 100 end-point ipv4 1.1.1.2 candidate-paths preference 100 dynamic pcep ! metric type te ! constraints affinity exclude-any name RED ! ! ! !</pre>

Callout No.	Description
2	The bandwidth statement is added to a PCE delegated SR policy to create a BWoD policy. Once committed, the PCC delegates the path compute to SR-PCE.
3, 4	SR-PCE then sub-delegates the policy to BWoD which attempts to compute a path that meets the bandwidth constraint.
5, 6	If a bandwidth-compliant path is found, the segment list is returned to SR-PCE which forwards it over PCEP to the PCC and the PCC instantiates it. If BWoD is unable to compute a bw-compliant path for the policy or doing so will force an existing BWoD policy to not have a bw-compliant path, best effort paths may be computed by BWoD which attempt to minimize violations. This occurrence will also trigger BWoD to issue an event to the COE events UI indicating which BWoD policies are now on best effort paths.
7	A BWoD SR-TE policy is instantiated.

Configure Bandwidth on Demand

There are two parts to configure Bandwidth on Demand (BWoD):

1. Enable and configure BWoD options.
2. Create BWoD SR policies. As long as BWoD is enabled, you can create multiple BWoD SR policies.

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- Step 1** From the main menu, choose **Traffic Engineering > Bandwidth on Demand > Configuration**.
- Step 2** Toggle the **Enable** switch to **True**.
- Step 3** Configure additional options. Hover the mouse pointer over  to view a description of each field.
- Step 4** Click **Commit Changes** to save the configuration.
- Step 5** To create BWoD SR policies, navigate to **Traffic Engineering > Traffic Engineering**.
- Step 6** From the SR Policy table, click **Create > PCE Init**.
- Step 7** In addition to entering the required SR policy details, click the **Bandwidth on Demand** option and enter the required bandwidth.
- Step 8** Click **Preview** to view the proposed SR policy.
- Step 9** Click **Provision** to commit the SR policy.
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Troubleshoot BWoD

The following are some of the most common error conditions for BWoD and some possible corrective actions that may fix the issue.

Table 1: Errors

Error Event Message	Possible Causes and Recommended Corrective Action
OptimaModelError	<p>The network model used by BWoD from the Optimization Engine is corrupt or is missing key data that is needed to properly support BWoD. Possible causes include network discovery issues or synchronization problems between the Optimization Engine and Topology Services. Try restarting the Optimization Engine pod to rebuild the model.</p> <p>This error can also occur if the time required to discover a policy and add it to the model after it has been deployed exceeds the Deployment Timeout option set for BWoD. The default is 30 seconds which should suffice for small to medium sized networks. However, larger networks may require additional time.</p>
NATSTimedOutError	<p>The deployment of a bandwidth policy through SR-PCE exceeds the Deployment Timeout option set for BWoD. Increase the Deployment Timeout option to allow for additional time for deployments in larger networks.</p>
Traceback or other errors found in the log file	Please contact your Cisco service representative.