# 12 Ring Design

SP Guru Transport Planner can model SONET/SDH ring-based networks. You can specify SONET/SDH rings within the DCL infrastructure of the existing topology, route DCL traffic on these rings, upgrade existing rings by adding stacked rings on top of them, or identify new rings to add to the network.

The following steps outline the general ring-design workflow in SP Guru Transport Planner.

1) Create or import a network topology.

2) Perform the following pre-design steps:

   a) Create ring models and set the cost parameters for the ring equipment.

   b) Specify how you want the optical layer to support these rings (using patch panels or standard switches).

   c) For each node in the DCL layer, specify how you want to perform ring interconnection.

   These steps are described in Pre-Design Steps.

3) Create one or more rings in the network, as described in Creating Rings on page TrP-12-4.

4) Dimension the rings for a DCL traffic matrix. This accommodates the traffic on the existing rings or upgrades the existing rings. This step is described in Ring Dimensioning on page TrP-12-7.

5) Identify new rings to be added to the network to decrease the overall network cost or route more traffic in the network. This step is described in Ring Identification on page TrP-12-15.

6) If the rings cannot support some traffic in the matrix, do a mesh design (that is, a grooming or routing operation).

You can interchange steps 4, 5, and 6. For example, you can

- Route part of the DCL traffic matrix on the current mesh capacity (step 6), then accommodate the unrouted part of the traffic matrix on DCL rings (step 4).
- Identify new rings (step 5), then route traffic on the legacy and new rings (step 5).

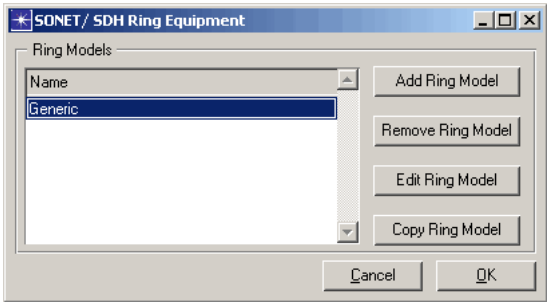
SP Guru Transport Planner has a ring browser that you can use to view details about installed rings. For more information, see Ring Browser on page TrP-12-5.

## Pre-Design Steps

You must do the following steps before you design any rings:

1) Create a ring model—When you add new rings, SP Guru Transport Planner uses such a ring model to determine the cost of the rings. You create a new ring model or adapt an existing one in the SONET/SDH Ring Equipment dialog box (Network > Equipment Properties > SONET/SDH Ring Equipment); see SONET/SDH Ring Equipment on page TrP-3-34 for more information.

**Figure 12-1 Create a Ring Model**




2) Set the cost parameters for the ring equipment—You can specify the following parameters per ring model:

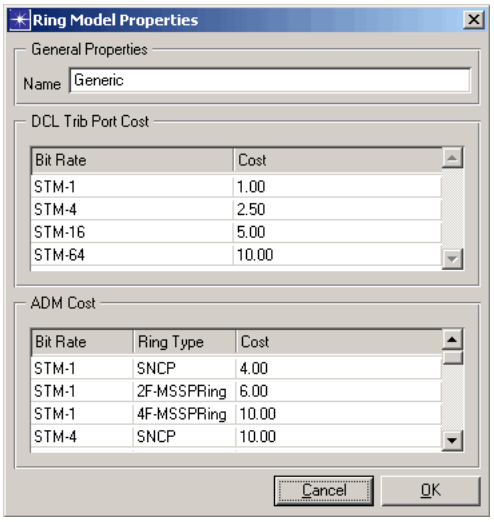
   a) The name of the ring model

   b) ADM costs per ring type (UPSR, 2F-BLSR, 4F-BLSR) and per OCH bit rate

   c) Costs of the tributary ports on the ADM per DCL bit rate

   You specify these costs in the Ring Model Properties dialog box. To open this dialog box, click the Add Ring Model or the Edit Ring Model button in the Ring Model Properties dialog box.

**Figure 12-2 Ring Model Properties Dialog Box**



3) Specify how you want rings to be supported at the optical layer.

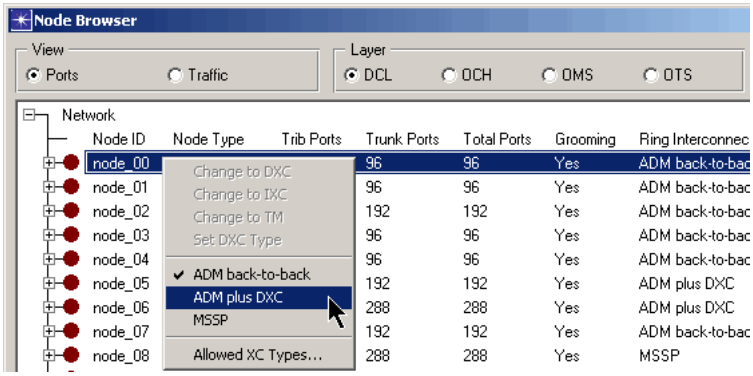
   If you create SONET/SDH rings between EOCC nodes, the ring links are supported by underlying OCH channels. You can use the "Support SONET/SDH Ring via Patch Panel" option to specify that these supporting channels should be switched via patch panels. If this option is not selected, the channels are supported by the standard node type in that location (such as OXC, IXC, OADM). You can set this option in the Network Properties dialog box (Network > Network Properties); as described Network Properties on page TrP-3-23.

4) Specify how you want to upgrade the defined rings. For each defined ring, you can set the type and bit rate of the upgraded ring to use when dimensioning for new traffic. To do this, set the Ring Design Options of the ring in the Ring Browser (described in Setting Ring Design Options on page TrP-4-30.)

5) For each DCL node, specify how you want to perform ring interconnection.

   In the Node Browser (Network > Node Browser), right-click on a DCL node to specify how you want ring interconnection to occur at that node. The three possible architectures (ADM back-to-back, ADM plus DXC, and MSSP) are discussed in SONET Nodes: ADM on page TrP-2-23.

**Figure 12-3 Specifying Ring Interconnection in the DCL Node Browser**




6) Create the rings that are currently present in the network as well as the candidate rings to be added to the network. This step is described in the following section.

# Creating Rings

Procedure 12-1 describes how to create SONET rings manually. (You can also create rings by importing data from a data file; for more information, see SONET/SDH Ring Data Files on page TrP-5-21.)

**Procedure 12-1 Creating a SONET Ring**

1 Open the Ring Browser (Network > Ring Browser) and click Create.

➥ The Create a DCL Ring dialog box appears.

2 Define the properties of the ring. You can specify the ring cost model, usage type, technology type, and bit rate. You must also specify the disjointness properties of the ring. This is especially important if the ring path includes non-adjacent EOCC nodes (that is, nodes that are not connected directly with a physical link). In this case, the logical DCL ring topology can differ from the physical ring topology.

**Figure 12-4 Create a DCL Ring Dialog Box**

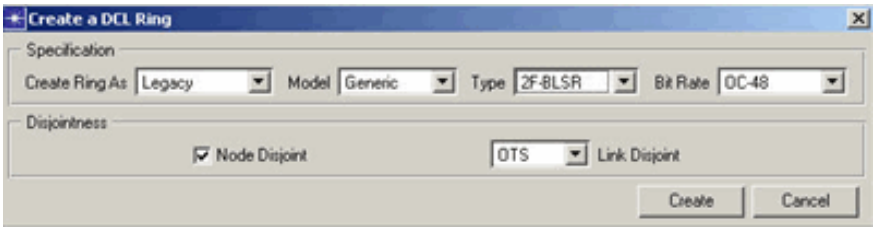



**Table 12-1 Create a DCL Ring Dialog Box**

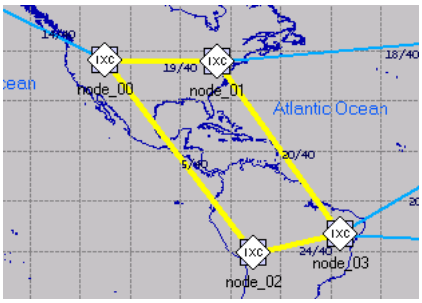
| Field | Description |
|---|---|
| Create Ring As | Usage type of the ring (Legacy, New or Candidate). Legacy and new rings are used during ring dimensioning. Candidate rings are used by the Ring Identification operation: when Ring Identification determines that a candidate ring is suitable to add to the network, it converts the candidate ring to a new ring. |
| Model | Ring model type. This ring model type determines the ring costs. |
| Type | Ring technology type (UPSR, 2F-BLSR, or 4F-BLSR) |
| Bit Rate | OCH bit rate of the ring |
| Disjointness | Disjointness properties of the ring. You can specify whether you want the links of the ring to be DCL, OCH, OMS, or OTS disjoint.<br>You can also specify whether you want the ring to be link disjoint only, or to be node disjoint as well (node disjoint means that no physical nodes appear twice in the same ring). |
| **End of Table 12-1** | |

3 In the Project Editor, left-click on each component DCL node to include it in the ring path. You can include ECC and EOCC nodes. Note the following:

- If a ring link connects ECC-ECC or ECC-EOCC nodes, it *must* be supported by a physical DCL link (that is, a direct fiber pair between both nodes).
- If a ring link connects EOCC-EOCC nodes, it can be supported by a logical link (that is, an OCH connection). Therefore, you can include EOCC nodes in the ring without a direct fiber pair between them, as long as the network can find an OCH path between the nodes.

After you include all nodes in the ring, click Create in the Create a DCL Ring dialog box to create the ring.

**Figure 12-5 Creating a Ring**




If you created the ring successfully, SP Guru Transport Planner adds the DCL links to support the rings. Note that the capacity indicated on the ring links is the *usable* capacity. A USPR at an OC-48 rate has a usable capacity of 48 STS-1 time slots per link. A 2F-BLSR at an OC-48 rate has a usable capacity of 24 time slots, because half of the capacity is reserved for protection. However, a 4F-BLSR OC-48 has a usable capacity of 48 time slots since the protection capacity is provided on two protection fibers.

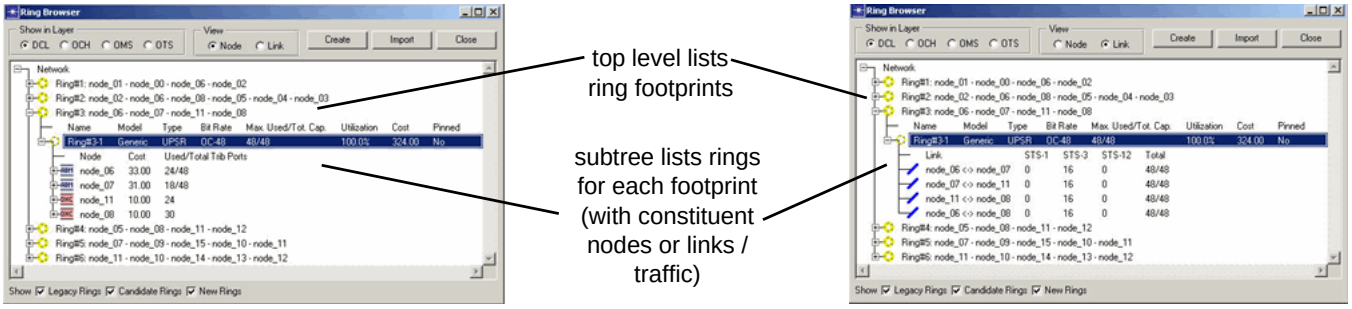
**End of Procedure 12-1**

## Ring Browser

You can see the links created by all the rings—in addition to the potential DCL mesh links—in the DCL layer view of the Project Editor. Because it might not be clear which links contribute to which ring, you can view links on a per-ring basis in the Ring Browser (Network > Ring Browser), shown in Figure 12-6 on page TrP-12-6.

The Ring Browser lists each ring in the network along with a list of nodes that constitute the ring's path (also called the ring's *footprint*). One ring footprint can support multiple rings with different types and bit rates. When you select a ring in the browser, the ring's footprint is highlighted in the Project Editor workspace.

**Figure 12-6 Ring Browser (Node and Link Views)**




For more information about this window, see Ring Browser on page TrP-4-27.

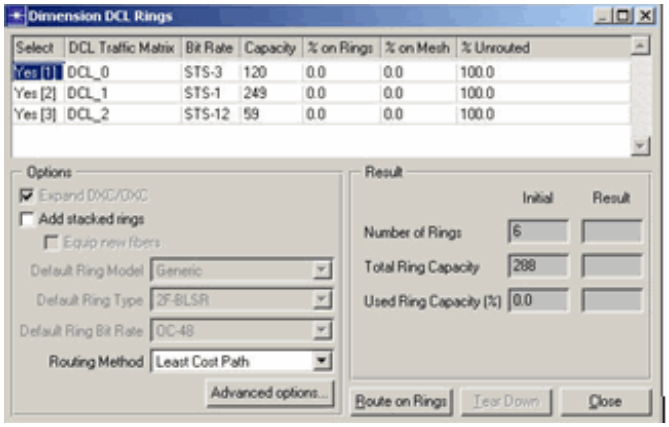
## Ring Dimensioning

With SP Guru Transport Planner you can combine ring and mesh architectures. This section describes how to accommodate traffic on the SONET/ SDH legacy ring infrastructure and off-load the remaining traffic to a DCL mesh architecture.

After you specify a set of rings in your network, you can use them to accommodate DCL traffic. You can reuse the legacy capacity on these rings; for the remaining traffic that cannot be routed on the rings, you can route this traffic in the meshed DCL network (as the result of a grooming operation, for example). Alternatively, you can add stacked rings to existing rings to expand them, then try to route all the traffic on the expanded rings. Even in this case, it is possible that SP Guru Transport Planner cannot route all the traffic on the existing rings. If the rings do not cover the entire network, you can route the remaining traffic again in the meshed network.

To route traffic on SONET rings and dimension the rings, open the Dimension DCL Rings dialog box (Design > Dimension DCL Rings). This dialog box lists all DCL traffic matrices, their bit rate and total capacity, and how they have been routed so far. You can include multiple DCL traffic matrices in one operation; all selected matrices (those whose Select field is set to Yes(*x*)) are considered by the dimensioning algorithm.

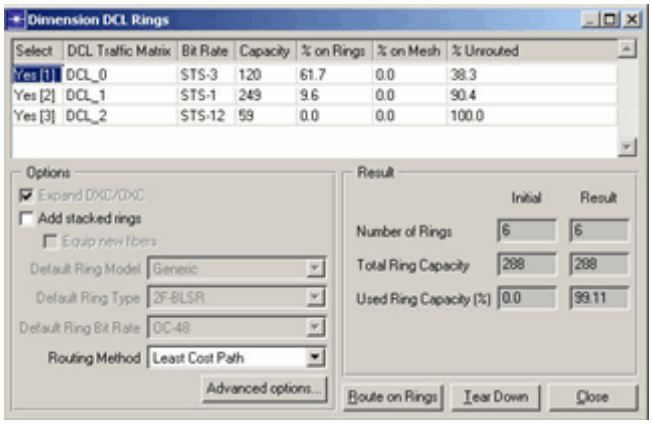
**Figure 12-7 Dimension DCL Rings Dialog Box Before a Dimensioning Operation**




The typical workflow is to use the Dimension DCL Rings dialog box to accommodate traffic on the rings. Then you can use the routing and grooming action to accommodate any remaining traffic that could not be routed on rings. (See Table 12-2 Dimension DCL Rings Dialog Box on page TrP-12-8 for information on the available options and fields.)

When the ring-dimensioning operation completes, the traffic matrix table shows the traffic that has been routed on the rings, the percentage that has been routed on the mesh, and the percentage of traffic that is currently unrouted. You can use the Result fields to compare the network state before and after ring dimensioning.

**Figure 12-8 Dimension DCL Rings Dialog Box After a Dimensioning Operation**




## Dimension DCL Rings Dialog Box

Table 12-2 lists the options and fields in the Dimension DCL Rings dialog box.

**Table 12-2 Dimension DCL Rings Dialog Box**

| Item | Description |
|---|---|
| Advanced Options | See Table 12-3 Advanced Options - Ring/Mesh Cost Dialog Box on page TrP-12-10 |
| Add Stacked Rings | Upgrade the existing rings with new stacked rings to accommodate the traffic.<br>• If enabled, SP Guru Transport Planner adds new rings of the same type and bit rate (as specified in the Default Ring Type and Default Ring Bit Rate pull-down menus).<br>• If disabled, SP Guru Transport Planner adds no new rings and only uses the current legacy rings to accommodate the traffic.<br>**Note**—The Add Stacked Rings, Ring Type and Ring Bit Rate options set in this dialog box are global options that apply to all rings in the network. To override these global options per ring, set the Ring Design Options in the Ring Browser (as described in Setting Ring Design Options on page TrP-4-30). |
| DCL Traffic Matrix table | • Select—Click in this field to select/unselect the traffic matrices used to route traffic and dimension the rings. The number in brackets (for example, “Yes [1]”) indicates the order in which the traffic matrix will be routed.<br>• DCL Traffic Matrix—The name of the traffic matrix. Only DCL matrices appear here, because no other traffic can be directly routed on DCL rings.<br>• Bit Rate—Bit rate of the traffic matrix<br>• Capacity—Total capacity of the traffic matrix<br>• % on Rings—Indicates the relative amount of traffic that could be routed on the rings<br>• % on Mesh—Percentage of traffic that has been routed on the mesh part of the network<br>• %Unrouted—Percentage of traffic that remains unrouted |

**Table 12-2 Dimension DCL Rings Dialog Box (Continued)**

| Item | Description |
|---|---|
| Equip New Fibers | If this option is selected, SP Guru Transport Planner equips new fibers if these are needed to add stacked rings. SP Guru Transport Planner uses the default DCL line system on electrical links and the default WDM line system on optical links. These options are defined in the Network Properties dialog box (Network > Network Properties).<br><br>If this option is not selected, SP Guru Transport Planner adds new rings only on the fibers that are currently equipped. |
| Expand DXC/DXC | Upgrade discrete DXCs (used for ring interconnection between ADMs or used as MSSP) or discrete OXCs.<br><br>• If enabled, SP Guru Transport Planner upgrades nodes as needed to route additional traffic on the rings.<br><br>• If disabled, some connections might not be routed (for example, if there is not enough node capacity for ring interconnection). |
| Result | Shows the network state before and after the last ring-dimensioning operation:<br><br>• Number of Rings—Total number of stacked rings in the network<br><br>• Total Ring Capacity—Total ring capacity available in the network<br><br>• Used Ring Capacity (%)—percentage of the ring capacity in use |
| Route on Rings | Routes the connections of the selected traffic matrix over the existing and (if “Add Stacked Rings” is enabled) additional stacked rings. SP Guru Transport Planner might route some connections partly on rings, in which case the remaining connections remain unrouted. You can set up the remaining unrouted part of the traffic matrix on the mesh part of the network using a grooming or routing action. |
| Routing Method | Controls how SP Guru Transport Planner calculates paths over the rings:<br><br>• Shortest Path—Route connections along the path of the rings that have the shortest fiber length<br><br>• Least Cost Path—Route connections over the rings in a way that minimizes the individual cost of each connection<br><br>• Optimized per Ring—Route connections over the lowest cost path on the rings, but optimize the routing on each individual ring to minimize the amount of stacked rings required per ring location<br><br>• Optimized over all Rings—Optimize the rings taken by the connection, as well as the routing on each individual ring, to minimize the total number of stacked rings required |
| Tear Down | Tears down the connections of the selected traffic matrix from the rings. If SP Guru Transport Planner added new rings to route this traffic, the Tear Down operation does not remove these new rings.<br><br>To remove unused rings, choose Design > Strip Capacity. If “Strip Stacked Rings” is enabled, SP Guru Transport Planner removes all stacked rings that have no traffic routed on them. Note that removing all stacked rings does not remove the ring footprint; to remove the footprint, right-click on it in the Ring Browser (Network > Ring Browser). For more information, see Ring Browser on page TrP-4-27. |

**End of Table 12-2**

## Advanced Options—Ring/Mesh Cost Dialog Box

Table 12-3 lists the options and fields in the Advanced Options - Ring/Mesh Cost dialog box.

**Figure 12-9 Advanced Options - Ring/Mesh Cost Dialog Box**

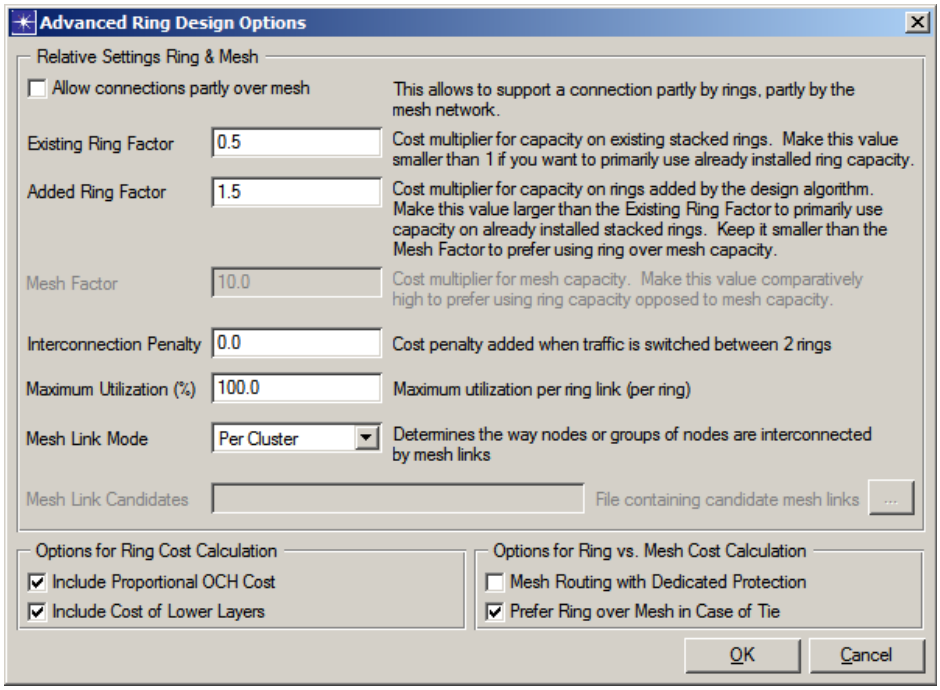



**Table 12-3 Advanced Options - Ring/Mesh Cost Dialog Box**

| Item | Description |
|---|---|
| Allow connection partly over mesh | If this option is selected, SP Guru Transport Planner can route a connection partly on rings and partly on mesh. Thus after performing ring dimensioning with this option enabled, you can end up with partly routed connections, because the mesh part of the connections is not set up during ring dimensioning (you should do this in a separate grooming or routing action).<br><br>If this option is not selected, SP Guru Transport Planner routes a connection either entirely on (one or more) rings or entirely on mesh. For more information, refer to Hybrid Ring-Mesh Design on page TrP-12-12. |
| Existing Ring Factor | SP Guru Transport Planner multiplies the cost of existing rings with this factor. To model the reuse of already existing rings, enter a value smaller than 1. |
| Mesh Factor | SP Guru Transport Planner multiplies the cost of links in the meshed DCL network by this factor. To model the use of rings, enter a value higher than the Existing Ring Factor and Added Ring Factor. To model the use of meshed links, enter a smaller value. |
| Added Ring Factor | SP Guru Transport Planner multiplies the cost of added rings by this factor. To model the reuse of already existing rings, enter a value higher than the Existing Ring Factor. |
| Interconnection Penalty | An extra penalty cost counted when traffic is switched between two rings. This can be used to discourage inter-ring traffic and let the traffic stay as long as possible on the same ring. |

**Table 12-3 Advanced Options - Ring/Mesh Cost Dialog Box (Continued)**

| Item | Description |
|---|---|
| Maximum Utilization (%) | The maximum percentage of capacity that can be used on each link of the ring. |
| Mesh Link Mode | This option is only available if the option 'Allow connections partly over mesh' has been chosen. This option determines the way nodes or groups of nodes are interconnected by mesh links to determine if mesh links may be a more cost effective solution opposed to rings.For more information, see Hybrid Ring-Mesh Design on page TrP-12-12. |
| Options for Ring Cost Calculation | These options specify extra costs included in the cost of a ring during ring dimensioning:<br>• Include Proportional OCH Cost—If selected, the cost of a ring also includes the proportional cost of the equipment required to set up this ring in the OCH layer. This includes the cost of equipment (such as WDM systems and amplifiers) divided by the number of wavelengths supported at the OCH layer.<br>• Include Cost of Lower Layers—If selected, the cost of a ring also includes equipment costs in the OMS and OTS layers (such as fiber costs). These costs are also included proportionately—that is, only equipment that is used by the ring is included. |
| Options for Ring vs. Mesh Cost Calculation | These options control what will happen in the case there is a tie when considering rings vs. mesh and also allow for the user to specify the protection level for connections traversing mesh links.<br>• Mesh Routing with Dedicated Protection—This option controls the protection level of the connections or portions of connections that traverse mesh links. When unchecked this means that connections will be unprotected and when checked dedicated protection (i.e. 1+1 protection) is considered.<br>• Prefer Ring over Mesh in Case of Tie—This option controls what route would be considered most optimal in the case that there is a tie in the cost calculation for placing the connection on rings, rings and mesh or just mesh. When checked the algorithm will prefer rings in the case of ties. When unchecked the algorithm will prefer mesh links in the case of ties. |
| **End of Table 12-3** | |

You can manipulate link costs—which determine how connections are routed—using the Existing Ring Factor, Added Ring Factor and Mesh Factor options. SP Guru Transport Planner multiplies these factors with the original costs of ring and mesh links (which are calculated based on the costs specified in the Equipment Properties). These factors have the following effects on routing:

- Given a low existing ring cost, SP Guru Transport Planner prefers to use existing rings and fill these up first.
- If the mesh cost is lower than the existing ring cost, SP Guru Transport Planner avoids the rings and leaves traffic unrouted (you can route the unrouted traffic on the mesh afterwards).

- If the mesh cost is between the existing ring cost and the added ring cost, SP Guru Transport Planner fills up the existing rings first and leaves traffic unrouted (you can route the unrouted traffic on the mesh afterwards).
- If the mesh cost is higher than the added ring cost, which is in turn higher than the existing ring cost, SP Guru Transport Planner uses existing rings and then creates additional rings. Only traffic that cannot be routed on rings will be left unrouted (you can route the unrouted traffic on the mesh afterwards).

## Hybrid Ring-Mesh Design

When the option “Allow connections partly over mesh” is selected, the ring routing algorithm considers both rings as mesh links to route traffic over. In certain cases, there might be no ring interconnectivity between two nodes so the only option is to route the connection (partially) over mesh links. In other circumstances, the shortest or cheapest path might include one or more mesh links. As such, the ring routing algorithm ends up with a solution in which certain connections are only partially routed over rings (or not routed at all).

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**Note—**The ring routing algorithm will not actually route the connections over the mesh links but will leave part (or all) of the connection unrouted instead. To route these unrouted portions of traffic over the mesh, use one of the mesh design actions, such as routing or grooming.

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You can control the number of mesh links considered by the ring routing algorithm by setting the “Mesh Link Mode” option in the Advanced Ring Design Options. The following options are available:

**Table 12-4 Mesh Link Mode Options**

| Option | Description |
|---|---|
| Per Cluster | This means that every cluster is connected to every other cluster by exactly one mesh link. Thus, (M*(M-1))/2 links are considered, where M is the number of clusters (adjacent ring groups and isolated mesh nodes). See figure below for example. |
| Full Mesh | The network is fully meshed such that every node is connected to every other node (i.e., (N*(N-1))/2 links where N is the number of nodes in the network). |
| No Mesh | No mesh links are allowed. |
| Candidate Mesh | Allows selection of a candidate link import file which defines possible candidate links. The links specified in the import file specify the mesh links that are considered during the routing process. The format of the Mesh Link Candidate file is the same as for the Candidate Links feature in Grooming DCL to OCH Traffic > Grooming DCL Traffic with Optimized Routes. For more information, see Import Candidate Node Pairs on page TrP-8-6. |
| **End of Table 12-4** | |

For definition purposes, a cluster is a set of nodes which is constructed by starting with a set containing a single node and then adding to that set all nodes that are reachable via adjacent rings. No node can belong to two clusters and pure mesh nodes constitute singleton clusters. Figure 12-10 illustrates the concept in more detail.

**Figure 12-10 Hybrid Ring-Mesh Design**

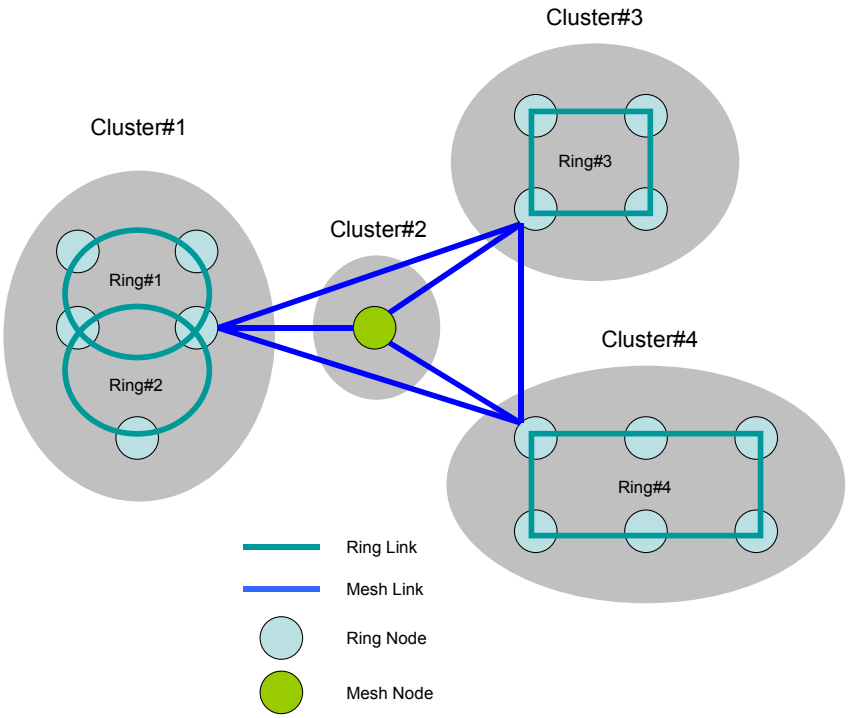



Figure 12-10 shows how clusters are formed and how they are then connected to each other by a single mesh link.

- With the Full Mesh option, each node is considered to be connected to every other node with a mesh link.
- The No Mesh option prevents the consideration of any mesh links. Thus, the connections can only be routed over rings and no candidate mesh link possibilities are considered.
- Candidate Mesh involves the importing of mesh link candidates via an import CSV file.

## Ring Identification

You can use Ring Identification to help you decide how to add new rings to an existing network. Ring Identification differs from Ring Dimensioning because it can also add new rings as well as stacked rings to existing rings. Given a set of candidate rings and one or more traffic matrices, Ring Identification provides metrics that enable you (or the software) to determine how well each ring will carry a specified amount of traffic. The overall goal is to add new rings in a way that minimizes the total network cost.

Ring Identification calculates which routes will be followed and which rings will need to be installed to carry the traffic, but (unlike the Dimension DCL Rings operation) does not set up traffic or add stacked rings. Ring Identification does convert candidate rings to new rings, and thereby makes these rings available for the Dimension DCL Rings operation to set up the traffic and add stacked rings.

## Workflow Description

The following steps outline the high-level workflow.

**Procedure 12-2 Ring Identification**

1. From the main menu in the Project Editor, choose Design > Ring Identification.

   ➥ The “Ring Identification - Step 1 - Select Traffic” dialog box appears.

2. Select traffic matrices by clicking in the "Select" column. For more information about the options in this dialog box, see Ring Identification, Step 1: Select Traffic Matrices on page TrP-12-17.

3. Select the traffic matrices that you wanted the identified rings to support, then click Next.

   ➥ The “Ring Identification - Step 2 - Ring Metrics” dialog box appears.

   This dialog box prompts you to select the candidate rings for which you want to calculate the cost. The Select Candidate Rings table includes metrics that enable you to select the most suitable candidate rings for routing the selected traffic. These metrics are derived from the routes of each connection when it is routed along its shortest path.

   For more information about the options in this dialog box, see Ring Identification, Step 2: Select Candidate Rings and Routing Metrics on page TrP-12-18.

4. Select the candidate rings and cost calculation settings.

5. If you are ready to install the existing candidate rings, click Finish. If you want to refine the ring list using more detailed cost metrics, click Next.

   ➥ The “Ring Identification - Step 3 - Ring Costs” dialog box appears.

   This dialog shows the additional stacked ring cost and other metrics for each candidate ring when it is added to the network. You can use these calculations to determine the most suitable candidate rings and the order in which they are installed in the network.

   For more information about the options in this dialog box, see Ring Identification, Step 3: Inspect Ring Costs and Install Candidate Rings on page TrP-12-22.

6. After you specify the list of candidate rings, click Install Selected Rings or Auto Install.

7. Click Close to exit the Ring Identification wizard.

8. Use Ring Dimensioning to set up traffic on the existing and new rings.

**End of Procedure 12-2**

### Ring Identification, Step 1: Select Traffic Matrices

This dialog box appears when you choose Design > Ring Identification in the Project Editor. In this dialog box, you select the traffic matrices used to identify candidate rings—specifically, the candidate rings that are most likely to support the traffic in these matrices.

**Figure 12-11 "Ring Identification - Step 1 - Select Traffic" Dialog Box**

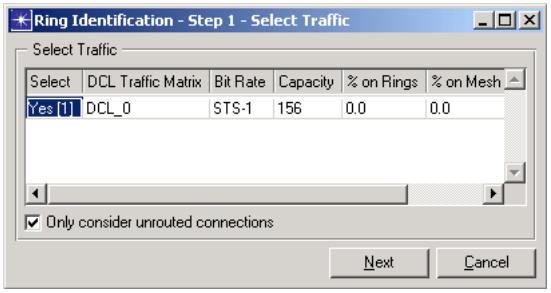



**Table 12-5 "Ring Identification - Step 1 - Select Traffic" Dialog Box**

| Item | Description |
|---|---|
| Select Traffic | The traffic matrices that can be considered for ring identification.<br>• Select—If selected, the traffic matrix will be considered for the ring identification<br>If a traffic matrix is selected, its entry in the 'Select' column appears as "Yes [*x*]", with *x* indicating the order in which the traffic matrix will be routed.<br>• DCL Traffic Matrix—The name of the traffic matrix. (Note that only DCL traffic matrices appear here, because no other traffic can be routed directly on DCL Rings.)<br>• Bit Rate—The bit rate of the traffic matrix<br>• Capacity—Total capacity of the traffic matrix (measured in the unit listed under Bit Rate)<br>• % on Rings—Percentage of traffic that could be routed on the rings before Ring Identification<br>• % on Mesh—Percentage of traffic that could not be routed on rings, but has been routed on mesh (using routing, dimensioning and/or grooming actions)<br>• % Unrouted—Percentage of traffic that is still unrouted |
| Only consider unrouted connections | Uncheck this if you want Ring Identification to consider already set-up traffic when it calculates candidate ring metrics and costs. The current resources used by this routed traffic will still be considered occupied. |
| **End of Table 12-5** | |

### Ring Identification, Step 2: Select Candidate Rings and Routing Metrics

This dialog box appears when you click Next in the “Ring Identification - Step 1 - Select Traffic” Dialog Box. In this step, you select the candidate rings for which you want to calculate the cost. The Select Candidate Rings table includes metrics that provide an initial estimate of how much traffic can be routed on each candidate ring. The metrics are derived from the routes of each connection when it is routed along its shortest path.

When you change the Metric, the metrics in the Select Candidate Rings table are updated automatically. To sort the rings based on a specific metric, click in the column header (for example, “Cap Eff.” or “Cap. Used”).

After you select the best candidate rings (click in the Select column or use the Select Top menu), you can do one of the following:

- To convert the selected Candidate rings to New rings and finish Ring Identification, click Finish.
- To further refine the list of candidate rings (by performing a detailed cost calculation) and to select the order in which they are installed, click Next and proceed to Ring Identification, Step 3: Inspect Ring Costs and Install Candidate Rings on page TrP-12-22.

**Figure 12-12 “Ring Identification - Step 2 - Ring Metrics” Dialog Box**

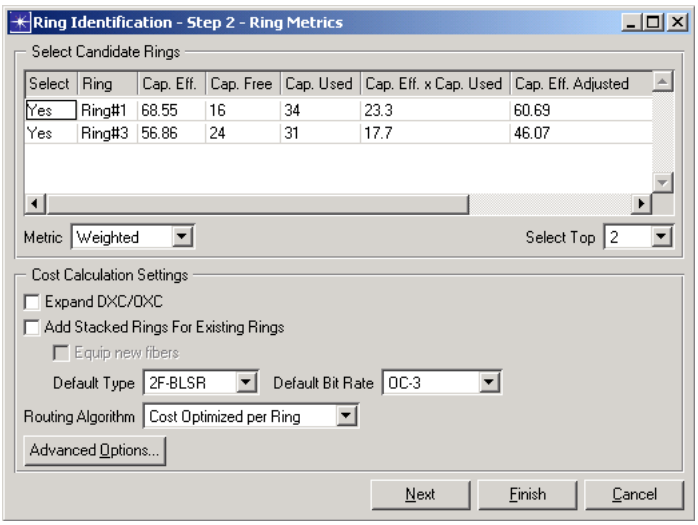


**Table 12-6 “Ring Identification - Step 2 - Ring Metrics” Dialog Box**

| Item | Description | Reference |
|---|---|---|
| Select Candidate Rings | Lists the candidate rings currently in the network. If you choose to install rings from this dialog box (by clicking Finish), SP Guru Transport Planner installs all selected rings in the order in which they appear in this table.<br><br>To sort rings based on a specific metric, click on the heading for that metric in this table. | Metrics Used in “Select Candidate Rings” Table on page TrP-12-20 |
| Metric | This setting affects how some ring metrics are calculated. | Formulae Used to Calculate Ring Metrics on page TrP-12-21 |
| Select Top | Selects the top x rings currently listed in the table, and deselects all others. The selection is retained even if the table is reordered. | — |
| Cost Calculation Settings | These options are the same as those shown in the Dimension DCL Rings dialog box, and are used when you click Next to calculate the cost for each candidate ring when it is added to the network. | Dimension DCL Rings Dialog Box on page TrP-12-8 |
| **End of Table 12-6** | | |

**Table 12-7 Metrics Used in "Select Candidate Rings" Table**

| Heading | Formula | Description |
|---|---|---|
| Cap Eff. | capacity_effectiveness<br>= used_bw / ring_bw | The fraction of the ring capacity that would be used if it carried all traffic that crosses the ring's links, assuming that traffic is routed along the shortest path.<br><br>Higher values mean that the ring would be used more effectively. (**Note—**this value does not indicate how much traffic the ring can carry; it only indicates how effectively the installed bandwidth would be used.) |
| Cap. Free | capacity_free<br>= ring_bw – used_bw | The amount of unused ring capacity (in STS-1 units) that would remain free if the ring carried all traffic that crosses the ring's links. This metric is calculated assuming that traffic is routed along the shortest path.<br><br>High values mean the ring has a lot of room to accommodate additional traffic. |
| Cap. Eff. x Cap. Used | cap_eff_x_cap_used<br>= cap_efficiency * cap_used<br>= (used_bw / ring_bw)<br>* used_bw | An "intermediate" metric obtained by multiplying Capacity Efficiency and Capacity Used.<br><br>High values mean the ring is used effectively and also carries a lot of traffic. |
| Cap. Eff. Adjusted | capacity_effectiveness_adjusted<br>= used_bw_adj / ring_bw_adj | Artificial measure that excludes the ring's most heavily used link in calculating ring efficiency. This results in an efficiency expression which is less biased by the number of links in a candidate ring.<br><br>High values mean the ring is used more effectively; in other words, a large portion of the installed ring capacity would be used. |
| Cap. Used | capacity_used = used_bw | The amount of capacity (in STS-1 units) that would be used to carry traffic, if the ring were to carry all traffic that crosses the ring's links. This metric is calculated assuming that traffic is routed along the shortest path.<br><br>High values mean the ring carries a lot of traffic. |
| **End of Table 12-7** | | |

**Table 12-8 Formulae Used to Calculate Ring Metrics**

| Parameter | Metric | Formula |
|---|---|---|
| weight [link_i] | Standard | weight [link_i] = traffic[link_i]<br>= sum (capacity [conns_j] )<br>/* conns_j = 1.. number of connections crossing link_i */<br>= amount of traffic crossing ring link i<br>/* measured in STS-1 equivalents */ |
| | Modular | weight [link_i] = traffic [link_i] |
| | Weighted | weight [link_i] = sum ( capacity [conns_j] / hops [link_1] )<br>/* conns_j = 1..number of connections crossing link_i */<br>capacity[j] = capacity of connection j<br>hops[j] = number of hops used for shortest-path routing of connection j |
| bw_per_link | Standard | bw_per_link = max_w<br>max_w = max ( weight [links_i] ) /* links_i=1..number of links on ring */ |
| | Modular | bw_per_link = stacked_ring_count * base_ring_bw<br>stacked_ring_count = ceil (max_w / base_ring_bw)<br>base_ring_bw = user configurable parameter<br>ceil (x) = smallest integer value that is greater than x<br>/* for example, ceil (8.13) = 9 */ |
| | Weighted | bw_per_link = max_w |
| used_bw | All Cases | used_bw = sum (weight [links_i]) /* links_i = 1..#links */ |
| ring_bw | All Cases | ring_bw = num_links * bw_per_link |
| used_bw_adj | All Cases | used_bw_adj = used_bw – max (weight [links_i])<br>/* links_i = 1..number of links on ring */ |
| ring_bw_adj | All Cases | ring_bw_adj = (num_links – 1) * bw_per_link |
| **End of Table 12-8** | | |

### Ring Identification, Step 3: Inspect Ring Costs and Install Candidate Rings

The “Ring Identification - Step 3 - Ring Costs” Dialog Box appears when you click Next in the “Ring Identification - Step 2 - Ring Metrics” Dialog Box. In this final step, you can narrow down the list of rings you want to install by applying more detailed ring-cost calculations to the list of rings you created in the previous step. Then you can install the selected rings (that is, convert the candidate rings to new rings).

The following steps outline the workflow in this dialog box:

1) If the Candidate Rings table shows one or more rings that you do not want to install, set the Selected fields to No in the Candidate Rings table.

2) Sort the candidate rings in the Candidate Rings table according to one or more cost metrics (percentage of total traffic, cost per ring, and so on). To sort the table automatically, click Auto Sort Order, specify the sort criteria, and click Auto Sort.

   After you select and sort the candidate rings, you are ready to install them. You can install the rings manually or using the Auto Install feature.

3) To install the rings manually—that is, to install all selected rings in the order in which they appear in the table—click Install Selected Rings.

4) If you install the rings using Auto Install, SP Guru Transport Planner installs the candidate rings as described in Auto Install: Algorithm Description. To install the rings using Auto Install, specify the ring threshold if desired (under Auto Install Options) and click Auto Install.

**Auto Install: Algorithm Description** The Auto Sort function installs rings using the following algorithm:

1) Calculate cost measures for the list of selected, uninstalled candidate rings.

2) Install the best candidate ring, based on the criteria specified in the “Candidate Ring Measure Order” Dialog Box.

3) Stop if either of the following conditions is true:
   - — Installing additional rings results in no increase in the percentage of total traffic on the rings or reduction in the total stacked ring cost
   - — The number of installed rings in the New Rings table equals the threshold specified in the Auto Install Options.

4) Otherwise, return to step 2.

**Figure 12-13 “Ring Identification - Step 3 - Ring Costs” Dialog Box**

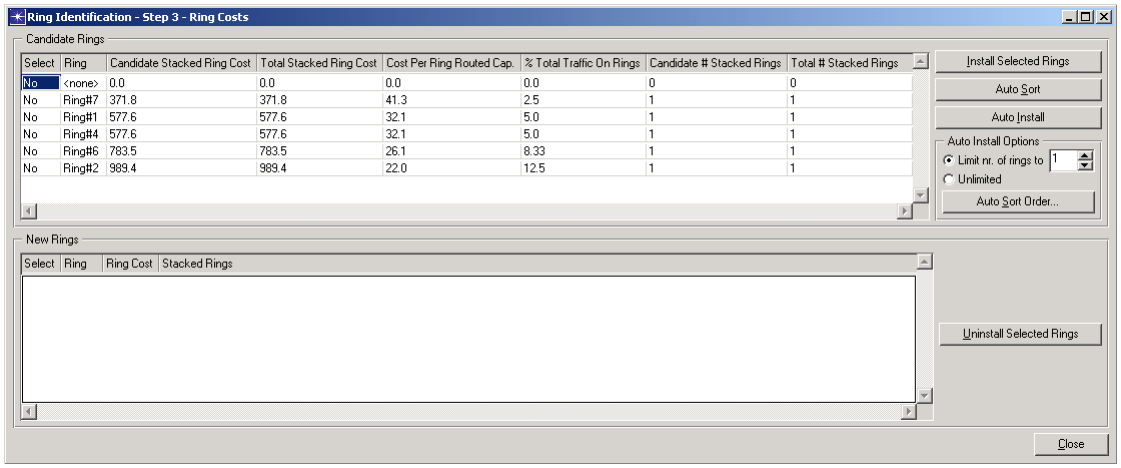



**Table 12-9 “Ring Identification - Step 3 - Ring Costs” Dialog Box (Part 1 of 2)**

| Item | Description | Reference |
|---|---|---|
| Candidate Rings | Lists the candidate rings currently in the network. If you choose to install rings from this dialog box (by clicking Install Selected Rings), SP Guru Transport Planner installs all selected rings in the order in which they appear in this table.<br><br>To sort rings based on a specific metric, click on the heading for that metric in this table.<br><br>This table has an initial entry of “<*none*>,” which shows the cost measures of routing traffic onto existing new and legacy rings only, without installing any candidate rings. The remaining entries show the cost metrics of routing traffic when the matching candidate ring is added to the network. | Table 12-10 Candidate Ring Cost Measures on page TrP-12-25 |
| Install Selected Rings | Installs all selected rings in the order in which they are listed | — |
| Auto Sort | Sorts the candidate rings according to the criteria listed in the Auto Sort Order dialog box | — |
| Auto Install | Installs some or all selected rings based on options in the specified Auto Install Options | Auto Install: Algorithm Description on page TrP-12-22 |

**Table 12-9 “Ring Identification - Step 3 - Ring Costs” Dialog Box (Part 2 of 2)**

| Item | Description | Reference |
|---|---|---|
| Auto Install Options | Specify options for the Auto Sort algorithm:<br>• Limit nr. or rings to—Upper limit of rings to install<br>• Auto Sort Order—Criteria used to select the candidate ring | Auto Install: Algorithm Description on page TrP-12-22<br>“Candidate Ring Measure Order” Dialog Box on page TrP-12-25 |
| New Rings | Lists rings that are currently installed. For each ring, the table shows the following metrics:<br>• Ring Cost—Cost for the stacked rings that would be added to the New Ring if traffic was to be routed on it, for the case of routing traffic on existing legacy and new rings only (without adding any candidate rings)<br>• Stacked Ring—The number of stacked rings that would be added on the New Ring if it were to be used for routing traffic on the set of rings formed by legacy and new rings only (without adding another candidate ring) | — |
| Uninstall Selected Rings | Uninstalls new rings that are selected (Select is set to Yes in the New Rings table) | — |
| **End of Table 12-9** | | |

**"Candidate Ring Measure Order" Dialog Box** This dialog box appears when you click Auto Sort Order in the "Ring Identification - Step 3 - Ring Costs" Dialog Box. Here you can specify the criteria used by the Auto Install algorithm to determine the best candidate ring to install in each iteration.

**Figure 12-14 "Candidate Ring Cost Measure Order" Dialog Box**

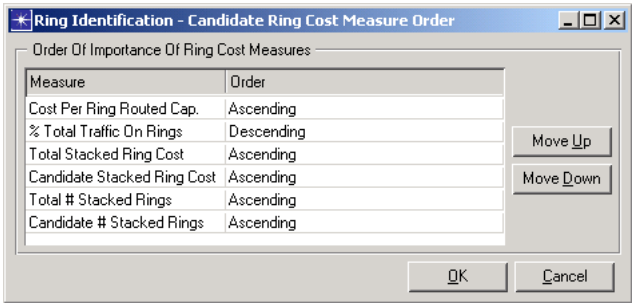



**Table 12-10 Candidate Ring Cost Measures**

| Item | Description |
|---|---|
| Candidate Stacked Ring Cost | Cost for the stacked rings that would be added to the candidate if traffic was to be routed on it. |
| Total Stacked Ring Cost | Cost for all stacked rings that would be added to either the candidate or the current set of existing (legacy and new) rings. The set of new rings includes rings installed in the current Ring Identification run as well as those from previous runs. |
| Cost Per Ring Routed Cap | The total cost divided by the traffic capacity that is currently routed on rings. |
| % Total Traffic On Rings | The fraction of the specified traffic that can be routed on the set of all legacy and new rings extended with the candidate. "Specified traffic" refers to the traffic matrices selected in the "Ring Identification - Step 1 - Select Traffic" Dialog Box. |
| Candidate # Stacked Rings | The number of stacked rings that would be added on the candidate if it were used for routing traffic. |
| Total # Stacked Rings | The total number of stacked rings that would be added to both the candidate ring and the existing (legacy and new) rings. |
| **End of Table 12-10** | |

## Evaluating Results

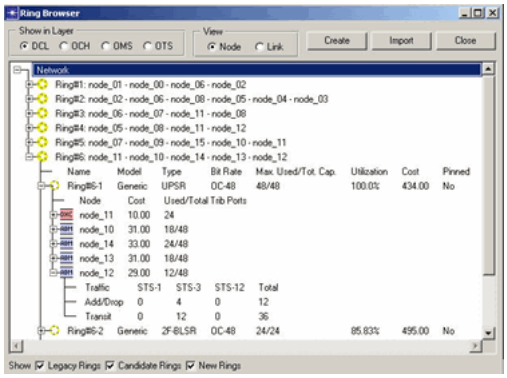
After you dimension the rings and (if needed) design the mesh, you can evaluate the results. You can view results in two different browsers:

- You can inspect the different rings and how they are utilized in the Ring Browser (see Viewing Ring Details in the Ring Browser on page TrP-12-26).
- You can inspect the path(s) of a connection—that is, the ring and mesh elements over which the connection is routed—using the Connection Browser (see Viewing Ring Paths in the Connection Browser on page TrP-12-26).

## Viewing Ring Details in the Ring Browser

In the Ring Browser you can inspect the amount and type of rings that are installed at each ring location using the Ring Browser (Network > Ring Browser). For each ring, you can inspect the used and total capacity, utilization and cost. You can switch between the Link and Node views to inspect the capacity on each link and node. You can use the Show checkboxes at the bottom to show or hide rings by usage type (Legacy, Candidate, and New). For more information, see Table 4-15 Ring Browser: Treeview on page TrP-4-29.

**Figure 12-15 Sizing Results in the Ring Browser**




## Viewing Ring Paths in the Connection Browser

You can inspect the paths of a connection using the Connection Browser (Network > Connection Browser). The Routed column shows per-connection routing information:

- Yes for routed connections. A routed connection has a full end-to-end path that can consist of multiple sub-paths over a combination of ring and mesh portions of the network.
- No for unrouted connections, which have no paths assigned to them
- Partial for connections that are partly established. A partial connection has an incomplete path (because the part on rings is routed but the part on the mesh is not).

The Carrier column shows the part of the network on which the connection is routed: Ring, Mesh, or Ring & Mesh.

When you select a connection in this browser, SP Guru Transport Planner highlights its path in the network topology. For a connection on a UPSR, SP Guru Transport Planner highlights the working path in green and protection path in red. For a connection on a BLSR, SP Guru Transport Planner highlights the working path only because there is no explicit protection path.

To examine these sub-paths in the Connection Browser, left-click on the '+' sign next to the connection to see detailed information. You can view the number of hops, whether the sub-path is routed on a particular ring or on the mesh, and the protection scheme applied to the subconnection.

The Connection Browser also has a By Ring view which enables you to inspect the connections that are routed over a particular ring.

For more information about this browser, see Connection Browser on page TrP-4-23.

**Figure 12-16 Connection Browser Indicating Paths over Rings and Mesh**