7   Hardware Configuration

The Hardware Configurator enables you to design network hardware with characteristics different from the generic equipment models provided with SP Guru Transport Planner. The Hardware Configurator relies on two major building blocks:

- Equipment files that contain detailed modeling of telecommunications equipment based on a set of devices and the relationships between them

- A configuration algorithm to select and configure the most suitable node and link equipment for the subject network

For more information about the equipment files and the configuration algorithm, see the SP Guru Transport Planner User Guide.

Note—The example equipment files are located in the following directory: `<install_dir>\<release>`\models\std\wdmguru\examples.

Procedure 7-1   Configuring Hardware in SP Guru Transport Planner

  1 Open the **WDMGuru_Tutorial_Hardware_Configurator** project.

    1.1 Select **File > Open...**

    1.2 Select the **WDMGuru_Tutorial_Hardware_Configurator** project, then press **Open**.

      ➥ The example project loads, and scenario **scenario1** appears in the workspace.

  2 Groom a SONET traffic matrix.

    2.1 Select **Design > Groom DCL to OCH Traffic > Fixed Routes...**

    2.2 Select the DCL traffic matrix **DCL_0**.

2.3 Select **OC-48** as the bit rate for the OCH traffic matrix and **Hop Count** as routing cost. Put a checkmark next to **Optimize**, **1+1 Protection in DCL**, **Client Protection** and **Node Disjoint**.
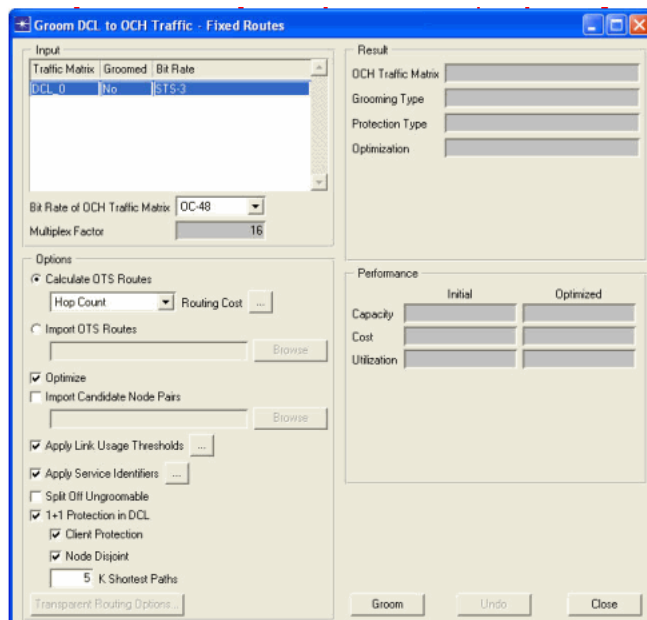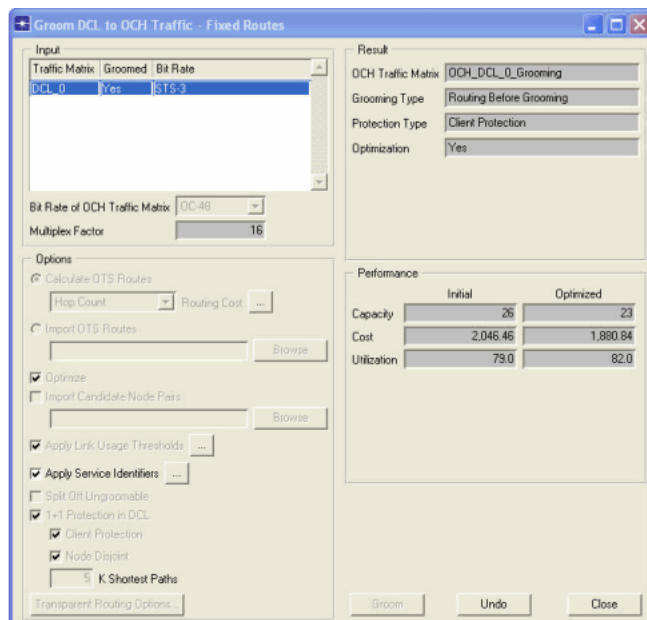

2.4 Press **Groom**.

➥ The **Grooming Optimization Progress** dialog box appears.

2.5 When the status is **Finished**, close this dialog box.

**2.6** Close the **Groom DCL to OCH Traffic - Fixed Routes** dialog box.

2.7 The SONET traffic matrix **DCL_0** and the wavelength traffic matrix **OCH_DCL_0_Grooming** (created by the grooming algorithm) are both entirely accommodated in the network. You can verify this in the DCL and OCH layer view (use he **DCL** and **OCH** toolbar buttons).

After you complete the initial network design, you can assign the appropriate set of hardware for this design using the Hardware Configurator.

3 Import the hardware library.

     3.1 Select **Hardware > Import Hardware Library...** This dialog box allows specifying the files that contain the device and card equipment.

     3.2 Select **…** in the **Devices** table to import a device file. Browse for the file **devices_tutorial.csv** in the example directory.

     3.3 Select **…** in the **Cards** table to import a card file. Browse for the file **cards_tutorial.csv** in the example directory.

     3.4 Press **OK** to import the equipment files and to add the devices and cards specified in the files to the equipment database.
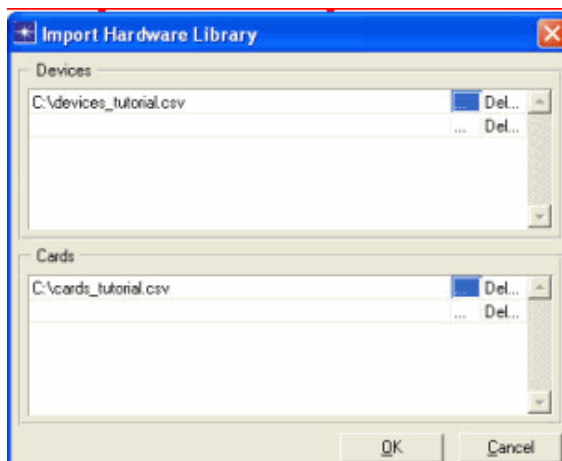
4 Browse the equipment files.

4.1 From a spreadsheet program or text editor, open the example file **devices_tutorial.csv**.

➥ This file contains specifications for the different equipment types supported in SP Guru Transport Planner.

➥ The first three columns in the device file (**Vendor**, **Family**, and **Model**) define a unique device. The Cost column contains the base cost of the device. Note that the first device (dxc1) has 2 base costs (separated by a +), implying this device is upgradeable. It has an initial cost of 500 and a cost of 850 after the upgrade.

➥ The **WDMG:Type** column specifies the SP Guru Transport Planner equipment type(s) supported by the device. The **WDMG:LS** column defines the corresponding line system in SP Guru Transport Planner and the **WDMG:Bit Rate** column specifies the aggregation bit rate for some devices.

➥ The last columns define the slot types supported by a device. The cards fitting into a certain slot are specified in the card file, by referring to the name of the slot type. A device contains a number of slots of a particular type. The upgradeable device dxc1 has an initial number of 16 and 32 after the upgrade.

| Vendor	Family	Model	Cost	WDMG:Type	WDMG:LS	WDMG:Bit Rate	Slot:DXC_	Slot:WDMTM_	Slot:OADM_	Slot:OA_	Slot:REG_	Slot:OXC_	Slot:TM_	Slot:PP_Slot
My Vendor	My Family	dxc1	500+850	DXC			16+32							
My Vendor	My Family	dxc2	1350	DXC+IXC			64							
My Vendor	My Family	wdmtm	1200	WDMTM	LH 8-WDM			8						
My Vendor	My Family	oadm	1600	OADM	LH 8-WDM				16					
My Vendor	My Family	oa	300	OA	LH 8-WDM					1				
My Vendor	My Family	regen	2500	REG	LH 8-WDM						8			
My Vendor	My Family	oxc1	1500	OXC								16		
My Vendor	My Family	oxc2	3250	OXC								64		
My Vendor	My Family	tm 10 Gbps	600	TM	OC-192								64	
My Vendor	My Family	tm 2.5 Gbps	250	TM	OC-48								16	
My Vendor	My Family	pp	700	PP										64

4.2 Open the example file **cards_tutorial.csv**. This file determines which cards fits in which slot type.

• The first two columns in the card file (**Vendor** and **Model**) define a unique card. The **Cost** column contains the cost of a card.

• The **Fits In** column relates the cards to the devices: it specifies which card fits in a particular slot type. The **Slots Taken** determines the number of slots taken by the card.

• The last columns define the client interfaces supported by the card.

| Vendor	Model	Cost	Fits In	Slots Taken	Port:STS-3	Port:OC-48	Port:OC-192	Port:Fiber
My Vendor	10 Gbps (single) DXC	60	DXC_Slot	2			1	
My Vendor	2.5 Gbps (quad) DXC	80	DXC_Slot	1		4		
My Vendor	2.5 Gbps (single) DXC	25	DXC_Slot	1		1		
My Vendor	155 Mbps (hex) DXC	70	DXC_Slot	1	16			
My Vendor	155 Mbps (quad) DXC	20	DXC_Slot	1	4			
My Vendor	10 Gbps WDMTM	100	WDMTM_Slot	1			1	
My Vendor	2.5 Gbps WDMTM	40	WDMTM_Slot	1		1		
My Vendor	OA	100	OA_Slot	1				1
My Vendor	10 Gbps REG	180	REG_Slot	1			1	
My Vendor	2.5 Gbps REG	70	REG_Slot	1		1		
My Vendor	10 Gbps OADM	40	OADM_Slot	1			1	
My Vendor	2.5 Gbps OADM	15	OADM_Slot	1		1		
My Vendor	10 Gbps OXC	60	OXC_Slot	1			1	
My Vendor	2.5 Gbps (dual) OXC	45	OXC_Slot	1		2		
My Vendor	2.5 Gbps (single) OXC	25	OXC_Slot	1		1		
My Vendor	155 Mbps TM	3	TM_Slot	1	1			
My Vendor	10 Gbps PP	15	PP_Slot	1			1	
My Vendor	2.5 Gbps PP	5	PP_Slot	1		1		

5 Manage the hardware library.

   5.1 Select **Hardware > Manage Hardware Library...** In this dialog box, the devices and cards in the equipment database can be verified per SP Guru Transport Planner equipment type.

   5.2 Select **DXC** (Type). All DXC devices and cards and their cost are shown. The **Consider for design** column indicates whether the device or card can be used for the next configuration run. Left clicking on **Yes** can change this setting. In this example, we are using all cards and devices for the configuration run.
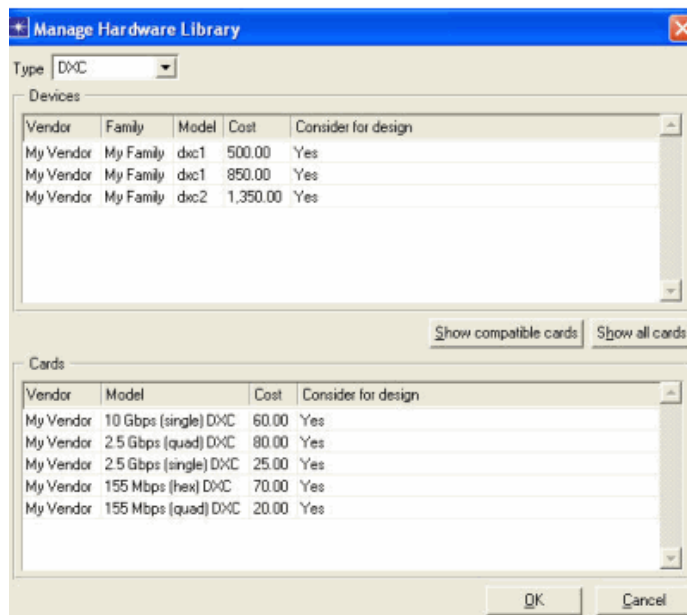

   5.3 Right-click on a device or card and select **View Equipment Details** to see the detailed properties of a device or card.

   5.4 Close the **Manage Hardware Library** dialog box.

6 Configure the hardware (design run 0).

   6.1 Select **Hardware > Configure Hardware...** This dialog box allows performing the hardware configuration for each SP Guru Transport Planner equipment type present in the network.

   6.2 Select **Best Family Network Wide** for each type, implying the same family for each device of a certain type in the network. Note that for SP Guru Transport Planner types that are not present in the given network the setting "Not needed" is fixed in the Configure column.

6.3 Uncheck **Upgrade Design** and choose **Exhaustive search** to perform an exhaustive search over all equipment for a particular SP Guru Transport Planner type in the hardware library and a configuration for each possibility, and choose the most economic solution for each SP Guru Transport Planner type.
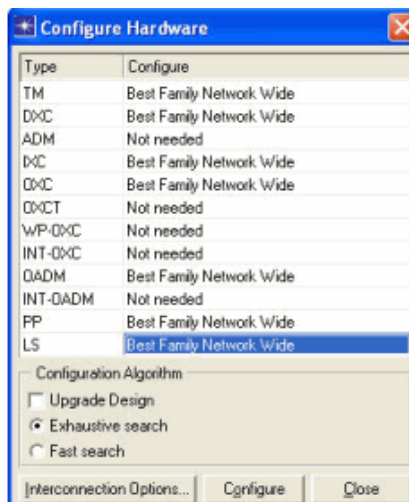
6.4 Press **Configure**.

➥ The **Hardware Configurator Report** dialog box appears to show the results of the hardware configuration algorithm; note that a valid configuration has been found for all equipment in the network.
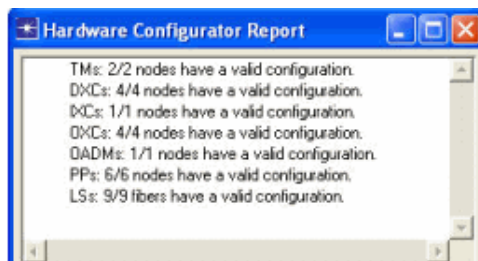

6.5 Close the dialog box.

7 Inspect the installed hardware (design run 0).

7.1 Select **Hardware > Open Hardware Browser**. The **Hardware Browser** dialog box gives an overview of all the installed hardware in the network.

7.2 Select **By Node** to inspect the installed equipment per node.

7.3 Select **node_06**. This node contains one patch panel device and one DXC device. The patch panel (type pp) contains 16 cards resulting in 16 used slots (out of the 64 available). On the DXC (of type dxc1) six of the 16 slots are in use.

7.4 Click on the **+** icon next to a device to see the cards on the device. The DXC in node_06 contains six cards: two 2.5 Gbps (quad) DXC cards (for the trunk ports), three 155 Mbps (hex) cards and one 155 Mbps (quad) card (both for the tributary ports). Note that instead of installing a fourth 155 Mbps (hex) card, the algorithm has chosen for the cheaper 155 Mbps (quad) card.

7.5   Click on **+** left of a card to inspect the ports on the card: two ports on the 155 Mbps (quad) card are in use (with STS-3 as interface).
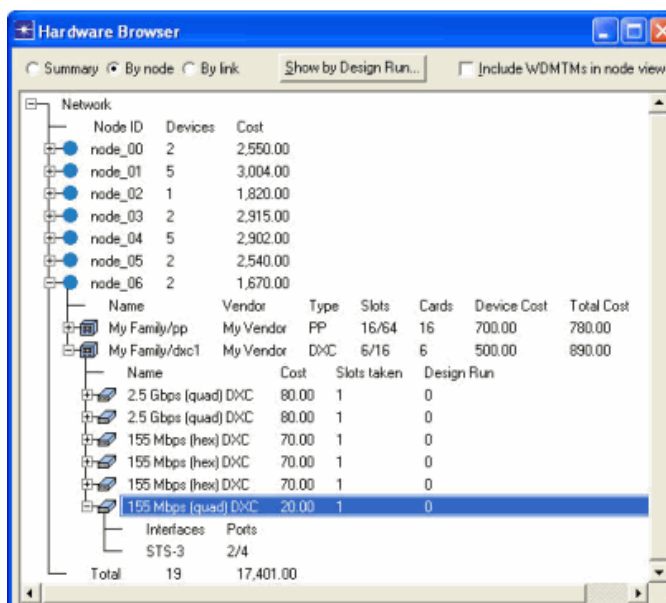
7.6   Select **By Link**. This shows the installed equipment per link. Select the link **node_06 <-> node_05**; two WDM terminal multiplexers, six optical amplifiers and one regenerator are installed on this link. The total cost of the equipment on this link is 7600.
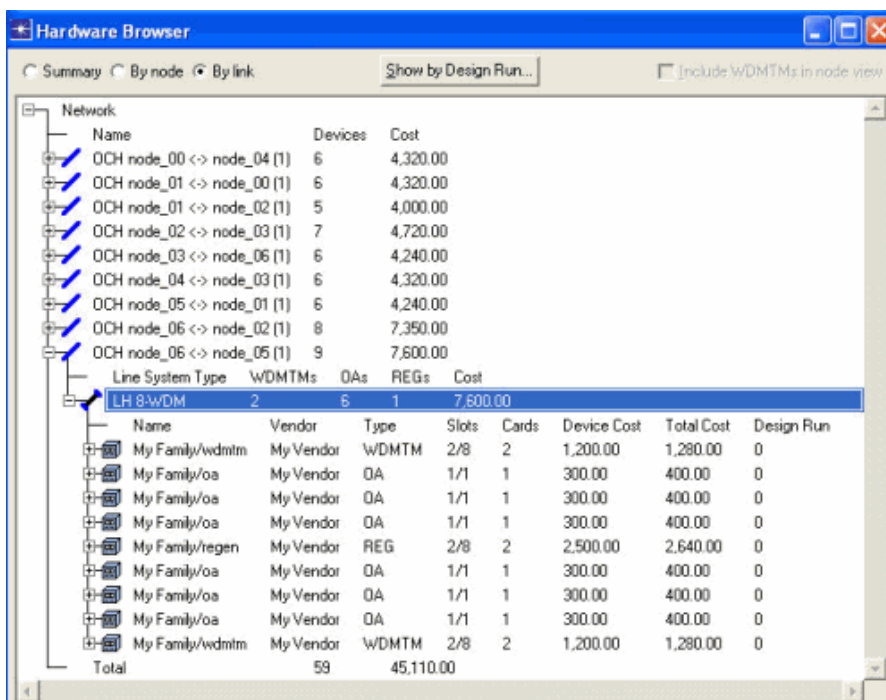
7.7   Close the **Hardware Browser**.

8   Generate the hardware web report (design run 0).

8.1 Select **Hardware > Generate Web Report...**

➡ The web browser is launched and the hardware configurator web report appears.

This report gives an overview of the installed hardware in the network.

8.2 Select **Summary**. This table gives an overview of all installed hardware per SP Guru Transport Planner equipment type.

Type	Devices	Device Cost	Cards	Total Cost	% Total Cost
DXC	4	2,000.00	25	3,530.00	5.65
IXC	1	1,350.00	7	1,820.00	2.91
OA	39	11,700.00	39	15,600.00	24.96
OADM	1	1,600.00	6	1,690.00	2.7
OXC	4	6,000.00	29	7,305.00	11.69
PP	1	700.00	16	780.00	1.25
REG	2	5,000.00	5	5,350.00	8.56
SONET TM	8	2,000.00	92	2,276.00	3.64
WDMTM	18	21,600.00	64	24,160.00	38.65
Total	78	51,950.00	283	62,511.00	100.0

8.3 Click on **DXC** in the Summary table.

➡ A new table appears with information about all DXC devices installed in the network.

Device	Quantity	Device Cost	Cards	Card Types	Quantity	Card Cost	Total Cost	% Total Cost
My Vendor My Family dxc1	4	2,000.00	25	My Vendor 2.5 Gbps (quad) DXC	6	480.00	3,530.00	100.0
				My Vendor 2.5 Gbps (single) DXC	4	100.00		
				My Vendor 155 Mbps (hex) DXC	13	910.00		
				My Vendor 155 Mbps (quad) DXC	2	40.00		
Total	4	2,000.00			25	1,530.00	3,530.00	100.0

8.4 Select **Summary By Node** to get an overview table of the hardware installed in the nodes.

Node	DXC	IXC	OADM	OXC	PP	SONET TM	Total	Total Cost
node_00	1		1				2	2,550.00
node_01				1		4	5	3,004.00
node_02		1					1	1,820.00
node_03	1			1			2	2,915.00
node_04				1		4	5	2,902.00
node_05	1			1			2	2,540.00
node_06	1				1		2	1,670.00
Total	4	1	1	4	1	8	19	17,401.00

8.5 Click on **node_06** in the Summary By Node table: an overview of all devices installed in node_06 is displayed.

Type	Devices	Device Cost	Cards	Total Cost	% Total Cost	
DXC	1	500.00	6	890.00		53.29
PP	1	700.00	16	780.00		46.71
Total	2	1,200.00	22	1,670.00		100.0

8.6 Select **DXC** in the node_06 table. This table lists the DXC devices and cards in the node.

Device	Quantity	Device Cost	Cards	Card Types	Quantity	Card Cost	Total Cost	% Total Cost	
My Vendor My Family dxc1	1	500.00	6	My Vendor 2.5 Gbps (quad) DXC	2	160.00	890.00		100.0
				My Vendor 155 Mbps (hex) DXC	3	210.00			
				My Vendor 155 Mbps (quad) DXC	1	20.00			

8.7 Select **Summary By Link** to inspect the hardware installed on the links.

Link	OA	REG	WDMTM	Total	Total Cost
OCH node_00 <-> node_04 (1)	4		2	6	4,320.00
OCH node_01 <-> node_00 (1)	4		2	6	4,320.00
OCH node_01 <-> node_02 (1)	3		2	5	4,000.00
OCH node_02 <-> node_03 (1)	5		2	7	4,720.00
OCH node_03 <-> node_06 (1)	4		2	6	4,240.00
OCH node_04 <-> node_03 (1)	4		2	6	4,320.00
OCH node_05 <-> node_01 (1)	4		2	6	4,240.00
OCH node_06 <-> node_02 (1)	5	1	2	8	7,350.00
OCH node_06 <-> node_05 (1)	6	1	2	9	7,600.00
Total	39	2	18	59	45,110.00

8.8 Click on **node_06 <-> node_02** in the Summary By Link table to get an overview of all devices installed on the link between node_06 and node_02 is given.

Type	Devices	Device Cost	Cards	Total Cost	% Total Cost	
OA	5	1,500.00	5	2,000.00		27.21
REG	1	2,500.00	3	2,710.00		36.87
WDMTM	2	2,400.00	6	2,640.00		35.92
Total	8	6,400.00	14	7,350.00		100.0

8.9 Select **OA** in the **node_06 <-> node_02** table. A table listing all optical amplifier devices and cards installed on the link is displayed.

| Device	Quantity	Device Cost	Cards	Card Types	Quantity	Card Cost	Total Cost	% Total Cost	
My Vendor My Family oa	5	1,500.00	5	My Vendor OA	5	500.00	2,000.00		100.0
Total		5	1,500.00			5	500.00	2,000.00	100.0

8.10 Close the hardware web report.

9 Route an OCH traffic matrix.

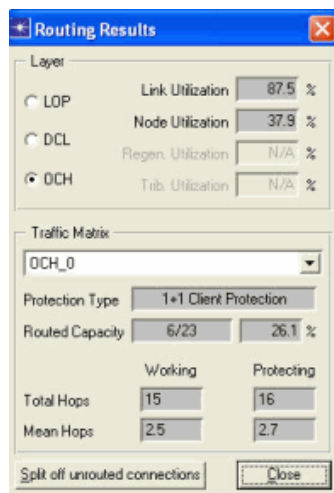**9.1** Select the **Design > Route DCL/OCH Traffic...** dialog box.

9.2 Select the **OCH Layer** and the traffic matrix **OCH_0**.

9.3 Choose **Protected** (Protection) and **OTS Link Disjoint**. Put a checkmark next to **Node Disjoint** and **Client Protection**. Select **Sequential** (Routing Algorithm), **Longest First** (Connection Order), **Hop Count** (Routing Cost). Uncheck **Allow Equipping Dark Bands** (Link Model Options), **Impose Node Limitations**, and **Constrain OCH Routing By DCL Node Size** (Node Model Options).
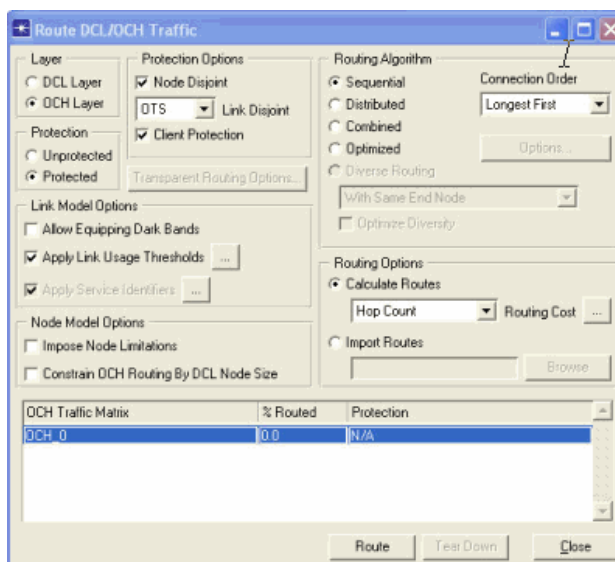
9.4 Press **Route**.

➡ The **Routing Results** dialog box indicates that only 26 percent of the traffic matrix is accommodated in the network. Note that the bit rate of this traffic matrix is OC-192 (i.e. 10 Gb/s). This can be checked in the **Network > Traffic Matrix Editor** dialog box.

9.5 Close the **Routing Results** and the **Route DCL/OCH Traffic** dialog boxes.

10 Configure the hardware (design run 1).

10.1 Select **Hardware > Configure Hardware...**

10.2 Check **Upgrade Design.** This implies that the configuration algorithm starts from the present configuration (no present devices are removed) and only adds new devices and cards if needed. Note that the newly added devices and cards are marked with design run number 1, while those that were already present are marked with design run number 0.

Note—When a design is upgraded, only the devices of the current family are upgraded or added—no new equipment family is added. That is why the **Configure** column is fixed to **Best Family per Node**.
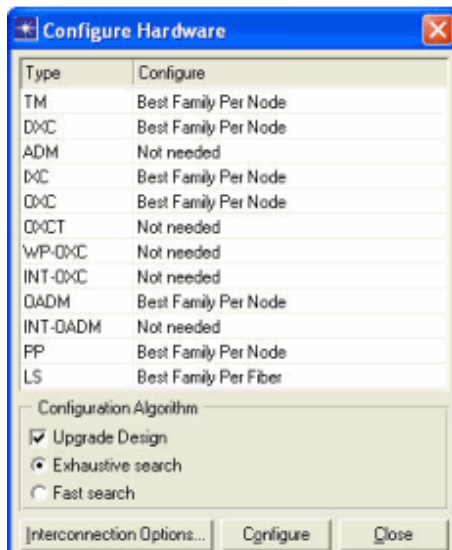
10.3 Select **Exhaustive Search** and click on **Configure**.

➥ The **Hardware Configurator Report** dialog box shows that a valid configuration has been found for all equipment in the network.
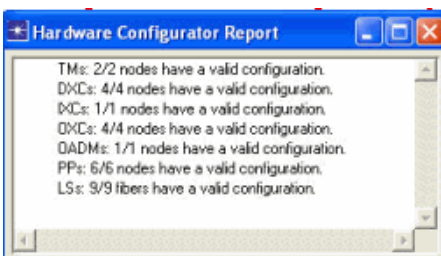
10.4 Close this dialog box.

11 Inspect the installed hardware (design run 1).

11.1 Select **Hardware > Open Hardware Browser**.

11.2 Select **By Node** and **node_06**.

The patch panel device and the DXC device were already installed during the previous design run. After design run 0, the number of available slots on the DXC was 16, but now the number of slots is 32. The DXC of type dxc1 is an upgradeable device and it has been upgraded to host all the needed cards.

The DXC now contains 14 cards. Six of the cards were installed during the previous design run (0), and eight 10 Gbps (single) cards were added during the current design run (1). Note that the interfaces on the latter cards are OC-192 interfaces, which is the bit rate of the traffic matrix OCH_0.


11.3 Click on the **Show by Design Run...** button to customize the view of the Hardware Browser so it shows only the hardware included up to a specified design run or of one specific design run.

11.4 Close the hardware browser.

12 Examine the upgrade history.

12.1 Select **Hardware > Show Upgrade History**. These dialog boxes show the cost of installed equipment per design run.

12.2 Select **Equipment Types** in the lower left corner of the tabular dialog box. The total cost of the equipment is displayed per design run. Note that only a smaller part of the equipment has been added during the last design run.
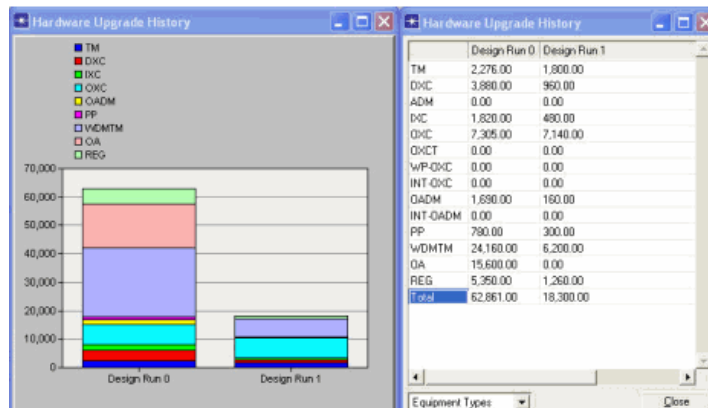
12.3 Select **Device Types** to verify the cost of the devices per design run. Only OXC and TM devices have been added during the last design run.
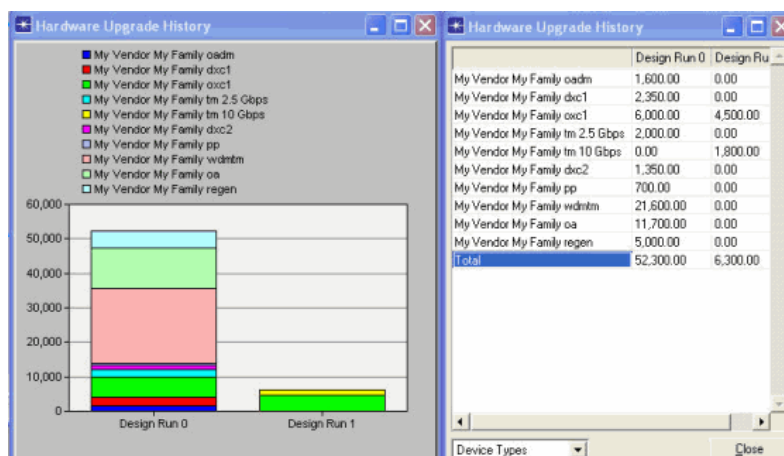
12.4 Select **Card Types**. The cost of the cards per design run is displayed. Because the traffic matrix OCH_0 has bit rate OC-192, all added cards during the last design run are 10 Gbps cards.
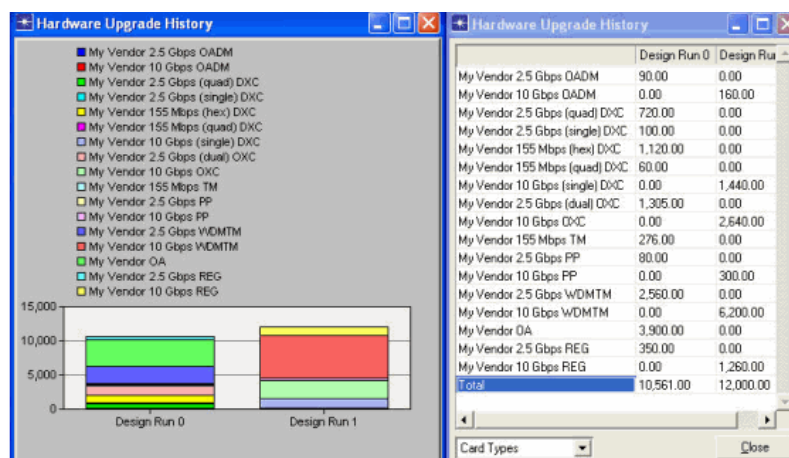
12.5 Close the dialog boxes.

13 Close the project

13.1 Select **File > Close.**

13.2 Select **Don't Save** in the Close Confirm dialog.

End of Procedure 7-1