



Overview

Cisco MetroPlanner Release 7.0.1 provides a way to model and test wavelength division multiplexing (WDM) optical networks in a graphical environment. The primary purpose of Cisco MetroPlanner is to help sales engineers (SEs) design and validate networks of Cisco Optical Networking System (ONS) 15454 Multi-Service Transport Platforms (MSTP). Using Cisco MetroPlanner Release 7.0.1, an SE can create multiple instances of a network to modify different parameters in each instance for comparison. Cisco MetroPlanner generates a shelf view of all the sites deployed in the optical network and provides a complete bill of materials (BOM) for the network and the differences between instances of a network.

This chapter describes how you use Cisco MetroPlanner to design, analyze, and optimize new or existing Cisco optical networks and contains the following sections:

- [1.1 Cisco MetroPlanner Features, page 1-1](#)
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- [1.4 Planning Traffic in Cisco MetroPlanner 7.0.1, page 1-7](#)
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1.1 Cisco MetroPlanner Features

Cisco MetroPlanner Release 7.0.1 provides a simple tool set for designing optical networks with Cisco ONS 15454 MSTP products. You can enter all of the network parameters or minimal information, such as site distance, and Cisco MetroPlanner will model the network you need to build and generate a detailed BOM with ordering information. Designing optical networks requires the verification of multiple constraints such as optical budget limitations and platform architectural restrictions. One Cisco MetroPlanner project can contain multiple copies of a network. This allows you to change parameters in one network copy, then analyze and compare to another network copy to determine the differences. In addition to this capability, Cisco MetroPlanner Release 7.0.1 provides the following new features:

- Network upgrade to implement forecasted channels
- Slot preprovisioning (by importing the NE Update file into the Cisco Transport Controller [CTC]))
- User-defined equipment lists in the parts database
- Fiber separation allowing a user to manage certain parameters (such as loss) for each strand in a fiber pair

- Forced equipment settings (user-defined parameters instead of Cisco MetroPlanner automatic settings)
- Power consumption calculation
- L-band design
- C-band enhanced booster
- C-band + L-band/50-GHz scalable design
- Multishelf management
- New DWDM client interfaces
- Meshed reconfigurable optical add/drop multiplexing (ROADM)
- Capability to select the type of maintenance contract desired to appear in the BOM

1.2 Network Design Process

To generate a network design, the SE enters the following parameters:

- The number of network sites
- The type of equipment used at each site
- The distance separating the sites
- The type of fiber connecting the sites
- Service demands, including the service type, the protection type, and the number of channels between nodes

When the network parameters are entered, Cisco MetroPlanner finds the best routing, defines the required add/drop filters, and places optical amplifiers and dispersion compensation units (DCUs) to fit the user traffic demands at the minimum cost. Optimization is performed to meet the boundary conditions. The optimization includes attenuation and amplification.

Finally, Cisco MetroPlanner generates a BOM, which includes the product codes, the quantities, and pricing information. In addition, it creates other reports, such as a shelf-level view of the configuration, which can be printed. This helps the SE understand how the shelf is built and helps to avoid confusion and errors during the actual deployment. Within the BOM is the total network cost, which allows a quick comparison of various design options. The total network cost is the cost of the equipment for all of the sites in the designed network.

1.2.1 Network Design Optimization

Cisco MetroPlanner searches for the best solution to a designed network using an optimization algorithm.

1.2.2 Network Design Constraints

A network design must meet the optical budget and receiver overload criteria to operate efficiently. An analysis of optical budget and receiver overload evaluates the strength of the signal traversing the ring. If a design solution satisfies the constraints, it is a valid design. The Cisco MetroPlanner Release 7.0.1

optimization algorithms generate multiple solutions and verify the constraints against those solutions. If the constraints are satisfied, the solution with the lowest cost-to-utilization ratio is selected as the optimal solution.

If the network design solution fails to satisfy all the constraints, Cisco MetroPlanner Release 7.0.1 makes adjustments to parameters such as signal attenuation and amplification. Amplification is achieved by using an erbium-doped fiber amplifier (EDFA). Attenuation is achieved by using variable optical attenuator (VOA) modules integrated into the platform. Cisco MetroPlanner Release 7.0.1 corrects the optical budget using an algorithm that includes automatic placement of EDFAs and VOA regulation.

For each internodal demand, Cisco MetroPlanner Release 7.0.1 performs an optical budget and receiver overload analysis and displays the results in various reports in the GUI. If the network design algorithms are not able to provide a solution, then you can modify the input data (for example, by relaxing some user constraints) and run the analysis again.

1.2.3 Platform Support

Cisco MetroPlanner Release 7.0.1 supports the Cisco ONS 15454 DWDM optical platform Software Releases 4.7, 5.0.x, and 7.0.x

1.2.4 Topology Support

Cisco MetroPlanner 7.0.1 supports the following network topologies:

- Bus (single span, point-to-point, and linear)
- Open (or hubbed) ring
- Closed (or meshed) ring
- Any-to-any ring (ROADM)

Cisco MetroPlanner 7.0.1 allows you to design flexible networks with up to 60 site locations. A flexible network is a network that, using ROADM nodes, allows traffic modification/reconfiguration as traffic requirements change. The main feature of flexible networks is the traffic reconfiguration/modification among all the networked nodes or among a subset of them.

The maximum number of locations where the optical service channel (OSC) is terminated is 20. The maximum number of add/drop locations is 16.

1.2.5 Protection Scheme Support

Cisco MetroPlanner 7.0.1 designs support the following protection schemes:

- Y-cable protected—In Y-cable protection, one transponder card is designated as active and the other as standby. The standby transponder card has the client-side laser turned off to avoid corrupting the signal transmitted back to the client. The active transponder monitors the signal from the trunk side and in the event of loss or signal failure, the system switches to the standby path.
- Client-based 1+1—Two client signals are transmitted to separated line cards or transponder cards instead of using a Y-cable to split one client signal into two line cards or transponder cards. In client 1+1 protection, the failure and switchover is controlled by the client system.

- Fiber-switched protection—The single client signal is injected into the client receive (Rx) port. It is then split into two separate signals on the two trunk transmit (Tx) ports. The two signals are transmitted over diverse paths. The far-end card chooses one of the two trunk Rx port signals and injects it into the Tx client port.
- Unprotected—Protection is not used.

1.2.6 Service Support

Cisco MetroPlanner 7.0.1 can support any subset of the following services:

- Alien (third-party DWDM interface)
- Cisco ONS 15530 2.5 Gbps Aggregated
- ONS 15530 10 Gbps Aggregated
- ONS 15530 Multirate (MR) Transport
- ONS 15530 Data Multiplexer (MXP)
- 2R Any Rate
- Gigabit Ethernet
- 10GE—10 Gigabit Ethernet (LAN and WAN)
- D1 Video
- DVB-ASI—Digital Video Broadcast-Asynchronous Serial Interface.
- DV-6000
- ESCON—Enterprise System Connection
- Fast Ethernet
- Fibre Channel 1G
- Fibre Channel 2G
- Fibre Channel 4G
- Fibre Channel 10G
- FICON—Fiber Connection 1G
- FICON Express 2G
- High Definition Television (HDTV)
- ISC-3 Peer (1G)
- ISC-3 Peer (2G)
- ISC-3 Peer (2R)
- ISC-Compat (ISC-3 Compatibility Mode)
- OC-3
- OC-12
- OC-48
- OC-192
- OC-768
- SDI—Serial Data Input

- STM-1
- STM-4
- STM-16
- STM-64
- STM-256
- Sysplex CLO—Control Link Oscillator
- Sysplex ETR—External Throughput Rate

**Note**

The Sysplex CLO and Sysplex ETR services are supported only on the following topologies:

- Single span—Two terminal sites with 32MUX-O and 32DMX-O cards, or 32WSS and 32DMX or 32DMX-O cards installed and no intermediate sites in between.
- Point-to-Point—Two terminal sites with 32MUX-O and 32DMX-O cards, or 32WSS and 32DMX or 32DMX-O cards installed. Line amplifiers can be installed between the terminal sites, but intermediate (traffic terminating) sites cannot be installed.
- Two hubs—Two hub nodes in a ring with 32MUX-O, 32DMX-O, 32WSS, and 32DMX cards or 32DMX-O cards installed. Line amplifiers can be installed between the hubs.

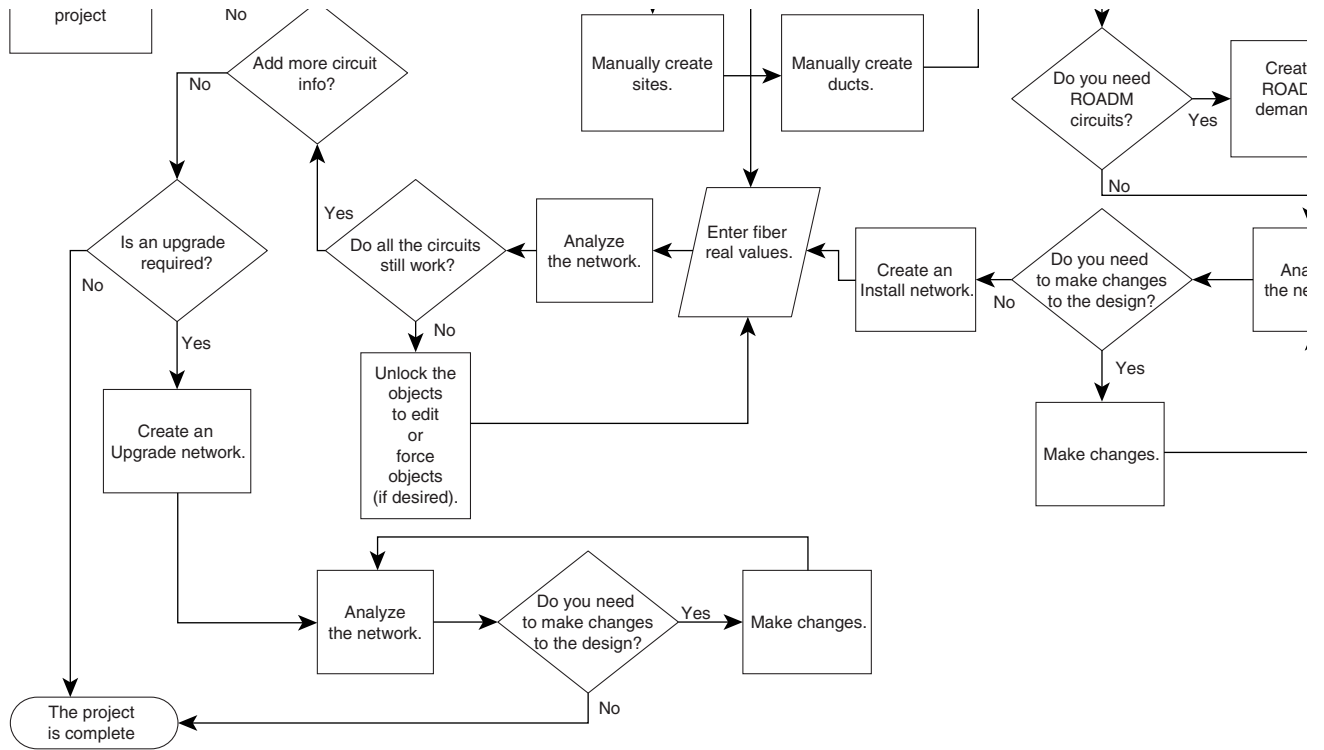
Refer to the *Cisco ONS 15454 DWDM Reference Manual* for more information about the supported topologies for the ETR and CLO services.

1.3 Cisco MetroPlanner Process Flow

The following stages are used to complete a network design. See [Figure 1-1](#) for the process flow.

1. Create a project using the Project Creation wizard.
2. Create a network using the Create Network wizard. The Create Network wizards adds sites and places the fiber spans between the sites. A span represents a pair of fibers.
3. Create a point-to-point, protected ring (P-ring), and/or ROADM service demand.
4. Analyze the network design.
5. If you would like to force automatic tool choices, adjust the design and repeat the analysis until you have reached the desired configuration.
6. Create an Install copy of the network and update the parameters with real data from the field.
7. Analyze the Install network.
8. Create an upgrade copy of the network, as needed, to add forecasted channels.

Figure 1-1 Cisco MetroPlanner Process Flow



1.4 Planning Traffic in Cisco MetroPlanner 7.0.1

Traffic in Cisco MetroPlanner is defined as an optical path for each pair of nodes requiring a service demand. An optical path is the combined channels between the two nodes. The following list gives definitions for some basic traffic items:

- **Circuit**—A single channel between a pair of source and destination nodes. Depending on the traffic demand type, the number of circuits can vary from 0 to 32 between a pair of nodes. In addition to the source and destination nodes and all the attributes that are common to the service containing the circuit, a circuit has the following attributes:
 - Present/forecast indication
 - Routing direction for unprotected service
 - ITU channel
 - Optical bypass indication
- **Demand**—A set of circuits with common characteristics, such as:
 - Service demand label
 - Number of existing circuits
 - Number of forecasted circuits
 - Client service type
 - Protection type
 - Optical bypass (number of channels and/or sites)
 - WDM interface type (TXT or ITU-LC)
 - WDM card type
 - Source client interface (SR, IR, or LR)
 - Destination client interface (SR, IR, or LR)
- **Traffic demand**—All traffic between the same set of nodes. Both L-band and C-band are supported. The following traffic demands are supported: P-ring, Fixed (point-to-point), and Any-to-any (ROADM).

In P-ring traffic demands, all the demands used to support traffic topologies similar to bidirectional line switch rings (BLSRs) or multiplex section-shared protection rings (MS-SPRings). Each P-ring demand is between a pair of added/dropped nodes where BLSR-like (or MS-SPRing-like) traffic must exist. The number of circuits is the same for each demand, and is user-specified (from 1 to 32).

In fixed (point-to-point) traffic demands, the set of nodes is restricted to two sites. The number of circuits is user-specified (from 1 to 32).

In any-to-any (ROADM) traffic demands, a minimum of two nodes and a maximum of every node in the network. An any-to-any traffic demand allows each node to establish one or more circuits with the other nodes, either as a hub or meshed configuration. In a meshed configuration, each node defined in the set is connected to each other node. This is the most common traffic type. In a hub configuration, the user-defined hub node is connected to each of the other nodes. ROADM circuits have the same protection types and services. The number of circuits is not user-specified and can vary from 0 to 32. For ROADM, only L-band is supported.

A ROADM demand can have multiple client service types and supports multiple DWDM card interfaces for each client service type. A ROADM demand supports the following routing strategies:

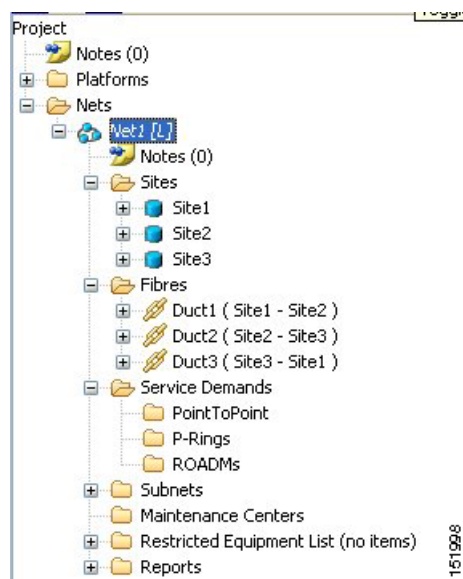
- **Protected (Default)**—Each node pair in the traffic demand is connected using two connections.

- Unprotected optimum optical path—Each node pair is connected using one connection. The unprotected optimum optical path minimizes the number of required optical amplifiers, but also restricts the number of channels that can be deployed among the nodes of the traffic demand (maximum of 32 channels between each node pair) in the installed network.
- Unprotected minimum hop count—Each node pair in the traffic demand is connected by one connection. The unprotected minimum hop count maximizes the number of channels (for unprotected traffic types only) that can be deployed among the nodes of the traffic demand, but can require a higher number of optical amplifiers on the unprotected optimum optical path (maximum of 32 channels between each node pair) in the installed network.
- Unprotected subnet—Each node pair in the traffic demand is connected using one connection. You can manually force connections on only one branch of the ring. For unprotected subnets, you must manually select one starting node of the branch and the direction the ring must be traversed to define the subnet, starting from the initial site. The branch direction is specified by defining the outgoing side first, referred to as the starting node. This routing strategy option allows you to exclude some critical paths and (with ROADMs traffic demands containing two sites) to force each ROADM connection clockwise or counterclockwise.

1.5 Cisco MetroPlanner 7.0.1 Traffic in the Project Explorer Pane

Cisco MetroPlanner 7.0.1 represents all of the user-defined traffic services as a tree view within the Project Explorer pane. The Project Explorer shows all of the open project information, including the networks, the network dependencies, sites, fibers, services, etc. (Figure 1-2).

Figure 1-2 Project Explorer View



After you analyze a network design, the colors of tree view change according to the error/warning condition of the network design. The icons display as red if there are errors in the network design; orange if there are warnings but no errors; and green if there are no warnings or errors. The icon shows the color of the most severe condition. For more information about analyzing the network, see the “2.4 Analyzing the Network” section on page 2-37.

Right-clicking on certain items in the Project Explorer tree allows you to edit the parameters. Refer to Chapter 2, “Designing Networks with Cisco MetroPlanner” for more information about optical results, the traffic matrix, and editing.

1.5.1 Point-to-Point Traffic Demands

Point-to-point traffic demands appear in the Service Demands > PointToPoint folders in the Project Explorer pane. Each point-to-point traffic demand is categorized by its source and destination site names. All of the point-to-point services between the two sites appear under the designated demand name (Figure 1-3).

Figure 1-3 Point-to-Point Traffic Demand in the Project Explorer



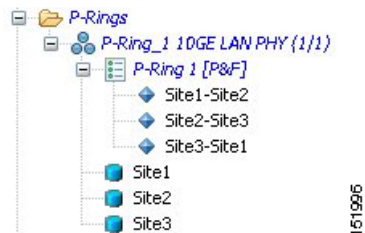
A point-to-point traffic demand includes the following information:

- Client service type
- Site# – Site# (source and destination site labels for this demand)

1.5.2 P-Ring Traffic Demands

Each protected ring (P-ring) traffic demand appears in the Project Explorer pane under the Service Demands > P-Rings folders. Figure 1-4 shows an example of a P-ring traffic demand in the Project Explorer.

Figure 1-4 P-Ring Traffic Demand in the Project Explorer



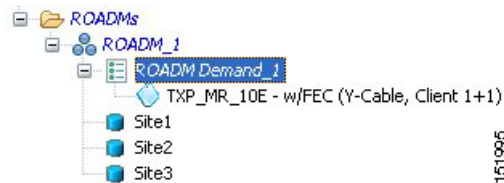
All the P-ring channels between each site pair are listed under each P-ring traffic demand. Each demand is labeled with the following information:

- P-ring number
- Client service type
- Site# – Site# (source and destination site labels for this demand)

1.5.3 ROADM Traffic Demands

Each ROADM traffic demand appears in the Project Explorer under the Service Demands > ROADMs folders. The ROADM folder contains each defined ROADM demand. You can define more demands for the same ROADM for the same set of nodes. [Figure 1-5](#) shows an example of a ROADM traffic demand.

Figure 1-5 ROADM Traffic Demand in the Project Explorer



In the Project Explorer, each ROADM includes the ROADM demand name and a list of DWDM card types that support the client service types. Protection types appear in parentheses.

1.6 Auto, Forced, and Locked Parameters

Parameters in Cisco MetroPlanner can be in one of three states:

- **Auto**—When a user selects Auto for a parameter setting, Cisco MetroPlanner chooses the parameter value during network analysis. Auto allows the highest degree of flexibility to the Cisco MetroPlanner in designing a network.
- **Forced**—The user sets a specific parameter value other than Auto causing Cisco MetroPlanner to design the network using these constraints. When a setting is forced, the item appears in blue italics in the Project Explorer pane.
- **Locked**—The state of a parameter after network analysis. The next Analyzer running cannot change the value when in the Locked state. A user can unlock an item using the Unlock command. For more information, see the [“2.7.4 Unlocking Parameters in the Network Design”](#) section on page 2-88

Figure 1-6 Locked Sites in the Project Explorer View



Depending on the initial state, the network analyzer will:

- Move the parameter into the Locked state when the unit or parameter was set to Auto.
- Leave the parameter in the same state if the user forced a specific value for the unit or parameter.