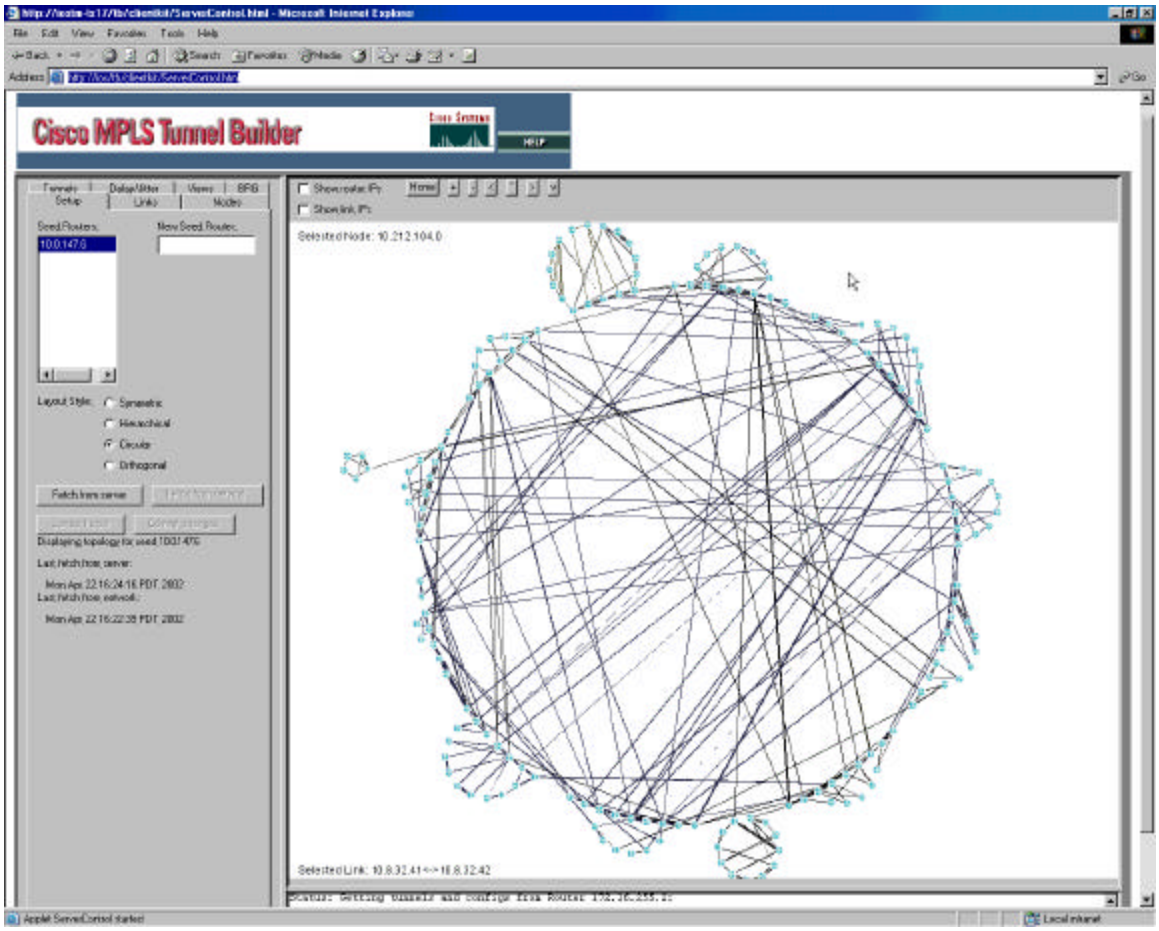
White Paper

Cisco MPLS Tunnel Builder

Introduction

Cisco MPLS Tunnel Builder is a Web-based graphical application that simplifies visualization, configuration and management of MPLS tunnels on a network using MPLS Traffic Engineering (TE). Without the use of a management tool, the complexities of a large network can limit the benefits obtained from the implementation of MPLS TE. Configuring and managing a large number of MPLS tunnels using the Command Line Interface (CLI) becomes tedious and error prone. Furthermore, the CLI on an individual MPLS TE node generally provides only partial information about nodes and links. The operator is forced to interact with multiple devices separately to produce a complete solution.

Conversely, Cisco MPLS Tunnel Builder provides an integrated graphical interface in which individual nodes and links can be configured and monitored within the context of a complete end-to-end topology. Cisco MPLS Tunnel Builder integrates the configuration of the different Cisco MPLS TE features (e.g. Auto-Route, Auto-Bandwidth, DiffServ-Aware Traffic Engineering, Fast Re-Route, etc) on a single management tool.

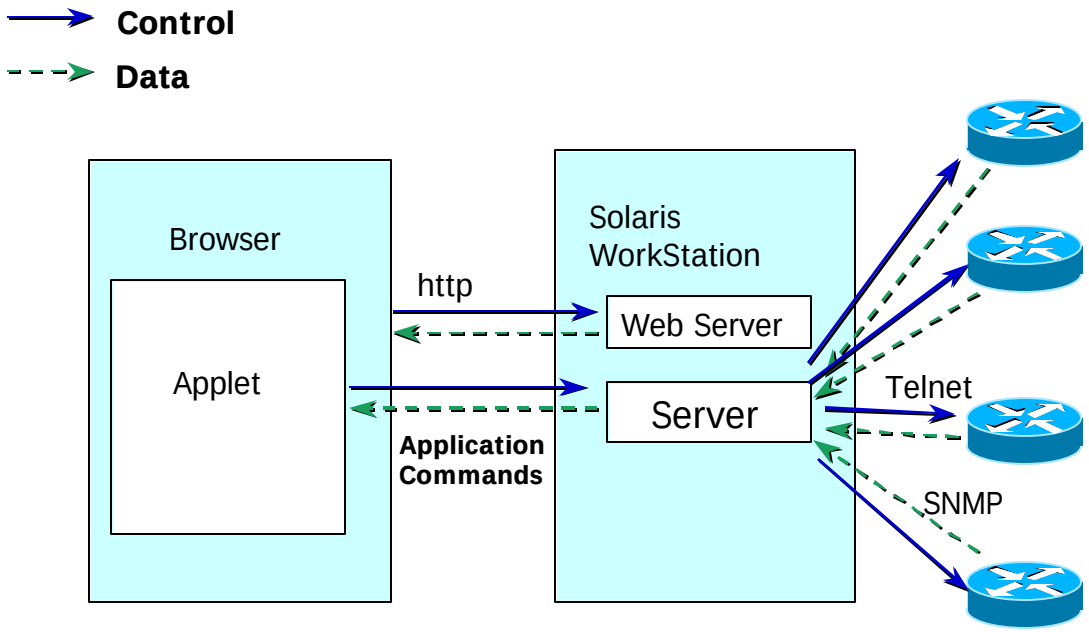


Cisco MPLS Tunnel Builder can discover, configure and monitor links, nodes, and tunnels in an MPLS TE-enabled network. Initially, the user only needs to identify a seed router that the Tunnel Builder server can use to discover all nodes and links using the *Setup* panel. This discovery process results in a graphical topology that helps to visualize the network.

Once the network topology has been discovered, separate panels are provided for monitoring and configuring MPLS TE parameters on individual links, nodes and tunnels. The *Links* panel is used to display and modify the bandwidth pools and attribute configuration of each link. The *Nodes* panel displays the Cisco IOS Software release, interfaces, the interface MPLS TE state (not configured, running, etc.), static routes and global Auto-Bandwidth parameters.

The *Nodes* panel can also be used to modify these global Auto-Bandwidth parameters and define static routes that can route traffic into MPLS tunnels. The *Tunnels* panel provides detailed information on the parameters associated with the tunnel (e.g. bandwidth, pool, priority, explicit route, etc) and can also be used to modify, delete and create primary and backup tunnels. The *Delay/Jitter* panel can be used to measure in real time the delay and jitter between any two nodes in the network. Finally, the *Views* panel can be used to monitor SNMP traps generated by tunnels or interfaces that change state (up or down) and to visualize tunnel counts, available bandwidth and utilization levels for different thresholds.

Architecture



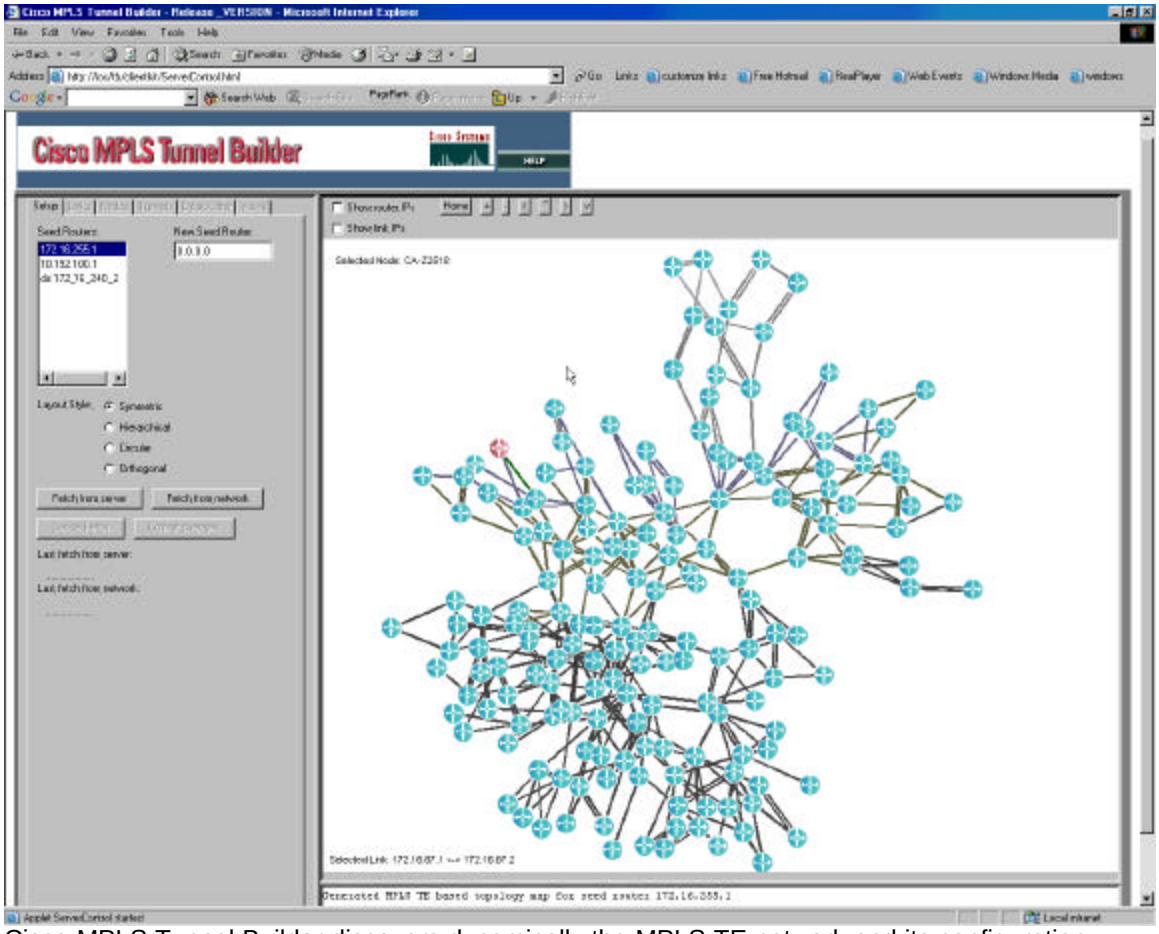
Cisco MPLS Tunnel Builder is based on a simple client-server architecture.

On the client side, a Java Applet provides the graphical interface to the user and acts a front-end for the server software that interacts with the MPLS TE network directly. The Java Applet is accessed using a Web browser. The client and server communicate via HTTP and a separate TCP session (port 7271 by default).

On the server side, there are two server applications running: a HTTP server and the Cisco MPLS Tunnel Builder server. The HTTP server handles the HTTP communication with the client brower. Facing the client, the Cisco MPLS Tunnel Builder server receives application commands and sends results from and to the client respectively via the TCP session. Facing the MPLS TE network, the Cisco MPLS Tunnel Builder server communicates with the MPLS TE nodes via

telnet and SNMP. The telnet connection is used to configure and collect state information from the MPLS TE nodes. SNMP is used to capture trap information generated by the MPLS TE nodes when links or MPLS tunnels change of state.

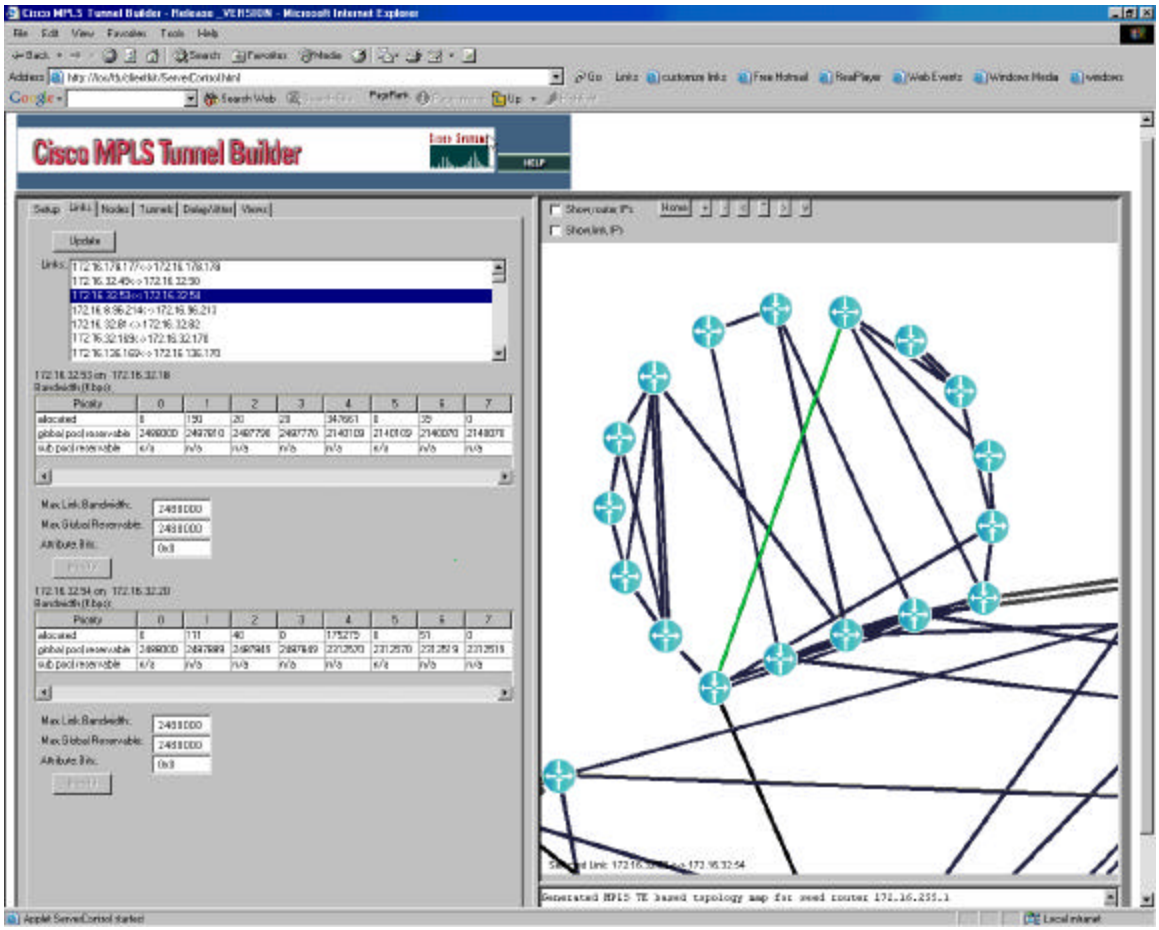
Discovering the MPLS Traffic Engineering Network



Cisco MPLS Tunnel Builder discovers dynamically the MPLS TE network and its configuration. This process is initiated from the *Setup* panel where a seed router is specified. Initially, the Cisco MPLS Tunnel Builder collects and parses the network configuration and topology directly from the network. This database is then stored in the server where it can be used later to upload this information without having to access the network nodes directly.

As a result of this discovery process, Cisco MPLS Tunnel Builder generates a graphic representation of the MPLS TE network. This topology map can be displayed using different layouts: symmetric, hierarchical, circular or orthogonal. The user can move, zoom in/out and select individual nodes or links on this topology map. Additionally, the *Setup* panel can be used to commit any configuration changes made on the network nodes. Even though configuration changes made using the other panels are applied in real time, those changes are not saved permanently until the changes are committed.

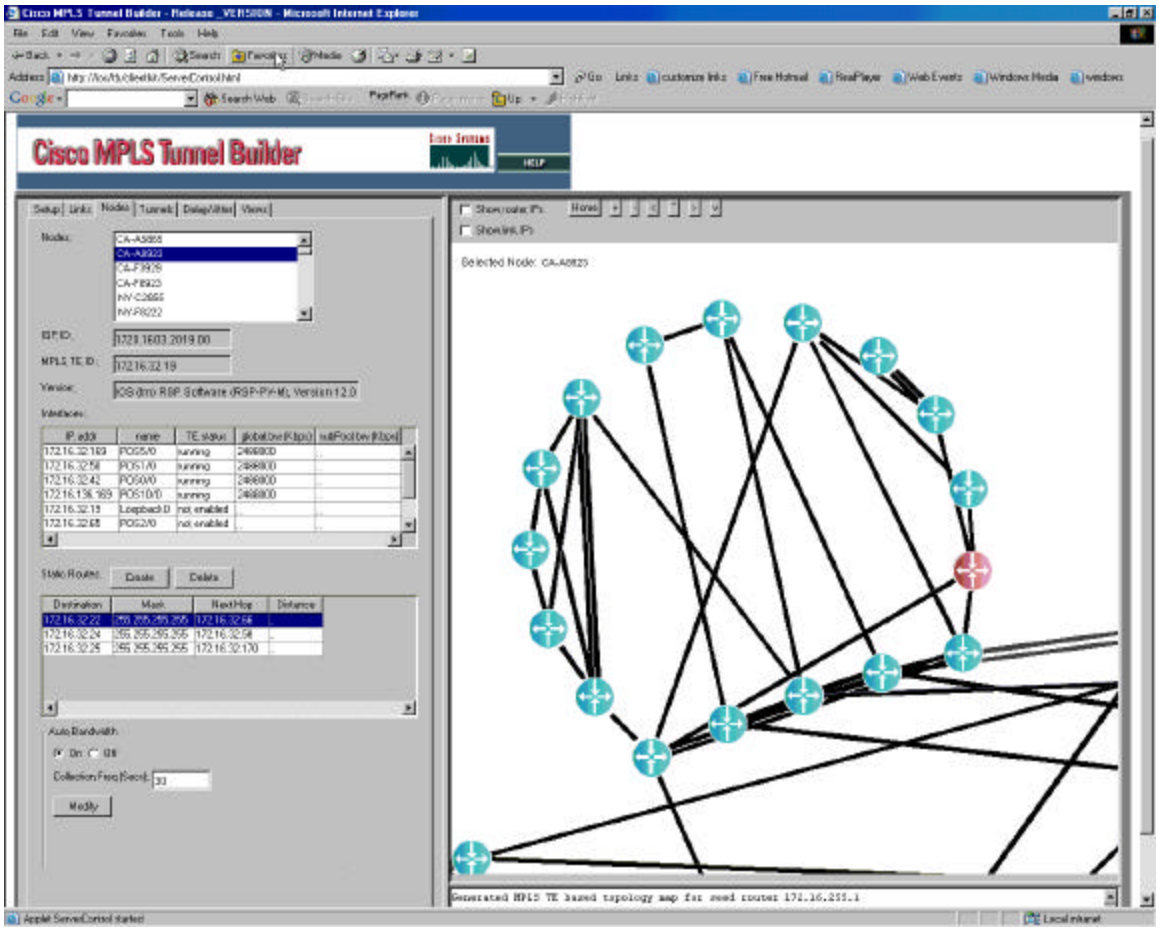
Configuring and Monitoring Links



The MPLS TE configuration of individual links can be displayed and modified using the *Links* panel. Links can be selected from the link list on this panel, or by clicking on the topology map. The link list and the topology map simultaneously display the currently selected link.

Once a link is selected, bandwidth and attribute information for the link is displayed. The bandwidth information includes the amount of allocated and available bandwidth on both ends of the link for each of the priority values an MPLS TE tunnel can have. It also includes the configured maximum bandwidth and maximum reservable pool bandwidth per interface. Entering new values on the text fields and clicking the Modify buttons can modify these two values and the attribute bits. The *Update* button can be used to force an update on the link information. The amount of allocated bandwidth on a link may not reflect the most recent value, especially when tunnels are created, deleted or modified.

Configuring and Monitoring Nodes

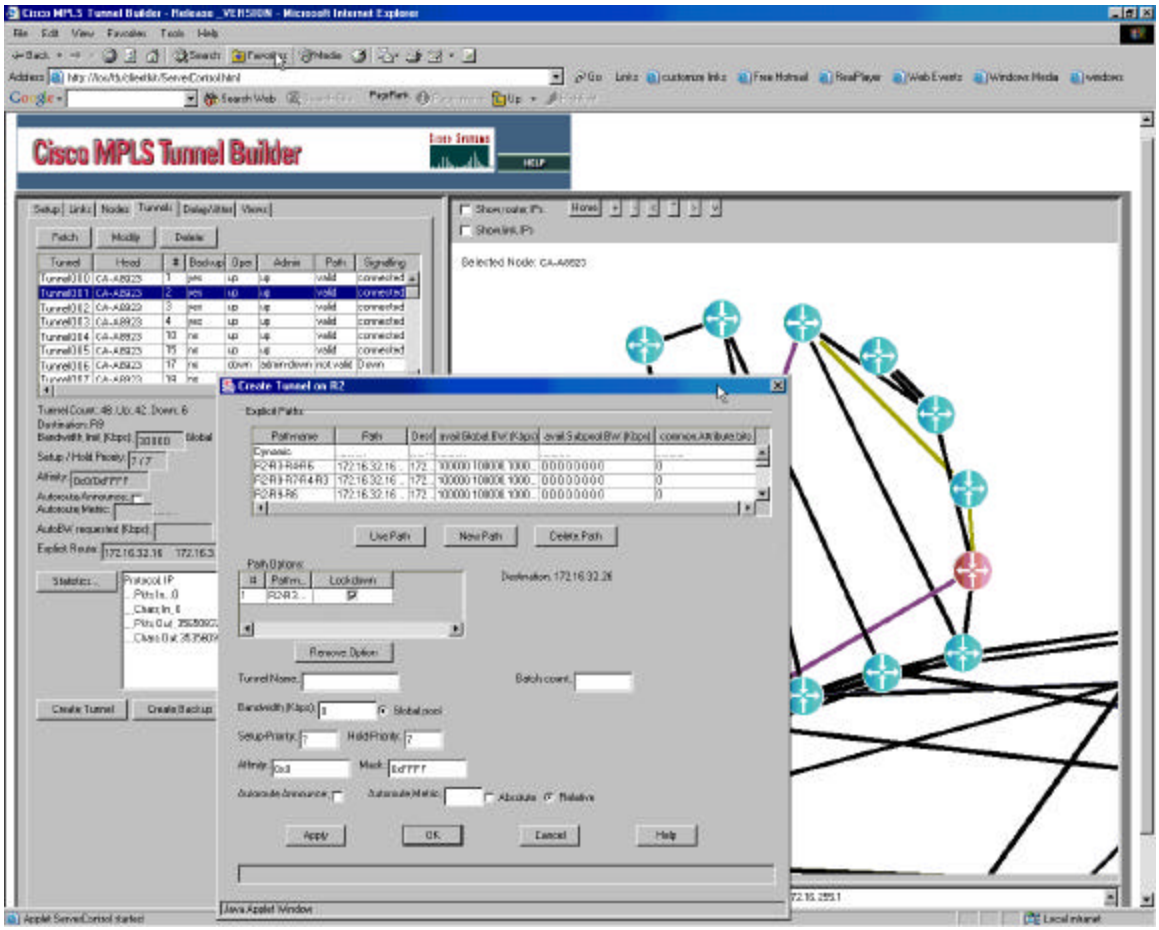


Cisco MPLS Tunnel Builder provides a *Nodes* panel to display and set the MPLS TE configuration of individual nodes. Nodes can be selected from the node list on the *Node* panel or by clicking on the topology map. The node list and the topology map simultaneously display the currently selected node.

Once a node is selected, this panel displays a summary of the Interior Gateway Protocol (IGP) Identifier, the MPLS TE Identifier, the Cisco IOS Software release deployed , the interfaces, the static routes and the global MPLS TE Autoroute configuration for that node. The interface summary shows the IP address, name, TE status (*running* or *not enabled*) and configured bandwidth pools for each interface.

Static routes can be defined by clicking on the *Create* button, which is next to the static route summary. A dialog window allows the user to specify the IP address prefix, tunnel interface and administrative distance of the new static route. As a shortcut, right clicking a node on the topology map and selecting the *Create Static Route* option also invokes this dialog window. Lastly, the *Nodes* panel can be used to enable, disable and configure the global frequency timer for the MPLS TE Autobandwidth.

Configuring and Monitoring Tunnels

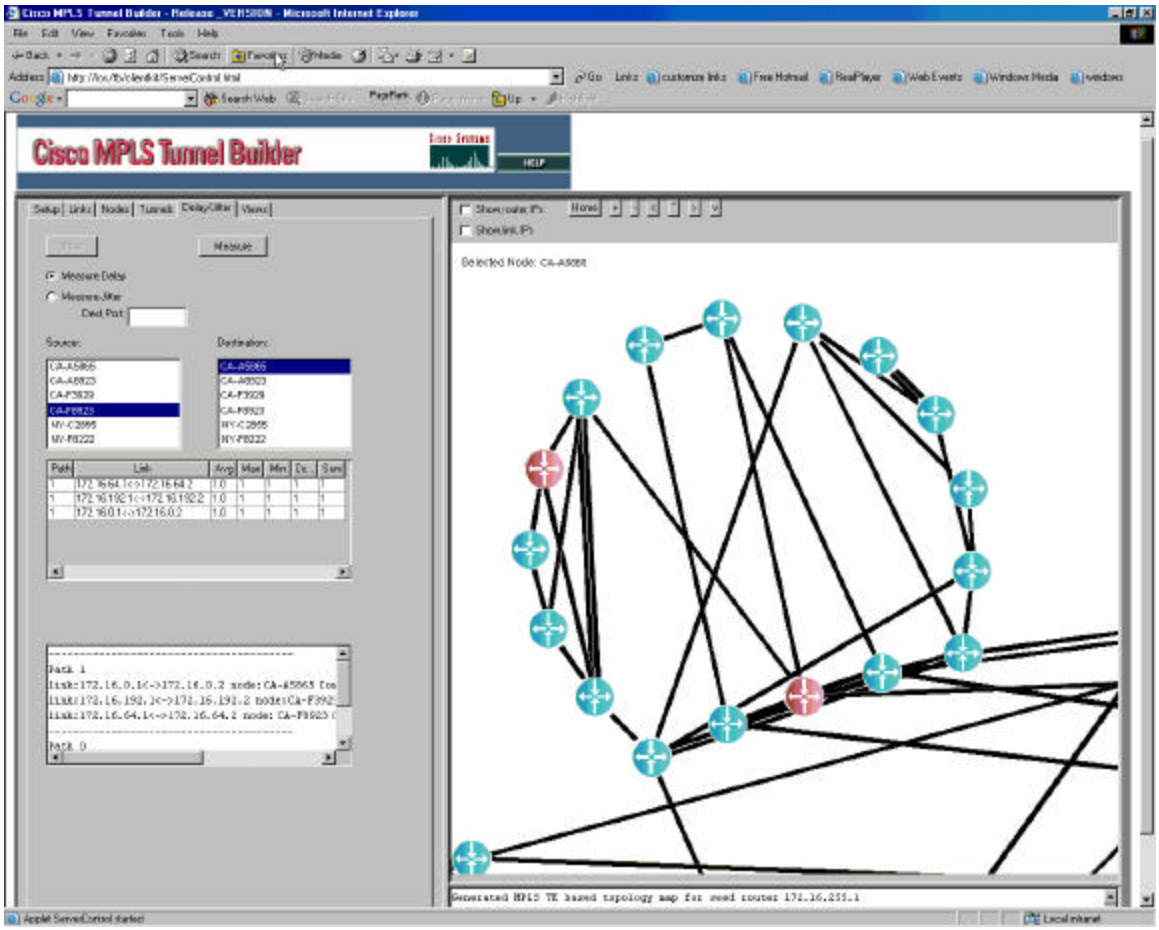


The *Tunnels* panel can be used to configure and monitor primary and backup tunnels on an MPLS TE network.

Initially, the tunnel information needs to be uploaded from the network by clicking the *Fetch* button. Once the server collects this information, the panel displays a tunnel list with the summary of tunnel variables: head, number, backup flag, and operational, administrative, path and signaling states. Detailed tunnel information is displayed and the tunnel can be visualized on the topology map when a tunnel is selected from the list. The tunnel details include: requested bandwidth, priority, affinity, Autoroute configuration, Autobandwidth configuration and explicit route associated with the tunnel.

The selected tunnel can be modified or deleted by using the *Modify* and *Delete* buttons, respectively, at the top of the panel respectively. The *Statistics* button captures a snapshot of the tunnel input and output traffic counters in bytes and packets. Finally, the *Create* button can be used to define a new primary tunnel, while the *Create Backup* button can be used to define a new backup tunnel. These buttons invoke a dialog window for the tunnel definition. This dialog allows the user to use, define and delete paths through the network, along with defining the attributes of the new tunnel (e.g. name, requested bandwidth, priority, etc.) As a shortcut, right clicking on a node on the topology map displays menu options to also invoke these dialog windows.

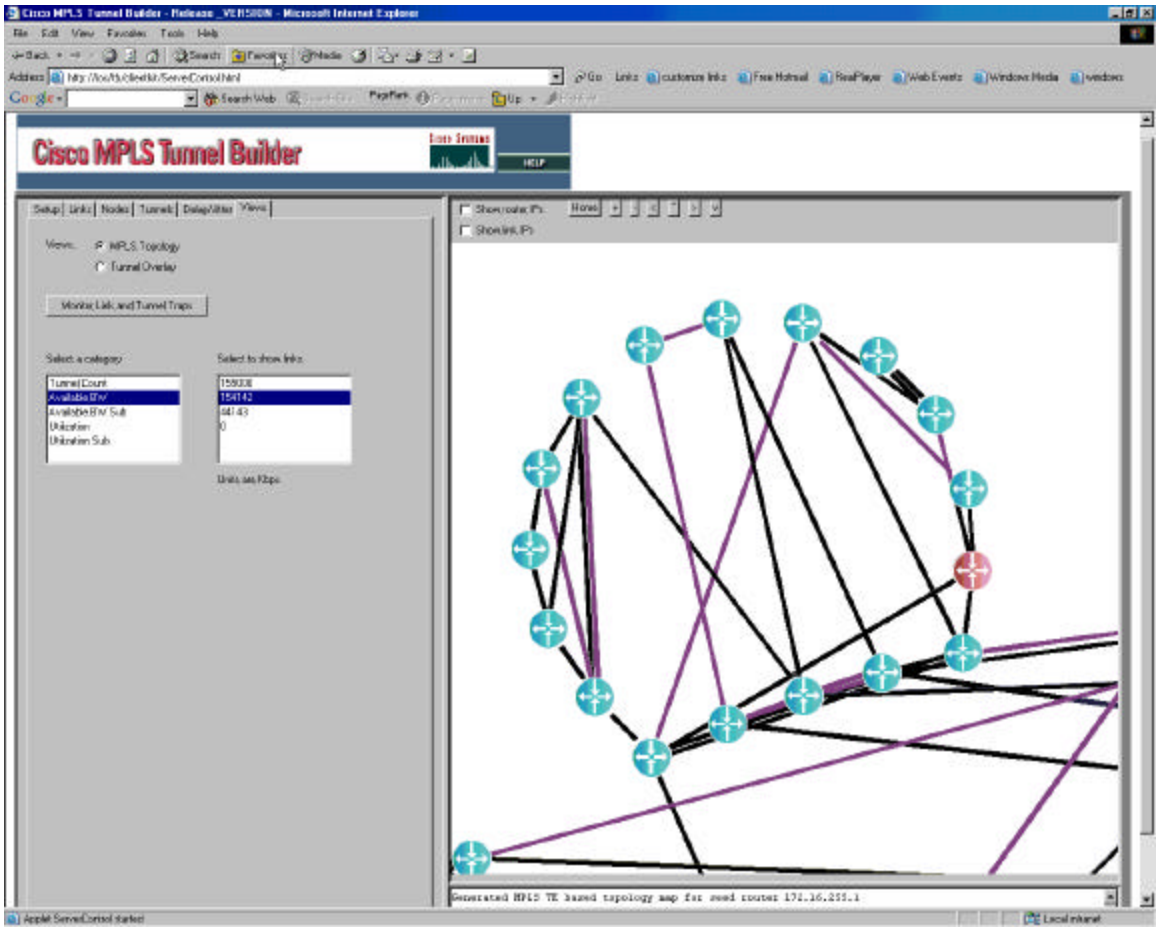
Monitoring Delay and Jitter



Cisco MPLS Tunnel Builder also provides the functionality required to monitor the reachability and delay characteristics of the MPLS TE network in real-time. The *Delay/Jitter* panel can be used to select any combination of source and destination nodes and then measure the delay or jitter between those two nodes. Once a source and a destination are selected, the *Measure* and *Stop* buttons can start and stop the measurement process respectively.

The delay measurement provides multiple delay statistics for all links between the source and destination nodes. The jitter measurement provides statistics on source-to-destination and destination-to-source jitter values. The text field at the bottom of the panel logs the results of individual delay or jitter samples.

Creating Network Views



Multiple views of the MPLS TE network can be defined using the *Views* panel. The user can select whether the topology map displays the overlay tunnel topology or only the MPLS TE topology. Additionally, multiple views can be specified based on several categories: tunnel count, available pool bandwidth for each pool and pool utilization.

Finally, the *Monitor Link and Tunnel Traps* button can be used to enable SNMP traps on all nodes in the network. The following traps are enabled as defined in RFC 1157: authentication, linkdown, linkup, coldstart and warmstart.

Reference Documents

Deploying Guaranteed Bandwidth Services with MPLS
http://www.cisco.com/warp/public/732/Tech/mpls/docs/deploying_gb_white_paper_final.pdf

Advanced Topics in MPLS-TE Deployment
http://www.cisco.com/warp/public/cc/pd/iosw/prodlit/mwglp_wp.htm

Voice Trunking and Toll-Bypass Trunking Using Cisco MPLS DiffServ-Aware Traffic Engineering
http://www.cisco.com/cpropart/salestools/cc/pd/iosw/prodlit/mpvoc_wp.htm

Virtual Leased Line Services Using Cisco MPLS DiffServ-Aware Traffic Engineering
http://www.cisco.com/cpropart/salestools/cc/pd/iosw/prodlit/msdvl_wp.htm

RFC 2702 - Requirements for Traffic Engineering Over MPLS
http://www.ietf.org/rfc/rfc2702.txt

RFC 3209 - RSVP-TE: Extensions to RSVP for LSP Tunnels
http://www.ietf.org/rfc/rfc3209.txt

Requirements for support of Diff-Serv-aware MPLS Traffic Engineering
http://www.ietf.org/internet-drafts/draft-ietf-tewg-diff-te-reqts-04.txt

Protocol extensions for support of Diff-Serv-aware MPLS Traffic Engineering
http://www.ietf.org/internet-drafts/draft-lefaucheur-diff-te-proto-01.txt

Fast Reroute Extensions to RSVP-TE for LSP Tunnels
http://www.ietf.org/internet-drafts/draft-ietf-mpls-rsvp-lsp-fastreroute-00.txt