White Paper

Using Cisco Network Planning Solution for Capacity Planning and Optimization

The highly complex—and individualized—set of interactions between applications and the network present a daunting management challenge. It is a struggle to maintain high application performance, and deploy new applications and services without disrupting existing ones, on a single infrastructure. Cisco Systems® extends network management beyond faults and delay metrics to determine whether network resources adequately enable optimal performance of applications and network services. Offline modeling facilitates problem identification and resolution, and uses real-world statistics to predict behaviors for proposed changes to networks and application environments.

SUMMARY

Cisco® Network Planning Solution (NPS) helps predict the impact of changes to your network's topology, configuration, traffic, and technology. This offline-modeling tool builds a model of the production network and validates proposed network changes against policies prior to deployment. With Cisco NPS you can accurately model characteristics of network operation including route maps, access control lists (ACLs), quality of service (QoS), and device and configuration characteristics. By removing the guesswork from much of the planning process, Cisco NPS both speeds the planning and design phases and reduces costs by automating many calculations and tasks. As a decision-support tool, Cisco NPS is valuable to network planning, and engineering organizations. Cisco NPS is central to the Cisco Network Application Performance Analysis (NAPA) solution, which is a comprehensive set of tools and services that provides information about application and network performance. For more information about the Cisco NAPA solution, please visit http://www.cisco.com/go/napas.

This paper discusses the challenges and workflow details for capacity planning analysis with Cisco NPS. You will learn how Cisco NPS evaluates the current network and estimates when application and service demands will exceed its capacity. You will understand how Cisco NPS identifies traffic trends in the current network, forecasts what traffic levels will be in the future, assesses whether the existing network capacity is sufficient to handle the projected load, and automatically redesigns the network to support future traffic demands.

CHALLENGE

Managing the interactions between applications and the network is a struggle to maintain high application performance—and to deploy new applications and services without disrupting existing ones—on a single infrastructure. Consider this scenario: As part of regular operations, a corporation has been monitoring usage on its WAN links for the past 12 months. The network staff wishes to identify trends within the measured traffic, with the goal of forecasting future traffic demands. They must determine if existing service-level agreements (SLAs) will be violated as network traffic grows and the network capacity remains constant.

SOLUTION

A capacity planning analysis involves the following workflow:

1. Evaluate current network capacity
   - Build a high-fidelity network model
   - Import traffic demands from NetFlow
   - Analyze network utilization

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2. Configure capacity planning analysis
   - Calculate traffic trends
   - Configure output reports
   - Configure SLA evaluation criteria
3. Analyze network capacity with trended traffic
   - Predict when links become overutilized
   - Identify overutilized links
4. Redesign the network
   - Re-dimension links
   - Specify network design goals
   - Evaluate the redesigned network

Evaluate Current Network Capacity

Cisco NPS uses information learned from device configuration files in Cisco and third-party network management systems to build a high-fidelity model of the network.

The baseline network or "network model" is imported from the Cisco NPS Virtual Network Data Server in near-real time. The Virtual Network Data Server collects and merges detailed network data from a broad range of sources. Hardware and software configuration data, connectivity information, and utilization statistics can be collected directly from network devices, including Cisco routers, switches, and firewalls as well as equipment from other vendors. The Virtual Network Data Server can also acquire data from Cisco NetFlow Collector and other third-party traffic sources.

Cisco NPS generates a map with NetFlow traffic demands collected over 52 weeks (Figure 1). These demands are source and destination traffic flows measured in bits per second and packets per second. Figure 2 shows a profile of one of the traffic demands.

Figure 1. Network Traffic Demands

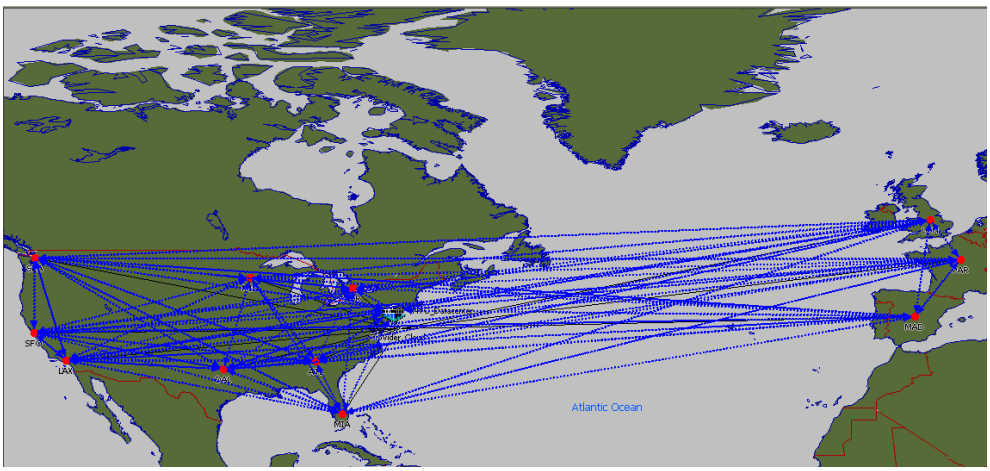

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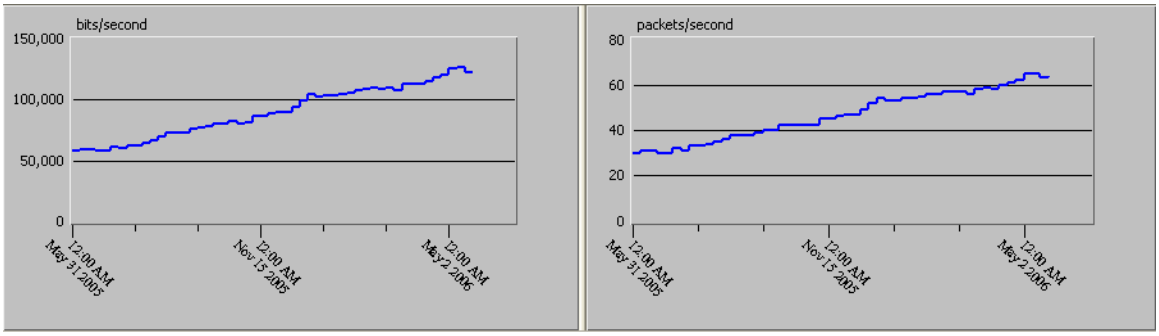
Figure 2. Traffic Demand Profile



These demands represent baseline traffic for 52 weeks. Traffic demands are steadily increasing in the corporation's network. Network staff must answer two questions based on this historical data:

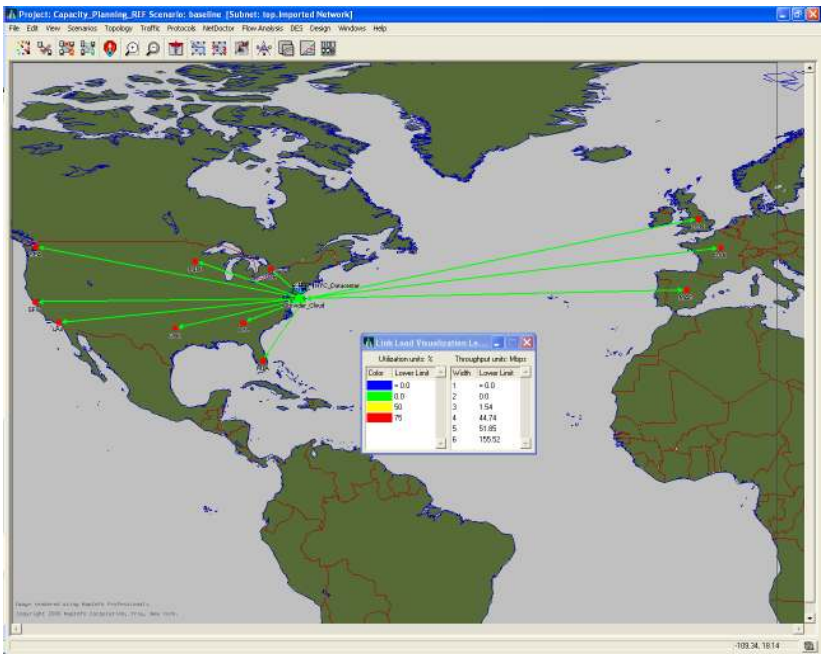
- When will existing network capacity become overloaded?
- How much network capacity is needed to support projected traffic growth?

The first step is to get a baseline traffic model. This can be done with the Cisco NPS Flow Analysis engine. By analyzing traffic flows in the network topology as well as the network addressing and routing configuration, Cisco NPS can determine how application traffic moves through the network and what the aggregate impact is on network capacity. The results from the Cisco NPS Flow Analysis show you the effects of traffic on the network.

You can configure link utilization and throughput thresholds to meet SLA requirements through configurable settings. Network capacity can then be visualized using these color-coded settings.

The results from the baseline analysis indicate that all links are less than 50 percent utilized, as shown in green in Figure 3. According to the network staff SLA definitions, the current capacity of the network is sufficient for current traffic demands.

Figure 3. Results from Baseline Analysis



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Configure Capacity Planning Analysis

The existing traffic data is used to predict future traffic levels using well-known techniques of traffic trending. To trend traffic as part of a capacity planning analysis, Cisco NPS examines the traffic in the network and modifies each traffic profile so that it continues its current trend. Traffic profiles can represent link loads, circuit loads, or flow volumes.

The first step is to pick Configure/Run Capacity Planning from the Flow Analysis menu (Figure 4). Cisco NPS gives you the option to import new traffic flows or trend current traffic. Because the network staff has been collecting traffic demands for the past 12 months, Trend Current Traffic is selected (Figure 5).

Figure 4. Configure/Run Capacity Planning

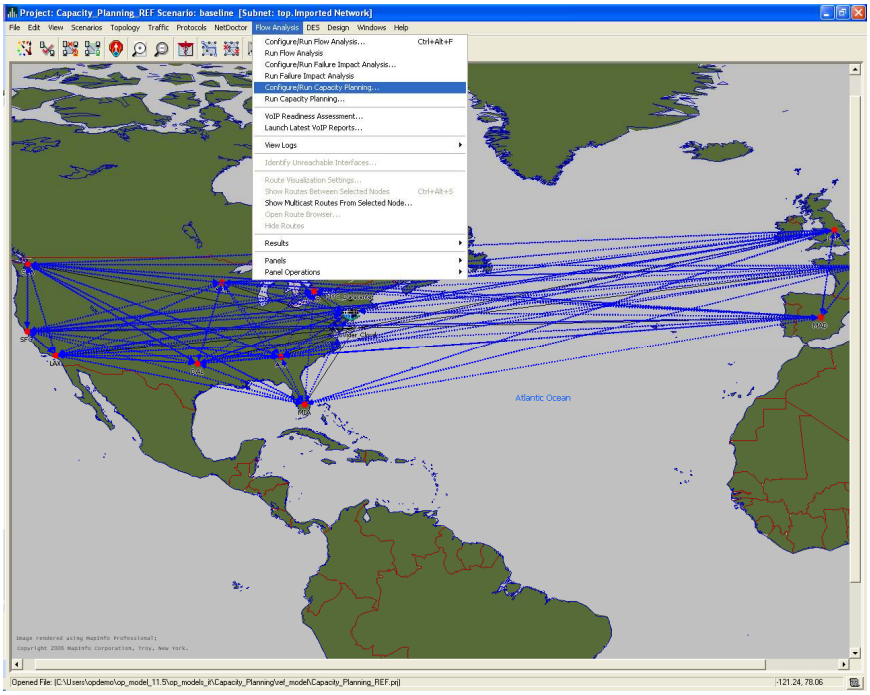
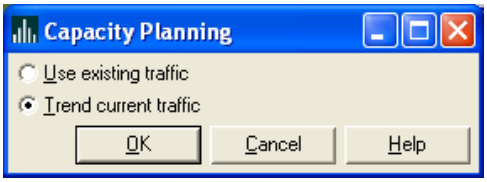


Figure 5. Trend Current Traffic Option



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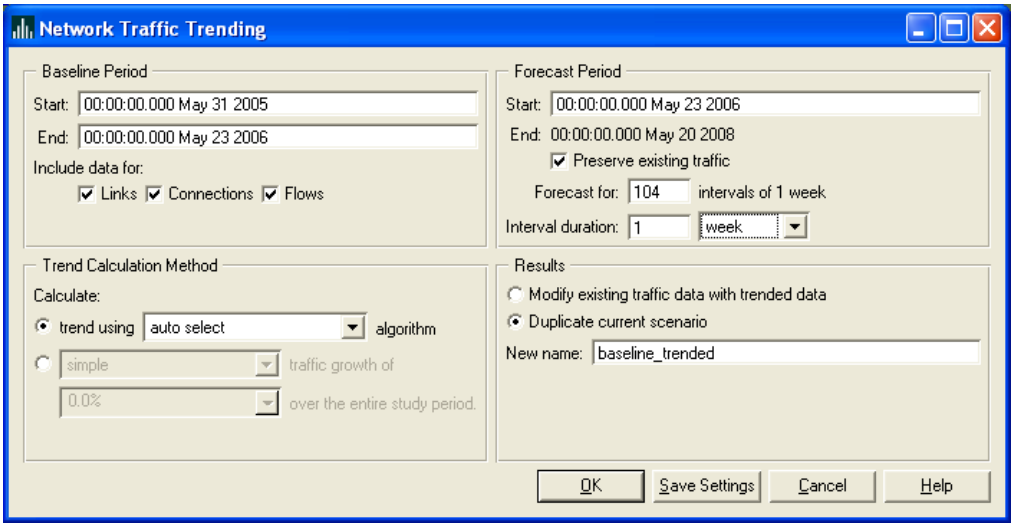
The next step is to configure the baseline period, forecast period, trend calculation method, and results (Figure 6).

Figure 6. Configure Time Periods and Trend Algorithm



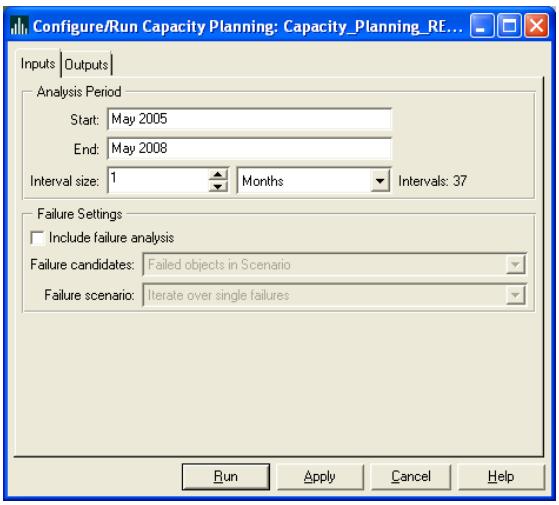
The corporation wants to project traffic for the next two years to evaluate budget for capital expenses. The baseline period is automatically set from the baseline traffic. The forecast period is set for 104 weeks, and the interval duration is set to one week. The current traffic will be extrapolated for two years in one-week increments.

Cisco NPS provides several options for how to compute the traffic trends. The default “auto select” algorithm is suitable for most cases, or you can select from linear, exponential, or logarithmic regression. You also have the option to set simple or compound traffic growth values.

Finally the results panel is set to duplicate the baseline scenario so you can easily compare it against the results. Through these actions a new scenario is created called “baseline_trended.”

The next step is to configure the output report including analysis period, SLA violations, and report format (Figure 7). Set the analysis to account for one year of baseline traffic and two years of forecasted traffic. The interval size is set to one month. Notice that the same capacity analysis can be run under failure conditions.

Figure 7. Configuring Capacity Planning Report Inputs



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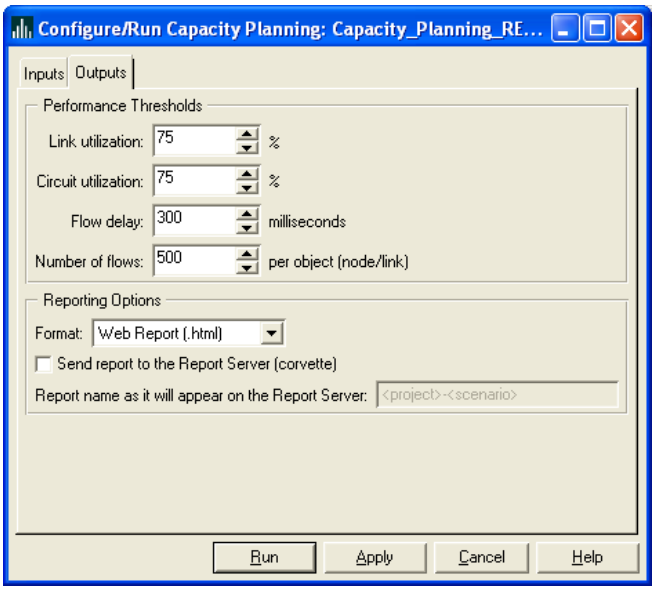
You also have the option to set SLA violations including performance thresholds for link utilization, circuit utilization, end-to-end delay, and number of flows per link (Figure 8). You can also specify the type of report you would like to generate.

Figure 8. Configure Capacity Planning Report Outputs Including SLA Violations

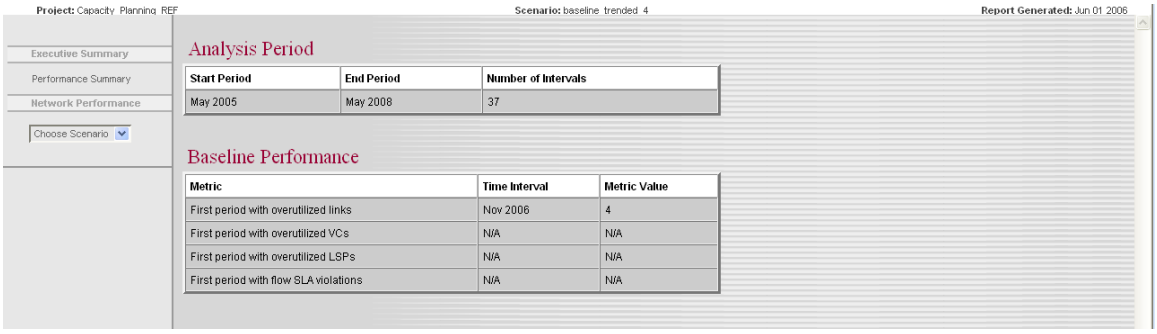


The capacity planning analysis generates a report in the format you specified. If you choose a Web report, it opens in your default browser when the analysis completes.

Analyze Network Capacity with Trended Traffic

The report opens to the Executive Summary, which gives you a short overview of the report highlights including when links, virtual circuits (VCs), and label-switched paths (LSPs) are expected to be overutilized and when network SLAs will be violated (Figure 9).

Figure 9. Capacity Planning Executive Report



It is easy to get more detailed results. Selecting Overutilized Links under Network Performance brings up indicating when current link capacity will be saturated (Figure 10). According to trended traffic patterns, links in the network will become saturated in November 2006.

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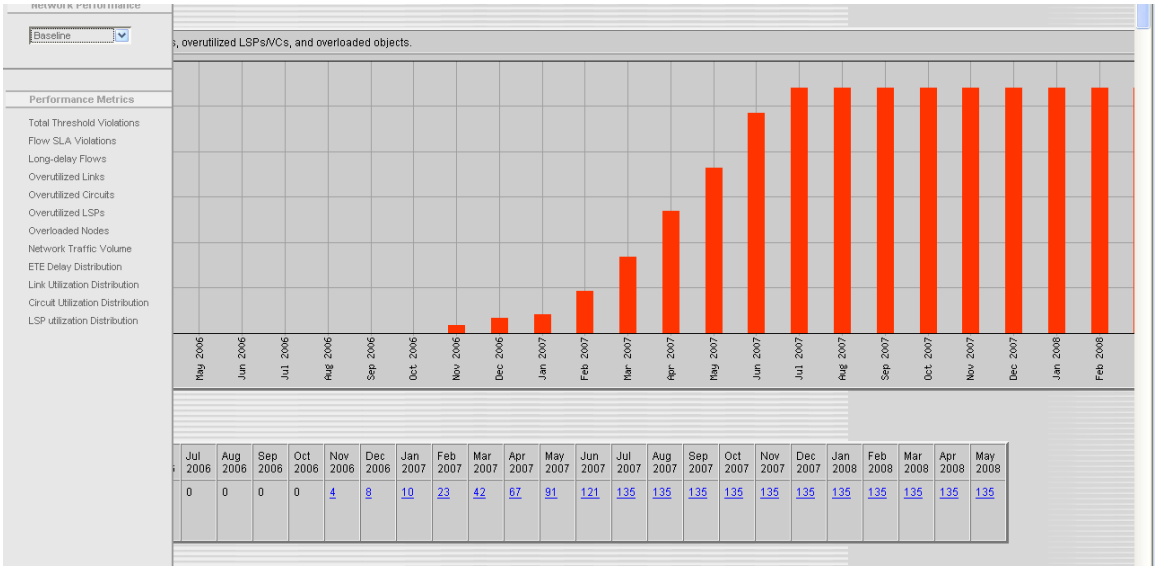
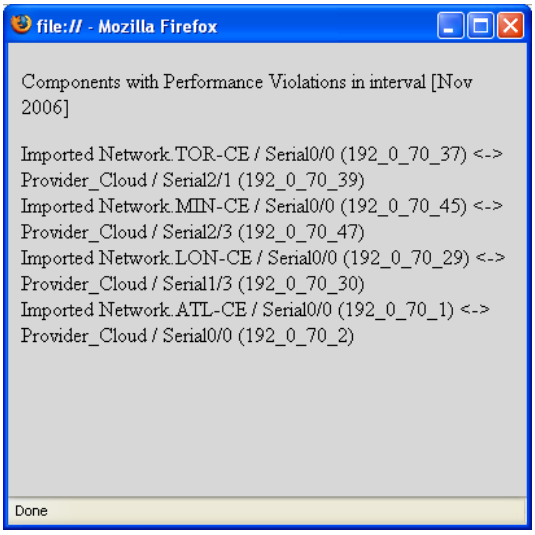
Figure 10. Overutilized Links Starting in November 2006



Selecting the link on the bottom of the report for November 2006 displays the links that will be affected, showing you exactly where you need to add network capacity (Figure 11). You can click for a list of overutilized links for each month.

Figure 11. Overutilized Links at Various Sites



The results from the capacity planning study reveal that several links will be overutilized by November 2006. The next step is to redesign the network to support the projected traffic demands.

Redesign the Network

Cisco NPS provides a library of automated *Design Actions* that allows you to optimize the use of bandwidth and automatically design network topologies based on configurable priorities for cost, resiliency, and performance considerations. This process helps eliminate the need for a trial-and-error approach to designing networks, accelerating new projects and improving the productivity of network staff.

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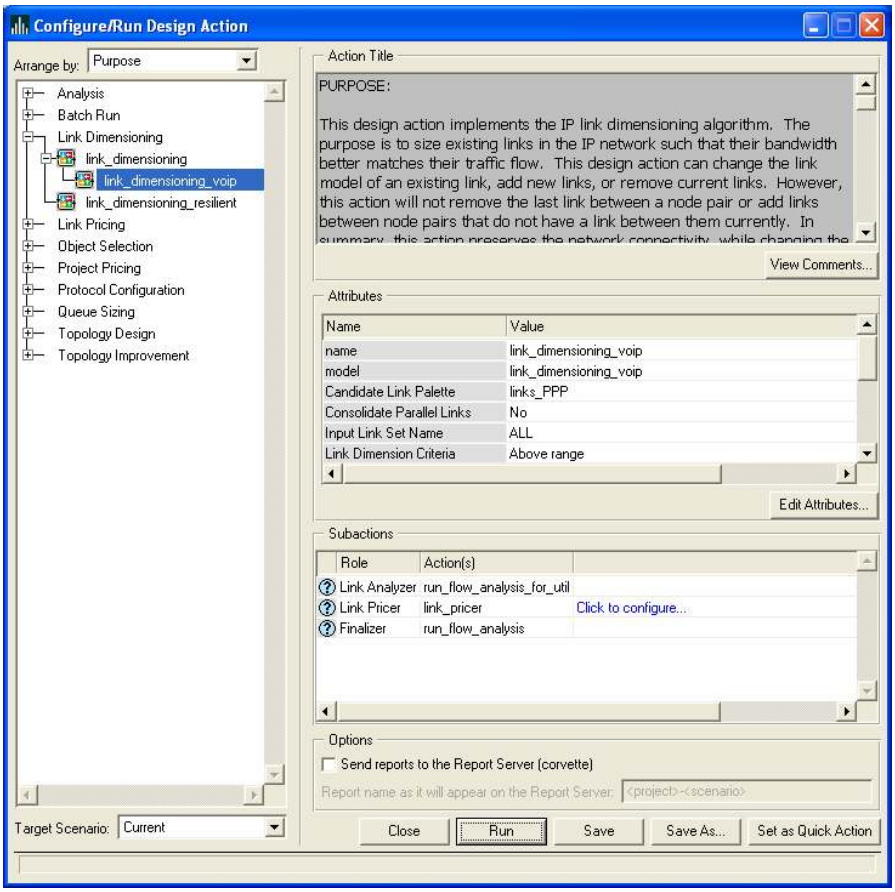
The capacity planning study identified links that are expected to be overutilized over the next two years. The next step is to redesign the network and virtually add capacity where needed using the Cisco NPS Design Action Engine.

A Design Action is a high-level operation that automates the process of changing a network model to achieve a design goal—in this case, to increase network capacity to support future traffic growth. With a design action, you modify the network model with one operation. Design actions provide a very flexible way to make automated changes to a model network without having to reconfigure the actual network. Design actions include link dimensioning, link pricing, queue sizing, and topology design (Figure 12).

Figure 12. Select a Design Action



The goal of this design action is to re-dimension links that are more than 80 percent utilized using the projected traffic growth. It generates a detailed report of the redesigned network including a list of links that have changed to support the projected traffic demands (Figure 13). The redesign algorithm found and upgraded 12 network links.

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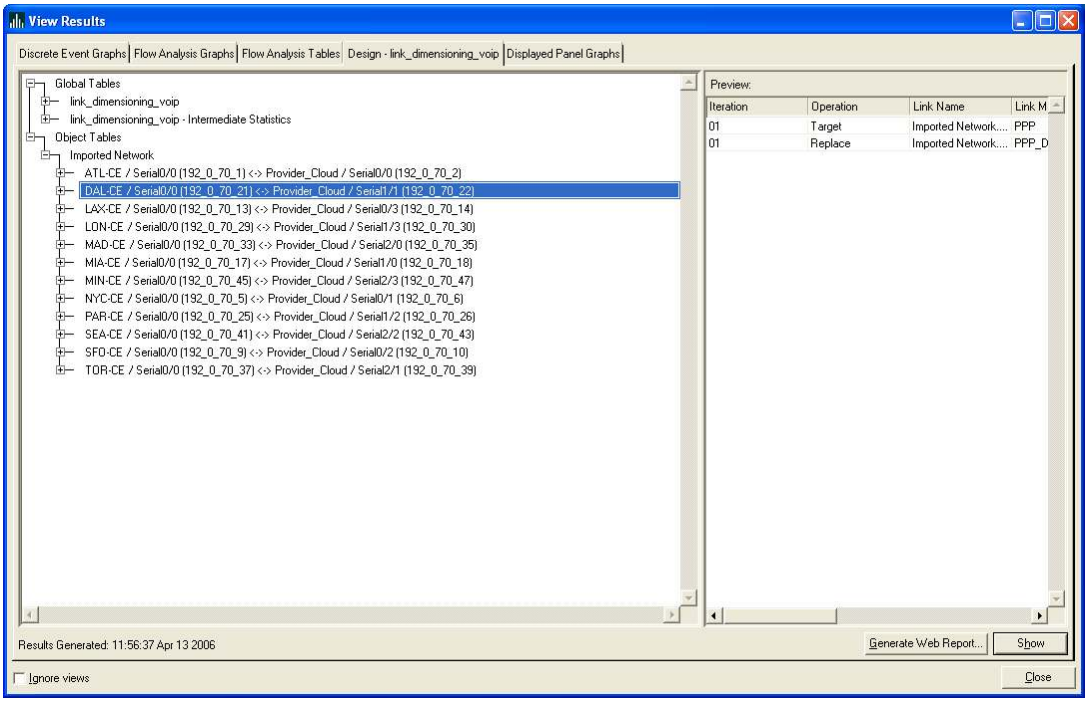
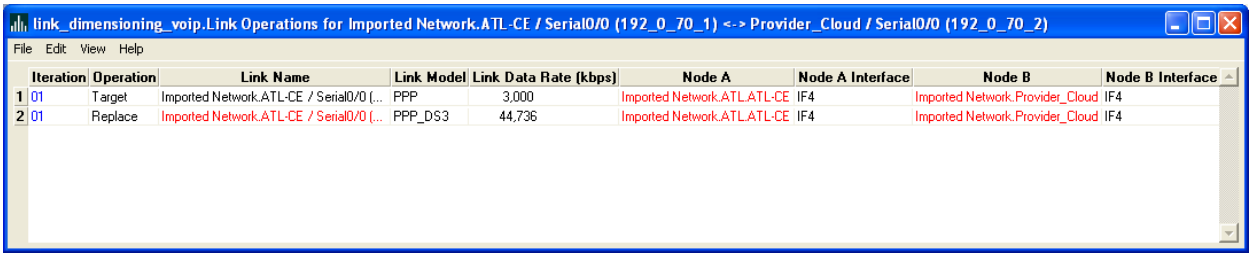
Figure 13. Re-dimensioned Links Report



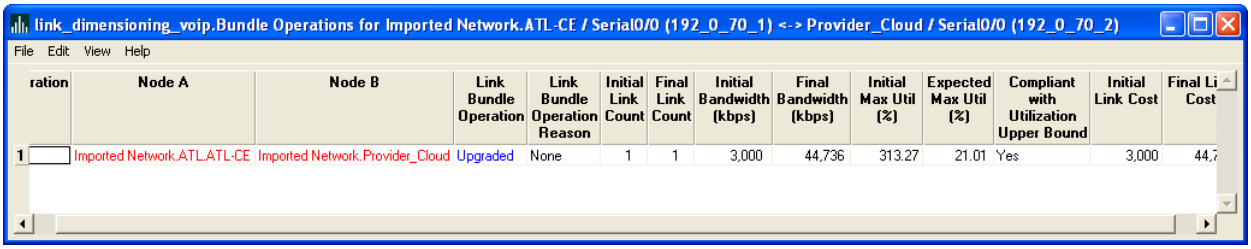
Selecting the first link in the list shows the details of the upgrade (Figure 14). The original link was a 3-Mbps link and it was replaced with a DS-3 link.

Figure 14. Detail of Recommended Link Upgrade



You also can view the utilization statistics for this link before and after the traffic demand process (Figure 15). As a 3-Mbps link, the link was 313 percent utilized. Upgrading to a DS-3 link reduces link utilization to 21 percent.

Figure 15. Detail of Modeled Link Utilization



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CONCLUSION

Cisco NPS is an impact analysis tool that can help you optimize network capacity and performance, ensure resiliency, plan for new technology deployments, and validate planned configuration changes. In the above use case, Cisco NPS analyzed the capacity of the network using both current and projected traffic demands and determined that network capacity is sufficient for current traffic demands but will become saturated under projected traffic growth. Cisco NPS identified exactly which network links will be overutilized and when traffic demands will exceed link capacity. This data is essential for accurately planning capital investments. Finally, Cisco NPS virtually redesigned the network to handle projected traffic growth. The design algorithm identified and upgraded 12 links in the network to meet expected traffic growth and business SLA requirements.

Cisco NPS allows you to proactively manage network capacity by analyzing existing traffic demands. By being proactive, you can plan network upgrades before SLA violations happen and help ensure that the network can continually support business objectives including maintaining high application performance and deploying new applications and services without disrupting existing ones. For more information, contact your Cisco representative or visit: http://www.cisco.com/en/US/products/ps6363/index.html.

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Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters
Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: 31 0 20 357 1000
Fax: 31 0 20 357 1100

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

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