

ROUTE EXPLORER™ FOR TRAFFIC ENGINEERING

Route Explorer™ for Traffic Engineering delivers unprecedented real-time visibility into traffic engineered networks that use RSVP-TE and/or Segment Routing, helping network operators assure the availability and performance of critical service traffic flowing over Traffic Engineered (TE) tunnels.

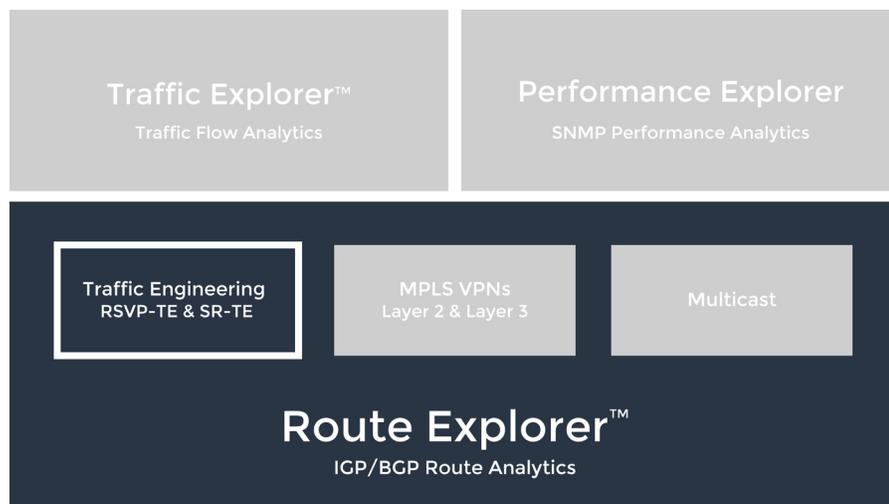
Packet Design’s industry-leading route analytics technology provides a comprehensive traffic engineering management solution that includes real-time TE tunnel monitoring, historical analysis, easy to use network modeling and simulation, and capacity planning reports. Route Explorer is the first analytics product to support both RSVP-TE and Segment Routing (SR-TE). This addresses the critical management visibility requirements of customers who are transitioning from one to the other or who plan to use both. It fills an important gap in IP/MPLS network management, dramatically lowering mean-time-to-repair, improving service assurance, and helping to minimize capital outlays for increased competitiveness.

The Need for Real-Time Traffic Engineering Management

Service providers and mobile operators deploy MPLS TE tunnels for sensitive services with high bandwidth and low data loss requirements, such as VoIP, video, and cloud computing. However,

Route Explorer for Traffic Engineering Benefits

- Assure critical services that rely on TE tunnels for optimal traffic delivery.
- Monitor real-time TE tunnel status, Fast Reroute protection, tunnel bandwidth availability, and traffic utilization.
- Detect and troubleshoot TE tunnel problems that go undetected by traditional network management solutions.
- Resolve intermittent problems with the ability to rewind network state to any point in time for forensic analysis.
- Analyze TE tunnel traffic utilization to catch emerging trends that could lead to congestion and service disruptions.
- Model traffic engineering and other routing and traffic changes to avoid maintenance and planning mistakes.
- Model and visualize before-and-after deployment scenarios to aid migration from RSVP-TE to SR-TE.
- Route Explorer’s small deployment footprint, low management overhead, and continuous auto-discovery deliver fast time to value and a low total cost of ownership.



The Traffic Engineering module is an optional extension to the Route Explorer base product.

configuring and maintaining RSVP-TE tunnels can be complicated, especially when large numbers of tunnels are involved. SR-TE provides some relief but still requires careful monitoring. Understanding the operation of TE tunnels and the underlying IGP (OSPF, IS-IS) routing, as well as BGP Internet and MPLS VPN service routing, is critical for service assurance.

While existing traffic engineering management solutions claim to provide comprehensive visibility, in reality they deliver only static snapshot views of TE tunnel status based on occasional SNMP polling or router configuration file downloads. Important dynamics, such as changes to tunnel paths, tunnel bandwidth utilization, and problems with links that are unprotected by Fast Reroute (FRR) or other mechanisms, go undetected. Traditional tools don't provide historical analysis so that engineers can see how TE tunnels have changed over time, making troubleshooting harder and more time-consuming. Finally, traditional tools don't provide any insight into how traffic engineering interoperates with underlying routing and higher layer services.

Without comprehensive, dynamic management visibility, network engineers must "fly blind," the result being much higher MTTR and operations costs, less accurate planning, and unacceptable service impacts.

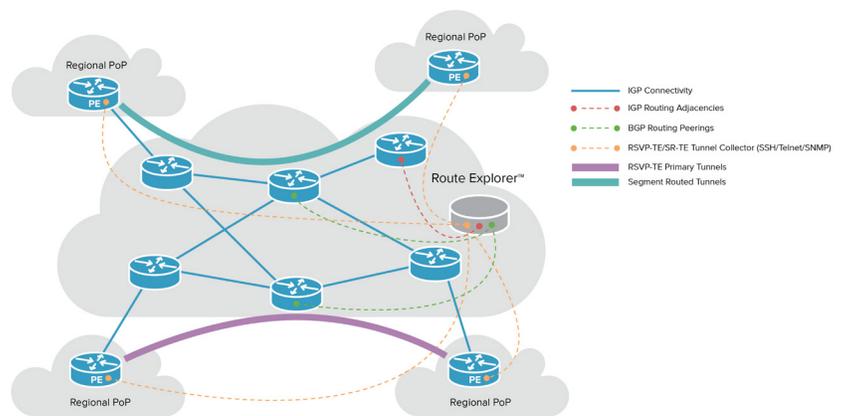
Real-Time, Dynamic Traffic Engineering Analysis

The Traffic Engineering module extends Packet Design's route analytics technology that works by passively recording IGP and BGP routing protocol update messages to compute, monitor, and analyze network-wide routing behavior. Route Explorer integrates TE tunnels into its routing maps, delivering real-time views of network-wide routing and traffic engineering.

Operational Monitoring and Alerts

Route Explorer provides visibility into traffic engineering tunnels in the context of the entire network.

- View an always-accurate map of IP routing and TE architecture to understand and monitor network health
- Drill in for "mini-map" views of specific tunnel paths, including secondary LSPs, FRRs, and contextual routing topology
- Receive alerts in real time to changes in TE tunnel paths, protection, and utilization



Route Explorer for Traffic Engineering gives visibility into primary, secondary, and fast-reroute backup tunnels.

Comprehensive TE Reporting and Analysis

Route Explorer enables engineers to audit and optimize TE tunnel performance and configurations much more easily.

- Report on all tunnels by head-end, mid-point, and tail-end routers
- Analyze primary, secondary, and FRR tunnels
- Identify routers and links with high concentrations of TE tunnels
- Analyze anomalous tunnel conditions, such as long-lived FRRs, inactive primary tunnels, or active tunnels with suboptimal constraints
- View SR-TE metrics, such as segment ids (SID), segment routing global block (SRGB) space, and more

When the Traffic Explorer and Performance Explorer modules are also deployed, Route Explorer's TE tunnel analytics are extended.

- View always up-to-date tunnel bandwidth and traffic utilization
- Easily find tunnels with available bandwidth or high utilization
- Know precisely which tunnels are consuming bandwidth or which flows are causing congestion
- Understand the traffic utilization and tunnel bandwidth impact of secondary tunnels and FRRs in the event of link failures

- Drill in to view individual tunnel performance metrics end-to-end and hop-by-hop, including latency, jitter, and packet loss
- Understand the service performance impact in the event of tunnel fail-overs

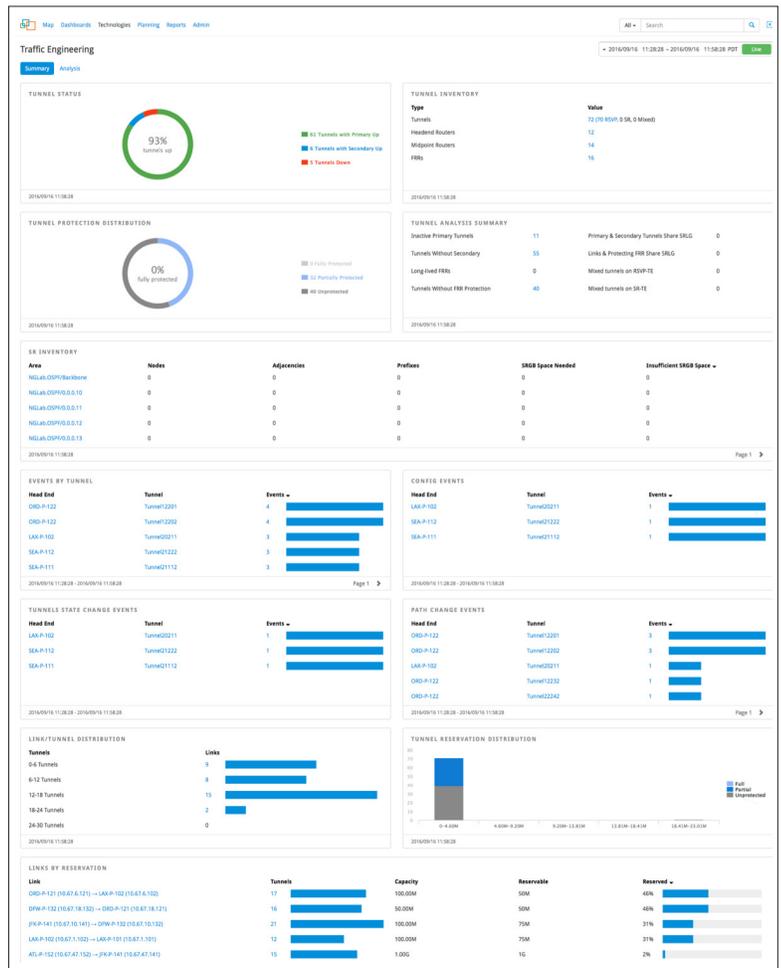
Fast Tunnel Problem Detection and Root Cause Analysis

Traffic engineering problems can severely impact critical services, making timely problem detection a must-have for network operators. Route Explorer monitors and alerts on TE tunnels that go down, are flapping, or are rerouted in real time, and identifies root causes such as router or link failures, re-optimization, or preemption. Engineers can quickly view tunnel status through comprehensive reports on tunnels, FRRs, head-end and mid-point routers, and TE links. Topology visualizations help engineers to easily understand the precise path of tunnels, and show node, link, Class of Service, and performance constraints. RSVP-TE and SR-TE tunnel misconfigurations across devices can be quickly identified, such as SRGB misconfigurations.

Rewindable History for Troubleshooting

Route Explorer’s “network DVR” feature allows engineers to perform analyses against the network state at the time problems were occurring. This makes troubleshooting transient and intermittent issues much more intuitive, speeding root cause analysis and reducing the number of trouble tickets closed without resolution.

- “Rewind and replay” the network to view routing and TE tunnel behavior during a specified time period
- Visualize and analyze a specific tunnel’s past status, paths, changes, traffic levels, and performance

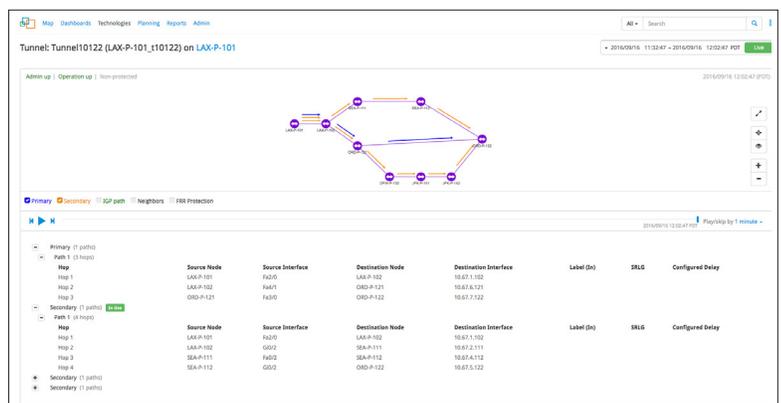


The summary dashboard provides an at-a-glance view of all the traffic engineered tunnels network-wide, including segment routes, their status, protection, and a host of tunnel metrics. Engineers can click on metrics to view detailed analysis pages.

Proactive TE Tunnel Protection

Traffic engineering is used to provide predictable and resilient network behavior in the case of infrastructure failures. With Route Explorer, engineers can ensure that protection mechanisms, such as secondary tunnels, FRRs, as well as protection constraints, like Shared Risk Link Groups (SRLGs), are properly deployed. Engineers can perform comprehensive analyses of tunnel protection.

- View secondary tunnel status
- Analyze why secondary tunnels are active
- Visualize primary versus secondary tunnel path diversity



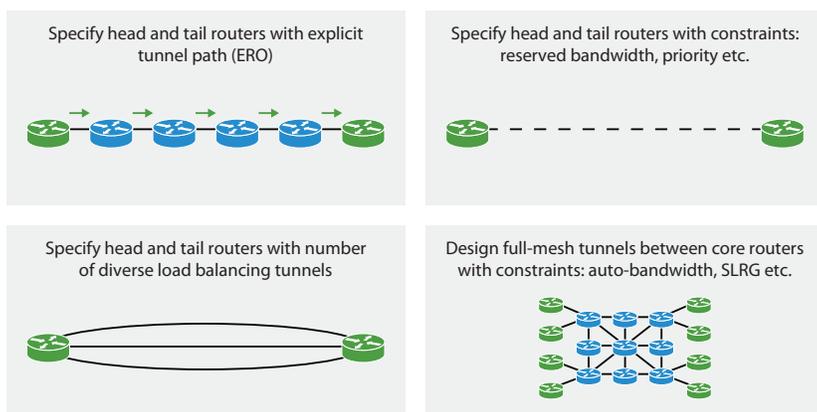
Engineers can select a tunnel or segment route to view its details, including the primary and secondary path, and FRR protection. They can also rewind and replay its behavior at a point in time to understand if path changes impacted service delivery.

- Track node, link or bypass FRR protection schemes
- Find tunnels and links that lack protection
- Visualize FRR tunnel paths in case of node or link failures
- View all configured SRLGs
- Identify primary tunnels that share a SRLG with secondary tunnels
- Identify links that share a SRLG with the FRR that protects them

Fast, Interactive Modeling of Traffic Engineering Changes

A large percentage of service-affecting problems are caused by misconfigurations. The deployment of traffic engineered tunnels increases network complexity, as well as the potential for costly maintenance and planning mistakes. Route Explorer allows engineers to model new TE tunnels interactively using its always-current topology model, so there is no risk of planning changes with out-of-date network information. Tunnel changes, as well as other network changes that impact tunnels, can be modeled easily to gain valuable insight into their impact.

- Model individual or full-mesh tunnels with the flexibility to specify any key tunnel attribute
- Determine optimal paths for new tunnels, including all intermediate routers and links
- Speed the TE planning process by modeling changes in routing, TE tunnels, or traffic flows
- Identify tunnels that will be preempted by planned network changes, including their current and previous paths
- Simulate failure scenarios to see the impact on TE tunnels
- Understand how to achieve diverse load-balancing tunnels given path constraints
- Identify links that will experience high traffic utilization or low available bandwidth



Route Explorer provides ultimate flexibility in modeling standard design variations for planned tunnel deployments.

Easy to Use Capacity Planning Reports Optimize Network Investments

Route Explorer enables engineers to accurately project future capacity needs and efficiently plan for required network upgrades. Network planners can analyze current and projected utilization of tunnels, identify tunnels with insufficient reserved bandwidth for future needs, and see when critical links will need an upgrade.

Efficient, Comprehensive, Scalable Data Collection

A single Route Explorer system can manage an entire service provider network, including thousands of TE tunnels. Multiple vendor-specific collection techniques maximize efficiency and completeness of data in heterogeneous network environments.

Low Total Cost of Ownership and Rapid ROI

Route Explorer's ease of deployment, high degree of automation and low overhead mean that it delivers uniquely valuable network management visibility with a very low total cost of ownership (TCO). Its network-wide, dynamic traffic engineering visibility delivers a rapid return on investment (ROI) by increasing the speed, efficiency and accuracy of network operations, engineering and planning processes, leading to a higher quality of user experience, lower MTTR and operations costs, and optimized capex investments.

