

Route Explorer™

EIGRP Technical Note

Introduction

This note provides information on the operation of Route Explorer in EIGRP networks, preparing for the deployment of Route Explorer in these networks, and how to get the most out of Route Explorer.

EIGRP is a distance vector routing protocol developed by Cisco Systems. Many of the largest enterprise networks in the world use EIGRP for routing. EIGRP networks can scale to thousands of routers in multiple Autonomous Systems (ASes).

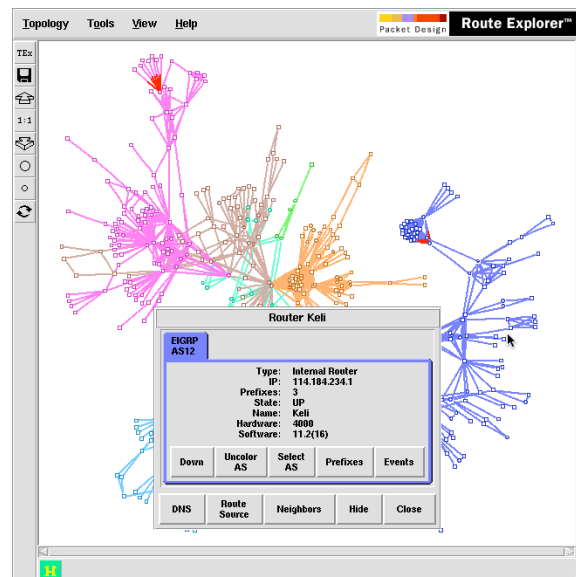


Figure 1 Route Explorer Topology Display

Route Explorer's EIGRP Routing Analytics software discovers and monitors multi-domain enterprise EIGRP networks, from a single appliance. The network topology map (see Figure 1) shows all EIGRP ASes clearly and distinctly using different colors for each area. Route prefixes are listed by the areas they belong to, making it easy to trouble-shoot problems. Additional information about the network such as router platform and IOS version is also displayed.

Complete prefix advertisement history from EIGRP update packets is maintained for the network, including prefix type, AS of origin, metrics, etc. These events are then resolved by Route Explorer's analysis into the link state change events that caused the EIGRP updates. Stepping through event history makes forensic analysis easy.

Tuning of link metrics, simulating down links and routers, simplifies network planning and allows corrective action to be taken.

Alerts and reports can be generated on flapping routes or prefixes, excessive network churn, and other events that indicate potential service outages.

Route Explorer monitors the entire enterprise network, seamlessly integrating multi-protocol, multi-domain networks (with multiple EIGRP processes or other routing protocols) into a whole network picture.

EIGRP Route Propagation

In a distance vector protocol such as EIGRP, the routing announcements heard by any given router in the network provide only partial information about the total network topology, namely only the “distances” to prefixes from the nearest neighbor routers. To build the complete routing topology of an EIGRP network requires more information than what is available in the routing protocol messages. Figure 2 illustrates this situation.

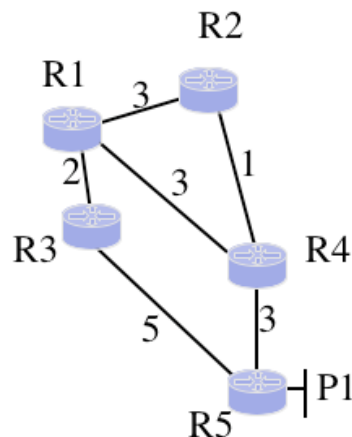


Figure 2 Sample Network

In this simplified network, there are five routers (R1 – R5). An end network connected to router R5 is denoted by the prefix P1. Router R1’s topology knowledge consists of its adjacencies with R2, R3, and R4, and the reachability of prefix P1 via each of the neighbors with the distance of 7 via R2, 6 via R4, and 7 via R3. Router R1 has no knowledge of the adjacencies R2 - R4, R3 - R5, and R4 - R5. Without additional information, it would be impossible to be aware of these links.

In a link state protocol (e.g. OSPF, IS-IS), router R1 would know of all adjacencies in the network. This is because link state protocol update messages provide the complete routing topology. It is only necessary to listen to the routing protocol in one location to get the topology information for the whole network (of one “area”).

Route Explorer's Operation in EIGRP Networks

In an EIGRP network, Route Explorer listens to the routing protocol updates from one or more neighbor routers where Route Explorer is attached. This is again a "passive" neighbor relationship because we listen to the routing updates but never send any routes. However, because EIGRP is a distance-vector protocol and Route Explorer only gets partial information about the topology, it must take additional steps to learn what other routers exist and what links are connecting them.

Route Explorer gathers the missing topology information by using TELNET to login to remote routers and collects information via the Command Line Interface (CLI). This mechanism is used for learning the topology of an EIGRP AS. Route Explorer uses GRE tunnels to routers in remote ASes to learn the full network topology of those ASes. The following diagram illustrates the configuration.

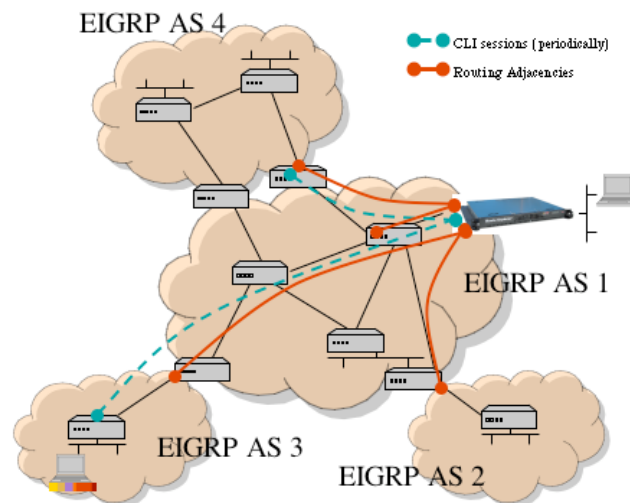


Figure 3 Route Explorer in an EIGRP Network

In Figure 3, we see a multi-domain EIGRP network. ASes 2, 3 and 4 are connected to each other via AS 1. Route Explorer maintains routing adjacencies with at least one router in each AS and then periodically opens CLI sessions to other routers as needed.

Topology Discovery and Monitoring

Route Explorer performs topology discovery in two phases: initial exploration to learn network-wide topology, and dynamic monitoring of changes. During the initial topology exploration phase, Route Explorer learns the complete network topology using a brief CLI session to each router in the domain. Packet Design has selected CLI (over SNMP) because it was found to be the most efficient mechanism and have dramatically lower impact on the routers. The CLI session is short-lived and executes in "login" access mode with minimum user privileges. "Enable" access is NOT required. The commands executed during the session are not lengthy or CPU intensive. Examples: "show version", "show ip interface", and "show ip eigrp interface".

The initial topology exploration may last up to one hour depending upon the size of the network. To minimize any load on the network, Route Explorer limits the total number of TELNET sessions open at any time to be no more than 10 (a selectable number). For any given router, Route Explorer allows only one TELNET connection at a time, except that during the initial topology exploration it is possible that it may discover the same node from two directions at the same time (this is rare). Since the commands that Route Explorer issues represent an insignificant load on the router, impact on network operation is minimal.

After the initial exploration phase, Route Explorer detects and displays changes in the topology in real-time by listening to the EIGRP routing updates. Route Explorer's advanced algorithms infer link-state changes from the distance changes heard in EIGRP and then confirm the link-state changes by targeted CLI access to specific routers. There is no continuous polling of routers; only a minimal set of targeted accesses when an event is detected. Periodic re-exploration of the entire topology takes places every 8 hours.

Getting Started with Route Explorer in your EIGRP Network

Site Preparation

Route Explorer is a rack mountable network appliance. It needs 1U of space in a standard 19 inch wide rack. Mounting hardware is included. Route Explorer can operate on 110V or 220V AC power at the line frequency of 50 Hz or 60 Hz.

Physical Connections

Route Explorer has two Gigabit Ethernet ports built in and can be configured with 4 additional Fast Ethernet ports or two additional fiber Gigabit Ethernet ports. These ports may be used for connection to a management LAN for the user interface to Route Explorer, as well as for connections to routers. Route Explorer may be connected directly to a router or may be connected via an Ethernet switch. The port connection speed is automatically sensed by default, but this setting may be overridden during installation to suit the site requirements.

Establishing Router Adjacencies

To be an EIGRP peer, Route Explorer needs to establish an adjacency with one or more routers in your network (one per EIGRP AS). This adjacency may be via one of the physical ports on the Route Explorer appliance or else over a GRE tunnel. If a GRE tunnel will be used, one end of the tunnel will be on a Route Explorer port while the other will be on a router. The router at the far end of the GRE tunnel will need to have a tunnel interface configured and enabled. A single Route Explorer port may terminate multiple GRE tunnels. Each tunnel will be a "stub", with no packet forwarding from one tunnel to another.

Enabling CLI Access

Packet Design recommends using an authentication server such as TACACS or Radius for enabling CLI access to routers by Route Explorer. If your network already uses an authentication server, all you need to do is set up an account for Route Explorer on the server and provide the user name and password for that account as input parameters to Route Explorer. The account should be set up so that it allows only “login” access and not “enable” access. If your network does not use an authentication server, Route Explorer can also work with an ordinary router password.

Getting the Most Out of Route Explorer in your EIGRP Network

EIGRP has certain features and controls that give much flexibility to the routing engineer, e.g. “K” values, but may also create problems such as routing instabilities if not used carefully. In many cases Cisco actively discourages the use of these control features. There are other features of EIGRP that may obscure information needed to discover and diagnose the network, e.g. auto-summarization. This section discusses some of these features and how they may affect Route Explorer operation.

“K” values

EIGRP provides a number of ways to modify the metric associated with a prefix. One of them uses selectable weights known as “K” values, for the components of the metric. (For more information please see the references cited in the section “Resources” below.) Cisco strongly recommends using the default values of K, and actively discourages modifying them. Route Explorer assumes that all routers in your network use default K values and currently ignores routers using non-default K values.

Variance

EIGRP allows unequal cost multi-path with a variance parameter. Route Explorer assumes that variance is set to one in your network.

Summarization

In the EIGRP router configuration, auto-summarization is turned on by default. This causes the router to aggregate or summarize prefixes across “major network boundaries”. This in turn hides topology change information from Route Explorer. This problem may be avoided by establishing GRE tunnels to routers beyond summarization points so that Route Explorer can receive EIGRP updates for routes that would otherwise be summarized, or else by turning off auto-summarization in routers when reduction of routing protocol traffic isn’t a requirement.

Resources

EIGRP Resources

- Cisco White Paper:
 - <http://www.cisco.com/warp/public/103/eigrp-toc.html>
- Cisco Product Documentation:
 - <http://www.cisco.com/univercd/home/home.htm>
 - http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/en_igrp.htm
- Zinin, Alex. Cisco IP Routing. Addison-Wesley, 2002.
- Pepelnjak, Ivan. EIGRP Network Design Solutions. Cisco Press, 2000.

Route Explorer Support Resources

To obtain product support for Route Explorer, please use one of the following methods:

- call us at 650-739-1840, Monday thru Friday, 8am to 5pm. PST.
- email us at rex-support@packetdesign.com.
- visit Packet Design's support web site at <http://www.packetdesign.com/support.html>. You will need a user id and password that will be issued to you when you start the evaluation or purchase Route Explorer for EIGRP. Here are the resources available at the support web site.
 - Frequently Asked Questions
 - Route Explorer Manuals
 - Route Explorer Software Update Information
 - VNC Clients
 - Data Upload Information



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