White Paper

Routed Access—An Option for Resilient Services

Real-time applications are heightening the demands on today's enterprise networks. Worker productivity is increasing and more communication and collaboration tools are available than ever before. Simplifying application deployment, decreasing network downtime, and maintaining application and network predictability have never been more critical for the success of your enterprise. By using the intelligence and resilience of Cisco® routing protocols such as Enhanced Interior Gateway Routing Protocol (EIGRP), your switches in the access layer or wiring closet deliver the mechanisms for fast and deterministic network recovery from failures.

This paper explains the role that a Routed Access solution can play in increasing network availability for real-time applications, decreasing network complexity, and enabling a standard set of configuration and troubleshooting tools for fast network implementation and timely resolution to network issues.

SUMMARY

Networks have become critical for the success of enterprise information systems. Real-time applications are enabling workers to be more productive regardless of time or location. Supporting these business-critical applications places new demands on the current network infrastructure and operations personnel. These new applications can have more stringent network demands than e-mail or Web browsing. Real-time applications including voice over IP (VoIP), multicasting, and peer-to-peer applications require methods to recover from network failures in a fast and deterministic way.

Lengthy network recovery times, complex configurations, and large numbers of complex troubleshooting tools can hamper or delay real-time application implementations. Increasing network availability, reducing network downtime, and implementing dynamic traffic load balancing can greatly enhance the quality of real-time applications and make them easier to implement, manage, and support.

The Routed Access solution uses routing protocols already deployed throughout the network. Routing protocols are used in the wiring closet or access layer as well as in the distribution and network core. Extending routing to the wiring closet allows the network to respond to outages with fast recovery times, often less than 200 milliseconds (ms), and to better utilize existing network links and ports.

By designing networks with more deterministic recovery mechanisms, real-time applications can be used to their full potential. Fast recovery times and predictable traffic flows and patterns result in successful VoIP and multicast application implementations. Peer-to-peer applications have just begun to show their promise within the enterprise. Enhanced communication tools and methods enable employees to become more productive regardless of time or location. The network can truly become a valuable tool for your business.

CHALLENGE

The applications that are increasing today's network requirements include:

- Voice over IP
- Videoconferencing
- Streaming audio and video
- Network management
- Disaster recovery

One characteristic that all of these applications have in common is the requirement for a highly available network infrastructure. Both voice and video streams become incomprehensible, drop traffic, and eventually drop their connection when even the most modest network failure is encountered. Network management outages are intolerable under any circumstance, especially when outages occur and swift disaster recovery is required. Subsecond recovery is essential.

Network outages cost money. The one-day cost for a person's lost time is US$1644 per employee (Source: Meta Group). In a medium-sized, 100-person office this soars to $164,000 per day. This number increases five-fold, to $820,000, for financial institutions. The resulting loss is more than just a loss of revenue. There are losses in productivity an institution's reputation and recovery expenses.

ROUTED ACCESS—AN OPTION FOR RESILIENT SERVICES

Cisco Systems® delivers a fully Routed Access network solution with convergence times from 80 ms to 200 ms. That is, in a worst-case single-failure scenario, traffic will be properly forwarded in less than 200 ms. These results were achieved in a real-world test bed with more than 10,000 routes, 10,000 hosts, control traffic, QoS, Multicasting, saturated links, etc. These results are made possible by Cisco innovations in EIGRP and Open Shortest Path First (OSPF) routing protocols—not by disabling routing protocol protection mechanisms, which could decrease network stability. For example, turning off all of the protocol timers is not a realistic solution because it can cause excessive control-plane CPU processing during route and link flapping conditions, all of which can ripple through a network. In a production network, turning off all of the timers can result in catastrophic network failure. Cisco has studied, tested, and made available design guidelines to ensure optimum and reliable network performance.

Number of Employees	Outage Daily Cost per Employee
1	$1,644
10	$16,440
100	$164,400
500	$822,000

High Availability Campus Network Design Guide

http://www.cisco.com/application/pdf/en/us/guest/netsol/ns432/c649/ccmigration_09186a00805fccbf.pdf

Even the most efficient and available network may not be worth the effort when it is difficult to implement and troubleshoot. A Routed Access network is simple because there is little margin for error during provisioning, and it is easy to troubleshoot because all of its network elements function in a similar way. They use the same:

- Layer 3 routing protocol to move packets and determine gateways
- Cisco Express Forwarding load-balancing algorithms
- Multicast protocols; each node uses the same set of rules to govern its behavior

Troubleshooting a Routed Access network is easy for two main reasons. First, the result of a Layer 3 error due to misconfiguration or protocol bugs is a closed failure.

Note: A "closed failure" typically restricts or closes access to the unreachable part of the network. The term "open failure" is also characterized by a reachability problem, however an open-ended failure results in an attempt to circumvent the failure with packet broadcasts and flooding.

An open failure state can compound the problems associated with the original network failure. Unwanted flooding may result in link over-utilization and node congestion. In a Routed Access network, a closed-failure Layer 3 access solution uses routing control protocols in an attempt to fix the failure. If the failure cannot be bypassed, the routing control protocols mark the destination as unreachable, communicate it to the rest of the

network. Finally, because a Routed Access solution decreases the number of broadcast domains, security issues related to flooded packets are reduced because the number of listeners declines. Thus, pinpointing the exact switch where the offender is located becomes trivial.

With a Routed Access solution Layer 3 troubleshooting tools are easy to use and the typical administrator is already familiar with them. For instance, when a user can not reach an application, an administrator simply uses the **ping** command to test for destination reachability. If a user is experiencing throughput degradation, the **traceroute** command is typically used to locate points in the network where congestion or other issues are occurring. The **traceroute** command delivers a vector of IP addresses where the packet traverses the network. Additionally, Cisco routing Layer 3 “debug” command-line interface (CLI) commands are available to pinpoint specific outages.

Implementing a Routed Access solution often means there are few commands and few protocols to troubleshoot, simplifying operational tasks.

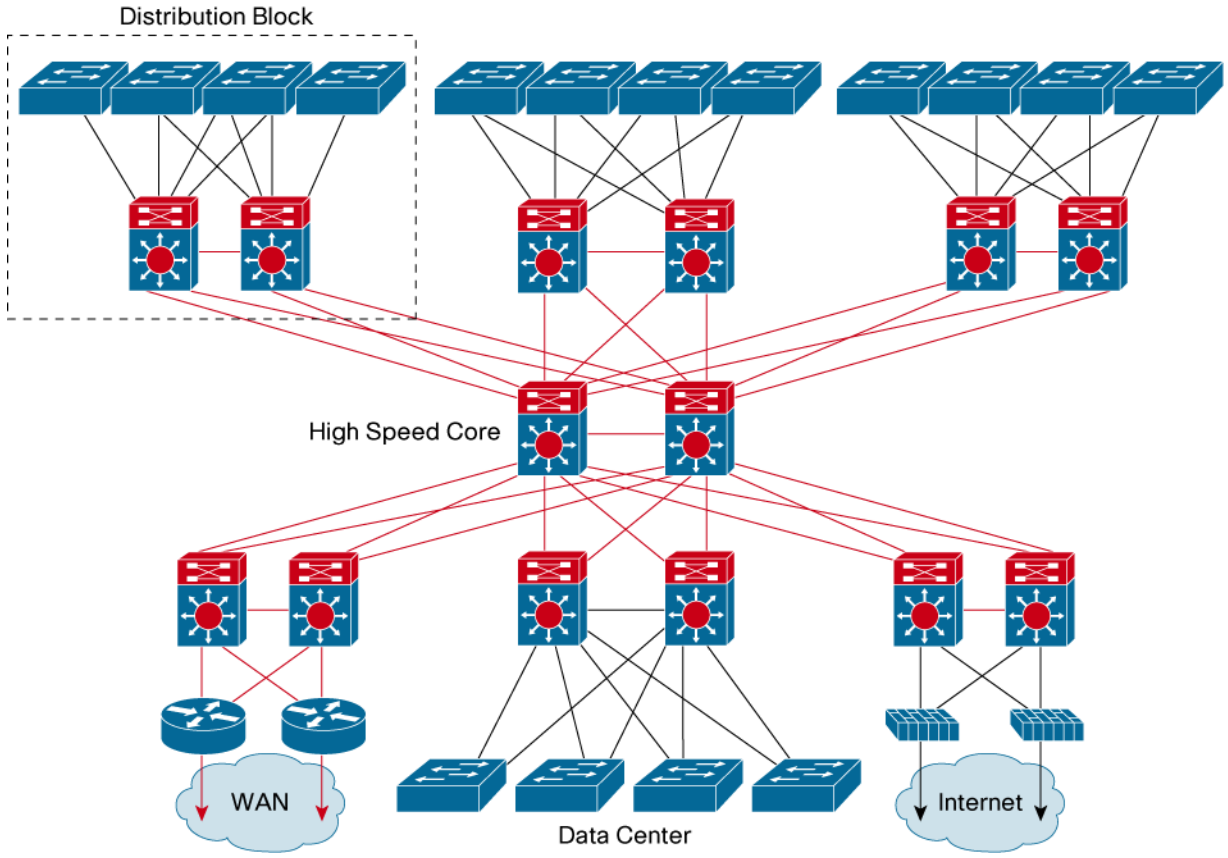
Routed Access utilizes Cisco Express Forwarding, an efficient IP-based real-time scheme that interacts with routing protocols to rapidly update as the network changes. Cisco Express Forwarding is a highly proven architecture that is used throughout the industry.

With a Routed Access solution, there are few configurations, few synchronizations, and few opportunities for mistakes. A Routed Access solution also avoids many configuration errors that occur during switch maintenance, replacement or network expansion.

Routed Protocols at the Network Edge

A Routed Access solution is more than simply turning on routing at an access node or configuring static routes. The Cisco Routed Access solution is comprised of proven Internet protocols. It is thoroughly tested by a Cisco Enterprise Systems Engineering task force in a large-enterprise, real-world testbed. See Figure 1.

Figure 1. Cisco Routed Access Solution Testbed



The test bed included the following:

- 10,000 routes
- 10,000 MAC addresses
- Links were saturated with traffic
- Traffic flow types
- VoIP
- Streaming video
- Bulk data
- Wireless traffic
- Multicast traffic
- Layer 2 control traffic
- Layer 3 control traffic
- QoS enabled

Each access node included in:

- Voice VLAN
- Data VLAN
- Unique VLAN

Cisco Routed Access relies on Cisco innovations including:

- Enhanced Interior Gateway Routing Protocol (EIGRP) and Open Shortest Path First (OSPF) route filtering, timer implementation, and tuning capabilities
- Cisco Express Forwarding load-balancing and route caching
- Feature-rich multicast enhancements in Internet Group Management Protocol (IGMP), PIM sparse mode (PIM SM), Multicast OSPF, and Distance Vector Multicast Routing Protocol (DVMRP)
- Feature-rich, high-availability network nodes such as the Cisco Catalyst® 3750, 3560, 4500, and 6500 Series Switches
- Networks are critical for the success of today's enterprise business. Real-time applications are more important than ever before in enabling workers to be more productive regardless of time or location. Supporting these real-time applications has changed the way we view, design, and manage our networks.

The Cisco Routed Access network solution simplifies network management by reducing network recovery times, simplifying configurations and troubleshooting, using simple and efficient IP load balancing, and tightening up broadcast domains. All of this results in operational cost savings. With a Routed Access solution, network uptime increases, mean time to fix errors is reduced, and provisioning downtime is decreased. All three of these advantages directly and favorably affect user productivity and network administration costs. Delivering a Routed Access solution not only enhances your network, it enhances your business.

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