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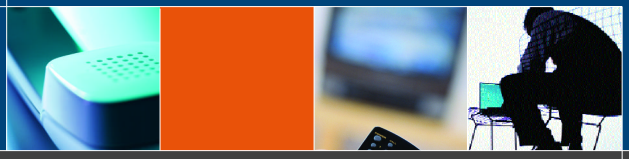


Broadband Loop Carrier Ethernet Protection Switching

Using Ethernet to Create a Reliable Broadband Access Network

FAQ

InnovationStartsHere

Occam® Networks has developed an innovative technology called Ethernet Protection Switching (EPS) that makes it possible for telecommunications carriers to use Ethernet in the access network and still meet the high reliability and "five nines" availability requirements of a public carrier network. EPS provides a simple method for delivering transport redundancy and fail over protection in case of link, node or equipment failure. Switchover to in-service facilities takes place in under 50 msec, a switchover rate that is equivalent to that provided by circuit-switched SONET equipment. Voice conversations and data sessions continue without interruption. EPS enables star, tree, string and ring network topologies. This deployment flexibility lowers cost allowing carriers to use less fiber while still ensuring high network availability.

Overview

Occam Networks' Broadband Loop Carrier has been designed to meet the growing demand for greater bandwidth at lower cost in the telephone system's local access network. The Occam BLC will allow service providers to meet the growing demand for high bandwidth data services, from DSL to gigabit Ethernet (GigE), as well as enable future video service offerings. Furthermore, Occam's BLC will support traditional Class 5 voice switch connections and provides an easy transition to a softswitch architecture.

Ethernet and Internet protocol (IP) are the core technologies that will enable advanced services delivery at lower capital and operating costs. Using Ethernet transport drives capital costs to the lowest levels possible, while providing increased bandwidth needed for high-speed data and streaming content services. Using IP as a common protocol for all services reduces operating costs to the lowest possible level, while providing an easy connection through the access network from the customer to the backbone network.

Ethernet Protection Switching is an integral part of the overall Occam BLC system. This paper introduces Ethernet Protection Switching as a technical solution for ensuring reliability in an Ethernet-based access network.

Is Ethernet really a technology for the local loop?

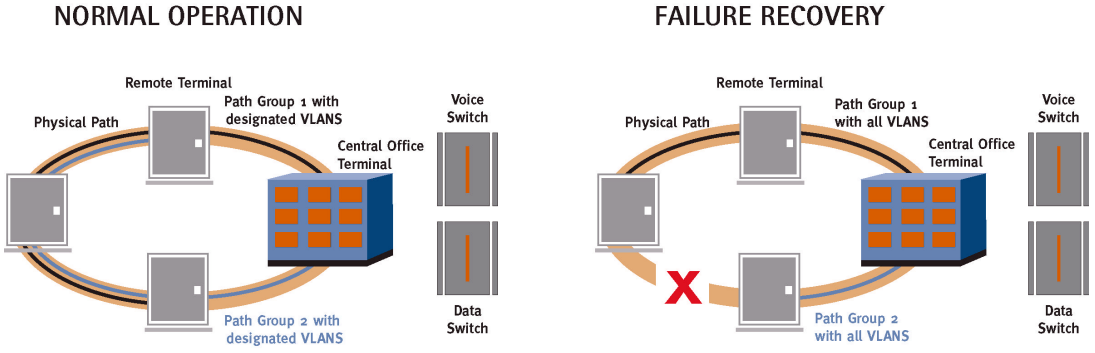
Yes. Carrier network planners face conflicting objectives. They must drive the cost of service delivery to the lowest possible level, yet increase the capabilities of the network to deliver higher bandwidth and higher margin services. Ethernet as a transport technology offers a clear solution for providing bandwidth and lowering cost, but Ethernet networks historically have not had the reach, reliability and quality of service (QoS) mechanisms necessary for the public carrier network.

Advances that allow Ethernet to run long distances over optical fibers have solved reach limitations. The QoS issues have been addressed with techniques, such as Diff. Serv., that make Ethernet and IP as useful for maintaining multi-service Service Level Agreements (SLAs) as ATM.

Reliability has remained a key issue in deploying Ethernet in telecommunications networks. Several solutions have been proposed, including Resilient Packet Ring, Rapid Spanning Tree and others, but none have provided the cost savings and performance to displace the SONET networks in use today. Occam Networks has developed EPS to deliver the cost and bandwidth advantages of Ethernet with the reliability of SONET. EPS gives networks planners the ability to construct high-performance, low-cost networks based on proven Ethernet switching technology.

What is Ethernet Protection Switching?

Ethernet Protection Switching (EPS) is a network configuration and failsafe switching technology that protects the access network against failures in the link, node and equipment. Like traditional protection schemes, Ethernet Protection Switching designates primary and alternate paths for the service traffic. Failure detection and switchover to alternate facilities takes place in under 50 msec, a rate equivalent to the failover rate provided by circuit-switched SONET equipment.



→ Service traffic is segmented into multiple Path Groups using Ethernet VLANS
→ Path Groups do not go around a full ring, preserving "legal" Ethernet configurations
→ Traffic is balanced across path groups, using all available facilities
→ When failure is detected, traffic is switched to a healthy path group facility

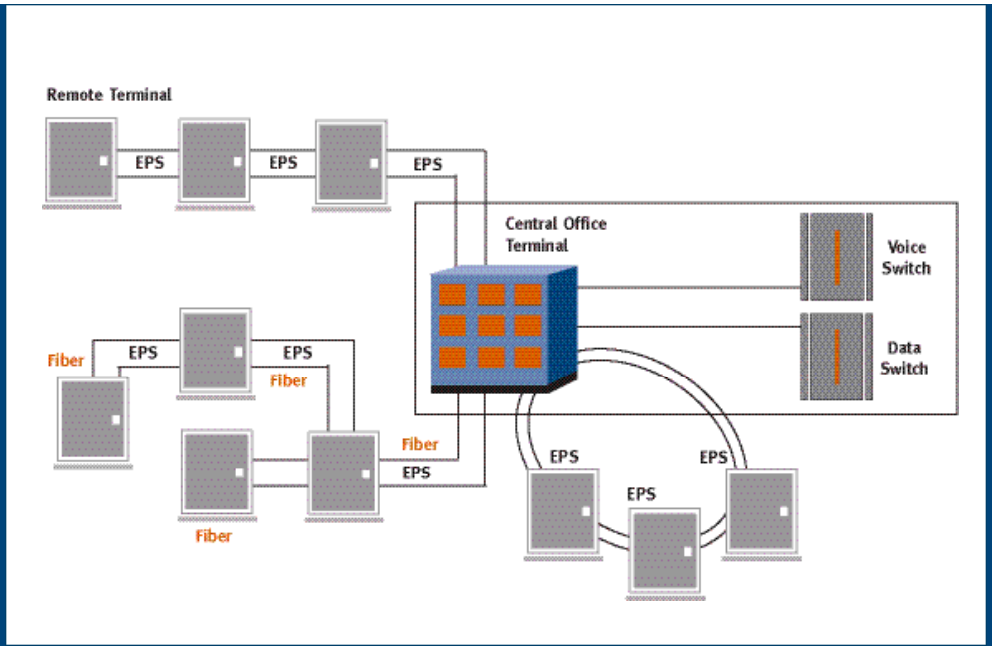
How does EPS work?

EPS segments the service traffic into pre-configured flows called Path Groups. Each Path Group is carried over facilities following a defined primary physical path. Each Path Group also has a pre-defined alternative physical path. A simple heartbeat originating at a central location is used for each Path Group to ensure the link is operating properly. Failure by any node to detect heartbeats triggers a switch to the alternate physical link.

EPS creates the Path Groups using standard 802.1q Virtual LANs (VLANs). Each Path Group may contain multiple VLANs. The networks are designed so that the Path Groups overlap and every site has alternate paths. They are also designed so that no VLAN completes a closed ring, and network topologies are "legal" Ethernet configurations.

The frequency of heartbeats and the number of missed heartbeats before switching to the alternate path are configurable parameters. Typical network designs send heartbeats at 20 msec intervals, and a failure to detect two sequential heartbeats triggers a protection switch. Two 20 msec heartbeats with switching time of less than 10 msec adds to the sub 50 msec failover time for Ethernet Protection Switching, matching or beating SONET failover rates.

Ethernet Protection Switching pre-configures primary and alternative paths and enables a rich mix of bandwidth-efficient network topologies.



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What network configurations does EPS support?

EPS enables star, tree, string and ring network topologies. In addition, Ethernet technology does not have the 16-node limitation of SONET networks. The flexibility to support multiple topologies; copper and fiber media; and any number of nodes allows the Occam BLC to fit current network topologies and enables lower cost deployment plans using less fiber in the future.

Does EPS use the bandwidth of the alternate back-up facilities?

Yes. The dynamic use of all bandwidth is a major feature of Occam Networks' Broadband Loop Carrier access network, providing significant cost and network planning advantages. Unlike SONET, EPS does not use separate "backup" physical alternate facilities. EPS configures the Path Groups to use all available bandwidth in all facilities during normal operation. The primary and alternate facilities are actually pre-defined paths through all facilities. Unlike SONET, where protection links are idle and wasted during normal network operation, EPS load shares over the bandwidth of all operating facilities. During a facility outage, the available bandwidth on the remaining facilities is used according to priorities set by the QoS mechanisms.

What services can I deliver over EPS networks?

The Occam Broadband Loop Carrier delivers all services to all customers – voice, data and video – from POTS to T1, from DSL to GigE, and from Internet browsing to video. Ethernet Protection Switching imposes no limits on the type of services that can be carried and ensures network reliability and Service Level Agreements for all services.

Why not use Resilient Packet Ring or Rapid Spanning Tree Protocol?

Both Resilient Packet Ring and Rapid Spanning Tree Protocol are emerging technology specifications with significant disadvantages compared to Ethernet Protection Switching.

Resilient Packet Ring (RPR) is not expected to be a fully complete standard until 2003. Even then, additional work to define IPoRPR will be required. RPR requires a new MAC protocol that is not supported by most network devices. Ethernet Protection Switching is based on standard low-cost, high-performance Ethernet switching technologies and can be delivered sooner and more cost effectively than RPR.

Rapid Spanning Tree Protocol (RSTP) does not use pre-configured alternate paths, but takes the network out of service while it re-learns and re-configures the paths after a failure. Furthermore, RSTP does not use a heartbeat protocol to detect failures. As a result, though it does detect link failures, it may not detect node or equipment failures. Finally, RSTP requires that a certain number of links remain inactive to avoid bridged Ethernet loops and therefore does not efficiently use the available access network facilities.

What about MPLS?

Multi-protocol Label Switching (MPLS) offers significant benefits to simplify traffic engineering and manage QoS parameters across multiple IP domains. It is an important technology that Occam Networks will adopt for those advantages. Unlike Ethernet Protection Switching, MPLS does not directly address the issues associated with “five nines” availability within the closed access network environment. In operation, MPLS will run on top of EPS with each technology independently delivering its unique features.

What network configurations does EPS support?

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Is EPS a proprietary Occam Networks technology?

Occam uses standards based technology in a unique application to create Ethernet Protection Switching and ensure network reliability. EPS Path Groups contain virtual LANS defined according to the IEEE 802.1q standard, and the failover switch is standard Ethernet layer 2 switch technology. The combined use of these technologies, along with use of heartbeats as a trigger mechanism, is an advance developed and patented by Occam Networks. In a sense, EPS is a simple application running on top of standard Ethernet. EPS will be offered to other vendors, and, as support grows, we will offer it as an industry standard.

Will Occam Networks support other protection technologies?

Occam Networks is committed to supporting industry standards that deliver cost-effective public carrier level network availability. Occam will adopt and support any standard that emerges as a better alternative and gains general acceptance.

Conclusion

Ethernet Protection Switching, along with the redundancy and carrier class designs of the Occam BLC equipment, provides the “public carrier level” availability required in carrier networks. Ethernet Protection Switching allows service providers to benefit from the cost and bandwidth advantages of Ethernet technology while maintaining the traditional high reliability of the public carrier network.