Ethernet circuit

Ethernet Circuit technology enables the construction of multiple streams of information. It also allows for the manipulation of various parameters that define these information streams and characterize the transport of the streams through the network. By implementing Ethernet Circuit technology, carriers can support Service Level Agreements with subscribers of their network services. The technology empowers enterprises with new carrier services such as outsourced IT services from Application Service Providers (ASPs) and unprecedented network control.

MRVs' OptiSwitch® product line is a unique integration of Ethernet multi-layer systems and a carrier circuit switch. It incorporates only field proven technology and industry standards (no proprietary protocols) and a combination of hardware features with Ethernet pricing and simplicity of operation.

Unlike regular LAN switches, OptiSwitch® Ethernet circuit switches have the ability to recognize frames as belonging to a specific stream of information, a circuit, and attach to this stream a variety of parameters related to the way these frames are to be handled across the network.

Introduction

Ethernet Circuit technology is based on the concept of circuit switching emulation over an Ethernet carrier. Regular Ethernet switches for corporate Local Area Networks (LANs) are designed to forward frames, but are incapable of treating a stream of frames as belonging to a specific flow of information. Ethernet circuit switches can recognize a series of Ethernet frames as belonging to a predefined circuit, and apply the same policy parameters on them.

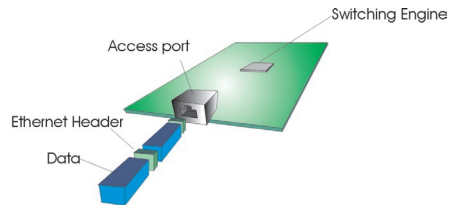

Figure 1: Standard Ethernet switches perform switching based on MAC/Port lookup per frame. They cannot recognize a frame as part of a stream of information

This technology is designed to allow carriers to enjoy the revenue from services, which traditionally required circuit-switching technology, as well as from new services, which require Ethernet and IP switching technology. This Ethernet Circuit technology empowers carriers with a new class of profit-making services and products, while dramatically reducing the cost of ownership.

The Ethernet Circuit technology is designed to empower enterprises with new carrier services such as outsourced IT services from Application Service Providers. With an Ethernet Circuit enabled LAN, an organization can securely deliver the required service and application directly to the desktop. An Ethernet Circuit OptiSwitch® can define what type and class of services a specific PC can receive. This concept creates a synergy between the carrier/ASP and the enterprise. For example, in an enterprise LAN, different access speeds and QoS can be defined per application/user using Ethernet switches. This allows the organization to reduce costs of access fees, optimize the Internet connection's performance, and improve employee's productivity. Ethernet Circuit systems also enable organizations to better utilize available IT services from ASPs, services such as data storage, ERP software, e-mail servers and rendering farms.

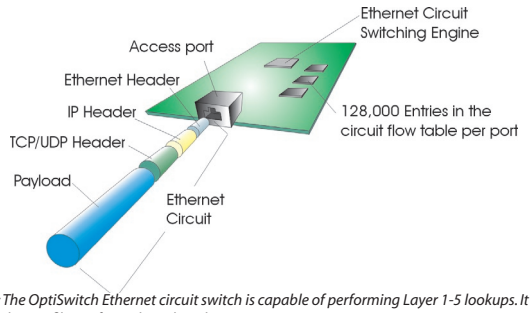

Figure 2: The OptiSwitch Ethernet circuit switch is capable of performing Layer 1-5 lookups. It can attach a profile per frame based on the circuit parameters.

An Ethernet Circuit can be defined based on a variety of Layer 1-4 parameters such as physical port, MAC, IP address and TCP or UDP port. Once the circuit is defined, actions and procedures are performed based on a database of circuit entries held internally within the switch's hardware. These actions can include: marking and remarking of fields in the different headers of the frame, conformity checks with the SLA, filtering and forwarding decisions, QoS decisions, statistics gathering and accounting.

Unlike in the traditional circuit-switching world, the provisioning of an Ethernet Circuit requires no manual re-configuration. Upgrading a 2 Mbps circuit (E1) to a 45 Mbps connection (DS3) can be performed in the software, without any manual, physical circuitry reconfiguration. This OptiSwitch® feature, when compared to today's slow provisioning times that are measured in days or even weeks, represents a huge upgrade of the service level a carrier can provide to its subscribers by offering on-the-spot changes and self-provisioning capabilities. When the OptiSwitch® Ethernet Circuit technology is extended into the entire access network and backbone, service providers can see additional benefits, including better use of technician's time, and operational cost savings from avoiding lost revenue from inactivated services and the need to purchase costly new systems.

Granular bandwidth (Rate limit)

The Ethernet standard defines three speeds: 10 Mbps, 100 Mbps and 1000 Mbps. A fourth speed, 10,000 Mbps, is currently being defined. While highly scalable, Ethernet lacks the ability to define more granular speeds, and there is a need to limit its rate. OptiSwitch® is capable of limiting the Ethernet rate in between 64kbps - 1Gbps in 1 Kilobits granularity. Each Ethernet circuit, that can be defined by Layer 1-4 parameters, can be rate-limited. For example, a specific port on an OptiSwitch can define that TCP/IP traffic going to the Internet will be limited to a specific speed, while remote access to a LAN will be performed at a higher speed. This rate limitation capability is performed in the hardware by the switching ASIC and is capable of limiting thousands of such circuits.

Maximizing Carrier Profit

The Granular bandwidth feature enables the carrier to create a tiered product-positioning scheme. While the ability to provide an actual access speed remains constant, this feature defines the maximum speed actually utilized. In a case where a Fast Ethernet connection is installed as the access medium, the speed of Internet traffic within the ISP's network can be unlimited, while external Internet access can be limited to 128 Kbps, LAN-to-LAN services to 5 Mbps and Voice or Videoconferencing can be enabled on demand. When implementing such tiered pricing models, carriers can maximize profit on the installed equipment and offer a competitive product set, while actually reducing operational costs.

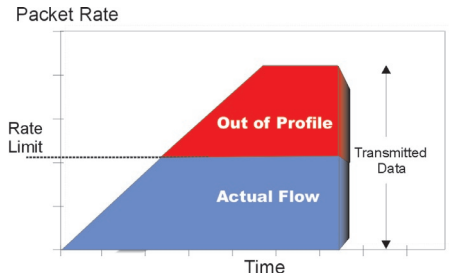

Figure 3: The permitted bandwidth of every circuit can be defined in Kilobits granularity.

Quality of Service/Class of Service

OptiSwitch's unique Ethernet Circuit technology enables Ethernet based end-to-end Quality of Service (QoS) and traffic Classification (CoS). Regular Ethernet switches, which are defined by the Ethernet standard as "non-guaranteed quality of service", cannot provide a solution for a network with delay sensitive applications such as voice and video. OptiSwitch® is capable of providing a unique end-to-end quality of service paradigm using the Ethernet Circuit technology.

The definition of QoS over the Ethernet circuits enables the creation of a minimum bandwidth threshold. This functionality is critical for applications such as telephony, video conferencing and video multicasting. The implementation of such a traffic classification scheme is based on the need to prioritize the traffic, which originates from multiple sources and multiple applications. Depending on the application, OptiSwitch® can define up to eight different Classes of Service.

The Classification feature is critical for carriers that are required to implement circuit switched applications over an IP network. This feature, which is implemented in every OptiSwitch® Ethernet Circuit port, is a critical SLA tool. It implements the SLA terms of guaranteeing the minimum bandwidth actually provisioned to the subscriber.

OptiSwitch implements the circuit classification starting at the access port level. This ability to check a circuit at the first port to which

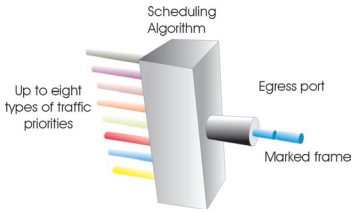

Figure 4: Quality of service for differentiated services are supported by individually classifying Ethernet circuits

the subscriber is attached ensures an end-to-end QoS scheme. Being able to perform the profile check in the Ingress port improves the overall network performance and resource utilization by preventing out-of-profile traffic from traveling on the network until reaching some central profile server.

The OptiSwitch® Classification hardware performs rate monitoring and performance checking for each circuit. It implements a combination of algorithms such as the "Token Bucket Algorithm" for defining a circuit's average rate and burst size or "Strict Priority" for a more stringent QoS challenging network. Frames that pass the algorithm are considered to be compliant, or in-profile, and are forwarded to their destination. Packets that do not comply with the defined profile will increase their chance of being dropped when there is congestion on the transmit port, or in some cases be dropped immediately, regardless of congestion.

Security

An important feature of OptiSwitch is the ability to define a circuit, which cannot be tapped or tempered with by neighboring users. In a LAN, the OptiSwitch® can separate the traffic of individuals or workgroups for security purposes. Furthermore, this scheme can be integrated as part of the general Internet security scheme, to provide an overall security solution. Using separate Ethernet circuits allows isolation of sensitive information and mission critical servers from LAN users and access from the Internet.

A carrier has to protect its subscribers' traffic from malicious intrusion by neighboring subscribers. This demand is critical especially in shared technology such as Ethernet. OptiSwitch® creates a separate Ethernet circuit by defining a VLAN between each subscriber and a specific router. Each subscriber is assigned a unique "VLAN ID" in the access network, and in all switches on the path to that router, creating a physical barrier between all subscribers in the access network. This architecture physically prevents subscribers from tapping into neighboring subscriber's traffic. Directly sending data between subscribers is impossible, as all circuits are terminated in the OptiSwitch Master® router, which implements further security checks. In such a security scheme the electric signals from a subscriber's traffic do not reach other subscribers' ports, preventing even electrical tapping (sniffing).

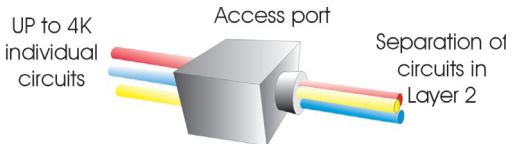

Figure 5: Strict security is implemented in Layer-2 using VLAN tagging. Using the OptiSwitch Master, the same scheme can be extended using MPLS.

The OptiSwitch® Ethernet Circuit security features also provide tools for prevention of subscriber masquerading. When not enforced, subscribers can impersonate other subscribers by using their IP source address. Such security flaws can result in subscriber's abusing their peer's SLAs and attacking other networks and computers without revealing the true source behind these attacks.

Using Ethernet circuits, OptiSwitch® can implement intrusion control by correlating each IP address to a physical port in a specific system. All incoming IP traffic is inspected on the access port. Incoming frames from a port are dropped if the source IP address is different from the IP addresses expected on this port. This feature disables a wire, which is not centrally activated by the carrier, thus preventing "pirate subscribers" which are intruders that physically gain unauthorized access to a wire or a port.