Advantages of Using Ethernet Pipes to Segregate Networks

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INTRODUCTION

The SEL ICON™ synchronous optical network (SONET) multiplexer has the ability to segregate time-division multiplexing (TDM) bandwidth to create dedicated Ethernet circuits or pipes. The ICON supports up to 32 Ethernet pipes per node and up to 4,095 pipes per network. A pipe is created through the concatenation of VT1.5 or STS-1 TDM bandwidth. For example, to create a 10 Mbps pipe, seven VT1.5 containers are concatenated, or grouped, together. To create a 100 Mbps pipe, two STS-1 containers are grouped.

The data in each of the Ethernet pipes are transported over separate TDM bandwidths. This means that there is no contention for bandwidth between services that are carried in different pipes. For example, if there is a pipe carrying Internet Protocol (IP) camera data from many sites and a pipe carrying supervisory control and data acquisition (SCADA) information, each service is carried over a separate dedicated bandwidth. Ethernet pipes operate as separate Ethernet networks.

Another advantage of using pipes to segregate the data carried over TDM is that ring network healing due to transport problems such as broken or intermittently failing fibers is performed within 5 milliseconds, regardless of the network size.

PROBLEM

Power system communications networks carry protection, automation, control, and corporate services. These services are a mix of point-to-point and point-to-multipoint circuits. The settings required to support multiple services over a single Ethernet network while also providing the required amount of security between services can make network design very complex.

SEL SOLUTION

Ethernet pipes provide multiple segregated wide-area networks (WANs) over a common SONET transport. WAN segregation isolates data traffic between different services, resulting in improved WAN security and performance. For example, when a pipe is carrying data from multiple streaming devices, such as IP cameras, any congestion or oversubscription effects are limited to data in that pipe and have no effect on data carried in other pipes. Another application would allow IP telephone data to be transported in one pipe at the highest priority setting without interfering with or affecting the highest priority control data in another pipe.

Using SONET transport also allows Ethernet and native TDM to be supported, with each service being carried over a dedicated pipe, as shown in Figure 1.
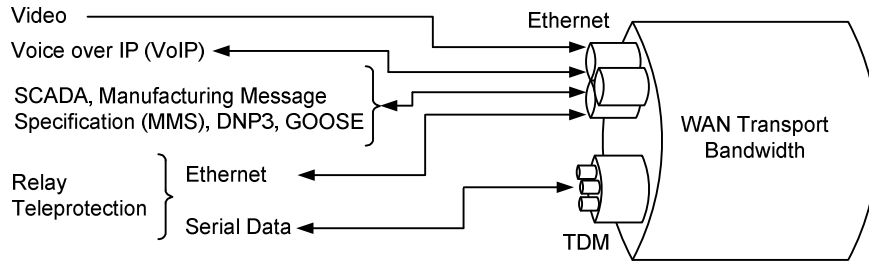
Figure 1   Segregation of Application Traffic Using TDM and Ethernet Pipes

A significant benefit of Ethernet pipes is the containment and isolation from other data traffic of Layer 2 broadcast commands used for control and monitoring, such as IEC 61850 Generic Object-Oriented Substation Event (GOOSE) messages. Pipes isolate these broadcast commands from all other network traffic. Figure 2 illustrates an application of two Ethernet pipes used to segregate corporate services and point-to-point IEC 61850 GOOSE messaging used for control. For simplicity, only traffic between two stations is shown. The 10 Mbps pipe is a direct connection between Stations A and B only; it should be noted that the backup path for this circuit is provided on an alternate path around the ring.
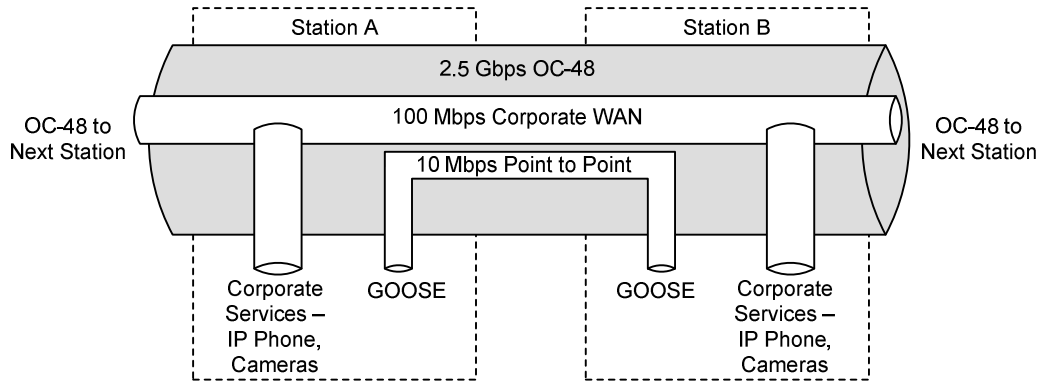
Figure 2   Example of Two Ethernet Pipes Carrying Different and Isolated Services

With the ICON, the following performance advantages of both Ethernet and SONET can be obtained within a single network:

- Deterministic and predictable TDM performance.
- System recovery in 5 milliseconds or less for link failures.
- Corporate and control data isolated using Ethernet pipes.
- Simple Ethernet configuration with the backup path automatically configured.
- Quality of service (QoS) settings for different services on a per-pipe basis.

Ethernet pipes transported over SONET provide the equivalent of multiple discrete networks sharing a single fiber-optic cable pair.