Symmetricom

APPLICATION BRIEF

Preparing Your Network for Synchronous Ethernet

5 Easy Steps to SyncE

- Update existing network synchronization plans to include SyncE
- Assure that synchronization infrastructure equipment supports SyncE ESMC (SSM) requirements and provides PRS traceability
- Assure the new SyncE elements are equipped with redundant synchronization reference ports (G.703, and/or J.211)
- Conduct a sync audit
- Prepare for time distribution requirements

SyncE Benefits

- Assured high customer QoE while migrating from SONET/SDH to Carrier Ethernet
- Synchronize Ethernet nodes at the same performance level as SONET/SDH
- Retain existing clock distribution architectures

As service providers transition to Ethernet based networks to support IP services, they must ensure the synchronization distribution chain is maintained throughout the network. Without effective synchronization, real time applications will at best suffer from degradation and at worst fail completely — giving a quality of experience far from consumer or service provider expectations.

Synchronous Ethernet (SyncE) is one technology that provides frequency synchronization at the same level of quality as existing SONET/SDH networks. It enables operators to migrate to packet networking while retaining backward compatibility with existing clock distribution architectures. SyncE is an evolution of Ethernet that retains the physical layer synchronization characteristics of SONET/SDH and addresses existing and future service provider requirements. It facilitates clock transport over the faster Ethernet link speeds and enables greater efficiency to support next generation services, while minimizing capital investment.

Replacing SONET/SDH

Today, most operators use existing SONET/SDH networks to carry packet protocols using Packet Over SONET/SDH (PoS); this architecture dominates carrier-class transport networks. With increasing demand for faster speeds, greater efficiency, and more diversity of services, this network architecture will evolve to native Ethernet. The main challenge, however, is that from a network synchronization perspective native Ethernet is not backward compatible with SONET/SDH. SyncE solves this problem by allowing the Ethernet to be synchronized at the physical layer using the same oscillator specifications as SDH/SONET. Using SyncE as a replacement path for SONET/SDH allows operators to upgrade their network link by link without the need for a fork-lift upgrade for the SSU clock distribution elements.

How SyncE Works

SyncE, specified by ITU standards G.8261-G.8263, builds on the existing Ethernet standards and is backward compatible with IEEE 802.3. The basic difference between native Ethernet and SyncE is the PHY transmit clock. Today 802.3 requires the transmit clock to have a free-running clock of 100ppm. In SyncE, the transmit clock must be 4.6ppm and must be traceable to a Stratum 1 clock via an external SSU/BITS reference, or via the internal receive clock.

Figure 1 shows the simple difference between native Ethernet and SyncE. By simply enabling the transmit and receive clocks of Ethernet to be linked together with the high specification 4.6ppm oscillator, SyncE can be used interchangeably with SONET/SDH.

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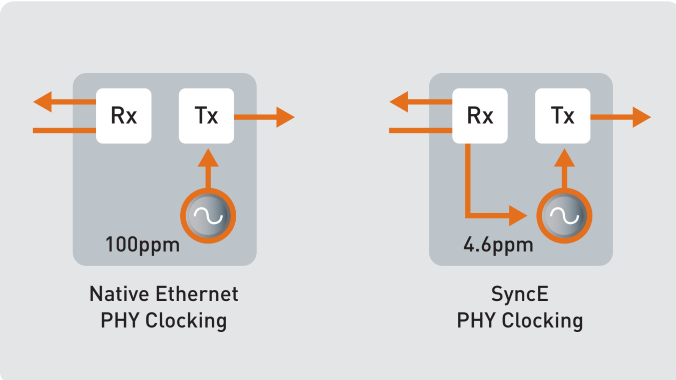

Figure 1: Comparison between the two Ethernet PHYs

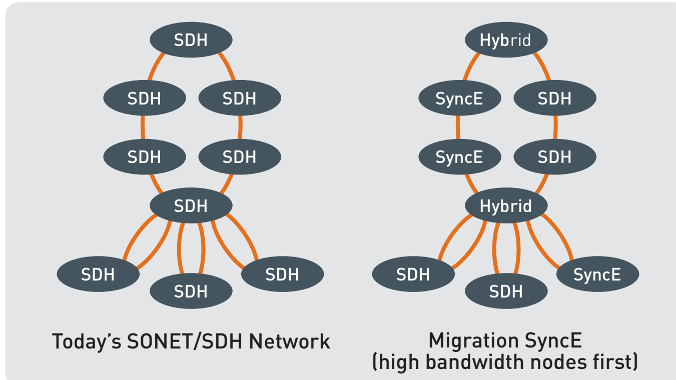

Figure 2: Migration from SONET/SDH to SyncE

This feature is already common in many high-speed Ethernet chips and is currently being engineered into commonly available ADM switches and routers.

With synchronization now a part of Ethernet, the SONET/SDH network can be upgraded on a link-by-link basis driven by the need for more bandwidth. Most first generation SyncE products will be hybrid devices that support both SyncE and SONET/SDH allowing nodes to be replaced gradually and either transmit or receive SyncE or SONET/SDH.

Figure 2 shows how SyncE can be deployed in an existing SONET/SDH network. Over time, SONET/SDH will be replaced by faster, lower-cost SyncE.

Physical layer clock is the most important feature of SyncE, however, it would not be complete without management. ITU standard G.8263 specifies how the Sync Status Messaging (SSM) used in SONET/SDH is to be carried over to SyncE. It uses the existing Ethernet OAM channels on a link-by-link basis to indicate the quality/status of the synchronization. This is known as Ethernet Synchronization Message Channel (ESMC). This encapsulation of SSM ensures backward compatibility with SONET/SDH equipment. In addition, the OAM used in SyncE has been implemented with a TLV (Type Length Value) structure enabling it to also carry future enhanced synchronization status messages. Note that the SSM encapsulation in OAM is only used between network elements. As with SONET/SDH equipment, the synchronization reference interface from the SyncE network element to the SSU/BITS is a standard G.703 interface utilizing existing SSM option II or AIS.

Similar to SONET/SDH, SyncE may not be used as a customer interface. At the edge of the network, SyncE will interface with an access or metro transport technology like PON, DSL, DOCSIS, Wireless, Metro Ethernet, etc. Many of these technologies require synchronization and will use SyncE as their reference clock (PON, Wireless, etc.). For technologies that typically do not carry a physical layer clock, like metro Ethernet, an interworking function in a next generation network SSU will translate the SyncE clock into a packet protocol such as IEEE 1588 (Precision Time Protocol or PTP). The IEEE 1588 (PTP) packets will then be used to tunnel frequency synchronization from the edge of the network to the end application, such as a wireless base station.

As in SONET/SDH, SyncE products need the ability to recover frequency synchronization from the network as well as the ability to be synchronized by a SSU/BITS as shown in Figure 3. In this respect, SyncE follows the same rules as existing SONET/SDH for frequency synchronization making it very easy to deploy using existing best practices and synchronization distribution architectures. Other than ensuring that new SyncE products have a G.703 frequency input (commonly called a BITS port), the only issue an operator needs to consider is if their existing synchronization architecture has been modernized. Without a SONET/SDH migration strategy, operators may have had limited motivation to upgrade or modernize their synchronization architecture but SyncE, along with the requirements from PON, IPTV, QoS measurements and wireless backhaul, creates a strong incentive to modernize that infrastructure. In addition to the new applications and network operation requirements to modernize the existing BITS/SSU platforms, it is important to plan for the next phase of network synchronization that includes advanced management and precise phase and time services.

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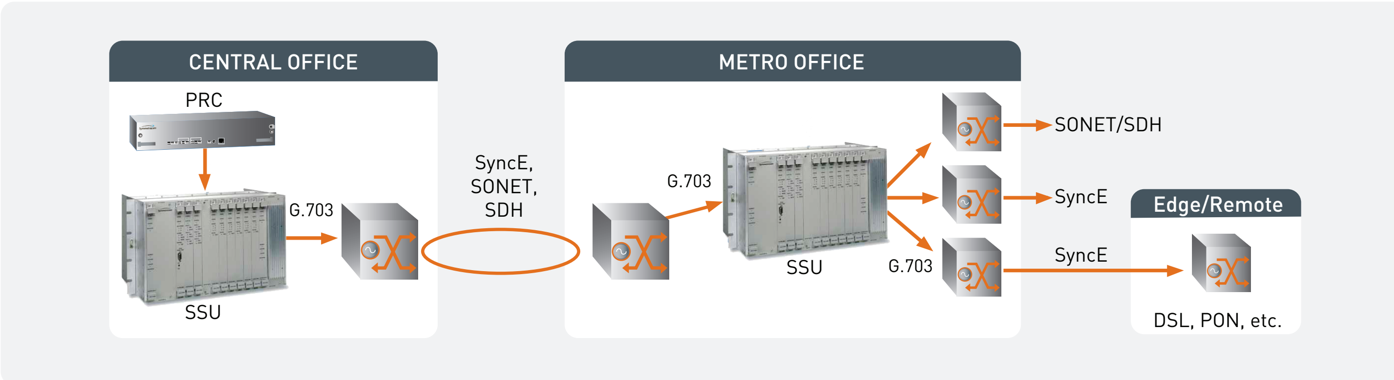

Figure 3: How the existing BITS architecture serves SyncE and legacy

Summary

SyncE, along with IEEE 1588 (PTP), carrier-class NTP and J.211 (DTI/UTI), offers a comprehensive frequency and time synchronization solution to carrier networks. Deploying SyncE allows an upgrade to next generation networks while driving cost out of such implementations. Moreover, SyncE is a simple link-by-link replacement for SONET/SDH that retains backward compatibility and leverages existing synchronization architecture to cost-effectively enable current and next generation services such as IP-based video services.

SyncE Minimum Requirements

- T1/E1 BITS Interface on NEs
- Reliable BITS/SSU infrastructure
- Assurance of PRS traceable synchronization

SyncE Recommended Requirements

- T1/E1 and NGN BITS Interfaces on NEs
- Reliable BITS/SSU infrastructure with:
  - SSM Option II on T1/E1 interfaces
  - ESMC enabled on the NE
  - SNMP Management System
  - NGN Interfaces or NGN Ready

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