

Network Synchronization of Metro and Access Layers with Node Clocks



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Introduction

Synchronization is a mission-critical infrastructure technology for telecommunications networks. Within a telecommunications network, synchronization networks are deployed and maintained separate from the traffic-carrying switching and transmission network. This is very similar to the way signaling networks are deployed.

The synchronization network is critical for the operation of switching and transmission systems. If the synchronization network begins to degrade, Quality of Service (QoS) problems including bit errors, garbled text, static and frozen video frames will occur. Without synchronization, switching and transmission systems will fail. Therefore, it is extremely important that the planning, design, and deployment of the synchronization network is tightly coupled to, and evolves with, the switching and transmission network. Over the past two decades, this pattern of the synchronization network following the evolution of the switching and transmission network has occurred.

The advent of digital communications in the late 1970's brought significant changes in the telecommunications industry. New concepts, like the Building Integrated Timing Supply (BITS) and Stand Alone Synchronization Equipment (SASE), were developed to address the emerging synchronization needs of the digital network. As network topologies, applications, and services of the 80's and 90's evolved, so did synchronization. The hieratical nature of the synchronization network was flattened through the deployment of synchronization equipment in all network core or backbone offices.

Core and long haul offices have hundreds of switching and transmission network elements and handle large amounts of network traffic. Large "mainframe" synchronization products were designed and deployed to meet the specific needs of the core and long haul offices.

Mainframe synchronization systems include master distribution shelves with hundreds of outputs and expandability through slave and/or remote shelves, very high quality holdover clocks, full system redundancy, and separate Primary Reference Source (PRS) systems (for added reliability). Mainframe synchronization is easily justified economically for core and long haul offices since they have hundreds of thousands, if not millions, of dollars of switching and transmission equipment. However, the proliferation of light-speed data, broadband multimedia, wireless 2.5/3G, and circuit-to-packet convergence is rapidly driving the need for high quality synchronization outside the network core and long haul into the metro and access offices.

Technical requirements for synchronization at metro/access offices are no different than core and long haul offices. However, metro/access offices have different economic requirements because they have far fewer network elements. Table 1 illustrates the main similarities and differences between the synchronization needs of core and long haul offices versus metro/access offices.

Mainframe synchronization systems are simply too expensive to deploy in these offices. A new type of synchronization system is required to address the unique timing needs of the network edge. Enter the node clock.

What is a Node Clock?

A node clock provides the key synchronization functionality of a mainframe synchronization system in a single compact and economical package for metro/access office requirements. A node clock must provide all the timing features required for a metro/access office including:

- Integrated PRS functionality
- Distribution of multiple types of synchronization signals
- Holdover in case of loss of timing inputs
- Redundancy for inputs, clocks and power
- Output protection
- Retiming of incoming signals
- Time of Day (TOD) outputs

Node clocks must meet established core/long haul central office synchronization standards including NEBS, CE, ANSI, ETSI and Telcordia requirements. Node clocks must be fully intelligent and manageable from remote, centralized centers. Node clocks must be cost effective for deployment at offices with few network elements. Node clocks must be compact enough to fit in Controlled Environmental Vault's (CEVs) and cabinets. Table 2 summarizes the feature set requirements of a node clock.

	Core/Long Haul Office	Metro/Access Office
Number of Outputs	Hundreds	2-64
Holdover Oscillator	Rubidium	Quartz
Physical Size Constraints	Of little concern	Very tight
Price Point	\$50k and up	\$20k and lower
Intelligence/Management	Yes	Yes
Performance/Standards	ITU, ETSI, ANSI, Telcordia	ITU, ETSI, ANSI, Telcordia
Integrated PRS	No	Yes
Synchronization Output Types	T1, 1.544 MHz, E1, 2.048 MHz, CCK, 8 KHz	T1, 1.544 MHz E1, 2.048 MHz, CCK, 8 KHz
Retiming	Yes	Yes
Time of Day Outputs	Yes	Yes

TABLE 1

Node Clock Feature Set

- Full SASE/BITS functionality
- Exceeds all established PRS and SASE/BITS standards
- Economical for metro and access office deployment
- Compact in size (4 RU or less)
- Fully intelligent and manageable

TABLE 2

Node clocks can receive multiple timing references and select one as the active reference, attenuate jitter and wander on the incoming reference, and create a number of stable output signals and distribute them to the switching and transmission equipment in the office. In the event that all references to the node clock fail, the node clock must be capable of maintaining operation within PRS and SASE/BITS standards requirements by entering into holdover operation. A node clock can be configured either as a master or slave. A master node clock includes an integrated Primary Reference Source (PRS) while a slave node clock receives its timing reference(s) from a higher stratum clock.

Node Clock Types

Node clocks configured for PRS operation must meet the applicable PRS clock specifications provided in Telcordia GR 2830 and ITU-T G.811. Node clocks configured for SASE/BITS operation must meet applicable SASE/BITS clock specifications provided in Telcordia GR 1244 and ITU-T G.812. Slave clock "types" are specified in G.812. Node clocks must comply with G.812 Type I and III.

The Type I node clock can be used at all levels of the synchronization hierarchy in E1 (2048 kbit/s) networks. Type I node clocks can also be deployed in T1 (1544 kbit/s) networks as long as noise generation, noise tolerance and transient behavior comply with the more stringent requirements stated in ITU-T G.813 option 1.

The Type III node clock has a less stringent holdover stability requirement than Type I. It is typically deployed in end offices in T1 networks. However, a Type III node clock may also be deployed in E1 networks as long as its noise generation, noise tolerance and transient behavior comply with the more stringent requirements stated in ITU-T G.813 option 1.

Node Clock Applications

Until recently, economics and a lack of application drivers severely limited the use of synchronization systems in metro and access offices. These offices were synchronized via a core/long haul office or not at all. This

arrangement is no longer acceptable due to several market drivers including Circuit to Packet (C2P) network convergence, 2.5/3G wireless deployments, and multimedia broadband. These rapidly growing applications require high quality synchronization at the network edge. Node clocks are designed specifically for use in access applications where real estate is prime and cost must be kept low. As illustrated in Figure 1, core and long haul offices require a full PRS and SASE/BITS system. Intersection points from the core to the access arena also require a full PRS and SASE/BITS system. The node clock fills the current gap in affordable synchronization for metro and access offices.

Synchronization for wireless networks is shown in figure 2. The Mobile Switching Center (MSC) requires a PRS and SASE/BITS system. Node clocks are sized for Base Station Controller (BSC) and Radio Network Controller (RNC) sites. Unique to wireless networks is the use of OEM synchronization modules at the Base Transceiver Station (BTS).

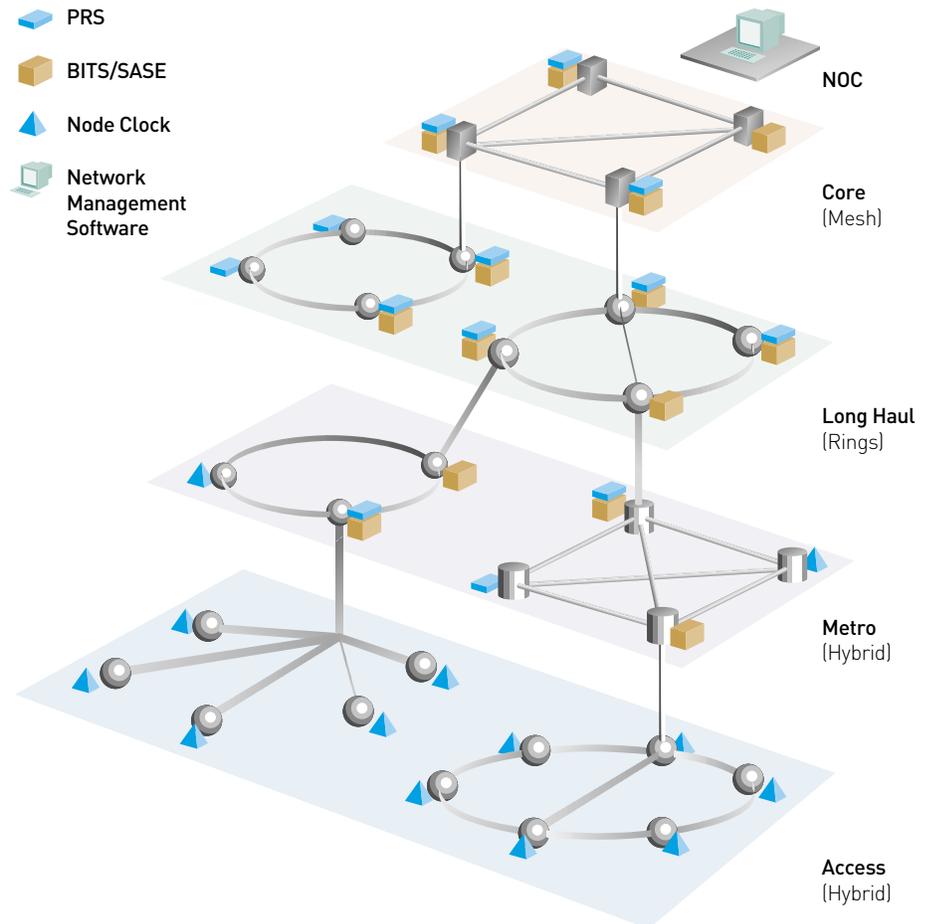


FIG.1 Wireline synchronization network

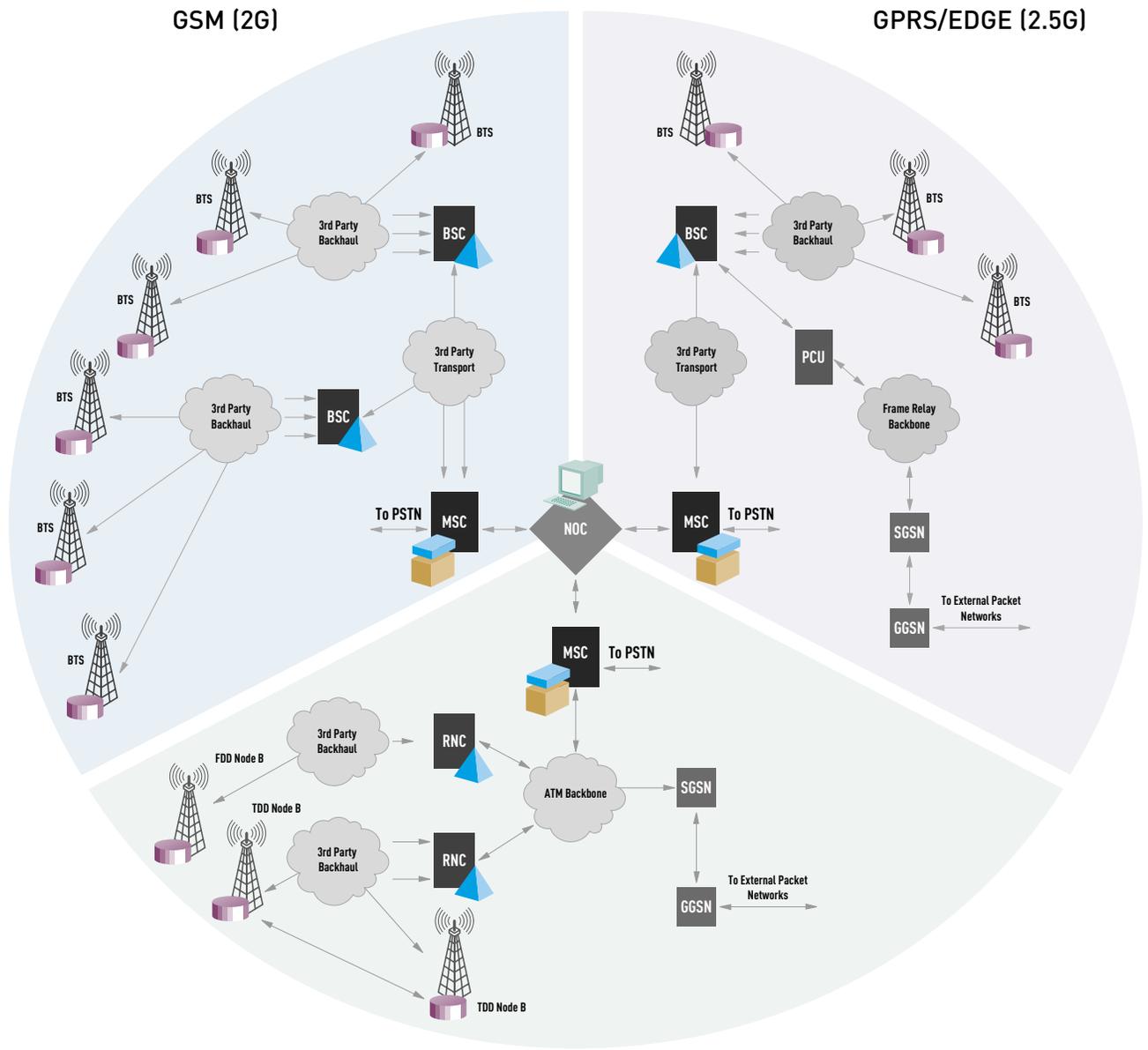


FIG.2 Wireless synchronization network

TimeProvider – The World’s First Node Clock
 TimeProvider™ is Symmetricom’s new node clock product solution. It is innovative, intelligent, flexible, and affordable.

Innovative

TimeProvider is the first product to combine the tasks of the input, clock and output cards onto a single universal Input, Output, and Clock (IOC) card.

The IOC card:

- Tracks incoming timing references
- Filters and distributes precise timing
- Provides holdover when all input timing signals are lost or unusable
- Monitors timing references

A second IOC card can be added to provide full 1:1 input and clock redundancy and output protection. TimeProvider’s unique and innovative node clock architecture is shown in Figure 3.

The IOCs accept E1, 2.048 MHz, T1 and Composite Clock (CCK) inputs and provide E1, 2.048 MHz, T1 and CCK outputs.

Intelligent

Consistent with Symmetricom’s SmartSync message, the TimeProvider is intelligent and readily manageable. Provisioning and managing TimeProvider is performed via the

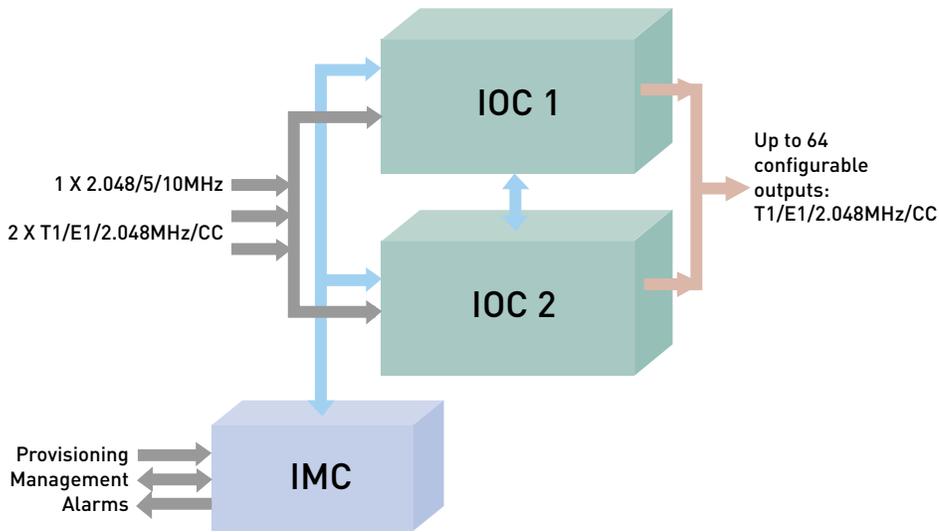


FIG.3 TimeProvider block diagram

Information Management Card (IMC). The IMC collects status information from the IOC cards in addition to collecting and processing the signal alarms. This information is then provided to the network management system and/or craft provisioning software.

Flexible

The three cards are housed in a 4 RU (front access) shelf or a 3 RU (rear access) that provides up to 32 outputs. 32 additional outputs can be optionally provided via a 2 RU expansion panel. That's all there is to it. This simple and affordable system provides full node clock functionality for any wire line or wireless metro/access office.

Conclusion

Through the advent of node clock products, service providers worldwide can deploy carrier-class synchronization at their metro/access offices at significantly lower costs. Each office can now have an independent timing reference providing a more stable, robust and reliable network. This capability is vital for enabling C2P network convergence and providing high-speed services, wireless 2.5/3G, and broadband multimedia to the network edge and customer premise.

About Symmetricom

Symmetricom designs, manufactures and markets timing and frequency solutions for telecommunications, computer networks, satellite systems, and test and measurement applications. Symmetricom is the only company in the world that supplies the full range of timing technologies. We constantly strive to help our customers find such innovative solutions with our comprehensive portfolio of products. For more information, visit our web site at www.symmetricom.com.



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