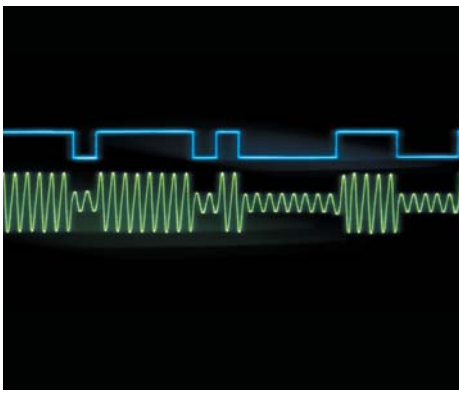
Symmetricom

Symmetricom Equips Brazil's Largest Utility with Advanced Time and Frequency Synchronization



CASE STUDY

Symmetricom Equips Brazil's Largest Utility with Advanced Time and Frequency Synchronization

A power company needs centralized time and frequency synchronization for power generation and distribution as well as for internal telecom and data network services. Symmetricom delivers.

Brazil is the world's 10th largest electricity consumer and Furnas Centrais Elétricas S.A. is Brazil's largest utility. With 9290 megawatts of installed capacity, Furnas serves 51% of Brazil's homes and a region responsible for $870 billion worth of its gross domestic product. As both a power producer and distributor, the Furnas system consists of 10 hydroelectric plants, two thermoelectric plants, 46 substations and 19,000 kilometers (11,806 miles) of transmission lines covering most of Brazil's South, Southeast and Center-West Regions, as well as the Federal District. By 2012, Furnas plans to bring an additional seven plants on line.

Furnas is also a leader in another respect. It is the first utility in Latin America to fully integrate all time and frequency synchronization across its entire business on a single technology solution — one provided by Symmetricom.

Precise time and frequency synchronization is vital to making and distributing electricity. Generators that produce alternating current must remain constantly in phase. Protection relays must also be precisely synchronized so they can — in an instant — isolate sections of the grid if outages occur. Systems that bill customers must be both accurate and reliable. Forensic analysis requires a common time index to trace the sequence of events in multiple locations that have lead to a failure. Line fault detection — measuring the time it takes for an electronic pulse to "bounce back" from a fault — also calls for precise timing.

But producing and distributing electricity is not the only reason a utility like Furnas needs widely distributed and precise timing sychronization. Like many large firms it also operates its own telecom and data networks, which in Furnas's case serves over 4200 employees. Those networks also require sychronization. Telecom switches, for example, rely on E1 synchronization signals to multiplex calls over a common transmission line. Data networks rely on NTP (Network Time Protocol) to ensure precise synchronization of networking elements.

In trying to serve three different timing applications — power, telecom and data — Furnas faced a problem common to many large utilities: incompatible systems with overlapping functionality and no centralized management. Over many years, Furnas had implemented different vendors' timing systems incrementally and independently at different sites. This caused significant added expense while making systems less reliable and at the same time more difficult to maintain. To repair equipment, technicians might travel long distances only to arrive without the needed spares — both because remote management was absent and because maintaining equipment from several different vendors required different types of spares.

Now, Furnas faces more severe timing demands with the deployment of intelligent electronic devices (IEDs), phasor measurement units (to align power cycles), and synchronized load management systems, among other new requirements. But meeting these new requirements also presented an opportunity. Working with Symmetricom, its partner of over eight years, Furnas would implement an integrated and centrally managed solution to meet all its timing needs.

A Single Solution for Everything

"Our challenge to Symmetricom," says project director Ronaldo Santarem, "was to meet the varied timing requirements of all the different locations, systems and applications with a single solution based on interoperable components and shared time sources — and to have it all managed from a single remote workstation." Some of those timing requirements are listed in Table 1. Furnas also wished to eliminate unneeded redundancy, such as separate GPS antennae for each application. Finally, the solution must not only support GPS, but also Galileo when available. Furnas called this concept of an all-in-one solution the Site Master Clock (SMC).

Each site, such as a generating plant or a substation, has its own particular timing requirements. So even though all SMCs are built from a common product set, some products might not be included at a particular site or products might be configured differently. Despite such differences, a common parts inventory would make spares management much easier than in the past. As shown in Figure 1, Symmetricom designed an SMC as consisting of:

- **XLi Time and Frequency System** — Produces IRIG and 1PPS for electric power applications, as well as NTP as a failsafe backup to the primary NTP server (S250i SyncServer). IRIG is also a backup timing source to other SMC components. The XLi receives Coordinated Universal Time (UTC) directly from GPS.
- **TimeSource 3100/3600** — Generates E1 signals for telecom applications and also serves as a backup timing source (1PPS for the S250i SyncServer and 10MHz for the XLi). Also provides NTP and 1PPS as SyncServer and XLi failsafe backups, respectively. The TimeSource receives UTC directly from GPS.
- **S250i SyncServer** — Produces NTP for both the enterprise network and the operational (command and control) network. Isolated NTP ports ensure traffic is securely separated between the two networks. The SyncServer also generates IRIG, 1PPS, and 10MHz, providing automatic failover for other SMC components and also backup timing sources for them. The SyncServer is synchronized to UTC via either the XLI or the TimeSource.
- **TimePictra** — Provides visibility of all other SMC components at all sites from a single workstation via TCP/IP. A rich web based interface (for the remote client) and HP OpenView® (for the central server) allows fully functional interactive maps, color-coded conditions and icons. Drill down functionality enables clear visibility into the synchronization status. Carrier-class synchronization management software provides comprehensive monitoring and control across multiple types of network elements.

A key consideration was holdover performance in case GPS is lost — a requirement satisfied by using highly accurate OCXOs

(ovenized crystal oscillators) in the remotely deployed elements. Human operators can easily monitor the current time, which is clearly displayed on Symmetricom ND-4 four-inch digital clocks that reference NTP over the existing Ethernet infrastructure.

A key benefit of this modular integrated approach, says Santarem, is its inherent scalability. "Adding sites and functionality to a centralized solution is more feasible and economical than implementing many solutions with dedicated Ethernet interfaces, management systems and communication protocols. Further investment at a site is now limited to firmware upgrades and additions of modules to support new interfaces. The end result is a more cost effective means to distribute time throughout the Furnas network, while preserving technology independence, interoperability and, most importantly, reliability."

Application	Measurement	Optimum Accuracy	Signal Required
Fault Locator	300 m	< 1µs	IRIG
Relaying (line protection)	1000 m	3 µs	IRIG
Phasor Measurement	+/- 0.1 degree	< 4.6 µs	IRIG
Networked Controls	+/- 0.1 degree	4.6 µs	IRIG
Stability Controls	+/- 1 degree	46 µs	IRIG
Event Recording	Record compare	1 ms	IRIG
Generation Control (AGC)	Freq, time error	10 ms	IRIG
Telecommunications	2 MHz / 2 Mbps	1x10-11	E1
Local Area Network	Time Offset	< 1sec	NTP

TABLE 1 Synchronization requirements for the Site Master Clock vary widely depending on the application.

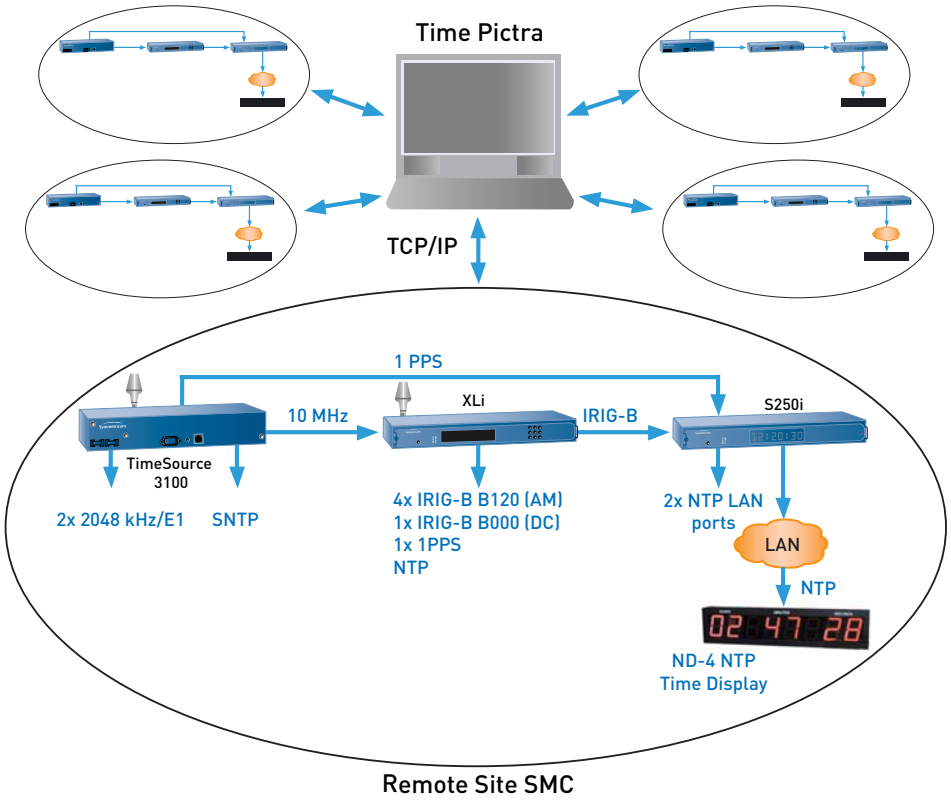


FIGURE 1 The Site Master Clock is based on a common set of interoperable products with shared time sources.

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