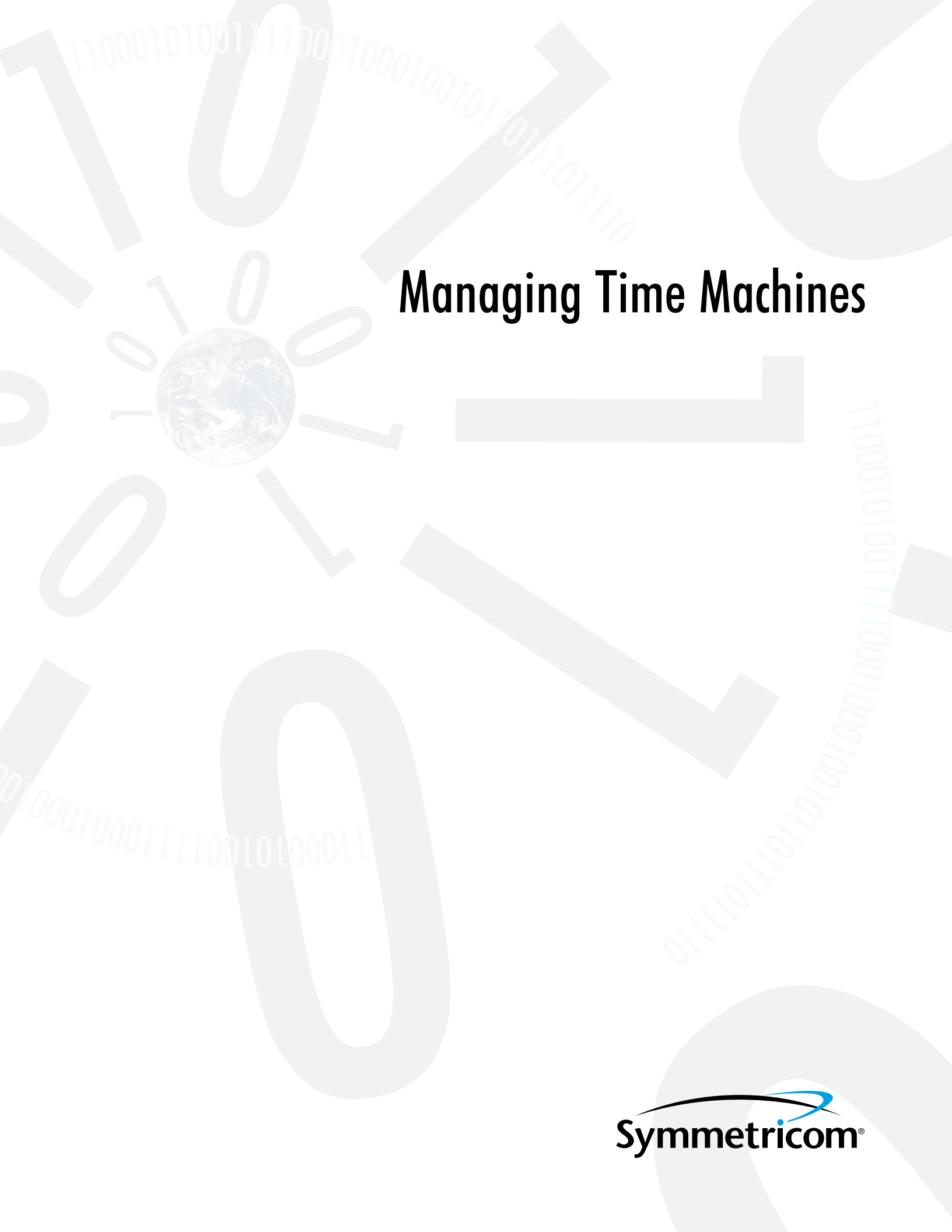
Managing Time Machines



Symmetricom®

Synchronization Network Elements

Historically, synchronization and timing equipment have been left unmanaged in the network. Primary Reference Sources (PRSs), Synchronization Supply Units (SSUs) or other synchronization equipment have been installed in central offices and exchanges and verified for proper operations through local "craft" terminal software. These units are then left to work relatively free from monitoring. Typically, hot alarm connections (or dry contacts) are used to take major or minor alarms into an alarm center or network operations center (NOC). These alarms indicate when a failure has occurred in these network elements.

Robust engineering and redundant design of synchronization equipment has ensured that this strategy worked satisfactorily in the past, when synchronization was organized in a more centralized scheme. Total system failures of synchronization equipment have been rare and the impact from such failures has been low.

The Telecom Industry Today

The telecommunications market is rapidly evolving. With the recent trends of convergence, telecom reform, fragmentation and re-alignment in the industry, the only constant that has emerged is that only those service and solution providers who deliver value to their customers and can collect on this delivered value will be the winners over the long haul. Competition is a reality, and the distinctions amongst PTTs, RBOCs, IXCs and wireless service providers are fast getting blurred.

Providers are focusing on providing their customers with high quality differentiated services. Quality of service, therefore, has become a key competitive advantage.

Increased business pressures from the market place have resulted in a mosaic of network providers who compete in particular businesses, but cooperate in others, leading to a more decentralized organization for synchronization. Providers are forced to inter-operate with one another through market and regulatory pressures. The economic reality of the telecom industry has also triggered a lot of merger and acquisition activity. The result has been service providers with infrastructure from different service providers, and in need of an intelligent system that gives them full visibility into their network.

These changes have also put pressure on the synchronization experts. Network complexity grows exponentially with any network expansion. Networks have evolved from a tree topology (PDH), to ring (SONET/SDH)

into mesh (DWDM) and now hybrid topologies. Instead of adding experts to keep pace with this growth in size and complexity, service providers are looking to leverage the expertise they have and operate in a cost-effective, efficient manner.

The case for intelligent network elements

The traditional strategy of leaving the synchronization elements unmanaged with just "alarm taps" is becoming increasingly risky. Leaving network resources unmanaged is a recipe for failure; it will only take one massive network failure to elicit focus on this problem, albeit a reactive one. The potential damage from synchronization failure or degradation is growing with rapid growth in digital data traffic. Technologies such as SONET/SDH and ATM have stringent synchronization requirements. There is an underlying assumption that all synchronization elements provide signals of high quality. Without proper visibility into and monitoring of the elements that provide this synchronization, it is difficult to prove this is true.

The changing competitive landscape in the telecom industry requires providers to be equipped with proof from performance metrics—which requires a sophisticated management system.

Problems with synchronization can have subtle, yet significant, impact on network performance and utilization efficiencies. Minimizing the diagnosis and resolution time for network problems is key to supporting SLAs to the end-customers. Eliminating synchronization as a cause of network degradation (through the use of detailed data from a sophisticated network management system) can be critical in determining the true source of such degradation.

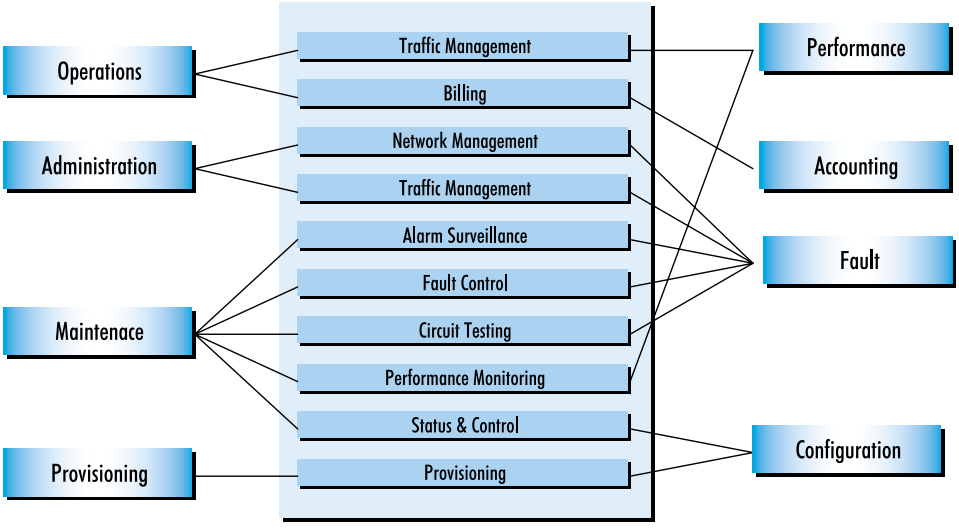


Figure 1: OAM&P and its relation to FCAPS

Moreover, a sophisticated management system provides operational efficiencies that result in significant cost savings and improvements in quality of service.

Timing Signal Generators (TSGs) and SSUs are logical points that provide synchronization throughout the network. Therefore a management system on these systems is well positioned to monitor the various interfaces and determine the health of other equipment, including slave clocks in other network elements.

Transmission and switching equipment, such as SONET/SDH and ATM network elements come with well-integrated management systems. These systems provide intelligence and remote visibility into these elements, and are critical to delivering high quality of service to the end customer. To keep this strategy consistent, it is necessary to add the same level of intelligence to the synchronization elements. Remote visibility, analysis and control are key to rapidly realizing revenue on the deployed systems, as well as containing costs through efficiencies and simplification of internal processes.

The key features of a management system are fault handling, configuration control, network inventory management, performance monitoring, and security (FCAPS), a framework laid down by the ITU. However, in today's business environment, this is necessary but not sufficient. Carrier-class management system's should be scalable (to accommodate a providers' growing network infrastructure), adaptable (to accommodate additions and modifications to its functionality), vendor agnostic (or be able to manage equipment from multiple vendors), easily usable (GUI interfaces with intuitive graphical representation of data) and have interfaces that interoperate with other management systems.

Detailed fault and alarm information (not just hot-linked alarms) enable the rapid identification of synchronization impairments. For example, when an input reference fails in a managed synchronization network the SSU element raises an alarm indicating failure of the reference as well as the cause of failure—i.e. loss of signal or an off-frequency condition. This information can now by used by the network operator. Often, reference failures are caused by an office up-stream (with respect to the sync trail). Connectivity maps (provided by the management system itself), could then be used to trace this source, determine the cause of the problem from that element and ultimately resolve it. For a detailed map of operational functions, and how they can be mapped into the traditional network management features (FCAPS), refer to Figure 1.

Remote access (leveraging Internet based web technologies) can enable network operators support far-flung offices where expertise may not be present at the time critical decisions and/or action is needed. Such access

leverages the limited number of synchronization experts to keep the entire network running smoothly. Problems can be isolated quickly, and remote trouble shooting keeps down maintenance costs as well as drastically slashes the "windshield" time spent by these experts traveling to sites to determine problems.

Provisioning systems become automatic with management systems in place. Management systems record a "snap-shot" of the system's state. After a power failure or hardware (card) replacement, the management system can automatically revert the system to operate from its saved snap-shot. Down time is minimized, operational effort reduced and the need for personnel to be on-site to re-configure the system is eliminated. These advantages will produce significant cost savings to the provider.

Equipment repairs and inventory management are made simpler with new network management systems. For instance, when equipment is added to the network, it identifies itself as well as registers its cards to the management system—eliminating error-prone and costly mistakes in manual data entry. For example, if a card in a PRS system needs replacement, a management system with configuration management will be able to determine remotely and accurately the exact card type to be changed. Any personnel dispatched to fix the problem can be equipped with the correct equipment and replacement parts. This will eliminate the need to carry redundant equipment or make multiple trips to fix the problem—reducing time and costs, as well as increasing the efficacy and productivity of the operations support personnel.

Managing with TimePictra™

To address the evolving needs of the telecom industry and to apply efficient management methods to the synchronization part of the network, Symmetricom, Inc. developed the TimePictra platform. TimePictra is based on the collective learning and experiences gathered from OSMF™ (an HP product acquired by Symmetricom with its acquisition of the CommSync Division of HP) and TimeScan NMS™, Symmetricom's original network management system. These two platforms bring a combined experience base of more than ten years, and deployments that number in the hundreds, with major telecom service providers across the world. The result has been a best-of-breed carrier class web-based solution, which is scalable, adaptable and extensible, in addition to providing a rich set of features and functionality.

TimePictra is built on a modular, stable architecture. Using the communication industry's standard software platform—HP OpenView®. It offers a scalable technology, which has been tested to withstand simultaneous management of more than 1500 network elements, through X-windows (HP OpenView)

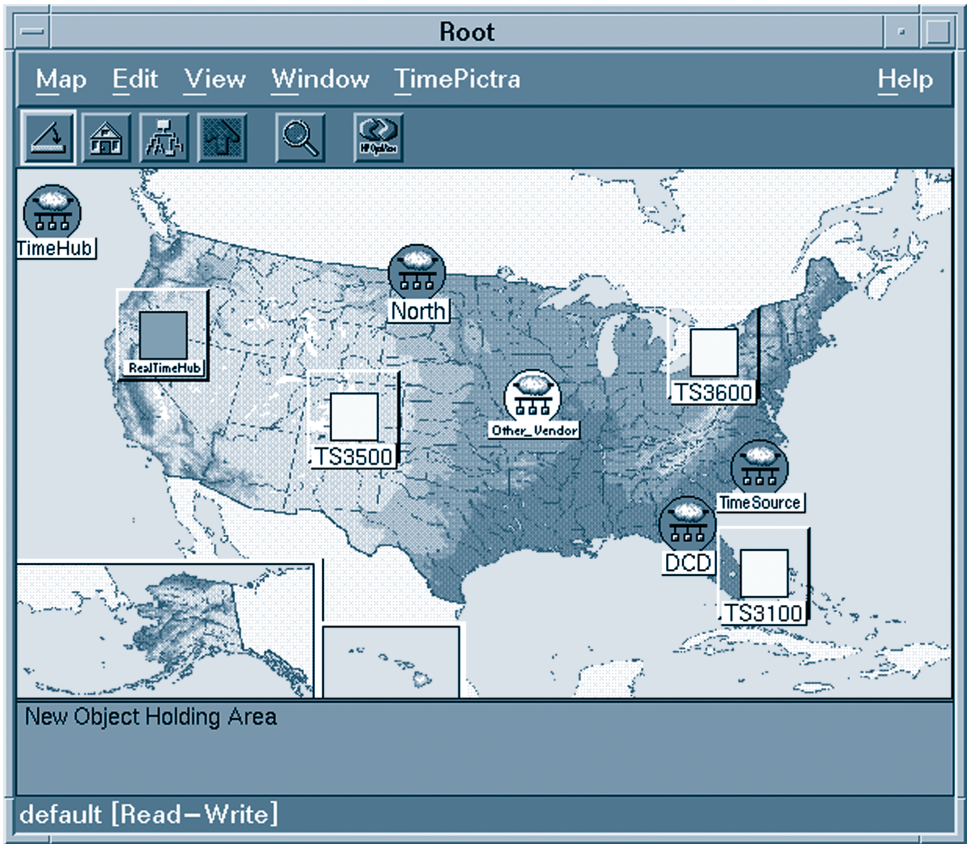


Figure 2: TimePictra's map oriented GUI

as well as web-browser based interfaces (see Figure 2). The HP-UX platform, and indeed UNIX platforms have proven to be stable, feature-rich, scalable and secure platforms suitable for carrier class and enterprise class applications. In addition, such platforms enable resiliency or fail-over features to be implemented, allowing applications to remain running smoothly regardless of equipment failures.

Value-added features and functionality that goes beyond offer of basic FCAPS, makes TimePictra™ the world's premier network management system for synchronization element management.

Fault management includes detailed alarm viewing, color-coded representation of the fault condition on a hierarchical map-based interface, and full logging of all alarms and events.

Configuration capabilities allow settings to the unit and port level. Remote firmware downloads are possible to update network elements.

Inventory control or accounting can be used to track network elements and the number of ports available—aiding network planners as well as help planning capacity. Symmetricom's new intelligent network elements, such as the TimeHub 5500, identify themselves to TimePictra™, and are automatically populated in the database—there is no need for error-prone manual data entry. The inventory control system can be used to track legacy equipment.

In any sync equipment, it is important to track performance data such as MTIE, TDEV, Variance etc. These readings provide a clear indication of deteriorating synchronization and impending problems, enabling operational personnel and sync experts to be pro-active. TimePictra™ provides analysis capabilities along with industry standard masks and overlays. Detailed analysis capabilities are provided through the analysis option (see Error! Reference source not found.), which takes accurate real-time data and provides a platform for more detailed graphical representation, including the ability to zoom into sections of the data. Statistical analysis can be applied to this data. In essence, this capability can transform the sync network into a real-time test and measurement system and aid in-depth trouble-shooting when necessary.

Security in TimePictra goes well beyond simple password based access control. The system allows sub-division into domains and a multi-class access control system in each of these domains. In addition, certain configuration

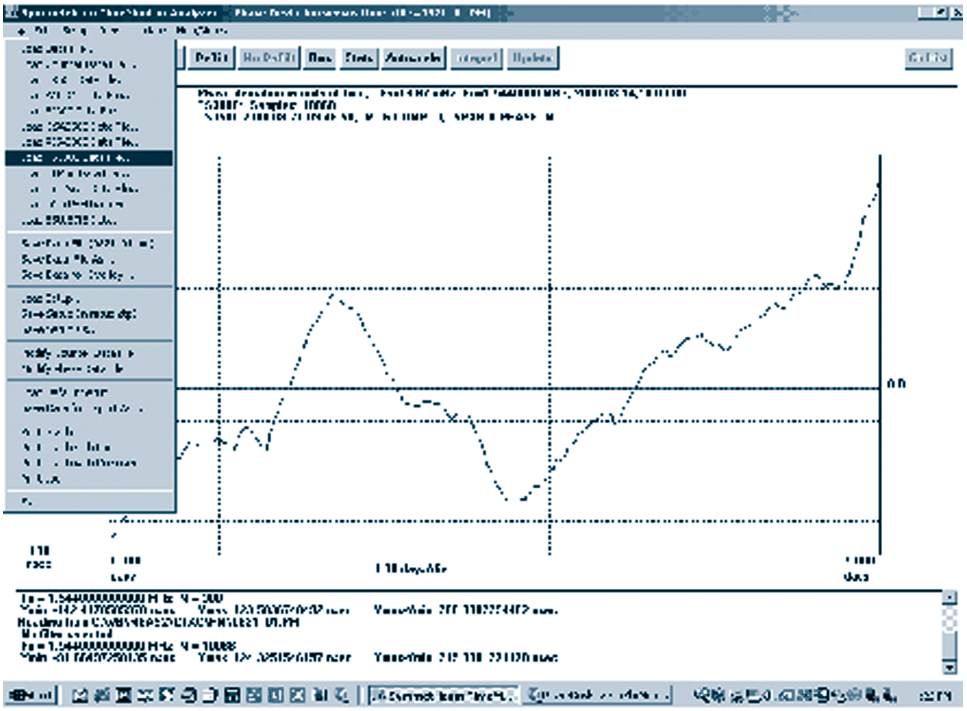


Figure 3: Sample screen from TimePictra's Analyzer option

commands can be restricted to certain classes of users. A sophisticated system such as this enables an enterprise to manage its entire synchronization network and keep it dynamic.

Depending on the nature of the customer's infrastructure, back-end systems, databases and other applications may need to be linked into TimePictra, to form part of a complete network management solution for the end-customer. Symmetricom's in-house development of TimePictra equips the customer with the expertise for such integration.

One of the key benefits that TimePictra delivers is the ability to automate regularly performed operational tasks. Alerts can be configured to trigger at levels set by the customer. These can be then linked to the "auto-action" module, which consists of a pre-determined set of actions to remedy the conditions which triggered the alarm. So, not only do alarms coming into the operations centers identify problems and equipment that these problems are associated with, but also afford the opportunity take pro-active action to correct them before human eyes see these problems. Supplemental remedial action (such as sending replacement parts to the central office concerned) can be taken when desired.

Conclusion

In the quest for quicker realization of equipment investment and greater operational effectiveness, TimePictra, coupled with Symmetricom's intelligent sync network elements proves an invaluable tool.

Deployed synchronization equipment can be controlled, monitored and utilized in ways that were not possible before. Service quality can improve. Cycles of synchronization element down times can be shortened and investments in the equipment can be realized quicker.

Synchronization experts become more effective with a tool that delivers information in a clear, useful manner. Some learning can be encapsulated and transformed into automated remedial action through automatic scripts using the Auto-Action feature. This level of visibility, consolidation of operations and the rapid turn-around on problems allow significant cost savings.

A sophisticated and automated inventory control system, as well as the tracking and recording of sync trails, allow explicit tracking of inventory and management of hidden costs. Legacy equipment can also be tracked and managed.

A growing network may have equipment from more than one vendor.

TimePictra's multi-vendor management capabilities, coupled with its modular architecture, ensure that the entire synchronization network can be managed with a high-quality carrier class network management system.

TimePictra's carrier class status ensures a sophisticated security system. In addition to regular data archiving and utilities available with any UNIX-based system, options exist for adding fail-over resiliency through the use of dual-server system.

Symmetricom has invested in an in-house software development team to develop TimePictra. The result is a responsive team supporting a modular system that is rapidly adaptable and fits into the operational modes of Symmetricom's customers.

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