SYSCON 2000
AND
THE DESA DATA RELAY SYSTEM

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ABSTRACT

The Defense Evaluation Support Activity (DESA) is an independent Office of the Secretary of Defense (OSD) activity that provides tailored evaluation support to government organizations. DESA provides quick-response support capabilities and performs activities ranging from studies to large-scale field activities that include deployment, instrumentation, site setup, event execution, analysis and report writing. As the applications of computer systems has dramatically increased in recent year a corresponding increased has ocurred in the data processing needs of test orgznization. One client in particular wanted the realtime ability to track the performance of a country-wide communications system. Commercially developed networking software and hardware were employed to facilitate this requirement. To enhance DESA's off range test support capability a DESA system named SYSCON 2000 has been under steady development for the last five years. In particular the ability to use multiple voice grade telephone lines to create a wideband data channel from almost anywhere has been developed and refined. Link flexibility has been enhanced by the use of dedicated, COTS RF spread-spectrum links, cellular telephones, and other transmission media. The current version of SYSCON 2000 supports test director virtual presence via live data displays and video teleconferencing capability.

KEY WORDS

Image Relay, Data Relay, COTS, DESA, LAN, WAN, Video Teleconferencing

INTRODUCTION

The Defense Evaluation Support Activity (DESA) is an independent Office of the Secretary of Defense (OSD) activity that provides evaluation support to government organizations. Chartered in 1990 to support joint test programs, the Activity now sustains a variety of projects not supported by more traditional ranges or test centers. DESA efforts focus on quick turnaround support of short-term projects and maximum use of commercial-off-the-shelf (COTS) technologies. This focus provides quick-response support capabilities flexible enough to allow DESA to perform activities ranging from studies to large-scale field activities that include test design, deployment, instrumentation, site setup, event execution, analysis and report writing. It was this approach to solving test related problems that led to the first request for support that led to the SYSCON 2000 system.

THE SYSCON 2000 DESIGN EVOLUTION

In 1992 a DESA test program required that large amounts of digital test data be collected simultaneously at a number of locations over a very widely dispersed area. Once collected, this data was to be transferred to a central location in near-real-time for in-progress analysis. Since these tests were to be conducted continuously over a period of several weeks, a cost effective solution was needed. In-house projects employing commercial networking technology offered a ready solution. This first effort met all test data collection goals: an aggregate 100 kbps data transfer rate, 100% data reliability, and data lag times of less than 10 seconds. The system also provided automatic data archiving and remote test site reconfiguration. The system used standard telephone lines, so no special communications links were needed.

This basic capability was expanded to meet more demanding requirements over the following two years. Data rates were improved, error correction processes were automated, and equipment installation and removal procedures were streamlined. As technology improved, equipment was replaced with easier to use, higher performance gear. A number of data relay technologies were tried, and refinements made to best improve the overall system. Portability concerns had been an issue from the start, and as commercial demands for the “mobile” office grew, the resulting technology was incorporated. Other projects began to use the basic concepts of this system, and a number of variants were used to meet DESA’s diverse client needs.

CURRENT SYSCON CAPABILITIES

The current iteration of the SYSCON 2000 system is based on a modular design that can be tailored to meet a wide range of test requirements. Each module is designed around a collection of off-the-shelf technologies that provide a range of performance and

compatibility that can be chosen to best match the data collection and management requirements of a particular test program. The basic modules support the processes of data collection, data transfer, test management, and records archive.

Data collection requirements in the field typically cover a wide range of technical capabilities. Most data collection is supported by personal computers (PCs) with a number of interface options. The most common interfaces are to analog signals and digital serial data. One of the desirable features of using a PC for these interfaces is the large variety of interface "adapters" available. Multi-channel analog measurements taken at hundreds of thousands of samples per second are common, and can be made using a wide variety of vendors products. These measureements can easily be made "smart" through the use of COTS control software. Hundreds of channels can be supported by a single PC, and PCs can be combined on a local area network to provide an almost unlimited number of analog channel measurements. Data from digital sensors, typically provided in a serial data stream at rates up to 115kbps, can likewise be collected via PCs and combined using local area networking technology to provide collection and transfer support for hundreds of channels.

More specialized data collection requirements can be met in a similar fashion. Such was the case for a recent set of requirements that included one for digitally captured and stored test control voice communications. A number of industrial-grade imbedded PCs were used with audio digitizer boards to provide a 6 channel capture and storage system that was controlled via a local area network. The entire system occupied a 4U high equipment rack box, and was integrated, tested, and deployed for field use in less than 30 days.

Digital and analog output, and automated closed loop control are also available using PC-based industrial control modules. Interfaces to test equipment via IEEE-488 or EIA-232D protocols are common, and also enable remote control of this equipment from throughout the test network. Although laptop and industrial-grade portable computers supply the bulk of the interface control, sometimes environmental or large capacity requirements force other solutions. For these conditions, industrial-grade rack-mount computer and digital storage systems are used. While more bulky than the typical PC used in field work, these systems will perform flawlessly under the harshest field conditions.

Once the PCs have collected the data in the field, there are a number of choices for transporting the data to the centralized test control activity. For single collection points (those using a single PC), the method of choice is via serial data line over existing media. Depending on data rate requirements and the acceptability of the estimated cost, this media could be a cellular phone link, a telephone line, a point-to-point RF data link, or even a satellite data link. All these methods have been used on recent projects. Where there are several data collection points essentially co-located, the PCs are typically inter-connected

using a COTS local area network (LAN). This interconnect provides access to a shared data channel that transports data at rates between 10 and 100 Mbps.

This network can be designed around COTS components using a variety of topologies and physical media. The exact design chosen is dependent on test requirements and the collection environment. The number of computers that can be multiplexed on the data link is driven by the network topology and control protocols, but up to 20 are not uncommon. Much larger numbers are possible, but more attention must be paid to system throughput rates for a large system to supply acceptable performance. When near-real-time relay of the test data is required by the data management scheme, the LAN is connected to a wide area network (WAN) router. The router acts as a buffer and media adapter that allows the information on the LAN to be transfer to remote locations (such as the test control center). A key feature of current WAN router technology is the ability to interface to a number of transfer media, and to automatically scale the use of these resources on demand. Each of the media access interfaces (typically 8 o 16 channels on most routers) can be configured for synchronous or asynchronous data transfer at rates from below 1kbps to 45Mbps. The router selects the type and number of channels to be used based on a predefined scheme and the current data transfer demand. Automatic channel management has several advantages. For metered service, costs can be controlled. Alternate data routes can automatically be activated if a link fails while in use. One easily overlooked advantage to the use of router technology is that of multiplexing lower data rate channels to provide a virtual high-speed data channel where one does not exist. This capability is typically used at sites where the only available communications media is public switched telephone network (PSTN) lines. In a typical installation using a WAN router, 16 telephone lines can be multiplexed at data rates of 28.8kbps (and sometimes higher), providing a theoretical 460.8kbps data rate. Network and multiplexing overhead typically reduce this value by approximately 50%. The real advantage to this approach is that no special arrangements (or additional expense) are necessary for installation of a high speed data line to get high speed data performance

When PCs are used in a data collection system, and the system is joined together using LAN and WAN technologies, real-time remote test management becomes a real capability. Desktop video teleconferencing can provide test site control from a centralized test operations facility. Beyond the face-to-face implementation that is a typical use for this technology, DESA has demonstrated the ability to relay near-real-time sensor data and video. These same tools provide remote sensor control. The key feature here is that the software and hardware necessary to implement this capability is COTS. Therefore the cost is low, the technology is improving rapidly with industry funding the research efforts, and the products exist in a competitive environment. The one drawback to using LAN/WAN technology for test control is that the process is not deterministic, i.e. the time of arrival of the data will vary slightly with traffic load, and data packets can be lost in the transfer

process. Thus, this technology is not suitable for extremely critical operations (such as high-speed event control) unless measures are taken to provide redundant data paths and prevent information bottlenecks.

The final piece to the SYSCON 2000 design is automated data archiving. COTS software and hardware designed specifically to operate in a LAN/WAN environment provide redundant data storage at the point of collection as well as at the test control center. With the current state of the art in digital image compression, even the most unwieldy image and data collection and storage requirements can be supported with COTS hardware and software.

FUTURE DEVELOPMENTS

The basic premise of SYSCON 2000 is to employ COTS hardware and software to meet portable data collection requirements. Future developments of the system are thus driven by availability and customer need. There are, however, a few trends. Recent commercial developments in video data compression are under review for inclusion in the SYSCON 2000 “tool kit”. This capability will serve to reduce bandwidth requirements for high quality video imagery. As computing power increases and dimensions decrease, more and more systems under test are able to host a built-in PC for data collection and relay. At least one test platform has been considered for and entire LAN/WAN suite. As commercial low-bandwidth, worldwide services (such as Motorola’s Iridium system) become available, these data channels will be employed for the low data rate, highly mobile test articles.

CONCLUSION

The SYSCON 2000 system has proven to be a cost-effective solution for data transfer and test control in off-range applications. The flexibility of the over all topology, and the inherent advantages of COTS hardware and software has allowed DESA to satisfy customer demands for high quality testing at a low cost.

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