DEVELOPMENT AND INTEGRATION OF A MATERIAL MONITORING/TRACKING SYSTEM AT ANL

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ABSTRACT

A Personnel and Material Tracking System (PMTS) demonstrated at Argonne National Laboratories-West (ANL-W) in 1987 has resulted in the further development of this system. The results of the demonstration indicated immediate potential for the Material Monitoring/Tracking (MM) portion of the system. The MM system provides the separate functions of 1) observing all container movements, 2) authorized access approval, and 3) initiation and receipt of material transfers. All three functions are coordinated through a single computer which is known as the Computer Augmented Material Access (CAMA) computer. The Wireless Alarm Transmission of Container Handling (WATCH) system provides Function 1, and the Mobile Accountability Verification Inventory Station (MAVIS) system provides Functions 2 and 3. Faster communications and the expanded and refined software package developed to provide Functions 2 and 3 stands out as the major accomplishment of this project. Increased functionality with enhanced protection against the insider threat in a more friendly operator interface is provided by this software.

INTRODUCTION

In July 1987, a PMTS was demonstrated in the Fuel Manufacturing Facility (FMF) at ANL-W[1]. This system was intended to aid in the transfer of inventory materials from area to area within the FMF as well as assure that the personnel conducting these transfers were authorized to do so. The motivation for such a personnel and material tracking system was threefold: to assure that personnel were performing authorized operations only in the correct locations, to assure that material had not moved if it was not part of an authorized movement operation, and to assure that material in movement arrived at its destination. The potential of the PMTS was recognized and further development of parts of the system were planned. In addition, it was decided that the overall system could be very helpful for inputing material transfer data to the material accounting system, known as PC-DYMAC, which was developed by Los Alamos National Laboratory (LANL)[2]. The integration of the CAMA portion of the PMTS and the PC-DYMAC system is known as the ARGonne Unified Safeguards (ARGUS) system[3].

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REVIEW OF PROTOTYPE SYSTEM

The prototype system (the PMTS demo) consisted of two functional components - the personnel tracking subsystem and the material tracking subsystem. Personnel tracking was provided by a proximity badge reader system which monitored personnel movement through strategically arranged checkpoints in the facility. Material tracking was provided by two systems. The WATCH system monitored material to assure it was not being moved when it was not authorized for movement; the MAVIS system provided the means for allowing authorized transfers of inventory material from area to area within the facility. A central computer was employed to coordinate the functions described.

The potential of the personnel tracking system was not realized mainly because of inadequate technology for the purpose. Further research in this area is being done. However, the demonstration pointed out the potential benefits to be gained from further development of the WATCH and MAVIS systems. This potential involved not only the intended security application but provided possibilities for improving day-to-day operations in the FMF. It is with these results that further development was begun.

SYSTEM PHILOSOPHY

The CAMA system is a system that is evolving and maturing in its sophistication and scope. Its original design philosophy was to combine Access Control and Material Control methods to provide a higher level of insider protection. This original philosophy has provided the foundation for the CAMA system development. The CAMA system development provides the functionality required by FMF operations and incorporates design requirements needed for integration with the material accounting system, PC-DYMAC.

SYSTEM DESCRIPTION

The CAMA system is composed of a subset of the original PMTS. The components of this subset are: 1) the WATCH material monitoring system, 2) the MAVIS material access system, and 3) the CAMA computer.

WATCH Material Monitoring System

The WATCH system monitors the movement of inventory material. The system, shown in Figure 1, consists of several remote, wireless tamper devices that communicate with a central receiver/controller unit. Each is equipped with a sensor/transmitter (STX) pack that consists of a connected sensor-transducer, a timing card, and a transmitter card. Movement of the STX generates an rf signal that is received by the central receiver/controller unit. The signal is processed, and an appropriate alarm message is sent to the CAMA computer.

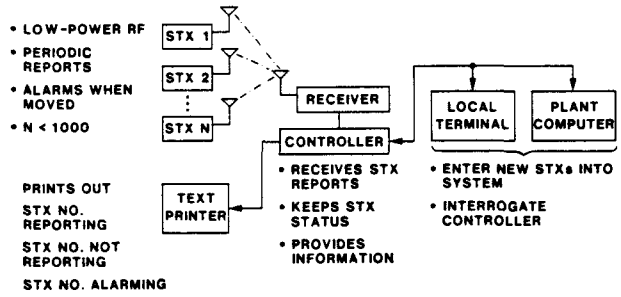

Figure 1

MAVIS Material Access System

The MAVIS units consist of a non-contact laser barcode scanner combined with an intelligent barcode reader and an RS232C rf communications modem. These components are mounted on a wheeled cart to ease transport of the station about the areas where it is needed. The MAVIS provides the interface from material handlers to the rest of the system.

CAMA Computer

The CAMA computer is an IBM PC/AT with 1 Mb of RAM and an 8-port RS232C communications board. The XENIX System V operating system is used and all software is written in C.

ARGUS System

The ARGUS system encompasses the CAMA system and the PC-DYMAC system. The CAMA system has been described. The PC-DYMAC system is a materials accounting system in use at the FMF. It is composed of a central computer and three peripheral area computers, shown in Figure 2. PC-DYMAC is designed to maintain a physical inventory for the materials that are stored and processed in the FMF. Part of the potential of the original PMTS system involved interfacing it with the PC-DYMAC system to provide a means of inputing material ID numbers into the accounting system in a quick and accurate way. The material access aspects of the PMTS provided the solution.

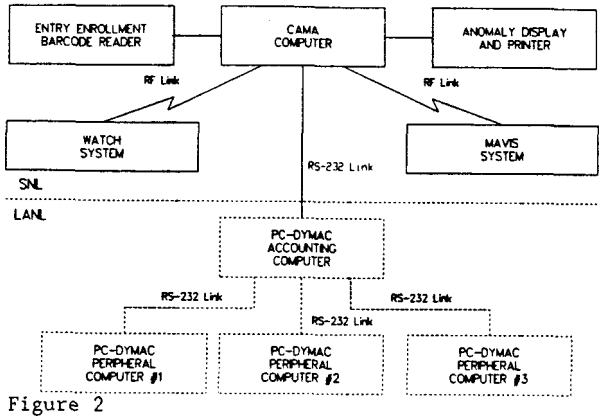

Figure 2

SYSTEM INTEGRATION

On a functional level, it was apparent to the ARGUS development team that the material movement and location data needed by the PC-DYMAC system could be provided by the CAMA system. Specific system requirements were identified and work was begun. The 1987 demonstration system allowed the transfer of material by use of two functions: deposits and withdrawals. The operation of the FMF requires a finer distinction to be made as does the functioning of the PC-DYMAC system. In essence, the operations that were needed to bring the CAMA system to full functionality coincided with many of the same requirements needed to interface with PC-DYMAC. These functions were developed along with functions which prevent the authorized movement of material to an area from other specific areas in the FMF. This was done as a cross check to prevent the honest error from going unnoticed and uncorrected. Secondly, it was done to prevent the possible diversion of material by entering information that indicated the material was being transferred from Area A to Area B; when instead, it was diverted to Area C. The software was also written to provide required data to a communications interface process resident in the CAMA computer which transmits this data via RS232 lines to the PC-DYMAC central computer. The communications interface process was written by LANL.

SYSTEM OPERATION

The fully functioning CAMA system operates very similarly to the 1987 demonstration system. A review of that operation follows.

The WATCH system provides the material monitoring function. Ninety fixed location containers and 35 movable containers will have WATCH STXs attached which provide for the monitoring of material within them. These sensors are always alive and provide alarm information any time they are moved.

The MAVIS system provides the material access capability, which is the operator's interface to the CAMA system. The rf modem for the MAVIS has been upgraded. A faster, more capable modem is now used which provides a 65 millisecond turnaround time for a message sent versus 1.25 seconds for the previous modem. The new modem is now set up to operate in a multiplexed mode. The modem firmware provides a means for automatically connecting and disconnecting several remote satellite units to a single host base unit. This means that with proper modification to the CAMA computer software, two or more MAVIS units can be operated simultaneously. They have been tested in this mode to confirm proper operation. MAVIS units were used to enforce the two-person rule by asking the operators to read the barcodes on their identification credentials. However, a means for preventing the possession of more than one credential by one operator did not exist. An enrollment procedure will be in place which will require the Security Inspector (SI) on duty to verify each fuel handler's credentials by reading the barcode when the individual enters and exits the FMF. The reading of this barcode will set an enrolled/not enrolled flag in the CAMA computer which should prevent access by an individual possessing a credential that has not been read upon entering the facility. MAVIS units now provide appropriate, more detailed prompting for operators, which allows them to complete the transfer operation they are intending to accomplish. It also provides them with an explanation when they answer prompting inappropriately and are denied access. The new system does cross checks on initiatation points for transfers, whether the appropriate individuals are initiating the transfer, and whether the destination of the transfer is appropriate. When all of the authorization checks have been made, the transfer continues. Data relating to who the operators are; when and where the operation took place; what material was involved; and what kind of operation is taking place, is then sent to the communications interface process which relays the information to the PC-DYMAC central computer. The PC-DYMAC central computer then performs the operations required to update the material accounting inventory database.

STATUS

The CAMA system and the PC-DYMAC system have been interfaced, and integration testing is being conducted. The checked-out ARGUS system will be reassembled and undergo final check-out at ANL-W in the Fall of 1989. If ANL-W approves the final operational functions and features, it will be installed in FMF in 1990.

CONCLUSIONS

The integration of the CAMA system with the PC-DYMAC system has provided ANL-W with the opportunity to upgrade security for the FMF to a new level. A projected side effect of this effort is the positive impact this effort will have on operations. From the security standpoint, the CAMA system provides a logical, friendly interface to the operator for accomplishing material transfers, monitors any WATCH movements, and maintains a state-of-health for each WATCH sensor. In addition, it also 1) provides the material accounting system with information regarding what containers are being accessed, who is accessing the containers, and the destination of transfers or changes in location of material; 2) maintains electronic confirmation of material surveillance procedures during material access, transfer, and receipting processes; 3) provides approval for authorized personnel attempting access to material; and 4) produces alarms when an anomaly occurs such as denial of access to material by unauthorized personnel. The positive operational impacts that are projected to save personnel time and effort involve 1) the 24-hour surveillance of all vault-stored material by the WATCH system, 2) the elimination of error-prone, hand-generated paperwork for material accesses, and 3) the provision of material transfer information to the materials accounting system, thus affording near real time accountability.

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