Upgrading TRANSCOM: A Tracking and Communications System for Radioactive Material Shipments*

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INTRODUCTION

The U.S. Department of Energy (DOE) has developed a transportation tracking and communications system that is used for selected unclassified radioactive and hazardous materials shipments (Boes 1994). This satellite-based system is the Transportation Tracking and Communications (TRANSCOM) System, which has been in operation since 1989. Since its inception, the TRANSCOM System has tracked over 500 shipments for DOE.

The mission of the TRANSCOM System is to provide tracking and communications for shipments of radioactive materials, hazardous materials, and other high-visibility shipping campaigns, as specified by DOE. The TRANSCOM System is managed and operated at the TRANSCOM Control Center (TCC) in Oak Ridge, Tennessee, for DOE's Office of Transportation, Emergency Management, and Analytical Services.

The TRANSCOM System provides the TCC staff, shippers, carriers, receivers, and State, Tribal, and Federal users with the ability to view information about shipments and communicate with each other during shipment tracking. Information about the shipment contents, points of contact, routes, status, locations, and emergency response information is available to each user. The information is displayed in tabular and graphical form using a series of national, state, and county maps.

The TRANSCOM System has a client-server architecture. The server is a UNIX™-based system that stores the information for each shipment in a central data base and controls all TRANSCOM activities and communications. Four versions of the DOS client system have been developed. The TCC version allows TCC operators to view all shipments, add information to the database, and send messages to any users on the system.

* This work was performed at Oak Ridge National Laboratory, Oak Ridge, Tennessee, operated by Lockheed Martin Energy Systems, Inc. for the U.S. Department of Energy under contract DE-AC05-84OR21400.

The carrier, shipper, and receiver version allows these parties to view and communicate with all shipments with which they are involved. The shipper is responsible for inputting the information about each shipment using this version of the software. The DOE version allows the Federal users to view all shipments and communicate with the TCC. The other government agency (OGA) version for states and tribes allows these parties to view only the shipments traveling through their jurisdictions and to communicate with the TCC. Neither the DOE version nor the OGA version allows users to change any information about a shipment.

The TRANSCOM client and server software are currently being rewritten to improve the system for all users. The client side is being rewritten in a Microsoft® Windows™ environment. This upgrade will provide an improved mapping system with zoom and pan features; an improved representation of the highway, rail, and waterway transportation networks in the United States; an enhanced set of political boundaries, including Native American reservations and urbanized areas; and a better set of table and message screens. The client and server sides will incorporate the latest commercial off-the-shelf software into the system to ensure reliability and easier long-term maintenance. The server system will include enhanced communications and database features that will increase the system's reliability and functionality. This paper will provide an overview of the current TRANSCOM System and the numerous improvements that are being incorporated into the upgraded TRANSCOM for Windows™ System.

OVERVIEW OF EXISTING TRANSCOM SYSTEM

The existing TRANSCOM System consists of a computer server located at the TCC in Oak Ridge, Tennessee, and four versions of client software totalling 61 client packages in the field. The server consists of a SCO™ UNIX™-based 486 computer system that operates an in-house developed software control package that stores the various shipment information for all materials tracked. The server uses two external mirrored hard drives to ensure data integrity. The client software, last upgraded in early 1992, consists of DOS-based routines written in C. Both the server and client software use an in-house-developed communications protocol written specifically for the TRANSCOM System. Unfortunately, this in-house protocol makes it nearly impossible to integrate new routines into the existing computer code.

The existing modem rack consists of a bank of 36 modems with a maximum speed of 2400 bauds. All the existing communications codes in the server and client software will operate at only 1200 and 2400 bauds. At the time that the existing software was written, 2400 bauds was one of the faster baud rates used. However, the need to transfer additional information for an increasing number of shipments coupled with the enhanced communications provided by newer, error-correcting modems has rendered the existing modem rack obsolete. An uninterruptible power supply (UPS) can operate the TRANSCOM System at full capacity for 2 hours and at a reduced level for about 4 hours.

UPGRADING THE TRANSCOM SYSTEM

The upgrades being performed to the TRANSCOM System are occurring on both the server-side and client-side of the system. The new TRANSCOM server consists of a Sun™ Sparc 20 workstation using the Sun™ UNIX operating system. The server database of shipment information is in Oracle™and the TCC control software is written in C. The new TRANSCOM client software is written in Microsoft Visual BASIC and C++. Pre-existing libraries of functions and routines have been used whenever possible to enhance the stability and reliability of the final computer codes.

The most significant improvements to the client software are to the mapping routines which are now able to display states, counties, interstates, state, and local roads, railroads, waterways, Native American reservations, and the location of major cities. Figure 1 shows a multistate region centered around the Missouri Boot Heel with a vehicle, labeled EF, being tracked moving South along I-55. Note that the multistate area map shows the major interstates and cities in the states of MO, IL, IN, KY, TN, AL, MS, and AR. Figure 2 shows the only equivalent view possible with the DOS client software which includes just the state of MO. The DOS version can display only the entire United States, a single State, or a single county. The Windows version allows the user to zoom in at any level of detail desired, and the map can pan at the current level of detail to follow a shipment.

Figure 3 is a more detailed zoom of the Windows version centered on the Missouri-Illinois border with the addition of State roads and added detail of the St. Louis area. A query has been performed on the interstate the vehicle is using, and the query-result window is shown in the upper left portion of the screen identifying the route as I-55 in MO. Note that the equivalent DOS version can display only a single county, as shown in Figure 4, for St. Louis county. The upgraded mapping utilities are significantly enhanced and more useful than the current maps.

The full capabilities of the Windows environment are demonstrated by the tabulation of shipment information. Figure 5 shows the basic shipment information screen of the Windows version. A similar DOS version screen is shown in Figure 6. Note that the Windows version can display multiple pages of information in a scrollable window whereas the DOS version shows only one page at a time (p. 2 of 3 is shown). Figure 5 also shows four additional windows tiled behind the foreground window that give health hazards, additional shipment information, Department of Transportation (DOT) *Emergency Response Guidebook* (ERG) advice for fire or explosion, and the recommended DOT ERG emergency actions to use in the event of an accident. With the Windows version, the user can open as many screens as necessary to have all required information readily available.

The message utility has been improved to allow the user to scroll through a list of messages in the summary screen while the full text of each message is displayed in another window below as shown in Figure 7. The familiar Windows help system, which is indexed and searchable, has been used throughout, as shown in Figure 8.

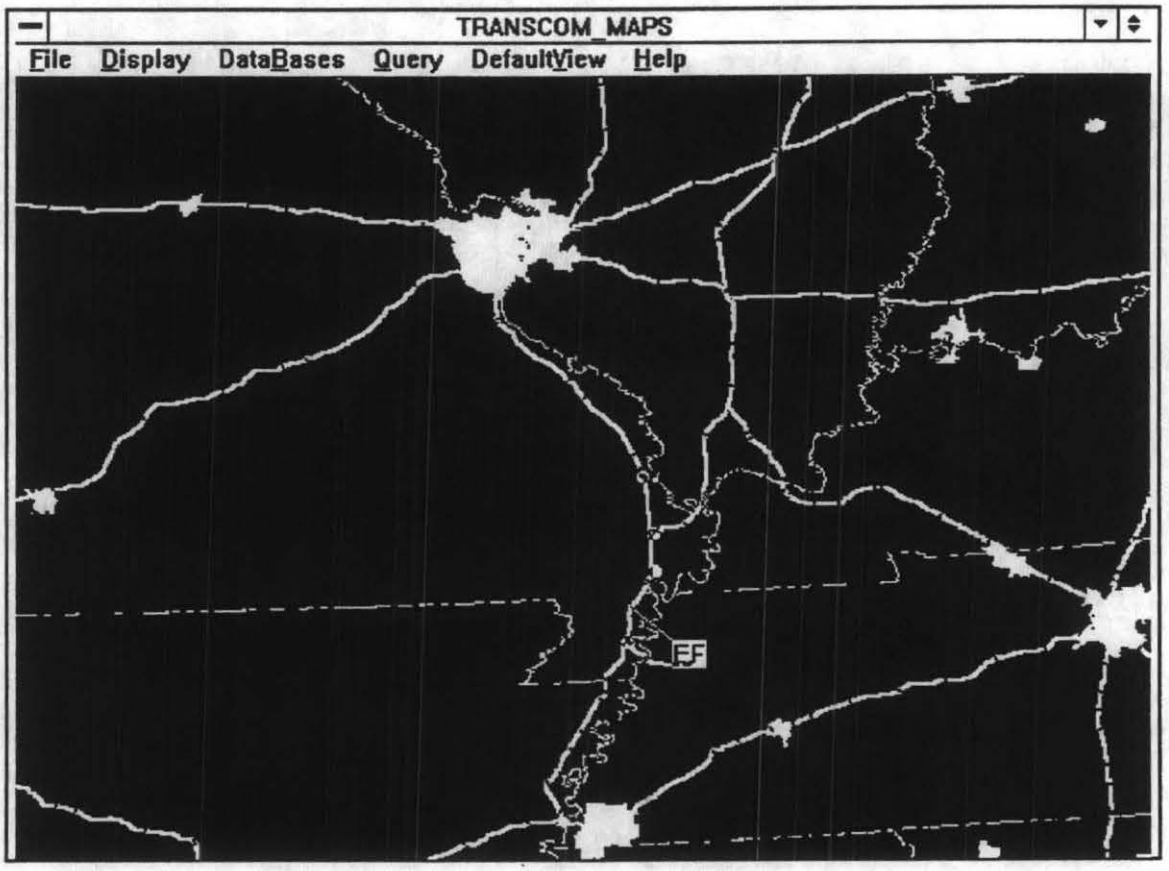

Figure 1. Multistate map view using TRANSCOM for Windows.

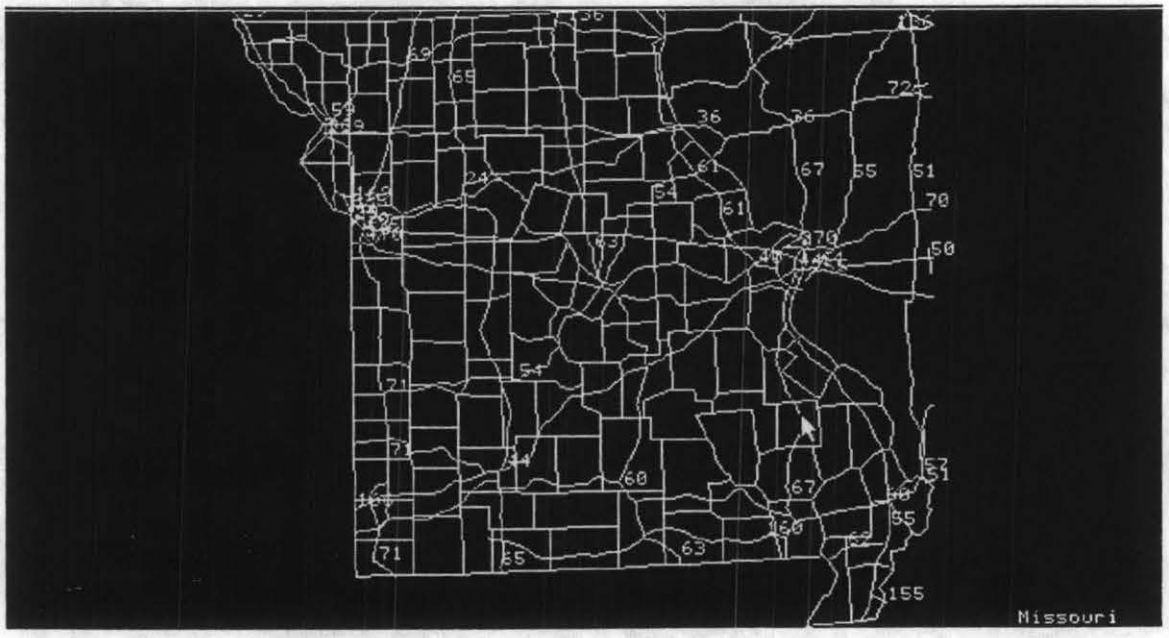

Figure 2. Equivalent map view of Missouri using TRANSCOM for DOS.

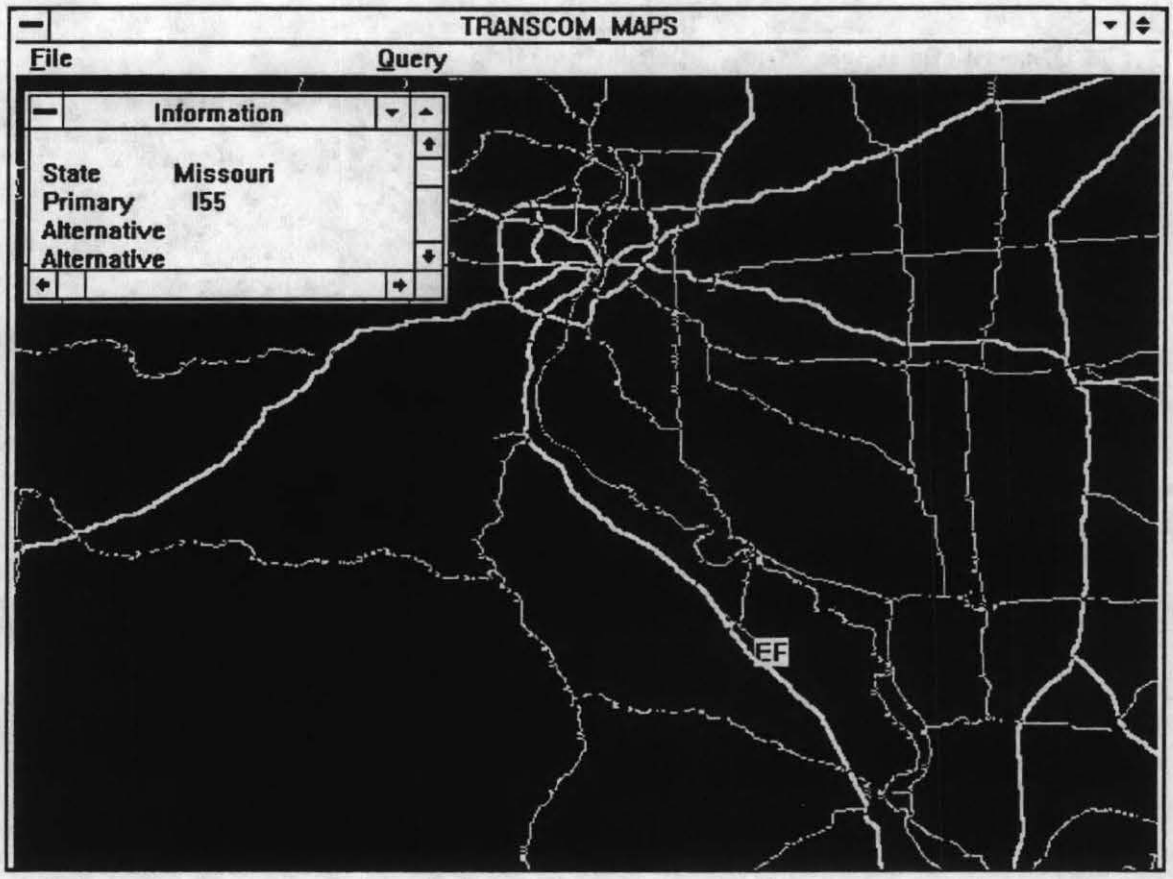

Figure 3. MO-IL border after applying zoom function to Fig. 1. Note query result window, which identifies the vehicle as traveling on I-55 in Missouri.

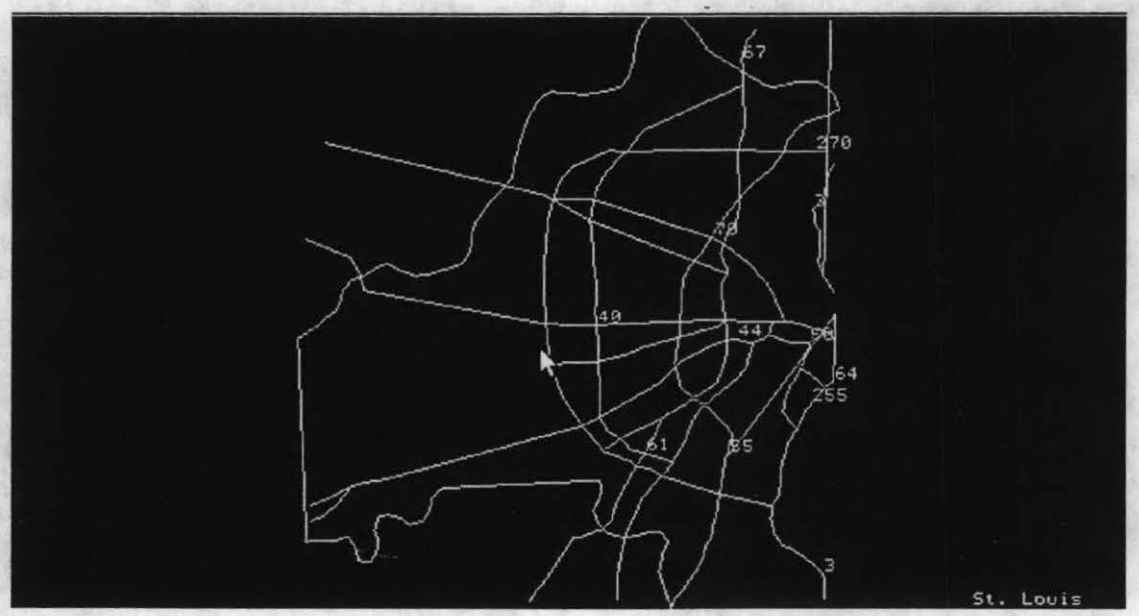

Figure 4. St. Louis county displayed using TRANSCOM for DOS.

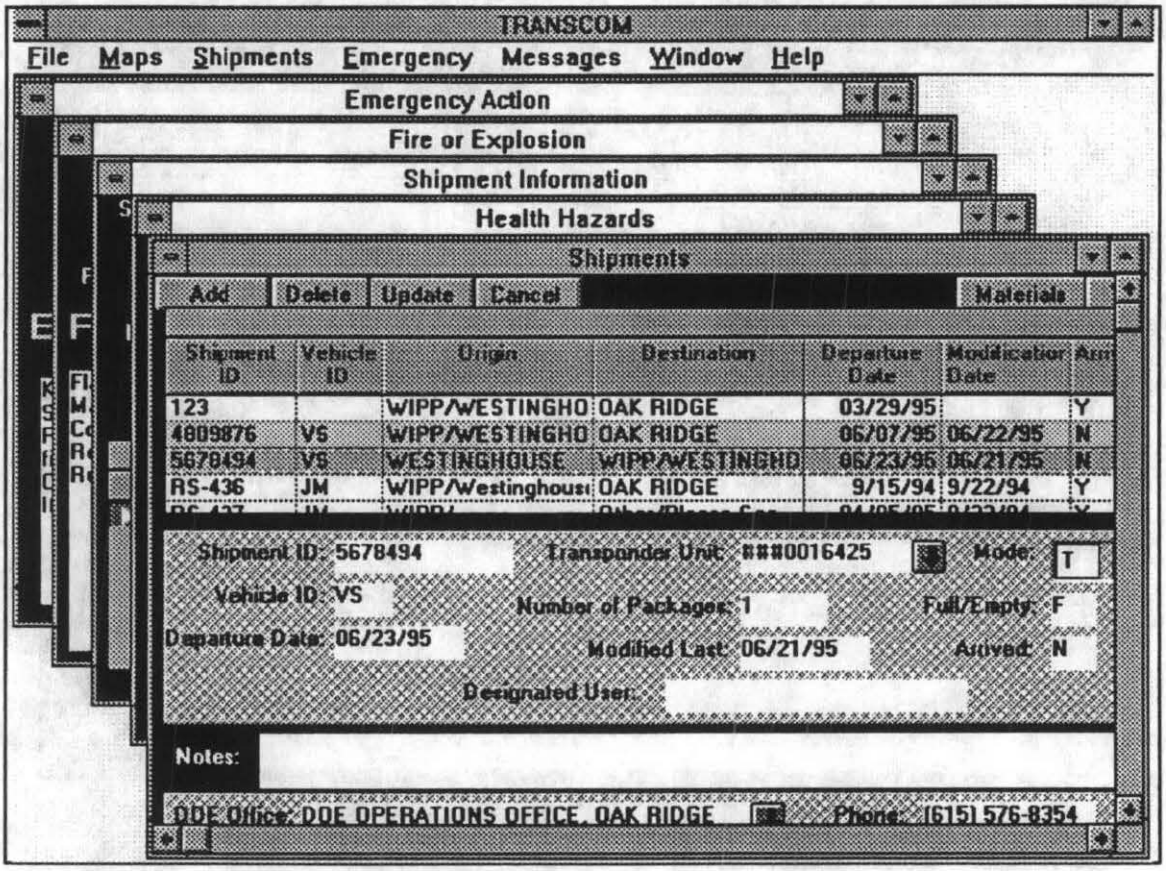

Figure 5. Basic shipment information tiled with 4 other TRANSCOM for Windows screens showing how a multitude of data may be displayed simultaneously.

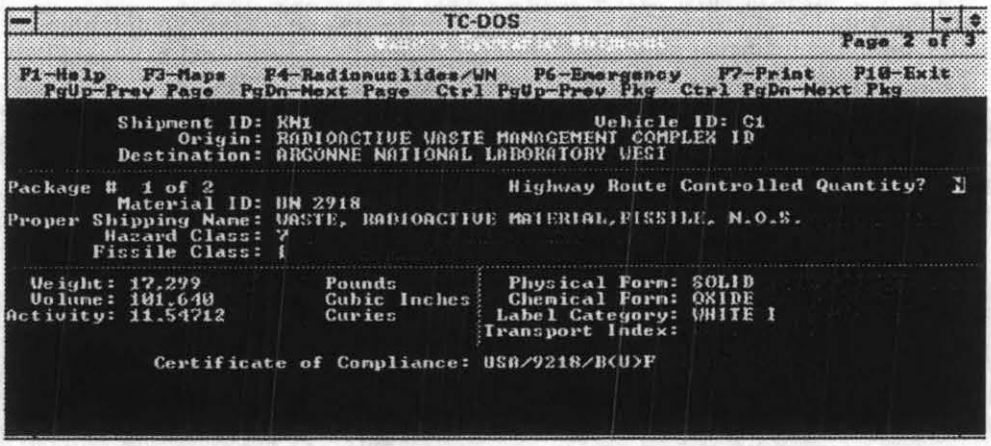

Figure 6. Basic shipment information from the DOS version.

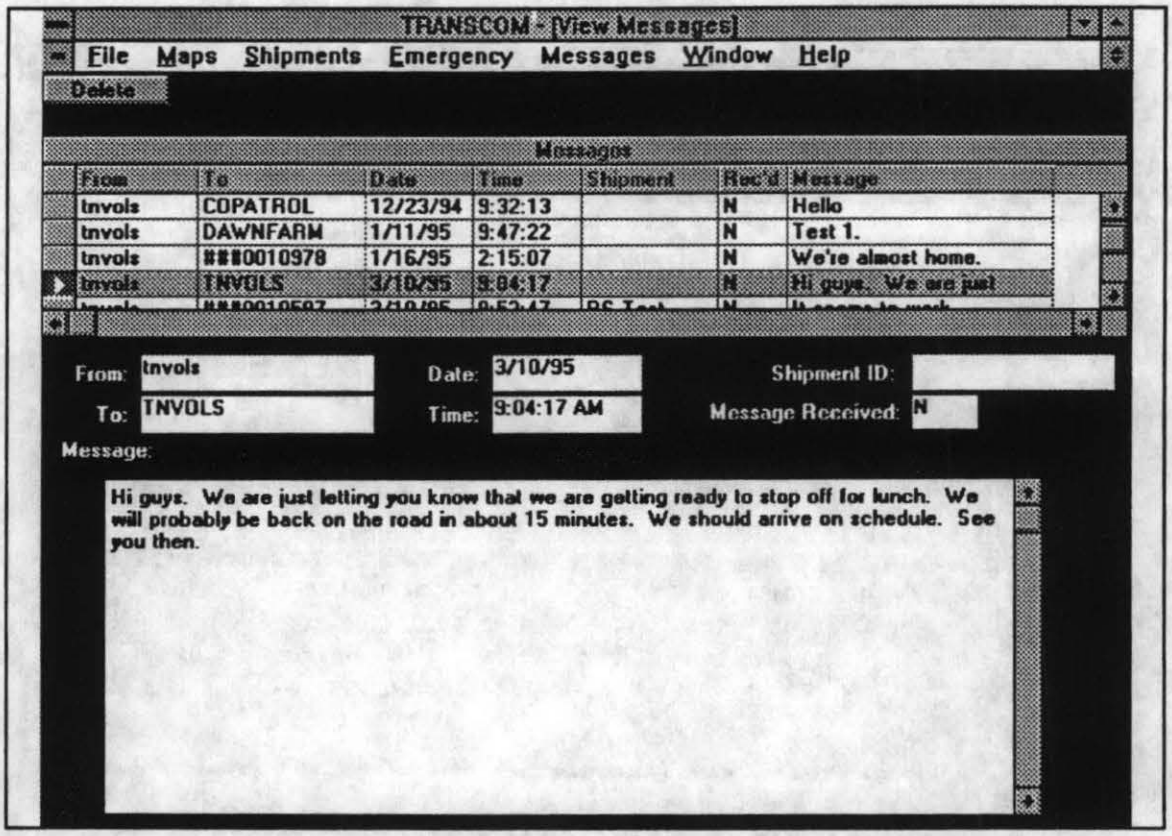

Figure 7. The view messages screen showing scrollable message summary at top and selected message detail below.

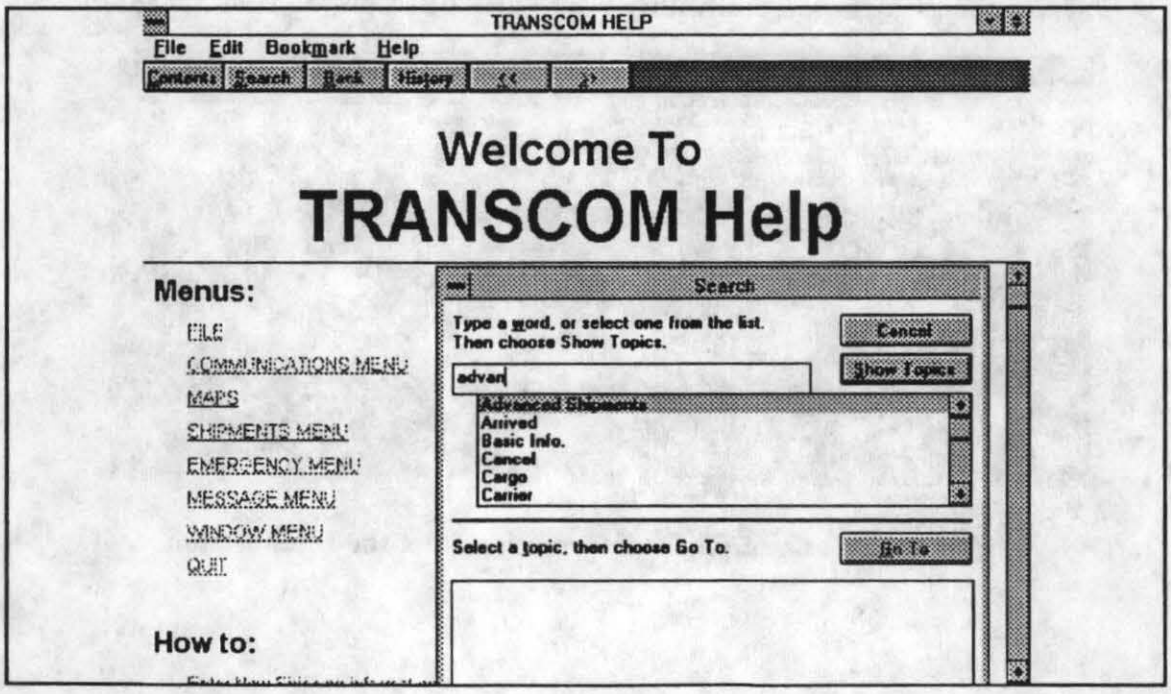

Figure 8. The TRANSCOM for Windows help screen showing search capabilities.

The TCC facility is also undergoing improvements. The facility is being redesigned to increase operational effectiveness and to allow an increasing number of DOE shipments to be successfully and efficiently tracked. As the number of DOE shipments continues to increase each year, the TCC facility must be upgraded to allow the increased transportation activities to be adequately monitored. A recent DOE transportation needs assessment (Pope 1996) has projected substantial increases in the shipping rates of some radioactive wastes and materials in the early decades of the twenty-first century. To prepare for these increased shipping rates, the new modular layout of the facility will allow multiple video display terminals (VDTs) to be monitored by each operator. A different VDT can be used for each area of the country where a shipment is in transit, or multiple shipments are in transit. In addition, the 24-hour weather and news channels are continuously monitored during shipments to ensure that inclement weather, natural disasters, and significant national events do not endanger the safety of each shipment being tracked. The modular operating stations will allow the numerous information displays to be properly monitored. The UPS system is being upgraded to allow full-scale operation of the TCC for at least 4 hours should a complete power failure occur. By scaling back operations to essential tracking only, this time could be extended even further.

CONCLUSIONS

This paper has shown how upgrading the existing TRANSCOM System to a UNIX workstation server and Windows client software will offer significant enhancements to system functionality and reliability for all TRANSCOM users. The upgraded TRANSCOM System will continue to provide tracking and communications for DOE transportation campaigns to ensure that rapid and effective action can be taken should a problem occur during a shipment. The upgrades to the TRANSCOM System described in this paper, when fully implemented, will allow the DOE to maintain its safe record of transporting radioactive and hazardous shipments into the twenty-first century.

REFERENCES

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Pope et al., *A Needs Assessment for DOE's Transportation and Packaging Activities—A Look Into the Twenty-First Century*, proceedings of the 11th International Conference on the Packaging and Transportation of Radioactive Materials (PATRAM '95), Las Vegas, NV, USA, to be published (1996).