THE INTEGRATION OF WEB TECHNOLOGY AT ATLAS

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Abstract

ATLAS (Argonne Tandem Linear Accelerator System) accelerates heavy-ion elements, and consists of 2 separate ion source injectors, 64 superconducting resonators, and 3 target areas. As with any complex accelerator facility, database management systems are used extensively to support both the archival of operational data, and the real-time control needs of the accelerator. Web technology has recently been integrated into the already existing ATLAS Oracle Rdb database system and control system documentation to enhance communication with the operators, control system engineers, and other technical support staff at ATLAS. This paper reviews the historical development of the control system database structure and user interface, and the Internet software developer tools used to create a new online interface.

1 ATLAS CONTROL SYSTEM

The demands on the control system from ATLAS operations include starting a new experiment every three to five days, with delivery of beam 24 hours a day. To meet these demands, the ATLAS control system has grown over the years to incorporate three major software applications: Vsystem [1], Oracle Rdb [2], and Corel Paradox [3].

1.1 Real-time Control

The interface of Vista's Vsystem software running on a Compaq AlphaServer [4] computer with an OpenVMS operating system to a CAMAC (Computer Automated Measurement And Control) Serial Highway provides real-time control of the accelerator. Vsystem graphical user interface displays located on workstations throughout the accelerator facility are used by operators for real-time control and monitoring of accelerator devices.

1.2 Database Structure

The Vsystem real-time database comprises numerous tables that are organized to record device control and readback values, hardware control conversion factors, device operating limits and alarm limits, and more. An Oracle Rdb relational database was later added to the control system architecture to provide a storage location for information about the accelerator that is relatively static. In-house written processes are used to retrieve information needed for specific accelerator control system functions from the Oracle Rdb tables. Likewise, other processes have been developed to continuously scan Vsystem's real-time database, and write critical values to Oracle Rdb database files for data archiving and acceleration configuration restoration purposes.

The third major component in the ATLAS database structure is a tune archiving application built with Corel Paradox relational database software as a single PC, stand-alone installation. The tune archiving application serves to scale previously archived experiments according to the charge states, energies and mass requirements of the new experiment; and then load the scaled values into the Vsystem real-time database. A more thorough discussion of the relational database aspects of the ATLAS control system are provided in a previous paper [5].

2 WEB-BASED APPLICATIONS

The development of Web-based applications at ATLAS began with the desire for non-computer programmers to quickly and easily query the Oracle Rdb database for accelerator hardware configuration information. When the Oracle Rdb software was originally purchased, an add-on graphical user interface feature was prohibitively expensive. Consequently, control system developers used interactive SQL (Structured Query Language) on the AlphaServer's OpenVMS operating system to view the contents of the Oracle Rdb database. The first Web technology software project for the ATLAS control system was to create Web pages that provided query access to the Oracle Rdb database. Since then, the ATLAS control system Web site has expanded in both the utilities it provides to users, and the types of Internet developer software used.

2.1 Overview of Control System Web Site

The main ATLAS control system Web site utilities are:
- Interactive query of the Oracle Rdb database
- Operators' Control System Manual
- Control System Developers' Manual

Currently, the control system Web pages are hosted on a single Web server PC that uses Microsoft IIS (Internet Information Server) [6] software on a Windows NT Server platform. The Web server PC, AlphaServer computer, and Paradox PC reside on an isolated Ethernet local area network (LAN), and use the TCP/IP protocol for transferring information. Eight PCs are available on this private ATLAS control system network for accessing the control system Web site. Plans are underway to split the control system Web site into two parts, and to host low-security Web pages on a division wide network. This project will be discussed later in the paper.

2.2 Internet Development Software

Initially, only standard HTML pages and Microsoft ASP (Active Server Pages) were used to create Web pages and forms. As time went on, new Internet developer tools were tested and used to enhance the appearance and functionality of the Web site utilities. Table 1 lists the

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developer software that has been used thus far to create the ATLAS control system Web site.

Table 1: Internet Development Software

Software	Application
MS Internet Information Server (IIS)	Web Server
MS Active Server Pages (ASP)	Database Query and Web Page Forms
MS ASP.NET	Advanced Database Query and Web Page Forms
Macromedia Flash MX [7]	Home Web Page
MS HTML Help Workshop	Online Keyword Search and Index
MS Visual Studio	HTML Pages
MS Visual Studio.NET	HTML Smart Pages
MS Front Page	Web Page Image Maps
CorelDRAW	Convert PostScript Images to JPEG
MS Photo Draw	JPEG Sizing

2.3 Web-Based Oracle Rdb Query

HTML pages are used in conjunction with Microsoft ASP files to query the Oracle Rdb database. The HTML pages use HTML forms that include check boxes, text entry, and radio buttons for interactive user input. The ASP files contain server-side script commands that build a SQL search string based on the user's selection and input. After a user submits a query request from the HTML Web page, the ASP script commands execute on the Microsoft IIS Web server. The results of the query are returned in tabular format as an HTML page to the client browser.

2.4 Online Help System

Development of the online ATLAS control system manual was a major undertaking since it contains many pictures that were converted from Vsystem Vdraw files on an OpenVMS platform to JPEG files on a Windows platform. Recently, the ease of use of the control system manual has been greatly improved by the addition of an online help system. As shown in Figure 1, this help system provides a keyword search option, and an expanding and contracting table of contents with hyperlinks to the corresponding section of the manual. Microsoft HTML Help Workshop [6] was used to create the Web-based help system.
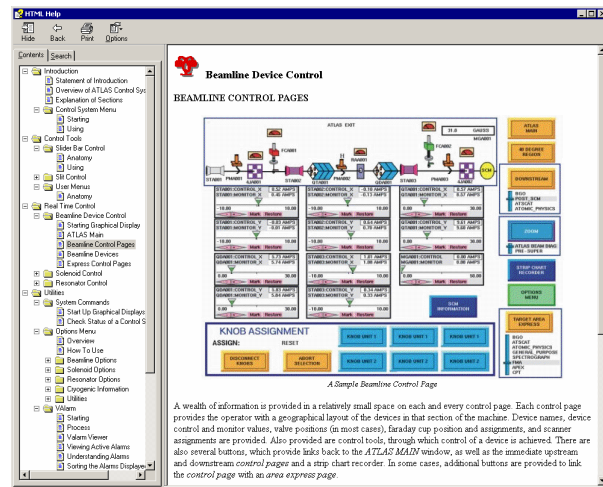

Figure 1: HTML Help - Online Control System Manual.

3 WORK IN PROGRESS

3.1 Dynamic Network Address Translation

For security purposes, the control system Web site currently resides on an isolated, private network. As this network configuration limits the number of PCs that have access to the Web site, it has been decided to split the Web site into two parts: a high-security content Web site, and a low-security content Web site. A second control system Web server on the division wide network that has a greater degree of user access has been added for maintaining the low-security control system Web site.

To provide a means for PCs on the private network to continue to view all of the control system Web pages that will now be split among two previously unconnected networks, a dynamic NAT (Network Address Translation) system has been created. The basic purpose of the NAT system, as used here, is to create a firewall between the Internet and the control system network. The NAT system is installed on a router, and the router will only allow network-to-network connections that originate from inside the private network domain. A computer on an external network cannot initiate a connection to a computer on the control system network, but can respond to requests from the control system network. The NAT system is able to do this by creating an address translation table, and tracking the source and destination computers' IP addresses and port numbers.

3.2 Vsystem Hyperlinks to Online Manual

Another Web-based project that is being pursued is to add Web page type hyperlinks on Vsystem's Vdraw displays. These links are established using Vdraw's user link control tool. When the user link is selected with a mouse cursor, a Netscape browser process is started on the AlphaServer's OpenVMS operating system, and the corresponding section of the online control system manual is displayed. The objective of this project is to provide operators with immediate access to a pertinent explanation of a control system feature.

Control System PCs &
Private Control System Web Server

Public Control System Web Server

NAT Router

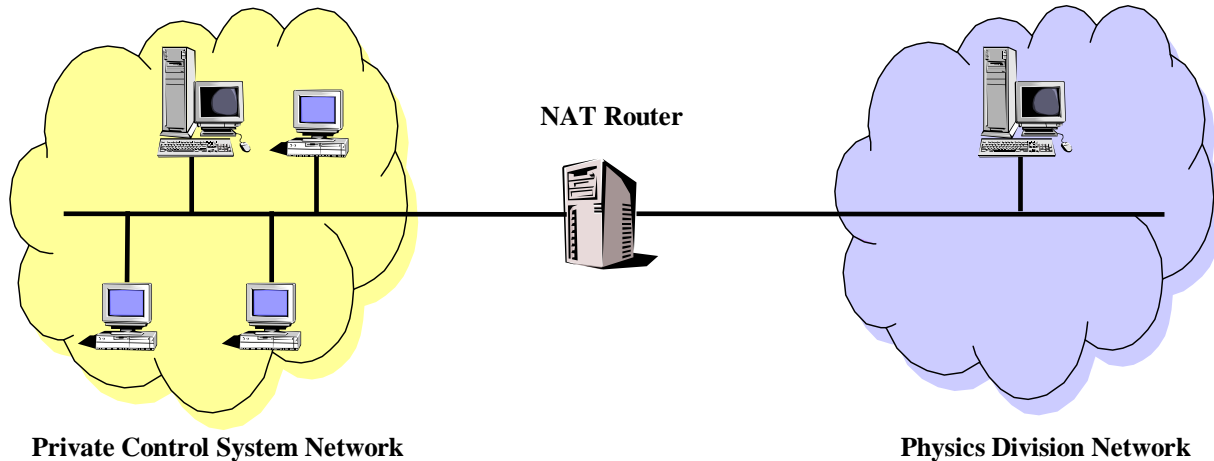**Private Control System Network**

Physics Division Network

Figure 2: Dynamic NAT Access to Public Control System Web Site.

3.3 Migration to ASP.NET

As discussed previously, Web-based access to the Oracle Rdb database is performed with Active Server Pages. Since the completion of this development work, a new version of ASP has been released. The new version, called ASP.NET, is a complete overhaul of ASP, and requires programming changes of existing ASP code for conversion. ASP.NET pages are compiled into machine code when they are requested by an Internet browser, whereas ASP pages use interpretive languages such as VBScript or JavaScript. Visual Basic is the recommended language for writing ASP.NET scripts. There are, however, several benefits of upgrading to ASP.NET:

- Improved performance (ASP.NET pages are compiled, and therefore execute faster)
- Security enhancements (password protection and encryption of ASP.NET pages)
- Interactive flexibility (can programmatically add new objects to a page or hide existing ones)
- Data transfer options (can save array data to a file)
- Over 3,400 classes exist in the .NET Framework class library (classes are used to add Web page functionality)

Fortunately, ASP and ASP.NET systems can coexist on the same Web server as the two systems have separate processing engines, and separate file extensions. A phased-in approach can be undertaken to gradually convert the ASP pages to ASP.NET pages.

4 CONCLUSION

Internet technology will surely continue to improve and change at a fast pace, and the types of Internet applications in the particle accelerator field will continue to change as well. As an example, at ATLAS the addition of an online help system for the control system manual was an easy project to implement, and quickly gave impressive results. In an attempt to keep up with the latest tools, the Oracle Internet Suite of products is being reviewed for possible use in converting traditional client/server PC database applications to Web-based database management systems. Motivations at ATLAS to learn and deploy the newest Internet development tools include the desire to automatically send email messages based on changes in the accelerator, and the need for a widely accessible document and drawing indexing system.

5 REFERENCES

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[6] Microsoft Corporation, Redmond, WA, USA.
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