ABSTRACT

The Telemetry Definition and Processing (TDAP II) application is a PC-based software tool that meets the varied needs—both now and into the 21st century—of instrumentation engineers, data analysts, test engineers, and project personnel in the Test and Evaluation (T&E) community. TDAP II uses state-of-the-art commercial software technology that includes a Microsoft Access 97® database and a Microsoft Visual Basic® Graphical User Interface (GUI) for users to view and navigate the database. Developed by the Test and Analysis Division of the 96th Communications Group for the tenants of the Air Armament Center (AAC), Eglin AFB Florida, TDAP II provides a centralized repository for both aircraft and weapons instrumentation descriptions and telemetry EU conversion calibrations. Operating in a client/server environment, TDAP II can be effectively used on a small or large network as well as on both a classified or unclassified Intranet or Internet. This paper describes the components and design of this application, along with its operational flexibility and varied uses resulting from the chosen commercial software technology.

KEY WORDS

PC Database, Telemetry Data Reduction, TDAP II, Client/Server Application, Database Security

INTRODUCTION

The wide variety of developmental and operational open-air tests at Eglin AFB AAC demanded the establishment of a standardized, parametric telemetry database at the start of the 90’s decade. Diverse aircraft avionics and instrumentation systems—along with
munitions and weapons—drove the need for this data-reduction database for the 96CG and the many distinct test organizations, project offices, contractors, and programs at Eglin AFB. The dynamic nature of weapons development testing with varied aircraft also justified the need for the development, operation, and maintenance of the original Telemetry Definition and Processing (TDAP) application. Hosted on DEC VAXes, TDAP was used by 96CG for all tenant Eglin organizations and customers, and after several years of successful operation, joint T&E range customers also benefited from its use. TDAP contains detailed PCM format attributes, PCM measurement attributes, and 1553 bus data attributes to reduce telemetry and on-board recorded data for aircraft, instrumentation, and weapon systems.

The latter part of the 90’s saw powerful PCs and networks that could process real-time telemetry data and digital recorded data, consisting of more volume and complexity than ever before. To meet this current and future 21st century challenge, TDAP also had to evolve from a mini-computer application to a distributed PC network environment. Several of the following factors drove this conversion: adaptability, availability, ease of use, low cost, scalability, and security. To these ends, TDAP II was developed by 96CG to migrate and convert TDAP to a PC platform and to add functionality as the Eglin test range requirements also evolve. This paper presents how TDAP II addresses these key concepts in a flexible, desktop client/server application.

DATABASE DESIGN AND COMPONENTS

The challenge of converting ASCII text-based files into a modern relational database lied in the multitude of choices available and the scalability and distributed nature of the target system. Since these TDAP files occupy roughly 250 to 500 megabytes of disk storage space, Microsoft Access 97™ was chosen as the relational database to use in a PC client/server environment. Access is a low cost, object-oriented application that is available to practically anyone with a PC on their desk. It offers various levels of data security and the TDAP files scale gracefully to Access databases, which in turn can scale upward to larger, high-end databases such as Microsoft Sequel Server™ in a distributed workstation environment, if necessary for future growth.

The text-based TDAP files are comprised of fixed-length records, where each record is a parameter—be it a PCM word, an EU-converted measurement, a 1553 bus parameter, or a discrete bit within a raw telemetry word. Each parameter contains fixed-length fields, or telemetry attributes, that describe everything needed to convert the raw telemetry and/or recorded data into meaningful quantities. A one-to-one correspondence exists between a TDAP file and a test item instrumentation program, or load, where the TDAP file describes the PCM map and calibrations needed to convert to EUs. Each weapons test project at AAC can contain one instrumentation program for multiple aircraft, with minor
differences between all of the aircraft used for that particular project. Also, an aircraft can be loaded with one of many instrumentation programs, depending on the project it is flying for that mission. This flexibility and dynamics within the test aircraft and test items results in a complex configuration of databases for telemetry data reduction and processing.

The components of the Access databases are shown in Figure 1. All of the databases reside on the Windows NT workstation server and are controlled and maintained by the TDAP database administrator. Separate project databases are created for each instrumentation program and consist of the different aircraft and/or version tables appropriate for that project. The ASCII TDAP files described above were basically converted to these tables with the largest TDAP file containing less than 15k records. This flexible design allows for expandability and scalability—a few databases can exist on a small disk, while the maximum size of many project databases is only limited by the size and number of server disks. At AAC, the disks are actually network disks in a storage shelf and are available to PCs, UNIX workstations, and DEC Alpha workstations. Each TDAP user’s client PC contains a client database, where instances of project tables are temporarily copied to the client by the TDAP II application. Clients cannot change any information from the project databases on the server, but can save tables for their own use. The client database also contains links to the TDAP Utilities database, which resides on the server and consists of PCM stream descriptions, current project databases and their status, and other pertinent information.

![Database Client/Server Model](image-url)
DATABASE SECURITY

Microsoft Access provides the developer built-in, flexible security features for the database objects. The three main reasons to use Microsoft Access security are:

- To protect the intellectual property of developers' code in Microsoft Access applications.
- To prevent users from inadvertently breaking applications by changing code or objects on which the application depends.
- To protect sensitive data in a database.

TDAP II uses both security models, the User-Level security and Share-Level security models. In Share-Level security, the objects are assigned passwords, and anyone who knows the password can access the object. TDAP II applies Share-Level security to the Project (Loads) databases as shown in Figure 2. In User-Level security users are authenticated when they start Microsoft Access by logging on with a password. Administrators grant specific permissions, such as Read Data or Modify Design, to specific users and groups on specific objects. Different users can have different permissions on the same objects. TDAP II applies the User-Level security to the Utilities database.

APPLICATION DESIGN

The design of the TDAP II application is based on the concepts of ease of use, ease of management and administration, and maximum user flexibility. The users can access any TDAP data available from the server data bases on their client PCs, but not change any
data, except with a Change Request. This creates a central point of configuration control for the TDAP administrator and facilitates database integrity. With an object-oriented GUI using software component technology, ActiveX Controls, and open data access, the user has vast capability to quickly and easily create displays, reports, exports, and subsets of any TDAP information, as shown in Figure 3. The user can also choose to save and manipulate data on their client PC in different forms to use in other applications. The GUI was divided into two parts—TDAP Loads and Utilities—for simplicity and efficiency. All TDAP Utilities can be displayed or printed from the tables linked to the Utilities database on the server; and one TDAP load at a time is selected and copied from the pertinent Project database on the server to the client database.

![Figure 3: TDAP II Application Design](image)

Visual Basic 5.0 was chosen as the GUI programming language for several reasons. It is a powerful development environment and one of the fastest, easiest to use, low cost, rapid prototyping tool for GUI screen development. VB applications can make use of component technology to quickly and easily develop a custom GUI using one or more ActiveX component controls. VB can access any open database using the Open Database Connectivity (ODBC) and Structured Query Language (SQL) interfaces. Rapid database development is greatly enhanced using Visual Basic’s data form wizards which generate all the database connectivity required to add, change, delete, update or refresh the data fields displayed on a generated dialog. Finally, VB is now totally compatible with the Microsoft Office suite of applications, which all use Visual Basic for Applications (VBA) as their programming language.
APPLICATION FEATURES

For the sake of simplicity a “Project,” as described in the earlier sections, is synonymous with a “Data Acquisition Stream (DAS) load,” and is also synonymous with a “Program load.” These terms are interchangeable and mean the same thing. The TDAP II Utility Section is a window that contains three tabs and a menu bar consisting of eight menu items. The DAS Program List tab is shown in Figure 4 and displays stream characteristics for each Project database, while the DAS Program Status tab shows other information about each Project such as security classification, availability, etc. The Work Request tab contains internal information on the development of the DAS loads.

![Utility Section]

**Figure 4: Utilities**

The PCM Stream menu item will display the PCM Stream Description window, shown in Figure 5, when selected. All PCM stream characteristics are contained in this display including telemetry wave form, main frame and sub frame structure, frame sync, SFID information, rates, lengths, etc.

TDAP II uses Microsoft Access Reports to format and structure seven different hard-copy layouts of TDAP attributes. These reports are similar to the displays in content and functionality, but contain slightly different TDAP attributes. Each report can be sorted by one of several and unique attributes within that report. When selected, the Report will be automatically printed out on the local or network printer attached to the client PC. Figure 7 displays the content of the report, with each printed page consisting of date, time, TDAP load, type of report, page number, security classification, and column headers (TDAP attributes).
Figure 5: PCM Stream Characteristics

Figure 6: Display Formats
The Subset menu item is a very dynamic and flexible function for the user in that it extracts groups (or subsets of parameters) from a selected TDAP load. Once the user selects the parameters to extract, this subset can be acted upon by the other functions (or menu items) on the menu bar. For example, a subset of 1553 bus parameters from one Mux bus could be created and then displayed using one of the display formats. This function is very useful for examining certain types of parameters, 1553 messages, or entire Mux busses. The Restore Load menu item will restore the entire parameter set of the selected load.

TDAP II is part of an integrated suite of PC applications for robust telemetry data processing at AAC, Eglin AFB. Part of that suite is the Common Airborne Processing System (CAPS), which reduces and EU-converts raw telemetry and instrumentation data streams, including PCM and 1553 data. The CAPS Dictionary menu item will create a CAPS 2.0 dictionary, a comma-separated value (CSV) formatted file, from the selected TDAP load. The data dictionary is needed by CAPS 2.0 to describe the details of the raw input stream conversions to meaningful EU quantities.

The functions of the File menu item in Figure 8 illustrate some of the more powerful and user-friendly features of TDAP II. The Print menu item will automatically format and send any of the displays and/or subsets to a client PC printer. The Print to File menu item
formats and saves any display and/or subset to an ASCII file, which later can be printed, edited, or imported into a Microsoft Office application. The Export menu item will export the entire selected TDAP load to an ASCII file, which is backward compatible with the older VAX VMS version of TDAP. The Help menu item is a fully integrated Windows Help utility that was developed using RoboHELP.

**FUTURE CAPABILITIES**

The client/server environment for the current TDAP II application has certain advantages, such as a built-in level of security. A user must have an account on the LAN in order to use the application. One of the disadvantages is network traffic. If traffic is high, access time to a load could be slow. One of the capabilities the PC provides is the ability to create a stand-alone TDAP II application. The load databases could be stored on compact discs (CDs) which would improve the retrieval time for data requests. The load databases that reside on the CD could still have as much or as little security applied to the stored data as required. Once a library of loads has been created, users could check out the loads they want to work with for a session. The time it takes to access data on a self-contained system compared to a client server application is noticeably improved.

With the release of Visual Basic 6.0 and ADO 2.x, the development of an Intranet or Internet version of TDAP II using Microsoft's multi-tiered model is also an option. Security is always a concern, and in a web-based application it would be a priority. The ability to share information over the net would enhance the dissemination of information among groups, in turn reducing the time needed for data analysis.
The current High Performance Computing (HPC) initiative at AAC includes modernization and upgrades to the Central Control Facility (CCF) mission rooms and ground telemetry stations. L-3 Com Loral 550s and Silicon Graphics Onyx engines are replacing older telemetry systems and DEC VAX mini-computers. This obviously impacts the software, databases, and telemetry setups needed to support current and future testing. The next version of TDAP II will include interfaces to the HPC Loral systems via the Telemetry Attributes Transfer Standard (TMATS). TDAP II version 2.0 is in the Design phase of automatically creating TMATS files from the existing TDAP loads databases. These TMATS files will then be used to create the Loral databases, thereby totally automating the telemetry setup process.

CONCLUSION

TDAP II demonstrates the power of current and future commercial PC hardware and software that is on the desktop. Because of the availability of this PC technology, TDAP II has succeeded in its goal to provide a low-cost, easy-to-use, and scaleable front end database and GUI for ground-station telemetry data reduction. Microsoft Access provides an available, secure, and open database engine to migrate existing, text-based data from as well as allowing for future expansion. Visual Basic is a powerful development environment and one of the fastest, easiest to use, rapid prototyping tools for GUI applications. These two widely available commercial software development products, operating in a PC or heterogeneous client/server environment, allows TDAP II to be used very effectively on a small or large network and in a classified or unclassified environment. The development of an Intranet or Internet version of TDAP II using Microsoft’s multi-tiered model in ADO 2.x and using new releases of Visual Basic and Access are future capabilities of TDAP to meet the 21st century telemetry computing challenges.

REFERENCES
