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14. ABSTRACT

There are many standards available to the telemetry community for internetworking systems together. The bast majority of these standards apply to the movement of data. A standard is needed to define the data itself. However, the format of the data being moved is closely tied to the applications that source and sink the data. This project will focus on defining a structure(s) for the various messages required within a data acquisition network.

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Standard Message Definition

Statement of Need

Naval Air Systems Command
NAWC-AD
Test Article Preparation
Development Division
May 10, 2001

Scope

There are many standards available to the telemetry community for internetworking systems together. The vast majority of these standards apply to the movement of data. A standard is needed to define the data itself. However, the format of the data being moved is closely tied to the applications that source and sink the data. This project will focus on defining a structure(s) for the various messages required within a data acquisition network.

Background

There has been growing interest in fast commercial busses operating via network concepts for the past 3 years. The Next Generation Instrumentation Bus (NexGenBus) project, through a series of trade studies, identified a network-based bus – Fibre Channel – as the likely candidate for future data acquisition systems. Around the same timeframe, packetized telemetry methods were being investigated. The decision was to use the CCSDS standard for Packetized Telemetry. Both of these standards are being adopted by the new release of the IRIG 106 Telemetry Standards (2001). This release marks a milestone in that it contains a new part dedicated to network based data acquisition.

Basis for Need

Data acquisition networks are the future of instrumentation data systems. Fibre Channel (an ANSI standard) has been selected as the next generation instrumentation bus. These airborne data acquisition systems will be using network protocols to move the data around the test article and to the ground. The area that has not been addressed by data acquisition networks yet is the structure of the data it is moving.

The structure of a message is highly dependent upon the type of data it contains. A calibration file will have a structure different from an executable file. Application designers construct the file format based on the type of data and how that data will be used.

A network approach to data acquisition provides opportunities to acquire data using advanced methods. The asynchronous nature of these networks makes it easy to insert new messages as the test conditions change (event driven data). Data acquisition networks also allow for increased connectivity from testing the system in the lab to remotely programming the system on the flight-line. To take advantage of these opportunities the message structure used in data acquisition systems needs to be judiciously defined.

Deficiencies with Current Message Definitions

The biggest deficiency with current message definitions is simply there aren't any developed around networked test and evaluation (T&E) data. With current systems, a central encoder gathers all of the digitized samples and creates a fixed set of messages (PCM minor frames). Each message has an ID number (subframe ID or SFID) that distinguishes it from the others (shown in Figure 1). After each message has been sent in order, the process starts over at the beginning. The number and content of the messages are typically fixed for a given session. Information concerning the processing of the data is handled extrinsically and is unique to each session.

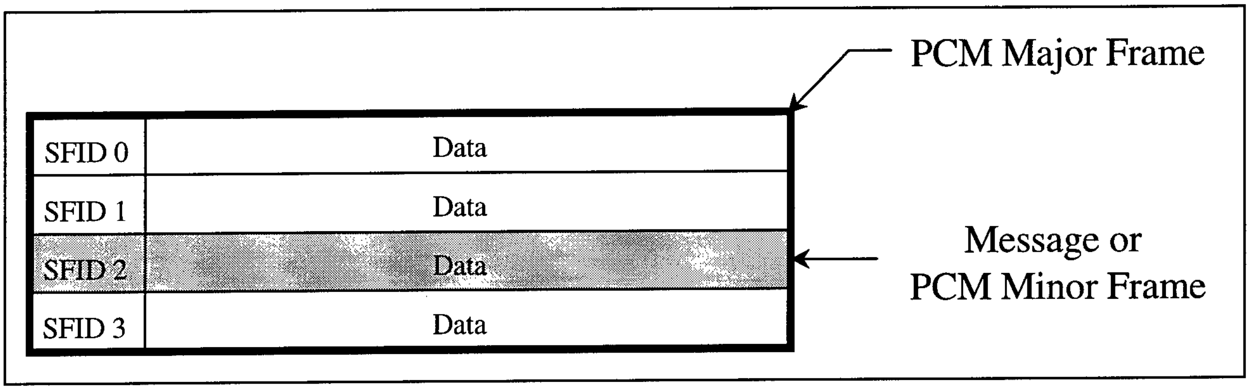

Figure 1 Current Messages (PCM Minor Frames)

Networked data systems allow a dynamic approach to data management that traditional fixed frames cannot easily support. Multiple message types can be defined and transported at any given time. The rest of the system can be producing data messages while one or more units are being programmed. Individual units can change their output data messages through external commands or preprogrammed data thresholds. All of this is easily achievable when a single message structure is defined to handle multiple data types coupled with an asynchronous network bus.

Alternatives

The identified alternatives are discussed below.

Don't define a standard

As with most situations, doing nothing is always an option. Vendors would define a message structure that works best from their point of view and by definition for their products. With homogeneous systems this isn't necessarily a crisis. The ground stations will have specific decoding algorithms for each vendor. For each test, the instrumentation engineer would identify the vendor/message type. This is not an ideal situation, but certainly a workable one.

One of the goals of standardizing the various interfaces within a data acquisition system is to make the components interoperable. Much like buying stereo or computer equipment, a user should be able to buy a bus monitor from one vendor, a thermocouple unit from another vendor, and a bridge conditioner from a third. All three units should work in the same system transferring their data messages to the transmitter or recorder. The ground station would need to identify each vendor's message and apply the appropriate decoding algorithm. Without minimum standards as to how to distinguish one vendor's message from another, interoperability of components becomes useless. Most users would prefer to buy a complete system from a single vendor. However, the real-world scenario is they are piecing a system together based on units currently in inventory or they need to add a specific capability to a current system.

Adopt a current standard

Adopting a current standard requires knowledge of standards in the market. This alternative would include a survey of current message structures with a trade study to choose the best one.

While selecting a standard that is both complete and in use would be the preferred method, there are few, if any, standards that appear to meet our basic requirement of handling T&E data. The limiting factor with this approach lies with the highly coupled nature of the message structure to the application. Data acquisition networks are a new and specialized niche. Finding ready to use message structures, while desirable, may not be realistic.

Adapt a current standard

The purpose of adapting a standard to fit a specific need is to leverage the advantages a commercial standard has to offer – e.g. saving the cost of developing the standard and using the existing user base to keep unit costs down. This approach can work well if the resultant adaptation is a subset of the original. The new standard would restrict the user from utilizing all of the capabilities of the commercial components. Once unique items or capabilities are added to the standard that excludes the use of the existing commercial products, a new standard is effectively being written and the next alternative would apply.

Write a new standard

This alternative is contrary to the trend being seen in DoD standards of late. With interface standards becoming so complex, the DoD generally can't afford, in many senses of the word, to develop their own standards. The trend has been summarized as "Adopt, Adapt, Develop". With the network hardware standards this has been a good approach. However, in defining the message structure, it doesn't appear as important. The data acquisition units must acquire the test data and format it into some message structure. There is no commercial firmware or software that can be leveraged by the developer. Code must be written regardless of the use of a well-known standard or not. Similarly at the ground station where the messages get processed, code must be written to process the data. Utilizing an existing commercial standard does not seem to carry the weight for this project as it has for previous ones.

Inter-Service Cooperation

As data acquisition networks gain ground, this message structure will become as well known to the telemetry community as the IRIG 106 PCM standards are today. This need is shared by all three services and is being coordinated through the Range Commanders Council Telemetry Group (RCC-TG).

Potential Areas of Study

There are at least two areas of study this project should address. The first area is researching current message structures. Two message structure sources come to mind. The first, and potentially more desirable, is standards produced by the well-known standards organizations like the IEEE, ANSI, etc. The second source, and potentially more useful, is other programs that may have similar needs. Though an exact match for this project may not be found, a lot of useful information can be gleaned from both of these sources. One of the more available examples is the EA IFF 85 Interchange File Format. This is what the WAV sound file is based on. The message attributes allow the computer to play the file without any prior knowledge of the file to be known. The format also allows many other types to be defined within the same broad structure. The second area of study is the requirements drivers. There are two broad sources of requirements – the data acquisition network or data source and the ground station or data sink.

Constraints

The introduction of network connectivity into the telemetry community allows many new capabilities, but also requires the community to look beyond its borders. The long view of network technology is that the network on the test article will be connected to the ground network via a telemetry network. This will give complete network connectivity from the data being acquired on the test article to the user's desk. Telemetry data can then be fed directly to simulators and training facilities as the need warrants. Any selection or development of a message structure must therefore take this big picture into consideration.

References

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ANSI X3.297-1997	Information Technology - Fibre Channel Physical and Signaling Interface - 2 (**FC-PH-2**), 1997
ANSI X3.303-1998	Information Technology - Fibre Channel Physical and Signaling Interface - 3 (**FC-PH-3**), 1998
ANSI X3.nnn-200x♦	Information Technology – Fibre Channel – Physical Interfaces (**FC-PI**)
ANSI X3.nnn-200x♦	Information Technology – Fibre Channel – Framing and Signaling (**FC-FS**)
EA IFF 85	Electronic Arts Interchange File Format, 1985

♦ FC-PI and FC-FS are currently in work and will supercede FC-PH, FC-PH-2, and FC-PH-3