

TELEMETRY GROUND STATION OPEN SOURCE DEVELOPMENT

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ABSTRACT

The Central Control Facility at Eglin Air Force Base has acquired full intellectual rights to a single board telemetry card with device driver and test software. This card has an integrated IRIG 106 PCM decommutator, IRIG time clock and minimal PCM simulator capability using the latest in Field Programmable Gate Array technology. Eglin will offer this capability to the telemetry community as both open source hardware and software and solicit partnerships with both government and private industry for both open source and closed source for-profit products.

KEY WORDS

Decommutator, Open Source, FPGA, TMATS, PCM

INTRODUCTION

Through a small business contract, the government has developed a single board telemetry card containing a PCM decommutator, IRIG time clock and simulator. As part of this contract the government received all intellectual rights to the hardware and software. Eglin has decided to release this intellectual property into the public domain for both open source projects and for closed source for-profit development. This paper will cover the specifications of the telemetry card and will discuss the developments that Eglin has planned. Also to be covered are recommendations for potential commercial developments around the card.

OPEN SOURCE TELEMETRY GROUND STATION DEVELOPMENT

1. Hardware Description

The telemetry card consists of a Frame Synchronizer, Time Code Translator, and PCM Simulator. It is based on a generic architecture including a high density Field Programmable Gate Array (FPGA), 128K bytes of look up table memory, 256K bytes of buffer memory and PCI computer interface. The card is plug-and-play compatible supporting both PCI Target and Bus Master modes. The Target mode supports memory mapped and burst mode transfers and the Bus Master mode supports DMA burst transfers at full PCI bus bandwidth.

The IRIG106 Class I/II frame synchronizer operates over a 1bps to 25 Mbps range and has TTL and RS-422 NRZ-L Clock and Data inputs. The following table summarizes the frame synchronizer features:

- Sync Pattern: 4 to 64 bits with masking
- Frame Length: 8 to 65,535 bits/frame up to 16384 words
- Word Length: 4 to 64 bits; MSB/LSB programmable on a word-by-word basis
- Sync Strategy: Search/Check/Lock; 0-15 errors/frames programmable
- Burst Mode
- Polarity: Normal, Inverted, and Auto Detect
- Parity: Test, Strip
- Asynchronous Embedded Formats supported via module chaining

The Time Code Translator supports IRIG B with a flywheel function that can be enabled or disabled. 1 PPS is available as a card output.

The PCM simulator operates over a range of 1 bps to 25 Mbps with TTL clock and data output. Output codes supported are: NRZ-L/M/S, BiPhase-L/M/S and RNRZ-9/11/15 fwd/rev. User defined, waveform, and random data patterns are supported.

Status outputs of Frame Synchronizer search, check, and lock are available to be inserted into the data buffer on a minor frame basis.

The card is expandable through a connector on the card. Bit synchronizers that operate up to 20 Mbps second will be available as a daughter card via this connector. Other cards may be available in the future.

The card FPGA core is downloadable from an on-board PROM or directly from the PCI bus. This allows for the configuration of the module at runtime. This allows for a future capability of developing multiple card personalities.

2. Software Description

Some software has been developed around the telemetry card in a Microsoft Windows only environment. At the time of this writing, the software has not been fully assessed by the government. Known to be included in this software set is a device driver and test software used in the hardware development as well as software for data distribution over a network. The government is planning to assess the software and make a determination of what parts will be converted to a cross platform environment. This initial set of software to convert to cross platform will be the initial basis for the open source distribution.

3. Product Availability

Open source documentation to include card schematics, Gerber files, FPGA core files, software source code and related documentation will be made available on a CD-ROM. Please request CD-ROMs and other materials from Neal Urquhart via email, neal.urquhart@eglin.af.mil.

4. Future Development

Eglin plans a number of uses for the telemetry card. The plan is to start small and build up to more complex uses in time. The following is a list of six proposed open source projects under consideration at Eglin:

- Research cross platform development tools that will allow for shared Linux and Windows source code
- Linux device driver and control store loader that will allow further Linux development
- TMATS (IRIG Telemetry Attributes Standard) loader or converter
- PCM Lock Monitor: The first simple application for the card will be to develop a simple PCM stream lock monitor. This will consist of a GUI screen displaying constant lock status of one or more streams with some level of statistical information. Statistical information could be number of frame lock transitions since last reset or for nn number of seconds.
- Simple Data Logger: A project to record PCM data to disk would be accomplished. The first data format to be supported would be the Digital Data Standard used at the Central Control Facility at Eglin.
- Simple Data Server: A project to create a data server application using the card as the data source. The first application at Eglin for such a server might be to connect to commercial digital stripchart software.

CONCLUSIONS

This project has the potential of placing telemetry hardware in applications that don't need high-end capabilities and where cost is a major factor. For instance, most users could not afford to dedicate costly commercial telemetry systems to such applications as lock monitoring to verify tape recordings. In addition, commercial software vendors that cannot afford the hardware research and development costs to develop their own telemetry hardware may opt to bundle their software with the hardware developed through this project. Presently Eglin AFB is soliciting for government and industry partners to continuing the development of the telemetry card and software. Eglin is looking for companies to manufacture cards at three levels; bare board, board with hard to solder components and complete card. Also Eglin is looking for developers to continue the open source product and commercial vendors interested in bundling their products. Although open source development is encouraged, Eglin is allowing full commercial development of the product.