REDUCTION AND ANALYSIS PROGRAM FOR TELEMETRY RECORDINGS (RAPTR): ANALYSIS AND DECOMMUTATION SOFTWARE FOR IRIG 106 CHAPTER 10 DATA

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ABSTRACT

Solid State On-Board Recording is becoming a revolutionary way of recording airborne telemetry data and IRIG 106 Chapter 10 "Solid State On-Board Recorder Standard" provides interface documentation for solid state digital data acquisition.

The Reduction and Analysis Program for Telemetry Recordings (RAPTR) is a standardized and extensible software application developed by the 96th Communications Group, Test and Analysis Division, at Eglin AFB, and provides a data reduction capability for disk files in Chapter 10 format. This paper provides the system description and software architecture of RAPTR and presents the 96th Communication Group's total solution for Chapter 10 telemetry data reduction.

KEY WORDS

IRIG 106, Chapter 10, Solid State Recorder, Recording, MIL-STD-1553, PCM, Data Reduction, Decommutation, PC, DDS, CAPS

INTRODUCTION

The Range Commanders Council (RCC) Telemetry Group (TG) has added Chapter 10 ("Solid State On-Board Recorder Standard") to IRIG 106 in order to standardize interfaces (Data Download and Electrical Interface, Interface File Structure, Data Format Definition, Solid State Recorder Control and Status and IEEE 1394B Interface) for solid state digital data acquisition and on-board recording systems.

RAPTR provides a user-friendly Graphical User Interface (GUI) environment to extract and analyze MIL-STD-1553 messages and Pulse Code Modulation (PCM) data from Solid State Recorder (SSR) telemetry recordings. In addition, RAPTR is extensible so that adding other

Chapter 10 data types (e.g., video, image and fire wire data) for reduction and analysis can be rapidly achieved.


SYSTEM DESCRIPTION

RAPTR is PC-based software running on both Windows (XP, 2000) and Red Hat Linux (v7.3 and v8.0) and requires a 200 MHz or above Pentium processor with 32 MB of memory.

The primary function of RAPTR is to extract MIL-STD-1553 messages, PCM and Chapter 8 PCM data as recorded on a disk file and report them into one or more Digital Data Standard (DDS) files. The DDS is a binary digital data standard used throughout the 96th Communications Group—a format required for follow-on processing with the Common Airborne Processing System (CAPS) application. A secondary function of RAPTR is to serve as an instrumentation data diagnostic tool. It provides information concerning the SSR format, as well as detailed stream specific information for both messages and frames. Figure 1 depicts input and output requirements:


Figure 1. Input and Output Files

RAPTR installation is distributed either from a network or on a single Compact Disk (CD). Figure 2 displays the main interface of RAPTR once installed and launched
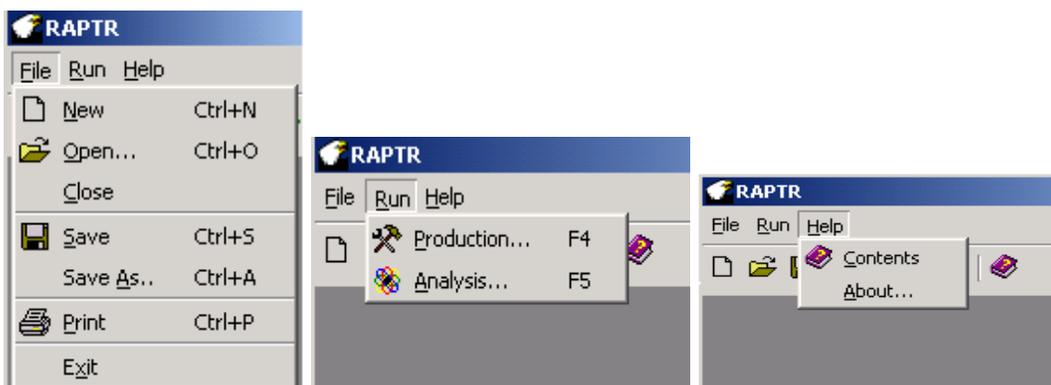

Figure 2. Main Interface

In order to process a recording, the message, PCM and project setups are required. The dialog box in Figure 3 is used to create a new MIL-STD-1553 message setup or modify an existing one. The user may specify messages of interest to be selected or deleted for output. The user can enter

either a command word or its four fields—Remote Terminal Address (RTA), Transmit/Receive Bit (T/R), Sub Address (SA) and Word Counts (WC).
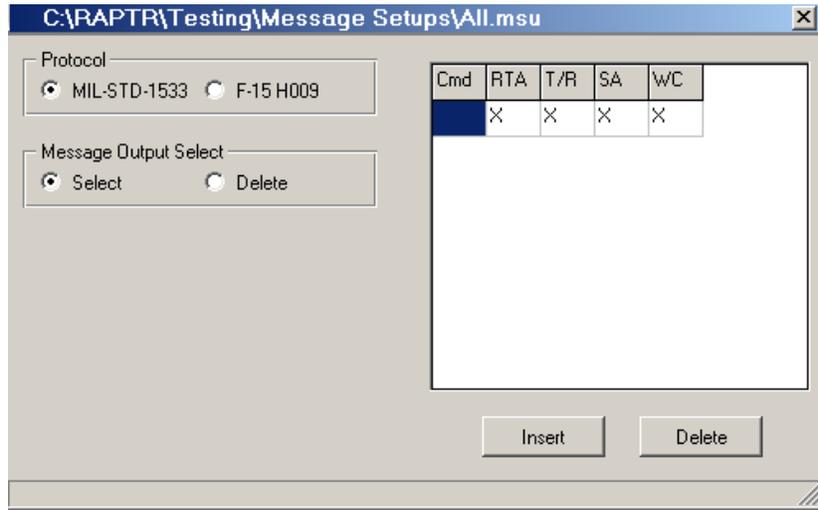

Figure 3. Message Setup

A PCM setup describes the frame structure of a PCM channel. The information is used to divide a bit stream into words and frames. Figure 4 displays the PCM setup dialog. It defines the rate of the PCM bit stream, the minor frame synchronization pattern and the number of bits, the number of bits per word, the number of words in a minor frame, the number of minor frames in a major frame and other PCM channel characteristics.
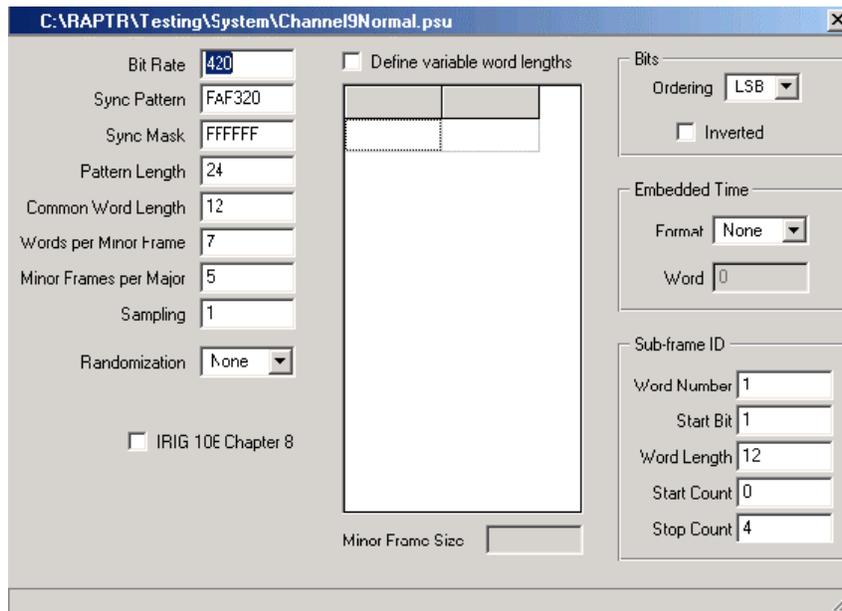

Figure 4. PCM Setup

A project setup selects the names and options of input and output files. It is composed of three tabs: Mission, Channels and Options. In the Mission tab (Figure 5), the user selects the reference time from a time packet, the input data file and the index file. An index file is an internally generated file that allows direct access to a channel's data stored on the disk file.
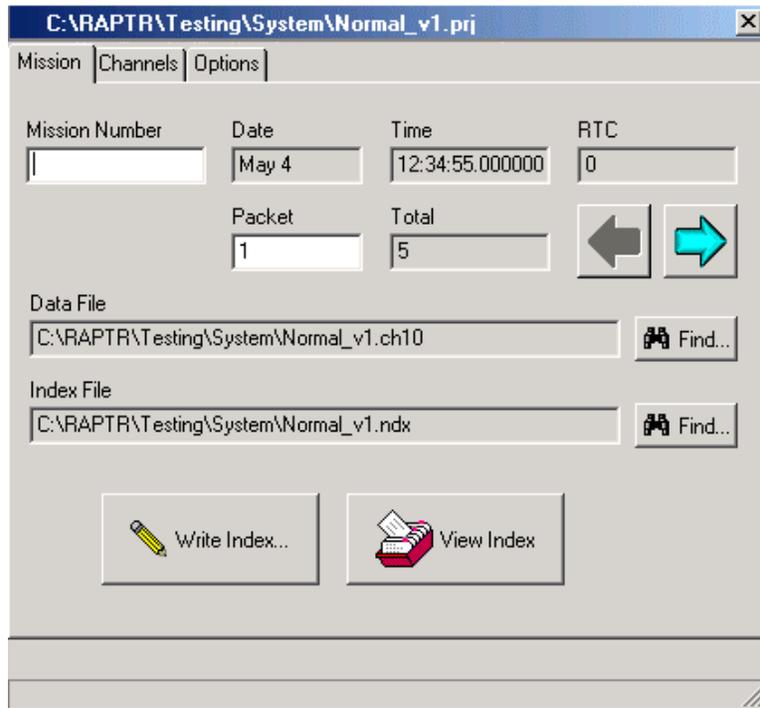

Figure 5. Project → Mission Setup

In the Channels tab (Figure 6), the user selects which channels to process from a list of channels available in the input data file and associates a message or PCM setup file to a channel.
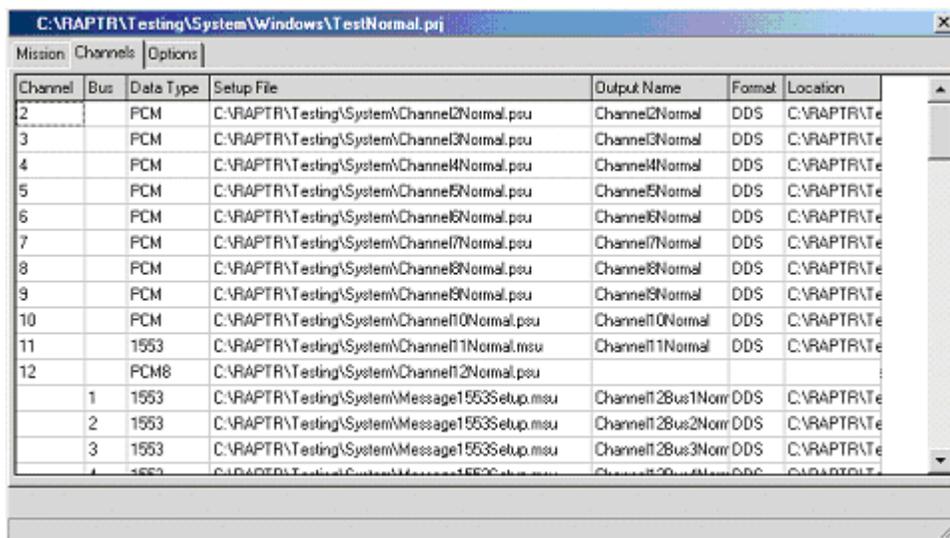

Figure 6. Project → Channels Setup

In the Options tab (Figure 7), the user chooses options for processing the input data file and for writing the output files.
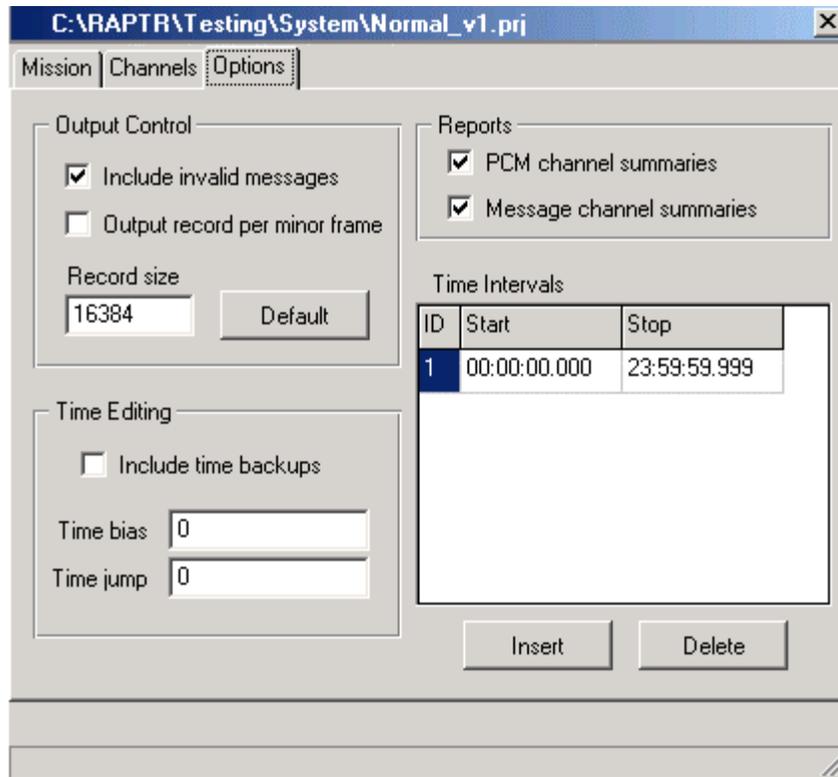

Figure 7. Project → Options Setup

Once the setups are complete, the user has two project execution options: Production mode or Analysis mode. Project execution is involved with the task of actually processing a data recording and includes viewing the mission data in numerous ways, in addition to controlling the progress of execution. The two options differ in degrees of insight into and control of the data reduction process. Production mode (Figure 8) offers the user a faster means to process a recording. It displays the data at a channel level.
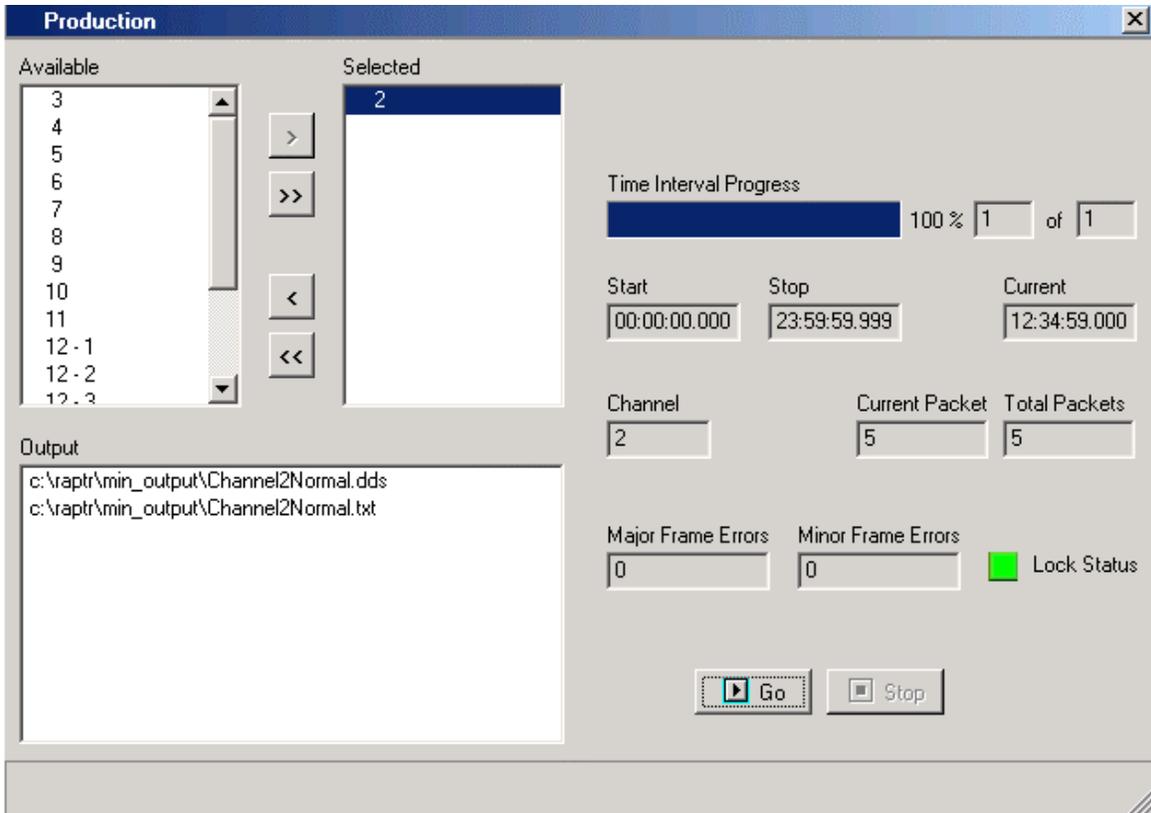
Figure 8. Run | Production Mode

Analysis mode (Figure 9) provides the means to analyze and process a recording. It offers data displays at the packet, frame and message levels.

- Status tab: Displays information about the packet currently being processed.
- Packet tab: Displays the packet currently being processed. Displays a 16-bit hexadecimal dump of all the data in the packet body beginning with the Channel Specific Data word.
- Frames tab: Displays the PCM major or minor frames from the channel currently being processed. A frame is listed if its time falls in a selected time interval.
- Messages tab: Displays the messages from the channel or bus currently being processed.
- Summary tab: Provides a breakdown, summarized by Command word, of the messages from the channel or bus that have been processed. There is also a list of selected messages that have not been output as of the current time.
- TMATS tab: Displays the contents of the TMATS (Telemetry Attributes Transfer Standard) packet from the recording.
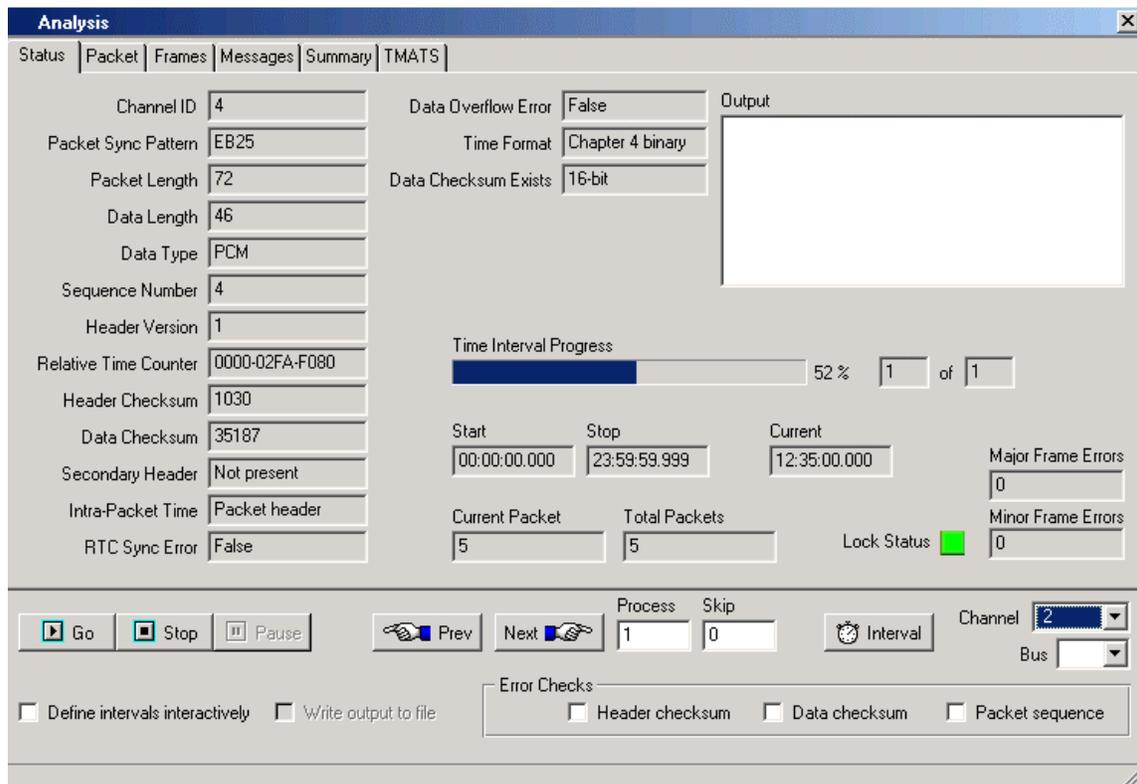
Figure 9. Run | Analysis Mode → Status

SOFTWARE ARCHITECTURE

The RAPTR software was designed using an object-oriented methodology and developed in Borland's C++ Builder on Windows and its cross-platform tool, Kylix, on Linux. It has two major components: a graphical user interface and decommutation. A simplified static class diagram is shown in Figure 10. The software utilizes many object-oriented methods, such as data abstraction, information hiding and polymorphism for ease of maintenance.

The ProcessingController class is executed in a separate thread. It receives the commands from "TProductionDisplay" and "TAnalysisDisplay" and handles the processing of the data file. TMdiBaseForm is an abstract base class used to setup interface classes. DataChannel is an abstract base class for processing data packets from a particular data channel. ProcessingController class interacts with both user interface and decommutation classes. It receives commands from "display" classes and handles the processing of the data file in a separate thread. As the data file is processed, it sends status messages to the ProcessingStatus class for display updates.

As with other object-oriented programs, the functionality of RAPTR is easily extensible. For example, adding a capability to decommutate another Chapter 10 data type, "Image data," would require two classes to be added for the user interface ("TImageSetupForm" and "ImageSetup") and two for decommutation ("ImageChannel" and "ImageData").

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Figure 10. Class Diagram

IRIG 106 CHAPTER 10 SOLUTION

This section introduces the total solution the 96th Communications Group presents to the test and training community for Chapter 10 data analysis and reduction. As noted earlier, the Chapter 10 data is stored in a disk file and is used as input to the RAPTR application. After the execution, one or more DDS binary files are generated. These DDS files are used as input to CAPS for further data reduction to extract and convert parameters into desired engineering units. This is achieved through CAPS by creating a parameter dictionary describing the raw data structure and output product description. The CAPS output is presented in one of the four file formats: ASCII, binary, DDS, or MATLAB. Figure 11 describes a flow of the complete Chapter 10 data reduction and analysis capabilities at the 96th Communications Group:
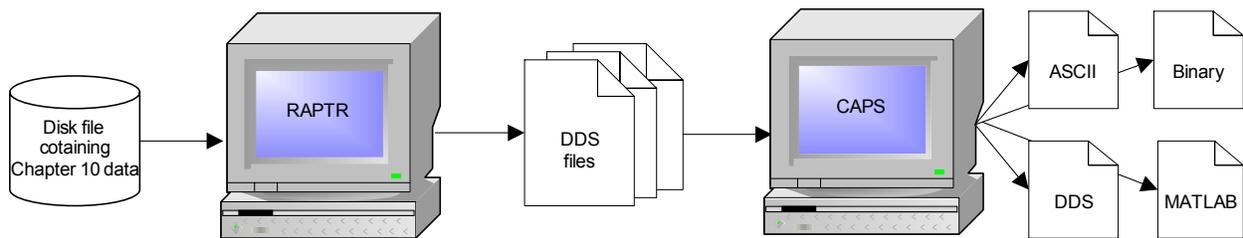
Figure 11. IRIG 106 Chapter 10 Data Reduction Solution

CONCLUSION

This paper has presented the capabilities of RAPTR in analysis and decommutation of IRIG 106 Chapter 10 data. One of the challenges that the RAPTR development team experienced was the instability of the Chapter 10 standard itself. The Telemetry Group of the Range Commanders Council is continuously working to improve the standard by optimizing interfaces, clarifying the definitions and adding new data types and formats. With a sound and flexible software design, more capabilities will be added to RAPTR as our needs grow at the 96th Communications Group.

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