EXTENDING CHAPTER 10 RECORDING WITH TELEMETRY NETWORK STANDARDS

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ABSTRACT

RCC 106 Chapter 10 has established the standard for interoperable flight test recording on the DOD ranges. The growth of network and distributed technologies in flight test instrumentation (FTI) has led to the recent adoption of Chapters 21 through 28 to provide standards for implementing interoperable telemetry networks. However, the new standards have led to confusion and concern that the investment in Chapter 10 recorders will be lost. This paper first clarifies the complementary nature of the RCC 106 chapters and proposes one possible path to extending the current capability of a Chapter 10 recorder with telemetry network capability while minimizing impact to existing recording and support systems.

KEYWORDS

Chapter 10, recording, TmNS, network

INTRODUCTION

RCC 106 Chapter 10 has established the standard for interoperable flight test recording on the DOD ranges. The success of the standard has provided interoperability between airborne and ground recorders across the distributed range infrastructure and across vendors. This commonality has allowed the development of standard data processing and analysis tools for use in ground stations. By leveraging the standard, the return on the investment by the ranges in these systems can be maximized.

The growth of network and distributed technologies in flight test instrumentation (FTI) has provided the benefits of flexibility, scalability, and compatibility with prevalent computing capabilities. In order to achieve interoperability with network FTI similar to what has been achieved with Chapter 10 recorders, the RCC adopted Chapters 21 through 28 in the 2017 IRIG 106 standard release to provide standards for implementing interoperable telemetry networks.

With these standards now in place test programs and vendors have a common target to allow maximizing the return on the investment in network technologies.

However, the new network standards have led to confusion and concern that the investment in Chapter 10 recorders will be lost. This paper first clarifies the complementary nature of the RCC 106 chapters and proposes one possible path to extending the current capability of a Chapter 10 recorder with telemetry network capability while minimizing impact to existing recording and support systems.

CHAPTER 10 RECORDER OVERVIEW

The Chapter 10 recorder standard covers the wide breadth of instrumentation types while providing a uniform recording format and data download interface to allow a standard set of data processing and analysis tools. To achieve this, the standard covers the key aspects of a recorder including recording file format, packet structure, recorder control and status, and data download interface. Figure 1 provides an overview of the functionality covered by the Chapter 10 standard and the interaction between each function. The standard has evolved and expanded over multiple years and thus grown in complexity. To help manage this complexity the standard was restructured in the 2017 release by separating the data format definition, with all of the instrumentation type-specific features, into a standalone Chapter 11. Likewise, recorder control and status was consolidated into the existing Chapter 6. For simplicity, this paper will simply refer to a "Chapter 10" recorder to match the terminology used in the industry.

The Chapter 10 recorder collects acquired data and multiplexes it into a series of packets for storage. The packet types cover numerous specifc input types including PCM, analog, MIL-STD-1553, and ARINC 429. In addition to the data packets, additional time and computer generated packet types are used to contain additional information about the recorded data and allow multiplexing of multiple data streams, data search, and data protection. The stream of packets are stored on the media. While the standard does not mandate a specific storage approach on the media, it does mandate a specific file system and file structure that is derived from STANAG 4575 be presented to the user through the required data download interface. This data download interface is available over either FibreChannel or FireWire from the On-Board recorders and Ethernet for the Ground-Based recorders.

The data interoperability is achieved through a tightly defined packet, file, and directory structure. In fact, much of the standard wording for Chapters 10 and 11 are focused on these areas.

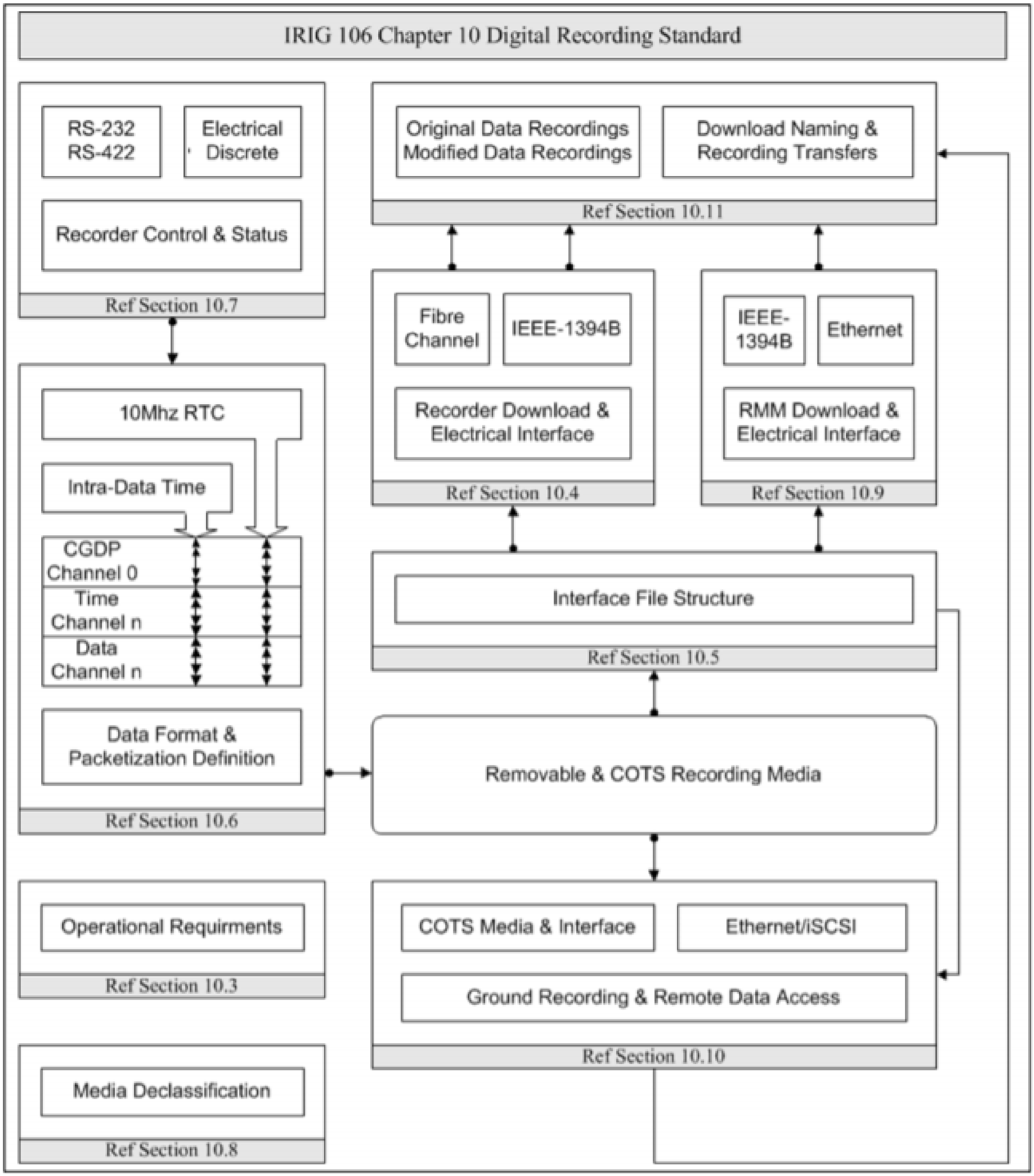

Figure 1. Chapter 10 Functional Breakdown [1]

TMNS INTERFACES OF INTEREST

The network standards defined in Chapters 21 through 28 of IRIG 106 collectively are referred to as the Telemetry Network Standard (TmNS). The TmNS is focused on interoperable network interfaces between components for data transfer, timing, configuration, control, and status. The TmNS interfaces leverage the Internet Protocol (IP) at their root and so are compatible on any physical medium that supports IP transport. In addition, Chapters 27 and 28 specifically define a two-way network telemetry to provide end-to-end IP network connectivity between the test articles and the ground stations.

While a recorder is clearly an important component of a test system, the TmNS does not focus on a recorder (or any other component). Instead it defines standard interfaces that can be used on a recorder (or any other component) to achieve the required functionality of that component. In fact, besides a few references to a recorder as an example to explain the use case of a particular interface defined in the TmNS, the only other mention of recorder is in the tmnsRecorder portion of the Management Resources. Some of the TmNS interfaces of interest to a recorder include:

Interface	*Recorder Use*
TmNSMessage [2]	Provides packet structure for transporting acquired data including IEEE 1588 timestamp
Reliability Critical (RC) Delivery Protocol [3]	Provides a data retrieval mechanism for transferring TmNSMessages
Metadata Description Language (MDL) [4]	Provides configuration of recorder resources
tmnsTmaCommon and tmnsRecorder Management Resources [5]	Provides status of recorder and control of recording state

EXTENDING CHAPTER 10 WITH TMNS

Concern has been raised by Chapter 10 recorder users that the emergence of the TmNS chapters of IRIG 106 will cause changes that risk the large investment in Chapter 10 recorders and associated processing and analysis tools. However, since much of the interoperability required for the installed base of tools relies on the packet and file formats specified in Chapter 10 (and 11) and since the TmNS chapters do not address recording or file format at all, we believe that these concerns can be alleviated. The interfaces specified in the TmNS are complementary to the requirements specified in the Chapter 10 portions of the IRIG 106 standards and thus should not conflict. Also, the interfaces in the TmNS portion of the standards are intended to be a “menu” of interfaces, not what is required of any particular component. Component specifications external of the standard are intended to specify which interfaces are required for a particular component.

An initial start to extending Chapter 10 recorders with TmNS capabilities is to add the RC Delivery Protocol. This will allow retrieval of data recorded in the usual Chapter 10 recording approach to be made available to other TmNS-based consumers through TmNSMessages. Since the recorded file format and existing Chapter 10 data download interface would remain unchanged then typical Chapter 10 processing and analysis would continue as usual.

Once the recorder is capable of producing TmNSMmessages through the RC Delivery Protocol, the natural next extension would be to support configuration through MDL. This will allow configuration of the TmNSMessage shapes produced by the recorder and other parameters needed by TmNS consumers. Adding system management support through the tmnsTmaCommon and tmnsRecorder management resources and associated interfaces in Chapter 25 will allow the Chapter 10 recorder to be consistently managed with other TmNS-based components.

Since the current Chapter 10 standard supports acquisition and recording of Ethernet inputs and since TmNSMessages are typically transported on Ethernet, the Chapter 10 recorder currently can record TmNSMessages. For further extension, the Chapter 11 data formats could be extended to have native TmNSMessage support which would allow indexing into the data based on the TmNS-specific parameters such as MDID and PDID and would also reduce storage requirements slightly by not having to record the Ethernet or UDP/IP headers.

CONCLUSION

The investment in Chapter 10 recorders has led to interoperability and tool reuse across the range infrastructure. As the new capabilities provided by the recent addition of network telemetry through the TmNS chapters of IRIG 106 are leveraged it is important to not lose the investment in Chapter 10 recorders. This paper has illustrated how the TmNS is complementary in nature and suggested ways to extend Chapter 10 recorders with these capabilities without losing the current mission of the recorders. These are just some of the possibilities and the needs of the test community will drive which combination of TmNS interfaces will become prevalent on future recorder upgrades.

REFERENCES

[1] "Digital Recording Standard", IRIG RCC 106-17 Chapter 10, August 2017.

[2] "Message Formats", IRIG RCC 106-17 Chapter 24, August 2017.

[3] "TmNSDataMessage Transfer Protocol", IRIG RCC 106-17 Chapter 26, August 2017.

[4] "Metadata Configuration", IRIG RCC 106-17 Chapter 23, August 2017.

[5] "Management Resources", IRIG RCC 106-17 Chapter 25, August 2017.