LS-28-DRSM Multi-Mode Modular Receiver

Chapter 10 Software Application User's Manual

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Acronyms

CH10 – Chapter 10

DRSM – Dual Receiver System Modular

Gbps – Gigabits per Second

GUI – Graphical User Interface

HDD – Hard Disk Drive

Hz - Hertz

ICD - Interface Control Document

IP - Internet Protocol

IPv4 – Internet Protocol Version 4

IRIG - Inter-Range Instrumentation Group

LED - Light Emitting Diode

MTU – Maximum Transfer Unit

OS - Operating System

PC – Personal Computer

PCM - Pulse Code Modulation

RFC – Request for Comments (Internet Documents)

RRC – Range Receiver Council

SSD – Solid State Drive

SW - Software

TCP - Transmisson Control Protocol

UDP – User Datagram Protocol

TMATS- Telemetry Attributes Transfer Standard

1 Introduction

1.1 General

The following document contains information on the Lumistar LS-28-DRSM multi-mode modular receiver IRIG-106 Chapter 10 software application designed by Lumistar Inc. The intent is to familiarize the user with the software application's design and operation, it's interaction with the primary LS-28-DRSM control software application, and the resulting data streams and recording files. This document is supplemental to the primary LS-28-DRSM User's manuals and is not intended to replace the functionality of this document.   Primary operations of the LS-28-DRSM are described through its associated documentation.

This document is not intended to define and illustrate the details of the IRIG-106 Chapter 9, 10 or 11 specifications. Please consult the IRIG standards and other resources for a further understanding of these specifications.

This document is not intended to define and illustrate the detailed communications protocol of the LS-28-DRSM necessary for independent software development. This information can be found in the device **Interface Control Document** (ICD). The document number is DOC-28M-01-ICD-*xx* where the *–xx* is the documentation revision number.

1.2 Document Outline

This document contains the following sections:

- Section 1 provides a document overview
- Section 2 provides a brief on IRIG Chapter 10 implementation in the LS-28-DRSM environment
- Section 3 provides details of the Chapter 10 Software Application Operation

The document will occasionally utilize document flags to highlight important factors.   These flags can appear in any location and relate to any topic. A document flag will always be placed in close proximity to pertinent information. Document flag examples appear in Figure 1-1 Document Flag Formats.

Warning:

(Critical Device Operational Information)
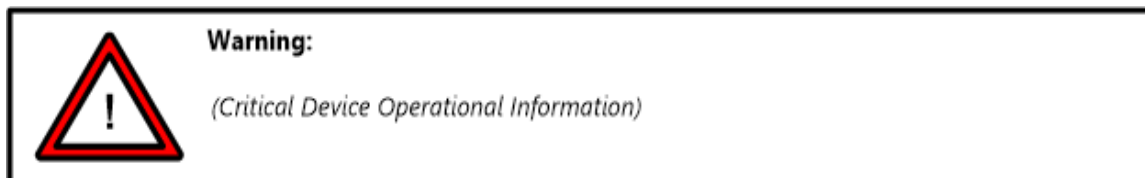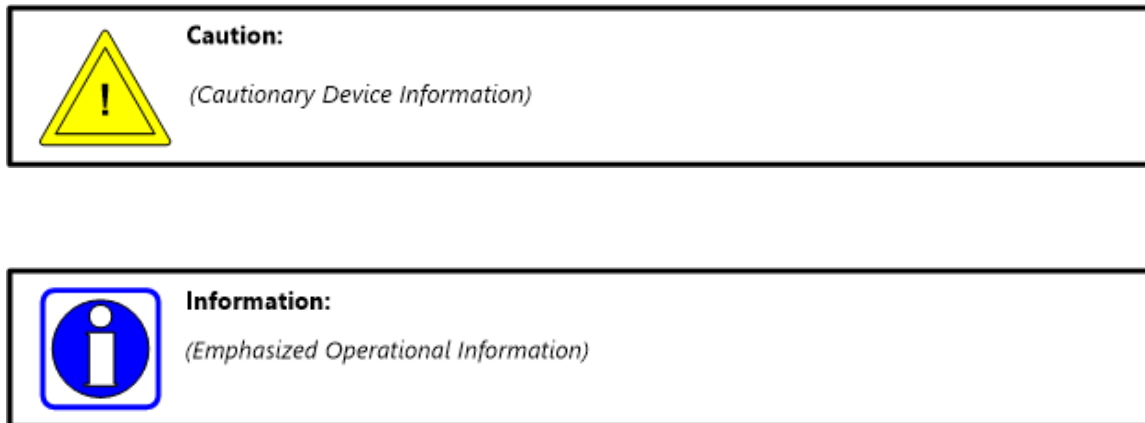
Figure 1-1 Document Flag Formats

Throughout this document, the abbreviation "CH10" is used interchangeably to refer to applicable portions of the RCC IRIG 106 Standards Chapters 9, 10 and 11.

1.3 List of Referenced Documents

A number of documents are references within this document. A list of these documents follows:

- Lumistar LS-28M Interface Control Document: (DOC-28M-01-ICD-06)
- Lumistar LS-28M Alternate Control Interface Document: (DOC-28M-01-ACI-01)
- Lumistar LS-28-DRSM Users Manual: (DOC-28M-01-USM-06)
- Telemetry Attributes Transfer Standard (TMATS): (RCC IRIG 106-17 Chapter 9)
- Digital Recording Standard: (RCC IRIG 106-17 Chapter 10)
- Packet Format Standard: (RCC IRIG 106-17 Chapter 11)
- IRIG Serial Time Code Formats: (IRIG-200-2016)
- User Datagram Protocol: (RFC 768)
- Transmission Control Protocol: (RFC 793)
- Host Extensions for IP Multicasting: (RFC 1112)
- IANA Guidelines for IPv4 Multicast Address Assignments: (RFC 5771)

Document updates occur over time. Consult the factory for the latest versions of Lumistar generated documents. Industry standards can be found via the Internet.

2   Chapter 10 Streaming and Recording

This document section will examine the architecture and design of the IRIG-106 Chapter 10 processing performed for the LS-28-DRSM product line.

2.1 General Description

The LS28_CH10 application is a Microsoft Windows® software application. This software can be operated in any of the versions of the Windows operating system listed in Figure 2-1.

Supported Operating Systems:

Windows 7 x86/x64   Windows Server 2008
Windows 8 x86/x64   Windows Server 2008 R2
Windows 8.1 x86/x64   Windows Server 2012
Windows 10 x86/x64   Windows Server 2012 R2
                                    Windows Server 2016

Figure 2-1 LS28_CH10 Application Operating System List

The LS28_CH10 software application is a licensed software option for the LS-28-DRSM product used to receive, translate, archive, and re-stream native LS-28-DRSM real-time data in an IRIG 106 Chapter 10 format.   The LS-28-DRSM *does not* natively stream data formatted per the IRIG 106 Chapter 10 specification (abbreviated through this document as CH10).   Lumistar developed this application to address this need.

Information:

The LS28_App and the LS-28-DRSM does not natively stream in IRIG Chapter 10 format.

When one refers to the Chapter 10 specification, this is a rather generic reference. The "generic" Chapter 10 reference is typically in reference to a composition of portions of several different and evolving IRIG 106 chapters. The Chapter 10 portion of the 106 specification has been dedicated to the "Digital Recording Standard".   This standard adopted the Chapter 9 "Telemetry Attributes Transfer Standard" (TMATS) as a header for its streamed data.   In 2017, the IRIG documentation added Chapter 11 which helps to further define chapter 10.6 sections for "Data Format Definitions".

In addition to the complex use of several different chapters within the IRIG specification, Chapter 10 contains many complexities and covers multiple data sources and applications. It is beyond the scope of this document to examine the depths of these chapters. The LS28_CH10 application only serves a very small distinct portion of the overall chapter. **This application only serves the CH10 PCM "throughput mode" and does not provide more complex processing**.

> **Warning:**
> The LS28_CH10 application provides for PCM "Throughput" mode processing ONLY. It does not provide for more complex processing formats

2.2 Integration Details

To illustrate the data flow through the LS28_CH10 application, refer to Figure 2-2. The LS28_CH10 application contains software components that act in the traditional role of a software data server and a software data client. Data arrives at the application is a predetermined datagram format which provides for maximum network data transfer efficiency from the accompanying LS-28-DRSM server. This efficient LS-28-DRSM data transfer format includes 1384 bytes of data plus 32 bytes of data packet header. When coupled with the UDP and IP overhead, all chapter 10 streaming datagrams **from** the LS-28-DRSM data server appear as 1458 byte packets on the network, the maximum transfer unit for the LS-28-DRSM and very near the IPv4 MTU limit. This datagram size is the same for all transmissions that are directed to the LS28_CH10 application when operating in the Decommutator IRIG Ch10_Mode.

Once the LS28_CH10 application software receives the streamed datagrams at its client port from the LS-28-DRSM network hardware, it reformats the received data into IRIG 106-17 Chapter 10 format and then either writes the data to the host disk as a .CH10 archive file, re-streams the data in Chapter 10 format, or performs both simultaneously. If streaming is selected, the server section of the application software allows the utilization of either Unicast or Multicast IP address modes as programmed by the user in data server portion of the application.

It is important to note that the LS28_CH10 application allows for a great deal of flexibility. The fact that the LS-28-DRSM streams data to a network application makes updates due to changes in the specification or the addition of capabilities a simple matter of updating the application software itself and does not require updates to the operating firmware of the LS-28-DRSM. Additionally, this software can be hosted on the same platform as the LS28_App control software or it can be hosted on an independent platform that has access to the same network data stream. This allows the customer to perform data storage on a dedicated platform which may contain the appropriate physical storage provisions. This software does not necessarily require a network switch for data transfer. Consult Figure 2-3 for a diagram of the application software hosting options.
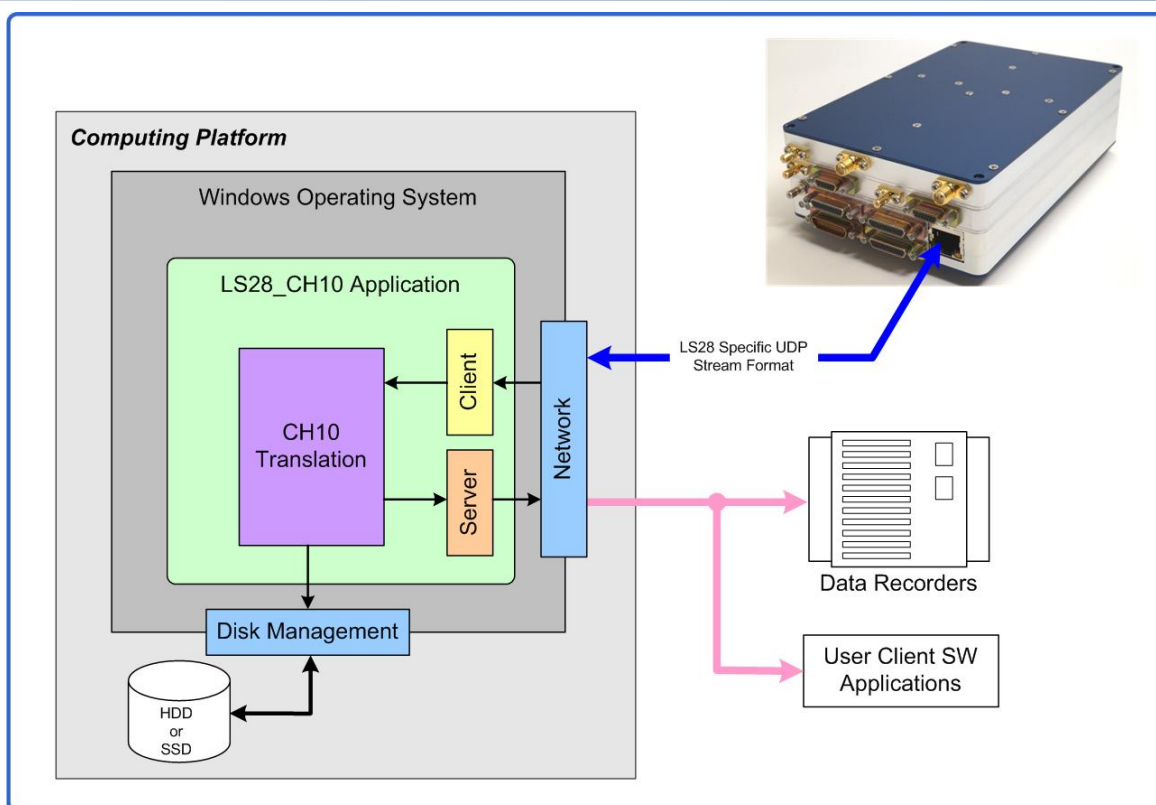
Figure 2-2 LS28_CH10 Application and Data Flow
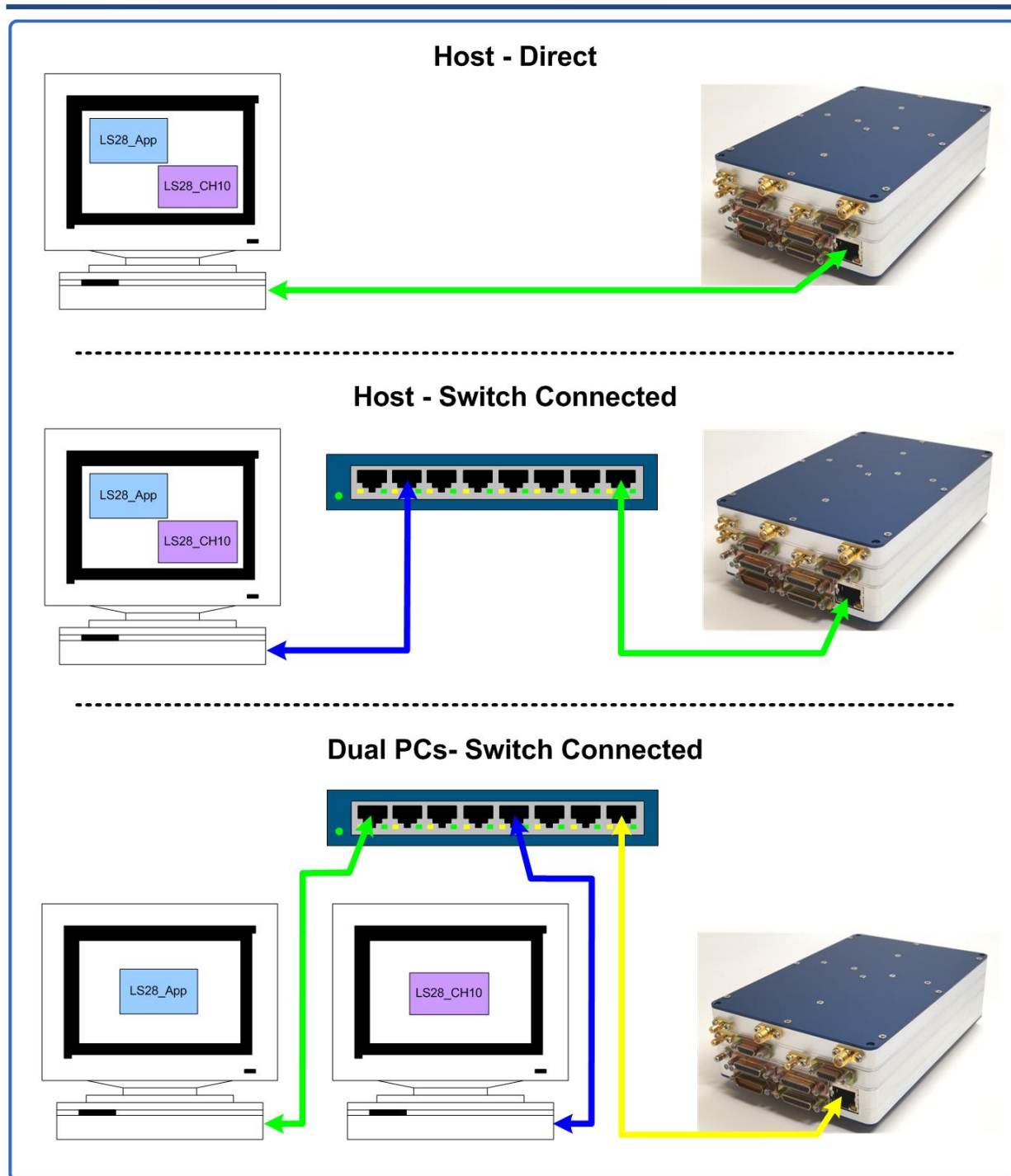
Figure 2-3 LS28_CH10 and LS28_App Application Software Hosting

Although it is beyond the scope of this document to detail the Chapter 10 data frame format, a simple diagram is provided for reference. See Figure 2-4 for a basic diagram of the Chapter 10 data transfer format.
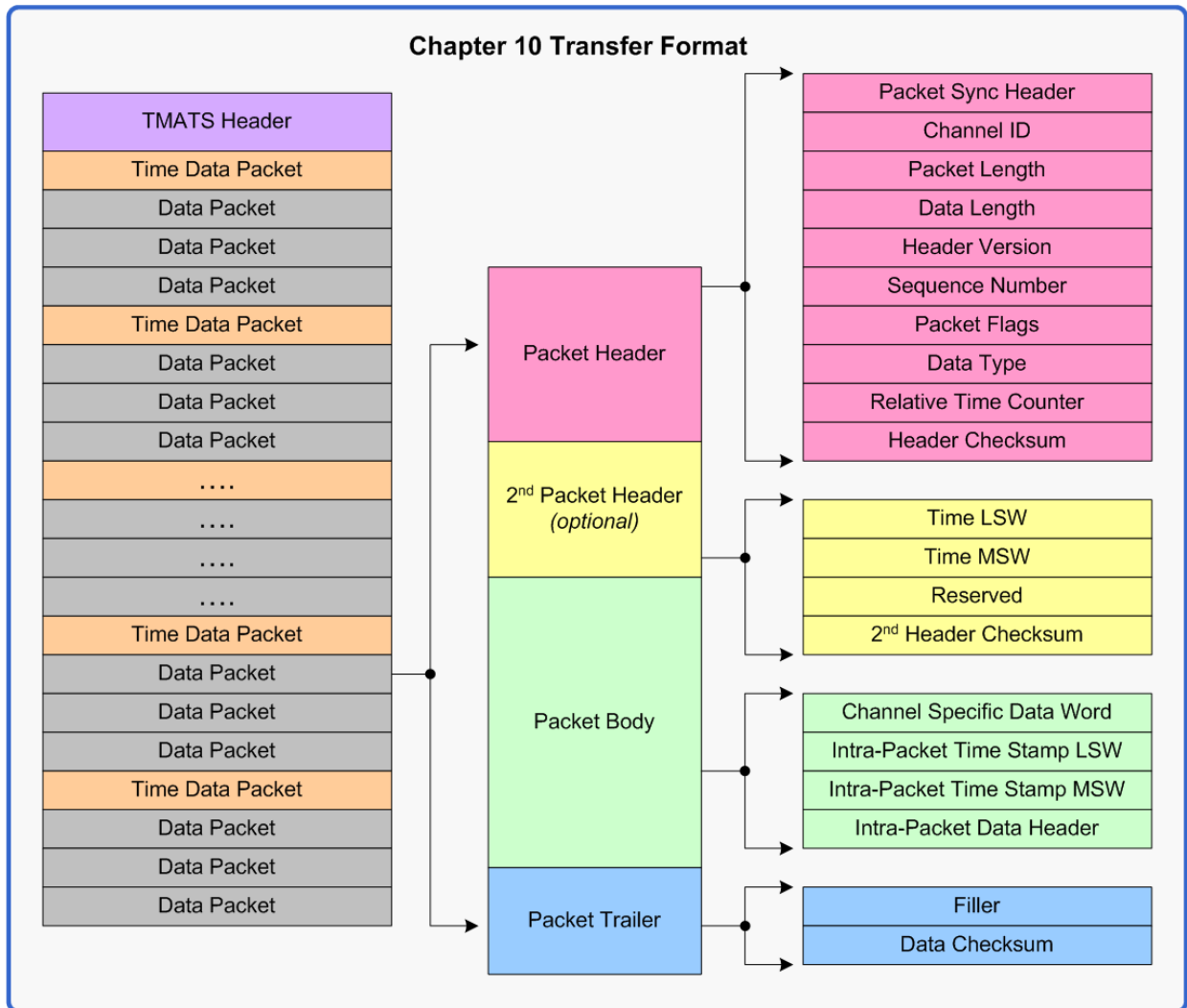
Figure 2-4 Basic Chapter 10 Transfer Format Diagram

The CH10 data frame transfer format for PCM data is composed of thee major components: a TMATS header, a time packet, and data packets. The TMATS (Telemetry Attributes Transfer Standard) header informs the receiving agents about the content of the data that is being transferred. A TMATS header is provided at the beginning of each data transfer package. Per the specification, the time packets must inserted at a minimum of a 1Hz rate.   No data packet generated may contain more than 100msec worth of data. Refer to the IRIG Chapter 9, 10 and 11 documents for further details.

3 LS28_CH10 Application Software Operations

This document section outlines the operational aspects of the LS28_CH10 application software.

3.1 Application Software Installation and Prerequisites

In order to use the Chapter 10 application software, several prerequisites must be satisfied for successful operation:

1. The associated LS-28-DRSM must be licensed for decommutation and IRIG time reader functions. If the LS-28-DRSM does not allow for real-time data streaming in IRIG Chapter 4 format, no Chapter 10 streaming can be achieved. Consult the ***INFO – License*** tab on the LS28_App for details on the licenses available for the target LS-28-DRSM.
2. In addition to the requirement for IRIG Chapter 4 real-time streaming, the associated LS-28-DRSM must contain an additional license allowing for the Chapter 10 streaming option. Without this license, no Chapter 10 connections can be achieved with the associated LS-28-DRSM hardware and LS28_CH10 application software.
3. There must be a network connected host that contains an operational copy of the LS28_App software application. This application must be version 1.10.10 or newer.
4. There must be a network connected host that contains an operational copy of the LS28_CH10 software application version 1.01.02 or newer. This host can be the same host which contains the LS28_App software application or it can be an independent host.
5. If the hosts for the LS28_App and the LS28_CH10 application are on separate platforms, the hosts must be able to communicate with one another. Specifically, the host containing the LS28_CH10 application must have folder access (sharing) to the LS28_App user setup files. Using the default installation folder assignments, this folder would exist at the following directory: ..\Lumistar\LS28M\User\SetupFiles. If alternate installation directories were selected, variations to this directory path will differ accordingly. Based on the OS being utilized, techniques for allowing platform to platform communications may vary. Consult an IT administrator.
6. There must be a Windows firewall "Inbound Rule" that allows the LS28_App access to any and all ports on the applied network under any protocol.
7. There must be a Windows firewall "Inbound Rule" that allows the LS28_CH10 access to any and all ports on the applied network under any protocol.

> **Information:**
>
> Installations on independent hosts will require folder sharing privileges.

3.2 LS28_App Control Software Setup

In order to use the Chapter 10 application software, associated software controls and setup must be initialized using the LS-28-DRSM LS28_App. All application support needed for the LS28_CH10 application

software can be found on the **DATA – Frame Sync** and the **DATA – Decom** tabs.   These two tabs are referenced in Figure 3-1 and Figure 3-2 respectively.
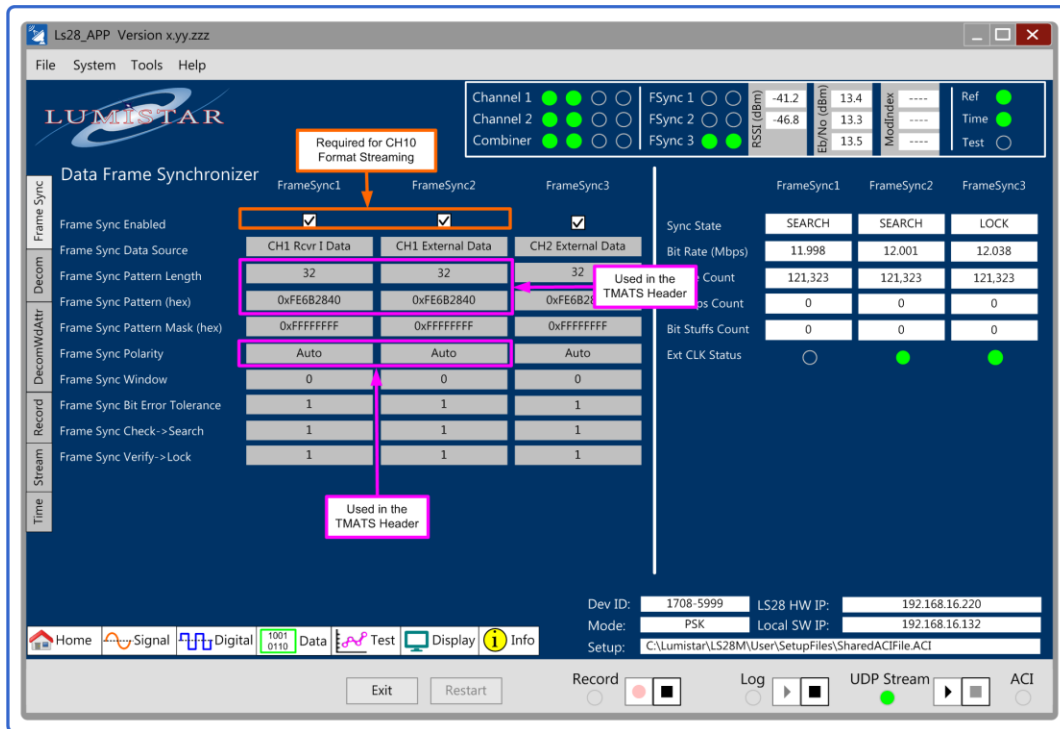

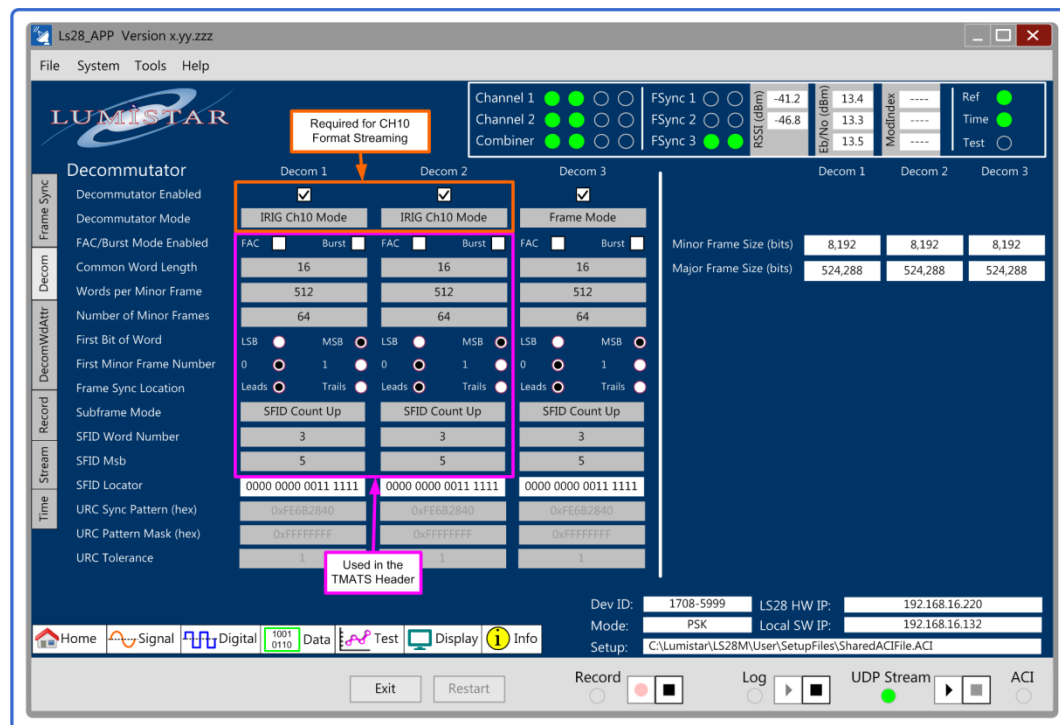**Figure 3-1** LS28_App DATA-Frame Sync Tab: CH10 Support Fields

Figure 3-2 LS28_App DATA-Decom Tab: CH10 Support Fields

As stated previously, the LS28_CH10 application supports the IRIG 106 PCM Data Format in throughput mode only. To initiate the real-time data stream for this application to translate, the user must first setup the LS28_App to initiate the physical LS-28-DRSM to serve the appropriate data format. This initiation happens in three parts.

The first part is to format the data stream in the most efficient format possible as described in section 2.2 of this document. This transfer format relates to data provided by the LS-28-DRSM to the LS28_CH10 application and DOES NOT represent the data transfer in Chapter 10 format. This special data format is setup automatically when the user selects the "IRIG Ch10 Mode" as the decommutator mode. Reference the items outline in orange in Figure 3-1 and Figure 3-2. Note that only channels 1 and 2 are allowed to operate in this mode because only these two channels are allowed to stream real-time data from the LS-28-DRSM. If the LS-28-DRSM decom is not set in the proper mode for IRIG Chapter 10 processing, the right hand pane of the display window will display the following cautionary message once the application client is initialized: "*Set Decom in IRIG Ch.10 Mode*".

The second part of the LS28_App initialization, is associated with the data used in the TMATS header. Both Figure 3-1 and Figure 3-2 contain data used to fill the TMATS header outlined in pink. The user should fill in these fields to represent the data as they anticipate it will be received by the LS-28-DRSM. It is very important to note that the LEDs in the LS28_App will not indicate frame or subframe lock while in the Ch10 transfer mode. Data is being transferred to the LS28_CH10 application as raw data. Data reformatted to CH10 is only provided in the "Throughput" mode, thus only raw data is required. End users of the data streamed or recorded by the LS28_CH10 would need to "soft decommutate" the data provided using the information provided in the TMATS header of the file to obtain framed data as it was originally transmitted.

The third and final part of the initialization is to save the setup information defined in the steps above to be read by the LS28_CH10 application. Saving the configuration can be in one of two formats: .ACI files, or .LS28 files. Configuration data must be stored for LS28_CH10 use.

3.3 LS28_CH10 Application Software Setup

The LS28_CH10 application should be configured after the LS28_App.

3.3.1 LS28_CH10 Application: Get File

The first action needed to initiate the LS28_CH10 application is to browse to and select an associated setup file from the LS28_App. For this step, reference Figure 3-3.

The LS28_CH10 application obtains necessary setup information from one of three LS28_App setup file types: .ACI files, .CFG files or .LS28 files. Select the "GetFile" button on the left half pane of the screen. Select the file format as saved in the final step of section 3.2. Selecting a file may require browsing to a shared folder if the LS28_CH10 application is installed on a host other than that of the LS28_App.
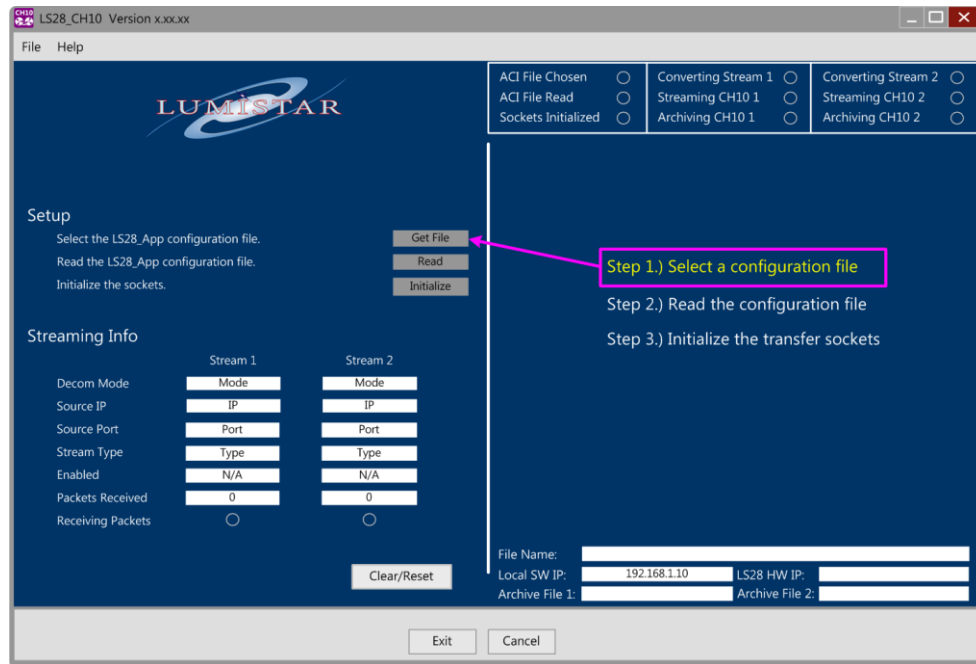
Figure 3-3 LS28_CH10 Application: Get File

3.3.2 LS28_CH10 Application: Read ACI File

The selected file must now be read into the application. To do this, select the "Read" button in the upper left frame of the screen. Reference Figure 3-3. Once this button is initiated, most of the Streaming Info section in the lower left screen pane of the LS28_CH10 application will be filled.
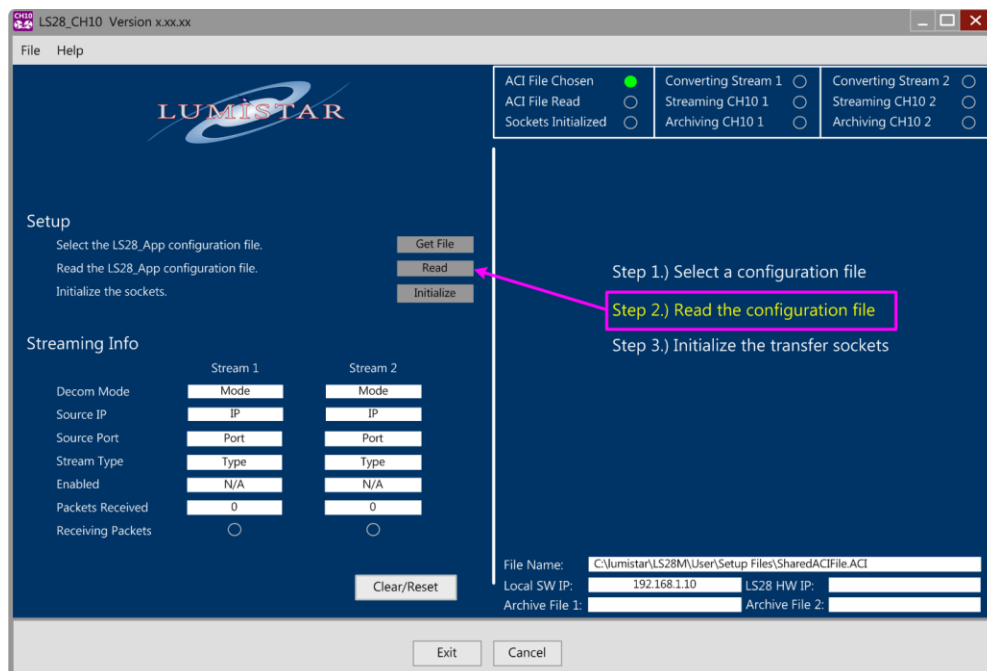

Figure 3-4 LS28_CH10 Application: Read

3.3.3 LS28_CH10 Application: Initialize Sockets

To initiate the data client section of the LS28_CH10 application, select the "Initialize" button in the upper left frame of the screen. Reference Figure 3-3. Once this initialization is complete the application will now be ready for translating, streaming and storing Chapter 10 data. This initialization does not start or stop data from streaming to or from the LS28_CH10 application.
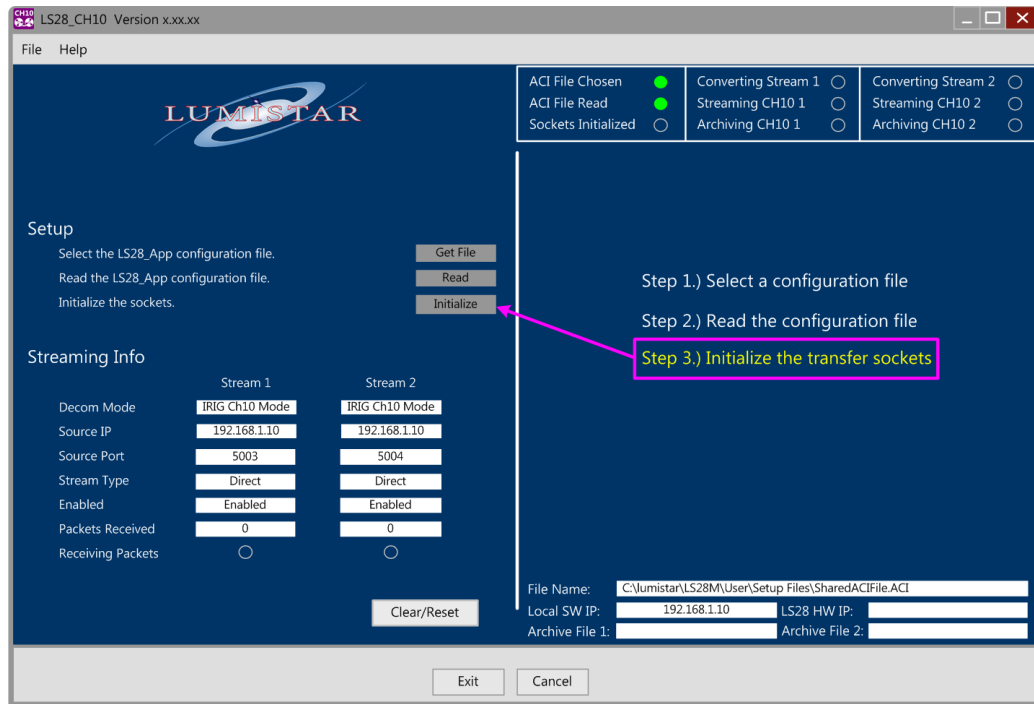

Figure 3-5 LS28_CH10 Application: Initialize

3.3.4 LS28_CH10 Application: Client/Server Chapter 10 Controls and Status

Once the client section of the LS28_CH10 application is initialized, the left hand pane of the application will contain status on the client reception of data from the source LS-28-DRSM while the right hand pane of the application allow for controls for the CH10 output data server. Reference Figure 3-6.

The left hand window pane contains streaming Info status and controls for each channel of the Chapter 10 client. Some of these status readings are a result of the data read and initialized from the LS28_App configuration file. Other status is "real-time" status data. Status includes the following:

Decom Mode: This status is read from the configuration file and describes the operational decom mode of the associated the LS28_App and its connected LS-28-DRSM. In order for the LS28_CH10 application to process data, this mode will be *IRIG Ch10 Mode*. If the mode set in the **DATA-Decom** tab of the LS28_App is not this setting, error flags will be issued in the right window status pane indicating incompatible modes. This mode must be saved in the LS28_App configuration file before reading.

Source IP: This status is read from the configuration file and provides the source data IP address. This is the IP address of the LS-28-DRSM streaming data port and will match the contents of the LS28_App Advanced Networking tab settings saved in the LS28_App configuration file.
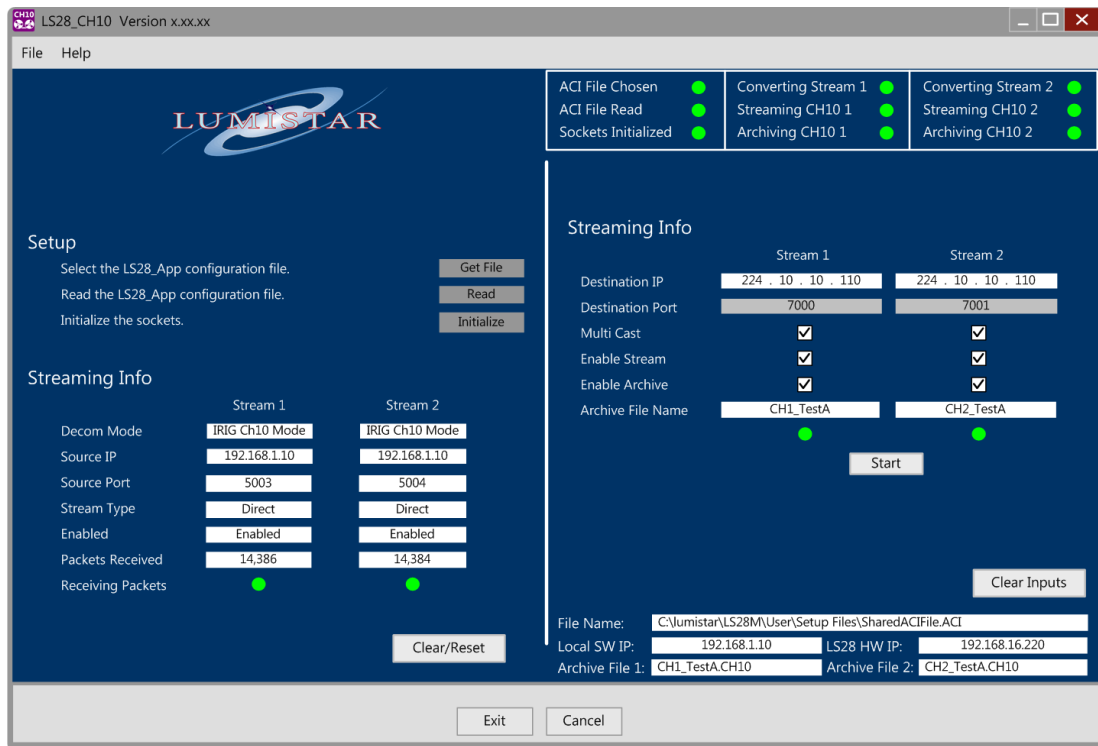
Figure 3-6 LS28_CH10 Application: IRIG CH10 Output Setup

Source Port: This status is read from the configuration file and provides the source data IP port address. This is the IP port address of the LS-28-DRSM streaming data port and will match the contents of the LS28_App Advanced Networking tab settings saved in the LS28_App configuration file.

Stream Type: This status is read from the configuration file and provides the source data stream transmission type. There are only two types that will be provided in this window: Direct (Unicast) or Multicast. This selection will match the contents of the LS28_App Advanced Networking tab settings saved in the LS28_App configuration file.

Enabled: This status is read from the configuration file and provides the Enabled/Disabled control on the LS28_App Advanced Networking tab for the real-time data streams of the LS-28-DRSM. These streams must be enabled for data transfer to the LS28_CH10 application. This selection will match the contents of the LS28_App Advanced Networking tab settings saved in the LS28_App configuration file.

Packets Received: This status is real-time status of the packets received by the LS28_CH10 application for processing. Once packets are received, they are contented and displayed. Data streaming controls are part of the LS28_App. Data must be streaming for this count to increment.

> **Information:**
>
> To start/stop data streaming to the LS28_CH10 application the user must use the streaming controls in the LS28_App.

Receiving Packets: This LED is a real-time status related to the activity of the LS28_CH10 client's reception of data for the associated LS-28-DRSM. A green LED indicates activity while a transparent LED indicates that no data activity is present. The LED may be transparent if data streaming has been halted in the LS28_App.

The left hand window pane client controls, other than the three file select and initialization buttons outline in paragraphs 3.3.1 thru 3.3.3, the remaining controls is the Clear/Reset Button:

Clear/Reset: This control allows the user to clear any of the LS28_CH10 data client file attributes. It will clear the all of the real-time and file retrieved content to be cleared from the left window pane. This button will not act to clear the selected file. However, once the button is selected, the user can then select a new configuration if desired.

The right hand window pane contains LS28_CH10 data server controls and status. The following paragraphs will outline their use and functionality:

Destination IP Address: This field provides the user the ability to program the network IP address to which they desire the translated CH10 output stream be delivered. This address can be either a Unicast address or a Multicast address.

> **Caution:**
>
> The IP addresses are not qualified by the LS28_CH10 application as Multicast or Unicast. The application relies on the user to select the appropriate transmission socket format. Selecting an IPv4 unicast address as a multicast address will likely be prohibitied by all commercial network switches.

Destination Port: This field provides the user the ability to program the network IP port address to which they desire the translated CH10 output stream be delivered. All applicable port address ranges are available.

Multicast: If the programmed destination IP address is a multicast address, the user must indicate this to the LS28_CH10 application via this selection box. This selection acts to change the network socket connection to match the desired transmission type.

Enable Stream: This data server control allows the user to enable the translated CH10 data to be streamed to the destination address. If this control is deselected, the translated data will not be streamed to the destination address programmed but may still be recorded to a local archive file based on the state of the Enable Archive control.

Enable Archive: This data server control allows the user to enable the translated CH10 data to be archived to a local file with the file name as defined in the Archive File Name window. If this control is deselected, the translated data will not be archived to a storage file but may still be real-time streamed to selected network location based on the setting of the Enable Stream control.

Archive File Name: When archiving a file to .CH10 format, the stored file name can be user defined via this entry window. Archived data will be stored at ..\lumistar\LS28_CH10\System\Archive\Channel*X* where "X" represents the selected channel number (1 or 2).   Entering a user selected name will result in the file containing the exact specified name. After the initial archive file is created, subsequent runs will append a run number to the end of the user programmed file name. Appending run numbers addresses the issue of unexpected overwrites for multiple start/stop cycles.

Start: This button controls that the output data server functions of the LS28_CH10 application. When selected, this control starts the conversion, archiving and real-time CH10 streaming as dictated by the states of the related controls.

Status of the conversion process, archiving process, and streaming process will be indicated by the associated upper left hand pane status LEDs.