GE Healthcare

Mac-Lab/CardioLab Data Pipe Reference Manual

Software Version 6.9.6 R2

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Publication Information

The information in this manual only applies to Waveform Data Pipe software version 6.9.6 R2. It does not apply to earlier software versions. Due to continuing product innovation, specifications in this manual are subject to change without notice.

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The document number and revision appear on the bottom of each page. The following table outlines the changes applied with each revision.

Revision	Date	Comment
A	24 July 2015	Internal release.
B	27 January 2016	Initial public release.

Contents

Chapter 1

Installation

Overview

The Mac-Lab\CardioLab Data Pipe service application has two features: data pipe and waveform data server. The service application is installed together with the CardioLab application to the Acquisition system.

■ The data pipe feature sends waveform data from an Acquisition system to a connected client computer. The feature consists of the service application that runs on the Acquisition system and an application that runs on a connected client computer. The client application is provided as source code that needs to be compiled using Microsoft Visual C++ 2010 Express on the client computer. The client application sample code receives the waveform data and saves it to a binary data file.

■ The waveform data server feature sends waveform data, patient demographics, channel configuration, and other information to a client, when requested. The feature consists of the service application that runs on the Acquisition system and an application that runs on a connected client computer.

Data Pipe Installation – Client Sample Application

The data pipe sample application source code is provided along with Microsoft Visual C++ 2010 Express solution and project files. Copy the client application folder from the Data Pipe Installation CD onto the client computer. After downloading Microsoft Visual C++ 2010 Express, the solution file can be opened. The source code will build without modification.

Uninstall

To uninstall the client components, delete the folders copied to the client system during installation.

Chapter 2

Developing with the Client Sample Application

Overview

The command line in Microsoft Visual C++ 2010 Express must be set up before the application will start. This can be done by right-clicking the **MLCLDataPipeSampleApp** project name and selecting **Properties**. Navigate to the **Configuration > Debugging** page and put the command line in the **Command Arguments** text box

The sample application saves waveform data (for the channel indice(s) specified on the command line) to a binary file. Each data point is saved in a double precision floating point format. The binary file has the following format and can be read into a signal processing application if desired.

Binary File Format:

[channel0, sample0][channel1, sample0][channel2, sample0] [channel0, sample1][channel1, sample1][channel2, sample1] [channel0, sample2][channel1, sample2][channel2, sample2]

Command Line Set Up

For the data pipe component of the sample application to work, the following command line parameters are required.

-localIP	The -localIP command line parameter identifies the IP address of the network adapter to use for sending/receiving data between the client and Acquisition system.
-channel	The -channel command line parameter identifies the channels to save to the binary data file. This parameter can be listed multiple times on the command line if more than one channel is to be saved. The data pipe sends all channel data that is actively being saved on the Acquisition system. The value associated with the -channel command line parameter is the channel index as shown in the study configuration on the Acquisition system.

For the DICOM component of the sample application to work the following command line parameters must be supplied in addition to the -localIP and -channel parameters.

-acqIP	This is optional. If this command line parameter is not present then the data pipe application must be running on the Acquisition system with a study open for DICOM functionality to work.
-clientAETitle	The -clientAETitle command line parameter identifies the AE title of the client application for DICOM communications. The AE title listed for the ultrasound or x-ray system on the Acquisition system must match the value provided for this parameter. The ultrasound or x-ray system's AE title can be found by going to the **Administration > System Settings** page. On the **System Settings** page select the '**Connectivity**' page and the '**Remote Hosts**' tab.
-acqAETitle	The -acqAETitle command line parameter identifies the AE title of the Acquisition DICOM application. The value for this parameter must match the Acquisition system's local AE title. The Acquisition system's local AE title can be found by going to the **Administration > System Settings** page. On the **System Settings** page, select the '**Connectivity**' page and the '**Local Host**' tab
-acqDICOMPort	The -acqDICOMPort parameter is the port that the Acquisition system's DICOM application uses for network communication. The value for this parameter must match the DICOM port listed on the Acquisition system. To find the DICOM port on the Acquisition system, go to the **Administration > System Settings** page. On the **System Settings** page select the **Connectivity** page and the **Local Hosts** tab

Optional Parameters

-outputFile	The -outputFile parameter specifies the file to save binary data to on the client system. If this parameter is not supplied, the data is saved to a file called ***output.dat*** in the application's working directory.
-timeout	The -timeout parameter specifies how long (in seconds) the application tries to find the data pipe before reporting an error. This parameter defaults to 10 seconds. During this time the client application is waiting to receive a broadcast message from the Acquisition system.

Example command line (data pipe functionality only):

-localIP 192.168.6.6 -channel 1 -channel 2 -channel 6

The command line above will use the client application to save channels 1, 2, and 6.

Example command line (data pipe and DICOM functionality):

-localIP 192.168.6.6 -channel 1 -channel 2 -channel 6 -acqIP 192.168.6.5 -clientAETitle DataPipeClient -acqAETitle DataPipeAcq -acqDICOMPort 1224

The command line above will use the client application to save channels 1, 2, and 6 as well as enable the application's DICOM functionality.

Error Codes

DICOM Error Codes

1	Timed out waiting to receive broadcast message from data pipe application.
2	Study not in progress.
795	Association request failed (cannot contact Acquisition system).
769	Association request failed (an AE title is incorrect).

Data Pipe Error Codes

1	Data pipe connection failure (timed out waiting to receive broadcast message from data pipe application).
2	Data pipe connection failed (local IP address on the command line is incorrect).
3	Another client is already connected to the data pipe.
4	A data pipe connection already exists for this connection, disconnect first.

Sample Rates

CardioLab study configurations can be setup for 1K, 2K, or 4K sample rates. The actual sample rates are:

1K Study: 977Hz

2K Study: 1953Hz

4K Study: 3906Hz

This information is provided for use in signal processing applications.

Study Configuration Notes

When using the data pipe, the ECG signals in the study configuration should have **_Always Save_** turned on.

Changing a study configuration is not supported while connected to the data pipe. Study configuration changes are not identifiable in the client application. With the sample application, this will result in an output binary file with data from two different study configurations. The point where the study configuration changed is not identifiable in the output binary file.

If a study configuration change is needed, close the client application first. Start the client application again with a new output binary file after the study configuration has been changed.

Chapter 3

Network

Set Up

To use the data pipe feature, the Acquisition system and the client application must be on the same subnet to communicate with each other. The recommended way of doing this is connecting the Acquisition system and client computer with an Ethernet cable. If a mapping system is not present, the mapping system Ethernet port can be used. Otherwise, the client system can be placed at an IP address anywhere on the Local Area Network that shares the same subnet as the Acquisition system.

1. Select *Start > Control Panel > Network and Sharing Center > Change adapter settings*.

2. Right-click the network adapter in use and select *Properties*.

3. Select the *Use the following IP address* radio button and assign an IP address and subnet mask.

Example IP Address / Subnet Mask Pair Using the Mapping System Port	
Acquisition System	**Client System**
IP: 192.168.5.2 (default mapping system address)	IP: 192.168.5.6
Subnet: 255.255.255.0	Subnet: 255.255.255.0

Example IP Address / Subnet Mask Pair Using the Local Area Network	
Acquisition System	**Client System**
IP: 192.168.0.1 (LAN address assigned by hospital IT)	IP: 192.168.0.10 (hospital IT assigned address on same LAN subnet)
Subnet: 255.255.255.0	Subnet: 255.255.255.0

4. Open a command prompt on each system and enter **ping [other system's IP]** to verify connectivity.

Troubleshooting

Firewalls may be blocking communications between the two systems. To use the data pipe feature, the Mac-Lab/CardioLab Data Pipe must be able to send broadcast messages from the Acquisition system to the client system to begin creating a connection. Make sure that the firewall is not blocking communications.

The following ports are used for data pipe communication:

- 10300: Broadcast message received on client on this port.
- 10301: Port that Acquisition system uses for TCP communication.
- 10304: Port that client system uses for communication with the Acquisition system.
- 10305: Port that Acquisition system uses for TCP communication.

1. Select *Start > Control Panel > Windows Firewall*.

2. Click *Allow a program or feature through Windows Firewall*.

3. Click *Change Settings*.

4. Click *Details*.

5. In the *Edit a Port* dialog enter the following:

    a. Name: **10300_DataPipe_Broadcast**

    b. Port Number: **10300**

    c. Protocol: *UDP*

6. Click *OK*.

Other required ports on the Acquisition system are already set up as part of the EPVision feature and do not require modification.

Ports on the client device might need to be configured using the same steps on port 10300 UDP and 10304 TCP.

Chapter 4

Waveform Data Server

Introduction

The Mac-Lab/CardioLab Data Pipe service application opens port 10305 on the Acquisition system for the waveform data server communication. Mac-Lab/CardioLab Data Pipe communicates with the client system using MIME encoded XML messages. The client can request the following from the Waveform Data Server:

- Current study status on the Acquisition system
- Version of the communication protocol
- The sample rate value of the current study
- Patient information from the current patient in Acquisition study
- Channel configuration of the current Acquisition study

NOTE: The data server sends the channel configuration based on the configuration recorded during the last save event.

- Time segment of waveform data of channels
- Acquisition study status change notification
- Channel configuration change notification

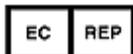The Waveform Data Server sends a response message to each client request.

Response Message Error Codes and Descriptions

Error Code	Description
100	No acquisition study in progress on the Acquisition system
110	Mac-Lab/CardioLab Data Pipe error
120	Mac-Lab/CardioLab Data Pipe application error
130	No waveform stored at all for the current acquisition study
140	Error in waveform request (error in the requested time)
150	No waveform stored for the requested time
160	Invalid request message (the XML message does not fit to the schema)