DAQFlex: Cross-Platform DAQ Solution for OEMs and End-Users

Overview

Measurement Computing has long served the end user and OEM data acquisition market by providing off-the-shelf products that deliver performance and ease-of-use at a low price. This approach provides a great solution to many customers who need Microsoft® Windows® support or a broad selection of form factors including PCI, PCI Express, and USB.

Increasingly, however, DAQ users and OEMs are looking for more, including:

- The ability to develop an application on one platform, and easily port it to another platform
- Support for non-Windows operating systems
- Small driver footprint
- Low cost
- Small form factor

To meet these needs, Measurement Computing has introduced a new line of data acquisition products designed specifically for the growing OEM DAQ market.

This new product line combines a small form factor with bus-powered USB hardware and a developer-friendly software framework that can be ported to multiple operating systems, including Windows® 32/64, Linux®, and Mac®. The DAQFlex framework is a core technology to these products, and is further explained in this white paper.

What is DAQFlex?

DAQFlex is a framework that combines a small footprint driver with a message-based command protocol. This framework allows DAQ programming in virtually any operating system (OS) or on embedded systems with no OS. The simplicity of the driver is enabled with a message-based protocol on select MCC DAQ devices. This protocol offers an efficient yet powerful interface to DAQ devices and a common command set that simplifies application development.

The DAQFlex framework (Figure 1) consists of three key components: The DAQFlex software application programming interface (API), the DAQFlex device driver, and the DAQ device "message engine." The message engine parses and converts the DAQFlex message-based command set into DAQ-specific commands that control the device and process data.
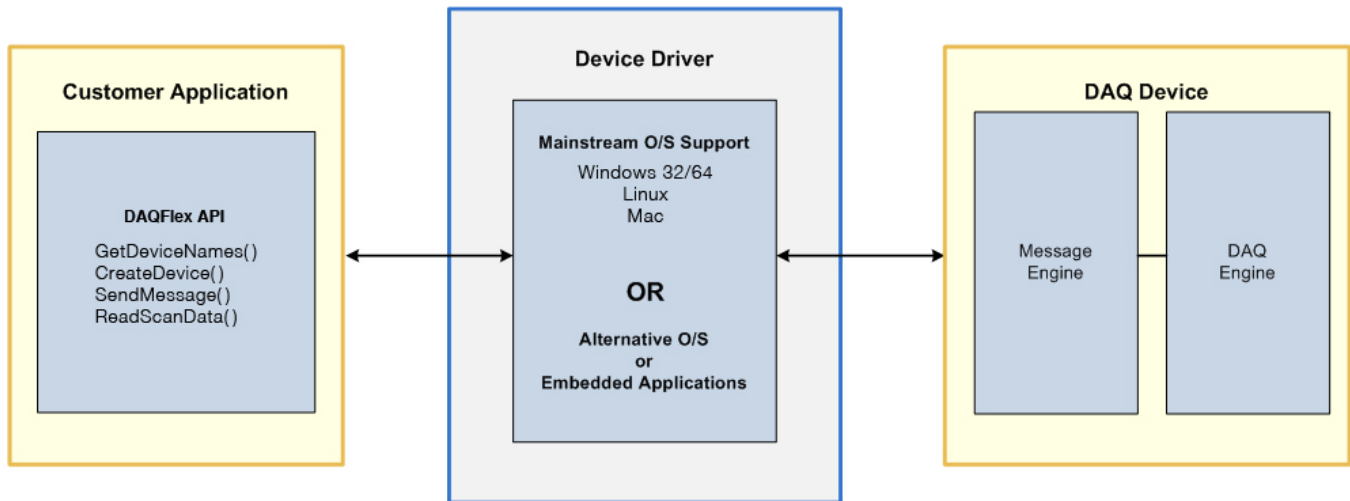
Figure 1. DAQFlex Framework

DAQFlex Software API

The DAQFlex framework has a simple API that is common to all DAQFlex-supported devices. This API was developed to allow users to write application code that is OS-independent. Because the DAQFlex API implements a message-based protocol, developers need to use only a handful of methods, allowing for a short learning curve and rapid application development.

DAQFlex Device Driver

The DAQFlex device driver receives DAQFlex messages from the customer program through the software API. The driver then sends these messages through the physical layer to the data acquisition device. Conversely, the DAQFlex driver receives data and messages from the data acquisition device and returns this information to the program through the API.

Measurement Computing supplies device drivers for Windows 7/Vista/XP (32 and 64 bit), Linux (Fedora, OpenSUSE , and Ubuntu distributions), and Mac OS X.

Developers can either use these supplied drivers or they can build their own drivers by modifying the open-souce code. Custom DAQFlex drivers can be built with standard USB drivers — such as WinUSB for Windows or libusb for Linux —or, for users who need more control, with kernel-mode USB drivers.

DAQFlex Device Engine

DAQFlex-supported devices contain a DAQFlex Device Engine which consists of the "Message Engine" and "DAQ Engine." Unlike most DAQ devices which interface to the computer via low-level commands, DAQFlex devices interface with simple messages. Once received, these messages, are parsed and converted to instructions and sent to the "DAQ Engine." The "DAQ Engine" then configures the device, performs the operations, and returns the data to the "Message Engine," which in turn sends the data to the DAQFlex device driver when requested.
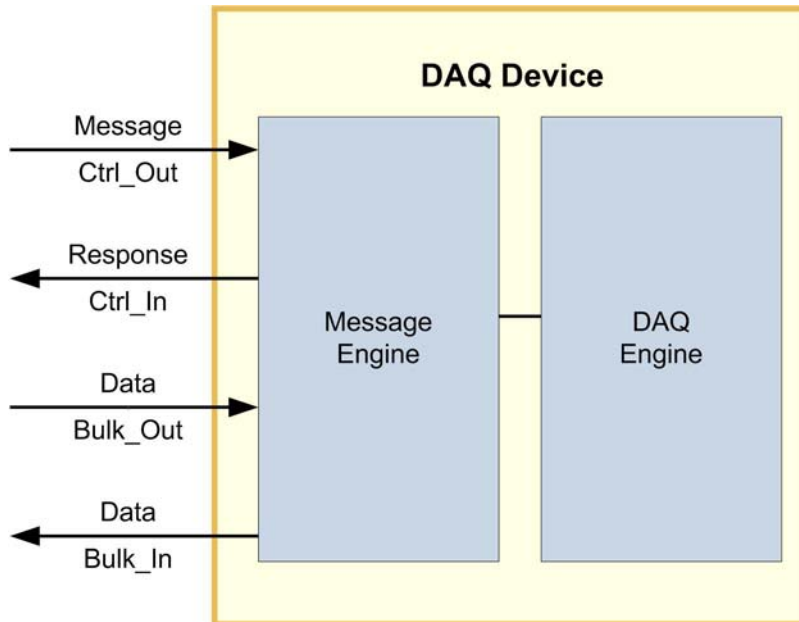

Figure 2. Device Transfer Types

DAQFlex Example

Below is a code snippet that demonstrates the DAQFlex API , device driver, and message protocol. The code sets up a DAQ device to a range of ±10 V, selects four channels (0-3), sets the sample rate to 1 kHz, and sets the number of samples to 4096. It then starts the acquisition and returns the data.

```
DaqResponse = MyDevice.SendMessage("AISCAN:RANGE=BIP10V")
DaqResponse = MyDevice.SendMessage("AISCAN:LOWCHAN=0")
DaqResponse = MyDevice.SendMessage("AISCAN:HIGHCHAN=3")
DaqResponse = MyDevice.SendMessage("AISCAN:RATE=1000")
DaqResponse = MyDevice.SendMessage("AISCAN:SAMPLES=4096")
DaqResponse = MyDevice.SendMessage("AISCAN:START")
ScanData = MyDevice.ReadScanData(4096)
```

The API methods in the code are "SendMessage()" and "ReadScanData()." These API methods call the DAQFlex driver.

As shown in Figure 1, the program sends DAQFlex messages to the driver. The DAQFlex driver sends the encapsulated messages to the device and reads the data over the physical layer (USB for currently-supported products). The data acquisition device interprets the message using the "Message Engine," and sets corresponding attributes using the "DAQ Engine." The data acquisition device then returns the requested data to the DAQFlex driver, which then returns the data in an array (ScanData) to the program.

Advantages of DAQFlex

DAQFlex offers the following advantages to DAQ users:

Easy to Program

- **Efficient API**

  Most tasks are performed with four programming methods:

  GetDeviceNames() - *Generates a list of all DAQFlex devices connected*

  CreateDevice() - *Initializes the chosen device*

  SendMessage() - *Sends a command to the device*

  ReadScanData() - *Reads captured scan data*

- **Easy-to-Learn Command Set**

  The DAQFlex command set is straightforward and easy to learn, with a defined hierarchy. All DAQFlex devices share the same firmware interface and therefore share the same command set. Learning to program one device means learning to program all DAQFlex devices.

  DAQFlex uses simple, easy-to-understand commands common among all supported hardware

Device Level Messages	Analog Input Scan Messages	DIO Messages
"?DEV:FWV"	"AISCAN:LOWCHAN=0	"DIO{0}:DIR=IN"
"?DEV:MFGSER"	"AISCAN:HIGHCHAN=3"	"?DIO{0}:VALUE"
"?DEV:ID"	"AISCAN:RATE=1000"	"DIO{0}:DIR=OUT"
	"AISCAN:SAMPLES=500"	"DIO{0}:VALUE=128"
	"AISCAN:START"	

- **Interactive Utility Provided**

  FlexTest is a GUI-based test utility for interfacing with DAQFlex data acquisition devices, and is provided with the driver software. This utility automatically recognizes an available DAQFlex device, shows all commands available for this device, and allows users to interact with the device one command at a time.

  During this interaction, the commands are captured in a log, allowing the user to cut and paste them directly into a program.
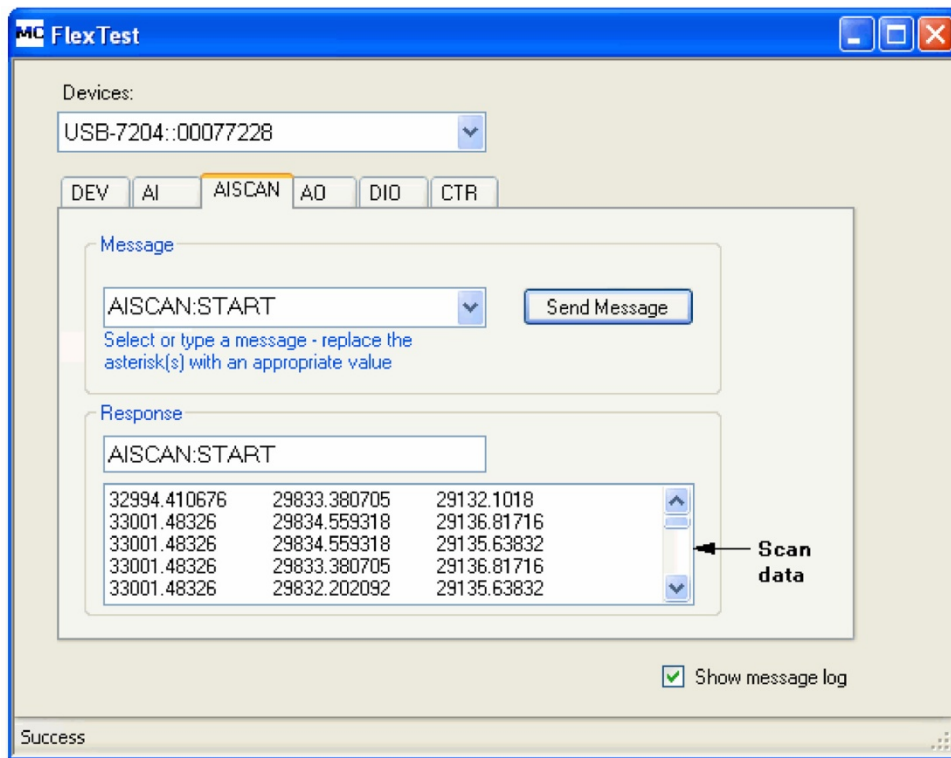
Figure 3. FlexTest Application

Flexible Driver

- **Multiple OS Support**

  Measurement Computing provides out-of-the-box support for Windows 7/Vista/XP (32- and 64-bit), Linux, and Mac OSX.

- **Simplified Driver Development**

  Unlike traditional DAQ devices with register maps that must be implemented at the driver level, DAQFlex devices use a command structure that greatly simplifies driver development.

  For USB devices, these commands are sent and received with Control_Out and Control_In transfers, respectively. Data sets are sent and received with Bulk_In and Bulk_Out, respectively.
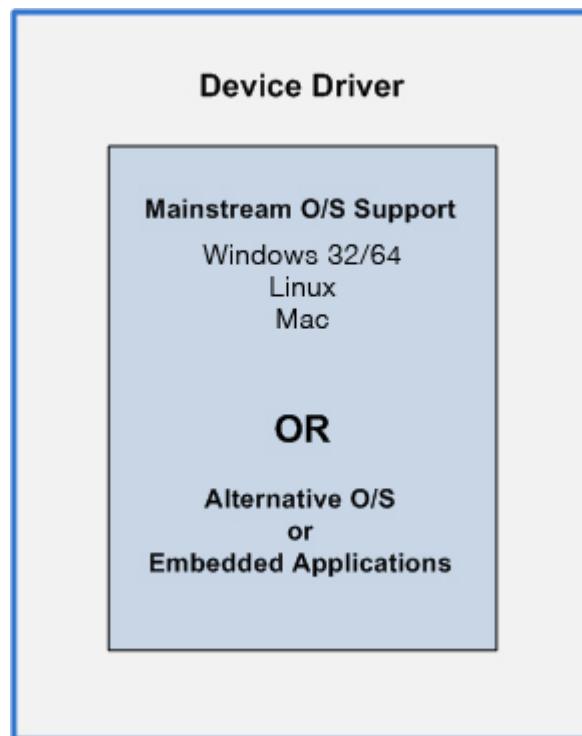
Figure 4. Driver Options

- **Open Source**

  MCC provides source code for each driver. Programmers can use the drivers provided by MCC, build their own driver using user-mode drivers such as WinUSB or libusb, or build a driver with kernel-mode USB drivers.

- **Portable Programs**

  MCC-provided DAQFlex drivers are built using the Common Language Runtime (CLR). Because MCC-provided drivers take advantage of this technology on all platforms, programs written on one platform are portable to other platforms. Users can develop in Windows 7 and deploy on Linux, or Mac, without modifying their DAQ code.

  The DAQFlex drivers provided by MCC use the following frameworks:

  - Windows 7/Vista/XP - Microsoft .NET framework (v2.0 and later) and CLR.
  - Mac OS X/Linux - Open-source Mono framework (v 2.4 or later) and CLR.

Conclusion:

A simple and flexible solution for DAQ programmers and OEMs

Measurement Computing has developed a new architecture for programming DAQ devices. The DAQFlex framework is ideal for developers who value a small driver footprint, an easy-to-learn API, and the ability to port their application to virtually any operating system.

DAQFlex is open source, so developers can strip it down, enhance it, and otherwise modify it depending on their specific needs. Flexible licensing permits end users and OEMs to lower their DAQ costs.

Measurement Computing continues to build on two decades of success as the value leader in data acquisition. DAQFlex is not a replacement for our established hardware and software offerings, but it is an added product offering for new and existing customers.

To learn more about DAQFlex and it's supported products, go to
http://www.mccdaq.com/solutions/DAQFlex-Solutions.aspx