Future Technology Devices International Ltd.

Technical Note TN_103

FTDI USB Data Transfer Efficiency

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This document examines some factors influencing the efficiency of data transfer for FTDI devices, in particular the FT232 series of USB-UART devices.

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1 Introduction

FTDI devices use USB bulk transfers to transport data. The efficiency of bulk data transfers relies on sending and receiving data in large chunks. This document outlines some factors contributing to data transfer efficiency for both sending data to FTDI devices and reading data back.

2 Bulk Data Transfers

FTDI devices transfer data using USB Bulk transfers. The most efficient way to conduct USB bulk transfers is in large chunks. FTDI devices are bi-directional and can therefore both send and receive data across a USB connection. Sending data and receiving data will be considered as separate cases.

2.1 Sending Data

When writing data to an FTDI device, as much data as possible should be buffered in the application and written to the device in a single write function call (either WriteFile for a VCP application using the Win32 API, FT_Write if using the D2XX classic interface or FT_WriteFile if using the D2XX FT_W32 interface). The result of this is that the data will be written to the device with 64 bytes per USB packet.

If data were to be written in small amounts or even individual bytes as many applications written for legacy serial ports do, the USB bulk transfer protocol would only be able to transfer 1 byte per USB packet. This method is not efficient when employing USB bulk transfers and performance will be greatly diminished.

2.2 Receiving Data

FTDI devices will return data to the host in 2 cases:

- The IC has a full buffer of data to send back to the host.
- The latency timer has expired.

If the IC receive buffer is full, data will be returned to the USB host in full USB packets of 64 bytes which contain 2 status bytes and 62 data bytes.

The latency timer acts as a timeout on the receive buffer which will trigger the transmission of any data in the chip's receive buffer back to the host. In cases when the amount of data being received is minimal, this prevents applications from having to wait a long time for a full packet.

If the receive buffer of the chip is empty when the latency timer expires, 2 status bytes are returned which contain the modem status and line status of the UART. For FT245 devices, these bytes are still returned but have no meaning.

If the latency timer is expiring before the receive buffer is full, short USB packets will be returned to the host. As this is not the most efficient packet size, this may be unsuitable for some applications.

For example, a UART receiving data at 9600 baud with a default latency timer value (16ms) will generate USB packets of around 16 bytes before the latency timer expires and transmits the data available back to the PC. If 64 byte IN packets were desired to minimise the number of INs required to complete a read, the packet size could be increased by increasing the value of the latency timer. In this case, a value greater than 64ms would be sufficient for the chip to transmit full USB packets back to the host assuming data was constantly being received by the UART.

In the case of FTDI's USB-UART devices, the IN packet size may appear to be dependent on baud rate. This is not the case: it is simply that the UART may receive data faster at a higher baud rate and thus has a better chance of filling the buffer before the latency timer expires.

3 Conclusion

When optimising data throughput for FTDI devices, the following factors should be considered:

- Send as much data to the IC from the host application as possible in a single write. This will maximise the size of the data packets being sent to the device and hence minimise the number of packets required and time to transfer an amount of data.
- Set the latency timer to a value appropriate for the application. Note that a low latency timer value may result in many short incoming USB packets rather than a single large packet, thus diminishing performance.

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Distributor and Sales Representatives

Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A - References

D2XX Programmer's Guide

AN232B-04 Data Throughput, Latency and Handshaking

Appendix B - Revision History

Revision History

Version 1.00	Initial Release of draft for comment	October, 2008
Version 1.00	Initial Release of V1.0	27th October, 2008