

VCOM: CONTROLLING A REMOTE RS232 INTERFACE OVER SPACEWIRE

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Short Paper

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ABSTRACT

The STAR-Dundee Virtual COM Port (VCOM) provides a serial interface from software on a Windows-based PC, via the standard COM port interface, to a remote UART, tunnelled over SpaceWire. It provides the ability to communicate with and test remote serial devices and applications in a lab environment. In this paper the features provided by the VCOM software, including remote UART configuration, and a protocol allowing serial errors and status to be propagated across SpaceWire are described. Applications of this technology to the configuration of a prototype wideband spectrometer, and potential extensions to the VCOM abstraction are also discussed.

1 OVERVIEW

The STAR-Dundee Virtual COM Port exposes a remote UART (universal asynchronous receiver/transmitter) on a SpaceWire Network [1] to a PC as a standard Windows COM port. A specially-designed Windows driver provides this driver/API interface. The virtual COM port driver may be used with any STAR-Dundee USB-based device.

The virtual COM port appears to Windows and may be interacted with in exactly the same way as a physical COM port using the Windows File and Communication functions. The system operates by placing serial traffic received from a UART into SpaceWire packets and transmitting them across the network to the PC. Similarly, SpaceWire packets of the correct form received at the UART node are transmitted in serial form (Figure 1).

When data is written to the virtual COM port, it has a SpaceWire logical address and protocol byte prepended, and is sent across the SpaceWire network. The VCOM driver continuously reads incoming SpaceWire data and buffers it, ready to be consumed by the user using the Windows File and Communication functions.

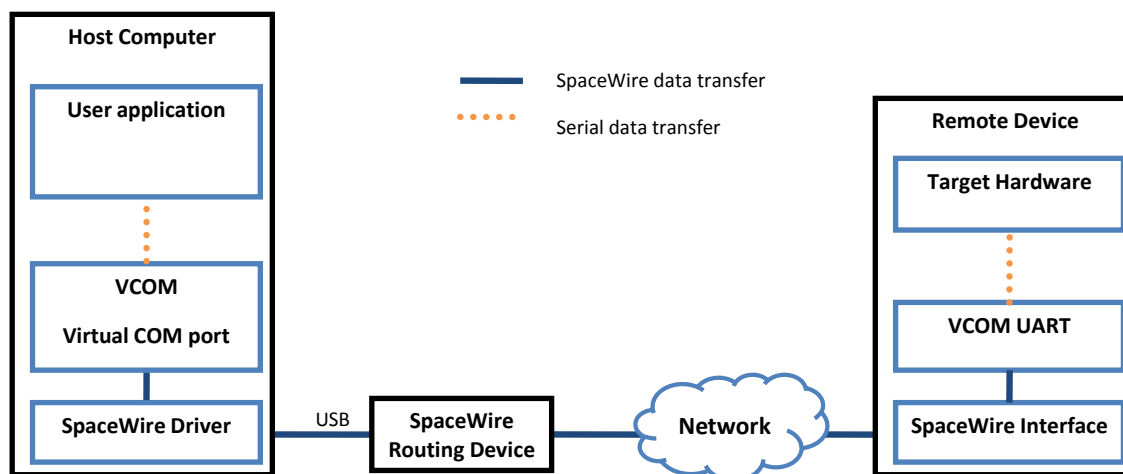


Figure 1: Overview of VCOM Communication

2 VCOM DRIVER

In order to appear to Windows as a COM port, the VCOM software must be implemented as a device driver.

2.1 UMDF

The VCOM driver makes use of the Windows User Mode Driver Framework (UMDF), which allows it to use the existing STAR-Dundee user mode API. A major benefit of using UMDF is that the VCOM driver runs in a different thread from the requesting process and has access only to the address space of the process in which it is running.

2.2 REMOTE UART CONFIGURATION

All Windows Serial IOCTLs (I/O controls) are handled by the VCOM driver, and the file type of the file handle returned when opening a VCOM port is a character file, enabling any legacy application that requires a COM port interface to be used with VCOM. RMAP (Remote Memory Access Protocol) [2] is used to perform all configuration operations on the UART over the SpaceWire link.

The SpaceWire Virtual COM port configuration API provides functions which can be called to configure both the virtual COM port device on the host PC and the remote UART attached via the SpaceWire link. A graphical configuration tool is provided which makes use of this API.

2.3 PACKET FORMAT

VCOM uses a simple packet format (Figure 2) containing the Protocol ID [3] and a status byte in addition to the data bytes. The protocol ID is the first byte after the logical address. The use of logical addressing allows multiple VCOM drivers on a single machine, each communicating with a different remote UART to share the same SpaceWire interface. The Protocol ID is used by the driver to ensure a valid packet has been received. ID 0xF0 has been chosen as it has not been assigned by the SpaceWire working group. The next byte in the packet is the status byte. This bitmask

provides information to the VCOM driver of any errors that have occurred at the UART, for example framing or parity errors, or whether a break state is in progress.

<i>First Byte Transmitted</i>				
Logical Address	Protocol Id	Status Byte	Data	EOP
0xAB	0xF0	0x00

Figure 2: VCOM packet format

2.4 FLOW CONTROL

Flow control between the host computer and the remote UART is performed using SpaceWire flow control. As the serial communication between the remote UART and the serial hardware is a 3-pin implementation (receive, transmit and ground) there is no flow control. Instead, a large buffer is present at the VCOM SpaceWire interface, and is used when receiving large numbers of packets in quick succession. When a 5-pin UART implementation is being used with the CTS and RTS signals available, flow control can be provided to the UART.

3 CURRENT APPLICATION OF VCOM

STAR-Dundee Ltd is currently developing a prototype wideband spectrometer instrument with the University of Dundee, EADS Astrium Ltd and RAL. This device samples an analogue signal at around 3 Gsamples/s and performs spectral analysis to extract a signal buried deeply in noise. The prototype instrument is targeted at atmospheric chemistry missions. A Xilinx FPGA is used to implement the prototype Fast Fourier Transform (FFT) with the FFT code itself being developed by Astrium.

The prototype wideband spectrometer is shown in Figure 3.

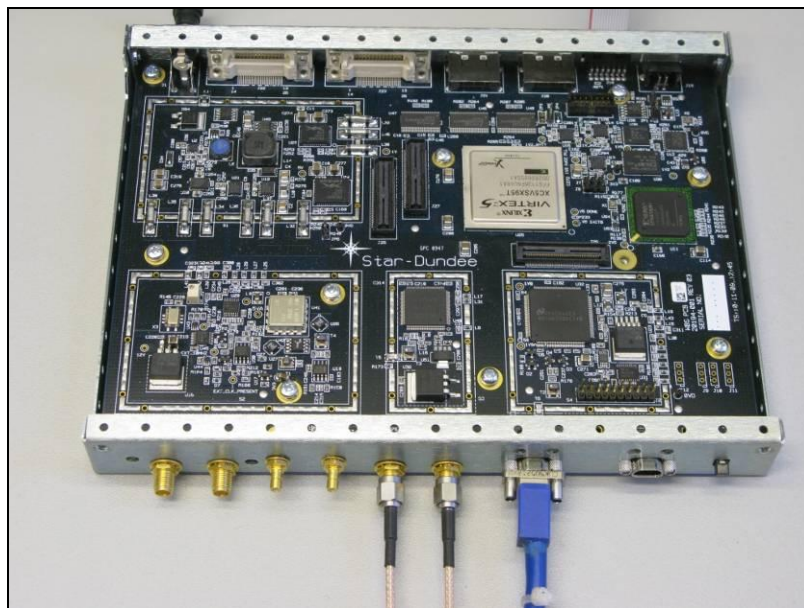


Figure 3: Prototype wideband spectrometer

To simplify integration in the development environment an RS232 interface was required for controlling the FPGA along with a JTAG port for programming it. However, using a single SpaceWire interface to configure and access the device is preferable. VCOM was developed to solve this problem.

4 POTENTIAL APPLICATIONS OF VCOM

The VCOM abstraction is not limited to controlling a remote UART. Keeping the same software and SpaceWire hardware, a VCOM core could be created enabling the remote UART to be replaced with *any* remote streaming interface. Instead of a remote UART, one could keep the same abstraction of a COM port, but control, for example, a generic FIFO, I²C, Serial Peripheral Interface Bus (SPI), a Xilinx LocalLink bus [4], Altera Avalon Streaming Interface bus [5] or a Xilinx Fast Simplex Link bus [6] (Figure 4).

The Windows serial functions would still be used to control the data streamed over SpaceWire (i.e. start bits, stop bits, data length parity, timeouts), with additional IOCTLs used to allow configuration of specific streaming interfaces where necessary.

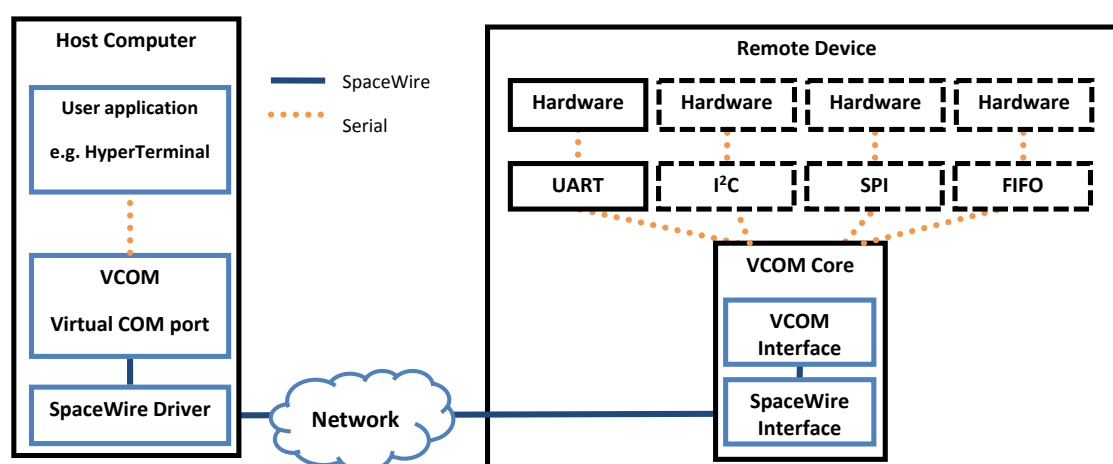


Figure 4: Extending the COM port abstraction for controlling any remote streaming interface

5 SUMMARY

VCOM allows serial applications using the standard windows COM port to be used to access hardware over SpaceWire. This paper has shown an application of VCOM to allow communication with a prototype FPGA to be performed over SpaceWire. In addition this paper has highlighted further potential uses of the COM port abstraction for controlling remote hardware.

6 REFERENCES

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