6. References

[1] IEEE-STD-1057 Standard for Digitizing Waveform Recorders.

[2] BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML , "Guide to the Expression of Uncertainty in Measurement", ISO, 1995.

[3] F. Alegria, A. Cruz Serra, "Uncertainty of ADC Random Noise Estimates Obtained With the IEEE 1057 Standard Test", IEEE Transactions on Instrumentation and Measurement, vol. 54. nº 1, pp. 110-116, February 2005.

Using the parallel port for data acquisition.

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1. Introduction

A PC based acquisition system normally uses serial ports to acquire digital data from an A/D converter. Also, serial ports are used for communication with GPS card (to get GPS messages), communication with data Centres by phone modem, and with others local PC's. Therefore, a large number of serial ports are needed, but this is no a problem in moderns PC that usually have enough USB and serials ports.

We have developed, in the Geophysical Department of the Royal Naval Observatory (ROA), an acquisition system based on a Linux embedded PC using the parallel port for collect digital data from a high resolution A/D converter. Serial ports are reserved to GPS and data transmission communications.

In this work an overview of the overall system is presented, focus on the parallel port function.

2. The PC based acquisition system.

The overall system is shown in figure 1. We use a 1Hz Mark L4C sensor with the band extended [1] using a simple capacitor. The amplifier has a non-inverter configuration in order to obtain a high input impedance.

The designed A/D card includes the A/D converter and the serial to parallel interface. We have used a CS5323/CS5322 high resolution 24 bits A/D converter that provides a high dynamic range (> 130 dB at 125 sps). This converter uses the oversampling technique, so analogical antialiasing filters are not needed.

Tree 74HC595 is used for the serial to parallel conversion and to carry out the byte transfer by the parallel port of the PC. A complete explanation of this card can be found in [2].

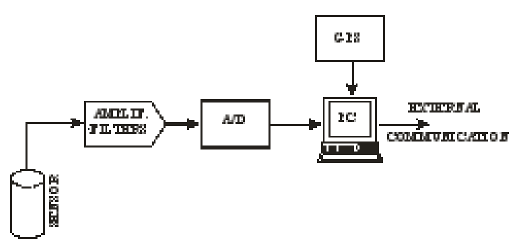

Figure 1. A PC based acquisition system scheme.

The system is synchronized using an ONCORE UTC GPS. The pps signal is connected to the IRQ11 (pin 4 of the PC104 connector) and the GPS messages are received by COM1. A PLL software, running in kernel space, was developed by the ROA Time department. It acts over the PC clock system and in the worse case the maximum observed differences was better than 700 microseconds.

The parallel port has 4 control line (output), 5 state lines (input) and 8 data lines (input/output). It can operate in several mode but we have configured it in the Enahanced Parallel Port (EPP) mode [3]. This mode permits a bidirectional data transfer, having a rate between 500K to 2 M bytes per second, and the I/O cycles are hardware controlled. Figure 2 shows the read cycle handshake.

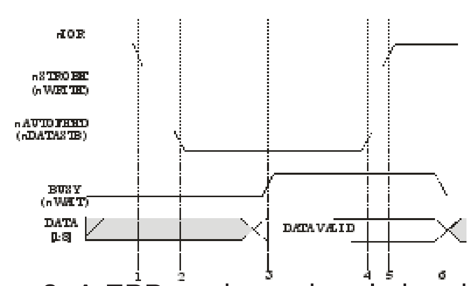

Figure 2. A EPP mode read cycle handshake.

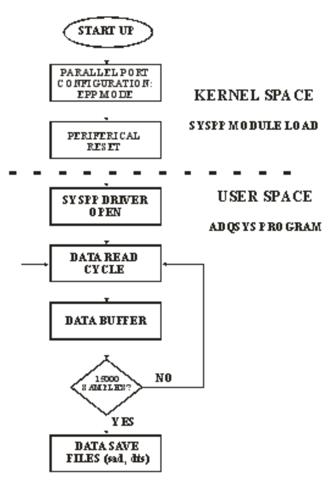

Figure 3. Data acquisition process.

The data ready signal from the A/D converter is used as IRQ7 (event 1 in figure 2). This signal produces a tree read cycles (24 bits data) and the data time mark is read. So, the SYSPP driver was designed to time stamp and data read every time that an IRQ7 is received. Data are stored in a buffer and later saved on hard disk. The figure 3 shows the data acquisition process.

This prototype of a digital seismic station was running at the ROA for several months with an excellent results (figure 4 shows an example), and nowadays is being modified including new data format (mseed).

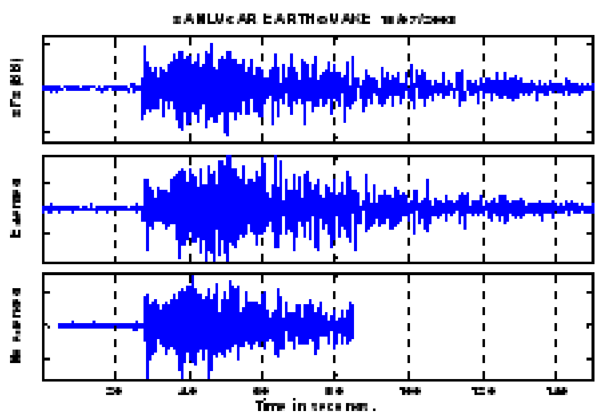

Figure 4. Sanlucar earthquake 18/07/2003 21:23:21, mb=3.7, recorded by 3 stations on the same pier.

3. Conclusions.
A high resolution acquisition system has been developed in the Royal Naval Observatory with an extended response. It is based in a Linux embedded PC.

Data are acquired using the parallel port and it allows save the two serial ports for external and GPS communications.

The software PLL time reference rise an accuracy better than 700 microseconds in the worst case.

EPP mode allows a high data transfer rate (>500KB/s) being the data read cycles hardware controlled.

A prototype was running at ROA for several months and nowadays is being modified. A new prototype will be available in a few months to upgrade the ROA short period network.

4. References
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[2] A.Pazos, Estación sísmica digital. Tratamiento digital de señales, Boletín ROA Nº2/2004, San Fernando, 2004.
[3] Warp Nine Engineering, IEEE 1284 info, , 2002.

A new software tool for Wide-Angle reflection/refraction Seismic data Processing And Representation (WASPAR)

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1. Introduction.
The seismic methods are the most powerful existing techniques to image the structure of the Earth's subsurface at different scales. Depending on the system layout, the seismic methods can be divided in: near-vertical reflection (NVS) techniques and wide-angle reflection/refraction (WAS) techniques. In contrast to NVS, where a wide number of tools have been designed by oil industry, the development of WAS pre-processing tools has deserve only minor attention to date. Most existing tools have been developed by research institutions in order to read raw data from their own instruments, construct and display the record sections, and pick the seismic phases. WAS processing is also done using existing tools as Seismic Unix [1], but these tools have been chiefly designed for NVS geometries and not all the techniques are therefore well-suited for proper WAS processing.

With all this information at hand, the main purpose of this work has been to develop a new tool for WAS data representation and signal processing. We have thus created the multi-platform modular software tool WASPAR that allows a user to represent and process data from its initial state (raw data) to its final state (processed record section) using a unique and friendly interface. WASPAR has been designed using a plug-in architecture to manage all processing modules and raw data access. In that way, it is easier to maintain the software tool as well as to expand it with new functionalities. We have chosen C++ programming language to facilitate the development of a multi-platform software tool, which is already available on Linux and MS Windows.

2. Program description
The tool we have developed is an open and free multi-platform software. It has been designed as a generic tool, originally developed to process active wide-angle reflection/refraction data using a unique interface. The main