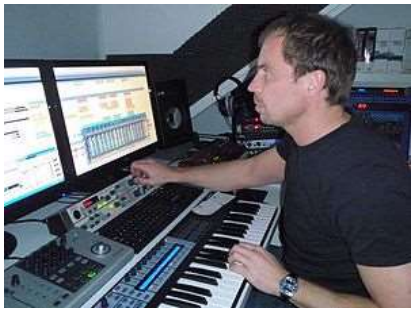
THE WERSI OAS TECHNOLOGY UPGRADE PROJECT
Part 1 - Introduction

The Idea for the Project

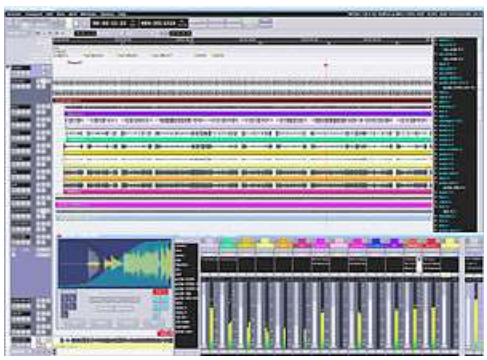
Whilst attending a concert by a well known Wersi artist I noticed that for the items requiring church and theatre organ registrations none of the standard OAS sounds were being used. Instead these registrations were being supplied by an external computer running an entirely new kind of sound processing software. The sounds from this software had an authenticity and realism that was absolutely astounding. Connecting equipment such as synthesisers and expanders to instruments like the Wersi organ has long been an established practice, but it never occurred to me that you could do the same thing with a computer. On further investigation I discovered that the software being used for this purpose was only the tip of the iceberg. There is a large and expanding range of this new generation software available that can replicate all kinds of musical instruments, and all of it can be incorporated into any Wersi OAS organ using the standard external MIDI facilities provided on the instrument. And so the idea for the project was conceived, to significantly enhance the quality, authenticity and versatility of the instrument by enabling it to run the very latest generation of industry standard state of the art MIDI based music software. This is the technology that the professionals use to create music for film and television, radio and podcasts, songs and compositions, videos, computer games and a whole host of other applications. It produces sound of amazing quality and realism, far in excess of anything that can be achieved on any standard OAS/X instrument.

Computer Based Music Systems



Whilst the Musical Instrument Digital Interface (MIDI) was being developed to enable one instrument to play another, computers were shrinking in size and increasing in power so that it soon became possible to have one in the home. Attach a MIDI equipped keyboard to a Personal Computer (PC), add a sound card and some music processing software, and a brand new way of playing music was created, We know this today as the Digital Audio Workstation (DAW).

The principal characteristic of a DAW is its ability to handle musical data in digital form. Unlike previous analogue systems that generated their sounds from electronic circuits, a DAW uses recordings of actual instruments that we call samples. Once in this form these can then be controlled by MIDI signals from a keyboard, combined together, modified with a range of audio effects, recorded and edited. So now we have a new and very versatile way of producing music.



The Wersi OAS Technology

Wersi were amongst the first companies to realise the potential of MIDI based computer music systems. Take the processing hardware out of the computer and place it into an organ console, add keyboards, a pedalboard, a display and a Windows operating system and we have a completely new musical instrument. To make all of this work however we need to design a customised applications package that can perform the same functions as the music processing software. Wersi call this the Open Art System (OAS).

The heart of the instrument is the MIDI control system which operates both in internal and external mode. Internally all the sounds that are available on the instrument have MIDI codes as do all the console controllers like the expression pedal, volume controls, octave shift, modulation and pitch wheels etc. All of this is replicated on the external MIDI system which means that we can attach any MIDI compatible device to the instrument via a MIDI cable and play this in exactly the same way as we would the internal system.

Limitations of the OAS/X Technology

Although both PC based MIDI systems and Wersi instruments appear to be very similar in nature, there is one fundamental difference between the two. The PC is a general purpose system onto which we can install any type of music processing software. The Wersi system by contrast is restricted to running the OAS/X. So as music processing technologies progress, the PC can keep pace with any new developments whilst the Wersi with its fixed configuration cannot. So it becomes progressively more out of date compared to current industry standards and practice.

Since Wersi instruments are based on standard PC technology, it would be theoretically possible to run more up to date music software on the instrument's processor. This could either be stand-alone software or Virtual Studio Technology (VST) plug-ins. Stand-alone software requires a standard Windows installation, which is not what Wersi provide. They use a specially configured version of Windows which is customised to the particular requirements of the instrument.

A VST is a version of a stand-alone software package that can be linked into a music processing system, known in this context as a host. There are many VSTs on the market that will integrate into a variety of different hosts. Wersi provide such a host facility within the OAS/X. However, all potential VSTs will have to be compatible with both the host environment and the operation of the OAS/X. For this reason, mostly only those VSTs re-configured by Wersi for use in their instruments have had the best chance of working successfully.

Modern music processing software achieves high levels of quality and realism by using considerable numbers of high definition sound samples that require fast processing speeds and very large capacity internal and external storage. Given that the instrument's computer is already running the Windows operating system, the OAS/X, the sound engine and many other utility programs, there are unlikely to be sufficient computing resources available to handle this additional demand.

The Dream Machine

The ideal instrument would integrate the customised features of a Wersi instrument with the flexibility of a MIDI based computer system. This can be easily achieved. The OAS range can provide all the comprehensive MIDI control required via its external MIDI facility, and the addition of a second processor linked to this can handle the installation and execution of new software. In this way we retain all the features and facilities of a standard OAS instrument, but greatly increase its quality and versatility by incorporating the very latest music processing technology.

The Hardware

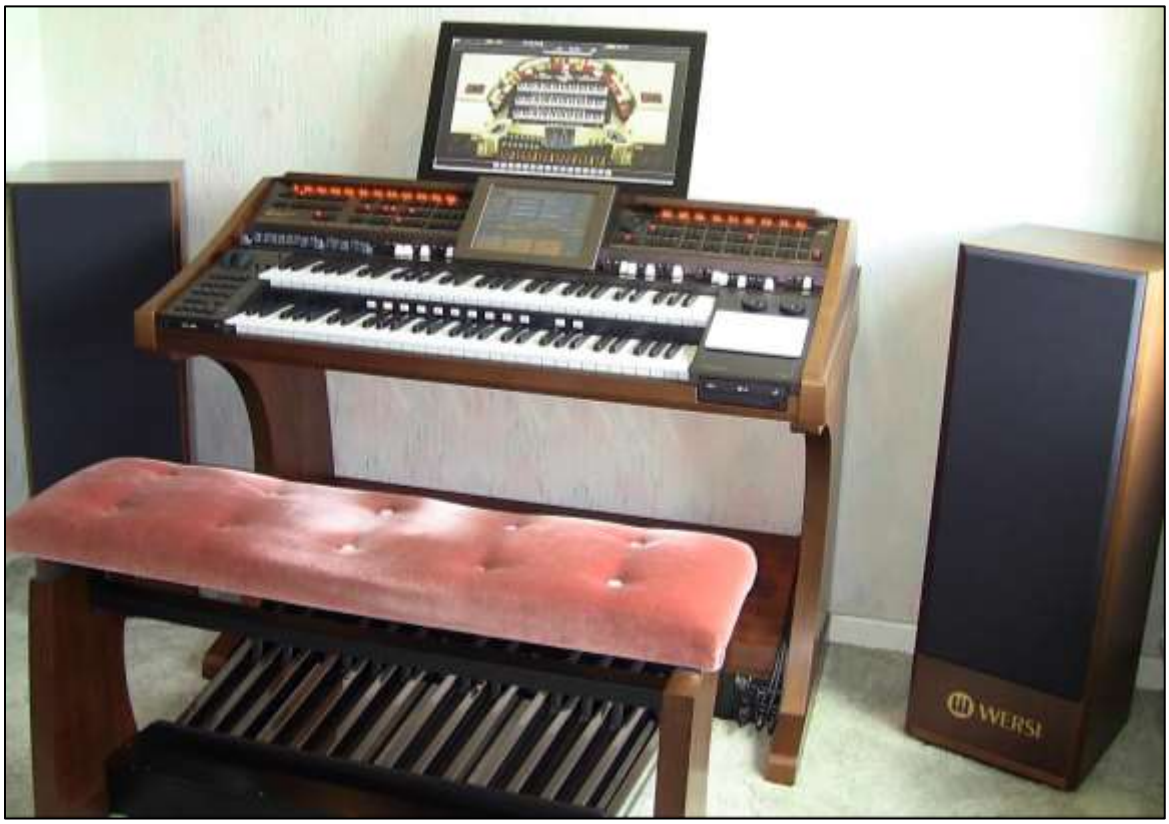
Just three items of hardware are required for the upgrade, a second processor, an Audio/MIDI Interface Unit and a widescreen display monitor.

The second processor can be any general purpose PC/Mac computer or laptop running a standard operating system. It is used exclusively to run the new generation software and operates completely independently of the organ's main processor. So no modifications to the OAS or the main processor's Windows operating system are required.

The Audio/MIDI interface unit receives MIDI data from the MIDI Out connector of the organ and feeds this to the processor. It also receives stereo audio from the processor and feeds this back to the Audio Input connectors of the organ.

A widescreen monitor is used to configure and display the new software, selection menus and sheet music. If the monitor is not touchscreen enabled, a mouse or trackpad can provide equivalent functionality. Any size and type of standard display monitor is suitable.

The picture below shows the author's upgraded Wersi Scala. An Acer touchscreen monitor replaces the music rest, a Steinberg Audio/MIDI interface unit is fitted inside the console, a Mac mini processor is installed under the console and its trackpad sits on the right of the console.



The processor can be located anywhere on or around the instrument, but out of site under the console is suggested. The Audio/MIDI Interface Unit can be installed either inside or under the console. Cabling to the instrument's MIDI and Audio sockets is routed internally within the console. The display monitor can be located anywhere on or around the organ.

The Audio/MIDI interface unit is necessary because computers don't generally have a MIDI input connector, so a conversion to a USB format is necessary. The unit also takes the audio output from the second processor and converts it to a stereo signal suitable for input to the organ's external audio input. It would be possible to take an audio output directly from the second processor's line output (if available) and feed this directly to the organ's external audio input. However, most general purpose computer sound cards have poor quality digital to analogue converters feeding into their line outputs. Using an interface unit ensures that the audio signal can be taken from the second processor in digital form via the same USB connector that is used for the MIDI signal, converted to analogue in the interface unit by high quality digital to analogue converters, and then fed to the organ's audio inputs. In this way we ensure that the highest quality audio signal is obtained and maintained throughout the system.

The Software

Connecting a general purpose computer to a Wersi instrument means that we can run any kind of software we wish, but since the organ is essentially performance based, the upgrade software chosen is that of the *Sample Player*. In this process, musical instruments are digitally sampled in precise detail by experienced sound engineers to create large quantities of very high quality samples known as *Sample Sets*. These sample sets are then played back in the computer by the sample player software. The instruments are sampled using professional musicians from the world's top orchestras playing in prestige concert venues. Adopting this approach produces stunning quality and realism in four important areas. Firstly, the instruments are sampled both individually and in a variety of different groupings, so we are not layering instruments together (as in the OAS/X technology), we are reproducing the actual ensembles in which they play. Secondly, each instrument is sampled with all the articulations that the instrument is capable of producing, so we are not synthesising this with some electronic processing (as in the OAS/X Hypersonic sound engine) but reproducing the work of an actual musician. Thirdly, we have a comprehensive array of sound controls available that have been obtained from the actual characteristics of the instrument, so we are not constrained by a limited set of artificially synthesised controls (as in the six sound controls of the OAS/X Hypersonic sound engine). Fourthly, in addition to recording the instruments in a particular venue, we also separately record the reverberation in that same venue and then apply this in the sample player. So instead of applying a general purpose reverberation (as in the OAS/X reverberation unit) we use the actual acoustics of a real environment. This is called *Convolution Reverberation*.

The Sample Players

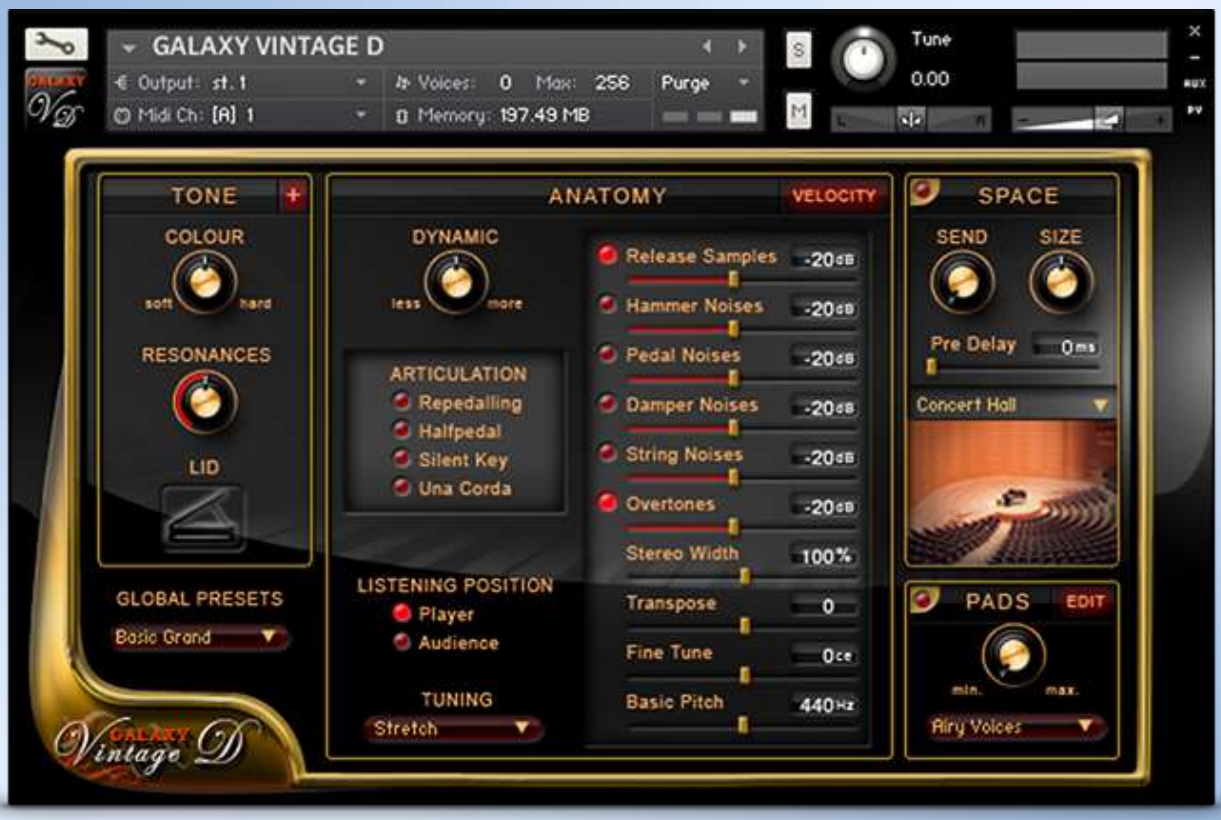
Two types of sample player have been included in the upgrade project, namely the *Kontakt Instrumental Player* and the *Hauptwerk Pipe Organ Player*.

The Kontakt Instrumental Player

The Kontakt player is one of a number of packages supplied by Native Instruments and is the market leader in sample players. It enables a huge array of instruments to be reproduced with astonishing accuracy from a comprehensive set of libraries available both from Native Instruments and from third party suppliers. The screen shot below shows the iconic Steinway Model D grand piano installed from one of the Galaxy piano libraries. As you can see, there is a comprehensive set of sound controls available both to accurately reproduce the true sound of the piano and also to ensure that this is authentically reproduced through any sound system.

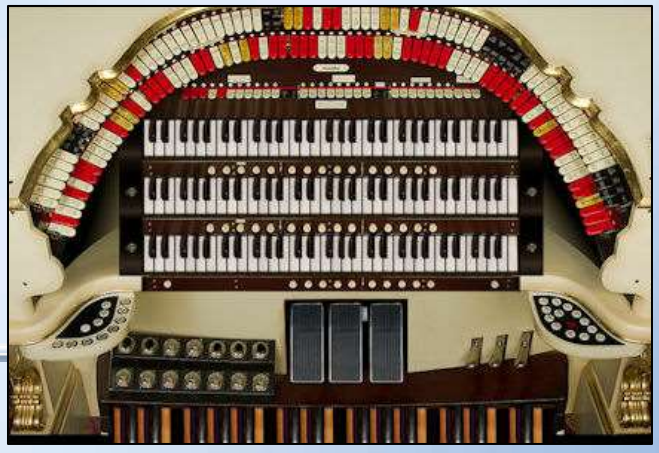
The Hauptwerk Pipe Organ Player

This is a unique piece of software that enables both classical and theatre pipe organs to be accurately reproduced by recording a complete sample set for each specific instrument. In this process every pipe in the instrument is sampled individually in the acoustic environment in which it resides. A comprehensive pipe voicing facility is available in the *Advanced* version of the software. This enables each of these pipes to be adjusted individually for volume, tone, stereo positioning etc. to compensate for any differences in the acoustics of the recording and playing environments. The software provides a series of displays showing the player's view of the console, stops and controls on the instrument. The console views for the Henry Willis organ in Hereford Cathedral and the Paramount Wurlitzer theatre organ are shown below.



Steinway Model D Piano

Hereford Cathedral Organ



Paramount Wurlitzer Organ

Design Objectives

The upgrade project has three principal design objectives relating to its software and hardware implementation, namely *Seamless Integration*, *Reliable Performance* and *Complete Versatility*.

Seamless Integration

Although the second processor is running completely independently of the organ's main processor, we wish to have all the sounds produced by its software available in the OAS. The Wersi external MIDI system makes this possible. All these sounds can be stored in the OAS sound database and so can be fully integrated into the instrument's Total Presets either on their own or in combination with any of the other OAS sounds on the instrument. They can also be programmed into the instrument's sound maps, selected on any layer on the upper and lower manuals and pedalboard, and used in any track in the accompaniment unit or MIDI Sequencer. From the player's point of view there is no difference in selection or usage between a new sound or an OAS sound. The new software runs seamlessly in the background and can be started automatically when the second processor is booted up.

Reliable Performance

This new generation software demands high levels of computing power and storage resources. For this reason it is not practical or sensible to try and run this on the main processor of any OAS/X instrument. All the performance operations of the instrument have to be implemented in real time and the main processor is already significantly loaded running the Windows operating system, the OAS/X procedures, the Hypersonic sound engine and many other computer utility routines. Having a second processor in the system that is exclusively dedicated to running the new software ensures that we completely avoid potential software crashes and freeze ups, audio drop outs, distortion, limits on polyphony, latency issues etc.

Complete Versatility

Since the second processor is a standard general purpose computing facility, we have complete freedom to load any kind of software we wish according to individual preference. This could include not only a range of sample players and libraries, but also applications like Digital Audio Workstations (DAW) and even professional level recording studio facilities. Upgrades to existing software can be easily implemented and new software quickly installed when it becomes available using a standard wired or Wi-Fi Internet connection. We also have the convenience of running software in stand-alone mode as opposed to trying to get it to work as a VST plug-in. This makes for a much simpler, more reliable installation and completely avoids all the hassle, inconvenience, unpredictability and complexity associated with using VST hosts.

Technical Expertise

All the computing hardware and software for the upgrade project is standard equipment and the interface technology is well established. However, a basic level of computing expertise is required, notably in the area of software installation and commissioning. It is recognised that anyone with the interest and competence to undertake a project such as this would more than likely want to define their own variant, particularly with regard to different hardware and software implementations. So although the upgrade text describes the author's own implementation, this will also provide the necessary information for those wishing to construct their own customised designs.

I hope that you will find the article both informative and useful. Should you decide to follow through with the upgrade, I'm sure that you will be rewarded with an interesting, engaging and worthwhile project.

And on completion you will have a state of the art instrument offering all the features and facilities of an OAS organ but significantly enhanced in quality, authenticity and versatility by the very latest in music processing technology.

Coming Next

Part 2 of this article will cover the setting up of the Wersi external MIDI and audio system

The Upgraded Instrument Specification

Features	Upgraded Instrument	OAS/OAX Instrument
Number of Processors	Two - Processor 1 running Windows, OAS and associated software. Processor 2 running the whole range of new generation software.	One processor running Windows, OAS/X, other associated software and a limited number of Wersi compatible VSTs.
Sound Engine	Hypersonic for OAS sounds Industry standard sampling software for the new sounds	Hypersonic for OAS/X sounds (This product discontinued from commercial sale in 2009)
Sound Quality	Large sets of high definition 24 bit uncompressed samples individually recorded live in top international venues	A core set of 16 bit compressed samples used to synthesise a wider set of instrumental variants
Instrumental Ensembles	A comprehensive set of ensemble sounds sampled from actual instrumental sections for maximum realism	Mostly individual instrumental sounds that have to be layered together to synthesise actual ensembles
Instrumental Articulations	Wide range of articulations recorded by real musicians	Limited range of articulations generally synthesised
Sound Controls	Comprehensive set of sound controls appropriate to each specific instrument	Limited by Hypersonic to a small sub-set of six mostly general controls
Effects	Convolution reverberation sampled in the same acoustic space as the instruments for the most realistic ambience	General purpose reverberation applied to all sounds producing an artificial synthesised ambience
Displays	10” standard display and 23” widescreen display	10” standard display (OAS) or 13” widescreen display (OAX)
Software Expansion	Unlimited new software installation and upgrade under user control	Restricted to OAS/X upgrades as and when available
Technology Tracking	Yes, can keep pace with the latest advances in music processing technology	No, locked into a fixed OAS/X architecture
Sheet Music Display	Full size, double page	Reduced size, single page
Internet Connection	Yes, hard wired and Wi-Fi	No
Upgrade From OAS	All OAS models	Specific OAS models to OAX
Upgrade Cost	Typically £700 for hardware plus instrumental libraries	Currently £6800 - £11,000

Jeff Ormerod - September 2016