

# Hamilton Sound

The Talking Newspaper for Hamilton and District

Disability Forum, 42 Campbell Street, Hamilton, Lanarkshire, ML3 6AS Tel: 01698 307733  
Email: [info@hamiltonsound.co.uk](mailto:info@hamiltonsound.co.uk) Web: [www.hamiltonsound.co.uk](http://www.hamiltonsound.co.uk)

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## Compact Cassette Replacement Project

### Phase 1 – Final Report

Version 1.0

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#### Disclaimer

This report has been deliberately written in a tutorial style to facilitate its dissemination to a wider (possibly non-technical) audience in the hope that it will best benefit other TNs.

In this context we would like to make it clear that Hamilton Sound can not accept responsibility for any errors contained herein nor for the consequences of following this report's recommendations.

Having said that we would like to reassure readers that we have taken great care over the accuracy and validity of what we report and we do hope that you find the contents inspirational and useful.

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# 1. Introduction

## 1.1 Background

Philips introduced the compact audio cassette medium for audio storage in Europe in 1963, and in the United States in 1964, under the trademark name Compact Cassette. Although there were other magnetic tape cartridge systems at the time, the Compact Cassette became dominant as a result of Philips's decision (in the face of pressure from Sony) to license the format free of charge.

Soon after its introduction, the Compact Cassette quickly became the 'backbone' media for Talking Newspapers and Magazines throughout the UK due to its ease of use, wide availability and relatively low cost of players and the media itself. Indeed, its very existence was probably responsible for facilitating the rapid proliferation of TNs throughout the UK.

The Compact Cassette has served Hamilton Sound and its listeners well since our launch in 1983 but there are growing signs that this happy association with the Compact Cassette may not last for much longer. Manufacturers are producing less equipment for recording and playing Compact Cassettes and some do not support the media at all. High street stores have ceased stocking the media although it remains available through some specialist outlets.

Whilst no one can be certain how rapidly the final demise of the Compact Cassette will be, it is probably a fair estimate that the media will cease to be viable for all practical purposes within 5 years from now. Some impacts may be felt earlier than this.

For this reason, Hamilton Sound has launched a project to explore its technical and organisational options, to select the most suitable these, seek the necessary funding and finally replace the existing Compact Cassette based service with a suitable alternative.

We have made an assumption that we need to have all facilities and procedures full operational by end 2008 albeit that we may operate a legacy Compact Cassette based service for an overlapping period thereafter. The assessment of the feasibility of this will form part of the Compact Cassette Replacement Project.

## 1.2 Project Objectives

Overall, the Project Objective is to implement an alternative program distribution system (to Compact Cassettes) by end 2008.

To achieve this the project will, for the replacement system,:

- Identify the replacement system's requirements
- Design the replacement system
- Evaluate the costs and acquire the necessary funding to implement the replacement system
- Implement the replacement system

We agreed that the requirements and design of our preferred solution would be influenced by our findings in the following areas:

- Listeners needs – Equipment cost, useability, serviceability, audio quality
- Media – Unit cost, serviceability, durability, size & weight, re-usability
- Production needs – Equipment cost, serviceability, useability, bulk reproduction speeds
- Procedures & Standards – Full life cycle processes (including interim parallel operations during cut-over).
- Funding – Capital and revenue funding needs for all of the above.

## 1.3 Project Plan

The project will comprise a series of phases as follows:

- Phase 1 – Selection of candidate solutions and preliminary technical evaluations (by end August 2007)
- Phase 2 – Conducting prototype trials and selection of final design proposals (by end December 2007).
- Phase 3 – Funding and Implementation Planning (by end September 2008)

- Phase 4 – Implementation and initial monitoring (by end December 2008)

#### **1.4 *This document***

This document provides a final report on Phase 1.

## 2. Initial thoughts

It is clear that the new media will be digital based but what was not quite so clear was how the physical distribution can be best performed cheaply, reliably and at reasonable cost.

Possible options we considered were:

- Download via the internet to a digital media player on a PC such as Windows Media Player software.
- Download (normally via the internet and a PC) to a portable media player such as an iPod.
- On CD via post.
- On Pen Drives (also known as Flash Drives or Thumb Drives) via post.

(We discounted Minidisk (MD) as it is apparent that portable MD players are rapidly being superseded by the iPod type of device)

### 2.1 Downloading

As there is no physical distribution media involved, download of programme material to media players (both PC based and portable devices) is cheap, reliable and minimal cost but currently could pose many obstacles for listeners not least of which would be the cost of ownership and mastering the use of PCs, the internet and/or a portable media player. We understand that RNIB are working on this problem and it has been suggested that suitable devices and even RNIB services will be available for TN distribution at some point in the future. We will continue to monitor this situation throughout our trials and be ready to take advantage of any solutions that may present themselves.

### 2.2 CD

Re-writeable CDs are relatively inexpensive and are by design re-usable, however, they could prove unreliable in re-use because of damage and/or finger-marking of the recording surface. They also have a relatively high natural failure rate (for no particular reason) and tolerate only a limited number of re-writes.

Write once CDs are also relatively inexpensive and even cheaper than re-writeable CDs but as they are not re-usable, even the modest unit costs of the media and single use packaging materials could pose significant recurring costs for the TN in the long term. To their credit CD players are readily available, inexpensive and easy to operate. Of course, the RNIB already make use of CDs (using the Daisy data compression format) to distribute their Talking Books and the RNIB players will also play normal audio CDs.

### 2.3 USB Pen Drive (Flash Disks)

Whilst not totally dismissed and out of the picture, we decided to put CDs on one side for now whilst we investigated more thoroughly the apparent attractiveness of Pen Drives. Whilst the media unit cost is relatively expensive (for bulk purchases we estimate these at around £2 to £3 each) they are robust and readily re-usable. They can be distributed by post in the same way as presently for cassettes.



Image 1 - Typical USB Pen Drive

Playback devices for Pen Drives are becoming more widely available at moderate cost. Many low cost entertainment systems are now equipped with a USB port and the capability to play MP3 files from Pen Drives or portable media players and we currently know of one player, manufactured by Goodman, which retails at around £20



*Image 2 - Goodmans ACTIVE 6USB Speaker*

and of another, manufactured by TeckNet, at £9.99.



*Image 3 - TeckNet AD-05 Portable USB Flash Memory MP3 Player Speaker System*

So we are confident that a good range of suitable playback options will be readily available to all listeners, whatever their preferences, within a year or two.

For all of the above reasons our initial analysis has encouraged us to investigate the other aspects of our study based on an assumption that distribution of Hamilton Sound will be by at least the following:

- Postal distribution on USB Flash Disk
- Download from the Internet

## 3. In the Studio

### 3.1 Quality

We believe there are a number points to consider when planning for a digital studio. The most important of these is the quality level of the equipment. Here prices will be found to be exponentially proportional to the quality of the equipment with Broadcast Quality being at almost unreachable levels for most TNs. However we don't believe you have to go anywhere near this far.

When creating MASTER recordings for distribution by cassette the highest achievable audio quality was paramount as there is an inevitable loss of quality during editing (if you use copy edit rather than open reel 'tape splicing' type of edits) and during the high speed copying of the Master to Listener's Cassettes. The media quality of the listener's tapes and the quality of the listener's listening device was yet another quality hurdle to be cleared. This is well understood by all TNs who for this reason will have invested in the highest possible quality of analogue recording and reproduction devices they can afford.

With digital recordings there is no loss of quality no matter how many times you copy the master. So a copy of a copy of a copy (ad infinitum) will be as good (or as bad) as the original. So, as long as you create the original Master to at least the quality level you decide is needed for the final copy (the listener's copy) there is no need to incur additional expense in striving for anything higher.

Digital quality is determined by the rate at which the original signal is sampled. Each sample is coded as strings of data in a computer readable file. As this data is used to reconstitute a facsimile of the original signal on playback it follows that the more detail available the better as the playback device has to 'estimate' what the original signal would have been in between samples.

So, high sample rates equate to high quality but also equate to high volumes of data. This can be troublesome in terms of the space you need to provide for storage of the audio files and the length of time it takes to copy or download. So this needs careful consideration.

In order to mitigate the need for these large data files to some degree, the industry has devised various types of data compression standards. The most popular and widely accepted compression format is known as MP3, familiar to all iPod owners. This compression format is not 'lossless' (i.e. there is some loss of detail when 'decompressing'), but is a reasonable compromise and should be undetectable in most circumstances. It is certainly perfectly adequate for TNs and its wide appeal and use is a big plus in its favour. So we opted to use MP3 format for both Mastering and Distribution.

Another important factor affecting audio file size is whether the recording is to be mono or stereo. A stereo recording will be twice the size of its mono equivalent. Hamilton Sound is mastered and distributed in mono and we saw no good reason to alter this.

So, taking MP3 as our preferred compression format we looked at the MP3 audio data file sizes needed for 90 minutes of mono audio material (to match our current C90 playing time).

There are two commonly used sampling rates used for digital audio (measured in thousands of cycles per second or kHz). These are:

- 44.1 kHz – most commonly used for audio CDs and MP3 recordings.
- 48 kHz – most commonly used for professional audio, films and Digital TV

Hamilton Sound opted for 44.1 kHz.

Now the level of MP3 compression is determined by the number of data bits we require to represent a second of audio. This varies from 32 kbit/s to 320 kbit/s which will require the following file storage space for 90 minutes of mono audio material.

<u>Bit Rate</u>	<u>File size needed to hold 90 mins.</u>
32 kbit/s	20 megabytes
64 kbit/s	40 megabytes
128 kbit/s	80 megabytes
320 kbit/s	200 megabytes

The most commonly used compression rate (when ripping CDs or downloading audio files for storing on an iPod) is 128 kbit/s. This provides HiFi quality to all but the most critical ear on playback.

For mono voice recordings we have found, so far, that 32 kbit/s is perfectly adequate however we may move up to 64 kbit/s once we have assessed end user feedback. For the remainder of Phase 1 of this study we shall assume 32 kbit/s is our preferred bit rate.

### **3.2 Existing Equipment**

The existing equipment of microphones, mixing desk and recorder are considered here.

The microphones currently in use are of high audio quality and in good repair. Digital microphones are available and affordable but of course would require a digital mixing desk if implemented. There is absolutely no benefit in having digital microphones feed into an analogue mixing desk and thence to a digital recorder.

The mixing desk is a recent acquisition, of good audio quality and in good repair. In a digital studio it is possible to consider the use of a digital audio mixer. These devices provide a fantastic range of clever features not available, or indeed possible, on analogue mixers. They are very expensive (compared like for like with an analogue equivalent) and can be horrendously costly as you start to add on the extra features many offer. Most of these the average TN will have no use for and, in any case, can be very complicated to use.

We decided that Hamilton Sound would continue to use it's analogue microphones and mixing desk on the grounds of cost and operator familiarity. There is negligible audio quality loss between microphone and final 'mix out' to justify such an expensive replacement strategy, however this area can be revisited at a later date if required.

### **3.3 New Equipment Requirements**

The analogue output signal from the mixer is what we plan to digitise and capture as our Digital Master.

To do this we of course require a digital recording device of some sort capable of the sampling rates we have decided upon.

Most modern computers (including laptops) come with a sound card and the capability to input an analogue audio signal. Equipped with suitable software it is possible to use a computer as the master recording device, which could prove to be convenient if this is also the computer to be used for editing and final distribution (see later sections). However for a variety of local logistical reasons and simplicity of operation for the existing recording teams we have decided that a stand-alone digital recorder should be implemented.

There is a wide range of digital recording devices available (and a wide range of prices to match). The most important considerations here are:

- Digital audio quality capabilities
- Ease of use
- Portability
- Recording media

Fortunately the digital audio requirements of most TNs (i.e. 44.1 kHz @ 32 or 64 kbit/s to MP3 format) will be well within the scope of most devices on the market at present so finding something at a sensible price should be no problem.

If a portable device is required there are a few pocket sized recorders available which would be eminently suitable for interviews etc. We didn't research this closely as we have no need for a pocket sized device (we don't do interviews).

Slightly larger than pocket sized but still portable is a device made by Marantz which we found had all the features and performance we needed. Below are brief details and the device is readily available at around £250 (ex VAT). We purchased ours from ACAudio.



Image 4 – Marantz PMD660 (Front)



Image 5 – Marantz PMD660 (Rear)



Image 6 – Marantz PMD660

### **Marantz PMD660 Features**

- Record directly to compact flash cards
- MP3,WAV,format compatible
- 44.1/48KHz sample rate selection
- Balanced XLR Mic input
- Unbalanced line in and out
- USB connectivity (for simple transfer to PC)
- 48V phantom power
- AA x 4 batteries
- Backlit display
- Built-in mic and loudspeaker

## 4. Phase 1 Activity Report

As described earlier in this report, we have selected the basic production equipment, distribution media and procedures which will form the basis of our larger scale evaluation trials.

The final stage of Phase 1 is to perform some rudimentary technical evaluations to reassure us of the feasibility of our hypothesis. We are in the process of conducting these evaluations in the following areas:

- Digital Master Production (in parallel with Analogue Master Production)
- Post Production Digital Editing of the Digital Master as a new (to Hamilton Sound) process stage.
- Production of multiple digital listener's copies
- Distribution

Our findings to date are described below.

### 4.1 Digital Master Production

As previously explained, we have assumed that we will need to produce both a Digital and Master Recording for a period of time to facilitate cut-over to a fully digital service.

We therefore have set up our studio to quite simply simultaneously feed an analogue signal from our final mix to our existing Cassette Master Recorder and our newly acquired Digital Recorder.

Our production method for our Cassette Master has always been to edit 'on the fly'. That is, our readers will normally correct minor misreads by self correction in real time by using the well worn expression "... I'm sorry I'll read that again...". However for more major or serious miscues, misreads, coughing fits and the like we will stop the recorder, re-wind to a convenient point and do a re-take from that point.

To do this for both recorders would have been too complicated for the production team so we decided to continuously record (mistakes and all) on our Digital Recorder without pausing. The only additional production step we have introduced is to make a note of the elapsed time counter on the digital recorder for each re-take we need to edit as a post-production process. More on this later.

It would be possible to mark these points on our Digital Recorder by using the 'MARK' feature provided on our Marantz PMD660. Most Digital Recorders will have this feature but we have found that it is much simpler for the production team to make a handwritten note on the Production Notes (with a brief comment as to the nature of the defect) for later use.

### 4.2 Post Production

Post Production Editing is a new concept and Production Stage to Hamilton Sound, however, we have found it very quick and straight forward. What is required is a PC (desktop or laptop) equipped with a sound card and good audio editing software. You will also need a USB or Flash Memory Card reader to import the Raw Master Recording from your digital recorder (unless of course you have used the same PC to record the Audio Master in the first place).

The faster the processor on the computer is the better but any processor speed of say 1 GHz or above will be fine. Ours runs at 3.8 GHz.

The more RAM memory your computer has the better. If you are running Windows XP you probably already have a minimum of 0.5 GB but 1 GB or more would be much better.

For the software required there is a wide range to choose from. Some shareware or freeware products are available for download from the web and most proprietary products can be downloaded and used fully functional for a trial period. Just Google 'audio editing software' and have a browse.

We have trialled Goldwave (available by download from <http://www.goldwave.com>) and found it easy to use and full of good features to help polish your Master Recording. It's not freeware but you can use a fully functional trial version of it which is limited, not by time as is the case of many others, but by the number actions you carry out on it. We were able to use our copy for several months and had a good feel for it's capabilities before our trial counter elapsed. We then purchased a licence at US\$45.

There is an interesting sister product to Goldwave which is called MULTIQUNCE Multitrack Mixer. This is a great product if you put together a Magazine or something similar. Again very easy to use and full of sophisticated features.

Editing the Raw Master we have found very easy (and quick). Using the Production Note's list of re-takes we can quickly locate the offending items and cut them out before saving the Final Master for copying to listeners devices. We have found that usually only 15 minutes or so are required for this stage.

### 4.3 Copying

Uploading the Final Master to our website is very straightforward. Anyone familiar with the management of websites will know how to do this using an FTP utility or a web design package such as Microsoft's FrontPage and it only takes a few minutes.

You will of course need to design your website page or pages to facilitate streaming and/or downloading. Visit <http://hamiltonsound.co.uk> to see what we have done.

Copying the Final Master to the listener's Pen Drive posed us with a bit more of a challenge.

We found company which markets a total solution comprising:

- Brand new PC or Laptop computer
- High quality external sound card, with professional microphone inputs
- 10-Port Thumbdrive Duplication Unit
- Digital Recording Software
- Full configured and installed at your site
- 1 day on-site training
- 3 year hardware warranty
- 3 year product updates and support

but we also found that the cost of taking this package solution (inclusive of listener's Pendrives and Speakers) was going to be prohibitive. For example, for 100 users the package price was £5,850. However, for the more technically challenged TNs this may be worthy of consideration as most of the technical challenges have been resolved and it comes with manufacturer's support.

[If this is of interest you can contact Bridge Digital at <http://www.bridgedigital.net> for more information.]

So Hamilton Sound decided to resolve the copying problem for themselves at, hopefully, a much lower cost.

Fortunately we already have access to good computer equipment to use for post production editing, web site maintenance and copying. So what was really needed was the means to make multiple copies of the Final Master to Pendrives.

To achieve reasonable throughput for large quantities of Pendrives a method involving simultaneous copying of a number of Pendrives was required.

This in turn requires the following:

- Multiple USB ports connected to the PC
- Software to control the copying process (and make it as automatic and user friendly as possible).

Multiple USB ports are easily possible by connecting one or more USB Hubs to the PC. Each hub usually provides around 4 ports but 6 and 8 port hubs are commonplace. A word of warning here though – USB hubs come in two forms, powered and passive. The passive type depends on power from the PC to provide power to the USB device (the Pendrive in this case). If a significant quantity of hubs of this type are to be attached the power limitations of the PC may be breached. To be safe it is best to use the powered type.

Another consideration when selecting the hub is it's physical design. Many hubs are physically very compact with little physical separation between the ports. This can impede the insertion of Pendrives in adjacent ports. Also some hubs can be light and flimsy so make sure that the hub will tolerate the high level of use that it will be put to. Nevertheless, even a high spec powered hub will be relatively inexpensive and shouldn't cost more than £100.

We suspect that 8 – 10 ports will be the optimum number for a single operator.

The licence for the software from Bridge Digital to control the Pendrive duplication is £395 (which was also the cheapest we found). This same software also includes recording and editing functions. We located other software products (or complete Pendrive duplication packages in some cases) but generally these were very expensive with most costing 4 figure sums.

We therefore developed our own software to perform this task. It took us about 40 developer hours to create and provides the following functionality:

- Auto detection of Pendrive insertion.
- Automatic asynchronous duplication to each inserted Pendrive
- Progress monitor (showing each pendrive's copying progress at a glance)

Hamilton Sound will be happy to make this software available to other TNs free of charge in due course but before we can do this we need to do further work on it to make it universally installable on a wide range of PC specs and to package it for easy installation.

There are a few additional features and utilities we have in mind for development so we shall probably not release this software for general use for some time yet. However, if there are any TNs who have the technical resources to make use of our prototype in the meantime on a 'no guarantee or support' basis we would be very pleased to hear from them.

In use, the above USB Hub and Software combination works like this:

The latest Master is placed in a nominated folder.

In our case this called HAMILTON\_SOUND\_DIGITAL\_MASTERS (see below).

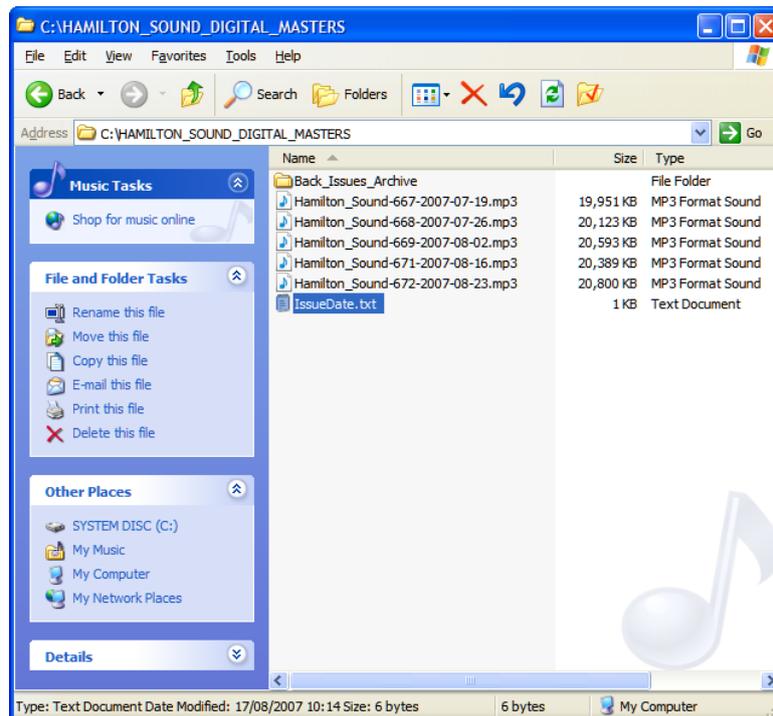


Image 7 – Master MP3 Folder

We also include the previous four issues of Hamilton Sound here (the Pendrives we have decided to use are 128 MB so 5 copies can be comfortably accommodated). The listener then has the latest issue plus earlier issues to choose from in case they missed one or want to listen to them again. Older copies are dropped into the Back\_Issues\_Archive subfolder and are not copied to the Pendrive.

The text file 'IssueDate.txt' is simply updated with the current week's issue date and is used by the Duplication and Monitoring software for various labelling and identification tasks it carries out automatically.

The operator simply plugs the listeners Pen Drives into to vacant USB ports (in any order). The insertion is automatically detected by the software and copying commences on each drive immediately on insertion. Whilst this is proceeding the next Pendrive can be inserted and similarly copying will commence on this whilst the next is inserted and so on.

The progress of the copying is displayed on a monitoring panel as shown below and each drive will be identified when complete. Completed drives can be withdrawn and a new one inserted at any time (without the need to wait for any of the others to complete). In this way the operator can create his or her own rhythm and style.

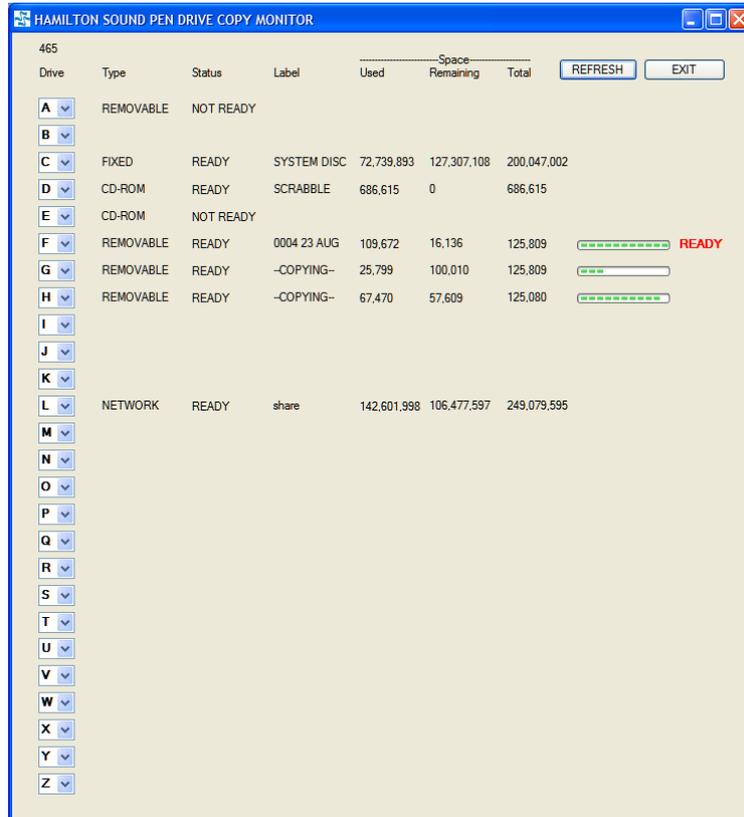


Image 8 – Hamilton Sound Copy Monitor

[Showing Drive F completed copying and Drives G and H partially complete]

[All Computer Drives are shown by the Monitor – Drives A, C, D, E & L are other drives on this computer. Drives F – K are used for Pendrives ]

Each Pendrive takes about 30 seconds to copy on our system but this could vary depending on other PCs depending on processor speed and other factors. In general terms it takes about a minute from insertion of the first Pendrive to extraction of the last to copy a batch of 6 Pendrives. Clearly copy production rates can be very much higher than that achievable with Cassette Bulk Copiers even with lower performance computer equipment.

#### 4.4 Distribution

Happily we don't have to contemplate changing anything with regard to postal distribution. The Pendrives easily fit into our Cassette wallets so it will be straightforward to pop a cassette or Pendrive into the listener's wallet as appropriate. We may make use of different coloured wallets or perhaps a special mark on the address label to help us identify who gets what.

As far as distribution by Internet is concerned there are two options – broadcast or post.

Broadcasting by email would mean sending out an email to each signed up listener with the MP3 file attached. As this file is approximately 20 MB it will take some considerable time to download from a listeners mailbox if their Internet connection speed is slow. Also many email service providers have an attachment size limit of 5 MB or lower so for both of these reasons we have decided not to offer this service option.

Posting the MP3 file to a suitably equipped and configured website allows the listener to 'pull down' the file in their preferred manner at a time of his/her convenience.

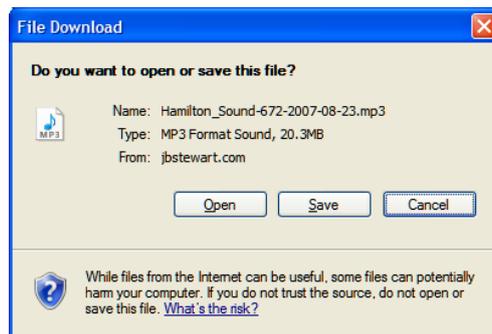
The file can be accessed on a website by 3 methods:

- Streaming to an embedded media player
- Streaming to the preferred media player (hosted by the PC)
- Downloading the MP3 file for later use on either a media player hosted by the computer or storage on a portable Media Player (such as an iPod).

Streaming to an embedded player. This involves the listener simply clicking the listen now link which causes a special web page to be opened and which immediately starts playing the selected file on a media player the controls of which are displayed on the webpage. In Hamilton Sound's case a prerequisite for this method is that Windows Media Player (free from Microsoft) must be installed on the computer. This is what our 'Listen Now' page looks like:



Streaming to the preferred media player (of the listener's choice and which is hosted by the PC) can easily be accomplished by opening the MP3 file on the website and, providing the relevant media player is installed and associated with MP3 files, the listener's preferred media player will run and open the selected file for immediate (streamed) playback.



Downloading works in a similar fashion to the above except that the listener opts to save the file (instead of opening it) whereupon the listener is asked to identify a folder in to which a copy of the MP3 will be transferred.

## 5. Conclusions

We believe that Phase 1 of our Project is now complete with no significant open questions remaining at this stage. We have identified the primary elements of our candidate solutions and have noted a few alternatives which we shall monitor for possible future implementation.

Technical evaluations have all been successful and there are no remaining technical obstacles of which we are currently aware that require resolution.

The next phase of our project (Phase 2) will be to conduct prototype trials and to identify the detail design of the final solution. This will start in September 2007 with completion planned for end 2007.

This will in turn lead in to Phase 3 which will identify the costs of implementing the final solution and seek the necessary funding to facilitate it. We have no clear idea of the timescales required for this phase – we would not be surprised to find it takes 6 months to 1 year to complete this.

The final phase – Phase 4 – will then roll-out the solution to all Hamilton Sound Listeners. This phase could well last for several years as the digital service is rolled out to a trickle of listeners to replace cassettes, however the bulk of the effort will be over in a very short period of time (probably in a matter of a few weeks).

Jim Stewart

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