Transfer Service Guide
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1 Introduction

This document guides individuals through the process of transferring material from digital carriers in the Digital Preservation Lab located at the University Library (UL).

The Transfer Service, which is being set up as part of the Cambridge University Libraries (CUL) Digital Preservation Programme, is the name for the service used to copy data from handheld storage carriers found in library collections so it can be prepared for preservation and access. The guide outlines the workflow and tools used to complete these transfers, and the method used depends on a range of factors that will be covered later in the guide.

Since this guide might be useful to a wider audience outside of the UL, pieces specifically relevant to UL staff will be highlighted. This guide is also a work in progress and is therefore versioned. Other relevant information to this guide can be found on the Digital Preservation pages of the Cambridge University Libraries website.

2 Getting Started

The Transfer Service is physically located in the Digital Preservation Lab at the UL. Within this space a multitude of drivers and computers can be found.

The UL purchased a Forensic Recovery Evidence Device (FRED), so the workflows outlined in the guide are built for this device, but the software within the workflows can be used on other devices.

2.1 FRED Workstation

This workstation provides the capability to transfer material from most carriers identified in CUL collections starting with those at the UL. This includes 3.5-inch floppy discs, 5.25-inch floppy discs, optical media, hard drives and flash storage.

The FRED is configured with a Windows setup. A Linux environment, specifically OpenSUSE, is provided with the FRED on an additional disc. However, the choice was made not to install this environment. OpenSUSE is not a common or widely used Linux environment, making the support at the UL and the wider University limited. This would mean that if problems were to arise, it may be difficult to get help to resolve them. However, there is a virtual BitCurator environment running on the FRED which provides a Linux environment within Windows. More on this topic can be found in the section discussing disk images.
A FRED is not necessary for transferring data from carriers. There are other options for building a more affordable setup, such as a Kryoflux. Another option is to invest in a write blocker and look into USB options for certain drives, such as one for floppy disks.

2.2 Internet Connection

The FRED is not connected to the Libraries’ internal network; instead, a Wi-Fi USB dongle is used to connect the FRED to a wireless network. This decision allows transferred data to be uploaded to an AWS S3 bucket and submitted to the repository without risking the threat of viruses or other malicious files infecting the internal network.

*UL only: To connect to the network, navigate to the network & internet settings and connect to the Uni_of_Cam Network. This will open up a web page where it is possible to log into the network with Raven credentials.*

3 Transfer Process

The transfer process consists of three parts: pre-transfer, transfer, and post-transfer. For all carriers there will be steps in every part, but these may differ depending on the workflow that is followed. For all transfer methods there will be a preferred method and an alternative method if the first method does not work.

A simple check list for all transfers:

- Photograph the carrier
- Identify the carrier (this may not be possible until plugging the carrier in, but identifying the right driver and hardware is already very helpful)
- Plug in or insert the carrier
- Check for viruses
- If necessary, check the properties of the carrier to help identify it (on Windows this information can be accessed by right-clicking on the plugged-in carrier within the File Explorer. This is especially useful for optical discs)
- Perform the chosen workflow
- If there are problems, perform the alternative workflow
- If there are still problems, discuss with Digital Preservation team how to move forward
- Create the correct documentation (log files, pictures of carriers, etc.) alongside the chosen workflow
Transfer Service Guide v.1.0

- Do a quality control
- Upload the transfer to the cloud

3.1 Pre-transfer
At this point it is useful at to identify what type of carrier and therefore what workflow should be followed. In most cases this will already be clear when the carrier is photographed, but there are a number of exceptions here to take into consideration:

- **3.5-inch floppy disk:** Is it a Double Density floppy disk? This does not get recognised by the driver at this moment, therefore no transfer is possible.
- **Optical media:** When working with a CD, a different workflow is needed if this CD is an audio CD. Files need to be ripped from these CDs, which is explained in the Ripping CDs section. Audio CDs can be difficult to identify, it could be noted on the CD or the supplementary material. *Specific to the UL: It could also be in the assessment record in the AMS.* It may not become clear that it is an Audio CD until plugging it in to the FRED, if .cda files are present on the CD, this is a clear indication of an Audio CD and therefore a different workflow. Also, there is no clear workflow for LaserDiscs, which are an analogue optical media form that needs specialised hardware.
- **Mac Formatted:** Currently there is no clear workflow for Mac formatted material. A workflow and Mac workstation can be considered as part of the Transfer Service in the future.

Outside of this, there is also a limited amount of carriers that can be currently processed:

<table>
<thead>
<tr>
<th>Floppy Disks</th>
<th>5.25-inch, 3.5-inch High Density and Zip Disk (if not formatted for Mac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Media</td>
<td>CD, DVD, Audio CD, Video DVD, and Blu-Ray</td>
</tr>
<tr>
<td>Flash Storage</td>
<td>All flash storage (<em>UL only: an extra flash storage connection, Forensic Card Reader, can be found in the FRED toolbox</em>)</td>
</tr>
<tr>
<td>Hard Drives</td>
<td>Internal and External</td>
</tr>
</tbody>
</table>

*UL Only: Also, additional information and context can be found in the Assessment Records filled in by the library staff.*
3.1.1 Photographing the carrier
The Digital Preservation team decided to photograph each carrier and include the digital image in the submission package to the preservation workflow. This decision was made to capture descriptive metadata written directly on a carrier that might not have been transcribed to its catalogue record and to document the physical state of the carrier at the time the data was transferred.

The team worked with CUL’s Digital Content Unit to select appropriate equipment, including a lightbox, camera, and rig to mount the camera and take overhead photographs. A Canon EOS 5DS camera is used within this workflow along with the free software that can be downloaded from the software page on the Canon Website.

On the FRED the software to capture a remote image is installed along with basic photo editing software. When turning on the camera, the software for remote imaging will launch automatically as the camera is plugged in to the FRED via USB. This makes it possible to take a picture of the carrier and save the image directly on the FRED.

The capturing software outputs a RAW image file, this then needs to be converted and saved using the other piece of Canon software (Digital Photo Professional) installed on the FRED. This editing software offers a lot of options when converting and editing pictures. The main thing when capturing the carriers that is of importance is that the potential writing on the carriers is clear, and the surface of the carrier is clearly photographed to showcase any scratches or other damage. If the picture is slightly off centre or if it needs to be cropped, this editing software offers those possibilities. When the potential editing is done, convert the RAW image file to a JPEG file.

When photographing carriers (see picture of example below), ensure that the light box is turned on, a greyscale is present in the pictures, and the camera is properly focused to prevent blurry images. Take a picture of the front and back of the carrier, including the casing that it came in. Make sure the surface of the carrier is clear; this is especially important for optical media. If there is additional material with the carrier, the choice can be made to either photograph it or scan it in. Pieces of paper may be easier and clearer when scanned, but the choice is made on a case-by-case basis.
The capturing of carriers is an ongoing process and will improve over time; at the moment it is most important that carriers are photographed and that any writing or damage is visible in these photos. It can be challenging to take pictures of these carriers as they may be reflective, especially the optical media discs. To help with the reflection, ensure the optical disc is photographed at a slight angle and to ensure less reflection; consider adding baking paper or similar material over the lights to diffuse and soften them.

3.1.2 Plugging in the carrier
If this is being plugged in via the USB Floppy drive, turn on the Ultrabay 4D and plug it into the USB port here. For optical media and for hard drives there is no safety in place. Additional information on the carrier can be obtained at this point by either right clicking on the carrier and accessing its properties.

It is possible to add another layer of protection software-wise if a write blocker is not feasible. Guides on this can be found online for different operating systems. This one for Windows showcases a number of different options.

3.1.3 Virus scanning
All carriers being plugged in to the FRED will be actively scanned.
UL Only: Before transferring any data from a carrier, run a virus scan over this material. In the background Windows Defender is running, but an active virus scan can be done on the plugged-in carrier using McAfee, which is regularly updated on the FRED. This can either be accessed by starting the McAfee software or right-clicking on the plugged-in carrier and selecting ‘Scan for Threats’. As McAfee does not produce a log, the choice was made to only record the virus scan and capturing this if a virus or other problem is detected by the program. Otherwise, the transfer process can be started.

In the case that a virus is found, a similar procedure to the British Library will be implemented.

3.2 Transfer

After completing the pre-transfer steps the actual transfer of material will take place. The choice at CUL has been made to primarily perform logical file transfers. This decision was made mainly on the practically of the material to be transferred. A lot of the material will be appraised after being uploaded to the cloud. Disk images therefore create another barrier and difficulty in accessing the material.

Furthermore, disk images may take up more space, as they create a bit-by-bit image of the full carrier, regardless of this space not being used to store any data on. There is a case to be made and an understanding that disk imaging is of importance for certain contexts, such as personal hard drives of authors or other important individuals. In these cases, the decision will be made to create a disk image, also for older carriers, such as the floppy disks, disk imaging may also be performed as this is the most straight forward way of obtaining this material.

Further information on the differences between disk imaging and logical file transfer can be found on the pages of the DANNNG working group.

3.2.1 Type of transfer

As discussed during the pre-transfer stage, it is important to have identified the type of carrier at this point to know which type of transfer is best suited for the carrier. For most carriers, except audio CDs and floppy disks, the choice has been made to proceed with a logical file transfer.

When transferring anything there will be a preferred piece of software, as discussed below, if this fails an alternative software will be used. If this also fails and it is deemed as important material a few other options are available and will be discussed. There are pieces of software which will try and transfer information even if errors arise. This does not solve the material from being corrupt but could give further options in recovering it. Also, a disk image could be created if a logical file transfer was
tried in the first place. However, these steps could be time-consuming and therefore discussing this with the Digital Preservation Team or staff at CUL may be more fruitful. For example, the possibility could be explored to contact the depositor for a new copy.

Another one that could be tricky to identify is the video DVD. This one will always contain an empty AUDIO_TS folder as this was common practice at the time, and is crucial for it to run on a DVD player. It is crucial that this AUDIO_TS folder stays part of this transfer.

There may also be software CDs in the collection, these will include an .exe file. It is crucial for these transfers that the file structure stay intact. A disk image may also be considered in this instance, but this should be assessed on a case-by-case basis.

The 5.25-inch floppy disk is the only carrier where both a logical file transfer (if possible) and a disk image will be created. This is done because of the age of these carriers and the fragility of them. Also, disk images of these carriers do not take up a lot of space and may be of use in the future.

<table>
<thead>
<tr>
<th>Type of Carrier</th>
<th>Preferred Transfer Method</th>
<th>In Case of a failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5-inch Floppy Disk (excluding Double Density disks)</td>
<td>Logical File Transfer</td>
<td>Disk Image</td>
</tr>
<tr>
<td>5.25-inch Floppy Disk</td>
<td>Disk Image and Logical File Transfer</td>
<td>N/A</td>
</tr>
<tr>
<td>Optical discs (excluding Audio CD)</td>
<td>Logical File Transfer</td>
<td>Disk Image</td>
</tr>
<tr>
<td>Audio CD</td>
<td>Rip Audio</td>
<td>Disk Image</td>
</tr>
<tr>
<td>Hard Drive</td>
<td>Logical File Transfer</td>
<td>Disk Image</td>
</tr>
<tr>
<td>Flash Storage</td>
<td>Logical File Transfer</td>
<td>Disk Image</td>
</tr>
<tr>
<td>Video DVD</td>
<td>Logical File Transfer</td>
<td>Disk Image</td>
</tr>
<tr>
<td>Software CD</td>
<td>Logical File Transfer</td>
<td>Disk Image</td>
</tr>
<tr>
<td>ZIP Disk</td>
<td>Logical File Transfer</td>
<td>Disk Image</td>
</tr>
</tbody>
</table>

### 3.2.2 Logical File Transfer

A logical file transfer is when files are transferred from one drive to another. This is normally done to ensure backups are made of files, but in this case, it will be done transfer data from files. The two options discussed below are tools where safety measures, such as checksums, have been put into
place to ensure the files are copied and are intact after the process is complete. On top of this, both tools have an option to output a log file that also includes this information.

3.2.2.1 FastCopy

The first choice of tool is FastCopy which has an easy interface to navigate. It will only need a drive to be selected and a destination, ensure the folder where the files are copied into is named after the ID given to the carrier. FastCopy does not automatically output a log file, this can be found in File --> FileLog History, here a number of logs can be found, the naming of this log indicated the time that this transfer happened on. This will have to be renamed and saved as a .txt file.

![Figure 2 – Locating the Log File in FastCopy](image)

3.2.2.2 TeraCopy

A second option for file transfer is TeraCopy. The interface is again easy to navigate and the tool will ask for a source location and a target destination. It is also possible to filter out any files that may not be needed, this application should only be used if FastCopy was not able to successfully transfer the material. After the process a folder will be created containing the transferred files, a log file will also be available. However, it should be kept in mind that TeraCopy only outputs the first 100 transfers into the log file, which is fine for smaller storage carriers, but needs to be kept in mind when working with larger carriers or carriers containing a large number of files.
3.2.2.3 Roadkill’s Unstoppable Copier

If both of the above software packages fail, it is recommended to use Roadkill’s Unstoppable Copier. This software is slightly different than the other copiers, as it will not stop if corrupted files are discovered and will copy this material over bit by bit. However, it should be noted that this will not fix the corrupted files, just ensure that the corrupted bits are also present in the logical file transfer.

This software does take a long time to run and it could therefore be more useful to explore other options, such as contacting the depositor, before trying out this approach.

3.2.2.4 Disk Image and Browse

This software is specifically for the 5.25-inch floppy disks and will only work with the FC5025 driver. Furthermore, the logical file transfer of these carriers will only work for a small number of floppy disks that are formatted in MS-DOS and some Mac formats.
Figure 4 – Interface for Disk Image and Browse

To create a logical file transfer for floppy disks, files need to be manually selected and transferred one-by-one. This can be a time-consuming process. To start this process, Browse Disk Contents should be selected in the Disk Image and Browse Interface (see image above). Do keep in mind again that this option is not available for all formats.

3.2.3 Disk Imaging

3.2.3.1 FTK Imager

In first instance FTK Imager will be used for disk imaging. This software can be found on the FRED. If plugging in the floppy drive unsure it is plugged in through the write blocker on the FRED, normally driver (:A) on the Windows computer will be recognised as the USB floppy drive. To start making a disk image in FTK Imager, navigate to the left hand corner of the tool and click on File – Create Disk Image.

Within FTK Imager there is a difference between a physical drive and a logical drive copy. The logical drive only makes a copy of the formatted material on storage carrier, this is the option to be picked for the disk imaging of floppy disks. For other storage carriers a decision will have to be made on the importance of keeping the unformatted section of this drive.

The process below is for a floppy disk, the disk images made for optical media will be .ISO, which the software will give as an option when plugging in these carriers.
The next step is to decide on the Destination Image Type, the standard approach to this is Raw (dd) and this will be the default option for disk imaging. This will result on a .001 file. After this the selection of the drive will be made, this will be the floppy disk drive for floppy disks, a different drive for other storage carriers.

In the next screen selection will be made on the file destination, make sure this in a place that can be found. Also ensure the file is named after the ID for the carrier. Another two things to be aware of are the log file that can be created that contains the directory and to ensure as big sections as possible are created when making a disk image. This will not necessarily be of concern for the older storage
carriers, which have a smaller disk space in general, but is something to take into consideration when making disk images of larger or more modern storage carriers, such as a hard drives or flash storage.

3.2.3.2 Guymager

A second option is to use Guymager in the BitCurator environment which can be run from the FRED. For this to run the Virtual Machine needs to be booted up in the Windows environment. Guymager should only be used if FTK Imager fails in creating a disk image, this choice has been made as it is more time consuming to work with BitCurator and there are difficulties in getting the BitCurator environment to recognise drivers that are being plugged in.

To open the BitCurator environment, the Oracle VM VirtualBox Manager needs to be opened. This will open a menu with all virtual machines available on the FRED. From this menu the newest version of BitCurator should be started. This will start running a virtual machine which will open the BitCurator environment. The reason why this is run from a virtual machine is because the BitCurator tools are only available in a Linux environment, which this virtual machine will replicate.

When in the BitCurator environment the Guymager tool can be found in the top folder. A disk image can be made by right-clicking on the correct drive. There are less options within this software compared to FTK Imager but a log file will be created alongside the disk image. Again, it is important to ensure the disk image is named after the ID of the storage carrier.
3.2.3.3 Disk Image and Browse

This software is specifically for the 5.25-inch floppy disks and will only work with the FC5025 driver. The software is able to create a disk image for a number of formats (see image below for the list). If it is unclear what format the disk is in, all formats should be tried out one-by-one. Sadly there is no way at this point to detect the type of format on the floppy disk. By using a Hex Editor, such as HxD it can be ensured a meaningful disk image has been created. The Hex Editor will make text readable on the disk image, and if there is a repeating pattern of blocks this may indicate the disk image is not in the correct format. Further guidance on this software can also be found on the LibGuides from MIT Libraries.
3.2.4 Ripping CDs

Audio CDs have a slightly different workflow, as the audio files have to be ripped (extracting audio from an audio CD) from the CD. Audio CDs may be difficult to recognise, but if it was not clear in earlier steps when working with the carrier it will be clear when transferring material from these CDs. If a transfer results in empty .CDA files, this is a sign of an audio CD.

On the FRED Exact Audio Copy (EAC) is used to rip CDs, as recommended by this guide. The default settings on EAC will rip to audio files track by track to .WAV files. It is also possible to extract the whole range on the CD in one file or convert the files to .FLAC. At CUL the choice has been made to do it track by track and convert them to .WAV files as this is a more trusted format for audio.

After ripping the audio files, EAC will give the option to save the log file. It is also important to create checksums for this workflow, as it is the only workflow where this is not automatically done by the software. More information on this can found on the post-transfer section.
3.3 Post-transfer

3.3.1 Documentation

3.3.1.1 Folder structure

Folder should be called after the identifier provided by the staff who identified the carrier in the collection, this folder should then contain two folders: Metadata and another folder with the identifier name. This second folder should contain the content from the carrier, either a disk image or a file transfer. The choice was made to split this out as there could be a metadata folder on the original carrier and this just makes sure there is no confusion between the metadata on the actual carrier and the metadata created during the transfer process.

The metadata folder will consist out of whatever extra documentation comes with the transfer process. In most cases this will be a picture of the front and back of the carrier, any supplementary material that may have been photographed or scanned. And then any logs that come with the chosen transfer process (this is discussed below for every single transfer). There may also be extra files such as checksums for software that does not automatically create these or other extra information that was deemed important, such as images of additional documentation that came with the carrier.

A few examples of file structure for the transfers:

```
CUL12345/
├── CUL12345/
│   ├── photo.jpg
│   ├── photo.jpg
│   └── text.doc
└── Metadata/
    ├── CUL12345_Back.jpg
    ├── CUL12345_Front.jpg
    └── FastCopy_Log_File_CUL12345.txt
```

This file structure represents the structure associated with a logical file transfer. A number of files can be found in a folder named in accordance with the identifier provided with the carrier. In the metadata folder the photographed front and back of the carrier can be found alongside the log file generated by FastCopy, a logical file transfer tool.
This file structure represents a transfer where a disk image has been created. The disk image is present in the folder named after the identifier provided with the carrier. Within the metadata folder a slightly different list of log files can be found alongside the photographed carrier.

This file structure is associated with an audio CD where the ripped audio is present in the file named after the identifier associated with the carrier. The metadata folder contains the photographed carrier alongside the generated log file from Exact Audio Copy. A list of checksums is also provided. As these ripped audio files are generated during the process, there are no checksums created at this point.

### 3.3.1.2 Transfer Service Spreadsheet

For every single transfer process, an entry will be found in a spreadsheet. This is also the case for the carrier. This information will be overarching and especially important for the running of the Transfer
Service, not necessarily for the material on the transfer itself. An example is this is carriers that need multiple processes or if other members of the library or consulted on it, this can be tracked here.

3.3.1.3 Log files

All software and tools mentioned above will create a log file, make sure to add this file to the metadata folder alongside the transfer. The log file should contain the identifier of that carrier to avoid confusion.

3.3.1.4 CD Ripping

Log comes with Exact Audio Copy that needs to be saved. When ripping CDs there are no checksums, these need to be generated separately. This can be done with a number of tools that generate these hashes, the command line can also be used for this process.

3.3.2 Quality Control

Quality control ensures that all files and material are present for every transfer. For this it is checked if the pictures are correct, if the log file reflects the files in the transfer and if all documentation is present. No files are opened in this process, as this may edit them in some way. However, if the file is 0MB, which may be a sign of a transfer that was incorrect or if there is a corrupt file, this is further investigated.

Another one that could be tricky to quality control is the video DVD. This one will nearly always contain an empty AUDIO_TS file as this was common practice at the time, and is crucial for it to run on a DVD media player. VLC Media Player, which is installed on the FRED should be able to handle these files and open the DVD menu. If this is not the case, and it is known that a DVD menu is present on the carrier, a disk image should be considered.

However, if VLC does not work, try inserting the DVD and playing it. If the DVD plays but VLC is unable to open the transferred files a disk image should be created of this DVD instead.

3.3.3 Uploading material to the cloud

Files are uploaded and stored in an Amazon S3 bucket which has versioning enabled and is also replicated to a second bucket to improve resilience. This is a holding area until digital preservation workflows are put into producing and the content can be ingested and stored in our repository. The rclone tool with a helper script wrapper is used to copy the files automatically whilst running in the background.

UL: rclone is used for this, a script is available on the FRED to start up rclone.
4 Troubleshooting

4.1 Damaged carrier

*UL: Reach out to conservation to see if they can help. It may also be worth talking to staff about getting a replacement copy from the depositor.*

There are also a number of tutorials and guides online if there is no expertise within an institution on certain carriers. Do ensure not to test anything if it is unclear, it may be useful to have a number of test carriers lying around. The digital preservation team put out a call when starting the Transfer Service and staff across CUL was kind enough to donate old carriers, which means there is material to test and try out new stuff on, which is very helpful.

4.2 Unreadable carrier

This could be down to the software/hardware/carrier. It can be helpful to reach out to other coworkers in similar roles to help with this. Also, forums on Reddit and StackOverflow are great help here, as the digital preservation community is not the only one who are trying to transfer material from old carriers and a large number of individuals are out there with a lot of knowledge online.

4.3 Not the right equipment

This is an ongoing process. May also be useful to reach out to other places locally and nationally who may be able to help with this. For example, AV material is very specialised and could be better being outsourcing these tasks. CUL is lucky to have a computing museum in Cambridge, which have a lot of expertise on older carriers and the equipment needed to transfer this material.