Federal Agencies Audio Visual Digitization Working Group

Interstitial Error Study

Volume II. Appendixes

Prepared
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AUDIOVISUAL PRESERVATION SOLUTIONS

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v2

TABLE OF CONTENTS

Page

3 Appendix A: Procedure Manual

11 Appendix B: Log Sheet

13 Appendix C: Interstitial Error Full Details

18 Appendix D: Notes on the Pilot Test System

20 Appendix E: 2011 Report Deliverables

- **21 Interstitial Error Overview (2011-12-01)**
- **26 Interstitial Error Requirements and Test Method (2011-12-01)**
- **37 Interstitial Error Null Test Wireframes (2011-12-01)**
- **44 Individual Sample Interstitial Error Report (2011-12-01)**
- **45 Batch Sample Interstitial Error Report (2011-12-01)**
- **46 Interstitial Error Workplan (2011-12-01)**
- **58 Interstitial Error Survey Summary Results**

Appendix A: Procedure Manual

UFX Operations Documentation
March 19th, 2012

AUDIOVISUAL PRESERVATION SOLUTIONS

Included equipment

1 x RME Fireface UFX ("UFX") audio interface, 2-piece power supply
1 x Olixir Data Vault external USB hard drive ("DAW-HD"), 2-piece power supply
1 x Olixir Data Vault external USB hard drive ("UFX-HD"), 2-piece power supply
2 x red AES cable
1 x Tripp Lite power strip

Required facilities

1 x 110V outlet free for length of project
2 x USB ports on DAW available for daily use

Overview

The procedure below outlines the simultaneous creation of a duplicate of each recording you make on your digital audio workstation (DAW). This is achieved by placing a recording device (the UFX) in the digital signal chain between your analog-to-digital converter and your DAW. In addition to the UFX, you will be supplied with two external hard drives. One is used to store recordings made by the UFX (UFX-HD). The other is used to collect duplicates of recordings made on your DAW (DAW-HD). Each drive is also used for backup of files from the other drive.

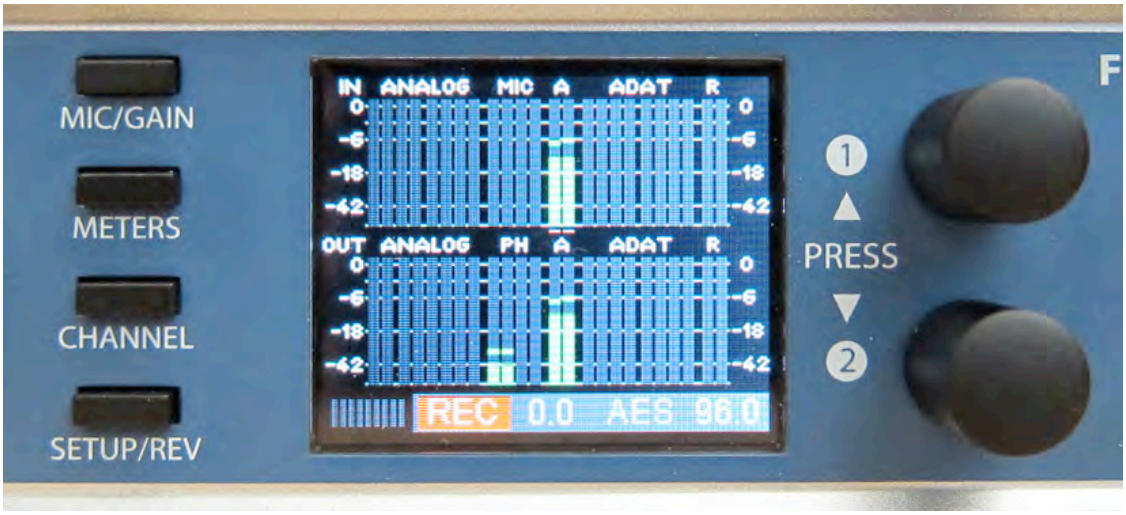

Figure 1. The controls of the RME Fireface UFX, showing meters screen and recording indicator.

Operating the UFX

1. The two dials to the right of the LCD display on the UFX rotate in either direction and also act as push buttons. To navigate a dialog, push **DIAL 2** to move downwards to the next field and **DIAL 1** to move back up. **DIAL 2** is used to make selections within settings, by rotation or push button action. **The large dial to the left of the display will not be used during the project.**
2. If left idle, the LCD display will return to the `meters screen`. Press **METERS** to call up the `Record/Playback dialog` or return to the `meters screen`. **The**

other three buttons to the left of the LCD display will not be used during the project.

3. The hard drive labeled UFX-HD connects to the UFX via the USB port located on the front panel of the UFX. There is no special procedure for mounting or unmounting the drive on the UFX. Simply plug it in or unplug it from the USB port, with the UFX powered on or off. Each time the drive is attached, the UFX will take a few moments to initialize the drive, during which time no recordings may be made.

Start-of-day procedures

1. Turn on the power strip connected to the 2 external HDs and the UFX.
2. Turn the UFX on via the power switch on the face plate. Wait for UFX-HD to initialize before attempting to start a recording.

Recording simultaneously to your DAW and the UFX

Start a recording

1. Once you have prepared an audio asset for digitization and set up your DAW, press the **METERS** button to call up the `Record/Playback dialog`.

Figure 2. The `Record/Playback dialog`.

2. Press **DIAL 2** to navigate down to the last line of the `Record/Playback dialog`. Rotate **DIAL 2** to select the **RECORD ICON**.

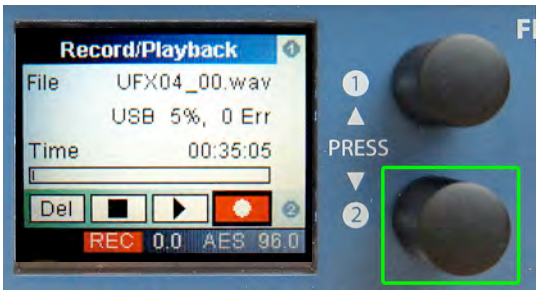

Figure 3. The `Record/Playback dialog`, with record button selected.

3. Press **DIAL 2** to begin a recording on the UFX. **Note: Press record simultaneously on the UFX and on your DAW.** The counter on the `Record/Playback dialog` will display the elapsed time (Figure 4). On all display dialogs, a red REC will flash while a recording is in progress, and the `meters screen` will display active db metering for enabled tracks.

Figure 4. Elapsed time shown during recording.

Stop a recording

1. Press **METERS** to return to the `Record/Playback dialog`.
2. Rotate **DIAL 2** to select the **STOP ICON**.

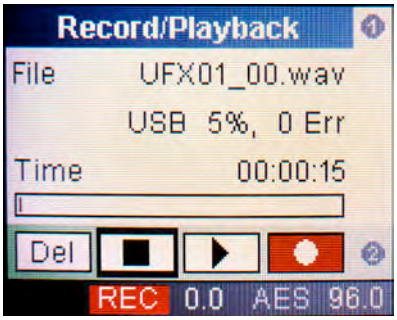

Figure 5. The `Record/Playback dialog` with stop button selected.

3. Press **DIAL 2** to stop the recording on the UFX. **Note: Press stop simultaneously on the UFX and your DAW.**

Begin the next recording

1. Press **METERS** to return to the `Record/Playback dialog`.
2. Repeat the steps above to begin and end the next recording.

Report file names

1. Record the file names of all DAW and UFX recordings on the provided file name log sheet (“AVPS_File_Log.xls”), found in the “Project_Documents” folder on DAW-HD. You may print the form and fill it out by hand or fill it out on a computer. If using the computer, please store the current, updated file in the “Project Documents” folder on DAW-HD.
2. Record the name of each file created on your DAW in the column marked “DAW file name”. Please follow your customary file naming practices.
3. Record the name of each file created on the UFX in the corresponding column marked “UFX file name”. While a recording is in process, the name of the UFX

recording is displayed in the **File** field at the top of the `Record/Playback dialog` (Figure 6). When not in record mode, the name of the most recent file will appear when the **STOP ICON** is highlighted, but note that the name displayed when the **RECORD ICON** is highlighted is the name of the next file to be created. **Always check which icon is highlighted when adding the name of the UFX file to the log sheet.** The file naming protocol of the UFX cannot be changed, but the numbering will reset when older files are moved out of the top-level directory (see *Move UFX files to dated folder on UFX-HD* section below).

Figure 6. The file name shown during a recording.

End-of-day procedures

Copy files from your DAW to Olixir drive labeled DAW-HD

1. Copy the recordings made on your DAW to the Olixir drive labeled “DAW-HD”. Folders named to correspond with the agreed upon project dates can be found inside the “DAW_daily_folders” folder. Copy and paste the audio files to the folder named with the corresponding date of the recordings. For example, all files created from transfers performed on March 26th should be copied to the folder named “DAW_files_20120326”. If recordings are made for the project outside of the project dates, create a new folder reflecting the date of the recordings.

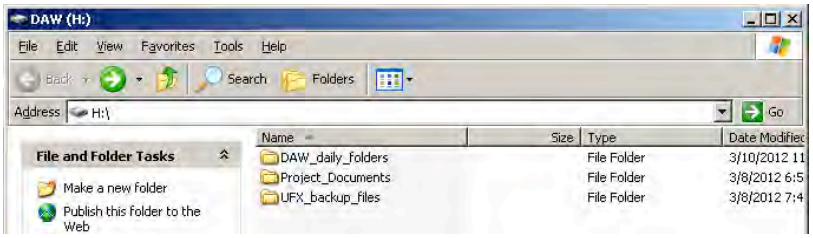

Figure 7. The top-level directory of DAW-HD.

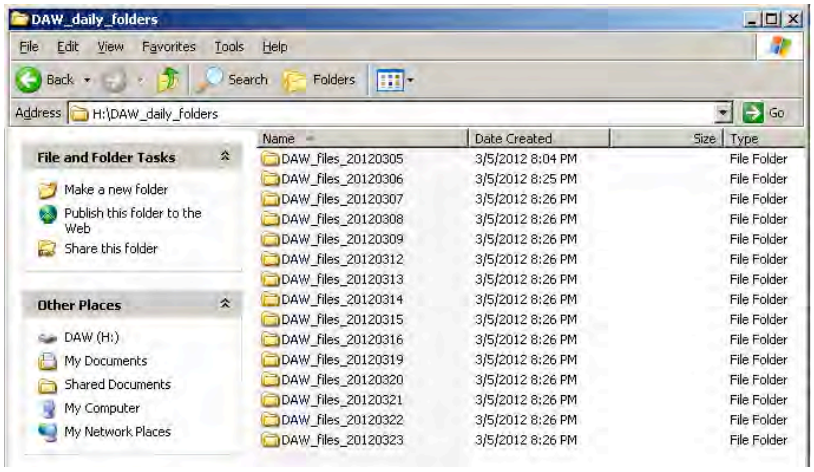

Figure 8. Folders for daily transfer of DAW recordings.

Move UFX files to dated folder on Olixir drive labeled UFX-HD

1. Remove the UFX-HD USB cable from the UFX and plug it into an available USB port on your DAW.
2. The day's UFX recordings will appear in the top-level directory of UFX-HD. Drag and drop the files to the appropriately dated folder, found inside the "UFX_daily_folders" folder. Be sure that all audio files have been moved out of the top-level directory, but leave any other, non-audio files in the main directory. Moving the files allows for the file sequence to start over at 01 on the following day, and prevents the UFX from reaching its internal file naming limit.

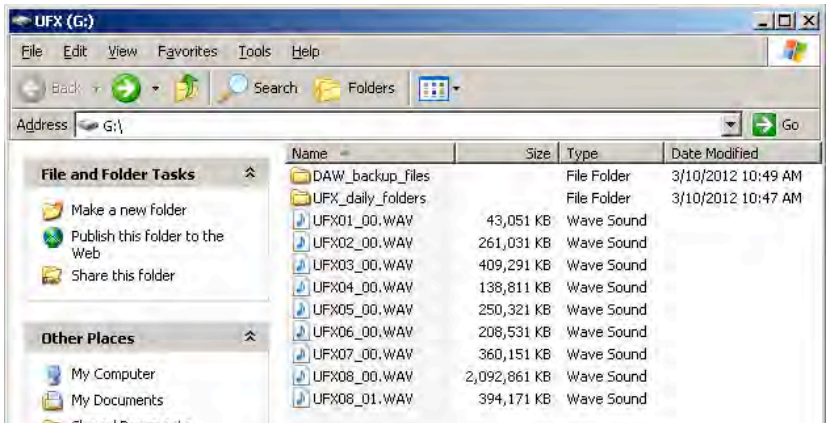

Figure 9. Daily UFX recordings appear in the top-level directory of UFX-HD.

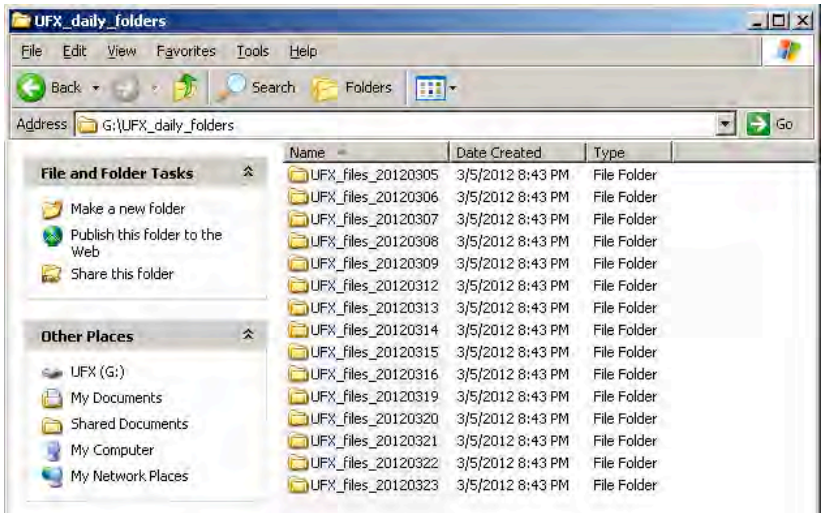

Figure 10. Folders for daily transfer of UFX recordings.

Backup UFX-HD files to DAW-HD and DAW-HD files to UFX-HD

1. While both drives are connected to your DAW, copy the folder containing the day's UFX recordings from "UFX_daily_folders" on UFX-HD to the "UFX_backup_files" folder on DAW-HD.
2. Copy the folder containing the day's DAW recordings from "DAW_daily_folders" on DAW-HD to the folder labeled "DAW_backup_files" on UFX-HD.

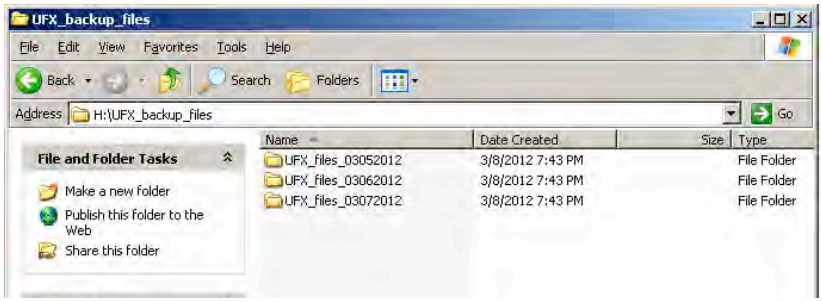

Figure 11. Daily folders backed up from UFX-HD to DAW-HD.

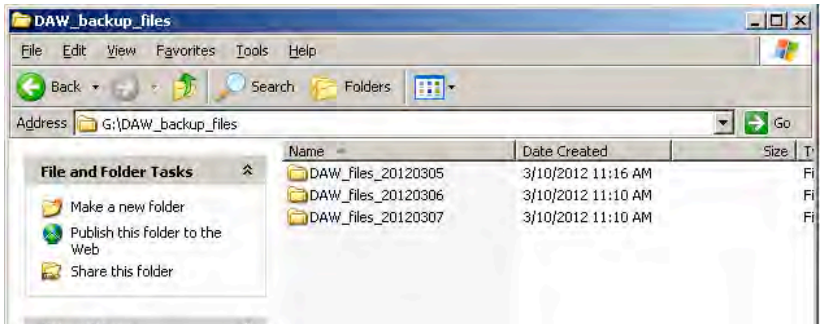

Figure 12. Daily folders backed up from DAW-HD to UFX-HD.

3. Unmount UFX-HD from your DAW.
4. Reconnect the UFX-HD USB cable to the UFX.

Shutting down the test equipment

1. After shutting down your DAW, turn off the UFX at the switch on the front panel.
2. Switch off the power strip to which the 2 HDs and the UFX are connected. If your local protocol calls for leaving hardware connected and/or running, leave the UFX and HDs connected and/or running.

Appendix B: Log Sheet

AVPS Project

File Naming Log

Instructions: Please fill out the following form with the appropriate data, matching the names of files created on your DAW with those created simultaneously on the UFX recorder. See the "Record file names" section of the accompanying instructions for details. For recordings longer than 60 minutes the UFX will create more than one file. Where more than one file is created place all sibling filenames in the same cell using ";" as the separator as shown below for the 2nd item. Examples shown in italics.

Date	**DAW file name**	**UFX file name**
3/26/2012	*02252012_01.wav*	*UFX01_00.wav*
3/26/2012	*02252012_02.wav*	*UFX02_00.wav; UFX02_01.wav*
3/26/2012	*02252012_03.wav*	*UFX03_00.wav*

Appendix C: Interstitial Error Full Details

								Position of Errors				
Institution	Date Created	Date Created	ID Appendix	Alternate Filename	Pass/Fail	Mono/Stereo	Duration	In Samples	h:mm:ss	Gap at error	Gap at end	Comments
Test Site 1A	20120323	3/23/2012	1001	201203231001	Pass	Mono	0:47:32					
Test Site 1A	20120323	3/23/2012	1002	201203231002	Pass	Mono	0:46:56					
Test Site 1A	20120323	3/23/2012	1003	201203231003	Pass	Mono	0:48:35					
Test Site 1A	20120326	3/26/2012	1004	201203261004	Pass	Mono	0:46:24					
Test Site 1A	20120326	3/26/2012	1005	201203261005	Pass	Mono	0:32:01					
Test Site 1A	20120326	3/26/2012	1006	201203261006	Pass	Mono	0:32:00					
Test Site 1A	20120326	3/26/2012	1007	201203261007	Pass	Mono	0:47:14					
Test Site 1A	20120326	3/26/2012	1008	201203261008	Pass	Mono	0:46:38					
Test Site 1A	20120327	3/27/2012	1009	201203271009	Pass	Mono	0:46:39					
Test Site 1A	20120327	3/27/2012	1010	201203271010	Pass	Mono	0:46:57					
Test Site 2	20120426	4/26/2012	1011	201204261011	Pass (512s error)	Stereo	0:24:30					
Test Site 2	20120426	4/26/2012	1012	201204261012	Pass (512s error)	Stereo	0:24:24					
Test Site 2	20120426	4/26/2012	1013	201204261013	Pass	Stereo	0:22:28					
Test Site 2	20120426	4/26/2012	1014	201204261014	Pass (512s error)	Stereo	0:24:24					
Test Site 2	20120427	4/27/2012	1015	201204271015	Pass (512s error)	Stereo	0:24:26					
Test Site 2	20120427	4/27/2012	1016	201204271016	Pass (512s error)	Stereo	0:14:27					
Test Site 2	20120427	4/27/2012	1017	201204271017	Pass (512s error)	Stereo	0:24:35					
Test Site 2	20120427	4/27/2012	1018	201204271018	Pass (512s error)	Stereo	0:24:27					
Test Site 2	20120430	4/30/2012	1019	201204301019	Pass (512s error)	Stereo	0:58:38					
Test Site 2	20120501	5/1/2012	1020	201205011020	Pass (512s error)	Mono	0:39:50					
Test Site 2	20120501	5/1/2012	1021	201205011021	Pass (512s error)	Mono	0:19:12					
Test Site 2	20120501	5/1/2012	1022	201205011022	Pass	Mono	0:33:50					
Test Site 2	20120501	5/1/2012	1023	201205011023	Pass (512s error)	Mono	0:59:46					
Test Site 2	20120502	5/2/2012	1024	201205021024	UFX FAIL	Mono	1:00:40	215856600				
Test Site 2	20120502	5/2/2012	1025	201205021025	Pass (512s error)	Mono	1:02:00					
Test Site 2	20120502	5/2/2012	1026	201205021026	Pass (512s error)	Mono	1:05:38					
Test Site 2	20120503	5/3/2012	1027	201205031027	Pass (512s error)	Mono	0:49:41					
Test Site 2	20120503	5/3/2012	1028	201205031028	Pass (512s error)	Mono	0:59:28					
Test Site 2	20120504	5/4/2012	1029	201205041029	Pass (512s error)	Mono	0:31:44					
Test Site 2	20120504	5/4/2012	1030	201205041030	Pass (512s error)	Mono	0:31:46					
Test Site 2	20120507	5/7/2012	1031	201205071031	Pass (512s error)	Mono	0:24:45					
Test Site 2	20120507	5/7/2012	1032	201205071032	Pass (512s error)	Mono	0:31:13					
Test Site 2	20120507	5/7/2012	1033	201205071033	Pass (512s error)	Mono	0:34:40					
Test Site 2	20120507	5/7/2012	1034	201205071034	Pass (512s error)	Mono	0:32:16					
Test Site 2	20120507	5/7/2012	1035	201205071035	Pass (512s error)	Mono	0:33:00					
Test Site 2	20120508	5/8/2012	1036	201205081036	Pass (512s error)	Mono	0:25:22					
Test Site 2	20120508	5/8/2012	1037	201205081037	Pass (512s error)	Mono	0:04:30					
Test Site 2	20120508	5/8/2012	1038	201205081038	Pass (512s error)	Mono	0:13:09					
Test Site 2	20120508	5/8/2012	1039	201205081039	Pass (512s error)	Mono	0:02:28					
Test Site 2	20120508	5/8/2012	1040	201205081040	Pass (512s error)	Mono	0:13:13					
Test Site 2	20120508	5/8/2012	1041	201205081041	Pass (512s error)	Mono	0:18:45					
Test Site 2	20120508	5/8/2012	1042	201205081042	Pass (512s error)	Mono	0:19:27					
Test Site 2	20120509	5/9/2012	1043	201205091043	Pass (512s error)	Mono	0:19:10					
Test Site 2	20120509	5/9/2012	1044	201205091044	Pass (512s error)	Mono	0:49:22					
Test Site 2	20120509	5/9/2012	1045	201205091045	Pass (512s error)	Mono	0:51:34					
Test Site 2	20120510	5/10/2012	1046	201205101046	Pass (512s error)	Mono	0:22:50					
Test Site 2	20120510	5/10/2012	1047	201205101047	Pass (512s error)	Mono	0:01:55					

Test Site 2	20120510	5/10/2012	1048	201205101048	Pass (512s error)	Mono	0:24:25					
Test Site 2	20120510	5/10/2012	1049	201205101049	Pass (512s error)	Mono	0:06:14					
Test Site 2	20120510	5/10/2012	1050	201205101050	Pass (512s error)	Mono	0:17:52					
Test Site 2	20120510	5/10/2012	1051	201205101051	Pass (512s error)	Mono	0:24:28					
Test Site 2	20120511	5/11/2012	1052	201205111052	Pass (512s error)	Mono	0:27:27					
Test Site 2	20120511	5/11/2012	1053	201205111053	Pass (512s error)	Mono	0:24:32					
Test Site 2	20120511	5/11/2012	1054	201205111054	Pass (512s error)	Mono	0:24:24					
Test Site 2	20120514	5/14/2012	1055	201205141055	Pass (512s error)	Mono	0:24:31					
Test Site 2	20120514	5/14/2012	1056	201205141056	Pass (512s error)	Mono	0:29:41					
Test Site 2	20120514	5/14/2012	1057	201205141057	Pass (512s error)	Mono	0:18:48					
Test Site 2	20120516	5/16/2012	1058	201205161058	Pass (512s error)	Mono	0:24:51					
Test Site 2	20120516	5/16/2012	1059	201205161059	Pass (512s error)	Mono	0:24:31					
Test Site 2	20120516	5/16/2012	1060	201205161060	Pass (512s error)	Mono	0:24:54					
Test Site 2	20120516	5/16/2012	1061	201205161061	Pass (512s error)	Mono	0:24:34					
Test Site 2	20120516	5/16/2012	1062	201205161062	Pass (512s error)	Mono	0:24:46					
Test Site 2	20120517	5/17/2012	1063	201205171063	Pass (512s error)	Mono	0:24:41					
Test Site 2	20120517	5/17/2012	1064	201205171064	Pass (512s error)	Mono	0:24:34					
Test Site 2	20120517	5/17/2012	1065	201205171065	Pass (512s error)	Mono	0:24:30					
Test Site 2	20120517	5/17/2012	1066	201205171066	Pass (512s error)	Mono	0:24:41					
Test Site 3	20120530	5/30/2012	1067	201205301067	Pass	Mono	0:31:41					
Test Site 3	20120530	5/30/2012	1068	201205301068	Pass	Mono	0:32:45					
Test Site 3	20120531	5/31/2012	1069	201205311069	Pass	Mono	0:12:28					
Test Site 3	20120531	5/31/2012	1070	201205311070	Pass	Mono	0:30:24					
Test Site 3	20120601	6/1/2012	1071	201206011071	Pass	Mono	0:52:56					
Test Site 3	20120601	6/1/2012	1072	201206011072	Pass	Mono	0:32:52					
Test Site 3	20120601	6/1/2012	1073	201206011073	Fail	Mono	0:30:47	164397056	0:28:32	22000	22000	
Test Site 3	20120604	6/4/2012	1074	201206041074	Pass	Mono	0:30:49					
Test Site 3	20120604	6/4/2012	1075	201206041075	Pass	Mono	0:16:50					
Test Site 3	20120604	6/4/2012	1076	201206041076	Pass	Mono	0:33:01					
Test Site 3	20120604	6/4/2012	1077	201206041077	Pass	Mono	0:25:04					
Test Site 3	20120607	6/7/2012	1078	201206071078	Pass	Mono	0:26:26					
Test Site 3	20120607	6/7/2012	1079	201206071079	Pass	Mono	0:39:45					
Test Site 3	20120608	6/8/2012	1080	201206081080	Pass	Mono	0:32:19					
Test Site 3	20120608	6/8/2012	1081	201206081081	Pass	Mono	0:25:14					
Test Site 3	20120608	6/8/2012	1082	201206081082	Fail	Mono	0:55:26	180371167	0:31:18	24700	24700	
Test Site 3	20120608	6/8/2012	1083	201206081083	Pass	Mono	0:56:45					
Test Site 3	20120611	6/11/2012	1084	201206111084	UFX FAIL	Mono	1:04:33	356047339	1:01:48	71700	71700	
Test Site 3	20120611	6/11/2012	1085	201206111085	Pass	Mono	1:07:08					
Test Site 3	20120612	6/12/2012	1086	201206121086	Fail	Mono	0:59:27	25311671	0:04:23	8200	8200	
Test Site 3	20120612	6/12/2012	1087	201206121087	Pass	Mono	0:47:55					
Test Site 3	20120612	6/12/2012	1088	201206121088	Pass	Mono	0:56:41					
Test Site 3	20120612	6/12/2012	1089	201206121089	Fail	Mono	0:54:44	188530688	0:32:43	32200	32200	
Test Site 3	20120613	6/13/2012	1090	201206131090	Fail	Mono	0:56:33	109970231, 141550390	0:19:05, 0:24:34	4100, 53200	57300	
Test Site 3	20120613	6/13/2012	1091	201206131091	Pass	Mono	0:37:55					
Test Site 3	20120614	6/14/2012	1092	201206141092	Pass	Mono	0:53:16					
Test Site 3	20120614	6/14/2012	1093	201206141093	Pass	Mono	1:17:05					
Test Site 3	20120614	6/14/2012	1094	201206141094	Pass	Mono	0:52:27					
Test Site 3	20120615	6/15/2012	1095	201206151095	Pass	Mono	0:59:00					
Test Site 3	20120615	6/15/2012	1096	201206151096	Fail	Mono	0:05:34	26407719	0:04:34	4100	4100	

Test Site 3	20120620	6/20/2012	1097	201206201097	UFX FAIL	Mono	0:51:26	1140394, 1232346	0:00:11, 0:00:12	4495, 15700	72000	Multiple errors over 752ms/72000s
Test Site 3	20120620	6/20/2012	1098	201206201098	Pass	Mono	0:36:06					
Test Site 3	20120621	6/21/2012	1099	201206211099	Pass	Mono	0:40:44					
Test Site 3	20120621	6/21/2012	1100	201206211100	Pass	Mono	0:18:53					
Test Site 1B	20120702	7/2/2012	1101	201207021101	Pass	Mono	0:46:52					
Test Site 1B	20120702	7/2/2012	1102	201207021102	Pass	Mono	0:46:55					
Test Site 1B	20120702	7/2/2012	1103	201207021103	Pass	Mono	0:47:49					
Test Site 1B	20120702	7/2/2012	1104	201207021104	Pass	Mono	0:47:18					
Test Site 1B	20120702	7/2/2012	1105	201207021105	Pass	Mono	0:32:10					
Test Site 1B	20120702	7/2/2012	1106	201207021106	Pass	Mono	0:32:41					
Test Site 1B	20120702	7/2/2012	1107	201207021107	Pass	Mono	0:47:38					
Test Site 1B	20120703	7/3/2012	1108	201207031108	Pass	Mono	0:48:02					
Test Site 1B	20120703	7/3/2012	1109	201207031109	Pass	Mono	0:48:08					
Test Site 1B	20120703	7/3/2012	1110	201207031110	Pass	Mono	0:47:54					
Test Site 1B	20120703	7/3/2012	1111	201207031111	Pass	Mono	0:46:07					
Test Site 1B	20120703	7/3/2012	1112	201207031112	Pass	Mono	0:46:35					
Test Site 1B	20120705	7/5/2012	1113	201207051113	Pass	Mono	0:47:22					
Test Site 1B	20120705	7/5/2012	1114	201207051114	Pass	Mono	0:33:11					
Test Site 1B	20120705	7/5/2012	1115	201207051115	Pass	Mono	0:32:36					
Test Site 1B	20120705	7/5/2012	1116	201207051116	Pass	Mono	0:47:37					
Test Site 1B	20120705	7/5/2012	1117	201207051117	Pass	Mono	0:47:56					
Test Site 1B	20120705	7/5/2012	1118	201207051118	Pass	Mono	0:47:10					
Test Site 1B	20120706	7/6/2012	1119	201207061119	Pass	Mono	0:47:14					
Test Site 1B	20120706	7/6/2012	1120	201207061120	Pass	Mono	0:47:08					
Test Site 1B	20120706	7/6/2012	1121	201207061121	Pass	Mono	0:47:32					
Test Site 1B	20120706	7/6/2012	1122	201207061122	Pass	Mono	0:34:05					
Test Site 1B	20120706	7/6/2012	1123	201207061123	Pass	Mono	0:32:36					
Test Site 1B	20120706	7/6/2012	1124	201207061124	Pass	Mono	0:47:34					
Test Site 1B	20120709	7/9/2012	1125	201207091125	Pass	Mono	0:47:59					
Test Site 1B	20120709	7/9/2012	1126	201207091126	Pass	Mono	0:49:31					
Test Site 1B	20120709	7/9/2012	1127	201207091127	Pass	Mono	0:47:16					
Test Site 1B	20120709	7/9/2012	1128	201207091128	Pass	Mono	0:47:39					
Test Site 1B	20120709	7/9/2012	1129	201207091129	Pass	Mono	0:47:30					
Test Site 1B	20120710	7/10/2012	1130	201207101130	Pass	Mono	0:31:56					
Test Site 1B	20120712	7/12/2012	1131	201207121131	Pass	Mono	0:32:16					
Test Site 1B	20120712	7/12/2012	1132	201207121132	Pass	Mono	0:32:37					
Test Site 1B	20120712	7/12/2012	1133	201207121133	Pass	Mono	0:47:39					
Test Site 1B	20120712	7/12/2012	1134	201207121134	Pass	Mono	0:47:48					
Test Site 1B	20120716	7/16/2012	1135	201207161135	Pass	Mono	0:47:42					
Test Site 1B	20120716	7/16/2012	1136	201207161136	Pass	Mono	0:47:32					
Test Site 1B	20120716	7/16/2012	1137	201207161137	Pass	Mono	0:47:53					
Test Site 1B	20120716	7/16/2012	1138	201207161138	Pass	Mono	0:47:56					
Test Site 1B	20120716	7/16/2012	1139	201207161139	Pass	Mono	0:32:37					
Test Site 1B	20120716	7/16/2012	1140	201207161140	Pass	Mono	0:32:20					
Test Site 1B	20120716	7/16/2012	1141	201207161141	Pass	Mono	0:47:35					
Test Site 1B	20120717	7/17/2012	1142	201207171142	Pass	Mono	0:47:35					
Test Site 1B	20120717	7/17/2012	1143	201207171143	Pass	Mono	0:47:22					
Test Site 1B	20120717	7/17/2012	1144	201207171144	Pass	Mono	0:47:08					

Test Site 1B	20120717	7/17/2012	1145	201207171145	Pass	Mono	0:47:55					
Test Site 1B	20120717	7/17/2012	1146	201207171146	Pass	Mono	0:47:35					
Test Site 1B	20120718	7/18/2012	1147	201207181147	Pass	Mono	0:46:59					
Test Site 1B	20120718	7/18/2012	1148	201207181148	Pass	Mono	0:34:01					
Test Site 1B	20120718	7/18/2012	1149	201207181149	Pass	Mono	0:32:40					
Test Site 1B	20120718	7/18/2012	1150	201207181150	Pass	Mono	0:47:15					
Test Site 1B	20120718	7/18/2012	1151	201207181151	Pass	Mono	0:47:51					
Test Site 1B	20120719	7/19/2012	1152	201207191152	Pass	Mono	0:49:03					
Test Site 1B	20120719	7/19/2012	1153	201207191153	Pass	Mono	0:47:17					
Test Site 1B	20120719	7/19/2012	1154	201207191154	Pass	Mono	0:47:20					
Test Site 1B	20120719	7/19/2012	1155	201207191155	Pass	Mono	0:47:28					
Test Site 1B	20120719	7/19/2012	1156	201207191156	Pass	Mono	0:46:24					
Test Site 1B	20120719	7/19/2012	1157	201207191157	Pass	Mono	0:31:58					
Test Site 1B	20120720	7/20/2012	1158	201207201158	Pass	Mono	0:31:14					
Test Site 1B	20120720	7/20/2012	1159	201207201159	Pass	Mono	0:47:01					
Test Site 1B	20120720	7/20/2012	1160	201207201160	Pass	Mono	0:47:08					
Test Site 1B	20120724	7/24/2012	1161	201207241161	Pass	Mono	0:47:05					
Test Site 1B	20120724	7/24/2012	1162	201207241162	Pass	Mono	0:47:28					
Test Site 1B	20120724	7/24/2012	1163	201207241163	Pass	Mono	0:47:27					
Test Site 1B	20120724	7/24/2012	1164	201207241164	Pass	Mono	0:32:10					
Test Site 1B	20120724	7/24/2012	1165	201207241165	Pass	Mono	0:32:32					
Test Site 1B	20120724	7/24/2012	1166	201207241166	Pass	Mono	0:47:36					
Test Site 1B	20120725	7/25/2012	1167	201207251167	Fail	Mono	0:47:03	763	0:00:00:008	763	763	Error in first 763 samples; realigns self
Test Site 1B	20120725	7/25/2012	1168	201207251168	Pass	Mono	0:47:23					
Test Site 1B	20120725	7/25/2012	1169	201207251169	Pass	Mono	0:46:57					
Test Site 1B	20120725	7/25/2012	1170	201207251170	Pass	Mono	0:47:55					
Test Site 1B	20120725	7/25/2012	1171	201207251171	Pass	Mono	0:47:35					
Test Site 1B	20120725	7/25/2012	1172	201207251172	Pass	Mono	0:32:00					
Test Site 1B	20120725	7/25/2012	1173	201207251173	Pass	Mono	0:31:56					

Appendix D: Notes on the Pilot Test System

In a DAW, the operating system (OS) manages a number of simultaneous (or near-simultaneous) activities, but can devote only a limited number of processing cycles and bandwidth. For this reason, operating systems employ an ordering mechanism for allocating resources (referred to as “deferred procedure calls”, or DPCs in the Windows domain). The resource allocation mechanism helps the OS prioritize the procedures at hand, sequencing them as possible and drawing resources from one activity to allocate to another. When the procedures associated with digitizing audio are deferred there is a buffer which is intended to hold samples until the file-writing stream can run again. If the resources are reallocated back to the audio procedures before the buffer runs out then all goes well. If not, the resulting file will contain errors.

Based on this, the author hypothesized that these issues should not occur in a standalone device such as the UFX because all of its resources are dedicated to recording audio 100% of the time. The only errors that should occur in the instance of the UFX are if the USB bus that is used to record direct-to-disk is overloaded or the USB disk is too slow. However, recording only one or two channels should never come close to overloading the USB bus. In three of the four cases we used hard disk drives, and in the fourth case we used USB flash drives (because the engineer found the fan noise caused by the drives we supplied to be distracting).

During the field study there were three instances when the DDR file exhibited interstitial errors. Two of the three errors occurred while using the USB flash drives. It is reasonable to assume that the flash drive’s write speed may have been deficient, causing the errors. The third error occurred using the hard drive and we could not determine why this occurred. In all of these cases the DAW copy of these files did not share these errors, and the issues were identified using the same null-test interstitial error analysis that we used to identify errors in the DAW files.

Another type of error that we cannot explain affected all of the DDR files from test site 2. These files lost the "values" for 512 samples (less than 1/100 of a second) at the very beginning and end of each recording. A unique feature of the site 2 setup entailed the location of the digital splitting. At sites 1 and 3, we employed the preferred approach, in which the UFX passes one digital audio stream through its AES digital audio output to the DAW while simultaneously routing the other stream to a front-mounted USB port for direct recording. The hardware configuration at site 2 precluded this setup. Instead, the split occurred within the IO for the DAW and it is possible that the 512-sample drops resulted from the signal management of the DAW. It did not impact the DAW files and did not represent missing samples; only missing sound. This error was easily identifiable and did not prevent the analysis of file pairs.

Do these issues have an impact on our consideration of a UFX-based system for day-to-day monitoring of a DAW? On their face, these issues appear potentially problematic: it would be

preferable for the parallel recording device never to exhibit errors. The problems, however, may not represent a fatal flaw to this approach. Both the DAW system and the DDR system can be imperfect as long as 1) they are not imperfect at the same time, 2) it is identifiable which system is generating the error, and 3) the error is occurring in the "right" place in the signal path (after digital splitting and distribution).

The software elements in a real-world monitoring system could be programmed to report the errors according to certain filters. For instance, the system could be programmed to identify the DDR errors as unimportant for reporting purposes, limiting reports to errors that occur in DAW files. And if you wanted to swap a bad DAW file with the DDR file, the system could be programmed to report that no errors were detected in the DDR file.

Appendix E: 2011 Report Deliverables

Interstitial Error Overview (2011-12-01) -- Page 21

Interstitial Error Requirements and Test Method (2011-12-01) -- Page 26

Interstitial Error Null Test Wireframes (2011-12-01) -- Page 37

Individual Sample Interstitial Error Report (2011-12-01) -- Page 44

Batch Sample Interstitial Error Report (2011-12-01) -- Page 45

Interstitial Error Workplan (2011-12-01) -- Page 46

Interstitial Error Survey Summary Results -- Page 58

Interstitial Error Detection & Reporting
Research and Development Project Overview

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Submitted December 1, 2011

Table of Contents

Introduction **3**
Deliverables **4**
Next Steps **5**

Introduction

This document is the result of a project commissioned by the Federal Agencies Digitization Guidelines Audio-Visual Working Group (see www.digitizationguidelines.gov). The aim of this project is to advance user capabilities to test and measure audio digitization systems that are deployed in archival or preservation settings.

One area of investigation is the development of a solution for detection and reporting of 'interstitial errors'. Interstitial errors consist of dropped or lost samples within the preservation master file, resulting in the loss of content and integrity. These errors -- often very momentary -- result from a failure in the chain of digital data, i.e., in the handoff from the A/D converter to the digital audio workstation (DAW), and in the DAW's writing of the file to a storage medium. For a variety of reasons, existing error detection solutions do not identify these errors accurately. In an effort to address this issue, the research and development activities resulting in this document focused on providing prospective solutions and quantifying awareness regarding interstitial errors.

Toward these ends, the activities in this project are intended to provide:

- Sufficient information to permit (a) a prospective manufacturer or (b) a grant funded organization to develop a prototype (or better) of the prospective hardware and software solution.
- A survey on the level of community interest in such tools, in order to inform prospective actors in the next phase, whether in the private or public sector, including funding organizations.

The resulting deliverables are:

- A test method providing step-by-step instructions
- A detailed description of the hardware requirements sufficient for building a prototype or identifying an existing product
- A detailed description of the software sufficient for developing a prototype. To include:
  - Wireframes
  - Information and formatting of the reports
- A detailed work plan for developing a prototype (or better) system using open source and off-the-shelf components.
- A report detailing the results of the "level-of-interest" survey.

Deliverables

There are two proposed test methods and associated hardware and software requirements detailed in *interstitial_error_requirements_and_test_method_2011-12-01.pdf.* The first test method detailed in this document follows through on a concept raised in a prior report on this same topic.[1] Because this concept was established early on the other deliverables in this project primarily revolve around and reference this approach. The second test method proposed was conceived well into this project, and therefore was not afforded the same level of time. Both of these test methods have been discussed in brief within the Audio Engineering Society Standards Working Group on Test and Measurement (SC-02-01) and were deemed worthy of continued investigation.

In addition to the test method and requirements for the first method[2], wireframes[3] were produced demonstrating a potential interface for an application used in the performance of the test method. Sample reports representing what the prospective solution may output were also created[4]. Furthermore, a [5]work plan was drafted detailing the activities, deliverables and estimated level of effort associated with developing the solution for the first test method. In order to best understand the information within these documents it is recommended to review them collectively.

Two instances of the level of interest surveys were setup in order to capture information from members within FADGI and external to FADGI. A call for participation was sent to several list-servs and professional user group forums. Summary results of these surveys were drafted[6].

[1] http://www.digitizationguidelines.gov/guidelines/digitize-audioperf.html
[2] interstitial_error_requirements_and_test_method_2011-12-01.pdf
[3] interstitial_error_null_test_wireframes_2011-12-01.pdf
[4] Individual_Sample_Interstitial_Error_Report_2011-12-01.csv
Batch_Sample_Interstitial_Error_Report_2011-12-01.csv
[5] interstitial_error_workplan_2011-12-01.PDF
[6] interstitial_error_survey_summary_results.pdf

Next Steps

The findings of this project raised some important considerations. The survey results demonstrated a relatively low amount of participation, which may indicate a lack of awareness and therefore disinterest. Additionally, within the survey responses there were a few dissenters bringing into question the existence and severity of this issue. The other realization that came to light was the level of effort required to develop a prototype solution.

These findings are compelling, increasing interest in better quantifying the issue prior to expending resources on development efforts. In order to do this it is recommended that a study be performed in order to test the frequency in which these errors occur across multiple systems. This will require a rudimentary version of the proposed test solution to be employed, ideally at several locations for 2 – 4 weeks. The interstitial error analysis can be performed periodically throughout this time, in the end, resulting in statistical data regarding the frequency of interstitial errors. Based on these findings, FADGI will be better equipped with an understanding of the cost-benefit ratio associated with moving forward in developing solutions.

Interstitial Error Detection & Reporting
Research and Development Project
Software and Hardware Requirements, Test Methods and Test Procedures

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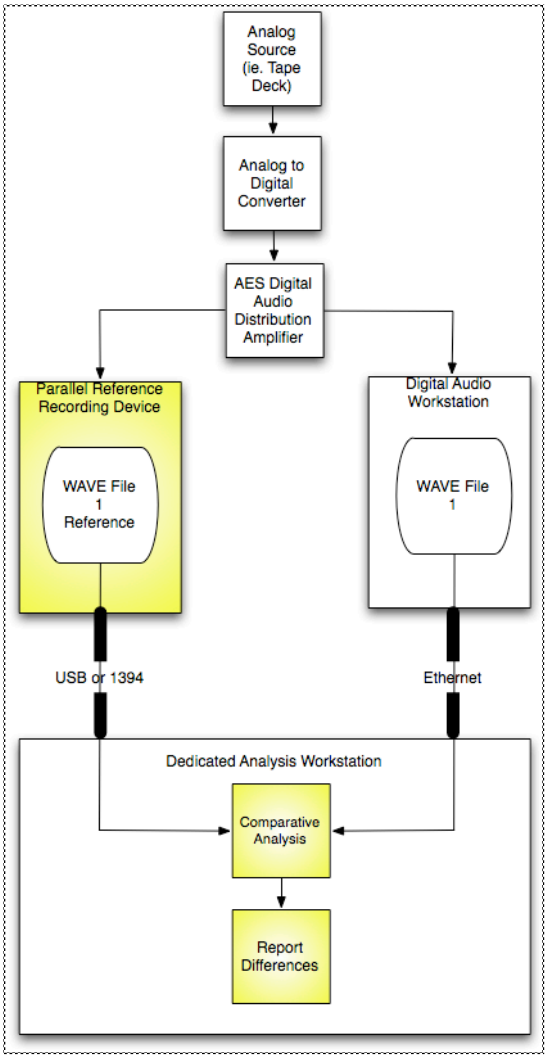
Interstitial Error – Null Test 3
Overview 3
Parallel Reference Recording Device 3
Software 4
Test Method 6
Error Identification Procedure 7
Interstitial Error Test Method 2 – Local Sample Address Code 9
Overview 9
Hardware 9
Software 9
Test Procedure 10
Test Method 10

Interstitial Error – Null Test

Overview

The approach is to record as usual to the DAW while simultaneously inserting a digital distribution amplifier (DA) at the digital output of the A/D converter (some A/D converters already provide multiple digital outputs, alleviating any need for a DA), yielding two identical digital outputs from the A/D converter. One digital output of the DA should be routed to the DAW digital input. The other digital output should go to a standalone file-based recording device. Comparative analysis of audio within the two resulting files, commonly referred to as a null test, will identify any differences, thereby revealing interstitial errors. This testing is intended to be performed on an ongoing basis with actual recorded material. This test is not intended to be performed only periodically or using standard reference signals.



Parallel Reference Recording Device

The diagram to the right demonstrates a possible signal path and setup as described in the previous paragraph. A device serving the role of the parallel reference recording device must meet the following requirements:

1. Must have an AES3 compliant input
2. Must synchronize to an external clock via AES input
3. Must provide jitter rejection at AES3 interface
4. Must capture Uncompressed Linear PCM WAVE files

5. Must at capture at sample frequencies including 44.1kHz, 48kHz and 96kHz

6. Must capture at bit depths including 16 bits and 24 bits

7. Must either contain a USB and/or Firewire interface or write to removable media via USB and/or Firewire

8. Must operate as a standalone device without the need for an Operating System such as Mac or Windows.*

9. Must provide mounting of the local directory structure on the Windows and Mac Operating Systems.

10. Must use systematic file naming protocol

* This note is to explain the supporting rationale and significance of using a standalone device without an operating system. Interstitial errors are the result of buffer issues relating to interrupt handling and allocation of system resources within an operating system. In a DAW the OS is performing numerous tasks simultaneously and on an ongoing basis with limited processing cycles and bandwidth. The OS deals the abundance of tasks and limited resources by constantly prioritizing and shuffling tasks. In other words, the OS constantly defers tasks in order to allocate resources elsewhere to tasks with a higher priority. This is the reason that audio recording applications use buffers. When the tasks associated with digitizing audio are deferred the buffer fills the gap. If the resources are reallocated back to the audio tasks before the buffer runs out then all goes well. If not, interstitial errors occur. This same problem is not encountered on standalone audio devices because all of its resources are allocated to recording audio 100% of the time.

Software

The software used for analysis and reporting must meet the following requirements:

1. Start Align: Must align two audio files containing the same audio content with sample-level accuracy. Must be able to align within temporal variances of up to 10 seconds (note: when recording identical

audio to two separate devices – the DAW and parallel reference device, there may be a time lag between pressing record on the devices. For a given sample of audio that is shared between the two files, the aforementioned time lag will result in differing times between file start and the shared sample. The tool must be able to accommodate variances of up to 10 seconds)

2. Polarity: Must be able to reverse the polarity of one of the two WAVE files.

3. Null: Must be able to sum the two wave files and generate a delta result.

4. Error Identification: Must identify, with sample accuracy, all samples where the delta does not equal 0.

5. Realign: Must be able to sample accurately identify and align two WAVE files based on analysis of the audio waveform within a range of 3 seconds following an error identification, with reasonably low and high amplitude levels.

6. Error Reporting: Must provide sample accurate reporting consisting of error start location and duration for all samples where the delta does not equal 0.

7. Batch processing: Must provide the ability to select groups of original and reference files for analysis and reporting in batch mode.

8. Matching: Must provide interface for matching two files for comparison.

9. Match Verification: Must compare the technical metadata of the two files being matched (e.g. number of channels, bit depth, sample frequency) to ensure that the baseline requirements for successful analysis are met. Upon identification of a mismatch, must disallow and

report.

10. Match Assistance: Must provide assistance in matching files through comparative analysis of technical metadata and attributes of a group of selected files.

11. Batch Access: When performing batch analysis and reporting, the software must enable a user to access files and reports for those that have completed processing.

12. Reporting: Must provide the ability to efficiently navigate, filter and sort by:
    a. Existence of errors
    b. Processed vs. unprocessed
    c. Unmatched files (original files which have no reference or vice versa)

13. ADL support: At minimum, must generate an AES-31 compliant ADL. Additionally may support ADLs for applications that are not AES-31 compliant.

14. Operating System Compatibility: Must operate on Windows and Mac Operating Systems.

15. Provide a graphical user interface

See Interstitial_Error_Null_Test_Wireframes_2011-09.pdf for a visual reference of a prospective software application meeting these requirements.

Test Method

1. Generate two audio files resulting from a digital audio distribution amplifier.

2. Identify a sample accurate audio sync point at content start.

3. Reverse the polarity of one of the audio files.

4. Monitor for samples that are not equal to 0 amplitude.

5. At the presence of samples not equal to 0
    a. Identify the samplecount of the first difference sample.
    b. identify the first sample representing common waveforms between the two files following the difference and realign. If one of the files is missing samples, the file which is missing samples should be split at the first difference sample and realigned to match the first common sample of the other file.
    c. Identify the number of samples making up the gap created by splitting and moving the file with missing samples.

6. Repeat steps 4 and 5 until the end of the file which ends first.

7. When complete, the difference file produced by summing the two files should contain 0 amplitude samples for all sections which had no errors. Sections with errors should equal the samples of the file with no missing samples.

Error Identification Procedure

1. Trigger record on the DAW and parallel recording device at the same time, and record source material.

2. Open Interstitial Error Software Application

3. Identify original and reference files for comparison.

4. Notate the unique identifier of the DAW that the original file was created on and the name of the operator that created the recording.

5. Identify the target folders for depositing the reports and audio decision list generated as an output of the comparison process, and identify the application that will be used to open the ADL.

6. Identify whether a delta file representing the difference between the original and reference file should be saved, and if so, the target folder.

7. Choose whether or not to swap the original reference file with the original file if the original is identified as having errors, thereby avoiding a retransfer if the reference file is without issue.

8. Select “Start” to perform the comparison.

9. If errors exist, review error reports within application and/or choose to open the files for review in an audio editing application.

10. Allow exporting of reports detailing the results of the analysis. See sample reports:
    a. Batch_Sample_Interstitial_Error_Report_2011-12-01.csv
    b. Individual_Sample_Interstitial_Error_Report_2011-12-01.csv

Interstitial Error Test Method 2 – Local Sample Address Code

Overview

This test method draws on AES3-2-2009. Specifically a component within the *Channel Status* portion of an AES3 stream referred to as *Local Sample Address Code.* This provides an index counter function, assigning a consecutive number to each audio sample in an AES3 stream. When the local sample address code is inserted into an AES stream prior to being written to disk, it can be leveraged to verify that all samples have been written to disk.

Based on available time for this project and the fact that this method did not come into consideration until after project start, this method has not been developed to the extent of method 1.

Hardware

This requires a soundcard that meets the following requirements:

1. AES3 input

2. Passes a full 32-bit AES3 stream

Software

This test requires software that meets the following requirements:

1. Must utilize multi-client drivers compatible with the soundcard.

2. Must allow parallel recording to DAW audio software application without interruption or causing errors.

3. Must insert a local sample address code for each audio sample in a 32-bit AES3 stream, beginning with 0 for each new audio event, prior to being written to file.

4. Must analyze local sample address code value for each sample within the channel status word of a recorded file, identifying gaps in series of consecutive numbers and associated samplecount locations.

5. Must generate a report of all errors and associated samplecount location within a file.

6. Must offer ability to delete bits greater than 24 without alteration of the first 24 bits.

7. Provide a graphical user interface

Test Procedure

1. Generate a file(s) populated with Local Sample Address Code data for each sample.

2. Open Interstitial Error Software Application.

3. Identify file(s) for analysis.

4. Notate the unique identifier of the DAW that the original file was created on and the name of the operator that created the recording.

5. Identify the target folder for the analysis report output.

6. Select “Start” to perform the analysis.

7. If errors exist, review error reports within application and/or choose to open the files for review in an audio editing application.

Test Method

1. Insert a Local Sample Address Code injection device with an AES interface in between the ADC and DAW, which injects a local sample address code in each consecutive sample of audio, incrementing by a number of 1.

2. Record a signal output from the ADC to the DAW, inserting incremental consecutive sample address values in each sample of audio.

3. After the recording is complete, create and document a checksum for the audio payload portion only.

4. From sample 0 through the last sample of the recording, analyze the local sample address code. Throughout the file, when an increment greater than 1 occurs in adjacent samples identify and document the samplecount of the last sample prior to the discrepancy. Also identify and document the value resulting from subtracting the value of the greater local sample address code from the lesser local sample address code in the two adjacent samples.

5. After analysis and reporting is complete, the channel status data may be removed.

6. Validate the documented checksum for the audio payload to ensure integrity.

FILE REPORTS VIEW HELP

ORIGINAL

drag file or folder here

REFERENCE

drag file or folder here

DAW

DAW#

SETTINGS

Operator Name

Choose Preset

ADL

Open ADL File with:

Application.exe

Select Output Folder:

d:\3044\

ERROR REPORTS

Select Output Folder:

d:\3044\

Keep Delta File

Select Output Folder:

d:\3044\

Enable auto-match

Swap reference file with original if missing samples

RESET

SAVE AS PRESET

FILE REPORTS VIEW HELP

FILTER ☑ MATCHED ☑ UNMATCHED ☑ CONFLICT

ORIGINAL	REFERENCE	DAW
3044R01S01.wav ✖	f:\STE-001.wav ✖	DAW#2
3044R01S02.wav ✖	f:\STE-002.wav ✖	DAW#2

Suggested file matches

f:\STE-002.wav	***100%***
f:\STE-003.wav	11%
f:\STE-004.wav	3%

UNMATCHED

3044R02S01.wav	f:\STE-003.wav
3044R02S02.wav	f:\STE-004.wav
3044R03S01.wav	f:\STE-005.wav
	f:\STE-006.wav

CANCEL START

SETTINGS

Chris Lacinak

Personal Preset 1

ADL

Open ADL File with:

MyApplication.exe

Select Output Folder:

d:\3044\

ERROR REPORTS

Select Output Folder:

d:\3044\

☑ **Keep Delta File**
Select Output Folder:

d:\3044\

☑ **Enable auto-match**

☑ **Swap reference file with original if missing samples**

RESET SAVE AS PRESET

FILE REPORTS VIEW HELP

FILTER ☑ MATCHED ☑ UNMATCHED ☑ CONFLICT

ORIGINAL	REFERENCE	DAW
3044R01S01.wav	f:\STE-001.wav	DAW#2
3044R01S02.wav	f:\STE-002.wav	DAW#2

	Original	Reference
File Path	d:\3044\	f:\
Creation Date	8/1/2011	8/1/2011
Creation Time	12:32:45-0000	12:32:45-0000
File Size	1531866624	1531866624
Format	WAVE	WAVE
Codec ID	1	1
Channels	1	1
Sample Rate	96000	96000
Bit Depth	24	24
Duration	1:28:39	1:28:39

UNMATCHED

3044R02S01.wav	f:\STE-003.wav
3044R02S02.wav	f:\STE-004.wav
3044R03S01.wav	f:\STE-005.wav
	f:\STE-006.wav

CANCEL START

SETTINGS

Chris Lacinak

Personal Preset 1

ADL

Open ADL File with:

MyApplication.exe

Select Output Folder:

d:\3044\

ERROR REPORTS

Select Output Folder:

d:\3044\

☑ **Keep Delta File**
Select Output Folder:

d:\3044\

☑ **Enable auto-match**

☑ **Swap reference file with original if missing samples**

RESET SAVE AS PRESET

FILE REPORTS VIEW HELP

FILTER ☑ MATCHED ☑ UNMATCHED ☑ CONFLICT

ORIGINAL	REFERENCE	DAW
3044R01S01.wav	f:\STE-001.wav	DAW#2
3044R01S02.wav	f:\STE-002.wav	DAW#2
3044R02S01.wav	f:\STE-002.wav	DAW#2
3044R02S01.wav	f:\STE-003.wav	DAW#2
3044R02S02.wav	f:\STE-004a.wav	DAW#2
	f:\STE-004b.wav	DAW#2

SETTINGS

Chris Lacinak

Personal Preset 1

ADL

Open ADL File with:

MyApplication.exe

Select Output Folder:

d:\3044\

ERROR REPORTS

Select Output Folder:

d:\3044\

☑ Keep Delta File
Select Output Folder:

d:\3044\

☑ Enable auto-match

☑ Swap reference file with original if missing samples

CANCEL START RESET SAVE AS PRESET

FILE REPORTS VIEW HELP

FILTER ☑ PROCESSED ☑ UNPROCESSED ☑ ERRORS

OPERATOR: CHRIS LACINAK

3044R01S01.wav (f:\STE-001.wav)	✓		DAW#2
3044R01S02.wav ✖	⚠	f:\STE-002.wav ✖	DAW#2
3044R02S01.wav ✖	◌	f:\STE-003.wav ✖	DAW#2
3044R02S02.wav ✖		f:\STE-004a.wav ✖	DAW#2
		f:\STE-004b.wav ✖	DAW#2

TIME ELAPSED: 1:21:39
TIME REMAINING: 0:19:17
PROCESSED 3 OF 4 FILES
PROCESSING: *3044R02S01.wav* **32% (0:21:54 LEFT)**

CANCEL PAUSE

REVIEW SELECTED OPEN ADL

▼ *d:\3044\3044R01S02.wav* ⚠

DETAILS

File Path	d:\3044\	f:\
Creation Date	8/1/2011	8/1/2011
Creation Time	12:32:45-0000	10:15:53-0000
File Size	3200268850	3197743841
Format	WAVE	WAVE
Codec ID	1	1
Channels	1	1
Sample Rate	96000	96000
Bit Depth	24	24
Duration	1:28:43	1:28:39

ERRORS (3):

0001

Error Start Sample Value	206388
Error Start Time Stamp	00:00:04.680
Error Duration Samples	192
Error Duration Time	00:00:00.210

0002

Error Start Sample Value	67165440
Error Start Time Stamp	00:11:39.640
Error Duration Samples	512
Error Duration Time	00:00:00.543

0003

Error Start Sample Value	163051200
Error Start Time Stamp	00:00:28:18.450
Error Duration Samples	64320
Error Duration Time	00:00:00:00.670

Select New Reference File RE-RUN

SWAP REFERENCE WITH ORIGINAL

FILE REPORTS VIEW HELP

FILTER ☑ PROCESSED ☐ UNPROCESSED ☑ ERRORS

OPERATOR: CHRIS LACINAK

3044R01S01.wav (f:\STE-001.wav)	✓		DAW#2
3044R01S02.wav ✖	⚠	f:\STE-002.wav ✖	DAW#2
3044R02S01.wav (f:\STE-003.wav)	✓		DAW#2
3044R02S02.wav (f:\STE-004a.wav , f:\STE-004b.wav)	✓		DAW#2

TIME ELAPSED: 1:40:56
TIME REMAINING: 0:00:00
PROCESSED 4 OF 4 FILES

REPORT

OVERVIEW

Interestitial Error Detection Version	1
Mode	Batch
Analysis Start Date	2011-08-01
Analysis Start Time	19:07:23
Operator	Chris Lacinak
Batch Duration	01:40:56
Total Original Files Analyzed	4
Total Original Files with Failures	1

FAILED FILES (1):

1) 3044R01S02.wav

0001

Error Start Sample Value	206388
Error Start Time Stamp	00:00:04.680
Error Duration Samples	192
Error Duration Time	00:00:00.210

0002

Error Start Sample Value	67165440
Error Start Time Stamp	00:11:39.640
Error Duration Samples	512
Error Duration Time	00:00:00.543

0003

Error Start Sample Value	163051200
Error Start Time Stamp	00:00:28:18.450
Error Duration Samples	64320
Error Duration Time	00:00:00:00.670

DELETE SAVE

FILE REPORTS VIEW HELP

FILTER ☐ PROCESSED ☐ UNPROCESSED ☑ ERRORS

OPERATOR: CHRIS LACINAK

3044R01S02.wav ✖ ⚠ *f:\STE-002.wav* ✖ *DAW#2*

TIME ELAPSED: 1:40:56
TIME REMAINING: 0:00:00
PROCESSED 4 OF 4 FILES

REPORT

OVERVIEW

Interestitial Error Detection Version	1
Mode	Batch
Analysis Start Date	2011-08-01
Analysis Start Time	19:07:23
Operator	Chris Lacinak
Batch Duration	01:40:56
Total Original Files Analyzed	4
Total Original Files with Failures	1

FAILED FILES (1):

1) 3044R01S02.wav

0001

Error Start Sample Value	206388
Error Start Time Stamp	00:00:04.680
Error Duration Samples	192
Error Duration Time	00:00:00.210

0002

Error Start Sample Value	67165440
Error Start Time Stamp	00:11:39.640
Error Duration Samples	512
Error Duration Time	00:00:00.543

0003

Error Start Sample Value	163051200
Error Start Time Stamp	00:00:28:18.450
Error Duration Samples	64320
Error Duration Time	00:00:00:00.670

DELETE SAVE

Individual_Sample_Interstitial_Error_Report_2011-12-01

Interestitial Error Detection Version	1.0
Mode	Individual
Analysis Start Date	2011-08-01
Analysis Start Time	14:07:53
Operator	Chris Lacinak
Batch Duration	00:09:37
Total Original Files Analyzed	1
Total Original Files with Failures	1

Original File Path	Reference File Path	Original File Creation Date	Original File Creation Time	File Size	Format	Codec ID	Channels	Sample Rate	Bit Depth	Duration	DAW	Errors	Error Start Sample Value	Error Start Time Stamp	Error Duration Samples	Error Duration Time
d:\3044\3044R01S01.wav	f:\STE-001.wav	2011-08-01	12:32:45-0000	1531866624	Wave	0001	1	96000	24	01:28:38.938	DAW#02	Yes	206388	00:00:04.680	192	00:00:00.210
d:\3044\3044R01S01.wav	f:\STE-001.wav	2011-08-01	12:32:45-0000	1531866624	Wave	0001	1	96000	24	01:28:38.938	DAW#02	Yes	67165440	00:11:39.640	512	00:00:00.543
d:\3044\3044R01S01.wav	f:\STE-001.wav	2011-08-01	12:32:45-0000	1531866624	Wave	0001	1	96000	24	01:28:38.938	DAW#02	Yes	163051200	00:28:18.450	64320	00:00:00.670

Batch_Sample_Interstitial_Error_Report_2011-12-01

Interestitial Error Detection Version	1.0
Mode	Batch
Analysis Start Date	2011-08-01
Analysis Start Time	19:07:23
Operator	Chris Lacinak
Batch Duration	00:36:12
Total Original Files Analyzed	4
Total Original Files with Failures	2

Original File Path	Reference File Path	Original File Creation Date	Original File Creation Time	File Size	Format	Codec ID	Channels	Sample Rate	Bit Depth	Duration	DAW	Errors	Error Start Sample Value	Error Start Time Stamp	Error Duration Samples	Error Duration Time
d:\3044\3044R01S01.wav	f:\STE-001.wav	2011-08-01	12:32:45-0000	1531866624	WAVE	0001	1	96000	24	01:28:38.938	DAW#02	Yes	206388	00:00:04.680	192	00:00:00.210
d:\3044\3044R01S01.wav	f:\STE-001.wav	2011-08-01	12:32:45-0000	1531866624	WAVE	0001	1	96000	24	01:28:38.938	DAW#02	Yes	67165440	00:11:39.640	512	00:00:00.543
d:\3044\3044R01S01.wav	f:\STE-001.wav	2011-08-01	12:32:45-0000	1531866624	WAVE	0001	1	96000	24	01:28:38.938	DAW#02	Yes	163051200	00:28:18.450	64320	00:00:00.670
d:\3044\3044R01S02.wav	f:\STE-002.wav	2011-08-01	14:12:36-0000	282820096	WAVE	0001	1	96000	24	00:16:22.000	DAW#02	No				
d:\3044\3044R02S01.wav	f:\STE-003.wav	2011-08-01	15:03:19-0000	1009812736	WAVE	0001	2	96000	24	00:29:13.140	DAW#02	Yes	65974080	00:11:27.230	512	00:00:00.543
d:\3044\3044R03S01.wav	f:\STE-004.wav	2011-08-01	17:52:26-0000	483864576	WAVE	0001	1	96000	24	00:28:00.000	DAW#02	No				

Interstitial Error Detection & Reporting
Research and Development Project Work Plan

Prepared
By

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Submitted December 1, 2011

Table of Contents

1 Introduction 3
2 Project Scope 4
3 Development Outline and Schedule 5
3.1 Identify and Test Hardware Devices (within 60 days of project start) 6
3.1.1 Activities 6
3.1.2 Deliverables 6
3.2 Software Development – Part 1: Alignment (within 60 days of project start) 6
3.2.1 Activities 6
3.2.2 Software Requirements 6
3.2.3 Deliverables 7
3.3 Software Development – Part 2: Matching (within 120 days of project start) 7
3.3.1 Activities 7
3.3.2 Additional Requirements 7
3.3.3 Deliverables 8
3.4 Software Development – Part 3: Comparative Analysis (within 150 days of project start) 8
3.4.1 Activities 8
3.4.2 Additional Requirements 8
3.4.3 Deliverables 9
3.5 Software Development – Part 4: Batch Processing and Reporting (within 180 days of project start) 9
3.5.1 Activities 9
3.5.2 Additional Requirements and Features 9
3.5.3 Deliverables 10
3.6 Beta Testing (within 240 days of project start) 10
3.6.1 Activities 10
3.6.2 Deliverables 10
3.7 Develop User Documentation (within 270 days of project start) 10
3.7.1 Activities 10
3.7.2 Documentation Requirements 10
3.7.3 Deliverables 11
3.8 Maintenance 11
3.9 Source Forge 11
4 Estimated Time 11

1 Introduction

This document is the result of a project commissioned by the Federal Agencies Digitization Guidelines Audio-Visual Working Group (see www.digitizationguidelines.gov). The aim of this project is to advance user capabilities to test and measure audio digitization systems that are deployed in archival or preservation settings.

One area of investigation is the development of a solution for detection and reporting of 'interstitial errors'. Interstitial errors consist of dropped or lost samples within the preservation master file, resulting in the loss of content and integrity. These errors -- often very momentary -- result from a failure in the chain of digital data, i.e., in the handoff from the A/D converter to the digital audio workstation (DAW), and in the DAW's writing of the file to a storage medium. Anecdotal reports from federal agencies and other audio professionals have identified interstitial errors as a common problem. These evasive errors are hard to detect with current test and measurement tools.

As part of the project activities a survey was conducted to assess the level of interest and the potential size of the market for development of a solution to address the interstitial error problem. On the flip side, effort has gone into quantifying the level of effort required to develop tools to address this issue. This document supports this by providing a workplan for developing a prospective tool to detect and report on digital audio interstitial errors. Thid document accompanies information addressing associated software requirements, hardware requirements, wire frames, test method and test procedures, and provides a framework for establishing the associated timeline and level of effort for development and implementation.

2 Project Scope

It is a primary goal of this project is to develop a solution which is low cost and open. The initial envisioned result is an off-the-shelf low cost audio recording device combined with open source software for analysis and reporting. This software is envisaged as being hosted at Sourceforge.com along with the aforementioned user documentation and information on the associated necessary hardware.

The scope of the project is:

- The development of a comparative analysis system, likely consisting of a combination of off-the-shelf hardware and open source software, for identifying and reporting on interstitial errors.
- The drafting of a user manual, help documentation and tutorials.
- The identification and documentation of threshold settings to aid in accurate and efficient interpretation of reports.
- All necessary documentation in support of project tracking, software development and ongoing development and maintenance.

3 Development Outline and Schedule

The project will start with an extended period of development to establish the foundational components of the system. Following this will be a series of testing and refinement phases. After the foundation is established additional layers will be added, continually developing, testing and refining the functionality and capabilities.

At pertinent milestones extended testing periods may take place. This real-world testing will provide extensive feedback on logistics, workflow, bugs and feature requests.

The result of this iterative process will be a release version of the tool accompanied by documentation of known issues, feature requests and recommendations for future development. After the release version is complete user documentation will be generated. At the end of the project all source code, compiled code and documentation will be uploaded to Source Forge.

The following sections describe the activities, requirements and deliverables of each phase. This schedule represents anticipated goals in the project development and may be adjusted as needed. Each section of the development schedule is given with an estimate of the number of days required for completion from the approval and initiation of the project.

3.1 Identify and Test Hardware Devices (within 60 days of project start)

3.1.1 Activities

a. Device sample set selection and acquisition
b. Refine test methodology
c. Produce reference files
d. Testing, analysis and documentation
e. Determine suitability for comparative analysis
f. Selection of device to move forward with for continued testing

3.1.2 Deliverables

- Report on suitability of devices for temporal and/or amplitude comparative analysis and associated feature sets
- Test method, reference files and results
- A selected device for continued research and development

3.2 Software Development – Part 1: Alignment (within 60 days of project start)

3.2.1 Activities

- Establish open source license strategy
- Development
- Document test method
- Produce Reference Files
- Testing and Review
- Issue-tracking and feedback documentation
- Refinement

3.2.2 Software Requirements

- Must be able to consistently sample accurately align two WAVE files based on analysis of the audio waveform within variances of file start times under 10 seconds, and with reasonably low and high amplitude levels

- Must be able to sample accurately identify and align two waveforms based on analysis of the audio within a range of 3 seconds following an error, with reasonably low and high amplitude levels.
- Must operate on Windows and Mac Operating Systems

3.2.3 Deliverables

- Test method, reference files and results
- Working tool meeting the above requirements
- Basic supporting user documentation
- Source Code with in-line source code documentation following best practices
- Documentation of feedback from review period
- Issue tracking documentation from phase and review period

3.3 Software Development – Part 2: Matching (within 120 days of project start)

3.3.1 Activities

- Development
- Document test method
- Produce Reference Files
- Testing and Review
- Issue-tracking and feedback documentation
- Refinement

3.3.2 Additional Requirements

- Must provide assistance in matching files through comparative analysis of technical metadata and attributes of a group of selected files.
- Must compare the technical metadata of the two files being matched (e.g. number of channels, bit depth, sample rate) to ensure that the baseline requirements for successful analysis are met.

3.3.3 Deliverables

- Test method, reference files and results
- Working tool meeting the above requirements
- Basic supporting user documentation
- Source Code with in-line source code documentation following best practices
- Documentation of feedback from review period
- Issue tracking documentation from phase and review period

3.4 Software Development – Part 3: Comparative Analysis (within 150 days of project start)

3.4.1 Activities

- Development
- Document test method
- Produce Reference Files
- Testing and Review
- Issue-tracking and feedback documentation
- Text and Graphic Layout and Design
- Refinement

3.4.2 Additional Requirements

- Must be able to reverse the polarity of one of the files
- Must be able to sum the two WAVE files together and generate a delta result
- Must identify, with sample accuracy, all samples where the delta does not equal 0
- Must be able to sample accurately identify and align two WAVE files based on analysis of the audio waveform within a range of 3 seconds following an error identification, with reasonably low and high amplitude levels
- Must provide sample accurate reporting consisting of error start location and duration for all samples where the delta does not equal 0

3.4.3 Deliverables

- Test method, reference files and results
- Working GUI-based alpha version of tool meeting the above requirements
- Basic supporting user documentation
- Source Code with in-line source code documentation following best practices
- Documentation of feedback from review period
- Issue tracking documentation from phase and review period

3.5 Software Development – Part 4: Batch Processing and Reporting (within 180 days of project start)

3.5.1 Activities

- Development
- Testing and Review
- Issue-tracking and feedback documentation
- Text and Graphic Layout and Design
- Refinement

3.5.2 Additional Requirements and Features

- Must provide the ability to select groups of original and reference files for analysis and reporting in batch mode.
- When performing batch analysis and reporting, the software must enable a user to access files and reports for those that have completed processing.
- Must provide the ability to efficiently navigate, filter and sort by:
    - Existence of errors
    - Processed vs. unprocessed
    - Unmatched files (original files which have no reference or vice versa)
- Must generate an AES-31 compliant ADL representing the original file, reference file, delta file and location of errors.

3.5.3 Deliverables

- Working GUI-based alpha version of tool meeting the above requirements
- Basic supporting user documentation
- Source Code with in-line source code documentation following best practices
- Documentation of feedback from review period
- Issue tracking documentation from phase and review period
- Recommended next steps, known issues and feature requests

3.6 Beta Testing (within 240 days of project start)

3.6.1 Activities

- Testing
- Feedback
- Refinement
- Text and Graphic Layout and Design

3.6.2 Deliverables

- Release version 1.0

3.7 Develop User Documentation (within 270 days of project start)

3.7.1 Activities

- Compiling
- Drafting
- Review and Editing
- Text and Graphic Layout and Design

3.7.2 Documentation Requirements

- Background and History
- Basic operation of the application
- Guidelines for use

3.7.3 Deliverables

- Stand-Alone Documentation
- Application Help Menu
- Sample files and reports

3.8 Maintenance

Following the completion of the deliverables all listed deliverables maintenance shall be provided for the lesser of 6 months, or a total of 40 labor hours of maintenance and bug correction.

3.9 Source Forge

Once the application is ready for release and all licensing language is cleared a Source Forge space to upload the application and associated documents will be created and prepared.

4 Estimated Time

Activity	**Estimated Days**
Identify, Test and Report on Stand-Alone Devices	7
Standalone Device Purchase	NA
Develop Software for Command-Line and GUI interfaces – Part 1: Alignment	16
Develop Software for Command-Line and GUI interfaces – Part 2: Matching	10
Develop Software for Command-Line and GUI interfaces – Part 3: Comparative Analysis	14

Develop Software for Command-Line and GUI interfaces – Part 4: Batch Processing and Reporting	7
Beta Testing and Refinement	19
Develop User Documentation for GUI and Command-Line Applications	10
Maintenance	5
Source Forge Space Creation and Kick-Off	2
TOTAL	**90**

Federal Agencies AV Working Group Interstitial Error Survey Summary Results

Survey respondents	83
Organizations with one or more audio collections responding	68
Digitization vendors responding	6
Respondents having previously encountered interstitial errors	56
Respondents planning or currently involved in audio digitization project	61
Respondents not interested in solution / don't need solution / believes issue is non-existent	8
Respondents more likely to hire a vendor that offers interstitial error detection and reporting*	17
If a tool were available to detect and report interstitial errors, respondents would be likely to purchase it if it cost:**	
Less than $20,000	1
Less than $10,000	4
Less than $5,000	7
Less than $2,500	12
Less than $1,000	18
Less than $500	20
Would not purchase	9

* Out of 23 that responded to the question. Others either skipped the question, were not involved in digitization effort, were a vendor themselves, or were not planning on using a vendor.

** Out of 71 that responded to the question. Others either skipped the question or believed the issue was non-existent.