
Flipping the Switch: Lessons Learned from a Major Digital Library Migration Project

Jon Dunn, Ryan Scherle, and Mark Notess

Digital Library Program

Indiana University

DLF Fall Forum - November 7, 2005





Outline

- Background
 - Review of Variations and Variations2 digital music library systems
- Migration
- Post-migration experience
- Lessons learned
- Future directions



Variations

- Digital library of sound recordings and scores in IU Cook Music Library
- Online in April 1996
- 10,000 recordings; 200+ scores
- Access to course reserves, general, and special collections
- Available from workstations in Music Library and selected on-campus locations
- Jointly supported by Digital Library Program and Music Library



Variations

T351 - PERMANENT RESERVE Music Library Reserve Recordings - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Stop

Bookmarks Location: <http://www.music.indiana.edu/reserves/t351permmlr.html> What's Related

Indiana University Bloomington Libraries

William and Gayle Cook Music Library

T351 - PERMANENT RESERVE Reserve Recordings

Adams, John, 1947-
<Orchestra music. Selections>
The Chairman dances : foxtrot for orchestra ; Christian zeal and activity ;
Two fanfares for orchestra ; Common tones in simple time <sound recording> /
John Adams. -- New York, N.Y. : Elektra Nonesuch, p1987.
CD .A214 Ge
[Listen to online copy in VARIATIONS](#)

Bartok, Bela.
<Duets, violins>
44 duos for violins (1931) <sound recording> / Bela Bartok. -- Loosdrecht,
Holland : Sound ; N.Y. : Dist<ributed> by Qualiton Imports, <198-?>
CD .B292 C2S1.1-3
[Listen to online copy in VARIATIONS](#)

Bartok, Bela, 1881-1945.
<Quartets, strings>
The string quartets <sound recording> : complete / Bartok. -- <Hungary> :
Hungaroton, p1984.
CD .B292 C4S-13
[Listen to online copy in VARIATIONS](#)

Bartok, Bela, 1881-1945.
(Music for Strings, Percussion, and Celesta)

Document: Done



Variations

IUCAT - Indiana University Libraries - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media Print Mail

Address <http://www.iucat.iu.edu/uhtbin/cgisirsi/gMRSxVWPH5/64250034/88> Go Links

Search Results

"leonard bernstein and http and sound" search found 137 titles.
Mark ☒ items for Print/E-Mail/Save

#1	1990	Limit Your Search Results to the Following Categories Diplomatics, Archives, Seals History: America and United States Instrumental and Vocal Music
Mark <input type="checkbox"/>	Songs and duets ; Arias and barcarolles [sound recording]	
URL AVAILABLE WWW	Bernstein, Leonard, 1918- Vocal music. Selections 1 sound disc : digital ; 4 3/4 in. copy available at B-MUSIC. Click DISPLAY for details.	
#2	2003	
Mark <input type="checkbox"/>	On the waterfront [sound recording] ; Chichester Psalms ; On the town	
URL AVAILABLE WWW	Bernstein, Leonard, 1918- Selections 1 sound disc : digital ; 4 3/4 in. copy available at B-MUSIC. Click DISPLAY for details.	
#3	2002	
Mark <input type="checkbox"/>	Medea [sound recording] Cherubini, Luigi, 1760-1842.	
URL AVAILABLE WWW	Médée. Italian 2 sound discs : digital, mono. ; 4 3/4 in. Copy currently not available. Click DISPLAY for details.	

Done Internet



Variations

IUCAT - Indiana University Libraries - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media

Address <http://www.iucat.iu.edu/uhtbin/cgiirsi/wOCh9s2n3F/64250034/9> Go Links

Author/Composer, etc: **Horne, Marilyn.**

Title: **I will breathe a mountain [sound recording] : songs of Barber, Be Bolcom.**

Published/Produced: **New York, N.Y. : RCA Victor Red Seal, p1998.**

Physical description: **1 sound disc : digital ; 4 3/4 in.**

URL: <http://www.music.indiana.edu/cgi-bin/var/access?CAR9723>

Label no.: **09026-68771-2 RCA Victor Red Seal**

Language: **Sung in English.**

Performer: **Marilyn Horne, mezzo-soprano ; Martin Katz, voice (in Nachspiel) Tokyo String Quartet (in Dover Beach).**

Recording info.: **Barber and Bolcom songs recorded Dec. 13 and 16, 1993, at Metropolitan Museum of Modern Art, New York; Dover Beach recorded Feb. 20 Manhattan Center, New York; Bernstein songs recorded Nov. 15, Clinton Recording Studios, New York.**

Notes: **Original works and arrangements, principally for voice and piano work with string quartet acc.; Nachspiel for 2 humming voices and Compact disc.**

Program notes by Steven Blier, biographical notes on performers, and texts in English ([16] p. : ports.) inserted in container.

Contents: **The daisies : op. 2 no. 1 (1:05) ; A nun takes the veil : op. 13 no. 1 (1:41) ; Bessie Bobtail : op. 2 no. 3 (3:14) ; The secrets of the old : op. 13 no. 2 (1:13) ; Sure on this shining night : op. 13 no. 3 (2:36) ; I hear an army : op. 10 no. 3 (2:26) ; Dover Beach : op. 3 (8:30) / Samuel Barber -- I will breathe a mountain (24:21) / William Bolcom -- My house (3:08) ; So pretty (2:21) ; Greeting (2:41) ; Take care of this house (1:55) ; Rabbit at top speed (1:19) ; Sonnet : What lips my lips have kissed (4:44) ; Nachspiel (2:04) ; Dream with me (3:31) / Leonard Bernstein.**

Variations Player

File Info Options Help

I will breathe a mountain <sound recording> : songs of Barb...
Horne, Marilyn. voc

Track Name
Bernstein, So Pretty

Time (MMM:SS): Track of Repeat
Track Time Elapsed 0:06 20 26 ☒ None ☐ All ☐ One

Track 1
Track 2
Track 3



Variations

Score: AGY4923 - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites Media

Address <http://www.dlib.indiana.edu/variations/scores/agy4923/large/index.html> Go Links

William and Gayle Cook Music Library
Indiana University School of Music

Arnold Schoenberg
Collected Songs

[View full bibliographic record from IUCAT](#)

[View smaller version of this score](#)

Contents

Two Songs, Op. 1

- [1. Dank](#)
- [2. Abschied](#)

Four Songs, Op. 2

- [1. Erwartung](#)
- [2. Schenk mir deinen goldenen Kamm](#)
- [3. Erhebung](#)
- [4. Waldsonne](#)

Six Songs, Op. 3

- [1. Wie Georg von Frundsberg von sich selber sang](#)
- [2. Die Aufgeregten](#)
- [3. Warnung](#)
- [4. Hochzeitlied](#)
- [5. Geubtes Herz](#)
- [6. Freihold](#)

Eight Songs, Op. 6

- [1. Traumleben](#)
- [2. Alles](#)
- [3. Mädchenlied](#)
- [4. Verlassen](#)
- [5. Ghazel](#)
- [6. Am Wegrand](#)
- [7. Lockung](#)

Page 3

Dank.
(Karl Frh. v. Levetsow.) Arnold Schönberg, Op. 1. No. 1.

Sehr langsam. (♩)

Gesang. Gro - sses hast Du mir ge -

Clavier. *p*

ge - ben in je - nen Hoch - stun - den, die für uns be - ste - hen im

Zeit - lo - sen

sf

Gro - sses hast Du mir ge - ge - ben: ich

Breit. sehr zurückhaltend

steigernd

Internet



Pre-Variations





Variations





Variations2 Project Overview

- R&D project funded by DLI-2 grant from NSF/NEH (2000-2006)
- Establish a digital music library testbed system supporting multiple formats: audio, video, score images, score notation
- Develop multiple interfaces for specific user applications in the music library and the classroom
- Conduct research in metadata, usability, copyright, and networking



Expanding on Variations

- Variations2 expands on Variations by:
 - expanding representations of music in other media
 - creating additional metadata and new software tools for enhanced access, synchronization and navigation
 - creating tools for pedagogical use
 - expanding access locations



Variations2 Overview

content



digitized audio



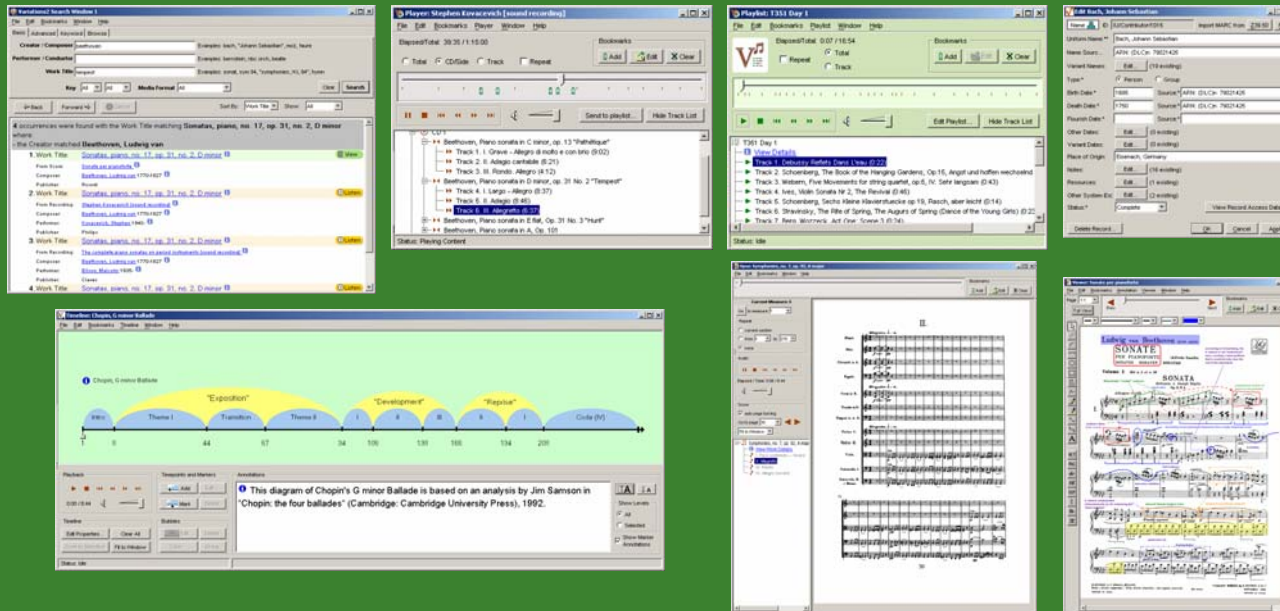
scanned scores



encoded scores



user interface



users

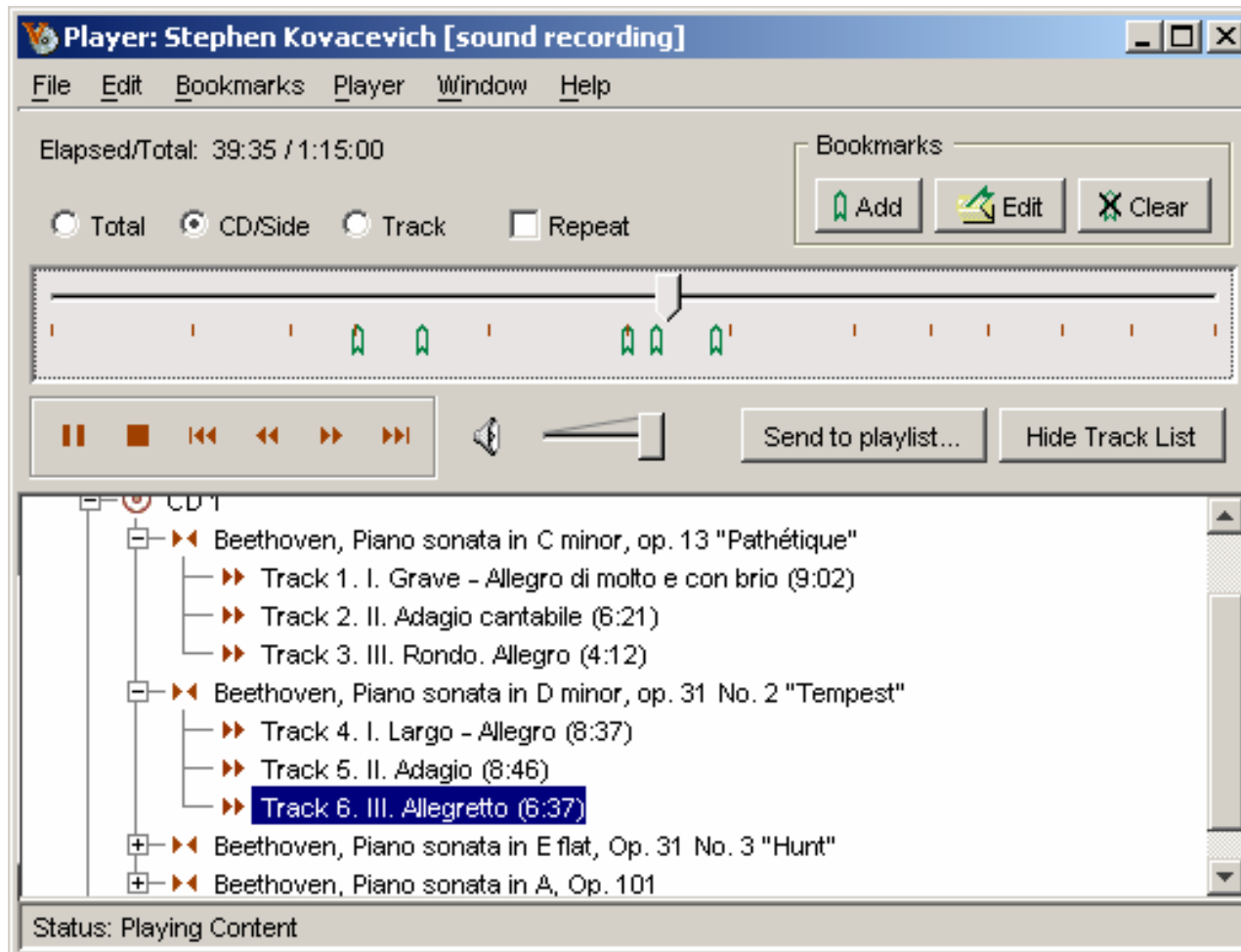
faculty

students

librarians



Audio Player



Users can bookmark locations in tracks, send tracks to a personal playlist.



Score Viewer

The screenshot displays the 'Score Viewer' application window. The title bar reads 'Viewer: Sonate per pianoforte'. The menu bar includes 'File', 'Edit', 'Bookmarks', 'Annotation', 'Viewer', 'Admin', 'Window', and 'Help'. The interface is divided into several sections:

- Zoom:** Contains 'Zoom In' and 'Zoom Out' buttons, a 'Fit to Window' dropdown, and a 'Two-Page View' button.
- Annotations:** Includes 'Show Tools' and 'Show Annotations' buttons.
- Left Panel:** A tree view showing the structure of the score:
 - Sonate per pianoforte
 - View Details
 - Volume 1
 - Volume 2
 - Title page and verso
 - Thematic table
 - Sonata no. 17, Op. 31. N. 2
 - I. Largo — Allegro
 - II. Adagio
 - III. Allegretto
 - Sonata no. 18, Op. 31. N. 3
 - Sonata no. 19, Op. 49. N. 1
 - Sonata no. 20, Op. 49. N. 2
 - Sonata no. 21, Op. 53
 - Sonata no. 22, Op. 54
 - Sonata no. 23, Op. 57
 - Sonata no. 24, Op. 78
 - Sonata no. 25, Op. 79
 - Sonata no. 26, Op. 81
 - Sonata no. 27, Op. 90
 - Sonata no. 28, Op. 101
 - Sonata no. 29, Op. 106
 - Sonata no. 30, Op. 109
 - Sonata no. 31, Op. 110
 - Sonata no. 32, Op. 111

- Page Navigation:** Shows 'Page 214' with 'Prev' and 'Next' buttons.
- Bookmarks:** Includes 'Add', 'Edit', and 'Clear' buttons.
- Compact View:** A button to toggle between compact and full view.
- Score Display:** The main area shows musical notation for piano. The first system is marked '14'. The score includes various dynamics (cresc., p subito, p, sf, mp legato ed espress., p, cresc., p subito, mp) and markings like 'senza fretta' and 'sempre piano'. The second system is marked 'Allegretto 1/4 = 84' and includes dynamics like 'a) p', 'cresc.', 'dim.', and 'p cresc.'. The third system continues the notation with 'cresc.', 'dim.', and 'p cresc.'. The bottom of the page is marked 'E.R. 2153'.

Users can page through scores, bookmark pages, zoom in and out, and switch to a two page view.



Score Annotation

Viewer: Sonate per pianoforte

File Edit Bookmarks Annotation Viewer Window Help

Page 1:1

Full View

Prev Next

Bookmarks

Add Edit Clear

Ludwig van Beethoven (1770 - 1827)

SONATE

PER PIANOFORTE (Alfredo Casella)

SONATES SONATEN SONATAS

Volume I Del n. 1 al n. 16

SONATA

dedicata a Joseph Haydn

(dedicated) Op. 2, N. 1.

Allegro vivace

1.

Mannheim "rocket" gesture

compressed version of previous two gestures

according to Schoenberg, the E natural is not "neutralized" here, creating a tonal problem that is resolved only near the end of the movement.

sentence form: 2+2 / 1+1+2

ascending rocket gesture compressed into a single downward event

poco rit.

a tempo

transition

Half cadence

two-voice imitation

espress.

E natural reinterpreted enharmonically as Fb, enhancing the "tonal problem"

second theme begins here

related to transitional material!

p molto espress.

pedal tone Eb

instrumentation

poco cresc.

mf

G. RICORDI & C. Editore, MILANO.

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PRINTED IN ITALY

RR 2442

(Copyright) WERKEL, by G. RICORDI & Co.)

RISTAMPA 1993

IMPRIMÉ EN ITALIE

Users can also annotate scores and save or print the annotations. Annotations scale with page zooming level.

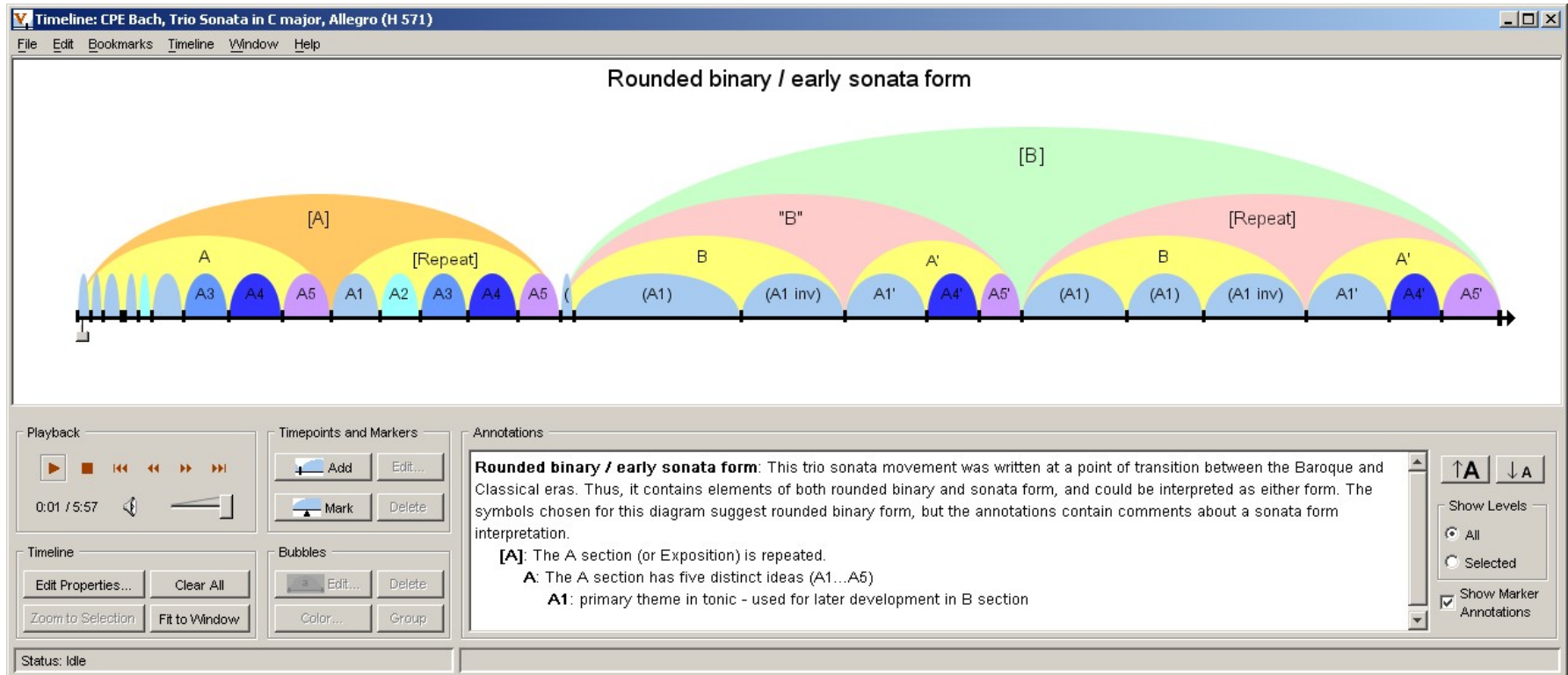
Synchronized Score & Audio

The screenshot displays a music software interface titled "Opus: Symphonies, no. 7, op. 92, A major". The interface includes a menu bar (File, Edit, Bookmarks, Window, Help) and a toolbar with "Add", "Edit", and "Clear" buttons. On the left, a sidebar shows the "Current Measure: 5" and navigation controls. Below this, the "Audio" section features a play/pause button, a progress bar, and a volume slider, with a display showing "Elapsed / Total: 0:08 / 8:44". The "Score" section has a checkbox for "auto page turning", a "Go to page" dropdown set to 30, and a "Fit to Window" button. A table of contents on the left lists the symphony's movements: I. Poco sostenuto — Vivace, II. Allegretto (highlighted), III. Presto, and IV. Allegro con brio. The main window displays the musical score for the second movement, "II. Allegretto, 4/4 - 78". The score is arranged in a grand staff with parts for Flauti, Oboi, Clarineti in A, Fagotti, Corni in E, Trombe in D, Timpani in A. E., Violino I., Violino II., Viola, Violoncello I., and Violoncello II. e Basso. The score is synchronized with the audio player, and the page number 30 is visible at the bottom.

Any recording can be synchronized with any score of the same work for easy navigation and even automatic page turning.



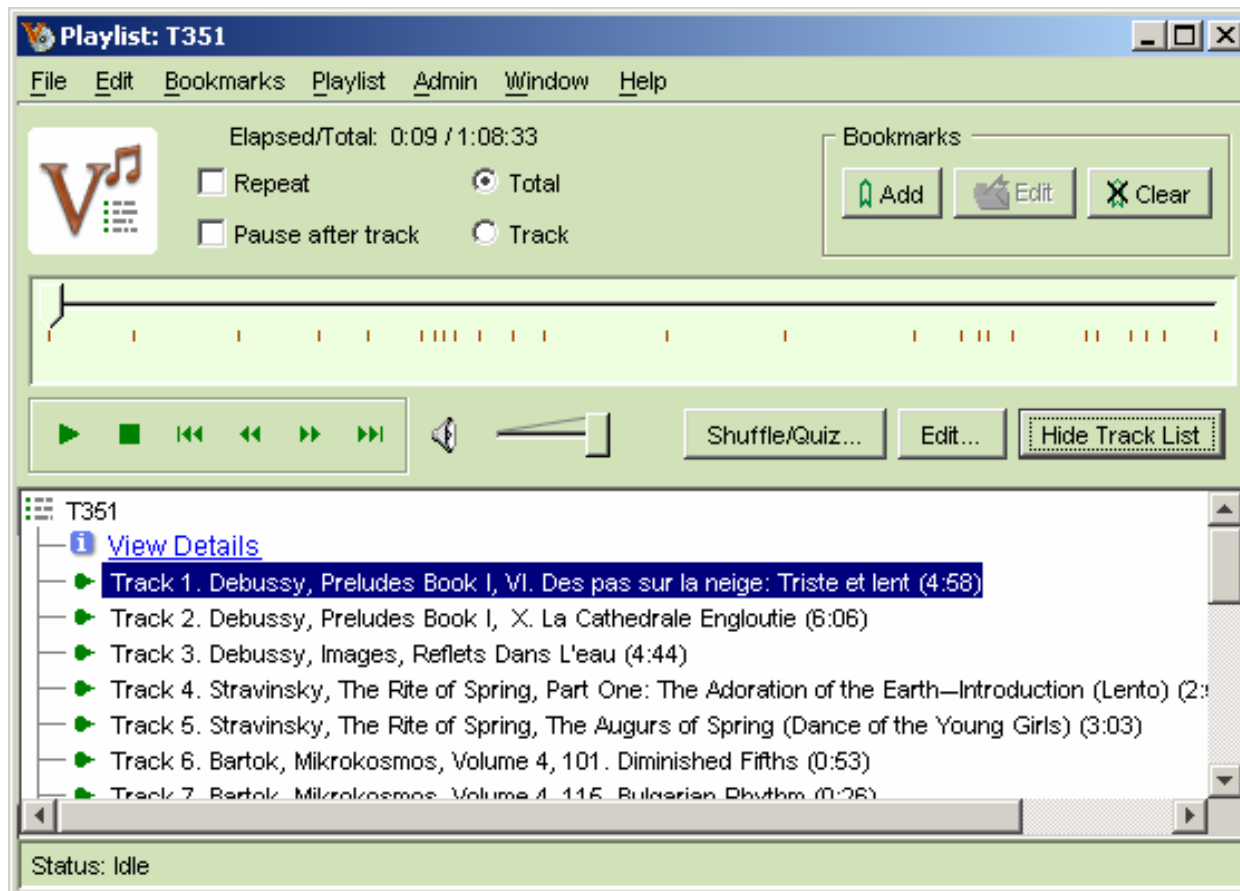
Audio Timeliner



Users can create visual timelines of any audio segment, annotating and labeling the diagram. Audio playback of the timeline displays the successive annotations. Diagram and annotations can be exported to a web page automatically.



Personalized Playlists



Users can create personal playlists from different albums.



With Variations2 you can page through a Beethoven score, listen to Tito Puente, or diagram a sonata, all with content residing in the Variations2 digital library.



Search Window

Variations2 Search Window 1

File Edit Bookmarks Window Help

Basic | Advanced | Keyword | Browse

Creator / Composer Examples: bach, "Johann Sebastian", moz, faure

Performer / Conductor Examples: bernstein, nbc orch, beatle

Work Title Examples: sonat, sym 94, "symphonies, H.I, 94", hymn

Key Media Format

Sort By: Show:

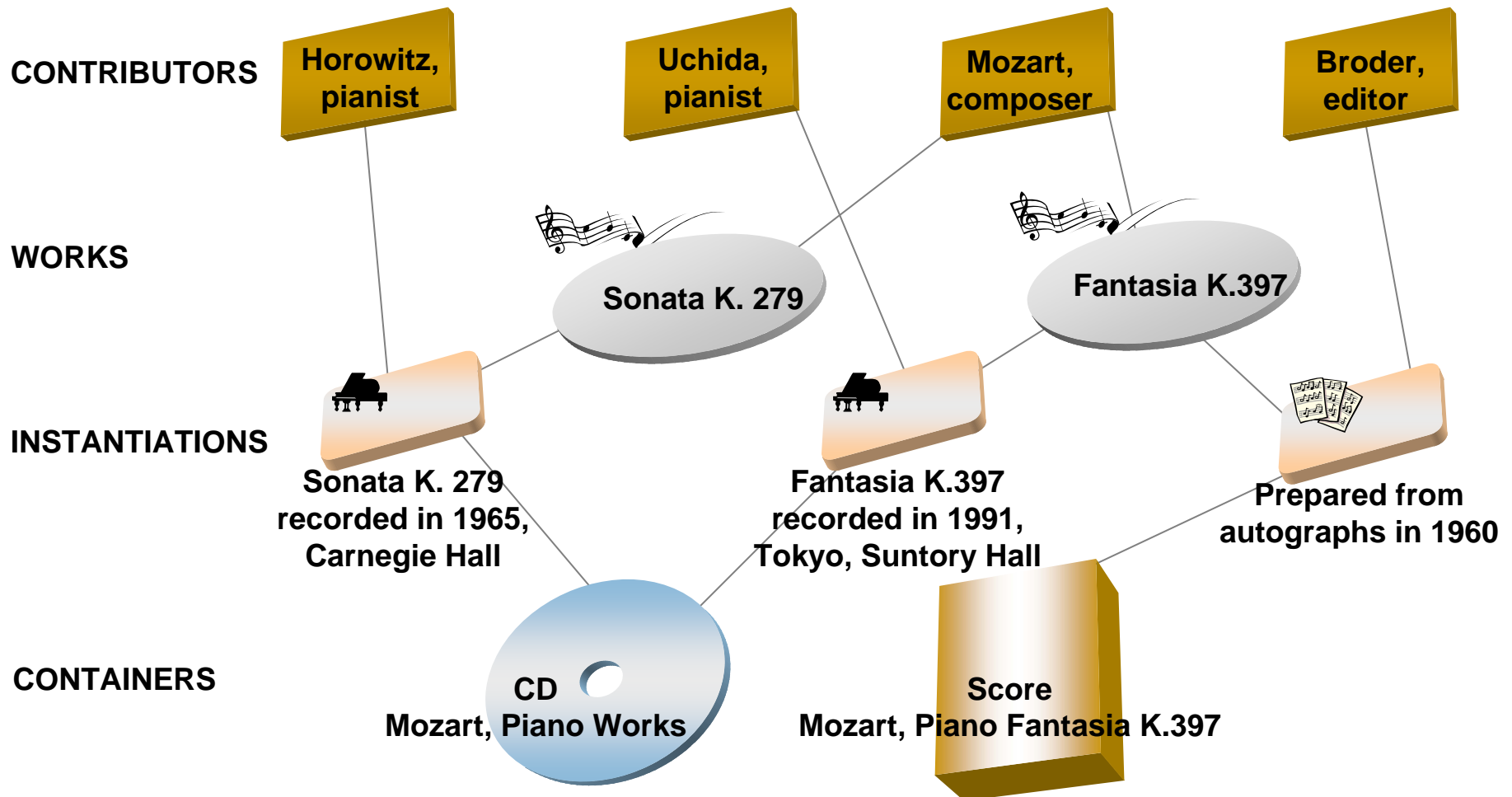
4 occurrences were found with the Work Title matching **Sonatas, piano, no. 17, op. 31, no. 2, D minor** where:
- the Creator matched **Beethoven, Ludwig van**

1. Work Title: [Sonatas, piano, no. 17, op. 31, no. 2, D minor](#)
From Score: [Sonate per pianoforte](#)
Composer: [Beethoven, Ludwig van](#) 1770-1827
Publisher: Ricordi
2. Work Title: [Sonatas, piano, no. 17, op. 31, no. 2, D minor](#)
From Recording: [Stephen Kovacevich \[sound recording\]](#)
Composer: [Beethoven, Ludwig van](#) 1770-1827
Performer: [Kovacevich, Stephen](#) 1940-
Publisher: Philips
3. Work Title: [Sonatas, piano, no. 17, op. 31, no. 2, D minor](#)
From Recording: [The complete piano sonatas on period instruments \[sound recording\]](#)
Composer: [Beethoven, Ludwig van](#) 1770-1827
Performer: [Bilson, Malcolm](#) 1935-
Publisher: Claves
4. Work Title: [Sonatas, piano, no. 17, op. 31, no. 2, D minor](#)

Users can search for music using music-related fields, such as performer, key or media format.



Data Model Example





Cataloging Tools

Edit Stephen Kovacevich [sound recording]

Description Contributors Container Structure Media Objects Instantiations

Container ID: IU/Container/8288 Import MARC from Z39.50 File

Display Title:** Stephen Kovacevich [sound recording] NFI: 0

Other Titles: Edit... (0 existing) Document Type: Sound

Series Titles:* Edit... (1 existing)

Publisher:* Philips

Edition:*

Document Description:* 2 sound discs (1532 min.) : digital ; 4 3/4 in

Publisher/Plate Numbers:* Edit... (1 existing) Format:* CD

Languages:* Edit... (3 existing)

Date of Copyright:* 1998

Date of Publication:* 1998

Place of Publication: [New York]

Notes: Edit... (2 existing)

Location: IU Music Library

Call Number: Copy Number: 0

Condition:

Holding Status:

ISBN:*

MCN/EAN/UPC:* 0028945687728

ISMN:*

Copyright Declaration:* Edit... (1 existing)

Other System IDs: Edit... (2 existing)

Status:* Complete View Record Access Data...

Listen... Delete Record... OK Cancel Apply

Catalogers enter metadata for items, contributors, or works. Data can be imported from existing MARC records.



Content and Metadata Comparison

	Variations	Variations2
Master files	CD-quality WAV	
Delivery files	384 Kbps MPEG-1 layer 2 ("MP2")	192 Kbps MP3 28 Kbps AAC
Metadata	MARC + "track file" stored on filesystem	Complex metadata model in DB2



Delivery Comparison

■ Variations

- ❑ Automated tape library managed by Tivoli Storage Manager
- ❑ Disk cache on IBM RS/6000
- ❑ IBM VideoCharger streaming server
- ❑ Custom Perl scripts on server, Player on client

■ Variations2

- ❑ Apple Xserve G5 with 7 TB RAID disk array
- ❑ Apple QuickTime Streaming Server
- ❑ Client-server Java application



Going Production

- Improve system reliability, stability
- Support out-of-library use
 - Student labs, other libraries, faculty offices, classrooms
 - Download for home use
 - Access control: authentication/authorization, integration with Student Information System (PeopleSoft)
- Develop support model
 - User guide, support processes
- Migrate content
- Migrate metadata
- Validate migration
- Get it done in less than 1 year



Planning for Migration

- Scope out and order new hardware
- Import all metadata into test database
- Design and build import process:
 - Do not require human intervention
 - Must be able to detect problems, and skip to the next item when a problem is detected
 - All output is logged, making it possible to diagnose/correct unanticipated errors



What we started with

- More than 18,000 .wav files in near-line “mass store” tape storage (HPSS)
- MARC records in our catalog
- Text “track files” with minimal bibliographic data and track listings:

Author=Beethoven, Ludwig van, 1770-1827.

Title=Symphony no. 5 in C minor, op. 67 ; Symphony no. 7 in A major, op. 92 ;
Egmont

Copyright=(P) 1979 The Decca Record Company Limited

[Track 1]

WorkTitle=Beethoven, Symphony No.5 in C minor, op.67

TrackTitle=I Allegro con brio

Offset=0

[Track 2]

TrackTitle=II Andante con moto

Offset=432734



Where we needed to end up

- 2 newly encoded QuickTime .mov files for each .wav file-- 192kbps and 28kbps of each "media object"
- Database records for each new CD or Side, plus a "container" record with combined bibliographic information

<Container>

<DisplayTitle offset="0">Symphonies 5 & 7 [sound recording] : Egmont overture</DisplayTitle>

<Structure label="Symphonies 5 & 7 : Egmont overture / Beethoven">

<Item label="CD 1">

<Div label="Beethoven, Symphony No.5 in C minor, op.67">

<Chunk label="Track 1. I Allegro con brio">

<ContentInterval begin="0" end="432734" mediaRef="IU/MediaObject/4061"/>

</Chunk>

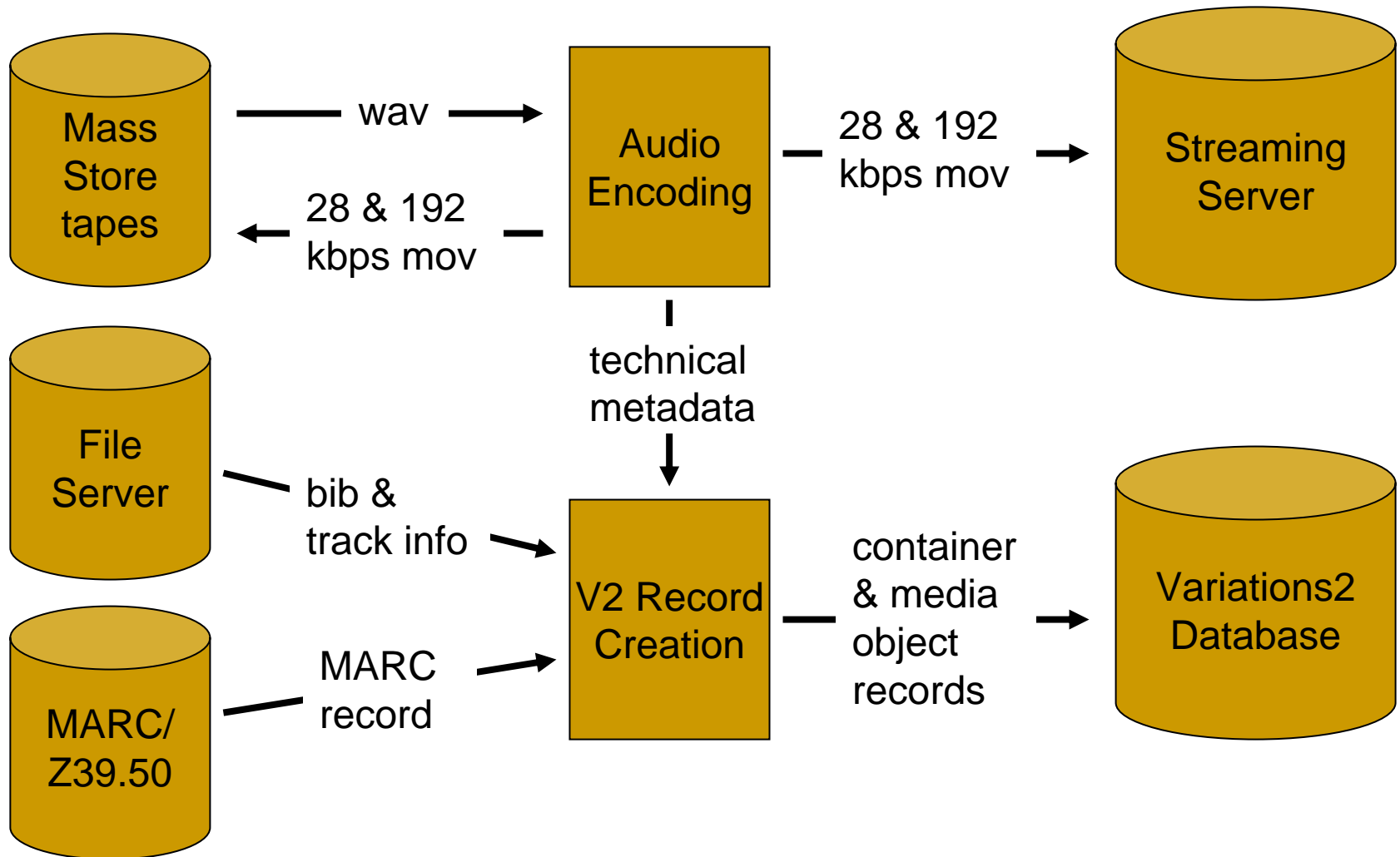
<Chunk label="Track 2. II Andante con moto">

<ContentInterval begin="432734" end="988734"
mediaRef="IU/MediaObject/4061"/>

</Chunk>



Migration process





Initial problems

- Speed of download from tapes in mass store
→ parallelize the process until CPU is always encoding
- LAME version/streaming problems
→ needed to find a version of LAME that worked





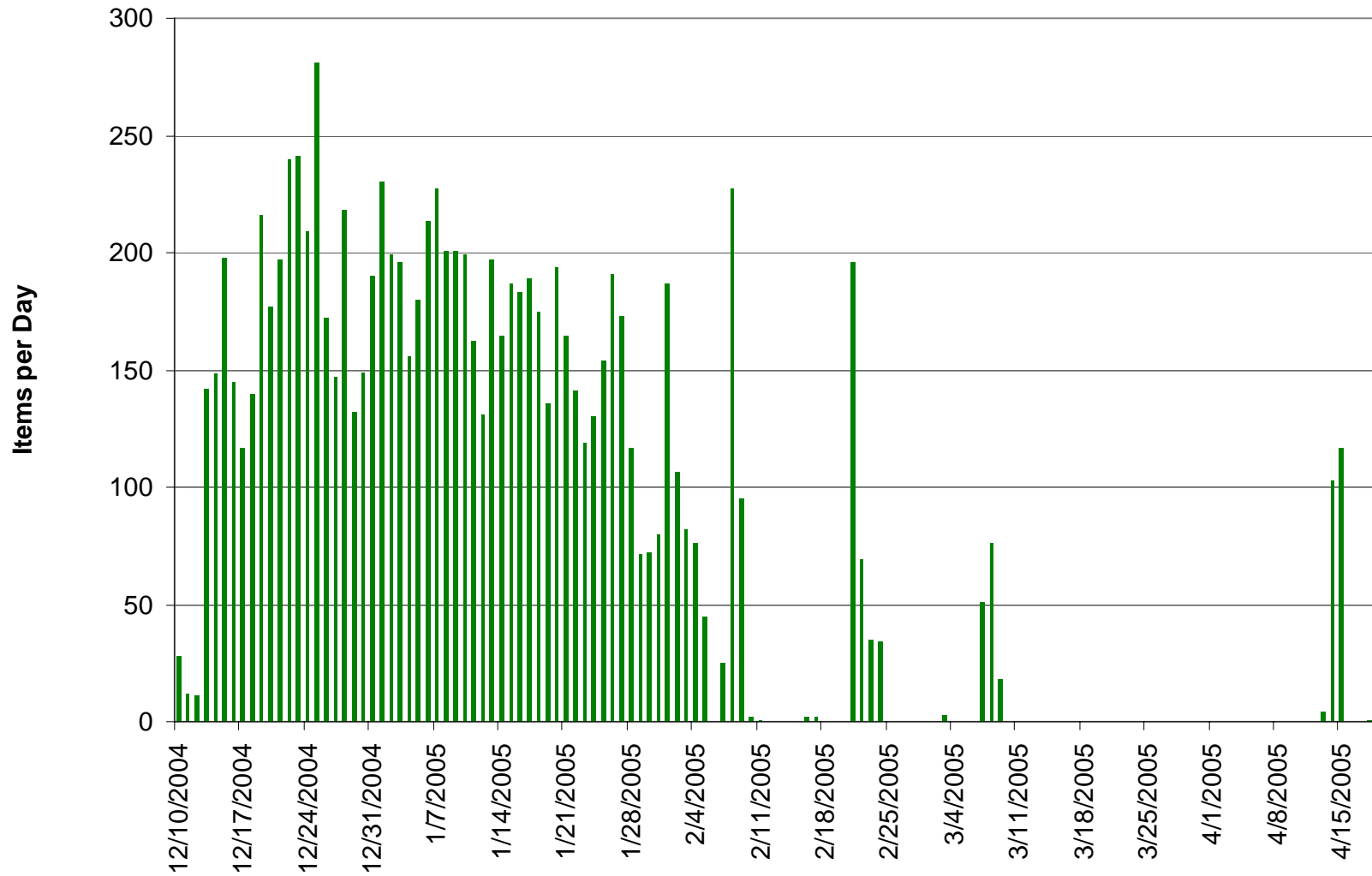
Migration timeline

Goal: Migrate 10,187 items consisting of 18,899 media files.

- **September 2004:** Initial planning started.
- **Mid-December:** New hardware installed, scripts written; migration begins
- **End of January:** First pass finished; over 1200 items had errors.
- **End of February:** Many problems resolved on second or third pass 400 remaining problems.
- **March/April:** Spot checking revealed some items appeared to load correctly, but were not playable. We built new validation tools, and identified 200 additional problem items.
- **May 2005:** System goes into production for users
- **End of Summer 2005:** Remaining failures resolved, just in time for fall semester.



Migration progress





Migration: Audio problems

- Files unobtainable from mass store (cache, system down)
- 465 files missing from mass store, but may be available elsewhere (TSM tapes, drawer tapes, redigitize)
- 225 files with unexpected .wav format
- Some poor quality files





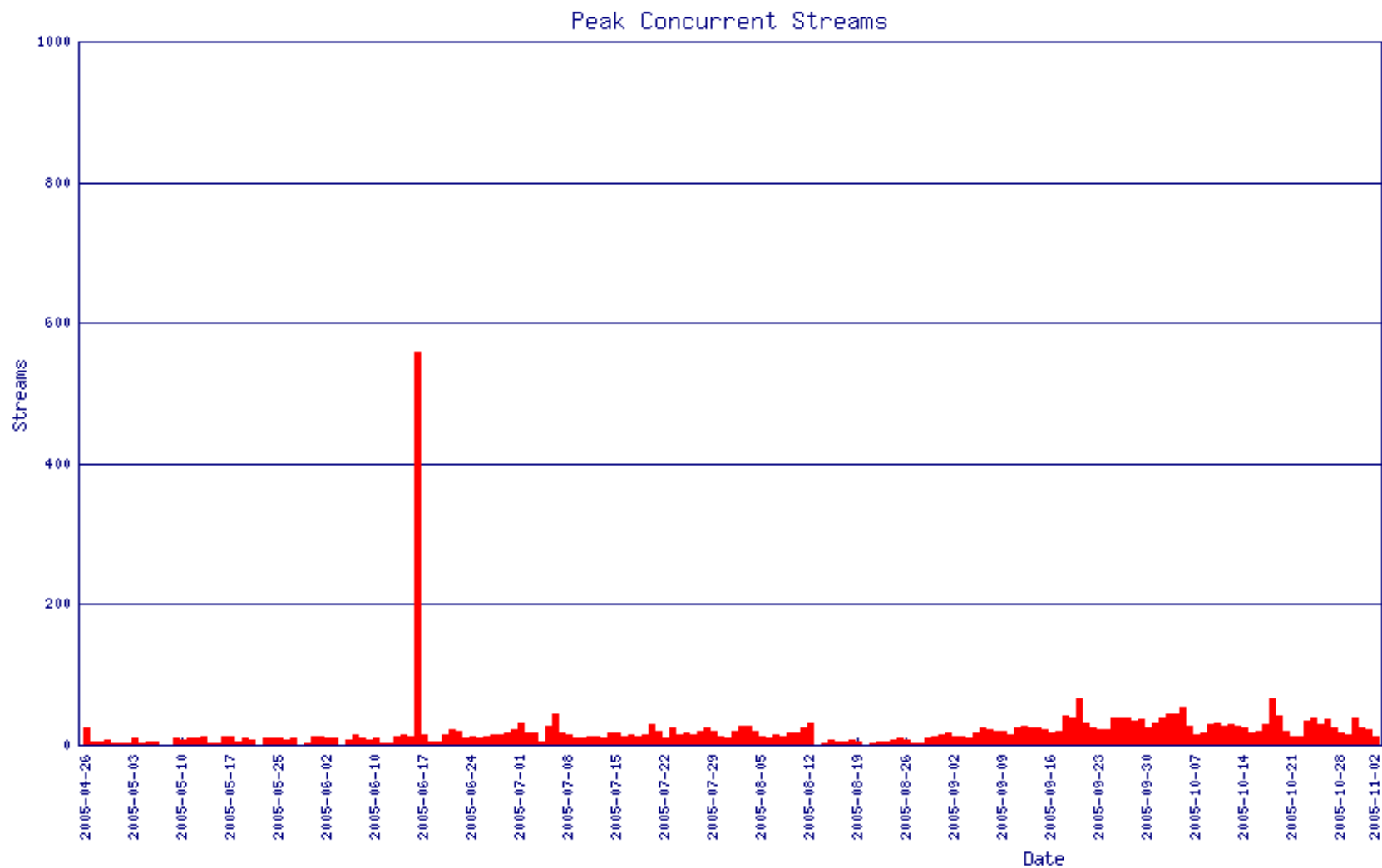
Migration: Metadata problems

- Problems that could be fixed in import scripts:
 - Inconsistent values (dates, copyright)
 - Abbreviations
 - Multiple MARC records

- Problems that required manual intervention:
 - 150 Items with offsets beyond end of file (really an audio problem!)
 - 92 Missing MARC records -- some items were never cataloged; some had been deleted
 - 22 Invalid characters in track file or MARC record
 - 4 Items with “dummy” offsets (10 min, 20 min)
 - 2 Items with more than 26 sides



Load testing





New ingest process

- More constrained vocabularies
- Extensive validation
- Item cannot be published until files have completed processing
- Automatic calculation of ending offsets
- Automatic import of MARC record
- Enhanced tools for creating track hierarchy
- “Listen” button allows just-in-time audio validation

Digitizing AGR0981. Symphonies 5 & 7 [sound recording] : Egmont overture

ID: AGR0981 (IU/Container/6)

Being Edited by: rscherle@IU.EDU

Description

Import MARC from: Z39.50 (slow)

Item Title: Symphonies 5 & 7 [sound recording] : Egmont overture

Format: CD

Copyright Statement: limited, (C) 1994 The Decca Record Company Limited

Notes: Edit... (3 existing)

Location: IU Music Library

Call Number: CD .B414 Ge.17

Copy Number: 0

Condition:

Availability: Restricted access

View Record Access Data...

Status: This record is valid.

Structure

- CD 1 (AGR0981A)
 - Beethoven, Symphony No.5 in C minor, op.67
 - Track 1. I Allegro con brio (0:00:000)
 - Track 2. II Andante con moto (7:12:734)
 - Track 3. III Allegro (16:28:734)
 - Track 4. IV Allegro (21:30:000)
 - Beethoven, Symphony No.7 in A major, op.92
 - Track 5. I Poco sostenuto-Vivace (30:31:000)
 - Track 6. II Allegretto (42:35:534)
 - Track 7. III Presto (51:19:841)
 - Track 8. IV Allegro con brio (60:31:374)
 - Track 9. Beethoven, Egmont Overture, op.84 (67:10:934)
- CD 2 (AGR0981B)
 - Beethoven, Symphony No.2 in D major, op.36
 - Track 1. I Adagio molto-Allegro con brio (0:00:000)
 - Track 2. II Larghetto (10:04:574)
 - Track 3. III Scherzo & Trio: Allegro (21:05:667)
 - Track 4. IV Allegro molto (24:33:374)
 - Beethoven, Symphony No.4 in B flat major, op.60

Title: Symphonies 5 & 7 [sound recording] : Egmont overture

CD/Side

Equipment:

Digitized by: MCE On: 1997-12-15

Add CD/Side ... Replace WAV File ...

Grouping

Add Grouping

Track

Beginning Offset: min:sec:millisec

Ending Offset:

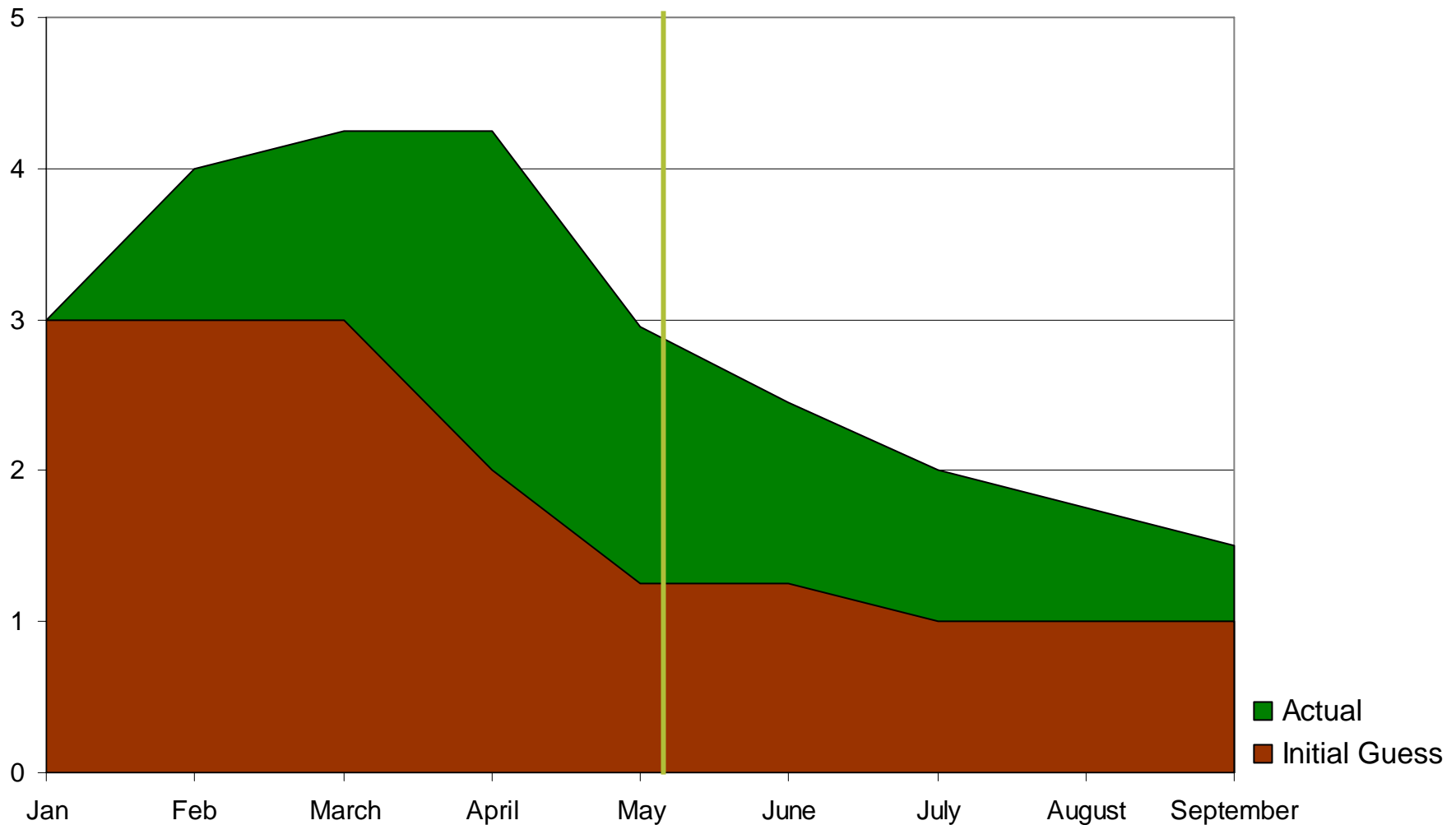
Add 1 track(s) Import Tracks ...

Listen Delete Record... Publish Save & Exit Save Cancel



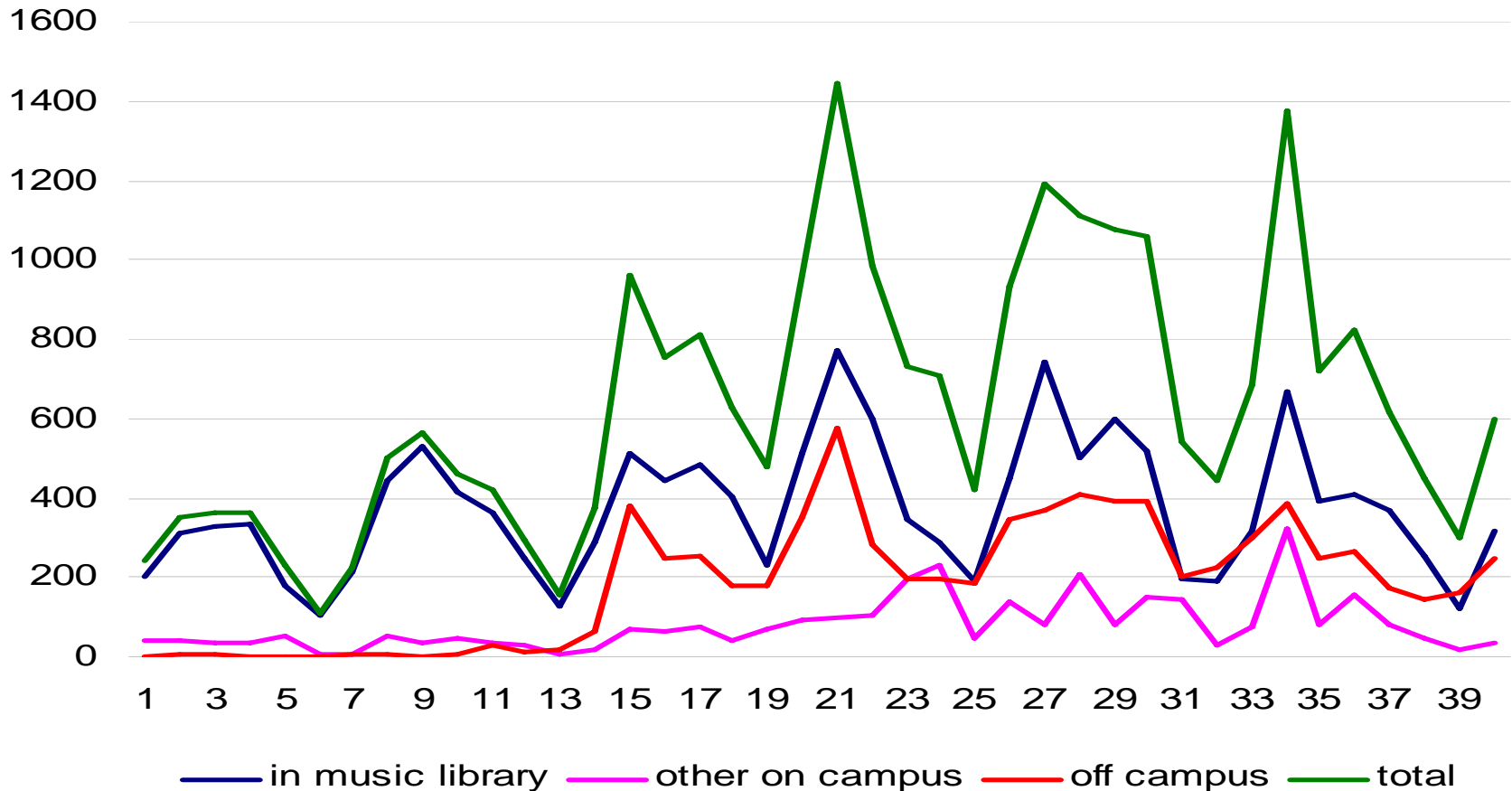
Migration Staffing

17 vs. 26 person-months





Usage



of audio players opened daily, beginning of Fall Semester, 2005
(excluding 2 days where logging broke)



User Reaction

- General user response
 - Mostly silence (a good thing!)
- Home use
 - 961 client downloads by unique network IDs as of 11/1/2005 (776 Windows, 185 Mac)
- Good signs of adoption of new tools (e.g Timeliner, Score Annotation) by students and faculty



Lessons learned

- Start early and have a good plan
- Automate the entire process
- Include validation and allow process to be rerun
- There will be problems with missing or invalid content
- No “one-off” fixes
- Generate good logs and keep them
- Plan for post-migration support
 - There will be cleanup work



Future Plans

■ Variations2

- Continue in production
- Figure out how to fund ongoing support

■ Variations3

- Just funded by IMLS National Leadership Grant
- 3-year project to make a “digital music library in a box” that can be deployed at other institutions
- Initial partners: Ohio State, New England Conservatory, Bryn Mawr/Haverford/Swarthmore Tri-College Consortium
- Use own content, but also integrate licensed content from vendors
- Explore options for metadata creation



For More Information

- <http://variations2.indiana.edu/>
- Jon Dunn: jwd@indiana.edu
- Ryan Scherle: rscherle@indiana.edu



Disclaimer

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