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                Wells B.; Moodie, Michael M.; Redmond, Linda
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ABSTRACT
                This monograph summarizes the status of the Library of
Congress's National Library Service (NLS) Talking Book Digital Conversion
Project, a project to offer digital sound reproducers and its library
materials in digital format beginning in 2008. Following an introductory
section describing National Library Service services and users and the
background of the project, a section details 20 steps to this next generation
of NLS technology broken down into a design phase (5 years) and an
implementation phase (9 years). The next section summarizes work accomplished
to date focused on: (1) building standards and creating management tools; (2)
creating a digital collection; and (3) designing a player. The following
section provides more information on the nine tasks necessary to implement
the use of digital talking books. The final section describes the Web Braille
program which uses digital Braille, noting that digital files of NLS-produced
Braille materials can now be downloaded from the Internet. (Contains 58
references.) (DB)

Digital Talking Books

Progress to Date

May 2002

National Library Service for the Blind and Physically Handicapped • The Library of Congress

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Digital Talking Books:
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John Cookson
Frank Kurt Cylke
Judith Dixon
Wells B. Kormann
Michael M. Moodie
Linda Redmond

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Digital Talking Books: Progress to Date

Prologue

Background

On March 3, 1931, Congress authorized the Library of Congress to initiate the Books for the Adult Blind Project. On July 1 of the same year, the first braille titles for the collection were procured. In 1932 "talking books" were being developed for the Library of Congress by the American Foundation for the Blind, and a sound reproduction machine was produced in 1933. Free mailing of talking books was approved by Congress in 1934, and by 1935 the Library of Congress talking-book program was in full operation.

From its 1931 mandate to serve blind adults, the program was expanded in 1952 to include children, in 1962 to provide music materials, and again in 1966 to include individuals whose other physical impairments prevent their reading regular printed materials. From an initial appropriation of $75,000 to be used for talking books, the national free library program's funding has grown to $49.788 million in fiscal year 2002.

Today under a special provision of the U.S. copyright law and with the permission of authors and publishers of works not covered by the provision, the National Library Service for the Blind and Physically Handicapped (NLS)

within the Library of Congress selects and produces full-length books and magazines in braille and on cassette. Reading materials are distributed to a cooperating network of regional and subregional libraries, where they are circulated to eligible borrowers. Reading materials and playback machines are sent to borrowers and returned to libraries by postage-free mail. U.S. citizens living abroad receive service directly from NLS in Washington, D.C.

Funding

The NLS program is funded annually by the U.S. Congress. Regional and subregional libraries receive funding from federal, state, and local sources. Under an additional appropriation to the U.S. Postal Service, books and materials are mailed as "Free Matter for the Blind or Handicapped." The combined expenditure for the program exceeds $160 million annually.

Eligibility

Anyone unable to read or use standard printed materials as a result of temporary or permanent visual or physical limitation may receive service. In 1979, a survey sponsored by the Library of Congress found that two million persons with some type of visual impairment, and another one million with physical conditions such as paralysis, missing hands or arms, lack of muscle coordination, or prolonged weakness may be eligible to register for the service.

Book and Magazine Materials

NLS selects books on the basis of their appeal to a wide range of interests.
Bestsellers, biographies, fiction, and how-to books are in great demand. Books
in fifty-five languages constitute the collection. Registered borrowers learn of
books newly added to the collection through two bimonthly publications.
Using a union catalog available in computerized form, eligible readers have
access to the entire NLS book collection as well as the resources of
cooperating agencies worldwide.

Consumer Relations

A consumer relations office maintains regular contact with consumer groups
and individual users of the program to identify and resolve service problems
and to ensure that users' needs are met. Consumers contribute to program
development by participating in surveys, evaluating new equipment, and
serving on advisory committees. Those with a technical aptitude are also
welcome to participate in audio-book-development discussions.

Research and Development

The NLS research program aims to improve the quality of reading materials
and playback equipment, control program costs, and reduce the time required
to deliver services to users. Recent research activities include (1) an
evaluation of the braille and audio magazine program, (2) the development of a

standard for digital talking books (DTBs), (3) a study of the application of digital techniques to NLS recorded material, and (4) the thorough investigation of recent and potential audio technologies for use in the program. The DAISY (Digital Audio-based Information System) Consortium is working on many of the same issues surrounding the development of digital talking books. NLS is closely monitoring their work, participating in key committee meetings, and has included DAISY members in NISO (National Information Standards Organization) working groups.

Users

In FY01, 695,907 users read braille and audio books and periodicals. Of that number, 663,781 read both books and periodicals on audio cassettes and discs.

Audio Book Reading

Playback equipment is loaned free to readers for as long as they continue to borrow recorded materials provided by NLS and its cooperating libraries. Talking-book machines are designed to play disc books and magazines recorded at 8 rpm and 16 rpm; cassette machines are designed for cassettes recorded at 15/16 ips and the standard speed of 1-7/8 ips on 2 and 4 tracks. A reader with very limited mobility may request a playback machine with a remote-control unit. A hearing-impaired reader may be eligible for an auxiliary amplifier to use with headphones. A cassette machine designed primarily for persons with limited manual dexterity is available, as is one that

plays both discs and cassettes. The inventory of active audio cassette machines is 713,082. In addition there are 167,550 disc players.

Available audio and braille reading materials listed in the NLS union catalog exceed 390,000 audio titles in approximately 21 million copies. Of these 247,000 are audio files.

Future

Ever changing audio technology requires that NLS always be aware of developments in the field but prepare carefully for any desired or required systemic changes. Because any major change in the program will affect nearly three million eligible users and require several hundred million dollars in investment, all proposals for change must be carefully reviewed and evaluated.

Usefulness, cost effectiveness, thoughtful stewardship, and educated oversight are the major criteria by which any audio reading program may be judged. Library of Congress/NLS professional staff work to apply these criteria to all facets of our program, with regular assistance from appropriate public- and private-sector experts.

NLS senior staff describe in detail in the following pages the Library of Congress/NLS approach to conversion to digitally based audio technology.

They strive to be thorough, imaginative, and open to influence by appropriate audio-technology developments outside NLS.

At NLS managers, engineers, technicians, librarians, and users contribute varying perspectives and talents to the challenge of developing the best possible talking-book program for the twenty-first century. Their combined efforts will result in a proposal for a Talking Book Digital Conversion Project, a project to find the best means of developing another cost-effective, user-friendly library program.

At this writing the National Library Service for the Blind and Physically Handicapped has determined that digital service will begin to be offered in April 2008. At that time 20,000 retrospective audio titles will be available in a digital form, with full digital production of current titles to commence in 2004. Thus, there will be more than 8,000 of these also available in 2008.

NLS plans to have 50,000 digital sound reproducers available in 2008, with approximately 50,000 produced each year thereafter.

In sum, the NLS staff works diligently to initiate a digital audio program in six years. The following articles will detail plans to advance this goal.

Sources

For a perspective on past and current Library of Congress audio activities for blind people, the following NLS publications may be examined: *Facts: Books for Blind and Physically Handicapped Individuals* 2002, the NLS factsheet; *That All May Read: Library Service for Blind and Physically Handicapped People;* and *Talking Books: Pioneering and Beyond,* by Marilyn Majeska. Many comments in preceding paragraphs first appeared in these sources. (Full publication information may be found in the bibliography that follows on page 43.)

Frank Kurt Cylke
Director
National Library Service for the Blind
   and Physically Handicapped

Twenty Steps to Next-Generation NLS Technology

Summary

When do we change the system?

- When enough patrons demand it, AND
- When digital methods are cheaper than the current cassette-based system.

What do we change to?

- Patrons and providers tell us with a standard and via consultation.
- We use new digital technology to best realize affordable expectations.

How do we know it's better?

- We offer software models of books and players for patron and provider appraisal.
- We use software modeling to compare all system costs, digital versus analog.

Background

This paper outlines steps to take in the design and implementation of next-generation NLS technology. Two factors motivate change: cost and patron expectations. As digital methods supplant analog in the consumer entertainment market, technology approaching obsolescence, i.e. cassette tape, may become expensive, and patrons are likely to demand features available with digital technology. Access to a future system will be via two routes: electronic

communications and postal delivery of players and recorded material. This summary focuses on replacing about 700,000 cassette-tape players with digital players, an undertaking in which there are major cost and risk factors. Before and during replacement of players, software-only players and establishment of a software infrastructure are planned. We see delivery at the outset via mass-duplication at contractors' sites, and duplication-on-demand at specialized centers, followed by postal delivery to patrons. In the long term, however, we see media inexpensive enough to allow postal delivery of disposable units containing multiple titles.

To the extent that a list format allows, I present the steps in a roughly chronological order of dependency. Many activities, however, occur in parallel. I offer the three-question summary above in deceptively simple terms, hoping to interest the reader in perusing the outline below to find out how complex the process really is. The key to success is to manage risk at every step by pursuing as many options at one time as the budget allows. To distinguish primarily between low-risk and high-risk activities, I divide the 20 steps into two sequential phases: design and implementation. (In this paper "digital talking book" (DTB) also refers to magazines.)

Design phase: 11 steps, 5 years, system approach, low cost, low risk, high visibility.

1. Define and prioritize digital talking-book (DTB) features.
   A. Propose mandatory, desirable, and specialized categories.
   B. Use the National Information Standards Organization (NISO) process involving community of users, librarians, advocacy groups, manufacturers, producers, international borrowers, and lenders.

2. Simulate a DTB player using a personal computer.

    A. Test feasibility and patron interest in specific features.

    B. Discover and refine user-control preferences.

    C. Monitor and test parallel efforts.

3. Develop a computer-based, life-cycle, cost-analysis (LCC) model for the NLS system and for candidate digital systems.

    A. Build an historical cost data set through annual updates of the model (mandated in NLS LCC policy).

    B. Examine and forecast long-term trends.

    C. Estimate critical decision points.

    D. Determine the cost range where DTB adoption is advisable.

4. Design and build prototype digital-collection archiving and access systems, and stock with legacy and new-production titles.

    A. For legacy titles, write or buy software to convert familiar NLS analog products to NISO-compliant digital files, select titles, and convert them to NISO format.

    B. Design and implement a system for short-term storage of digital review copies.

    C. Design and build a local area network to support in-house production of digital books. Expand to support experiments that provide access to a large collection of digital works.

    D. Design and build a long-term archive of DTB files.

5. Select an acceptable copyright protection system.

    A. Consider a system approved for consumer entertainment.

    B. If A is not acceptable, design and propose a minimum-cost acceptable system, in consultation with publishers.

    C. Obtain NISO concurrence, test decoding at three times real-time.

6. Develop computer software for DTB production and presentation.

    A. Develop expertise with the digital audio recording process.

    B. Build software "authoring tools" to enable DTB production by volunteers and professionals.

    C. Begin digital mastering with concurrent text linking in NISO format.

    D. Compare concurrent audio/text linking with software linking.

    E. Build modular playback software for multiple platforms.

    F. Establish a DTB software facility for maintenance and configuration control.

7. Develop software to test conformance of players and DTBs with the NISO standard.

    A. Develop a suite of sample DTBs that exercise and demonstrate player features.

    B. Develop software to test and certify NISO compliance of DTBs.

8. Examine distribution methods from a systems perspective, focusing on cost and convenience.

    A. Design mixed electronic and media delivery systems such as:

        • Postal delivery of media, mass-duplicated at contractors' sites or duplicated on demand at specialized facilities.

- Electronic delivery direct to patrons from regional centers and, for special cases, from a national center.

B. When considering cost, include regional production, storage, and packaging.

C. When considering convenience, include ease of operation by patrons, librarians, machine-lending agencies (MLAs), volunteer producers, and international borrowers.

D. In an options paper express technological choices. Use the cost-analysis tool developed in step 3.

9. Select or design players that best meet the NISO DTB standard.

A. Where feasible, use components of popular entertainment hardware to control cost and promote acceptance.

B. Design and test user interfaces required for NISO DTB compliance.

10. Build multiple prototype players.

A. Evaluate and compare each to find user preferences.

B. Evaluate and compare each to assess effects on regional libraries, MLAs, postal delivery, manufacturers, duplicators, contract studios, volunteer studios, and repair organizations.

11. Design and implement prototype testing to determine life-cycle cost.

A. Predict theoretical reliability (mean time between failures), and test for actual performance; identify vulnerable components.

B. Develop a maintenance plan that specifies:

- Which components can be repaired;

- Which components must be replaced;
- Range, depth, positioning, and value of
  repair parts.

C. Predict life-cycle cost (dollars per patron per year) and forecast the pay-back point, using the cost model developed in step 3 above.

Implementation phase: 9 steps, 5 years, high risk, high cost, high visibility.

12. Narrow player and media choices by selecting via decision matrix.

A. For the players chosen, refine cost estimates and design of packaging, storage, and maintenance. Get postal approval for packaging.

B. For the chosen media refine cost estimates and design of packaging and storage. Get postal approval of packaging.

C. Consider safety, pest control, and pilfering.

13. Design and test catalog-access and ordering systems that interested patrons will use.

A. Consider patron privacy and library personnel resources.

B. Automate updated catalogs from NLS.

14. Design and test circulation and inventory-management software for libraries, MLAs, and NLS.

A. For audit, build in self-identification of players.

B. Build in statistical reporting that ensures patron privacy.

15. Design and test software for international lending.

A. Ensure that international copyright requirements are met.

B. Design and test software for conversion of books to international formats.

C. Test electronic and media delivery methods.

16. Evaluate player manufacturers and communications providers.

    A. Begin the engineering, manufacturing, and development (EMD) phase.

    B. Qualify manufacturers who have sufficient production capacity available.

    C. Establish methods to guarantee the best value in communications.

    D. Award manufacturing and communications contracts.

17. Operate digital and cassette systems simultaneously.

    A. Scale back production of cassette book machines.

    B. Produce digital players for field evaluation.

18. Full-scale production and deployment of digital equipment.

    A. Set up QA process at manufacturers.

    B. Set up QA process at warranty repair and volunteer repair facilities.

    C. Cease production of cassette players, but for ten years continue repair.

19. Establish a method for continuous patron evaluation of the new system.

    A. Update player software in response to patron preferences and library support needs.

    B. Establish a maintenance process for player and software documentation; include configuration control.

20. Establish a method for continuous evaluation of infrastructure.

    A. Include librarians, MLAs, international institutional borrowers, and lenders.

    B. Include configuration control.

John Cookson

Head, Engineering Section

Work Accomplished to Date

NLS has been working on the development of a digital talking book (DTB) system on many fronts since the 1998 publication of *Digital Talking Books: Planning for the Future*. The following section describes NLS's progress in those efforts, which are grouped here into three categories: Building Standards and Creating Management Tools, Creating a Digital Collection, and Designing a Player. Each project discussed here includes a reference to the step(s) under which it falls in the Twenty Step plan laid out earlier in this document.

1. Building Standards and Creating Management Tools
ANSI/NISO Standard for Digital Talking Books (Step 1 in "Twenty Steps")
In December 2001, members of the National Information Standards Organization (NISO) voted to approve "Specifications for the Digital Talking Book" as an American National Standard. On March 6, 2002 the standard was approved by the American National Standards Institute (ANSI) as ANSI/NISO Z39.86-2002.

The standard is the result of a nearly five-year effort by an international committee representing a broad range of stakeholders working to provide alternative-format materials to print-disabled readers. NLS led the effort begun in 1997 all the way to final adoption of the standard. It chaired the NISO Digital Talking Book Committee, organized and ran the meetings, created and managed work groups, wrote much of the

standard from committee input, and edited the entire 125-page document.

In this complex effort NLS's partners were the Association of Specialized and Cooperative Library Agencies (of the American Library Association); American Council of the Blind; American Foundation for the Blind; American Printing House for the Blind; Blinded Veterans Association; Canadian National Institute for the Blind; the DAISY Consortium; Hadley School for the Blind; Assistive Devices Industry Office – Industry Canada; IsSound Corporation; National Federation of the Blind; Recording for the Blind and Dyslexic; Talking Book Publishers, Inc.; Telex Communications, Inc.; VisuAide, Inc.; and the World Blind Union.

The ANSI/NISO standard is built on specifications and requirements formulated by blind and visually impaired users, who were heavily involved in every aspect of the development. During the process, the full committee met eleven times across the United States and Canada, and smaller working groups met countless times both in person and in conference calls and e-mail. As far as possible, the standard was built on existing standards and specifications. Thus programming skills and software tools developed for other purposes can be applied to the DTB world.

The standard is important because it makes possible a powerful, flexible reading system that adapts easily to different types of documents and different users. It provides a framework under which a person or agency can produce DTBs ranging from a very simple novel to a long, complex reference work or textbook. And it allows users great flexibility in how they read those DTBs – some will want a straight linear reading experience, while others will need sophisticated functions, among them random access to sections of the DTB, the flexibility to turn on or off selected elements (e.g., footnotes), and the capability to set bookmarks, highlight portions of text, or do

keyword searches. So this single standard addresses the needs of a variety of agencies serving users with a wide range of reading needs.

A DTB is a collection of electronic files arranged to present information to the reader via alternative media. The most common medium, of course, will be human speech. However, a DTB produced in accordance with the ANSI/NISO standard can include a file that presents the contents of the document in text form, thereby permitting output via synthetic speech, refresh able braille, or visual display (e.g., large print). Because of the large expense involved in creating text files, NLS is not likely to produce many DTBs incorporating them. However, the capability is there when needed.

An aspect of the standards effort worthy of mention is the NISO /DTB committee's collaboration with the DAISY (Digital Audio-based Information System) Consortium, an international body established to develop specifications and tools for the production and delivery of DTBs. When the NISO committee began working, there was fear that it was trying to displace the DAISY group. DAISY was invited to provide representatives to the NISO committee and did so, greatly expanding the committee's international reach. It became evident very soon that sharing resources would benefit both groups.

It was agreed that the NISO committee would focus on an XL-based standard that would provide capabilities not possible in DAISY's HTML-based specifications. (XL is becoming the successor to HTML as the language of the World Wide Web.) The expertise DAISY developed in creating the first DTB specifications was invaluable to the NISO work. As stated in the acknowledgments section of the standard: "It is no

exaggeration to state that without their groundbreaking efforts and their ongoing contributions to Committee work, this standard would not exist in anything like its current level of sophistication."

Life-Cycle Cost-Analysis Model (Step 3)

In September 2000, NLS took delivery of a computer-based cost-analysis system that allows comparison of costs for the current audio cassette program with costs likely in the deployment of a new technology. Produced by the Northrop Grumman Corporation under contract to NLS, the Life-Cycle Cost-Analysis Model is being used by NLS to compute system costs associated with a variety of DTB distribution scenarios.

The model looks at all costs expected to be incurred in the production, distribution, and maintenance of audio books, magazines, and playback machines by NLS and its multistage centers, and the network of cooperating libraries. It computes comparative costs for a ten-year period of both the current program and any alternative scenario.

The model is a dynamic application running within a spreadsheet program. It was developed by an interdisciplinary team of NLS personnel thoroughly knowledgeable of the current audio-book system. NLS engineers, librarians, managers, and production analysts met with a contractor team that included cost analysts and software engineers. The joint team identified 101 distinct data elements, along with their interrelationships. For NLS costs, exact expenditures are captured for the "current year," which rolls forward every twelve months. For the network, the basis was formed by the exhaustive study of activity costs conducted in 1989-1990. Network costs were brought forward using standard inflation factors published by the U.S. Commerce Department.

The model provides a way to model alternatives rapidly. Costs can be expressed in terms of dollars per reader per year, dollars per circulation, etc., or they can be reported as year-by-year totals over a ten-year period, reflecting the effects of anticipated inflation. The model will rapidly recompute the effects of say, halving the cost of the book media or doubling the reliability of the playback machine.

The model, because it uses many estimated values, is not expected to produce precise values for overall system costs. Rather, the model will be used not only to develop comparisons between alternatives but also to determine which factors have the greatest effect on overall costs. It will also ensure that NLS and the network examine all the elements that contribute to the total cost of a system and that none are overlooked.

As part of their contract, Northrop Grumman compared actual costs of the current analog cassette system with projected costs of a CD-ROM-based system. This exercise, which included NLS staff in the gathering and analysis of data, demonstrated how the tool would be used and gave NLS insights into its power and flexibility. The scenario indicated, however, that the CD-ROM alternative would be considerably more expensive than the cassette system, largely because of the higher costs to purchase and maintain CD-ROM players.

Digital Long-Term Planning Group (Step 8)

During 2001, NLS established a group made up of consumer representatives and network librarians, who, along with appropriate NLS staff, will contribute to planning for the deployment of digital information technology throughout the network in years to come. In order to guarantee continuity and responsiveness to ever-changing

prospects, the group will likely meet once or twice each year through the next five years. It held its first meeting at NLS October 24-26, 2001. While the group's mandate covers a range of subjects related to digital technology, at least half of its time will be devoted to planning the implementation of a digital talking-book system.

At the first meeting, NLS presented detailed background on current NLS DTB initiatives. The presentation described progress in the development of the DTB standard, production of new digital recordings as well as selection of analog titles to be converted to digital format, development of a PC-based DTB player, identification of critical design issues for a DTB system, and analysis of digital distribution options (such as CD-ROM, Internet, or solid-state memory). The group then discussed in detail three possible scenarios for distributing DTBs on solid-state memory cartridges.
In the discussion of distribution scenarios, NLS introduced the Life-Cycle Cost-Analysis Model to the committee, reviewing some of the previously mentioned 101 elements and demonstrating how the model can be used. The group was established partly to involve members in developing data values for network costs to be used in the cost-analysis model, ensuring that NLS develop figures that are as accurate as possible. Another key reason for bringing the group together was illustrated during distribution discussions, as network and consumer representatives brought forth issues critical to their respective communities. This group will play an important role in the design of the digital talking-book system, ensuring, in concert with NLS, that it is cost-effective and also meets the needs of libraries and consumers alike.

2. Creating a Digital Collection

Digital Recording (Steps 6A and 7A)

The NLS recording studio has been experimenting with a variety of digital recording systems for several years, an effort serving a number of purposes. First, it has enabled NLS staff to maintain an understanding of the kinds of available software and hardware as well as the trade-offs associated with each. Second, NLS studio staff gained experience with features that are entirely different in the digital domain from in the analog world – notably working with PCs instead of the standard five-button interface on open-reel recording decks, and learning how to manage the very large audio files demanded by a DTB. Third, the effort has offered to the recording studio the chance to begin developing a collection of digital recordings. And fourth, it has provided vital first-hand information to NLS staff and contractors who are designing a low-complexity digital recording system (described below) for network libraries.

Two of the three studios in the NLS recording complex have been outfitted with digital recording equipment. The staff, many of whom were not experienced PC users, have learned to work efficiently in the digital environment. At this point, the studio is producing only digital master recordings; it is not creating fully-functional DTBs. Simple and efficient-to-use software capable of producing ANSI/NISO-compliant DTBs will be installed once it is available, and the staff trained on the new aspects of DTB production.

Beginning with *The Complete Fairy Tales of Charles Perrault*, the studio has digitally recorded over 50 titles to date. Some of these have been added to the current cassette collection, while some have also been developed into DTBs using a combination of

experimental automated tools and manual efforts. These test DTBs, selected because they include a wide variety of structures and such text elements as footnotes, indexes, glossaries, etc., have been used with the PC-based player (described below) in order to test the player's functions as well as to demonstrate the feasibility of different features. NLS audio-book contractors began recording a portion of their assigned titles digitally in fiscal year 2002. NLS contracts stipulate that at least 10 percent of the titles produced in 2002 be recorded digitally. In 2003, contracts will require half of all titles recorded to be in digital form; in the following year, all new titles will be recorded digitally. For the next several years at least, all titles–whether recorded in digital or analog format–will continue to be distributed on analog cassette. However, the digital recordings will be available for distribution when NLS begins to circulate books on a digital medium.

Low-Complexity Mastering System (Step 6B)

NLS has developed specifications for a recording system especially designed for network libraries' use. After reviewing a broad range of digital recording software products and gaining experience with several of them in our studios as described above, NLS staff concluded that no existing digital audio recording system meets NLS requirements for efficiency and quality.

The majority of such digital audio systems are designed for recording music, are highly complex, and assume that following a recording session considerable time will be spent editing the sound track(s) to produce a finished product. In contrast, a recording system designed for library use must be straightforward and easy to use, making efficient use of the narrator's and monitor's time. NLS staff's specifications for the

Low-Complexity Mastering System are based on analysis of existing commercial and talking-book-specific systems, discussions with both contractors and network library staff, and focus-group sessions with NLS studio staff. Development of the system is underway and a prototype has been installed in the NLS studio.

Experimental DTB Production Tools (Steps 6B and 6D)

As mentioned above, NLS will only produce a limited number of DTBs that include a full text file. However, the presence of the text file will greatly increase the usefulness of some titles, making cookbooks or reference books, for example, easier to read and richer sources of information. Producing full-text/full-audio DTBs can be a complex process. It requires the production of a very detailed synchronization file linking the audio file to the text file. In one approach to creating this file, the monitor must perform frequent, repetitive tasks during the recording process. To free the monitor of this burden, NLS is experimenting with software that automatically captures the necessary timing information (the times at which each word in the text file begins and ends) and then generates the synchronization file. NLS works with several different alignment tools (software that captures word timing) and has developed a program that automatically generates the synchronization file—an approach that is still experimental but shows great promise for simplifying the production of full-text/full-audio DTBs.

Converting Analog Titles to Digital (Step 5A)

The current analog cassette collection contains over 50,000 titles. Some portion of this collection will need to be converted to digital format in order to be available to readers when audio books begin to be distributed on a digital medium. What proportion of the collection should be converted? To answer that question, the NLS Collection

Development Section (CDS) staff has begun a multiyear analysis of the cassette collection, identifying the titles appropriate for conversion.

In 2001, CDS chose an initial 1,000 cassette titles to be transferred from analog to digital format. Selection of these titles created a cross-section of the cassette collection, with genres selected in proportion to their representation in the full range of cassette titles. For this first group, CDS selected titles it judged to be of most enduring value. The process will be repeated in 2002 and subsequent years, with the annual number of selected titles increasing as needed to meet production goals. This approach assures that whenever NLS begins to convert titles to digital format, a broad, representative range of titles will be available to readers.

3. Designing a Player
PC-Based DTB Player (Step 2)

NLS has designed and programmed a software-based digital talking-book player that runs on a personal computer.

This software serves several purposes. First, it enables NLS to test whether concepts developed during the standards process actually prove to be useful. For example, do navigation techniques really work as planned?

Second, it helps NLS to determine whether production tools are creating DTBs that comply with the standard. (Conversely, the sample DTBs help identify bugs in the software-based player.)

Third, and most important, the PC-based player allows NLS to experiment with different user interfaces; that is, the control and command arrangement enabling the user to read a digital talking book. The software is written in a manner allowing quick and efficient updates in response to user suggestions. It is likely that NLS will eventually develop two kinds of DTB player—a basic player designed for linear reading and a more sophisticated device aimed at users wishing to randomly access or efficiently navigate complex documents. At this writing, the software player includes most of the functions expected in the basic player, among them play/pause; jump forward or back by paragraph, section, or chapter; set and go to bookmarks; and follow links (e.g., jump directly from the table of contents to the fifth article in a magazine). Several additional features planned for the advanced player are also present in the player, such as the ability to highlight segments of text and "turn off" selected types of material (such as footnotes), so that the player automatically skips over them. The basic functions of the software-based player were programmed by NLS staff and later enhanced by a software firm under contract to NLS.

Player Design Contest (Step 9)

NLS has teamed up with the Industrial Designers Society of America (IDSA) to sponsor a contest for industrial design students, challenging them to design the shell of a digital talking-book player. Students at any of the 55 IDSA-accredited industrial design schools were eligible to participate in the January 1-May 15, 2002, contest. NLS provided a list of features desired in a DTB player, drawn from the initial work on the DTB standard. The list offered students a range of often conflicting constraints which they were obliged to attempt to satisfy.

Students were asked to design the exterior of the device, including the layout of controls, configuration of speaker and jacks, and the design of tactile and visual labels. NLS probably will not use any single design, but will most likely draw interesting ideas or design features from multiple entries. A jury assembled by NLS and IDSA will meet in June 2002 to select contest winners.

Michael M. Moodie

Research and Development Officer

Nine Tasks to Implement
the Use of Digital Talking Books

In the July 1998 pamphlet *Digital Talking Books: Planning for the Future*, nine steps for implementing digital talking books (DTB) were described, and these steps have changed little since planning began.

Task 12: Narrow player and media choices by selecting via decision matrix.

This task aims to narrow the player and media choices using a decision matrix--that is, a mathematical model used to help select from among a range of possibilities. Such a model will help NLS decision makers determine the best available technology. The model will be the basis for a development options paper ensuring the selection of the best technology.

In addition, NLS will refine the cost estimates obtained in the early life-cycle cost model. Cost estimates will include packaging, storage, and maintenance for the DTB alternatives. NLS is currently studying the impact of duplication and logistics on regional libraries and MLAs through a group called the Digital Long-Term Planning Group. NLS will also examine costs both to the states and to the federal government (U.S. Postal Service and NLS). For packaging, NLS will be directly responsible to

obtain postal concurrence. In addition, NLS will have to examine the product from safety, pilfering, and pest-control perspectives early in the DTB systems development.

Task 13: Design and test a catalog-access and ordering system that interested patrons will use.

This task will include NLS review of patrons' privacy issues and network library personnel resources. To ensure proper design, NLS must base the system on what is currently in the field so as to avoid integration problems. Integrating two different systems can be technically challenging, because requirements and definitions may not be the same and can sometimes change in both systems. NLS will examine ways to automate the catalog and then provide configuration control in order to ensure that no anomalies are introduced into the system.

Task 14: Design and test circulation and inventory management software for libraries, MLAs, and NLS.

In this task, NLS will review inclusion of a means of self identification, for audit purposes, in players. Players should also have self diagnostic tests (also known as built-in test) circuitry to facilitate repair by maintenance personnel and help point to where both the hardware and/or software errors are. In addition, the errors should be reportable to NLS, while ensuring patron privacy. Error reports would be similar to the current reporting procedure, but with extra fields to handle digital statistics.

Task 15: Design and test software for international lending.

This task will entail NLS's requirement to obtain publishers' international copyright requirements.

Task 16: Evaluate the players and media produced by manufacturers and communications providers.

One of the most important steps, this one requires contracting for the DTB Engineering and Manufacturing Development (EMD) phase. The process necessitates drafting a DTB request for proposal (RFP) for industry comment prior to RFP formal release. After receipt of industry feedback on the draft RFP, NLS will consider conducting an industry-government forum. Based on the feedback from such a forum, NLS will issue a formal RFP for industrial competition.

Whether or not the RFP will be a cost or fixed-price contract is yet to be determined. It is important to allow a three-year minimum for EMD before full production begins (see step 17). EMD normally occurs after the R&D "bread board" testing is completed and NLS is comfortable that the technology works for the DTB application. One of the three years is needed to allow time to conduct the various engineering reviews and configuration-audit checks of the contractor. Included in the checks before NLS starts "bending metal" to produce the DTB system are: formal engineering reviews upon completion of system design, preliminary design, and critical design reviews. Another two years are needed to build and then test the system–first in a developmental mode (contractor in-house testing) and then in the final patron (operational) mode.

Throughout the EMD and production process, the NLS Engineering Change Control Board will convene, as necessary, to identify design or manufacturing flaws in units that fail to meet specifications. NLS will recommend to the contractor that these be corrected, usually under warranty repair. If, on one hand, the Library is at fault, NLS will pay for the repairs and recall units already in the field. On the other hand, if the

contractor failed to follow specifications, the contractor must remedy the situation at no cost to the government.

Task 17: Operate parallel digital and cassette systems simultaneously.

NLS will have a transition period of several years from analog to digital technology and will eventually begin scaling back the production of cassette book machines (CBM) in order to have funding available for the new technology. When to shut off CBM manufacture will entail serious consideration, because there is a point where manufacture without sufficient quantity becomes inefficient. In this phase, initially two design and then twenty EMD samples will be tested, first from a developmental, later an operational standpoint to ensure that the DTB works according to design, and can be produced in an assembly line. A significant number of units will be distributed to patrons for field evaluation of reliability and patron acceptance.

Task 18: Begin full scale production and deployment of digital equipment.

In this step, NLS will set up quality assurance at the manufacturer, who will provide two hundred production samples for examination by NLS. NLS representatives will travel twice per month to the manufacturer until production is firmly established with near zero defect. Once the line is mature, the inspection visits can be reduced to monthly. NLS will also need to work with the repair volunteers (the General Electric Elfuns and the Telephone Pioneers of America), helping them understand the new DTB unit's maintenance. Further, a warranty process will be established with the manufacturers in coordination with the libraries. Although NLS will eventually cease production of cassettes and machines, it will continue to repair them through lifetime buys of repair parts for ten years or until parts supplies are exhausted.

Task 19: Establish a method for continuous patron evaluation of the new system.
The patron evaluation method will include ways to update the software in response to patron preferences and library-support needs. Development might be done by the NLS National Audio Equipment Advisory Committee, or perhaps by a separate digital committee, as long as updated accurate information is ensured. NLS will also establish a maintenance process for player and software documentation, including configuration control.

Task 20: Establish a method of continuous system evaluation of infrastructure.
This method, to include input from the libraries and MLAs, will also include configuration control. Continuous evaluation can be done in conjunction with the libraries and their regional conferences.

Wells B. Kormann
Chief, Materials Development Division

Digital Braille:

Web-Braille Puts Braille Books on the Internet

Introduction

As NLS continues planning the next generation of audio books, the next generation of braille books has already arrived.

Digital files of NLS-produced braille materials can now be downloaded from the Internet. Thanks to the foresight in the early 1990s of Lois Mandelberg, former head of the NLS Production Control Section, an archive of electronic files, created in the production of embossed braille books, has been retained at NLS since 1992 as backup for possible future use. The dual facts that braille material can now be easily stored on computer disk (affording their easy storage and retrieval using the Internet) as well as that virtually all the books produced by NLS are in grade 2 contracted braille (meaning that these books are in the required "specialized format" that allows their free distribution to eligible users under U.S. copyright law) made Web-Braille possible.

NLS currently has more than 30,000 hard-copy braille titles in its national collection. These paper braille books are circulated to patrons from thirty-two libraries throughout the U.S. At its inception, Web-Braille included nearly 10 percent of the entire NLS braille collection. We now have virtually every braille book produced by NLS in the last ten years on Web-Braille, except for print/braille, foreign language, and grade 1 braille books.

The Web-Braille system makes braille books immediately available. Patrons neither have to await arrival in the mail nor deal with bulky volumes. The system also has obvious advantages for "how-to" and similar information, for which only one volume of several volumes may be needed at a time. Other advantages of downloadable braille books include immediate, twenty-four-hour access to thousands of grade 2 braille books; portability, whereby books can be used on portable refreshable braille devices allowing patrons to carry dozens of braille volumes at once; and searchability, a tremendous advantage when looking for particular short stories, recipes, and the like.

A user needing immediate access to specific information contained in an online braille book (e.g., a recipe in a cookbook or a passage from a poem) can obtain it in a matter of minutes. Alternatively, readers can browse books online to determine if they wish to order embossed copies from their library.

Pilot Phase

The idea for Web-Braille was first proposed by NLS staff in September 1997. While many things were known at that time–for example, the files for producing braille books could be easily read by users with portable refreshable braille equipment, many blind persons were becoming familiar with the Internet, were finding it a viable means for getting information; and Library of Congress servers could provide a good host for downloadable files–many other aspects of the project needed further investigation. These included the user interface to be used, the security measures to limit access to eligible readers, and the system file structure and file naming conventions.

It was decided to conduct a pilot test for which fifty titles were selected from the NLS braille collection. These books, covering a wide variety of subjects, include

cookbooks, short story collections, novels, finance, and self-help books. Cataloging records, pulled from the NLS CD-ROM catalog, were reformatted, and from them a web page was created for the user interface, with active links to the braille files. Working with the archived diskettes, each volume of each title was checked, converted to a standard format, and loaded onto a Library of Congress mainframe computer.

In March 1998, a three-month pilot test was launched, whose evaluators were recruited from several electronic mailing lists. More than 175 individuals and institutions agreed to download files, use them with their available equipment, report difficulties, and make suggestions for improvement. Test participants included individuals who read braille, teachers and librarians in public schools, staff of cooperating network libraries, teachers in schools for blind individuals, braille transcribers, and braille producers.

Evaluators used a variety of braille equipment and software so that the downloading and reading process could be tested under a wide range of circumstances. Sixty-two of the individuals used such braille note-takers as Braille Lite and Braille 'n' Speak, which are handheld devices. Braille Lite produces braille by means of pins that rise and lower electronically rather than by generating embossed paper. Braille 'n' Speak converts braille to speech output. Fifty-five participants used braille embossers, and thirty-six used refreshable braille displays.

For Internet web browsers, sixty-four evaluators used Lynx (a text-only browser popular among blind persons) for downloading the files from the Internet, twenty-four used Internet Explorer, and fifteen used Netscape. People logging on to the Internet site were presented with a web page that featured information about the fifty braille books. The listing was arranged by book number and included the title, author, and

annotation for each book. Because the files were originally created during the production of the hard-copy braille version, the text was separated into braille volumes. Links on the web page led readers to each volume, which could then be either downloaded for embossing or read online with a braille display. In a seven-week period, there were 2,808 "hits," or accesses, on the Web-Braille page and the braille volumes.

After completing the pilot, users were surveyed for information that proved crucial in designing the full system. Pilot testers gave the service an overwhelmingly favorable review and expressed interest in continuing the program on a permanent basis. Evaluators also provided valuable technical suggestions regarding file structure and naming, downloading instructions, searching capability, adjustable line length, and other issues.

Implementation Phase

In July 1998, NLS decided to make Web-Braille a permanent part of its program. Implementing Web-Braille on a full-scale basis meant that many things still needed to be done. We knew now that user satisfaction was high, and we knew how users would use these electronic materials, but a major challenge remained: how to integrate Web-Braille into a system that previously had not included electronic materials.

The next tasks included:
- arranging for sufficient storage space for Web-Braille to occupy, allowing for six years of growth
- retaining a contractor to prepare the files for 5,550 braille volumes

- checking each of the 5,550 prepared files for accuracy and transferring them to the server where Web-Braille would reside
- designing a system to permit network libraries to register Web-Braille users
- creating a security system to password-protect all files
- creating HTML files to provide a user interface and to divide books into children's/adult, fiction/nonfiction, etc., listed by author and title
- establishing procedures for adding new braille titles to Web-Braille as the embossed versions are approved for shipment and
- implementing a link checker to ensure that all of the links on the Web-Braille user-interface page are functional.

Once Web-Braille was opened to all eligible users, it was necessary for NLS staff to respond to a flurry of questions from network libraries and patrons. We created a "frequently asked questions" section to answer some of the more frequently occurring concerns.

Ongoing Issues

Piloting and implementing Web-Braille has been a very instructive process, and many aspects of this effort will no doubt provide valuable lessons when NLS pursues similar activities for the digital talking book.

Among the most significant were:

Scope of Audience. Throughout the initial planning stages for Web-Braille, our assumption had been that the primary–and probably only–audience for braille books on the Internet would be technically savvy braille readers. Early in the pilot phase,

however, we began hearing from classroom teachers, special educators, media librarians, and the like, all telling us that they desperately needed braille materials for their students. At first, this was puzzling–our libraries had vast quantities of braille books. What was the problem? After many conversations with these educators, a clearer picture emerged. Apparently, all braille readers in a given state in a specific grade are likely to need the same book at the same time. This could mean that as many as twenty or thirty copies of *Pride and Prejudice* might be needed, and the library would have only one or two copies at the most. In addition, the problem was a matter of budget. While few school districts have budgets that enable them to purchase multiple copies of *Pride and Prejudice*, it is entirely possible for them to emboss as many copies as needed.

At present, nearly half of those who have registered for Web-Braille are, in one way or another, connected with the educational system. We have communicated with dozens of teachers who are enthusiastic about braille for their students and are encouraged that they can get these materials from the Internet.

Staff Training. Maintaining Web-Braille has meant that a number of NLS staff find it necessary to acquire skills not previously needed for their jobs. New duties include electronic file preparation and checking, server maintenance, and various skills associated with using the Internet. Many regional library staff, as well, have also had to acquire skills to register Web-Braille users online and respond knowledgeably to patron inquiries.

User Support. Users of Web-Braille employ a dizzying variety of software and hardware to access the system including operating systems from the latest version of

Windows to proprietary systems running on dedicated notetakers, more than a dozen different web browsers, a variety of speech and braille screen readers, numerous brands and models of braille displays, braille embossers, and other specialized products. User support has thus been especially challenging, because each user's problem presents its own unique issues. It is increasingly clear that only the most general situations can be addressed with "Frequently Asked Questions."

Recent Developments and Next Steps

Books are added to Web-Braille at the rate of about forty per month. As each grade 2 braille book, embossed for the collection, is approved for shipment, the files are routinely transferred to the Web-Braille system. To learn of and access the latest Web-Braille titles, patrons can browse the online version of *Braille Book Review*, locate a title of interest, and (after entering their valid user ID and password) select the desired volume to view or download.

In July 2000, links added to the NLS online catalog for each Web-Braille title enabled users to enjoy the sophisticated search capabilities of a full-scale catalog system. Once the record for a title is located in the catalog, eligible Web-Braille users can directly access each volume via the provided links.

In May 2001, all NLS-produced magazines were added to Web-Braille. To this end, many additional issues had to be resolved, since NLS does not receive the braille files used to emboss the hard copy. The procedure is for braille producers to transfer magazine files into secure locations that have been created for this purpose. If an automated process, scanning these locations twice a day, detects a new file, the automated process loads the file into Web-Braille. The magazine name, issue date, and

part number are determined from the name of the file, and the automatically generated web page presents users with the list of available issues.

In late 2001, NLS began testing newly developed optical braille recognition software's capability to scan physical braille books and store them as grade 2 braille files. By thus scanning older braille titles, we could add classic literature, prequels to existing Web-Braille titles, and other books of interest to Web-Braille users.

In December 2001, one music magazine and nearly two hundred braille musical scores were added to Web-Braille.

At this writing, Web-Braille has been launched for 2-1/2 years. We have over 1,800 registered users and more than 4,000 titles on the site. User feedback from individuals and schools continues to be extremely positive. For many, Web-Braille provides a whole new way to access library materials—a chance to browse and select a book after having given it a thorough perusal. Web-Braille is another element in the ongoing movement to enhance braille literacy among blind persons—a movement that is heartily endorsed by blind persons and librarians alike.

Judith M. Dixon
Consumer Relations Officer

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Linda Redmond
Head, Reference Section

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